REPORT

M-264 | 2014

RIVERINE INPUTS AND DIRECT DISCHARGES TO NORWEGIAN COASTAL WATERS – 2013

Preface

This report presents the results of the 2013 monitoring of riverine and direct discharges to Norwegian coastal waters (RID). The monitoring is part of a joint monitoring programme under the "OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic".

The Norwegian Environment Agency has commissioned the Norwegian Institute for Water Research (NIVA), the Norwegian Institute for Agricultural and Environmental Research (Bioforsk), and the Norwegian Water Resources and Energy Directorate (NVE) to carry out the work. The contact person at the Norwegian Environment Agency has been Eivind Farmen.

Kari Austnes at NIVA has co-ordinated the RID programme. Other co-workers at NIVA include John Rune Selvik (direct discharges), Tore Høgåsen (databases, calculation of riverine loads, TEOTIL), Ian Allan, Sissel Ranneklev, Marthe Torunn Solhaug Jenssen (organic contaminants), Liv Bente Skancke (quality assurance of sampling and chemical analyses), Øyvind Garmo (passive sampling metals), Odd Arne Segtnan Skogan (sensor monitoring) and Marit Villø, Tomas A. Blakseth and Kine Bæk (contact persons at the NIVA laboratory).

At Bioforsk, Eva Skarbøvik has been the main responsible for writing the 2013 report. Per Stålnacke has carried out and reported the statistical trend analyses with the assistance of Attila Nemes.

At NVE, Trine Fjeldstad has been responsible for the local sampling programmes, Stein Beldring has carried out the hydrological modelling, and Morten N. Due has been the administrative contact.

Overall quality assurance of the annual report has been carried out by Øyvind Kaste, NIVA.

The sampling has been performed by several fieldworkers; their names are given in Appendix II. Sub-contractors and data sources include the Norwegian Meteorological Institute (met.no) for precipitation and temperature data; Statistics Norway (SSB) for effluents from wastewater treatment plants with a connection of > 50 p.e. (person equivalents); the Norwegian Environment Agency for data on effluents from industrial plants; the Directorate of Fisheries (Fdir) for data on fish farming.

Oslo, November 2014

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Elvetilførsler og direkte tilførsler til norske kystområder – 2013

Riverine inputs and direct discharges to Norwegian coastal waters – 2013

Summary – sammendrag

Riverine inputs and direct discharges to Norwegian coastal waters in 2013 have been estimated in accordance with the requirements of the OSPAR Commission. Nutrients, metals and organic pollutants have been monitored in rivers; discharges from point sources have been estimated from industry, sewage treatment plants and fish farming; and nutrient inputs from diffuse sources have been modelled. Trends in riverine inputs have been analysed. Concentrations above given threshold levels have been detected for both metals and organic pollutants in some rivers.

Rapporten presenterer resultater fra Elvetilførselsprogramnmet i 2013. Næringsstoffer, metaller og organiske miljøgifter er overvåket i norske elver, mens punktutslipp er beregnet fra industri, renseanlegg og akvakultur. Tilførsler av næringsstoff fra diffuse kilder er beregnet ved hjelp av TEOTIL-modellen. Trender i tilførsler fra utvalgte elver er beskrevet. Konsentrasjoner over gitte grenseverdier er funnet for både metaller og organiske miljøgifter i enkelte elver.

4 emneord

Elvetilførsler, direkte tilførsler, norske kystområder, overvåking

4 subject words

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Abstract

Riverine inputs and direct discharges to Norwegian coastal waters in 2013 have been estimated in accordance with the requirements of the OSPAR Commission. Nutrients, metals and organic pollutants have been monitored in rivers; discharges from point sources have been estimated from industry, sewage treatment plants and fish farming; and nutrient inputs from diffuse sources have been modelled. Trends in riverine inputs have been analysed. Concentrations above given threshold levels have been detected for both metals and organic pollutants in some rivers.

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2. Direkte tilførsler	2. Direct discharges
3. Norske kystområder	3. Norwegian coastal waters
4. Overvåking	4. Monitoring

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Contents

Summary

This report presents the results of the 2013 monitoring of riverine and direct discharges to Norwegian coastal waters (RID). The monitoring is part of a joint monitoring programme under the "OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic", where the purpose is to estimate the total loads of selected pollutants to Convention waters on an annual basis. The programme also gives information on pollutant concentration levels in Norwegian rivers, and the collected data can be further used to explain pollution levels along the coast.

In 2013, the average air temperature was 1.0 °C above normal (1961-1990) and average precipitation was 10 % above normal. The high precipitation was reflected in high water discharges in the rivers.

The total inputs to coastal Norwegian waters in 2013 were estimated to about 12 700 tonnes of phosphorus, 162 000 tonnes of nitrogen, 440 000 tonnes of total silicate, 505 000 tonnes of total organic carbon (TOC), and one million tonnes of suspended particulate matter. The inputs of metals were estimated to about 276 kg of mercury, 2.2 tonnes of cadmium, 5.8 tonnes of silver, 28 tonnes of arsenic, 38 tonnes of lead, 80 tonnes of chromium, 141 tonnes of nickel, 952 tonnes of zinc and 1163 tonnes of copper[1]. Silver was monitored for the first time this year, but only one single sample was above the detection limit. Metal concentrations were compared with threshold levels of the EU Water Framework Directive (WFD) or the EQS daughter directive 2013/39/EU where available, or otherwise national thresholds. Levels exceeding or close to the threshold value were found for copper (Rivers Glomma, Alna, Orreelva, Orkla, Jostedøla, Stjørdalselva, Verdalselva, Gaula); zinc (Rivers Glomma and Tista) and chromium (River Jostedøla).

The organic pollutants PCB7 and lindane have earlier been monitored in 10 rivers in this programme. Since the concentrations were mainly below the detection limit, this monitoring was terminated after 2012, and new methodology was applied in 2013 in Rivers Glomma, Alna and Drammenselva. The methodology proved to be well suited for the purpose, and annual loads of PAHs, PCBs, PBDEs, HBCDD, S/MCCPs, BPA, TBBPA and PFOS could be calculated (only the particulate bound fraction for the latter four). Concentrations of organic pollutants were compared with threshold levels of the WFD, which revealed that concentrations of the PAHs fluoranthene and benzo[a]pyrene , as well as PFOS were near or above the threshold level in all the three monitored rivers.

Trend analyses of nutrients and some metals were performed for two periods (1990-2013 (complete data set); and 2004-2013 (last 10 years). Overall, the loads of these metals and nutrients have either decreased or not changed significantly in most rivers, but there are some exceptions. An increase has been detected in total nitrogen loads in River Numedalslågen in the period 1990-2013. Similarly, during the last ten years (2004-2013) increases have been found in loads of total nitrogen in River Vefsna, total phosphorus in River Alta, and zinc in River Glomma.

There were no significant changes in the distribution of sources for neither nutrients nor metals as compared to recent years. Fish farming continues to be a major direct source of nutrients to the sea.

A Norwegian summary has been made as a 4-page information sheet, and are shown in the next pages.

[1] Upper estimates, which means that samples with concentrations below the detection limit were set equal to the detection limit.

Sammendrag

Norsk sammendrag er gitt i form av et infoark på de neste fire sidene.

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Tovdalselva. Foto: Kari Austnes.

Tilførsler til havområdene 2013

I dette faktaarket gis en oversikt over tilførsler av næringsstoff, metaller og organiske miljøgifter fra norske elver og utslipp i 2013, sett i lys av tidligere års tilførsler. En viktig nyhet i 2013 er økt fokus på organiske miljøgifter.

Elvetilførselsprogrammet

Hvert år overvåkes utslipp til norskekysten av næringsstoff, tungmetaller og organiske miljøgifter (på siste side beskrives hvordan dette beregnes). I 2013 ble organiske miljøgifter målt med en helt ny metodikk, side 3 i dette faktaarket oppsummerer resultatene av dette.

Hovedfunn i 2013

I 2013 ble det tilført om lag 12 700 tonn fosfor, 162 000 tonn nitrogen, 440 000 tonn silikat, 505 000 tonn totalt organisk karbon og en million tonn suspenderte partikler til norske havområder. Av tungmetaller ble det tilført 276 kg kvikksølv, 2,2 tonn kadmium, 28 tonn arsenikk, 38 tonn bly, 80 tonn krom, 141 tonn nikkel, 952 tonn sink og 1163 tonn kobber. Sølv ble overvåket for første gang i 2013, men så godt som alle analyser ga verdier under deteksjonsgrensen.

Metallkonsentrasjonene ble sammenlignet med grenseverdier for stoffene, og det ble funnet for høye konsentrasjoner av kobber i elvene Glomma, Alna, Orreelva, Orkla, Jostedøla, Stjørdalselva, Verdalselva, og Gaula. Tilsvarende var det for høye konsentrasjoner av sink i Glomma og Tista, og av krom i Jostedøla.

Når det gjelder organiske miljøgifter var konsentrasjoner av fluoranthene, benzo[a]pyrene (begge PAHer) og PFOS nær eller over grenseverdiene i de tre elvene hvor dette ble undersøkt, dvs. Glomma, Alna og Drammenselva.

Analyser av trender i ni elver antyder at tilførslene enten har vært stabile eller blitt redusert, men i noen elver har tilførslene økt. Detaljer om dette finnes på side 2.

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Tilførsler siden 1990

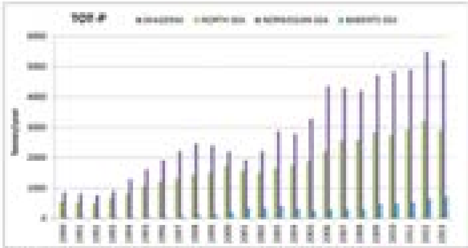
Trender i tilførsler fra elvene

Tabellen under viser trender i tilførsler til havområdene av næringsstoffer og metaller i ni norske elver hhv. for de 10 siste årene (siden 2004) og for perioden 1990-2013. Grønn farge betyr at tilførslene har gått ned, rød farge at de har gått opp. Lys grønn farge indikerer en tendens til nedgang mens oransje farge indikerer en tendens til økning.

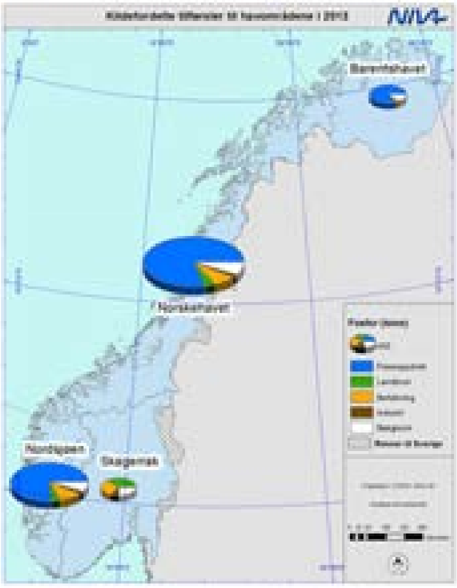
I hele overvåkingsperioden (1990-2013) har det vært en økning i tilførsler av total nitrogen fra Numedalslågen, og i løpet av de siste 10 årene har det vært en økning av nitrogen i Vefsna, fosfor i Alta og sink i Glomma. Bortsett fra dette har det i de fleste elver enten vært en nedgang, eller ingen endring i tilførsler i overvåkingsperioden.

Variasjoner i direkte tilførsler

Det beregnes direkte tilførsler fra fiskeoppdrett, industri og kloakkrenseanlegg. Det er særlig en type direktetilførsel til havområdene som har økt, og det er næringsstoffer og kobber fra fiskeoppdrett. Grafen oppe til høyre viser økning i tilførsler av fosfor fra fiskeoppdrett siden 1990, mens kartet viser fosforkilder fordelt på fire havområder, fra akvakultur, jordbruk, kloakk, industri og avrenning fra skog og utmark.



Tilførsler av fosfor fra fiskeoppdrett 1990-2013



Fordeling av fosforkilder (basert på Teotil-modellering)

Tabellen viser trender i tilførsler. Se tekst for forklaring av fargene.

Stoff	Periode	Glomma	Drammenselva	Numedalslågen	Skienselva	Otra	Orreelva	Orkla	Vefsna	Alta
TN	2004-2013									
	1990-2013									
TP	2004-2013									
	1990-2013									
Cd	2004-2013									
	1990-2013									
Cu	2004-2013									
	1990-2013									
Ni	2004-2013									
	1990-2013									
Pb	2004-2013									
	1990-2013									
Zn	2004-2013									
	1990-2013									

TN: Total nitrogen, TP: Total fosfor, Cd: Kadmium, Cu: Kobber, Ni: Nikkel, Pb: Bly, Zn: Sink.

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Organiske miljøgifter

Overvåkingsmetode

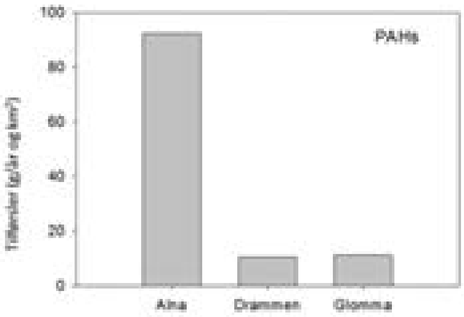
Fram til og med 2012 ble kun PCB7 og lindan overvåket i dette programmet. Ettersom konsentrasjonene stort sett var under deteksjonsgrensen, ga dette liten informasjon. Fra 2013 gikk man derfor over til å overvåke organiske miljøgifter med metoder som gjør det mulig å påvise stoffene ved langt lavere konsentrasjoner enn det som er mulig med vanlige vannprøver. Denne overvåkingen ble kun utført i Glomma, Alna og Drammenselva.

Den løste fraksjonen av stoffene overvåkes med passive prøvetakere. Dette er prøvetakere av silikon, som tar opp miljøgiftene fra vannet. Ved hjelp av opptakshastigheten, mengden stoff i prøvetakeren og tiden prøvetakeren har stått ute, kan man regne seg tilbake til konsentrasjonen i vann og beregne tilførslene.

Den partikkelbundne fraksjonen måles ved å samle inn partikler ved en sentrifugeteknikk. Mengden stoff i partiklene og beregnet partikkeltransport i elva brukes så til å beregne tilførsler. Summen av de to fraksjonene (løst og partikulært) gir et estimat på totale tilførsler.

Resultater

Det første året med overvåking har vist at de nye metodene er velegnet til å måle svært lave konsentrasjoner. Tabellen under viser tilførsler av de forskjellige stoffene. Tilførslene er høyest for PAH og MCCP, og er generelt høyere for Glomma og Drammenselva (som jo har større vannføring). Men når tilførsler beregnes per areal, som vist i figuren, er de klart høyest i Alna. Denne elva har en stor andel av nedbørfeltet sitt i Oslo.



Beregnede totale konsentrasjoner ble sammenlignet med grenseverdiene i EUs Vanndirektiv. Konsentrasjoner av fluoranthene, benzo[a] pyrene (begge PAHer) og PFOS var nær eller over grenseverdien i alle de tre elvene.

Tabellen viser beregnede elvetilførsler av organiske miljøgifter for Alna, Drammenselva og Glomma i 2013
"a" betyr at tilførslene bare er basert på den partikkelbundede fraksjonen

Stoff	Enhet	Alna	Drammenselva	Glomma
SPAH$_{16}$	kg/år	3.2	178.4-178.9	465.5-470.1
SPCB$_7$	g/år	8.49	257-566	656-1481
SPBDE (excl. BDE28)	g/år	1.4-1.6	217-246	407-462
BDE209	g/år	8.65	183-194	203-292
SHBCDD (α, β, γ)	g/år	0.32-6.8	10.6-352	270-1284
SCCPs[a]	kg/år	0.24	1.55	20.2
MCCPs[a]	kg/år	0.47	3.96	242.8
BPA[a]	g/år	18	1830	2531
TBBPA[a]	g/år	2.7	178	575
PFOS[a]	g/år	0.17	2.5	4.3-13.3

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Informasjon om overvåkingen

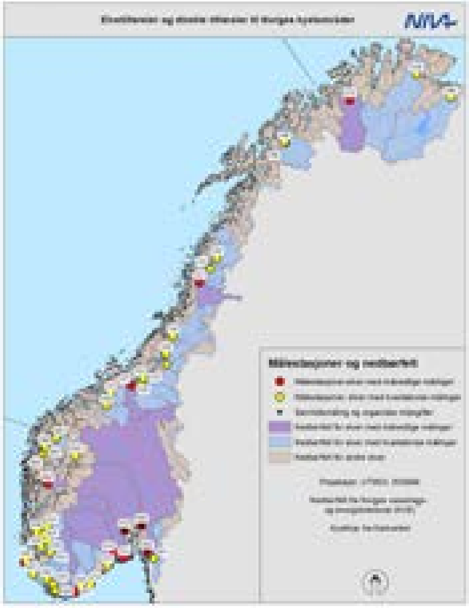
Elvetilførselsprogrammet og OSPAR

Elvetilførselsprogrammet er en del av oppfølgingen av OSPAR-konvensjonen (www.ospar.org), som gjelder for alle europeiske land som grenser til Nord-Atlanteren. Tilknyttet denne konvensjonen er også et program som måler luftforurensing og ett som måler tilstanden i kystvann.

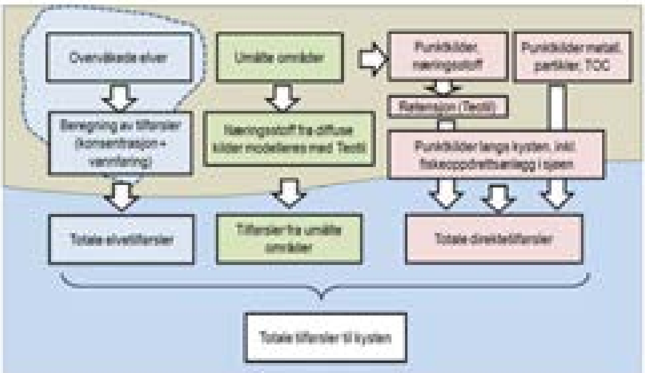
Programmet finansieres av Miljødirektoratet, og det er NIVA, Bioforsk og NVE som utfører arbeidet.

Beregningsmetoder

Innenfor dette programmet overvåkes hvert år et femtitalls norske elver (se kartet), samtidig som programmet samler inn data over utslipp fra flere ulike tilførselskilder.



Kartet viser elver som ble overvåket i 2013.



Figuren til venstre viser hvordan totale tilførsler til havområdene beregnes. Den forurensingen som kommer med elvene omfatter også utslipp fra punktkilder (særlig industri og renseanlegg). Direktetilførsler omfatter punktkilder langs med kysten og i de umålte feltene. Næringsstoffer som tilføres fra diffuse kilder modelleres.

I Norge beregnes utslipp til de fire havområdene Skagerrak, Nordsjøen, Norskehavet og Barentshavet.

FAKTA

Mer informasjon om overvåkingen i 2013 finnes i Rapport NIVA 6738-2014/M-264 2014. Dette faktaarket er utarbeidet av Eva Skarbøvik og Kari Austnes (hhv. Bioforsk og NIVA).

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1. Introduction

1.1 The OSPAR RID Programme

The Riverine Inputs and Direct Discharges to Norwegian coastal waters (RID) is carried out as part of the obligations under the OSPAR Convention. This Convention is the current legal instrument guiding international cooperation on the protection of the marine environment of the North-East Atlantic.

Work under the Convention is managed by the OSPAR Commission, made up of representatives of the Governments of 15 Contracting Parties and the European Commission, representing the European Union. The general principles of the RID Programme are posted at www.ospar.org, the main objectives are listed in Appendix I.

The programme has been on-going since 1990 and reports loads to the sea of nutrients, metals and pesticides. Contracting parties comprise all European countries bordering the North Atlantic Sea, as well as the EU. The RID Programme, together with the programmes for monitoring of air (Comprehensive Atmospheric Monitoring Programme – CAMP) and marine environments (Co-ordinated Environmental Monitoring Programme – CEMP) are all parts of OSPAR's Joint Assessment and Monitoring Programme (JAMP).

The Norwegian mainland drains to four maritime OSPAR regions (Figure 1):

I. Skagerrak:	From the Swedish border to Lindesnes (the southernmost point of Norway), at about 57°44'N
II. North Sea:	From Lindesnes northwards to Stadt (62° N)
III. Norwegian Sea:	From Stadt to the county border of Troms and Finnmark (70°30'N)
IV. Barents Sea:	From 70°30'N to the Russian border.

1.2 The Norwegian RID Programme in 2013

In Norway, the RID programme is carried out through a combination of monitoring and modelling.

A subset of Norwegian rivers has been selected for monitoring to fulfil the RID requirements (Table 1). In 2013, 11 rivers were monitored monthly or more often; and 36 rivers were monitored quarterly. The location of the sampling sites is shown in Figure 2. More information on the catchments of the monitored rivers is given in Appendix III. A number of 109 rivers were monitored once a year in the period 1990-2003. One of these, River Alna, is monitored monthly from 2013, so it is now listed under this category, rather than with rivers monitored once a year.

Table 1. The Norwegian RID monitoring programme.

Type of river	Number of rivers
Rivers monitored at least monthly	11
Rivers monitored quarterly since 2004, and once a year in 1990-2003	36
Rivers monitored once a year in 1990-2003; estimated from 2004 onwards	108

To calculate the total load of constituents to the sea, monitoring data are combined with estimated and modelled results. In addition, direct discharges reported from sewage treatment plants, industry and fish farming are registered and included in the calculations. The result is divided into inputs from rivers, unmonitored areas and direct discharges, but it is important to understand what these terms mean. For example, the term "direct discharges" to the sea also covers effluents from point sources upstream in the unmonitored areas. Table 2 and Figure 2 have been provided to clarify some important terms within the RID Programme.

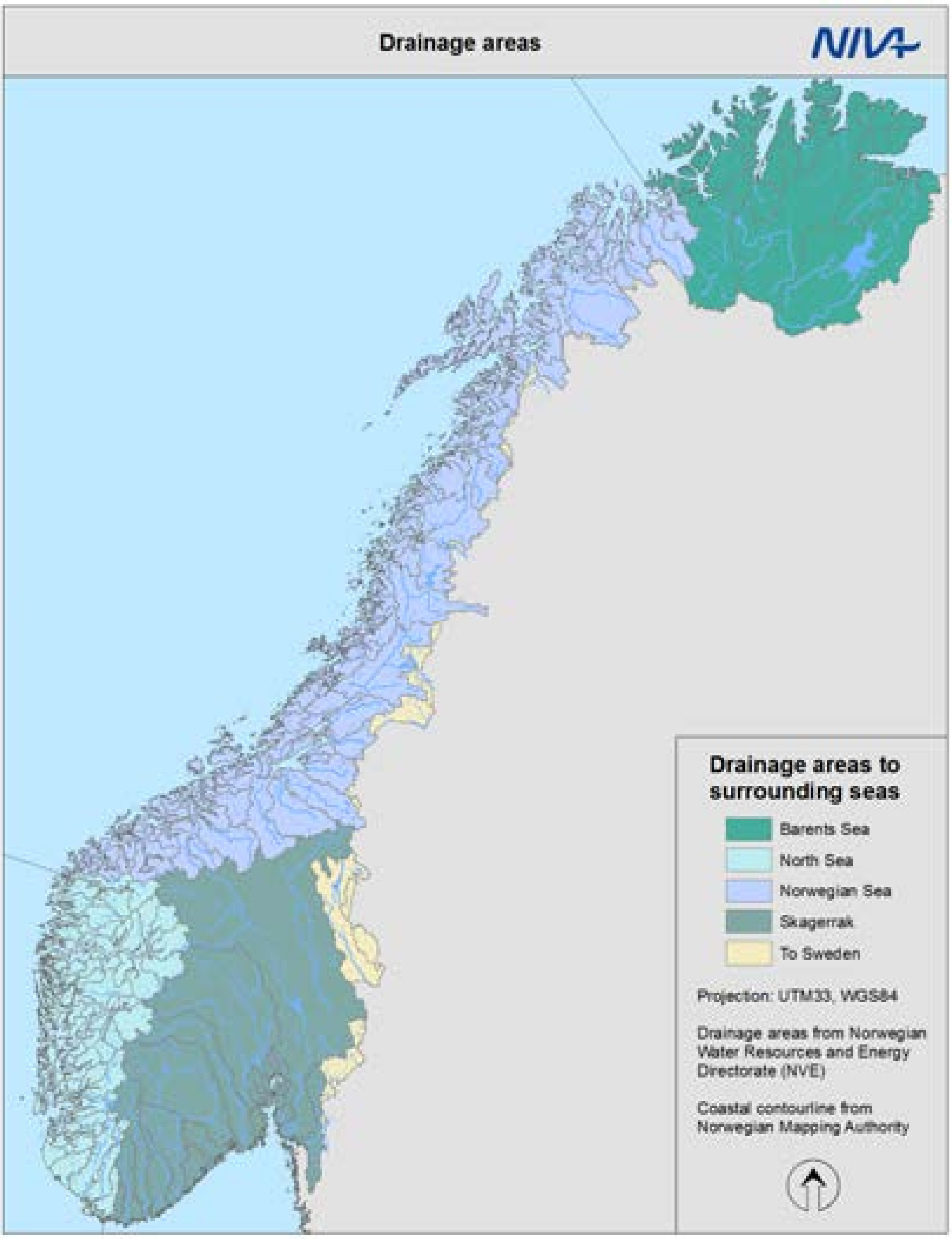


Figure 1. Norway is divided into four drainage areas, which drain into the Skagerrak, the North Sea, the Norwegian Sea and the Barents Sea. Minor parts of Norway drain to Sweden.

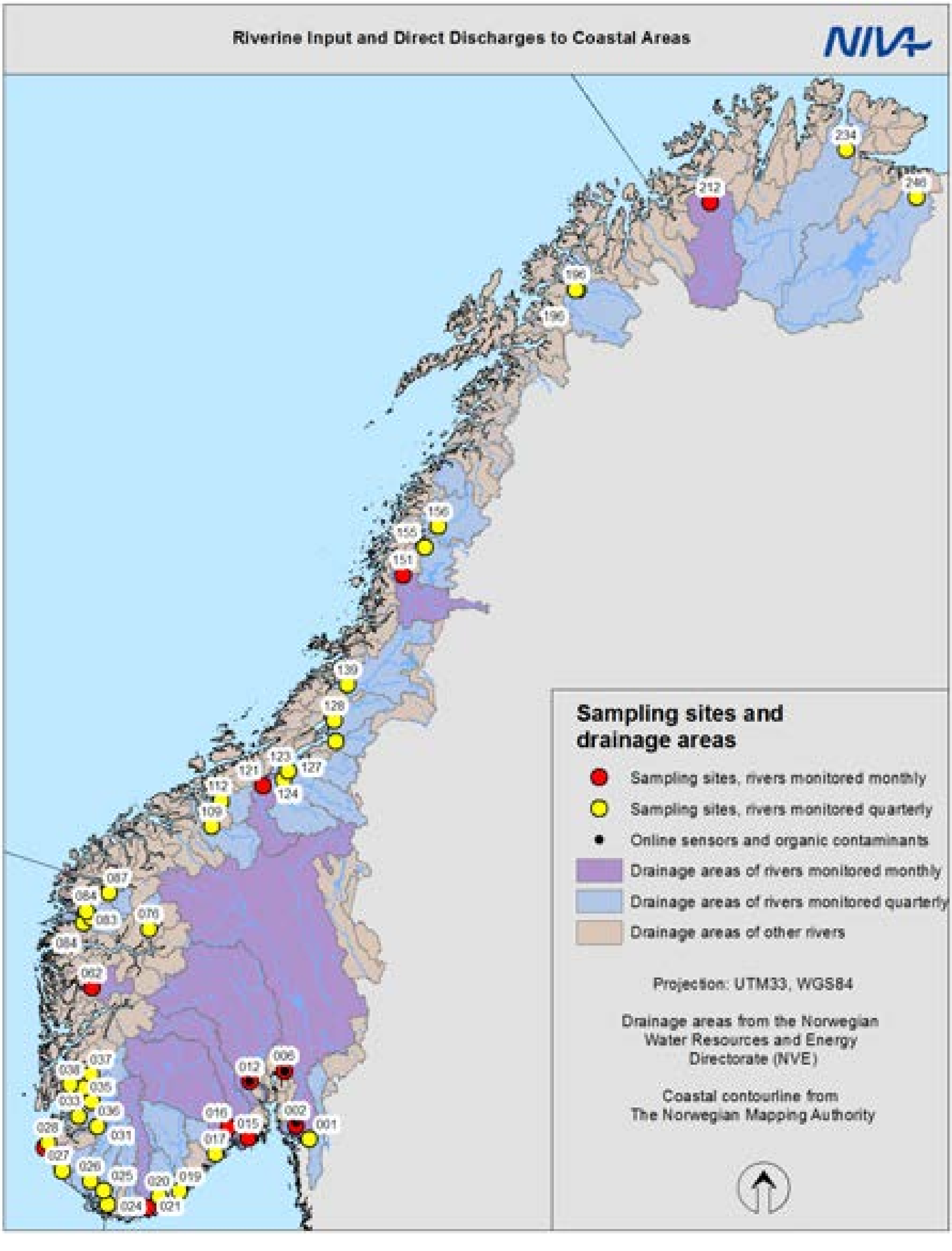


Figure 2. River sampling sites in the Norwegian RID programme. The numbers refer to the national river basin register (REGINE; www.nve.no). The river basin register system classifies the Norwegian river basins into 262 main catchment areas, of which 247 drain to coastal areas.

Table 2. Definitions of the main constituent 'sources' and the main methodology associated.

Name	Definition	Comments
Monitored area	Area upstream the sampling points of the 11+36+108 rivers (cf. Table 1).	Grab sampling is done each year in 11 + 36 rivers. For the 108 rivers monitored once a year before 2004, an average of concentrations in former years is used (but combined with the current year's water discharge to calculate loads).
Unmonitored area	Covers the entire area that is not monitored, i.e. unmonitored river catchments, coastal areas and areas downstream of the sampling points in the 11+36+108 rivers.	Only nutrient load from diffuse runoff is estimated, with the TEOTIL model.
Direct discharges	Reported emissions from point sources in the unmonitored areas. This also includes *upstream* point sources in the unmonitored area.	For point emissions of nutrients, the TEOTIL model is used to account for retention from the source to the sea. For metals it is assumed that no retention occurs.
Total loads	Loads calculated based on monitored areas + unmonitored areas + direct discharges.	

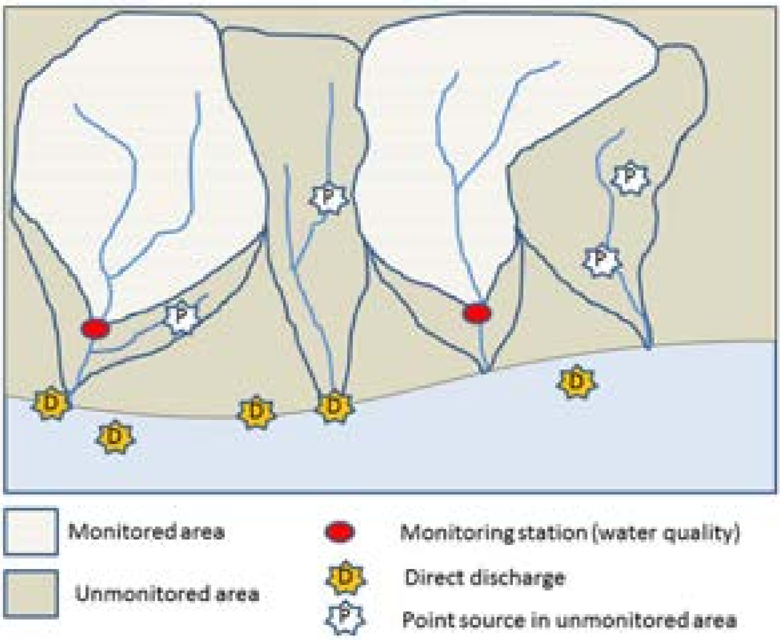


Figure 3. Illustration of RID areas, point sources and direct discharges (source: OSPAR RID Agreement 2014.04; www.ospar.org). See also Figure 8 for the Norwegian adjustments to these principles.

To fulfil the requirements of OSPAR, the following parameters were monitored in 2013:

- six fractions of nutrients (total phosphorus, orthophosphate, total nitrogen, ammonium, nitrate and silicate);
- nine heavy metals (silver, copper, zinc, cadmium, lead, chromium, nickel, mercury and arsenic);
- five other parameters (suspended particulate matter, turbidity, pH, conductivity, and total organic carbon).

Of these, silver and turbidity are new parameters in 2013.

In addition, Norway monitored the following parameters in 2013 (not used to calculate total loads to the sea):

- Organic contaminants in Rivers Glomma, Alna and Drammenselva.
- Turbidity, conductivity and pH using automatic sensors in Rivers Glomma, Alna and Drammenselva.
- Water temperature in all rivers, using different methods.
- Metals monitored using Diffusive Gradients in Thin films (see Appendix VII)

The main changes in this year's regular RID programme, as well as details on changes in the RID monitoring programme throughout the years, are given in Appendix IV.

2. Materials and methods

2.1 Water discharge and hydrological modelling

For the rivers monitored monthly, daily water discharge measurements have been used for the calculation of loads. Except for River Alna, where discharge data has been provided by Oslo Water and Sewerage Works, discharge data have been provided by NVE. Since the hydrological stations are not located at the same site as the water quality stations, the water discharge at the water quality sampling sites have been calculated by up- or downscaling, proportional to the respective drainage areas.

For the remaining area, water discharge has been simulated with a spatially distributed version of the HBV-model (Beldring *et al.*, 2003). The use of this model was introduced in 2004. Appendix IV gives more information on the methodology. There have been no amendments or changes in this method since last year's reporting (Skarbøvik *et al.,* 2013).

2.2 River grab samples: Sampling and calculation

2.2.1 Sampling methodology

Sampling has been carried out in the same manner as the previous year (Skarbøvik *et al.*, 2013). Monthly sampling is done in 11 rivers. However, two of the rivers, the Glomma and Drammenselva, are sampled 16 times per year due to additional sampling during spring. The quarterly sampling in 36 rivers is designed to cover four main meteorological and hydrological conditions in the Norwegian climate. These include the winter season with low temperatures, snowmelt during spring, summer low flow season, and autumn floods/high discharges. Sampling dates are shown in Addendum's Table 1a.

2.2.2 Chemical parameters – detection limits and analytical methods

The parameters monitored in 2013 are listed in section 1.2. Information on methodology and levels of detection (LOD) for all parameters included in the grab sampling programme is given in Appendix IV.

In the RID Programme, chemical concentrations are usually given as two values; i.e. the upper estimate and the lower estimate. These are defined as follows:

- For the lower estimates, samples with concentrations below the detection limit have been given a value of zero;
- For the upper estimates, samples with concentrations below the detection limit have been given a value equal to the detection limit.

This implies that if no samples are below the detection limit, the lower and upper estimates are identical. However, for compounds that have a high number of samples below the detection limit, the highest and lowest estimates may differ considerably.

According to the RID Principles (www.ospar.org), the analytical method should give at least 70 % of positive findings (i.e. no more than 30% of the samples below the detection limit). In 2013, two metals did not reach this requirement, i.e. mercury and silver (Table 3). Mercury usually does not meet this requirement due to low concentrations in Norwegian waters. Silver was monitored for the first time this year, and only one sample was above the detection limit. As the analytical methods used have acceptably low detection limits, the number of samples below the detection limit reflects that the concentrations of these compounds were low in Norwegian river waters in 2013.

Table 3. The proportion of analyses below the detection limit for all parameters included in the sampling programme in 2013. The detection limits are shown in Appendix IV.

Parameter	Unit	% below detection limit	Total no of samples	No of samples below detection limit
pH		0	292	0
Conductivity	mS/m	0	292	0
SPM	mg/l	0	292	1
TOC	mg C/l	0	292	0
TOT-P	µg P/l	3	292	8
PO_4-P	µg P/l	27	292	80
TOT-N	µg N/l	0	292	0
NO_3-N	µg N/l	1	292	2
NH_4-N	µg N/l	11	292	33
SiO_2	mg/l	0	292	0
Pb	µg/l	3	292	8
Cd	µg/l	28	292	82
Cu	µg/l	0	292	0
Zn	µg/l	0	292	0
As	µg/l	15	292	45
Hg	ng/l	67	292	195
Cr	µg/l	28	292	82
Ni	µg/l	1	292	4
Ag	µg/l	100	292	291

2.2.3 Quality assurance and direct on-line access to data

Data from the laboratory analyses were transferred to a database and quality checked against historical data by researchers with long experience in assessing water quality data. If any anomalies were found, the samples were re-analysed. The data are available on-line at www.aquamonitor.no/rid, where users can view values and graphs of each of the 47 monitored rivers.

2.2.4 Calculating riverine loads

As outlined in Stålnacke *et al.* (2009), the RID calculation formula has been slightly modified from the original formula recommended by the RID/OSPAR Programme (PARCOM, 1988). The main improvement with this modified method is that it handles irregular sampling frequency in a better way and allows flood samples to be included in the annual load calculations.

The following formula is now used:

$$Load = Q_r \frac{\sum_{1}^{n} Q_i \bullet C_i \bullet t_i}{\sum_{1}^{n} Q_i \bullet t_i}$$

where Q_i represents the water discharge at the day of sampling (day i);
C_i the concentration at day i;
t_i the time period from the midpoint between day i-1 and day i to the midpoint between day i and day i+1, i.e., half the number of days between the previous and next sampling; and
Q_r is the annual water volume.

For the 109 rivers[2] monitored once a year in the period 1990-2003, but not from 2004 onwards, the calculation of loads was conducted as follows:

- For nutrients, sediments, silica and total organic carbon, the modelled annual water volume in 2013 was multiplied with average concentration for the period 1990-2003.
- For metals, the modelled annual water volume in 2013 was multiplied with average concentration for the period 2000-2003 (data from earlier years were not used due to high detection limits).

2.2.5 Statistical methodology for trends in riverine inputs

Only rivers monitored monthly[3] are included in the statistical trend analyses, due to the lower sampling frequency for the remaining monitored rivers.

Some historical concentrations were removed from the riverine datasets prior to the concentration trend analyses; an overview of these is given in Skarbøvik *et al.* (2010). For the trend analyses, the loads were estimated based on extrapolation or interpolation of the trend line wherever concentrations were missing. The bars with estimated loads (extrapolated or interpolated) have been given different colours in the charts in Appendix V, to separate them from the loads based on measured concentration values.

Statistical trend analyses were conducted for a limited number of metals, given the problem with changed levels of detection (LOD) over time and/or a large number of samples reported below or at LOD. The lower and upper estimates are, however, given in graphs supplemented with a qualitative assessment based on a visual inspection of these graphs and underlying data (Appendix V).

The partial Mann-Kendall test (Libiseller and Grimvall, 2002) has been used to test for long-term monotonic[4] trends (including linear trends) in annual riverine inputs and monthly concentrations measured in nine of the ten main rivers. The method has its methodological basis in the seasonal Mann-Kendall-test (Hirsch and Slack, 1984) with the difference that water discharge is included as explanatory variable. The test also includes a correction for serial correlation up to a user-defined time span; in our case a span of one year was used. The method also offers convenient handling of missing values.

The trend analyses for nutrients and suspended particulate matter were performed on the upper estimates of the loads, except for orthophosphate where both upper and lower estimates were used. The trend analyses for metals were performed on both the upper and lower estimates of the

[2] From 2013 onwards, this is reduced to 108 rivers, since River Alna is now monitored monthly.
[3] Neither River Suldalslågen nor River Vosso have been analysed for trends due to incomplete datasets.
[4] Monotonic is here defined as a consistent increase or decrease over time. Monotonic trends may be linear (the same slope over time) or non-linear.

loads. The trends were regarded as statistically significant at the 5%-level (double-sided test)[5], and trend slopes were computed according to Sen (1968).

In addition to the formal statistical test, a visual inspection of all the time series was performed (cf. graphs in Appendix V).

Apart from the long-term trends, this year we also specifically report on trends observed in the data of the last ten years (2004-2013) where those differ substantially from the long-term trends. We note already here that the statistical power of the applied analysis decreases when applied on shorter time-series. The same slope in two time-series trends may not prove significant in the case that is supported by a lesser number of observations.

Chemical variables analysed for trends include ammonium nitrogen (NH_4-N), nitrate nitrogen (NO_3-N), total nitrogen (TN), orthophosphate (PO_4-P), total phosphorus (TP) and suspended particulate matter (SPM), cadmium (Cd), copper (Cu), lead (Pb), zinc (Zn) and nickel (Ni). Analyses were also performed for mercury (Hg), but we note that the analysis of Hg is affected by great analytical uncertainty, and that a different analytical method was used from 1999 to 2003 (Weideborg *et al.*, 2004). The same holds true for arsenic (As). PCB7 and lindane (g-HCH) are not analysed for trends due to the shortness of the available time series, gaps in the series and/or many observations being at or below LOD (Limit of Detection). Lindane is also no more part of the monitoring programme, and PCB7 is monitored using different methodology. Chromium (Cr), total organic carbon (TOC) and Silica (SiO_2) are not included in this analysis.

Some methodological challenges when assessing the trends include:

- River Alta was sampled less than 12 times a year during the period 1990-1998.
- Some rivers have had more frequent sampling during floods in some years (e.g., Rivers Glomma and Drammenselva in 1995)
- All samples from 1990 up to 1998, and from 2004 to date, were analysed by the same laboratory, but samples in the period 1999-2003 were analysed by a different laboratory. Such changes in laboratory often mean changes in methods and detection limits.
- Some data were excluded from the dataset prior to the trend analyses; a detailed overview of excluded data is given in Skarbøvik *et al.* (2010). Examples are total phosphorus and mercury data 1999-2003 (see also Stålnacke *et al.,* 2009).
- Many concentrations were below LOD-values, especially for metals. This is partly a result of relatively low contamination levels in Norwegian rivers, and partly because of analytical techniques in the early years of the RID-Programme. Many below-LOD values were reported in the period 1990-2003, with a general increase in frequency of below-LOD values for some metals, SPM and total phosphorus during the period 1999-2003 (change in laboratory and therefore higher LODs). However, this problem was reduced after 2003, due to improvements in analytical techniques.

2.3 Unmonitored areas

For the unmonitored areas, nutrient and metal loads are treated as follows:

For nutrients, only loads originating from diffuse sources are reported under unmonitored areas. The nutrient loads from point sources in the unmonitored areas are reported as part of the direct discharges (see Chapter 2.4). Nutrient loads are calculated by means of the TEOTIL model (e.g.

[5] In statistics, a result is called significant if it is unlikely to have occurred by chance. "A statistically significant trend" simply means there is statistical evidence that there is a trend; it does not mean that the change necessarily is large, important or significant in the usual sense of the word. Thus, the 5%-level in this case, does not mean a 5% or larger change in concentrations.

Tjomsland and Bratli, 1996; Bakken *et al.,* 2006; Hindar and Tjomsland, 2007). The model has been utilised for pollution load compilations of nitrogen and phosphorus in catchments or groups of catchments. The model estimates annual loads of phosphorus and nitrogen from point and diffuse sources. The point source estimates are based on national statistical information on sewage, industrial effluents, and aquaculture (see Chapter 2.4). Nutrient loads from diffuse sources (agricultural land and natural runoff from forest and mountain areas) are modelled by a coefficient approach (Selvik *et al.*, 2007). Area specific export coefficients for nutrients have been estimated for agricultural land in different geographical regions. The coefficients are based on empirical data from agricultural monitoring fields in Norway and are adjusted annually by Bioforsk based on reported changes in agricultural practice (national statistics). For forest and mountain areas, concentration coefficients for different area types and geographical regions have been estimated based on monitoring data from reference sites. The annual loads of natural runoff vary from year to year depending on the annual discharge. The model adjusts for retention in lakes between the source and the sea. The inorganic fractions of phosphorus and nitrogen are estimated using different factors for the different sources.

For metals, no relevant model is available to estimate loads from diffuse sources. This means that the contribution of metals from diffuse sources in unmonitored areas has been set to zero in the RID estimates. However, point source discharges of these substances in the unmonitored areas are included in the estimates of the direct discharges to the sea (see Chapter 2.4). Organic contaminants loads are only estimated for the three rivers where these compounds are monitored.

2.4 Direct discharges

The direct discharges calculated in this programme comprise effluents from point sources in the unmonitored areas. Thus, the Norwegian RID Programme includes inland point sources under the RID term “direct discharges to the sea”. This practice has been followed for all years of the RID Programme and is kept as before in order to avoid major jumps in the data series.

The discharges of nutrients from point sources in unmonitored areas are each year estimated using the TEOTIL model, as explained in Chapter 2.3. It should be noted that for metal emissions that are not directly discharging to the sea, retention is not accounted for. Organic contaminants are not included in the estimates, as the number of point sources and compounds reported is low, and thus not representative for calculating regional and national discharges.

The estimates are based on national statistical information, including:

- Sewage: Municipal wastewater and scattered dwellings (Statistics Norway - SSB / the KOSTRA Database);
- Industry: the database “Forurensning” from the Norwegian Environment Agency.
- Aquaculture: Nutrients (from the Directorate of Fisheries / the ALTINN-database (altinn.no)) and copper (based on sales statistics of antifouling products made available by the Norwegian Environment Agency)

The details on how these data were extracted are given in Appendix IV. The location of the reporting units of point source pollution is shown in Figures 4 (industry), 5 (sewage treatment plants), and 6 (fish farming).

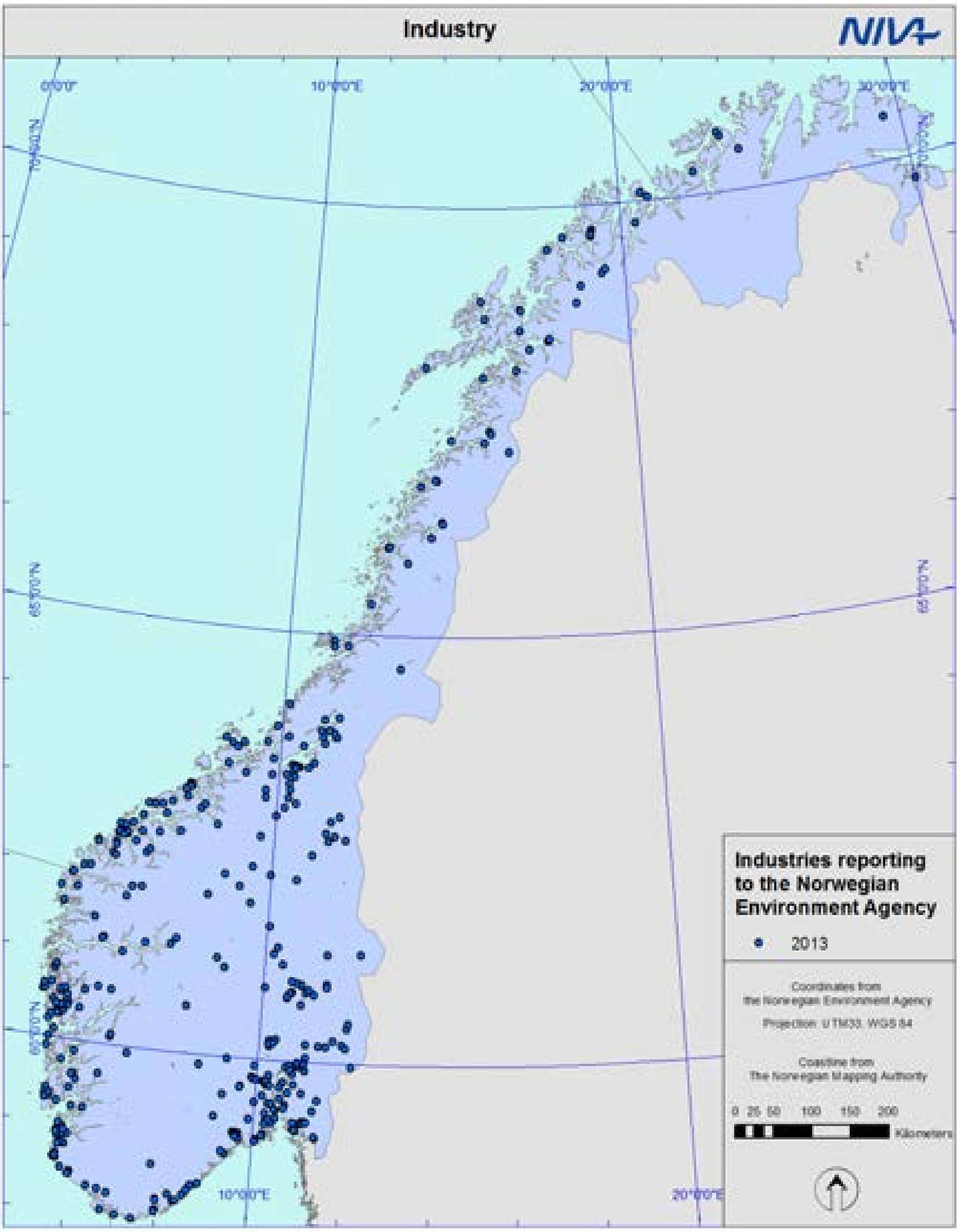


Figure 4. Industrial units reporting discharges of nitrogen and phosphorus in 2013. Data from the database 'Forurensning' (Norwegian Environment Agency).

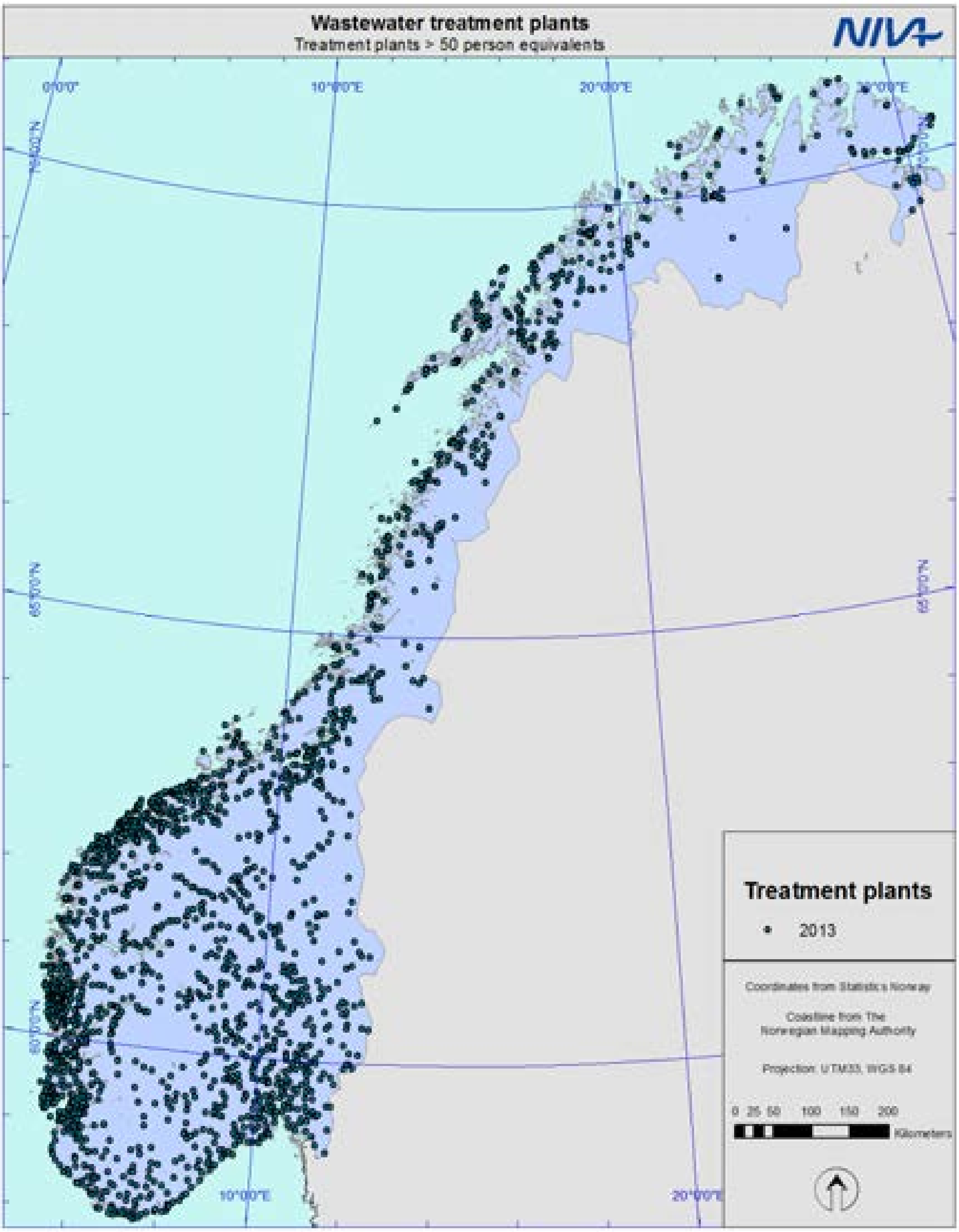


Figure 5. Sewage treatment plants > 50 p.e. in Norway in 2013. Data from SSB (Statistics Norway).

Figure 6. Fish farms for salmon and trout in Norway in 2013. Based on data from the Directorate of Fisheries.

Estimation of nutrient inputs from fish farming followed the same procedure as in recent years. The loads from fish farming were first included in the grand total values in 2000, i.e. originally these loads were not included in the input figures for the period 1990-1999. However, in the recalculation project in 2007, a time series for nitrogen, phosphorus and copper from aquaculture was established, and covered the entire period from 1990 to 2007 (Stålnacke *et al.*, 2009). Then, in 2011 another adjustment was made: Over the years the nutrient content in fish fodder has been reduced. In 2011 a table showing changes in nutrient content over the period 2000-2010 was established, in cooperation with The Norwegian Environment Agency (see Skarbøvik *et al.*, 2011). As a result, nutrient loads were adjusted from the year 2000 onwards. The nutrient content of the fish fodder has been kept at the same level as last year because no new information was available (see Appendix IV). Tables of direct discharges to the sea for total phosphorus, total nitrogen, and copper in all years since 1990 are given in Appendix VII.

The sales statistics from Norwegian Statistics (SSB) with regard to trout and salmon show that there has been a steady increase since 1995 (see Figure 7), but a 6% reduction is reported for 2013 compared with 2012.

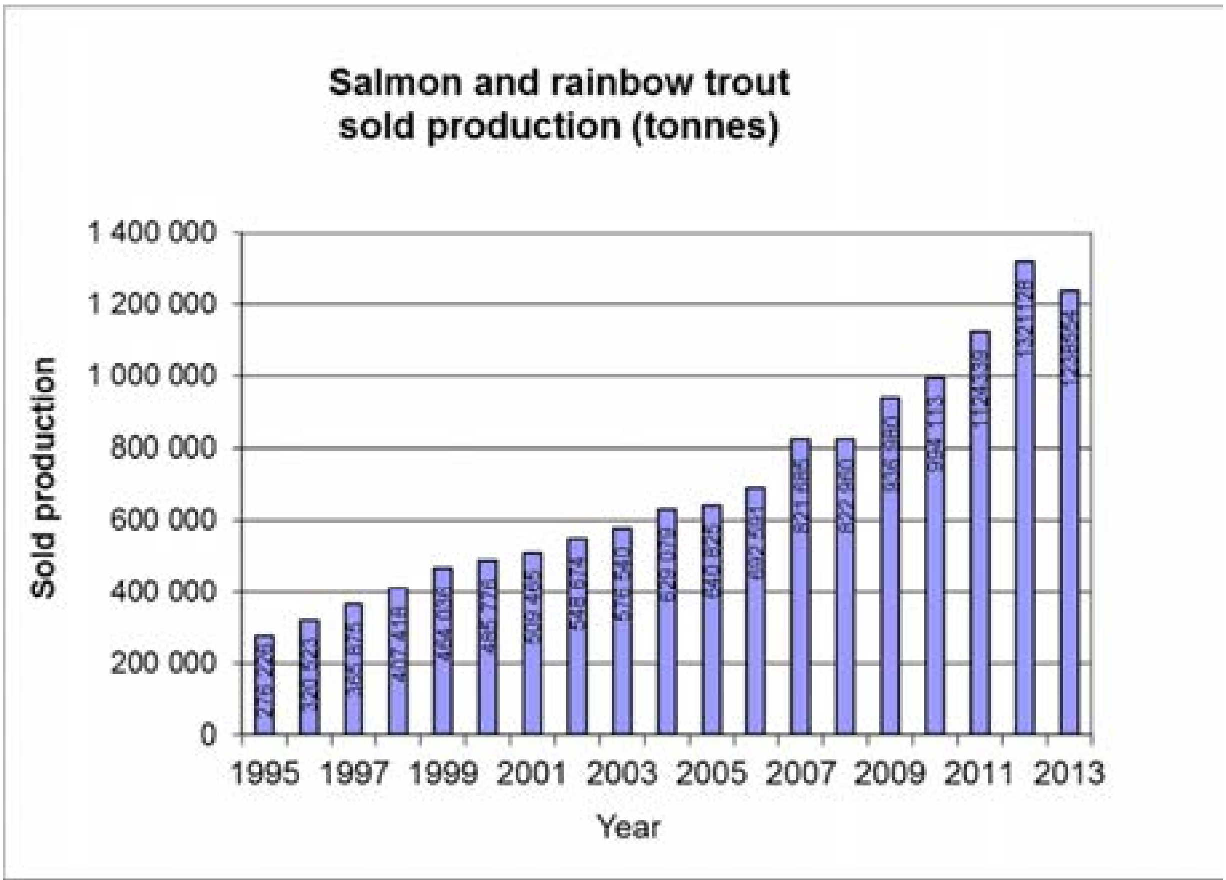


Figure 7. Quantities of sold trout and salmon for the period 1995-2013. Based on data from SSB (Statistics Norway).

In terms of copper loads from fish farming, the quantification of discharges is based on sales statistics for a number of antifouling products in regular use. The Norwegian Environment Agency assumes that 85% of the copper is lost to the environment. The quantity used per fish farm is not included in official statistics, but for the RID Programme, a theoretical distribution proportional to the fish production has been used. The sales statistics for 2013, as compared to former years, are given in Chapter 3.

2.5 Calculating total loads to the sea

The above information is used to calculate the total loads to the four maritime OSPAR areas, i.e., the Skagerrak, the North Sea, the Norwegian Sea and the Barents Sea. Table 2 in the introduction describes this, and Figure 8 shows an overview of how the total loads are calculated.

The deviations from the recommended procedures in the RID Programme (cf. Figure 3) are that point sources upstream in unmonitored areas are included in the direct discharges, and not as inputs from unmonitored areas. As noted above, this deviation has always been a part of the Norwegian RID Programme and it is not recommended to change this now, as it would mean an unfortunate shift in the datasets.

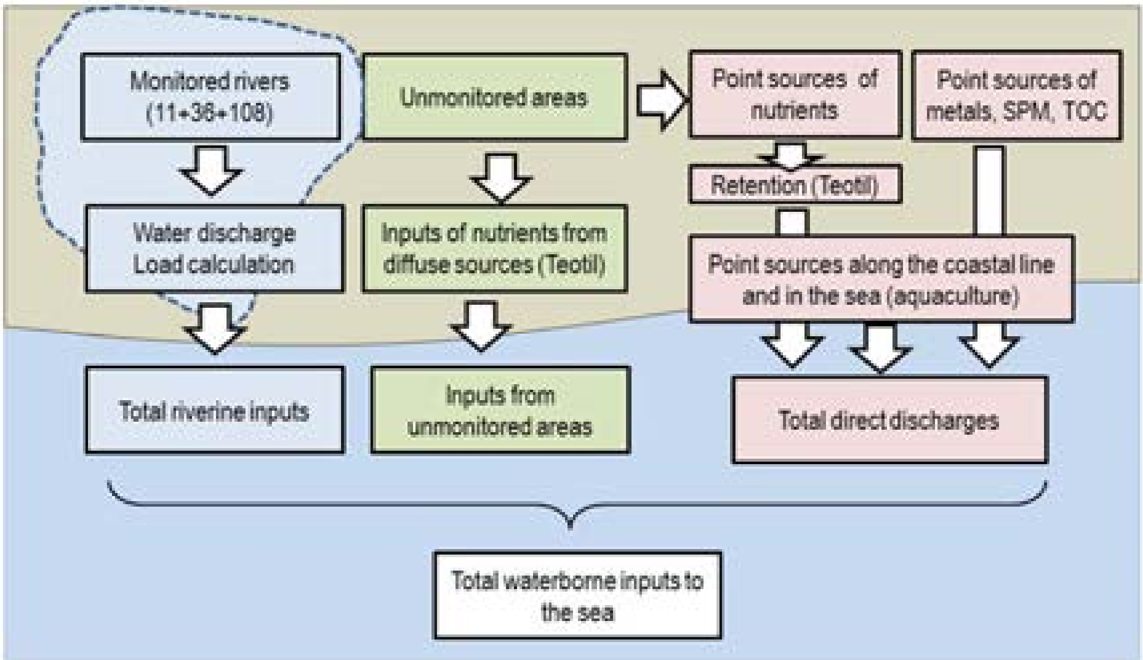


Figure 8. Overview of how total waterborne inputs to the Norwegian maritime waters are calculated. See also Figure 3.

2.6 Organic contaminants: Sampling and calculation

Organic contaminants were monitored in Rivers Alna, Glomma and Drammenselva (cf. Appendix IV). The monitored contaminants in 2013 included polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane (HBCDD), perfluoro chemicals (PFCs), bisphenol A (BPA), tetrabromobisphenol A (TBBPA), short/medium chain chlorinated paraffins (S/MCCPs) and siloxanes. PFCs in River Drammenselva and PAHs in general are not part of the core programme, and were included as extra in 2013.

2.6.1 Sampling methodology

Hydrophobic organic contaminants present in overlying river water are typically distributed between the freely dissolved phase, the particulate matter phase and the dissolved organic matter phase (Warren et al., 2003). The relative proportion of contaminants associated with the particulate and dissolved matter depends on the type and amount of particulate and dissolved organic matter. In this programme, organic contaminants are monitored using two different techniques: passive sampling, for sampling of freely dissolved contaminants, and continuous flow centrifugation (CFC), for sampling of suspended particulate matter-associated contaminants. When more data is available the dissolved organic matter-associated fraction may be estimated for some compounds, based on the observed sorption capacity of the particulate matter. This will be a conservative estimate, as the sorption capacity for dissolved organic matter is likely to be lower than that of particulate matter.

Freely dissolved concentrations of hydrophobic and non-ionised contaminants were estimated from AlteSil™ silicone rubber passive samplers deployed in situ for periods of weeks to months. Passive sampling devices accumulate contaminants from the medium they are exposed to by diffusion. The concentration of contaminants in the medium being sampled can be estimated from the masses of chemicals found in the samplers after exposure if sampler-water exchange kinetics are known. The dissipation of performance reference compounds (PRCs, labelled analogues of substances of interest, e.g. deuterated PAHs) spiked in the samplers before exposure allows the estimation of deployment-specific sampling rates (R_s, equivalent volume of water cleared by the sampler per unit of time, i.e. expressed in L/d).

A single batch of AlteSil™ silicone rubber (1000 cm^2 nominal sampling surface) passive samplers was prepared for 2013. The silicone was initially cleaned with a Soxhlet extractor to remove oligomers from the silicone. Further cleaning was done by soaking in methanol. PRCs were loaded into the samplers using a methanol:water solution (Booij, 2002). Samplers were then kept frozen until use. For each sampling period, two samplers were deployed at each site. 2013 was the first year of monitoring of organic contaminants with this methodology, and primarily due to ice cover on the rivers at the beginning of the year, the passive samplers were not deployed throughout the whole year (Table 4). However, based on daily discharge data, passive samplers were able to sample 93, 78 and 86% of the total annual discharge of the Rivers Alna, Drammenselva and Glomma, respectively for 2013.

Table 4. Exposure periods for silicone rubber passive samplers in 2013.

	Alna	Drammenselva	Glomma
Sampling period 1	70 d (31.01.13-11.04.13)		
Sampling period 2	85 d (11.04.13-05.07.13)	105 d (17.04.13-31.07.13)	98 d (23.04.13-30.07.13)
Sampling period 3	81 d (05.07.13-24.09.13)	45 d (31.07.13-14.09.13)	72 d (30.07.13-10.10.13)
Sampling period 4	87 d (24.09.13-20.12.13)	90 d (14.09.13-13.12.13)	83 d (10.10.13-04.04.14*)

* Samplers could not be collected in December due to the ice

Suspended particulate matter-associated contaminants were sampled using a CFC. Deployment of the CFC at secures sites (with electrical power supply) near the rivers allowed the continuous collection of suspended particulate matter (SPM) for periods of 4 days to over one week (Table 5). While the passive samplers deployment period covered the whole of the spring flood in all rivers (section 3.6), the CFC sampling period only coincided with the spring flood in Drammenselva (only the start of the flood was captured). This SPM sample collected (5-50 g dry weight on average) was then extracted and analysed for the contaminants of interest (and particulate organic carbon content). More details of sampling with CFC can be found in earlier reports (Allan et al., 2011; Allan et al., 2009; Allan et al., 2010).The need for a secure site with electrical power supply for the CFC sampling means that the sampling sites in Rivers Glomma and Drammenselva were not identical to the ones for the grab samples, but slightly upstream (same place as the sensor monitoring, cf. section 2.8). The passive samplers were deployed by the CFC sampling site in River Glomma, but in River Drammenselva the grab sample site was used.

Table 5. Deployment periods for 2013 for the continuous flow centrifuge

	Alna	Drammenselva	Glomma
Sampling event 1	4 d (31.01.13-04.02.13)	6 d (15.05.13-21.05.13)	7 d (23.04.13-30.04.13)
Sampling event 2	5 d (11.04.13-16.04.13)	8 d (02.08.13-10.08.13)	6 d (05.06.13-11.06.13)
Sampling event 3	7 d (17.09.13-24.09.13)	7 d (07.09.13-14.09.13)	6 d (11.10.13-17.10.13)
Sampling event 4	3 d (19.12.13-22.12.13)	5 d (23.12.13-28.12.13)	9 d (22.12.13-31.12.13)

Siloxanes were monitored with bottle grab samples, collected at the time of passive sampler deployment.

2.6.2 Chemical parameters and analytical methods

Silicone rubber passive samplers (field exposed samplers, control samplers and spiked samplers) were extracted and analysed at NIVA for performance reference compounds (deuterated PAHs and fluorinated PCBs), for PAHs, PCBs, PBDEs and HBCDD. BPA and S/MCCPs concentrations cannot be estimated from passive sampling because sampler-water partition coefficients are not available and sampling rate estimations for these substances would be uncertain. At the moment, passive sampling technology cannot be used reliably for the measurement of compounds such as TBBPA and PFCs.

Silicone rubber samplers were extracted using analytical-grade *n*-pentane. The volume of the sample was reduced to 1 ml and split into different fractions for further sample clean-up prior to analyses. Size-exclusion chromatography was used to clean-up extracts before PAH and PCB analysis by gas chromatography-mass spectrometry (GC-MS). Extracts for PBDE analysis were cleaned up with concentrated sulphuric acid and acetonitrile partitioning before GC-MS analysis in negative chemical ionization mode. Analysis for HBCDD isomers was by liquid chromatography Mass spectrometry (LC-MS).

Suspended particulate matter samples were analysed for PAHs, PCBs, PBDEs, and HBCDD at NIVA. Freeze-dried SPM samples were extracted (for PAHs, PCBs, PBDEs and HBCDD) using an ASE 200 accelerated solvent extractor using a mixture of dichloromethane and cyclohexane (50:50). Samples were extracted three times at 100°C and 2000 PSI. For PFCs, samples were extracted twice with 90% acetonitrile. Combined extracts were diluted with LC mobile phase and analysed by LC-MS.

A subsample of SPM was sent to the Norwegian Institute for Air Research (NILU) for analysis for BPA, TBBPA and S/MCCPs. BPA and TBBPA were extracted from oven-dried and homogenized SPM samples with methanol by shaking. Further sample clean-up was undertaken prior to analysis with UPLC-HR-TOF-MS. For S/MCCPs, the samples were Soxhlet-extracted using 10% ethyl ether/hexane. Following clean-up, SCCPs and MCCPs were analysed using GC-HRMS.

Siloxanes were analysed at an accredited laboratory (Eurofins).

2.6.3 Quality assurance

Spiked samplers (loaded with known/measured amounts of PAHs, PCBs, PBDEs and HBCDD) were used to evaluate the inter-batch variability in extraction and recovery of these substances during sample preparation and analysis. A spiked silicone rubber sampler was extracted together with every batch of passive sampling devices.

Six spiked samplers were analysed following the production of the batch of spiked samplers to obtain a reference average value for the amounts of contaminants in the spiked samplers. The deviation between the contaminant amounts measured in spiked samplers analysed during RID sampler batch analyses and the reference values were on average -14% (min and max values of -57 and 37%) for PAHs, 24% (min and max value of -3 and 46%) for PCBs, 8% (min and max values of -41 and 70%) for PBDEs, and -1% (min and max values of -30 to 41%) for HBCDD.

The deployment of duplicate passive sampling devices is important as it provides critical information for quality assurance purpose. There was excellent agreement of the information on water-polymer exchange kinetics (from PRCs, and masses of contaminants accumulated) from duplicate samplers. This indicates that our results are not influenced significantly by the use of multiple silicone rubber polymer batches (very little is known of inter-batch variability in partition properties of polymer batches). Relative percent deviation (%RPD) between estimated freely dissolved concentrations by duplicate passive sampling devices for PAHs and PCBs and most PBDEs are well below 40% (Addendum, Table 1b). Higher %RPDs can be observed in some cases for BDE209 and HBCD, demonstrating the difficulty in sampling and analysing these chemicals.

2.6.4 Calculating riverine concentrations of freely dissolved contaminants

Sampling rates for AlteSil™ silicone rubber passive samplers were estimated using PRC data. PRC dissipation rates were estimated from the amount of PRCs remaining in the samplers after exposure (Booij et al., 1998; Huckins et al., 2002). Since the exchange of chemicals between the water and silicone is an isotropic phenomenon, the release of PRCs (analogues of chemicals of interest) provides us with information on the uptake kinetics for substances of interest. The non-linear least square method by Booij and Smedes (2010) was used to estimate sampling rates for each sampler for each deployment individually using all available PRC data. A boundary layer-controlled uptake rate model by Rusina et al. (2010) was used to estimate sampling rates for compounds for all substances of interest. The PRC data and the non-linear least square method were used to obtain estimates of an exposure-specific parameter β_{sil} for each sampler and exposure period:

$$R_s = \beta_{sil} K_{sw}^{-0.08}$$

Silicone-water partition coefficients, K_{sw} for PRCs (except for fluoroPCBs), PAHs and PCBs were from Smedes et al. (2009). These data were not corrected for temperature, and published literature values obtained at 20 °C were applied to all exposure periods. For substances for which K_{sw} values are not available (i.e. PBDEs and HBCDD), a $\log K_{sw}$-$\log K_{ow}$ (K_{ow} is the octanol-water partition coefficient) regression with a slope of 0.82 and intercept of 0.976 was used to estimate K_{sw} values from their K_{ow}. Since the model by Rusina et al. (2010) predicts only a minor drop in sampling rate with increasing $\log K_{sw}$, it is not expected that the uncertainty in K_{sw} results in substantial uncertainty (or bias) in the result.

Values of β_{sil} (see equation above) ranged from 1.6 to 223 depending on the river and the period of deployment. Lower values were obtained for deployments with lowest temperatures. Standard errors on the estimation of β_{sil} were in the range 6-57% (with median value of 14%). Differences in β_{sil} values for duplicate samplers were in most cases very low. Sampling rates for substances with $\log K_{ow} = 5$ were in the range 0.68 to 94 l/d depending on the river and exposure period.

Freely dissolved concentrations ($C_{w,free}$) were calculated using the following equation:

$$C_{w,free} = \frac{n_{acc}}{K_{sw} m_{sil} (1 - e^{-\frac{R_s t}{K_{sw} m_{sil}}})}$$

where n_{acc} is the amount of chemical absorbed into the sampler during deployment (ng), m_{sil} is the mass of the silicone rubber sampler (g) and t the deployment time (d).

Analytical limits of detection (in ng/g silicone rubber sampler) were transformed into field limits of detection using the equation above.

2.6.5 Calculating riverine loads and whole water concentrations of organic constituents

Riverine fluxes or loads of contaminants in the freely dissolved phase or associated to suspended particulate matter were estimated separately from the passive sampling data and from the CFC sampling, respectively.

The riverine load of contaminants in the freely dissolved form was estimated using the following equation:

$$F_{w,free} = Q_{average} \times t_{PS} \times C_{w,free}$$

where $F_{w,free}$ is the freely dissolved contaminant load (g) per passive sampler exposure period, t_{PS} (d), $Q_{average}$ is the average riverine water discharge (m^3/s) for the passive sampler exposure (calculated from daily recording), and $C_{w,free}$ is the contaminant concentration measured with passive sampling (ng/l). $F_{w,free}$ values were estimated for each passive sampler exposure for each river and were added to estimate the annual load (g/yr). Passive samplers were not deployed for the entire year in any of the three rivers. Loads were corrected for this by upscaling the data to the total annual discharge for each river.

The riverine load of contaminants associated with suspended particulate matter was estimated using the following equation:

$$F_{SPM} = Q_{average} \times t_{SPM} \times [SPM] \times C_{SPM}$$

where F_{SPM} is the particulate matter-associated contaminant load (g), [SPM] is the SPM content of the water (flow-weighted mean, mg/l) estimated from bottle sampling for the period of time the CFC sampling is representative of, t_{SPM} (d), $Q_{average}$ is mean riverine discharge (m^3/s) for the t_{SPM} period, and C_{SPM} is the contaminant concentration in the SPM sample (ng/g dry weight (dw)). The period of time that CFC sampling is assumed to represent is from the mid-point between the sampling event and the previous sampling event to the mid-point between the sampling event and the following sampling event. Loads were upscaled to total annual loads for 2013 using the annual SPM load. Analytical limits of detection for particulate matter-associated contaminants (in ng/g SPM) were transformed into field limits of detection using [SPM] and $Q_{average}$ where needed.

Annual average "whole water" concentrations were calculated by adding the annual estimate of freely dissolved load of contaminants and that associated with the suspended particulate matter phase and dividing that value by the total annual discharge of the river. This was done for each single chemical. For contaminants where passive sampler data were not available, freely dissolved concentration was predicted from SPM concentrations using established values of $\log K_{poc}$. Such estimates of the freely dissolved concentration are likely to suffer from significant uncertainty (cf. section 3.5.4), so they are used solely to estimate the annual average "whole water" concentration, not in calculations of annual loads.

When freely dissolved and particulate matter data is given as a range of concentrations, this is the result of certain concentrations being below limits of detection. When datasets presented some concentrations below limits of detection, these concentrations were assumed to be either zero or at the limits of detection level for the calculation of annual averages and of sums of concentrations of chemicals. This procedure yielded ranges of concentrations with a lower estimate representative of a minimum expected concentration and an upper estimate representative of an expected maximum concentration.

2.7 Water temperature

Water temperature data were acquired from four different sources: Sensor monitoring (hourly), TinyTag temperature loggers (hourly), manual temperature measurements (single measurements) and NVE temperature logging (daily averages from bi-hourly measurements).

Temperature sensors were applied in the three rivers with sensor monitoring also for other parameters (cf. section 2.8). In the remaining rivers monitored monthly, except River Orkla, temperature was monitored with TinyTag temperature loggers (TG-4100 or TKC-0002 from Intab). These loggers were secured to land and deployed in the river at the grab sampling locations. The loggers were replaced in the autumn, as the battery lasts only one year. In River Orkla, there are two outlets from hydropower plants just upstream of the sampling point, so the temperature at the grab sampling point was not considered representative. There were also difficulties with deployment at the sampling site. Hence, NVE data from further upstream were used instead. There are no major tributary rivers between the temperature logger location and the grab sampling point.

In the rivers monitored quarterly, temperature was measured directly in the water using a thermometer at the time of sampling, as a general rule. In some rivers NVE data were used instead. As this is high-frequency data they have much higher temporal representativity, but they were only used when there was a logging station close to the grab sampling site and where there were no major tributaries, to ensure geographical representativity. In 2013 NVE data were used for 11 of these 36 rivers.

2.8 Sensor monitoring

Sensor monitoring was applied in Rivers Alna, Drammenselva and Glomma. YSI 600 XL V2-O multiparameter sondes were installed, measuring turbidity (optical sensor number 6136), pH (probe number 6561), conductivity and temperature.

In River Alna the sonde was installed vertically in a tube attached to a walkway alongside/above the river, about 0.5 m from the river bank at 0.5-1 m depth. In Rivers Drammenselva and Glomma the sondes could not be installed at the grab sampling locations, due to the lack of power supply. Instead they were installed at the same location as the sampling for organic contaminants was conducted (cf. section 2.6.1 and Appendix IV). In River Drammenselva, the sonde was in a tube installed diagonally into the river, attached to the wall of a building, at about 5 m from the river bank and at 1 m depth. In River Glomma the sonde was installed inside a water works. The river flows under the building and is accessible through an opening in the floor. In 2013 the sonde was installed in a flow cell, with water being pumped from the river.

All sensors were installed during April. In River Drammenselva there was missing power supply for part of August. In River Glomma the flow cell and tubes had to be replaced, and the pumping frequency adjusted in order to get sufficient flow through the flow cell. Especially in June and July several days of data had to be deleted. The sensors in Rivers Alna and Drammenselva were maintained and calibrated once after installation, while River Glomma had several maintenance visits.

Data are logged using an Observator OMC-045-III data logger and transferred directly to NIVA's server via GPRS. The data are then immediately available online at www.aquamonitor.no/rid. A QA routine was set up, flagging data which were obviously wrong, due to e.g. interrupted power supply, maintenance and in the case of River Glomma, interruptions of the flow through the flow cell. Flagged data are not visible online and are not included when downloading data, but are kept in the database.

3. Results

3.1 Climate, water discharge and temperature

3.1.1 Climate in 2013

Kristiansen et al. (2013) summarised the climate in 2013 and concluded that the average air temperature was 1.0 °C above normal (1961-1990), whereas average precipitation was 10% above normal. This made 2013 one of the 20 wettest years since 1900. The winter was colder and dryer than normal, whereas spring (March-May) had relatively normal temperatures, but 20% more precipitation than normal. The south-eastern part of the country experienced 50% more precipitation than normal, which resulted in the 7th wettest spring in this region since 1990. In the summer (June-August) the average temperature was 1.1 °C above normal. Especially the northern parts of the country experienced an unusually warm summer. Summer rainfall was 20% above normal, with the highest precipitation in the south-eastern and western parts of the country. In the autumn the warm weather continued, with temperatures 1.4 °C above normal. Precipitation in this season was 5% lower than normal.

3.1.2 Water discharge

Variations in water discharge can explain variations in both contaminant loads and concentrations. Hydrological stations in nine of the eleven rivers monitored monthly have historical data that can be used to assess long-term changes. The monthly mean water discharges in 2013 at these stations have been compared to the mean water discharges of the 30-year normal (1971-2000) (Table 6). In this table, also the results of statistical analyses of water discharge at sampling dates (cf. Chapter 2.2.5) are shown. Time series of annual water discharges as derived from continuous monitoring are presented in Appendix V.

Table 6. Average annual water discharges for nine stations in the 30-year period 1971-2000 and 2013 (increases greater than 5% are marked in orange); and statistical analyses of water discharge (Q) at the dates of water sampling (see colour codes in the footnotes to the table).

River	30-year normal of Q (1971-2000)*	Q in 2013*	Difference (2013 vs. 1971-2000)*	P-values from statistical trend analyses of Q (at dates of sampling)**		Maritime area
	m^3/s	m^3/s	%	1990-2013	2004-2013	
River Glomma	678.0	760	12	0.0256	0.0095	Skagerrak
River Drammenselva	281.3	382.6	36	0.0064	0.0397	
River Numedalslågen	104.7	119.6	14	0.0530	0.3252	
River Skienselva	259.5	321.2	24	0.0741	0.2449	
River Otra	145.6	143.7	-1	0.9210	0.2449	
River Vosso	72.8	90	24	0.1016	0.3252	North Sea
River Orkla*	48.5	53.4	10	0.4568	0.5312	Norwegian Sea
River Vefsna	150.0	164.4	10	0.6198	0.9287	
River Alta	75.4	89.7	19	0.5516	0.5312	Barents Sea

* These water discharges derive directly from the hydrological stations depicted in the left column: Solbergfoss in Glomma; Døvikfoss in Drammenselva; Holmsfoss in Numedalslågen; Norsjø in Skienselva; Heisel in Otra; Bulken in Vosso; Syrstad in Orkla; Laksfors in Vefsna; and Kista in Alta.

** P-values below 0.05 are significant; P-values between 0.5-1.0 show tendencies of change. Red colour: Significant upward trend. Orange colour: Tendency of increase. These Q-values have been adjusted to the sampling sites.

All but one river (River Otra) had higher water discharges in 2013 than the 30-year normal. The trend analysis performed on the water discharges at the dates of water sampling show statistically significant upward trends in annual water discharge both for the 10-year and the long-term period in two rivers: Glomma and Drammenselva ($p<0.05$). This is mainly due to an increase in water discharge the last 3-4 years. Rivers Numedalslågen and Skienselva show an insignificant upward trend ($0.05<p<0.10$) in water discharges at the dates of water sampling in the long-term, but not within the last 10 years.

3.1.3 Water temperature

Table 7 shows the water temperature in the 11 rivers monitored monthly. Temperatures are in general recorded every hour, and the monthly averages are shown in the table. Temperatures typically vary from the north to the south, and also according to whether or not the river's headwaters are located in mountains (with/without glaciers) or lowland forested areas (River Alna).

Table 7. Water temperature as monthly means (ºC) from hourly observations in the 11 rivers monitored monthly.

River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Glomma					7.5			17.8	15.7	9.4	5.7	2.7
Alna					9.0	12.3	13.2	13.6	11.0	8.0	5.1	3.6
Drammenselva					5.9	11.9	16.4		14.9	9.4	5.2	2.5
Numedalslågen						14.3	17.4	17.1	13.5	7.9	2.8	0.8
Skienselva	1.3	1.0	1.0	1.8	4.1	9.3	15.2	16.8	15.3	11.2	7.5	4.6
Otra	0.4	0.2	0.6	2.3	6.3	12.5	17.9	18.3	15.2	10.1	5.1	3.0
Orre	1.5	1.8	2.0	7.1	11.3	15.5	17.8	17.6	14.4	9.8	6.0	4.5
Vosso	0.8	0.6	-0.5	1.1	3.6	8.9	12.9	14.4	12.6	9.4	5.9	3.3
Orkla*	0	0	0	1.0	5.0	10.0	11.7	12.2	9.7	5.1	1.2	
Vefsna	0	0	0	0.1	3.7	10.5	13.1	13.6	10.5	5.1	1.2	0.4
Alta		0.3	0.3	0.4	3.2	8.2	11.9	11.5	9.6	5.1	1.5	0.7

* Data from NVE's sensor, based on daily average values.

Temperatures were monitored for the first time in this programme in 2013 and no trends can be discussed as yet. Figure 9 shows three typical charts of hourly temperatures. River Alna is a small river in Southern Norway, which originates in lowland forests and runs through the capital of Oslo. The temperatures during the summer season varied between 10 and 16 ºC. River Otra, on the other hand, is the largest river in the southern part of Norway, and with its 3700 km^2 it originates in the mountains and moors of this region. Temperatures lie around 0 ºC until March/April, but in August the temperatures reached 20 ºC during a short period. In River Alta in Northern Norway, snow melt sets in much later in the spring of 2013, and temperatures only started to increase in May. The maximum temperature in this river was about 15 ºC in August. It should be noted that the sensors may not be on the same water depth in all rivers, although they should be located at least 0.5 meters below the surface.

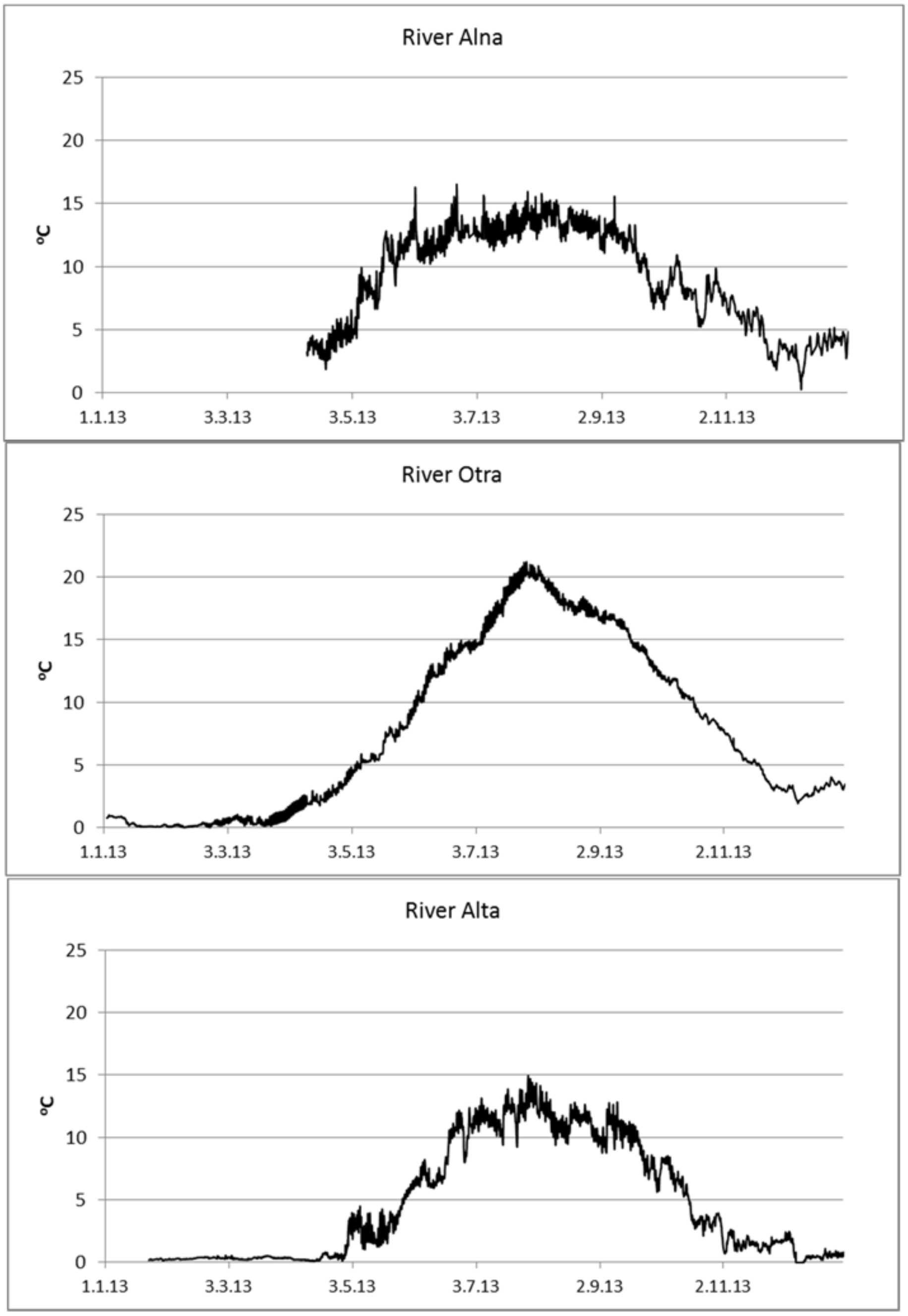


Figure 9. Temperatures recorded at hourly intervals in three selected rivers in 2013. In River Alna with a YSI 600 XL V2-O multiparameter sonde, in Rivers Otra and Alta with TinyTag loggers.

3.2 Nutrients, particles, silicate and TOC

3.2.1 Total inputs in 2013

The total inputs to Norwegian coastal waters in 2013 were estimated to about 12 700 tonnes of phosphorus and about 162 000 tonnes of nitrogen (Figure 10). Total silicate inputs were estimated to about 440 000 tonnes and total organic carbon (TOC) to about 505 000 tonnes. The input of suspended particulate matter amounted to about one million tonnes (Table 3 in the Addendum).

An overview of the inputs of the different nitrogen and phosphorus fractions per coastal area is given in Figure 10. Overall, nutrient inputs were highest to the Norwegian Sea and lowest to the Barents Sea.

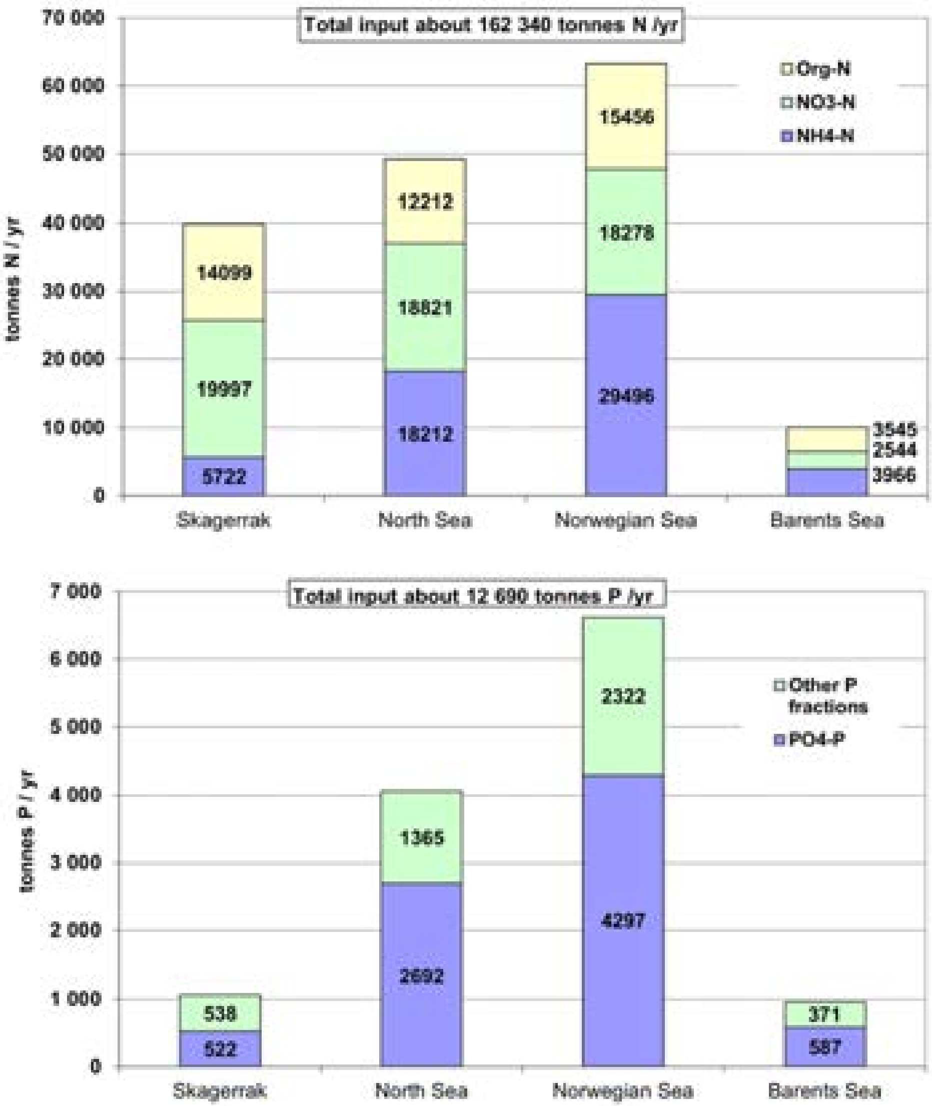


Figure 10. Inputs of total nitrogen (upper panel) and total phosphorus (lower panel) divided into different fractions for the four Norwegian maritime areas.

The loads of silicate and SPM are not estimated for unmonitored areas due to lack of methodology. It should also be noted that particulate matter is discharged from fish farming; and silicate is present in effluents from some types of industry, but neither of these are reported.

3.2.2 Trends in riverine nutrient loads and concentrations

All calculated annual SPM and nutrient loads for rivers monitored monthly from 1990 onwards are presented in charts in Appendix V; whereas all concentrations monitored since 1990 are presented in charts in Appendix VI.

Table 8 shows the riverine loads of nutrients and SPM in 2013, as compared to the average for the period 1990-2012. River Alna has been monitored monthly in 2013, but was one of the rivers monitored once a year from 1990-2003 (under its alternative name, River Loelva).

Table 8. Total riverine loads (155 rivers) of total nitrogen (TN), total phosphorus (TP) and suspended particulate matter (SPM) as an average for 1990-2012 and in 2013. Changes greater than 5% are marked in orange (increase) and green (decrease).

Maritime area	Nitrogen (tonnes)		Phosphorus (tonnes)		SPM (1000 tonnes)	
	Average 1990-2012	2013	Average 1990-2012	2013	Average 1990-2012	2013
Skagerrak	29 870	30 747	758	811	368	383
North Sea	13 893	12 017	281	469	101	226
Norwegian Sea	10 113	9 403	333	496	217	391
Barents Sea	3 248	3 021	116	148	39	28
Total Norway	57 125	55 187	1 488	1 925	725	1 028

In order to analyse these trends further, statistical trend analyses (for which the methodology is described in Chapter 2.2.5) of nutrients and suspended particles loads and concentrations were carried out. The results are given in Tables 9 and 10, and further commented in the sections below. Both trends for the last 10 years and for the entire period have been analysed. The terminology ‘long-term’ is used for the entire 24-year data record period of 1990-2013, while the shorter period of 2004-2013 is referred to as ‘10-year trends’.

Table 9A. Trends in annual water discharge (Q; estimated from daily measurements), nutrient and particle loads (upper estimates) in nine Norwegian main rivers in the last 10 years (2004-2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

	LOADS						
River	Q	NH_4-N	NO_3-N	Tot-N	PO_4-P	Tot-P	SPM
Glomma	0.0095	0.9462	0.5662	0.6753	0.6042	0.4964	0.8009
Drammenselva	0.0397	0.8251	0.8593	0.7943	0.5341	0.6458	0.7029
Numedalslågen	0.3252	0.0789	0.3066	0.7106	0.2247	0.3424	0.7198
Skienselva	0.2449	0.5065	0.0804	0.5014	0.3203	0.6235	0.5899
Otra	0.2449	0.2059	0.0716	0.4489	0.6140	0.6878	0.0569
Orreelva	0.3252	0.5034	0.0947	0.2742	0.3398	0.2724	0.3569
Orkla	0.5312	0.6289	0.8700	0.1385	0.5213	0.3143	0.7348
Vefsna	0.9287	0.0561	0.9740	0.0326	0.9517	0.8668	0.9640
Altaelva	0.5312	0.9832	0.2047	0.1951	0.3192	0.0720	0.5311

Significant downward (p<0.05)
Downward but not significant (0.05<p<0.1)
Significant upward (p<0.05)
Upward but not significant (0.05<p<0.1)

Table 9B. Trends in nutrient and particle concentrations (upper estimates) in nine Norwegian main rivers in the last 10 years (2004- 2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

	CONCENTRATIONS					
River	NH_4-N	NO_3-N	Tot-N	PO_4-P	Tot-P	SPM
Glomma	0.3507	0.2525	0.9751	0.6971	0.5187	0.8610
Drammenselva	0.4552	0.1925	0.9498	0.8163	0.0840	0.2566
Numedalslågen	0.8799	0.6033	0.1148	0.0392	0.0108	0.7445
Skienselva	0.1921	0.0058	0.9372	0.2293	0.9880	0.1245
Otra	0.0575	0.1363	0.4409	0.2148	0.1579	0.0699
Orreelva	0.6999	0.1410	0.1195	0.1569	0.8896	0.3787
Orkla	0.1299	0.8781	0.0961	0.4743	0.1683	0.1762
Vefsna	0.0904	0.1153	0.0065	0.0481	0.0574	0.5562
Altaelva	0.4515	0.0902	0.0332	0.1035	0.0209	0.6634

Significant downward (p<0.05)
Downward but not significant (0.05<p<0.1)
Significant upward (p<0.05)
Upward but not significant (0.05<p<0.1)

Table 10A. Long-term trends in annual water discharge (Q; estimated from daily measurements), nutrient and particle loads (upper estimates) in nine Norwegian main rivers 1990- 2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS							
River	Q	NH_4-N	NO_3-N	Tot-N	PO_4-P	Tot-P	SPM
Glomma	0.0256	0.0007	0.7911	0.4241	0.9597	0.2145	0.2484
Drammenselva	0.0064	0.1036	0.9625	0.2747	0.3371	0.2464	0.2621
Numedalslågen	0.0530	0.5710	0.8283	0.0230	0.3030	0.4647	0.3856
Skienselva	0.0741	0.0431	0.0001	0.0038	0.1897	0.3850	0.7546
Otra	0.9210	0.2023	<0.0001	0.1520	0.9966	0.1126	0.0308
Orreelva	0.1016	0.0767	0.0570	0.5871	0.7538	0.4880	0.2402
Orkla	0.4568	0.0153	0.7090	0.4295	0.4579	0.1588	0.4795
Vefsna	0.6198	<0.0001	<0.0001	0.0053	0.0610	0.0012	0.1692
Altaelva	0.5516	0.0473	0.0314	0.0695	0.0722	0.0441	0.2767

Significant downward (p<0.05)

Downward but not significant (0.05<p<0.1)

Significant upward (p<0.05)

Upward but not significant (0.05<p<0.1)

Table 10B. Long-term trends in nutrient and particle concentrations (upper estimates) in nine Norwegian main rivers 1990- 2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS						
River	NH_4-N	NO_3-N	Tot-N	PO_4-P	Tot-P	SPM
Glomma	0.0085	0.8151	0.1201	0.1107	0.3309	0.2977
Drammenselva	0.2372	0.8070	0.1087	0.5875	0.1727	0.4126
Numedalslågen	0.3187	0.0554	0.0031	0.2553	0.0046	0.3049
Skienselva	0.3235	<0.0001	0.0003	0.0708	0.7142	0.7440
Otra	0.1641	0.0007	0.1649	0.0774	0.0146	0.0006
Orreelva	0.3754	0.0170	0.0720	0.3996	0.7099	0.8620
Orkla	0.0184	0.9139	0.1079	0.0966	0.4024	0.1501
Vefsna	0.0000	0.0001	0.0135	0.1111	0.0483	0.0119
Altaelva	0.0207	0.0412	0.8524	0.0108	0.1358	0.0681

Significant downward (p<0.05)

Downward but not significant (0.05<p<0.1)

Significant upward (p<0.05)

Upward but not significant (0.05<p<0.1)

Nitrogen
When the last 10 years (2004-2013) of data are examined, few statistically significant trends are found in nitrogen related substances. The exceptions are a significant upward trends in both total N loads and concentrations in River Vefsna, and a significant upward trend in total N concentrations in River Altaelva (Table 9). The trends in Vefsna are difficult to detect visually in Figure 11 and in the supporting figures in Appendices V and VI. More precisely, the total N load trend in Vefsna is explained by on average 30% higher loads in 2011-2013 compared to the years 2004-2010 but at the same time still well below the loads in the 1990s. The significant upward trend in total N concentrations in Altaelva is not large in absolute values; we could though note that concentrations in years 2004-2007 only at one occasion exceeed 200 µg/l whereas it in years 2008-2013 exceeded 200µg/l at 25 occasions with a peak value of 770 µg/l in October 2013 (see Figure A-VI-2b). Downward trend was found for nitrate concentration in River Skienselva, where the concentrations have declined on average from around 175 to 125 µg/l in the last 10 year period, which is a further reduction of the concentrations 1992-2003 (see next paragraph). Rivers Otra, Orreelva and Vefsna show nearly significant downward 10-years trends in either nitrate or ammonium N loads or concentrations, these tendencies may be worthwhile to follow up in the coming years.

However, in the long-term trend analyses we see substantially different trend developments for the nitrogen related components: Statistically significant long-term trends in total nitrogen (TN) loads were detected in three out of nine rivers (Table 10A). Two of those trends were downward (Skienselva and Vefsna), but an upward trend was found in River Numedalslågen. For ammonium and nitrate loads, statistically significant *downward* trends were detected in five and four rivers, respectively. For TN-concentrations, two rivers showed a downward trend and one river an upward trend (Table 10B).

A clear downward long-term trend in total nitrogen loads and concentrations (as well as for the ammonium and nitrate loads and concentrations, Table 10) was detected in River Vefsna (Figure 11) when the entire period of 1990-2013 is evaluated. In Vefsna, the decline is around 23 tonnes per year, which corresponds to a total reduction of around 550 tonnes over the 24 year period. As reported in earlier years (Skarbøvik et al., 2013), this river shows a rather abrupt change in loads of some substances before and after 1999, including the load of nitrogen. In this river also loads of lead and copper, and to some extent ammonium, dropped after 1999 (see Chapter 3.3.2). As noted in previous years, the relatively high concentration levels of these substances in this river might indicate that the substances derive from either industrial discharges or sewage treatment effluents. This theory is further supported by the fact that high concentrations before 1999 were mainly observed at low water discharges, when dilution is at a minimum. However, in spite of efforts to reveal the reasons for this decrease, including contacts with local experts, no clear explanation has been found. The sampling site in River Vefsna is located upstream of both major industries and the major settlement (Mosjøen).

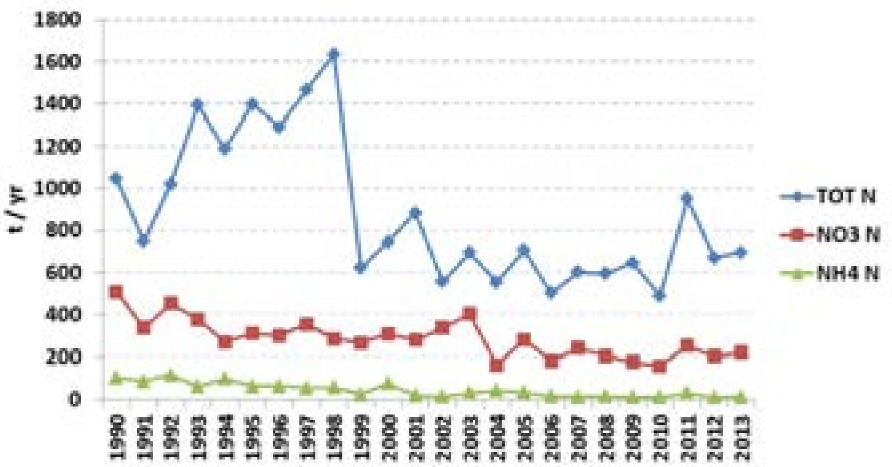


Figure 11. Annual riverine loads in River Vefsna of total nitrogen, nitrate nitrogen and ammonium in 1990-2013. Loads shown are the upper estimates. See text for discussion.

Based on the long-term dataset, a downward trend in total nitrogen loads as well as concentrations was also detected in River Skienselva when variations in water discharge were taken into account, although it was difficult to visually identify such trends in terms of loads (Figure 12). In Skienselva the trend magnitude (i.e., trend slope) is low with a reduction of only around 0.8 tonnes/yr compared to the average annual load of 2800 tonnes. In River Otra, a visible and statistically significant downward trend of nitrate loads and concentrations was detected (Figure 13). However this was not the case with total nitrogen. The reason for this apparent increase in organic nitrogen is not yet known.

A long-term statistically significant upward trend was detected for total nitrogen concentrations and loads in River Numedalslågen (Table 10; Figure 14). This seems to be related to an almost statistically significant upward trend in nitrate-N concentrations ($p<0.06$). In addition, total organic carbon (TOC) loads show an upward trend, to some extent indicating an increased transport of organically bound nitrogen in this river. On the other hand, four other rivers (Rivers Skienselva, Otra, Vefsna and Altaelva) showed clear long-term downward trends in nitrate-N loads and concentrations, while River Orreelva showed similarly significant downward trend in concentrations, and a nearly significant downward trend in nitrate-N loads ($p<0.06$).

A statistically significant long-term downward trend in ammonium load was detected in Rivers Glomma, Skienselva, Orkla, Vefsna, and Altaelva (Table 10A), and a non-significant downward trend was found for River Orreelva. Statistically significant downward trends were also detected for ammonium concentrations in four of these rivers (Table 10B). Changes in ammonium loads are shown in charts in Appendix V. Ammonium loads in most rivers only account for 1-5 % of the total nitrogen loads. Ammonium is normally quickly assimilated by plants or converted into nitrate in river water (through nitrification processes) and therefore represents a less informative parameter for long-term trend assessments.

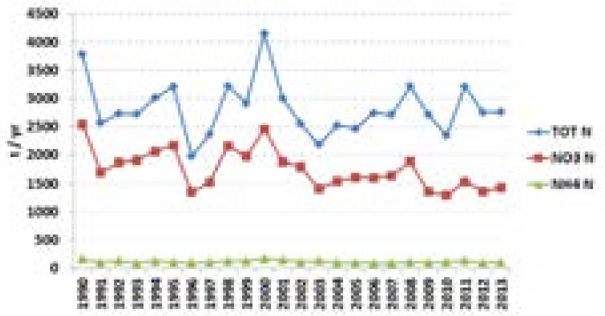


Figure 12. Annual riverine loads in River Skienselva of total nitrogen, nitrate nitrogen and ammonium in 1990-2013. Loads shown are the upper estimates. See text for discussion.

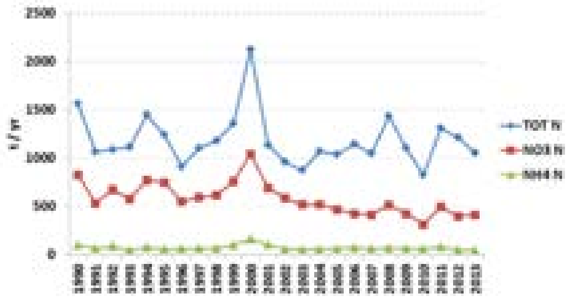


Figure 13. Annual riverine loads in River Otra of total nitrogen, nitrate nitrogen and ammonium in 1990-2013. See text for discussion.

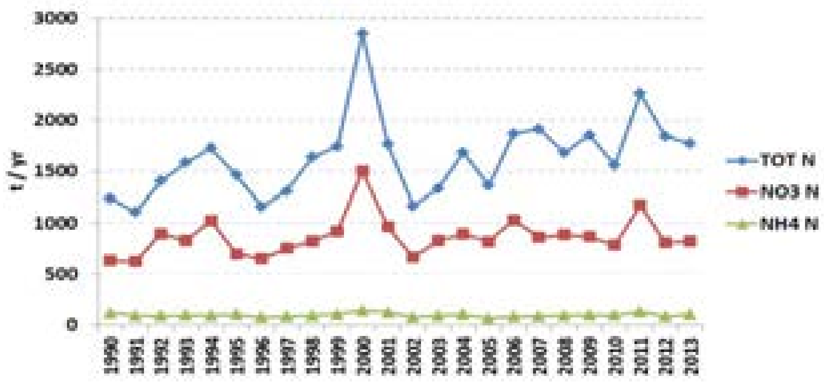


Figure 14. Annual riverine loads in River Numedalslågen of total nitrogen, nitrate nitrogen and ammonium in 1990-2013. See text for discussion.

Phosphorus

Examining only the last 10 years of data, few statistically significant trends are seen in the phosphorus related compounds. There are significant upward trends in terms of concentrations in River Numedalslågen (all examined P related substances), Vefsna (orthophosphate P, upper estimate) and Altaelva (total P). Rivers Vefsna, Altaelva and Drammenselva show notable but insignificant upward trends in either or both orthophosphate and total P loads or concentrations, which may deserve attention in the future.

Examining the available longer term data, one sees a different picture. Statistically significant long-term downward trends in total phosphorus loads were detected in two out of nine rivers (Table 10A), i.e., Vefsna and Altaelva. For concentrations, two rivers showed statistically significant downward trends (Rivers Otra and Vefsna), but an upward trend was also found in River Numedalslågen (Table 10B). For the orthophosphate loads no significant trends were found when considering the upper estimates, although statistically significant downward trends were detected in Rivers Vefsna and Altaelva when analysing the lower estimates. In terms of orthophosphate concentrations, only River Altaelva had a concurring significant downward trend in the upper estimates, whereas three rivers presented significant downwards trends when the lower estimates were analysed.

From the long-term and short term trend analysis it is apparent that the phosphorus loads and/or concentrations in Vefsna and Altaelva show a general decline over the 24 year time period whereas the loads and/or concentrations have increased since 2004. Besides more frequent peak observations in recent years (2010-2013) in Altaelva, the average concentrations have increased from around 5 µg/l in the years 2004-2009 to around 8 µg/l in 2010-2013. In Vefsna, the increase in average levels are lower; from 2.6 µg/l in 2004-2009 to 3.8 µg/l in 2010-2014.

The total phosphorus loads generally show large inter-annual variability in a majority of the nine rivers, varying by a factor of three or more over the 24-year study period (Appendix V). This hampers the detection of trends over time. Peaks in phosphorus loads are often – but not necessarily - associated with high particle (SPM) loads in the same year. Moreover, total phosphorus usually varies with water discharge, and monthly sampling will therefore imply relatively uncertain estimates of this parameter.

Particulate matter

When the last 10 years are examined, there is only a near significant downward trend found in River Otra in both particulate matter (SPM) loads and concentrations. For the long-term period of 1990-2013, statistically significant downward trends in particulate matter concentrations were detected in two out of nine rivers, Rivers Otra and Vefsna, while there is a near-significant downward trend in River Altaelva. For loads, only River Otra showed a statistically significant trend (downward), see Figure 15. However, the high loads in this river in 1994-95 may be explained by the construction of a sewage mains. There are visible lower SPM concentrations in River Vefsna in the 2000s than in the 1990s (Figure 16).

As in the case of total phosphorus, there are major inter-annual variabilities in loads of suspended particulate matter (SPM), and monthly sampling will give high uncertainties. More frequent sampling would have improved this uncertainty factor. However, a common feature in the time series was the high particle loads in 2000 for several of the rivers, but notably in all five Skagerrak rivers, even if it is somewhat less noticeable in River Glomma. This is in good correspondence with the high water discharges that year, as witnessed in Appendix V. A more general discussion concerning the sampling frequency in RID and particulate material can be found in Skarbøvik et al. (2012).

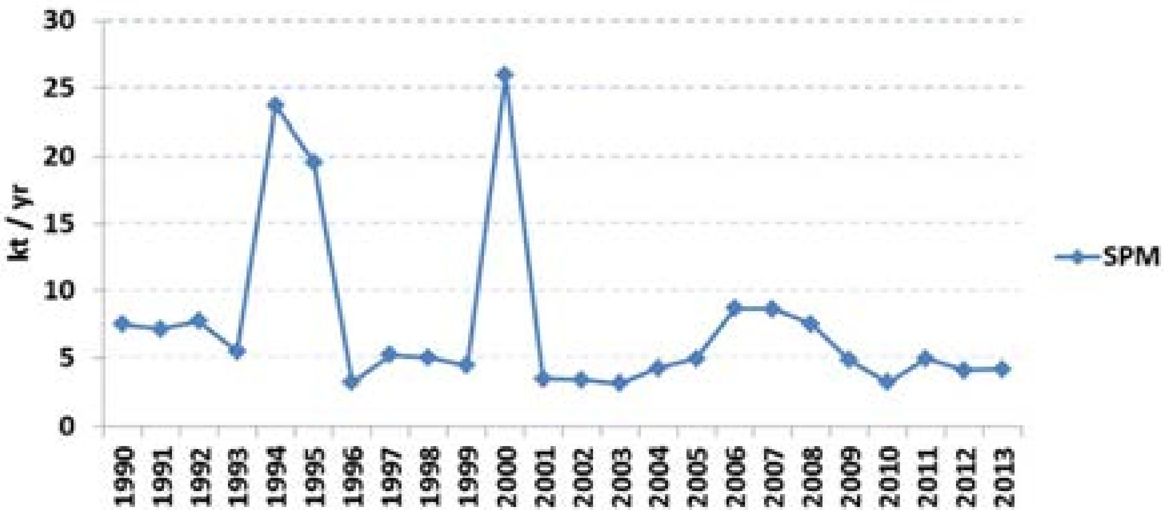


Figure 15. Riverine loads of suspended particulate matter (SPM) in River Otra 1990-2013.

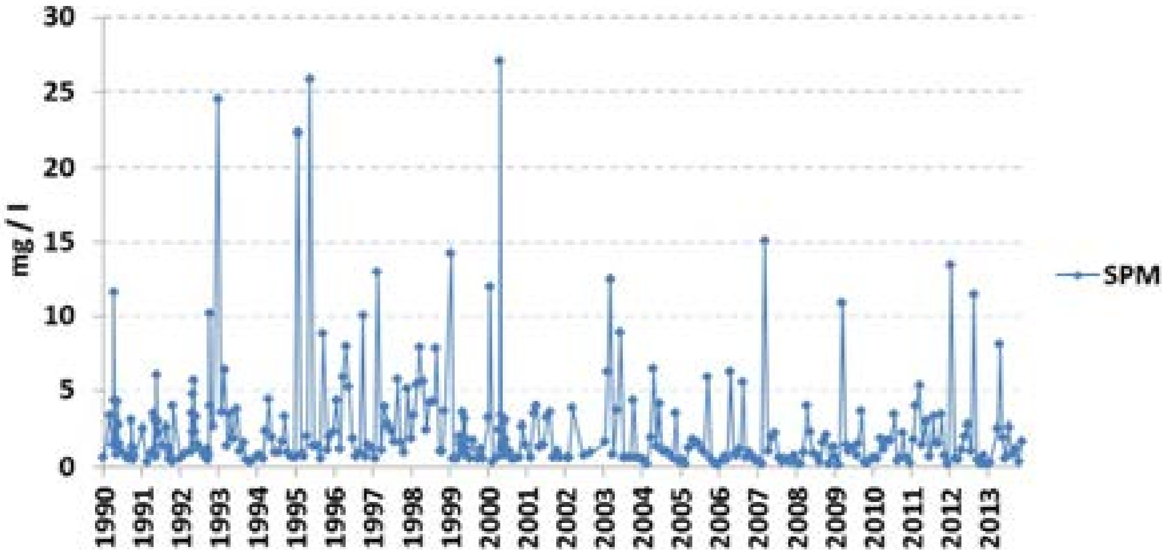


Figure 16. Monthly concentrations of suspended particulate matter (SPM) in Vefsna 1990-2013.

3.2.3 Source apportionment of nutrients

Source apportionment is presently not a part of the RID programme, but in Norway, the TEOTIL model is run for the entire country (i.e. not using river monitoring data), and source apportionments from this modelling for nitrogen and phosphorus are therefore shown in Figures 17 and 18, respectively.

Especially for the three northernmost coastal areas, fish farming contributes to a significant part of the nutrient inputs.

For Norway as a whole, the nutrient loadings from fish farming contributed to about 70 % of the total phosphorus inputs and about 30 % of the total nitrogen inputs, cf. Table 11.

Table 11. Proportion of discharges of different nutrient fractions from fish farming.

	NH_4-N	NO_3-N	PO_4-P	TN	TP
% of total inputs	73	10	75	32	70
% of direct discharges	79	88	90	78	88

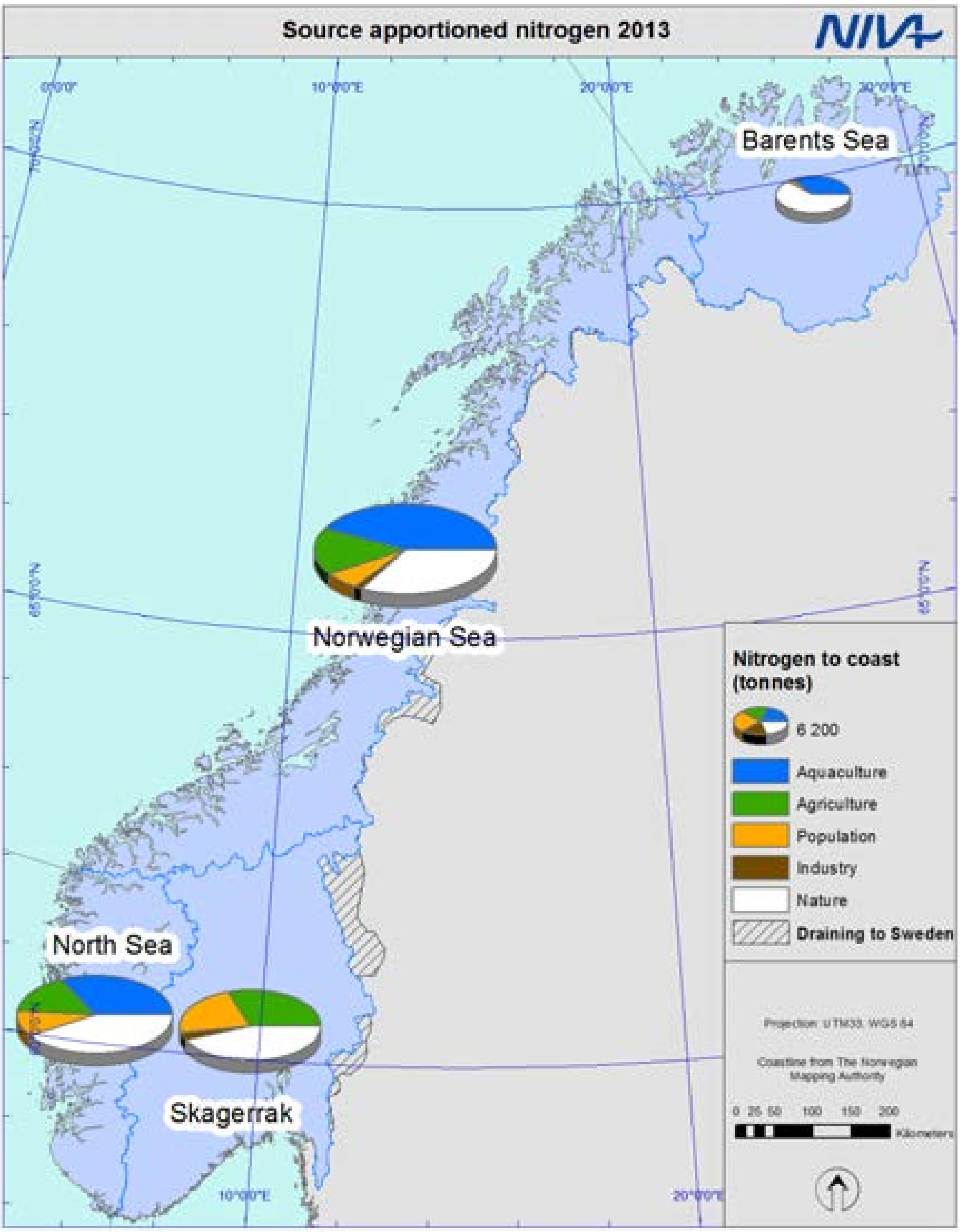


Figure 17. Source apportionment of nitrogen in 2013. Based on the TEOTIL model.

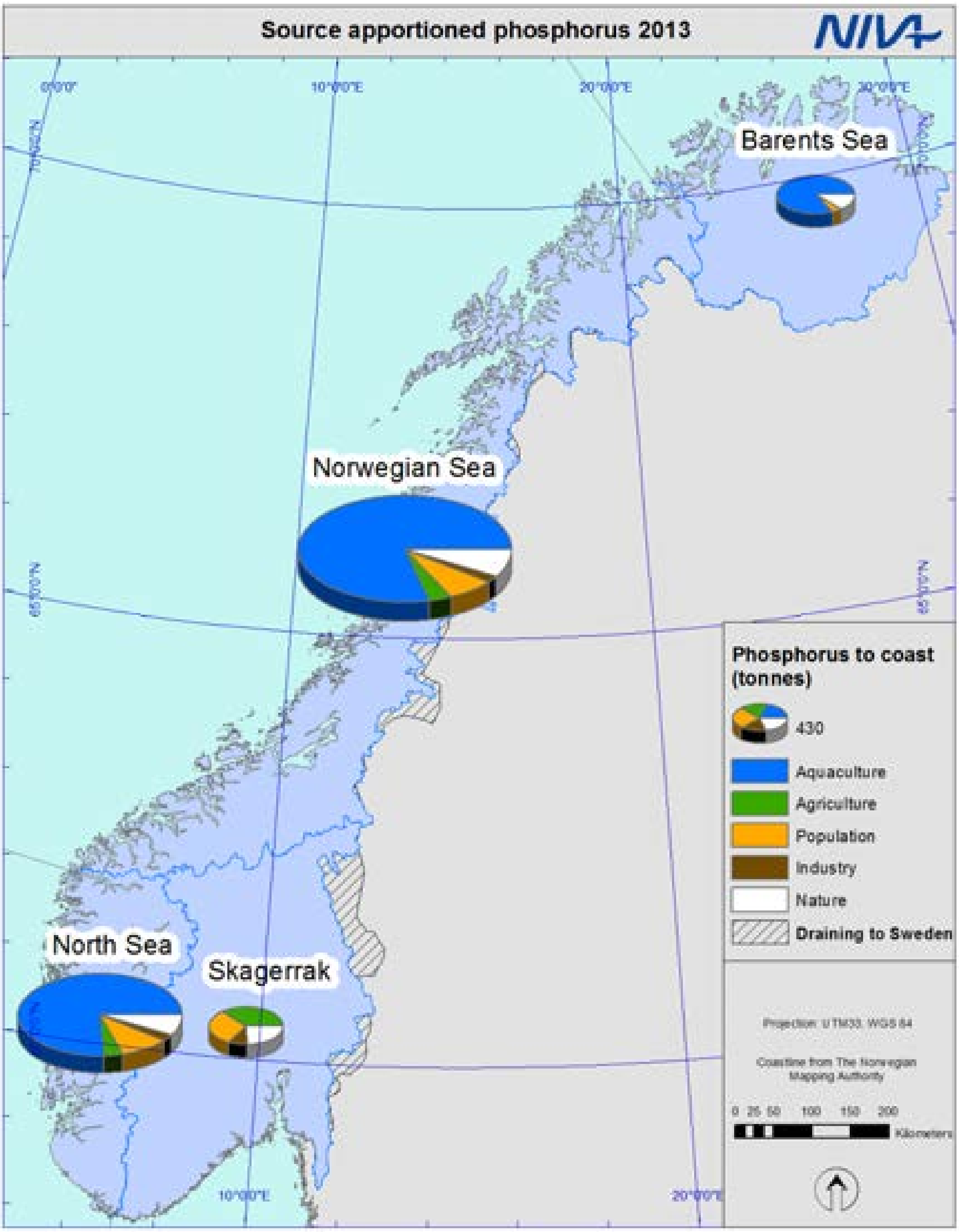


Figure 18. Source apportionment of phosphorus in 2013. Based on the TEOTIL model.

3.2.4 Direct discharges of nutrients and particles

In 2013, the total inputs from direct discharges of total nitrogen amounted to about 67 000 tonnes, of total phosphorus about 10 000 tonnes and of suspended particulate matter about 13 000 tonnes. The majority of the nutrients derive from fish farming along the coastline. Figure 19 shows the development of nitrogen and phosphorus discharges from fish farming in the period 1990-2013. Although the discharges have decreased slightly since last year, the general development is an increase in discharges from this industry.

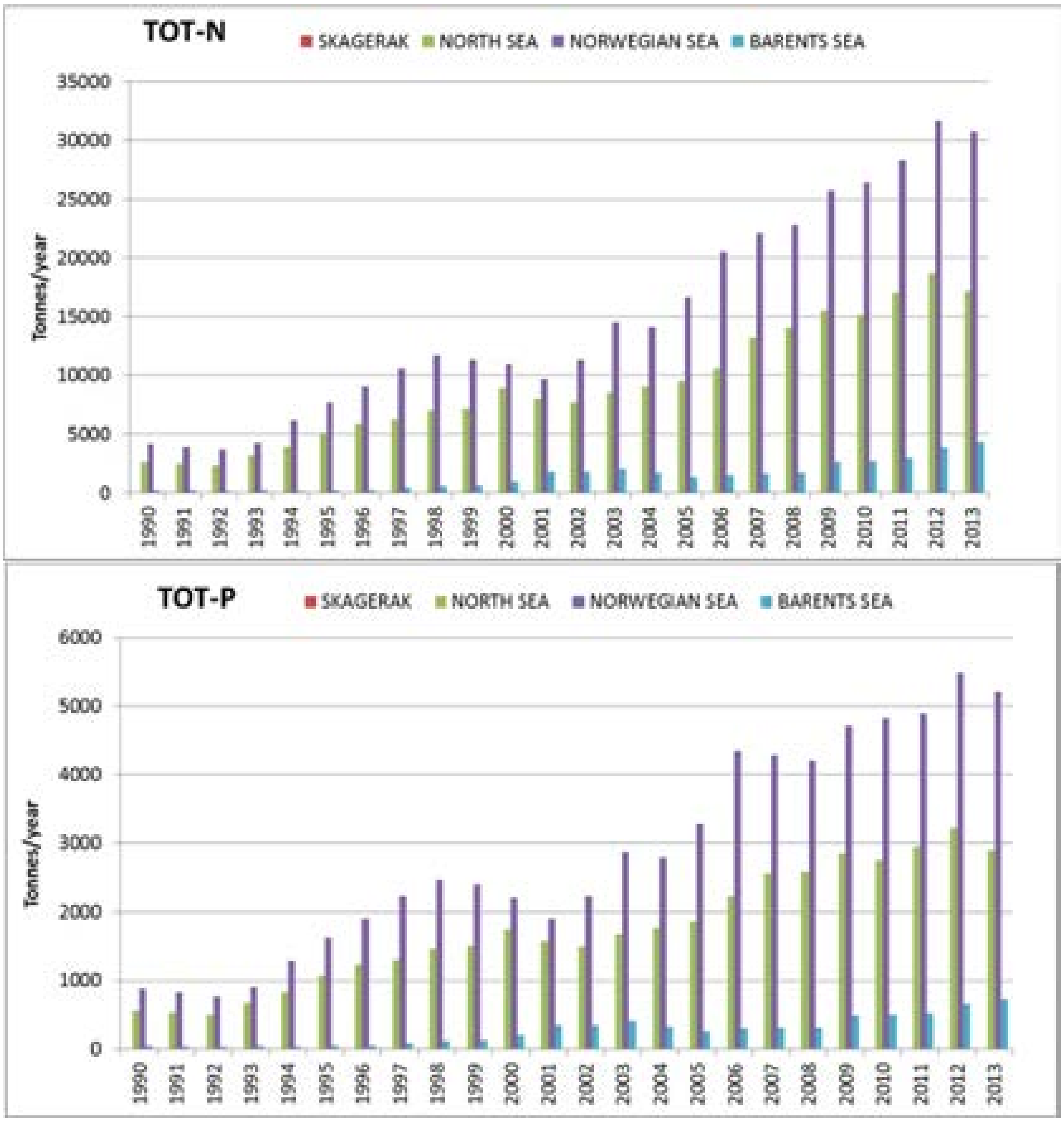


Figure 19. Nitrogen (top chart) and phosphorus (bottom chart) discharges from fish farming since 1990.

3.3 Metals

3.3.1 Total inputs of metals in 2013

In 2013, the inputs of metals to the Norwegian coastal areas were estimated to 276 kg of mercury, 2.2 tonnes of cadmium, 5.8 tonnes of silver, 28 tonnes of arsenic, 38 tonnes of lead, 80 tonnes of chromium, 141 tonnes of nickel, 951 tonnes of zinc and 1163 tonnes of copper (upper estimates). Silver was monitored for the first time this year, and only one single sample was above the detection limit. Since the upper estimate uses the detection limit as a basis for the load calculation, this resulted in an estimate of total loads of 5.8 tonnes (upper estimates) or zero tonnes (lower estimates).

For all metals except copper the riverine loads account for about 90% of the total inputs to Norwegian coastal waters. The high proportion of copper in the direct discharges is explained by fish farming. The fish cages are protected from algae growth with copper-containing chemicals. Discharges of other metals from fish farming, including any residues from the fish fodder, are not estimated. The metal inputs per sub-region and other details are given in the Addendum (Table 3).

As noted in the methods' chapter, the quantification of discharges of copper from fish farming is based on sales statistics for a number of antifouling products in regular use. The chart in Figure 20 shows the total discharges, amounting to 923 tonnes in 2013. A considerably higher quantity is registered for 2013 compared to previous years. The chart reflects a 36% increase as compared to 2012. The number of new product declarations in the official register has increased from 2012 to 2013. The Norwegian statistics include new products with an expected sale in 2014 and the total quantity for 2013 has been adjusted for this error.

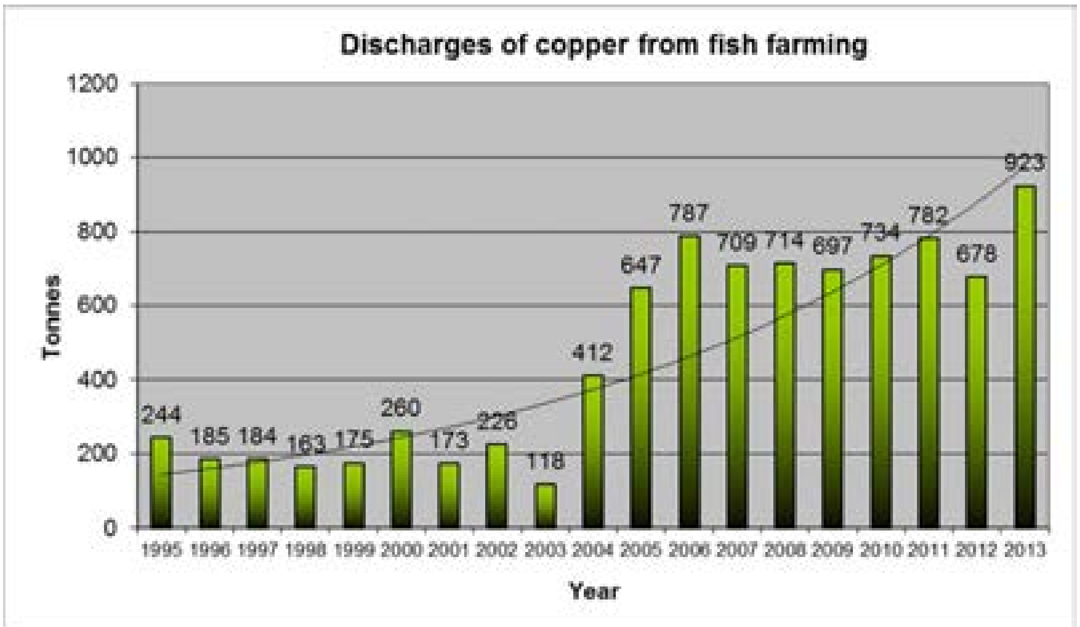


Figure 20. Discharge of copper from fish farming, deriving from antifouling impregnation of net cages, in the period 1995-2013. The figures represent total losses, including those above the RID rivers' sampling locations (minor contribution). It should be noted that the basis for these data is uncertain. A trend line has been inserted in the figure, indicating the increasing trend in this discharge to the seas.

3.3.2 Trends in metal loads and concentrations

Charts of long-term (1990-2013) metal loads are given in Appendix V and charts of concentrations since 1990 are given in Appendix VI. Table 12 shows the difference in riverine inputs of metals in 2013 as compared to an average for the period 1990-2012, as a total for Norway. With a few exceptions, the general trend is that the riverine loads of all 155 rivers have been reduced. The exceptions include arsenic and copper in the Barents Sea, zinc in the Skagerrak, and a small increase (although >5%) of nickel in the North Sea.

Table 12. Total riverine loads (155 rivers) of eight metals as an average for 1990-2012 and in 2013. Changes greater than 5% are marked in orange (increase) and green (decrease). Only upper estimates are used.

Metal	Skagerrak		North Sea		Norwegian Sea		Barents Sea		Total Norway	
(tonnes except Mercury (kg))	Mean*	2013	Mean*	2013	Mean*	2013	Mean*	2013	Mean*	2013
Arsenic	11.8	11.5	6.12	4.9	8.01	5.5	2.87	4.9	29	27
Lead	28.5	17.5	13.2	9.0	10.9	6.8	2.8	2.9	55	36
Cadmium	2.22	0.94	1.47	0.46	1.31	0.44	0.33	0.28	5.33	2.13
Cobber	91	95	31	25	77	48	24	69	223	237
Zinc	360	663	152	103	181	128	34	32	727	925
Nickel	42	40	17	19	42	37	41	36	143	133
Chrome	26	22	18	17	52	33	12	6	108	78
Mercury (kg)	214	97	80	64	103	77	29	21	426	259

** 1990-2012.*

In order to analyse these changes more in-depth, statistical trend tests (for which the methodology is described in Chapter 2.2.5) were performed for the following metals:

- Copper (Cu)
- Lead (Pb)
- Zinc (Zn)
- Cadmium (Cd)
- Nickel (Ni)

The results are given in Tables 13 (10-year trends) and 14 (long-term trends), and will be described in detail below, but in short the analyses show:

- When the shorter, 10 year, period was assessed, only six significant downward trends in loads were detected. Interestingly for the concentrations series, statistically significant upward trends are detected for cadmium, copper and zinc in Orrelva and for zinc in Glomma.
- In the long-term period, out of the 45 trend tests carried out for the upper estimates of metal loads, 32 were statistically significant downward ($p<0.05$). Similarly, for the upper estimates of the long-term concentrations series, 36 downward trends were statistically significant ($p<0.05$).
- It should be emphasised that no firm conclusions can be drawn about long-term changes in metal loads, except for copper, zinc and to some extent lead. This is due to the problem with changed detection limits over time and/or large numbers of samples reported at or below the detection limit (see Skarbøvik *et al.*, 2007 and Stålnacke *et al.*, 2009 for details). Apparent visual trends in the data are, therefore, not necessarily explained by 'real' changes in loads. Thus, interpretations of metal trends should be done with great caution. However, as the detection limits have not declined over time, upwards significant trends based on upper estimates would be fairly robust.

Table 13A. Trends for metal loads (upper estimates) in nine Norwegian main rivers in the last 10 years (2004-2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS						
River	Q	Cd	Cu	Ni	Pb	Zn
Glomma	0.0095	0.6118	0.8540	0.7692	0.6466	0.0716
Drammenselva	0.0397	0.4997	0.4062	0.4715	0.8563	0.0962
Numedalslågen	0.3252	0.7930	0.4219	0.4668	0.8868	0.7524
Skienselva	0.2449	0.7983	0.9041	0.1896	0.2897	0.9789
Otra	0.2449	0.0322	0.0428	0.0411	0.0550	0.0105
Orreelva	0.3252	0.9339	0.9796	0.5541	0.3514	0.7423
Orkla	0.5312	0.2451	0.0380	0.8685	0.0495	0.1802
Vefsna	0.9287	0.4576	0.5312	0.4987	0.8327	0.1364
Altaelva	0.5312	0.2470	0.8643	0.4572	0.7560	0.2635

(dark green)	Significant downward (p<0.05)
(light green)	Downward but not significant (0.05<p<0.1)
(red)	Significant upward (p<0.05)
(orange)	Upward but not significant (0.05<p<0.1)

Table 13B. Trends for metal concentrations (upper estimates) in nine Norwegian main rivers in the last 10 years (2004-2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS					
River	Cd	Cu	Ni	Pb	Zn
Glomma	0.5803	0.3168	0.9459	0.4798	0.0271
Drammenselva	0.8393	0.1088	0.2944	0.0949	0.0598
Numedalslågen	0.4679	0.6372	0.4110	0.6691	0.3173
Skienselva	0.3513	0.1298	0.0596	0.4833	0.2848
Otra	0.1884	0.4741	0.1291	0.7750	0.1025
Orreelva	0.0411	0.0184	0.3364	0.7557	0.0235
Orkla	0.2164	0.0719	0.6699	0.0795	0.1015
Vefsna	0.2045	0.9994	0.1322	0.7544	0.3710
Altaelva	0.2192	0.0691	0.4079	0.7310	0.9854

(dark green)	Significant downward (p<0.05)
(light green)	Downward but not significant (0.05<p<0.1)
(red)	Significant upward (p<0.05)
(orange)	Upward but not significant (0.05<p<0.1)

Table 14A. Long-term trends for metal loads (upper estimates) in nine Norwegian main rivers 1990-2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS						
River	Q	Cd	Cu	Ni	Pb	Zn
Glomma	0.0256	0.0017	0.2215	0.0178	0.0044	0.4650
Drammenselva	0.0064	0.0001	0.9659	0.4653	0.3938	0.2441
Numedalslågen	0.0530	0.0013	0.0205	0.1264	0.0099	0.0116
Skienselva	0.0741	0.0002	0.0128	<0.0001	0.4109	0.0098
Otra	0.9210	<0.0001	0.1800	0.0005	0.0119	0.0029
Orreelva	0.1016	0.0259	0.3716	0.0019	0.1115	0.9460
Orkla	0.4568	0.0002	0.0008	0.0085	0.0082	0.0002
Vefsna	0.6198	<0.0001	0.0005	<0.0001	0.0001	0.0004
Altaelva	0.5516	<0.0001	0.0002	0.0010	0.0077	0.3041

Significant downward (p<0.05)

Downward but not significant (0.05<p<0.1)

Significant upward (p<0.05)

Upward but not significant (0.05<p<0.1)

Table 14B. Long-term trends for metal concentrations (upper estimates) in nine Norwegian main rivers 1990-2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS					
River	Cd	Cu	Ni	Pb	Zn
Glomma	0.0007	0.0427	0.0110	0.0014	0.8351
Drammenselva	0.0004	0.1961	0.1219	0.0621	0.0702
Numedalslågen	0.0005	0.0111	0.0107	0.0209	0.0070
Skienselva	0.0001	0.0146	0.0002	0.1088	0.0005
Otra	0.0003	0.1309	0.0019	0.0010	<0.0001
Orreelva	0.0010	0.6191	0.0013	0.0054	0.5321
Orkla	0.0014	0.0008	0.0029	0.0001	0.0001
Vefsna	<0.0001	0.0001	0.0009	<0.0001	<0.0001
Altaelva	0.0003	0.0004	0.0082	<0.0001	0.0029

Significant downward (p<0.05)

Downward but not significant (0.05<p<0.1)

Significant upward (p<0.05)

Upward but not significant (0.05<p<0.1)

Analyses of the 10-year data series
Table 13 depicts the results of the trend analysis performed on the last 10 years of metal loads and concentrations data. In quite sharp contrast to the long-term data presented later, four metals (Cd, Cu, Ni and Zn) in Otra, and two metals (Cu and Pb) in Orkla showed downward trends between 2004-2013. We demonstrate such a trend by the example of Cu loads in River Orkla (Figure 21).

In a few instances, mostly in case of Cu or Pb loads or concentrations, non-significant downward trends are seen in the last 10 years.

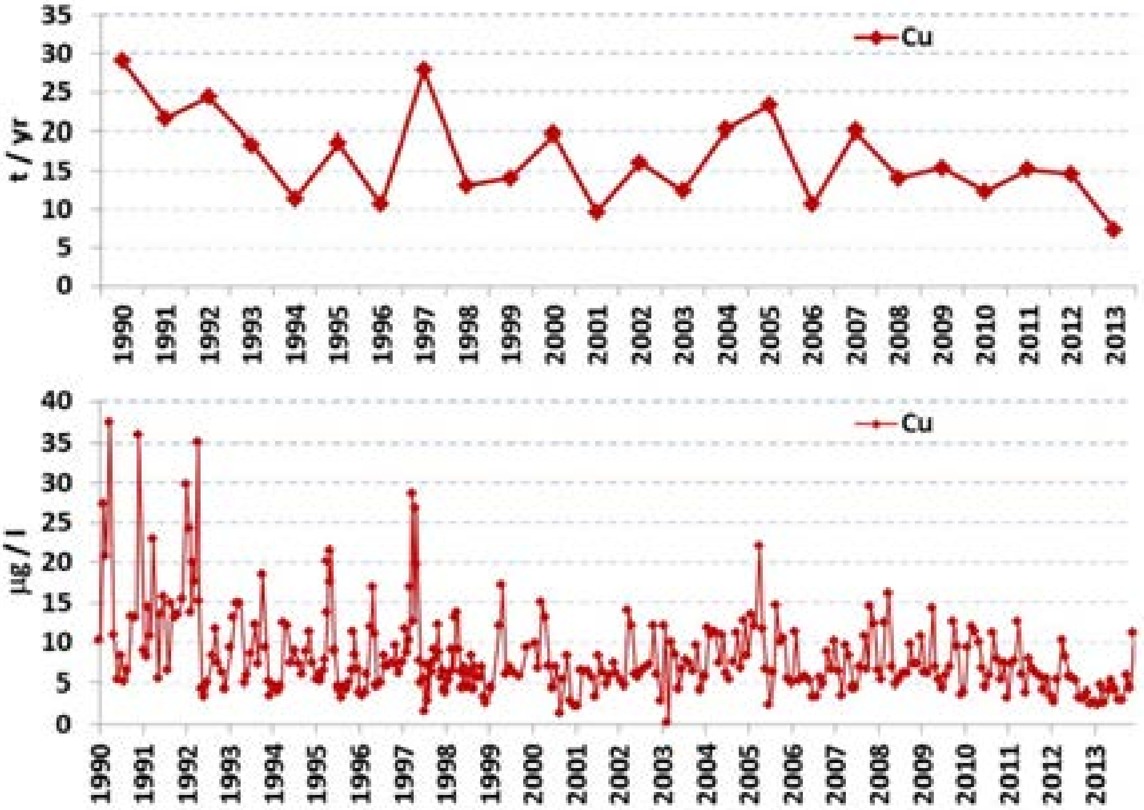


Figure 21. Annual riverine loads (upper panel) and monthly concentrations (lower panel) of copper in River Orkla, 1990-2013.

At the same time, Cd and Cu concentrations present an upward trend over the last 10 years in River Orreelva, and Zn loads show similarly significant upward trends in both Rivers Orreelva and Glomma. In River Orreelva, it is difficult to visually detect an upward trend in Zn concentrations in the last 10 years by studying the chart in Figure 22, while in River Glomma, the chart in Figure 25 hints at an upward trend of Zn in the approximately last three years. The reason for this rather sudden increase is not yet known.

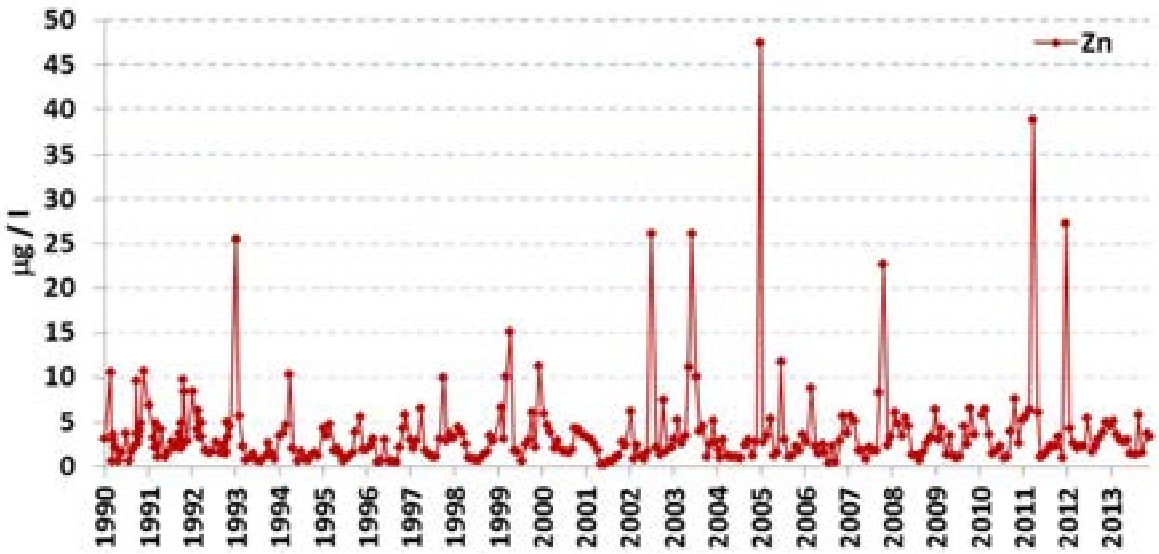


Figure 22. Monthly concentrations of zinc in River Orreelva, 1990-2013.

Long-term (1990-2013) trends in metal loads and concentrations

Copper (Cu)
Copper was, together with lead and zinc, the only metal with few values below LOD and/or few changes in LOD over the monitoring period 1990-2013. In five out of the nine rivers a statistically significant decline in the copper riverine loads was detected for the upper estimates (Table 13) on the longer term. Statistically significant downward trends in the concentrations were detected in 6 rivers for the upper estimates. Similarly to the nutrients addressed above, River Vefsna shows a sharp decline in some substances after 1999, and copper is one of these. The annual loads of copper during the years 1990-1998 amounted to around 12-17 tonnes, while in the following period (1999-2013) the loads dropped to 2-5 tonnes (Figure 23). A statistically significant decline in copper loads in Rivers Numedalslågen, Altaelva, Orkla and Skienselva was also detected (Table 13). In River Altaelva, the loads have declined from 4-7 tonnes in the early to mid-1990s to 1-3 tonnes in the 2000s; except for years 2002 and 2005 (Figure 23). The trend seen in the 2000s continues until the present. The decline in loads in Rivers Numedalslågen and Skienselva can be related to high loads in single years, i.e. 1993 in River Numedalslågen and 1990 in River Skienselva. The high copper load in River Numedalslågen in 1993 (Appendix V) is explained by generally high concentrations during the entire year, with e.g. 8 observations out of 13 with concentrations above 5 µg/l. In comparison, concentrations above 5 µg/l have only occurred four times during the time period 1994-2013 (Appendix VI). The high load in River Skienselva in 1990 (Figure 23) is explained by two samples with high concentrations (17 µg/l and 20 µg/l), whereas normally the values in this river are below 1 µg/l (Appendix VI). River Orreelva presented an extraordinarily high peak concentration reading in April 2011, which triggered a peak load in 2011 that was about 4 times greater than the long-term average annual load. It should be noted that such single peak observations do not influence the statistical trend test.

The copper concentrations in River Otra show a parabolic pattern over the time period, with declining concentrations from 1990 to the mid-1990s and increasing concentrations since 2003 and onwards (Figure 24). The pattern is also reflected in the loads (Figure 23). The higher concentrations at the start of the time series are related to one single sample with high concentration (6 µg/l) in combination with several observations around or above 1 µg/l. The increase between 2003 and 2008 is particularly pronounced, but since then there is a decrease, which is even more pronounced in the loads. The reason for this concentration pattern has not been identified so far.

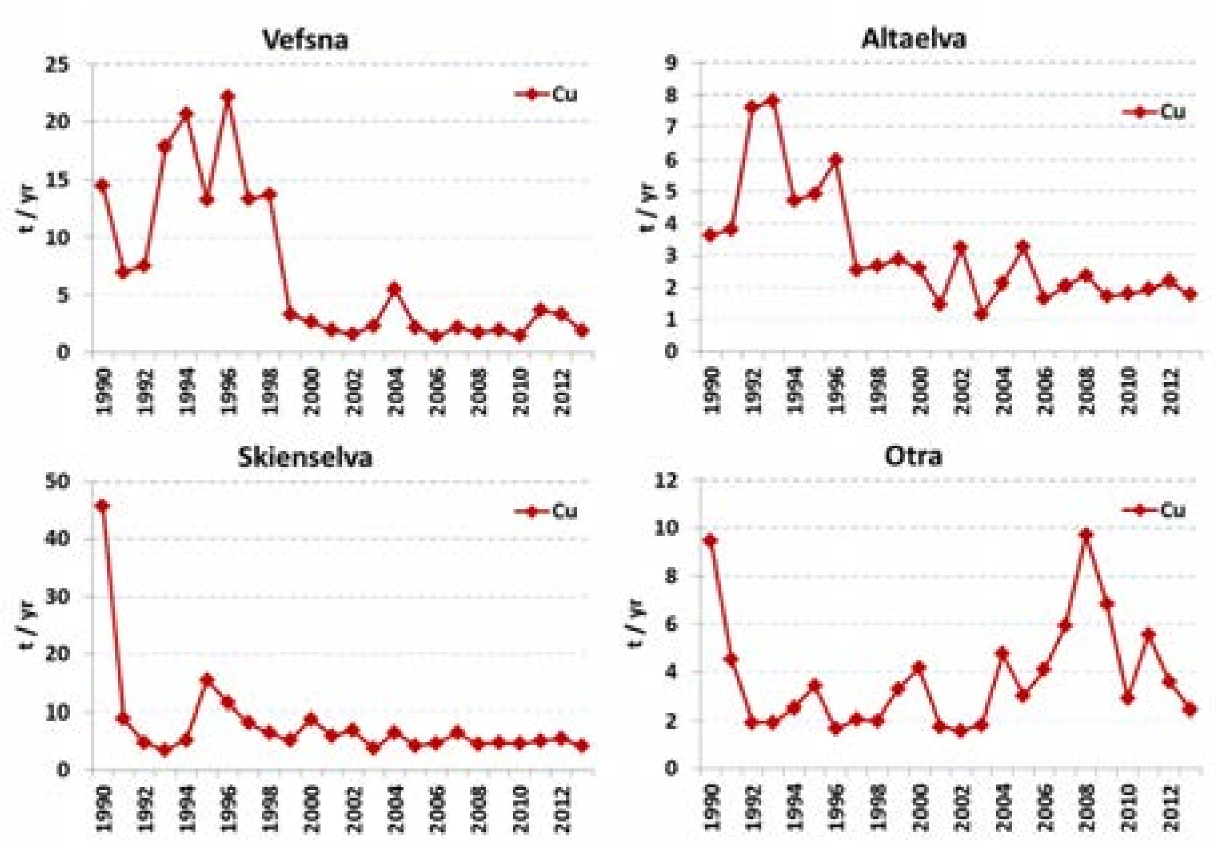


Figure 23. Annual riverine loads of copper in Rivers Vefsna, Altaelva, Skienselva, and Otra 1990-2013.

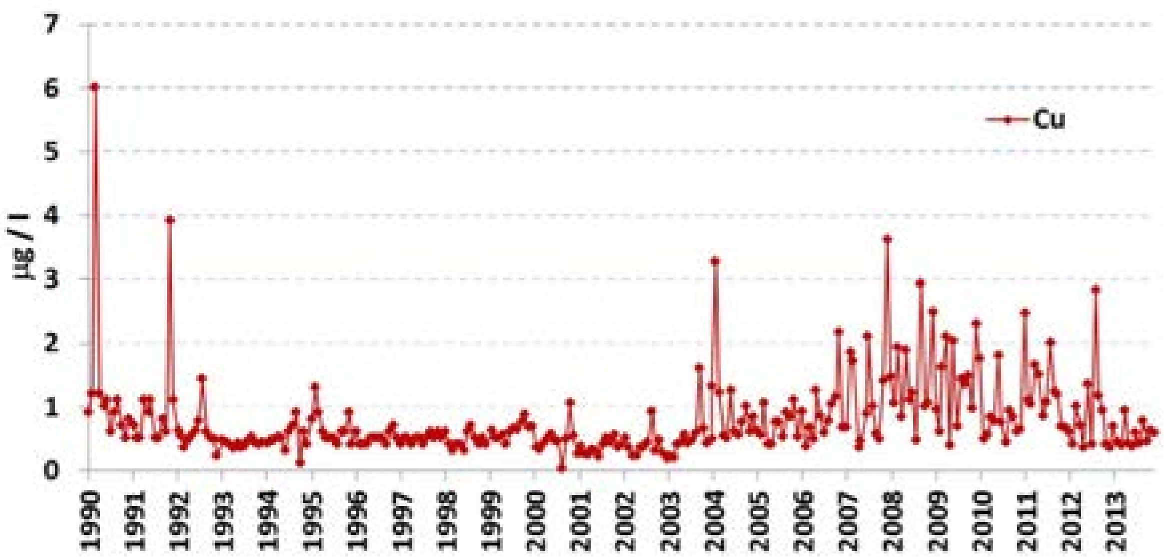


Figure 24. Monthly concentrations of copper in the Otra River, 1990-2013.

Lead (Pb)

On the longer term, the inter-annual variability and downward trends in inputs of lead are mainly due to changes in LOD. Table 15 shows that the LOD for lead has changed by a factor of 100 during the monitoring period (1990-2013). This means that the interpretation of especially downward trends in lead loads should be done with great caution. Nonetheless, the statistical analysis of trends showed downward trends for upper load estimates in six and five rivers, respectively (Table

14A). The most prominent load trends were found in Rivers Glomma and Vefsna (Appendix V). The LOD concerns do not affect the 10 years' trends (presented earlier); as the LOD has not changed since 2004.

For the concentrations series, seven out of nine rivers for the upper estimates showed statistically significant downward trends and an eighth was close to significant ($p<0.07$; Table 14B).

Table 15. Changes in detection limits (LOD) for lead (µg/l).

Year	1990	1991	1992 -1998	1999	2000	2001	2002-2003	2004-2013
LOD	0.5	0.1	0.02	0.01 (0.1)[1]	0.01	0.01-0.02 (0.1)[1]	0.02-0.05 (0.2)[1]	0.005

[1)] The values in parenthesis are probably due to errors, as the detection limit (LOD) may have been given in the wrong unit.

Zinc (Zn)

For many of the examined rivers, the zinc loads show relatively low inter-annual variability as compared to many of the other metals. A downward long-term trend in both loads and concentrations was statistically detected in five of the nine investigated rivers for the upper estimates: Rivers Orkla, Vefsna, Numedalslågen, Skienselva and Otra (Table 14). In addition, River Altaelva showed a statistically significant downward trend in the concentration series for both the upper and lower estimates. High loads in single years were almost solely explained by high single concentration values (e.g. 1993 in River Numedalslågen, 1990 in River Skienselva, 2005 in River Orreelva, and 2008 in River Altaelva; Appendix VI). Elevated loads in 2011 to 2013 in River Glomma can be noted in the upper panel of Figure 25. As seen from the raw-data series (concentrations panel of Figure 25), there is a general increase in the concentrations in all of these three recent years although elevated concentrations have been observed in earlier time periods as well (i.e. 1996-1999). The reason for the increased loads in 2011 to 2013 is not yet known.

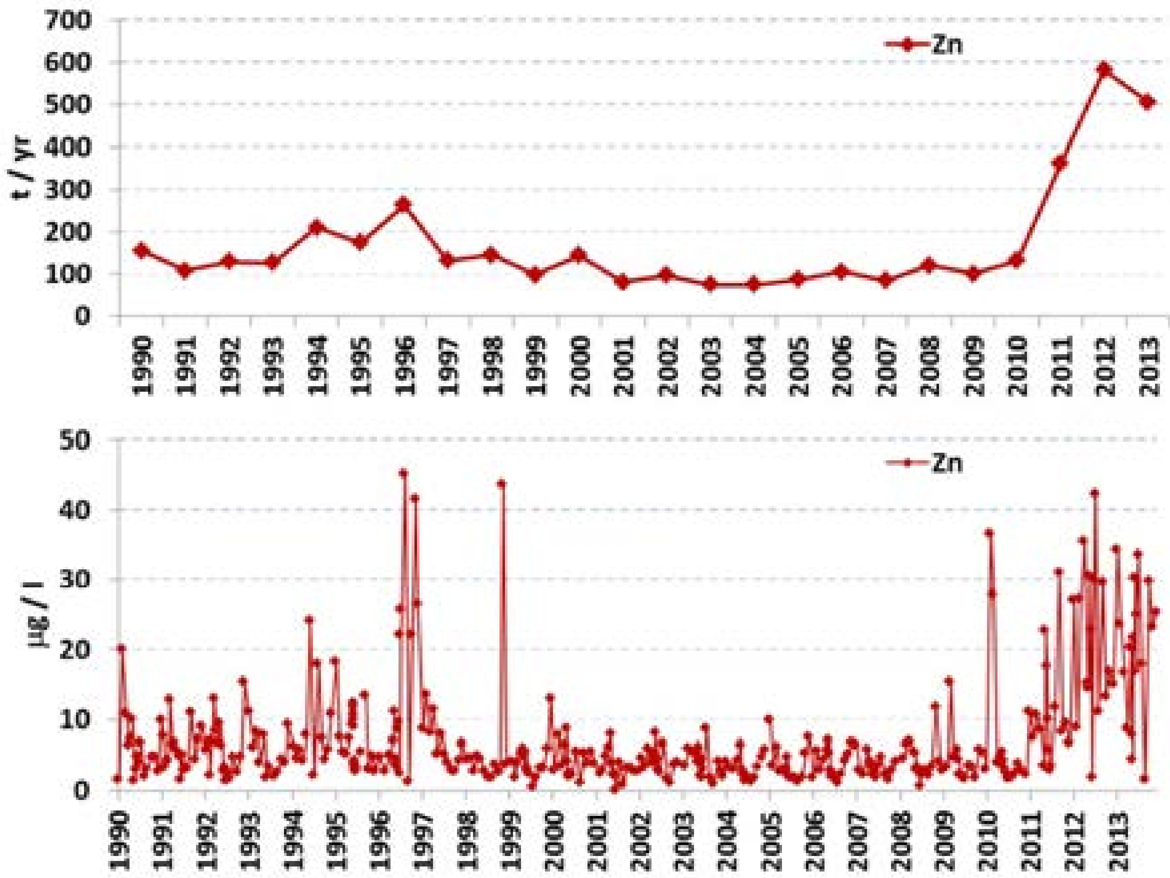


Figure 25. Annual riverine loads (upper panel) and monthly concentrations (lower panel) of zinc in River Glomma, 1990-2013.

Cadmium (Cd)
For the long-term trends, for the upper estimates, all nine rivers showed a statistically significant downward trend for both the loads and concentrations of cadmium (Table 14). The different results were due to the fact that more than 25% of the observations of cadmium in the nine main rivers were below LOD, hence weakening the length of the available time-series and the associated statistical power. In addition, the LODs have changed substantially during the course of the monitoring period; e.g., from 100 ng/l in 1990 to 10 ng/l in 1991 and down to 5 ng/l in 2004-2013. For this reason, a trend assessment on especially downward trends of the annual loads and concentrations is highly uncertain and should be interpreted with great caution. The load estimates given in Appendix V should therefore solely be used as an indication of the magnitude of the loads.

Nickel (Ni)
For the long-term upper estimates, seven and eight out of nine rivers showed a statistically significant downward trend for both the loads and concentrations respectively (Table 14). Similarly to the case of Pb and Cd, the LOD have changed over the monitoring period, so firm conclusions about time-trends were difficult to draw.

Mercury (Hg)
As mentioned in the beginning of this section, there is a high analytical uncertainty related to this parameter, and there have also been changes in analytical methods during the period 1999-2003. Moreover, 67% of the observations in the nine rivers were below LOD. The LODs have not changed much during the course of the monitoring period. In most rivers, the concentrations were just above LOD, thus no meaningful trend assessment of the annual loads was possible. The load estimates should only be used as an indication of the magnitude of the loads. It should also be noted that the loads in 1999-2003 are based on estimated concentrations.

3.3.3 Metal concentrations and threshold levels

Threshold levels used for this assessment are given in Table 16, along with the annual means of those rivers (out of 47) for which annual means exceeded the threshold levels. The annual means based on upper estimates have been used in this assessment. It should be noted that for 36 of the rivers, sampling is only done four times a year. Threshold levels for lead, mercury and nickel are according to the Water Framework Directive (WFD) or the EQS daughter directive 2013/39/EU. The other thresholds are from the Norwegian guidance on classification of freshwater environment (Andersen et al. 1997).

Table 16. Exceeded threshold levels (annual means except for Hg which are annual maximum concentrations). Number in italics are levels close to the threshold level.

Metal	Pb	Cu	Zn	Ni	Cr	Hg
Threshold level* (µg/l)	1.2	1.5	20	4	2.5	70
Rivers	µg/l	µg/l	µg/l	µg/l	µg/l	ng/l
Glomma		2.6	20.1			
Alna		3.1				
Orreelva		1.67				
Orkla		4.4				
Tista			*19.65*			
Jostedøla		3.39			3.75	
Stjørdalselva		1.56				
Verdalselva		1.7				
Gaula		*1.48*				

* Sources: Hg: EU WFD (EU, 2000); Pb and Ni: EQS (EC 2013); Cu, Cr, and Zn: national threshold levels (Andersen et al. 1997)

For cadmium (Cd), the EQS threshold values depend on alkalinity, which is not available within this programme. However, none of the monitored rivers had average concentration levels above the EQS for the class with the lowest threshold (i.e., Class 1: < 40 mg $CaCO_3$/l; 0.08 µg/l) (EU, 2013).

3.4 PCB7 and lindane

PCB and lindane are no more included in the regular RID monitoring, due to very low concentrations (mainly below LOD) in all former years. PCB is now monitored with other techniques in selected rivers (see 3.5). A few wastewater treatment plants report PCB losses. This year, about 2 kg were reported, of which one kg was discharged to the Skagerrak area and one to the Norwegian Sea. These estimates are, however, believed to be highly uncertain and are therefore not included in national or regional load estimates (Table 3 in the addendum).

3.5 Organic contaminants

3.5.1 Organic contaminant concentrations

Siloxane concentrations were never above the detection limit (1µg/l). Hence, data from this contaminant is not reported further.

Polycyclic aromatic hydrocarbons (PAHs)
Most PAHs were found above LODs in the freely dissolved form and associated with suspended particulate matter in 2013 (Addendum, Table 1b). In the River Alna, concentrations were lowest for dibenzo[ah]anthracene (4 pg/l) and highest for pyrene with a concentration close to 10 ng/l. For most PAHs, freely dissolved concentrations in 2013 varied at most by a factor of 2 to 5 depending on the passive sampler exposure period. A higher variability in concentration can be observed for the lighter PAHs. These are the compounds for which the concentration in the samplers equilibrates the fastest with the concentration in water. This equilibration time can be a few days only for a substance such as naphthalene. PAH concentrations in River Drammenselva were below the limit of detection (LOD) (< 7 pg/l) for dibenzo[ah]anthracene and up to 5.4 ng/l for phenanthrene. Freely dissolved concentrations were a little more variable than those in River Alna and varied by a factor of 1.5 to 11. Concentrations were generally slightly lower than those estimated for River Alna. PAH concentrations in River Glomma were lowest and below LOD for dibenzo[ah]anthracene (< 9 pg/l) and highest for phenanthrene (8.2 ng/l). Concentrations were also more variable for River Glomma than they were in River Alna. Freely dissolved concentrations measured in 2013 in Rivers Alna, Drammenselva and Glomma are in line with those measured in previous studies from 2008-2012 (Allan et al., 2011; Allan et al., 2009; Allan et al., 2010; Allan et al., 2013b; Allan and Ranneklev, 2011).

SPM concentrations of PAHs in River Alna were lowest for naphthalene (18 ng/g dw) and highest for pyrene (1800 ng/g dw) (Addendum, Table 1b). SPM concentrations of PAHs in River Drammenselva were < 10 ng/g for naphthalene and highest for fluoranthene (540 ng/g dw). PAHs concentrations in SPM from River Glomma were clearly lower than for the other two rivers with 9-10 PAHs below LODs with LODs in the range 2-10 ng/g dw.

As this dataset develops, it will be interesting to evaluate to what extent DOC and SPM emission to the rivers modulates freely dissolved concentrations for PAHs, PCBs and PBDEs.

Polychlorinated biphenyls (PCBs)
PCBs were consistently detected in the freely dissolved phase in all three rivers in 2013 at a concentration level in the low pg/l. PCB congeners with lower chlorination (less hydrophobic) were present in higher concentrations than the ones with a higher degree of chlorination. In River Alna, concentrations of individual PCB congeners ranged from 0.6 pg/l for CB180 to 21 pg/l for CB28. The variation in concentrations was a factor of 1 to 4 for most congeners. An example of variation in PCB congener concentration in River Alna is given in Figure 26. PCB concentrations in River Drammenselva were a little lower than those in River Alna. PCB concentrations in River Drammenselva were lowest for CB180 (< 0.8 pg/l) and reached a maximum of 14 pg/l for CB28. Congeners 156 and 180 were consistently below LOD. Concentration estimated for the different exposure times varied by a factor of 1.4 to 3. PCB concentrations in River Glomma were generally similar to those found in River Drammenselva. Depending on the congener, concentrations varied by a factor of 1-5 over the year. CB153 and CB180 were below LOD (< 0.9-1 pg/l). Freely dissolved PCB concentrations obtained for River Alna are very similar to those from passive sampler exposures from 2012 (Allan et al., 2013b). The freely dissolved concentration of CB153 in River Glomma is also in agreement with previous data but from Low density polyethylene (LDPE) exposures in River Glomma (Allan et al., 2011).

PCB congeners were only detected in the particulate matter phase in SPM samples from River Alna. Concentrations were in the range 0.6-7 ng/g dw. Concentrations were below LOD in Rivers Drammenselva and Glomma (< 0.5-1 ng/g dw).

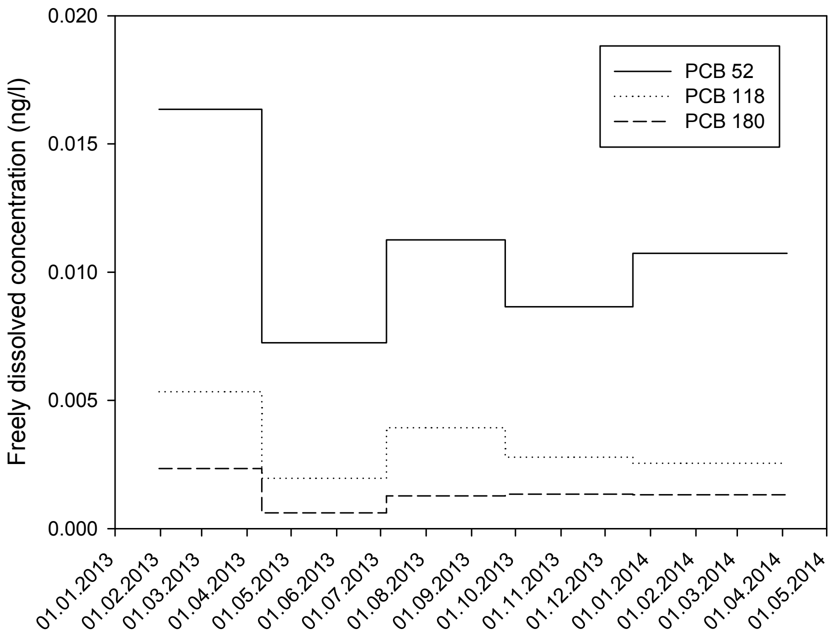


Figure 26. Freely dissolved concentrations of selected PCB congeners (52, 118 and 180) in River Alna for the period from January 2013 to April 2014. Note: preliminary data from 2014 is included in the plot.

Polybrominated diphenyl ethers (PBDEs)

PBDE concentrations in the three rivers ranged from well below pg/l level to tens of pg/l for the least hydrophobic PBDE congeners. The congeners that were mostly detected and quantified were BDE47, 99, 100, 153 and 154. Concentrations of BDE126, 183 and 196 were consistently below limits of detection in all three rivers.

PBDE concentrations in River Alna were lowest for BDE153 and BDE154 (0.025-0.03 pg/l) and highest for BDE47 with concentrations of 1-3pg/l. Estimated PBDE concentrations were slightly higher in River Drammenselva than in River Alna. Concentrations of BDE47 were in the range 7-17 pg/l. Concentrations for BDE congener 99/100 and 153/154 were in the range 0.7-11 and 0.1-0.2 pg/l respectively. In River Glomma, concentrations of BDE congeners 47, 99 and 100 were in the range 4-8, 1-5 and 0.3-3 pg/l, respectively. BDEs 153 and 154 were below limits of detection in River Glomma. An example of variations in BDE47 concentrations in all three rivers can be found in Figure 27. PBDE concentrations in the dissolved phase in River Alna in 2013 are in a similar range to data published in 2013 (Allan et al., 2013b). The freely dissolved concentration of BDE47 in River Drammenselva is in agreement with data from silicone rubber samplers from 2008 (Allan et al., 2009).

BDE congeners 47, 99, 100, 153 and 154 were measured in the concentration range 0.27-2.8 ng/g dw in SPM from River Alna. In River Drammenselva, only congeners 47, 99 and 153 were found above LOD (range of concentration: 0.16-0.36 ng/g dw). In River Glomma, PBDEs were mostly below LOD with LODs between 0.05 and 0.5 ng/g dw. BDE 47, 99 and 153 were found above LOD in one sample of SPM.

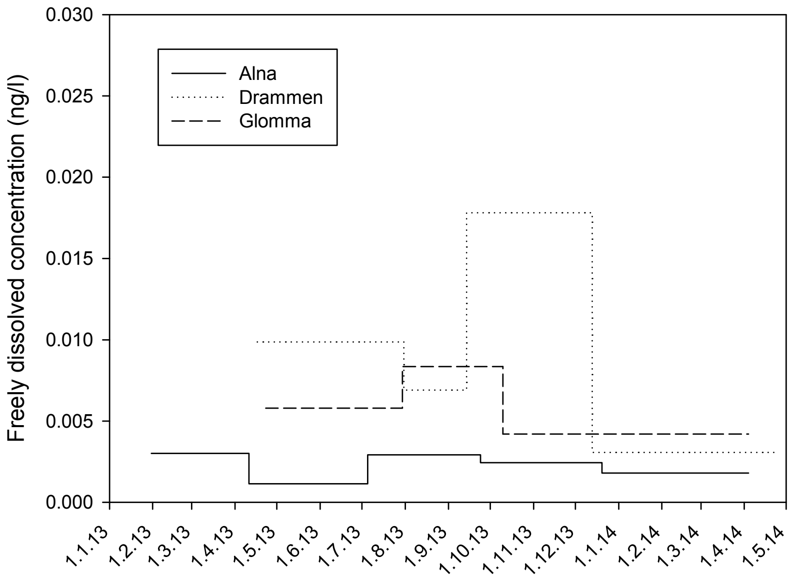


Figure 27. Freely dissolved concentrations of PBDE 47 in Rivers Alna, Drammenselva and Glomma for the period from January 2013 to April 2014. Note: preliminary data from 2014 is included in the plot.

Freely dissolved concentrations of BDE209 are subject to much uncertainty. Analysis for this chemical is challenging. The quality of the data relies strongly on adequate blank data and since sampling rates are expected to be relatively low (compared with less hydrophobic compounds), masses accumulated also remain low. Concentrations in the freely dissolved form are likely very low owing to its high hydrophobicity. More variability between duplicate silicone rubber samples was observed than for other classes of chemicals. Freely dissolved concentrations for BDE209 for 2013 were in the range 0.4-4, 2-38 and 3-8 pg/l in Rivers Alna, Drammenselva and Glomma, respectively. SPM concentrations of BDE209 were in the range 10 to 50 ng/g dw for River Alna. This range is similar to bed sediment concentrations measured in 2008 along the River Alna bed sediments (Ranneklev et al., 2009), and is generally higher than SPM concentrations in Rivers Drammenselva (ranging from < 0.5 to 6 ng/g dw) and Glomma (<0.5 to 1.6 ng/gdw).

Hexabromocyclododecane (HBCDD)

HBCDD isomers were consistently detected in passive samplers exposed in River Alna with concentration estimates in the range 0.3-3 pg/l. These chemicals were less consistently detected in River Drammenselva (LODs in the range 1-20 pg/l). The alpha isomer of HBCDD was measured consistently in River Glomma with concentrations between 3 and 20 pg/l.

HBCDD was below LODs in SPM samples of all three rivers with LOD between 1 and 5 ng/g dw.

Short and medium chain chlorinated paraffins (S/MCCPs)

Suspended particulate matter concentrations for SCCPs were higher in River Alna than in the other two rivers. Concentrations of MCCPs were also generally higher in River Alna than in the other two rivers. Concentrations of S/MCCPs varied by over two orders of magnitude depending on the sample (5-1100 ng/g dw). Ratios of concentrations of SCCPs over those of MCCPs were consistently below 1. For River Alna, the concentration range was similar to the range found for S/MCCPs in bed sediments sampled in 2008 (Ranneklev et al., 2009).

Bisphenol A (BPA)
SPM concentrations of BPA appeared highest in River Alna and these were between 10 and 400 ng/g dw. Most BPA concentrations in River Drammenselva SPM were below limits of detection, except for one sample with close to 400 ng/g dw of BPA. In River Glomma, SPM concentrations varied between the limit of detection and 25 ng/g dw. For comparison, previous measurements in River Alna bed sediments were between 0.4 and 47 ng/g dw (Ranneklev et al., 2009).

Tetrabromobisphenol A (TBBPA)
TBBPA was measured above LODs in SPM samples from all rivers in 2013. Concentrations were slightly higher in River Alna (2-30 ng/g dw) than in River Drammenselva (2-13 ng/g dw) and were generally lowest in River Glomma (1-5 ng/g dw).

Perfluorochemicals (PFCs)
Perfluorooctanesulfonic acid (PFOS) and perfluorodecanesulfonate (PFDS) were the only two perfluoro chemicals consistently detected and measured in River Alna SPM (0.09-1.5 ng/g dw). A much larger range of relatively short chain PFCs were found in the final sample collected in 2013 (PFHxA to PFTeA). In River Drammenselva, PFOS was found at concentrations in the range 0.05-0.15 ng/g dw. PFCs were mostly below LODs (LODs in the range 0.05-1 ng/g dw) in River Glomma.

3.5.2 PCB concentrations in biota

Many of the substances of interest (e.g. PCBs or PBDEs) in this study are hydrophobic and have been shown to be persistent and to bioaccumulate into organisms. Contaminant accumulation in passive sampling devices can be informative with regards to bioaccumulation into organisms. The main component responsible for the accumulation of these hydrophobic contaminants in organisms is the lipid. This is the reason why biota concentrations are often given on a lipid weight basis. Passive sampling data (in water or sediments) can be used to provide estimates of contaminant concentrations (on a lipid weight basis) that would be found in an organism at thermodynamic equilibrium with the sediment or water sampled by the passive sampler. Lipid-silicone partition coefficients ($K_{lip-sil}$) have previously been measured for PCBs for various model lipids (Jahnke et al., 2008) as well as with "in tissue" (Jahnke et al., 2011) or in vivo implantation passive sampling (Allan et al., 2013a). Equilibrium passive sampling data obtained with silicone rubber passive sampling in water or sediment (based on calculated or established equilibrium) can be expressed in ng per gram of lipid. This is done by multiplying the PCB concentration in silicone (ng/g silicone at equilibrium) by a generic lipid-silicone partition coefficient ($K_{lip-sil}$ in g/g). This method yields an estimated PCB concentration in model lipids at thermodynamic equilibrium with the water phase. Freely dissolved PCB concentrations expressed in ng/g lipid (C_{lip}) can then be used for comparison with PCB concentrations in biota normalized to the lipid content of the matrix sampled. PCB concentrations in model lipid that would be at thermodynamic equilibrium with the water phase in River Alna for 2013 range from 64 to 1076 ng/g lipid.

These concentrations, expressed per amount of lipids, can be compared with PCB concentrations measured in biota in the Inner Oslofjord in recent projects for the Norwegian Environment Agency. PCBs (median values) in polychaete and mussels sampled near the River Alna outflow were measured as part of the Urban fjord project (Ruus et al., 2014) . Ratios of PCB concentrations in biota (C_{biota}) over passive sampler-based PCB concentrations in lipid at thermodynamic equilibrium with River Alna river water are plotted in Figure 28. Ratios of polychaete concentrations from near the River Alna outflow over C_{lip} from River Alna passive samplers are slightly above 1 for CB52, CB101 and CB118, close to 0.7 for CB153 and below 0.5 for CB28, CB105 and CB138. For mussels, CB52, CB101 and CB118 exhibit ratios above 0.5 while others are below 0.4. The chemical activity in the Alna River and in biota for PCB congeners with ratios close to one can be considered similar. This potentially indicates that the two are connected and the contamination of the Alna may be affecting biota concentrations near the River discharge site into the Oslofjord. For PCBs with ratios well below one, we can expect that the Alna River is a likely contributing parameter to increasing concentrations of these PCB congeners in biota near the river discharge point. One has to bear in mind that the freely dissolved concentrations in the river are variable and data from biota tends be variable too.

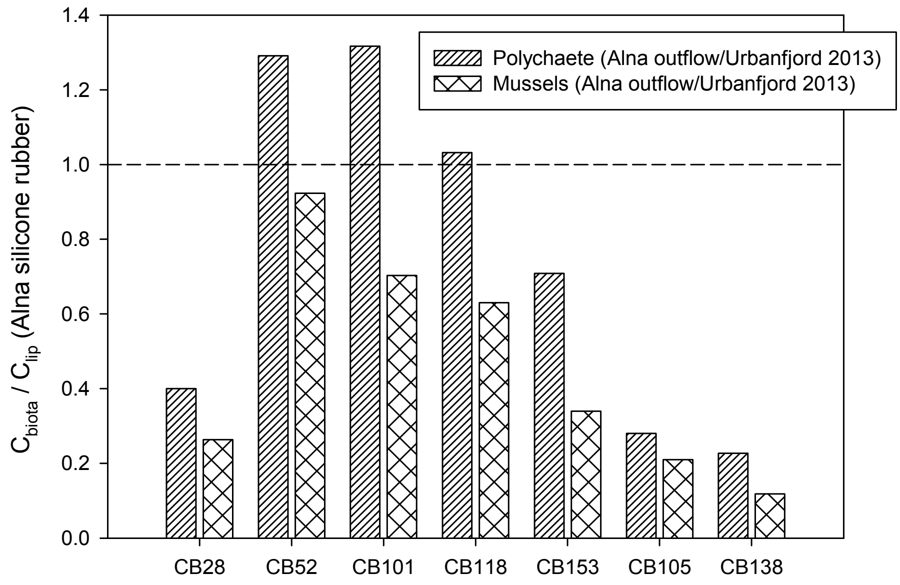


Figure 28. Ratios of PCB concentrations in biota (C_{biota}) over passive sampler-based PCB concentrations in lipid (C_{lip}) at thermodynamic equilibrium with River Alna water. Note: no temperature or salinity correction to the passive sampling data has been undertaken.

3.5.3 Suspended particulate matter-water distribution of contaminants

Since the concentration of many of the contaminants of interest here were measured both in the suspended particulate matter and in the freely dissolved form, it is possible to calculate particulate organic carbon-water distribution coefficients ($logK_{poc}$) for data from 2013. $LogK_{poc}$ values help to check that we have realistic numbers both for the SPM and dissolved concentrations. They can also be used to estimate the dissolved organic matter-associated fraction when more data is available. In general it is also useful to study the variability in $logK_{poc}$ values.

Values of $logK_{poc}$ for PAHs and PCBs in River Alna are plotted in Figure 29 as a function of $logK_{ow}$. More variability in calculated $logK_{poc}$ can be observed for the lighter, less hydrophobic PAHs (with low logK values). A significantly lower variability in $logK_{poc}$ can be seen for the higher molecular weight PAHs. $LogK_{poc}$ for PAHs in River Alna are consistently above the 1:1 relationship with $logK_{ow}$, showing relatively high SPM sorption coefficients for PAHs. Particulate organic carbon-water distribution coefficients for PAHs in Rivers Drammenselva and Glomma are in agreement with those found for River Alna. Such a partitioning behaviour is not unexpected for PAHs, since a stronger sorption of PAHs to carbonaceous organic carbon compared with sorption to amorphous carbon has been shown(Cornelissen et al., 2005). However, it has not often been measured in surface waters. Little is known of the temporal variability in concentrations of PAHs associated with suspended particulate matter in rivers or of the connection between particulate matter concentrations and those measured freely dissolved.

A different behaviour of the PCBs in River Alna can be seen. $LogK_{poc}$ values for PCBs in River Alna are close to the 1:1 relationship with $logK_{ow}$. The spread of $logK_{poc}$ data for individual PCB congeners is relatively low, particularly considering that no temperature correction of the data has been applied. In general, these data support the correctness of the freely dissolved phase measurements made with the passive samplers.

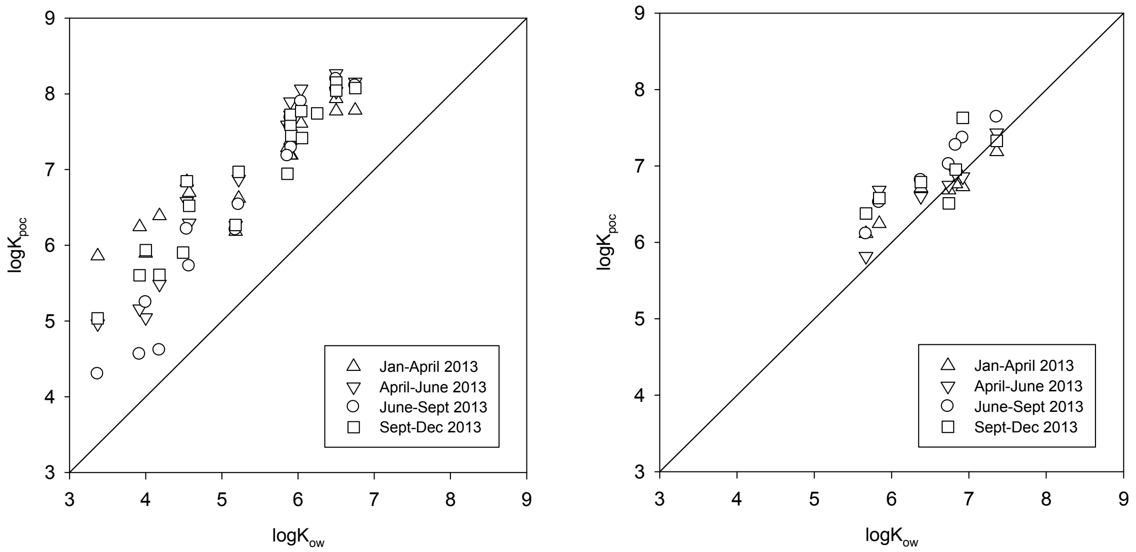


Figure 29. Particulate organic carbon-water distribution coefficients for PAHs (left) and PCBs (right) in River Alna for the four different periods of sampling in 2013.

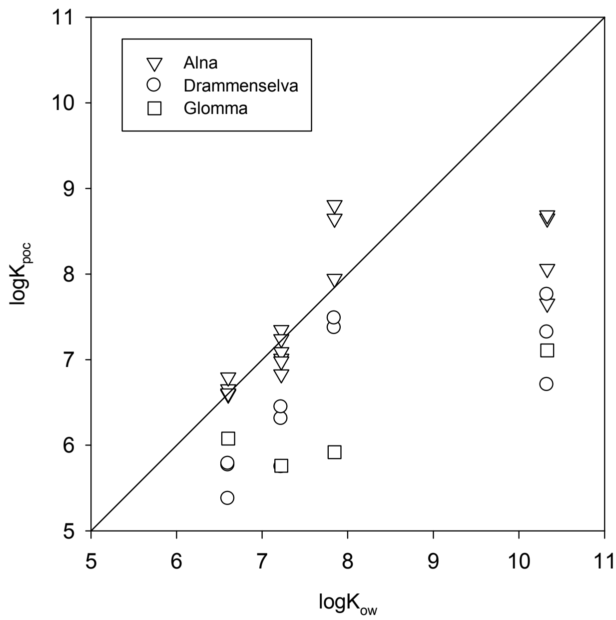


Figure 30. Particulate organic carbon-water distribution coefficients for PBDEs in Rivers Alna, Drammenselva and Glomma for the different periods of sampling of 2013.

LogK_{poc} were also calculated for PBDE data from the three rivers for 2013 and the data are plotted in Figure 30. Distribution coefficients for BDE47, 99, 100, 153 and 154 in River Alna are close to the 1:1 relationship of logK_{poc}-logK_{ow} with more variable data for the more hydrophobic congeners. The data for the two other rivers are generally below the 1:1 relationship. For BDE209, particulate organic carbon-water distribution coefficients are consistently below the 1:1 relationship (and in some cases, by a few orders of magnitude). It may be that the SPM data for BDE209 is extremely variable and our continuous flow centrifuge data is not very representative of ambient BDE209 concentrations in SPM. It may also be that the passive sampling data overestimates BDE209 concentrations in the freely dissolved phase.

3.5.4 Comparison with WFD environmental quality standards

Environmental Quality Standards (EQS) have been set at European level through the Water Framework Directive for a number of substances that have been monitored during this study. The latest EQS values were published in 2013 and are given in Table 17.

Table 17 presents a comparison of annual average estimates of "whole water" concentrations for 2013 for the Rivers Alna, Drammenselva and Glomma with annual average WFD EQS (AA-EQS). Such a comparison however needs to be treated carefully since our data is based on adding the concentrations estimates given for the freely dissolved phase and that measured associated with SPM, and this may or may not be an optimum way to obtain an (annual averaged) estimate of whole water concentrations. One has to bear in mind that the present monitoring programme was not established specifically for compliance monitoring (i.e. to compare against WFD AA-EQS values).

Estimates presented below clearly indicate that concentrations of naphthalene, anthracene, PBDEs (without BDE28), HBCDD and SCCPs are well below WFD EQS values in all rivers. The concentration of fluoranthene and benzo[a]pyrene appear to be close to or above EQS level in all three rivers. PFOS was monitored in the SPM only and the whole water concentration estimates are likely to suffer from significant uncertainty (due to K_{poc} used to estimate freely dissolved concentrations from SPM concentrations and unknown temporal variability of the concentration in river water). While our monitoring programme was not specifically aimed at compliance checking with WFD AA-EQS values, "whole water" concentration estimates close to or above AA-EQS for fluoranthene, benzo[a]pyrene and PFOS in all three rivers certainly warrant further investigation.

The overall uncertainty in estimates of annual average concentrations will be dependent on the uncertainty of (i) freely dissolved concentrations, (ii) SPM-associated concentrations and (iii) the size of the fraction of contaminants not measured by the two techniques used in the present study. For fluoranthene, the freely dissolved concentration represented 15.7, 74.3 and 96.8 % of the estimated "whole water" concentration in the Rivers Alna, Drammen and Glomma, respectively. For benzo[a]pyrene, these values were 1.7, 8.4 and 62 %, respectively. Differences in the distribution of fluoranthene and benzo[a}pyrene between the particulate and dissolved phase in the different rivers will affect the overall uncertainty of the "whole water" estimates. The standard error on the estimates of sampling rate provided by the non-linear least square method (Booij and Smedes, 2010) are in most cases between 10 and 20 %. For fluoranthene, however, in many cases, the uncertainty is not related to the sampling rate estimation but to the uncertainty in K_{sw} values since measurements with silicone samplers are made close to equilibrium with the dissolved phase. An uncertainty of 0.2 log unit can be expected for $\log K_{sw}$ values. This also means that the passive sampling of fluoranthene was not truly time-averaged over the entire period of deployment. The uncertainty resulting from this will depend on the temporal variability of the dissolved fluoranthene concentration in water. Since benzo[a]pyrene is more hydrophobic, time to equilibrium is longer than for fluoranthene and most passive sampling measurements remained time-averaged. Bias in passive sampling data can result from the temperature-dependency of K_{sw} values. Higher K_{sw} values at lower temperatures (as a result of decreasing solubility of hydrophobic chemicals in water with decreasing temperature) can be expected for deployments where the average temperature are significantly lower than that at which K_{sw} values have been measured (20 °C). Applying a temperature correction to K_{sw} values will result in the estimation of higher R_s and lower concentrations in water. Since a significant proportion of fluoranthene is found in the particulate fraction in River Alna, uncertainties in the estimation of average SPM-associated fluoranthene and benzo[a]pyrene concentrations will play a major role in the overall uncertainty of estimated "whole water" concentrations. This is also the case for benzo[a]pyrene in Rivers Alna and Drammenselva. Knowledge of temporal variability of SPM-associated concentration and factors contributing to this variability is needed.

Table 17. Comparison of calculated annual average contaminant concentrations for the Rivers Alna, Drammenselva and Glomma for 2013 with Water Framework Directive annual average environmental quality standards (AA-EQS). Blue, orange and red shading are for when "whole water" concentration estimate are well below EQS, close to EQS (i.e. within a factor of 2-4 below EQS) and above EQS, respectively.

Substance	Annual average "whole water" concentration (ng/l) for 2013			
	Alna	Drammenselva	Glomma	WFD AA-EQS
Naphthalene(1)	6.9	5.4	2.9	2000
Anthracene(1)	2.3	0.14	0.17	100
Fluoranthene(1)	12.6	1.9	2.9	6.3
Benzo[a]pyrene(1)	3.1	0.25	0.071	0.17
PFOS(2)	0.5-5	0.2-1.8	0.07-0.7	0.65
PBDEs (- BDE28)(3)	0.011	0.020	0.012	140
HBCDD	0.008 - 0.17	0.001 - 0.03	0.01- 0.05	1.6
SCCPs(4)	5.4 – 78	0.1 - 12	0.8 - 32	400

(1) Whole water refers here to the sum of the freely dissolved concentration and that of the suspended particulate matter-associated contaminant concentration.
(2) PFOS annual average concentration are based on the measured concentrations in the SPM phase and predicted freely dissolved concentration based on measured SPM concentrations and a $\log K_{poc}$ range of 3-4. Note that this chemical is primarily found in the dissolved phase and these estimates may suffer considerable uncertainty.
(3) The sum of PBDE congeners according to the WFD includes congener 28.
(4) SCCP annual average concentration are based on the measured concentrations in the SPM phase and predicted freely dissolved concentration based on measured SPM concentrations and a $\log K_{poc}$ range of 5 to 8. The upper level estimates may suffer considerable uncertainty.
Note: Contaminant sorption to DOC is not taken into account here.

3.5.5 Estimation of riverine loads of contaminants for 2013

Annual riverine contaminant loads are given in Table 18. Riverine loads of S/MCCPs, BPA, TBBPA and PFOS are for the suspended particulate matter fraction of contaminants. A summary of sources of uncertainty in the estimation of annual contaminant loads can be found in Appendix IV. Generally the loads were higher in River Glomma compared to River Drammenselva, and loads from both rivers were substantially higher than in River Alna. This reflects the large difference in annual water discharge.

Annual loads of individual PCB congeners for 2013 were below 2 g/yr for River Alna. Annual loads of PCB congeners for Rivers Drammenselva and Glomma range from < 32 g/yr for CB156 to 245-374 g/yr for CB28 in River Glomma. These data represent a significant improvement to the use of bottle sampling for the estimation of loads of PCBs from Norwegian rivers. With a LOD of 0.2 ng/l per PCB congener for bottle sampling, all data would have been below LOD. In these conditions, riverine load estimates for the 7 indicator PCBs would be < 63 g/yr for River Alna, < 20.5 and 37.4 kg/yr for Rivers Drammenselva and Glomma, respectively for 2013. Estimates of loads for 7 indicator PCB congeners were 8.5, 257-566 and 656-1481 g/yr for Rivers Alna, Drammenselva and Glomma, respectively. These estimates are a little more uncertain for Rivers Drammenselva and Glomma since concentrations in the suspended particulate matter phase were mostly below limits of detection.

Loads of individual PBDE congeners were below 1 g/yr for River Alna, while the loads were in the range 1.4-131 g/yr for River Drammenselva and 38.4-170 g/yr for River Glomma. Riverine loads for HBCDD isomers were in the range 0.32-6.8, 10.6-352 and 270-1284 g/yr for Rivers Alna, Drammenselva and Glomma, respectively.

Annual loads of individual PAHs were below 1 kg/yr for River Alna and up to 130 kg/yr for phenanthrene in River Glomma. Riverine loads for PAHs were far higher than those estimated for all the other organic contaminants. The riverine discharge of S/MCCPs in Glomma, however, was approaching the same level as PAHs. The loads of PFOS were below 10 g/yr for all rivers. For PFOS, calculated loads of freely dissolved PFOS assuming a $logK_{poc}$ value of 4 (Ahrens *et al.*, 2011) were 23.2, 2673 and 1791-5492 g/yr for Rivers Alna, Drammenselva and Glomma, respectively.

Table 18. Estimated riverine contaminant loads in Rivers Alna, Drammen and Glomma, 2013

Compound	Unit	Annual contaminant load		
		Alna	Drammenselva	Glomma
ΣPAH_{16}	kg/yr	3.2	178.4-178.9	465.5-470.1
ΣPCB_7	g/yr	8.49	257-566	656-1481
ΣPBDE (excl. BDE28)	g/yr	1.4-1.6	217-246	407-462
BDE209	g/yr	8.65	183-194	203-292
ΣHBCDD (α, β, γ)	g/yr	0.32-6.8	10.6-352	270-1284
SCCPs[a]	kg/yr	0.24	1.55	20.2
MCCPs[a]	kg/yr	0.47	3.96	242.8
BPA[a]	g/yr	18	1830	2531
TBBPA[a]	g/yr	2.7	178	575
PFOS[a]	g/yr	0.17	2.5	4.3-13.3

[a]Estimated loads for these substances are only for the particulate matter-associated fraction

Expressing contaminant loads relatively to the size of the drainage basins of the rivers shows a very different picture. For all sets of chemicals, annual loads per km^2 of drainage basin were highest for River Alna (Figure 31). This reflects that the majority (68%) of the River Alna catchment is urban area. Loads for Rivers Drammenselva and Glomma were generally lower by a factor of 4-10. Estimated loads for Rivers Drammenselva and Glomma were similar for many classes of chemicals, except for MCCPs which were far higher in River Glomma.

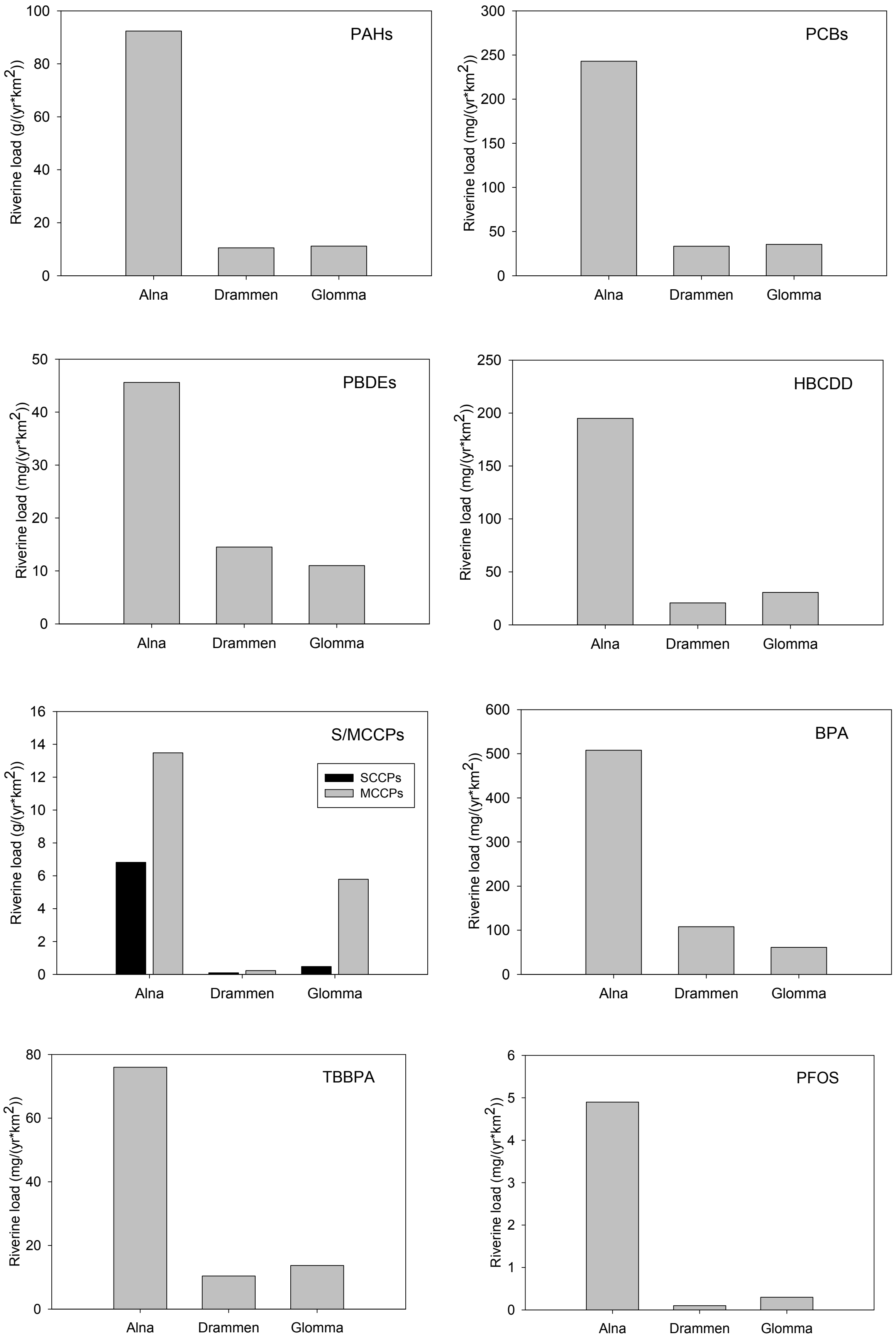


Figure 31. Estimates of river basin surface area-normalised riverine loads of contaminants in Rivers Alna, Drammenselva and Glomma for 2013.

3.6 The spring flood in 2013

During the spring flood 2013, additional samples were collected in Rivers Glomma, Alna, Drammenselva, Numedalslågen and Skienselva. For example in River Drammenselva, this resulted in a total of 8 samples for the months of May and June. The results from this river have here been used to illustrate how some of the monitored constituents react on an increase in water discharge. Figure 32 shows this for particles and nutrients (see also Figure 34). Typically, suspended particulate matter, total phosphorus, total nitrogen and nitrate-N increased immediately when the water discharge increased, but did not stay high for the rest of the spring flood. This "hysteresis effect" is well known from literature (e.g., (Smith & Dragovich 2009; Eder et al. 2010) and can be related to such factors as higher water velocity during increasing water discharges and/or to the location of pollutant sources, and the release of substances from these.

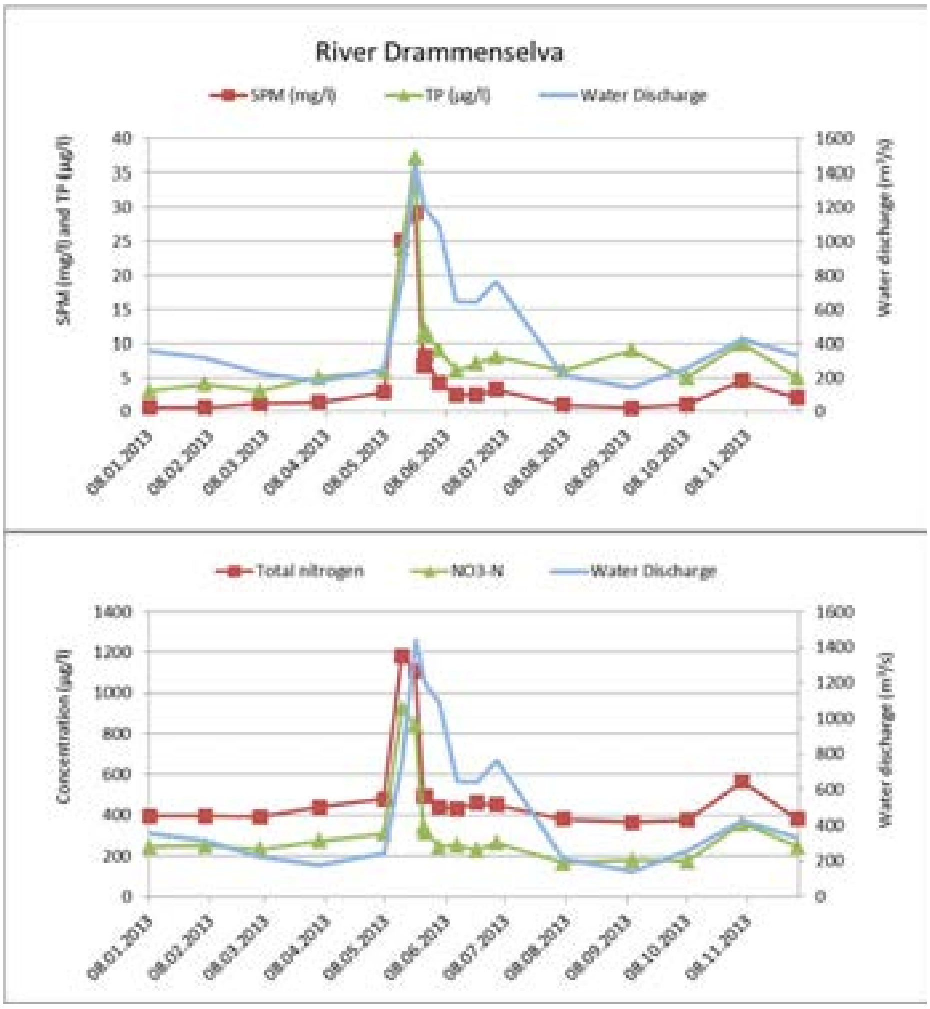


Figure 32. Illustration of how the concentration of particles and nutrients reacted when the water discharge increased in the 2013 spring flood in River Drammenselva. Water discharge is from days of sampling only.

Similarly, for metals (Figure 33), the concentrations clearly increase during the higher water discharges. Especially zinc, nickel and lead react quickly to the increased water discharges.

These diagrams illustrate the importance of sampling during high water discharges, in order to obtain more reliable load estimates. If such episodes are omitted, serious errors in the estimation of total loads may be the result. This is an important reason why turbidity meters were installed in three RID rivers in 2013, cf. next chapter.

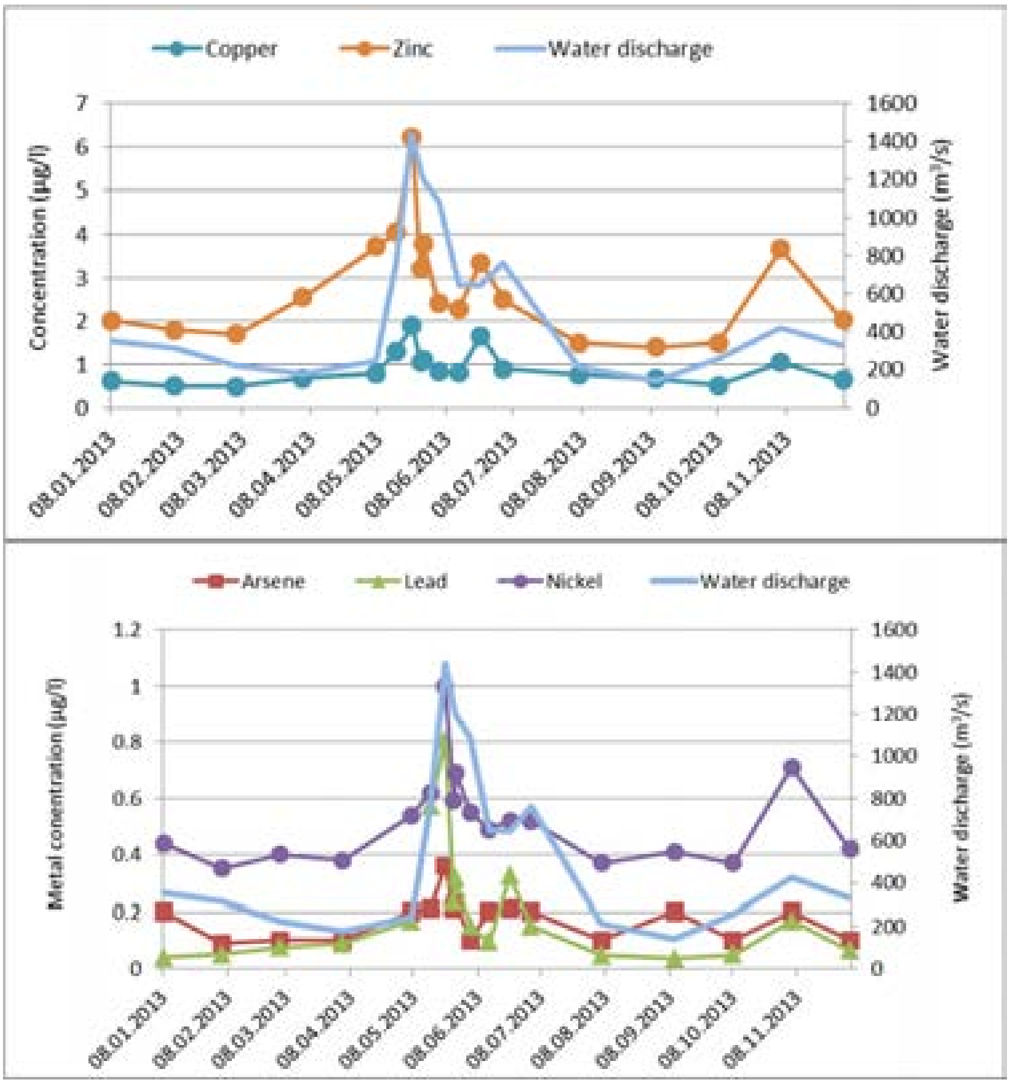


Figure 33. Illustration of how the concentration of metals varied when the water discharge increased in the 2013 spring flood in River Drammenselva.

3.7 Turbidity from sensor recordings

In 2013, sensors for turbidity, pH, conductivity and water temperature were positioned in three rivers (River Glomma, Alna and Drammenselva). Figure 34 shows an example of data from the turbidity recordings in River Drammenselva. Turbidity is often used as a substitute for suspended particulate matter (SPM), not least since this parameter is known to have high concentration variations in rivers (e.g., Skarbøvik and Roseth 2014). The figure therefore also shows the SPM-measurements done in the same period. Clearly, the added value of the sensor data is the high resolution of data.

In an earlier study of RID data from River Numedalslågen, Skarbøvik et al. (2012) demonstrated that SPM correlated well with arsenic (As), lead (Pb), nickel (Ni), total phosphorus (TP) and orthophosphate-P (PO_4-P). Once data also from the 2014 period becomes available, it is recommended that comparisons are done between sensor recordings and the regular monitoring of substances, in order to assess the correlation. In cases where the correlation is good, the sensor data can be used to calculate loads of these substances, and, hence, to assess uncertainties in the calculated RID loads based on monthly (or less) samples per year.

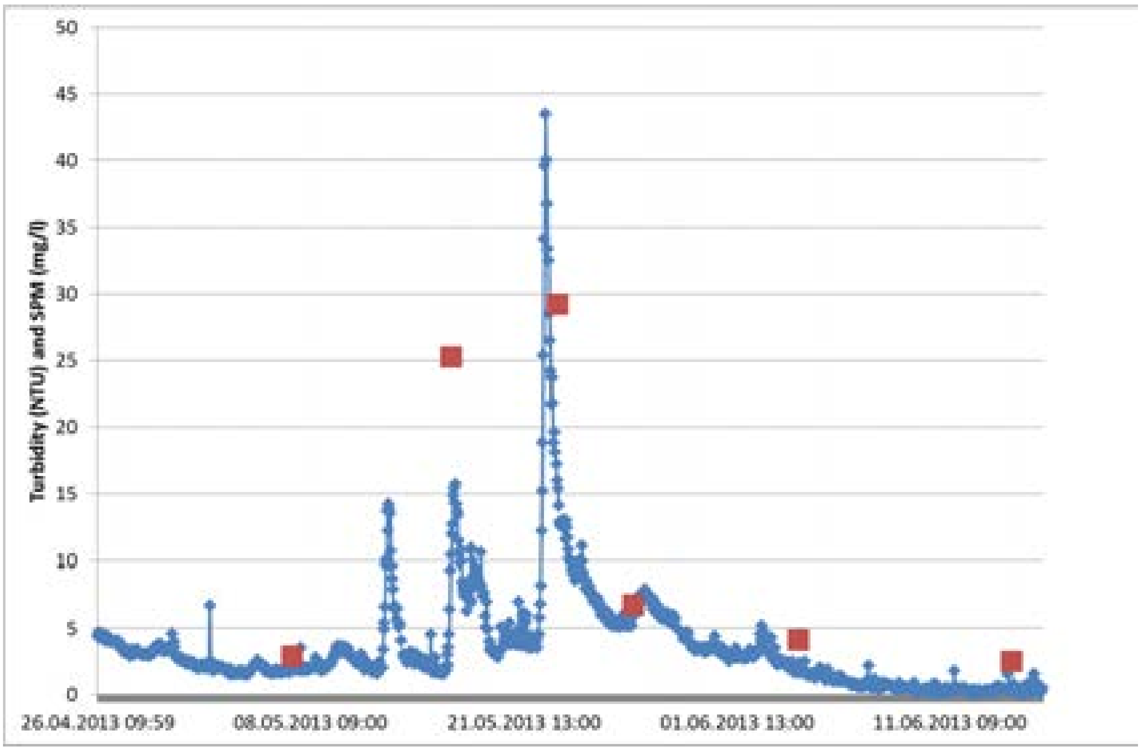


Figure 34. Turbidity data (blue) and SPM analysed on water grab samples in River Drammenselva.

4. Conclusions

Climate, water discharge and temperatures

In 2013, the average air temperature was 1.0 °C above normal (1961-1990), whereas average precipitation was 10 % above normal. The high precipitation was reflected in high water discharges in the rivers.

Total inputs of nutrients and metals in 2013

The total inputs to coastal Norwegian waters in 2013 were estimated to about 12 700 tonnes of phosphorus, about 162 000 tonnes of nitrogen, about 440 000 tonnes of total silicate, about 505 000 tonnes of total organic carbon (TOC), and about one million tonnes of suspended particulate matter.

The inputs of metals to the Norwegian coastal areas were estimated to 276 kg of mercury, 2.2 tonnes of cadmium, 5.8 tonnes of silver, 28 tonnes of arsenic, 38 tonnes of lead, 80 tonnes of chromium, 141 tonnes of nickel, 952 tonnes of zinc and 1163 tonnes of copper (upper estimates). Silver was monitored for the first time this year, and only one single sample was above the detection limit. Since the upper estimate uses the detection limit as a basis for the load calculation, this resulted in an estimate of total loads of 5.8 tonnes (upper estimates) or zero tonnes (lower estimates).

Metal concentrations were compared with national and EU (2000; 2013) thresholds (cf. Table 16), and levels exceeding or close to the threshold value were found for copper (Rivers Glomma, Alna, Orreelva, Orkla, Jostedøla, Stjørdalselva, Verdalselva, Gaula); zinc (Rivers Glomma and Tista) and chromium (River Jostedøla).

There were no significant changes in the distribution of sources for neither nutrients nor metals as compared to recent years. Fish farming continues to be a major direct source of nutrients to the sea.

Trends in nutrient and metal inputs

In 2013, total nitrogen loads were lower and total phosphorus loads higher than the long-term mean of 1990-2012. Most metal loads were lower in 2013 than for the mean of the long-term period 1990-2012.

Statistical trend analyses of data from the last 10 years (2004-2013) indicate that:

- For the nutrient loads, one statistical significant trend could be detected (an upward trend in total nitrogen loads in Numedalslågen). However when the corresponding nutrient concentrations where analysed, upward trends were detected in total nitrogen, orthophosphate and total phosphorus in two rivers, and a downward trend in nitrate-N in one river. Differences in results between loads and concentrations are due to the higher temporal variability in load amplitude;
- No significant trends were identified for loads of suspended particles;
- Two out of nine rivers showed statistical significant trends in the metal loads. More specifically, in River Otra downward trends were detected in loads in copper, cadmium, nickel, zinc and an almost significant trend in lead, while River Orkla showed downward load trends of copper and lead;
- Notable are the clearly visible concentration and load increases in zinc in the River Glomma in the last three years.

It should be noted that the trend analysis performed on the shorter time-series have considerable less statistical power than the time series of the entire monitoring period.

The main conclusions of the trend analysis on annual loads for the period 1990-2013 are as follows:

- For total nitrogen loads, downward trends were detected in two rivers (Skienselva and Vefsna) and upward trends in one river (Numedalslågen);
- For total phosphorus loads, downward trends were detected in two rivers (Vefsna and Altaelva);

- There is a downward trend in nitrate-N, ammonium-N, copper, zinc and lead loads in approximately half of the rivers;
- For suspended particle (SPM) loads, a downward trend was detected in one river (Otra).

Table 19. Overview of trends in riverine loads to the seas, for both short term (S) (2004-2013) and long-term (L) 1990-2013 datasets.

		Glomma	Drammen selva	Numedals -lågen	Skiens- elva	Otra	Orreelva	Orkla	Vefsna	Alta
NH_4N	S			orange					light green	
	L	dark green			dark green		light green	dark green	dark green	dark green
NO_3N	S				light green	light green	light green			
	L				dark green	dark green	light green		dark green	dark green
TN	S								red	
	L			red	dark green				dark green	light green
PO_4P	S									
	L								light green	light green
TP	S									orange
	L								dark green	dark green
SPM	S					light green				
	L					dark green				
Cd	S					dark green				
	L	dark green	dark green	dark green	dark green	dark green	dark green	dark green	dark green	dark green
Cu	S					dark green		dark green		
	L			dark green	dark green			dark green	dark green	dark green
Ni	S					dark green				
	L	dark green			dark green	dark green	dark green	dark green	dark green	dark green
Pb	S					light green		dark green		
	L	dark green		dark green		dark green		dark green	dark green	dark green
Zn	S	orange	light green			dark green				
	L			dark green	dark green	dark green		dark green	dark green	

dark green	Significant downward (p<0.05)
light green	Downward but not significant (0.05<p<0.1)
red	Significant upward (p<0.05)
orange	Upward but not significant (0.05<p<0.1)

Organic contaminants

Contaminant monitoring using a combination of passive sampler deployments and use of continuous flow centrifugation to measure both the freely dissolved concentration as well as the contaminant concentration associated with suspended particulate matter was successful and yielded an extensive dataset that was used to estimate riverine discharges of contaminants to sea. The consecutive deployment of passive sampling devices enabled continuous time-integrated monitoring of concentrations of PAHs, PCBs, PBDEs and HBCDD in water. The sensitivity of the methodology put in place here allowed the estimation of contaminant concentrations at levels below pg/l in some cases. This means a more realistic estimation of riverine fluxes of contaminants can be done than with bottle sampling and limits of detection in the low ng/l range. The monitoring of suspended particulate matter was also suitable for a range of chemicals. It demonstrated that concentrations of contaminants associated with suspended particulate matter can be relatively variable and more knowledge and understanding of these variations is needed.

Additionally, a screening of contaminant levels against legislative thresholds was undertaken by comparing calculated "whole water" concentrations (sum of freely dissolved and that sorbed to suspended particulate matter) of WFD priority pollutants with WFD annual average environmental quality standards (AA-EQS) published in 2013. Estimates of "whole water" concentrations for fluoranthene, benzo[a]pyrene and PFOS were close to or above WFD AA-EQS for all three rivers

The estimation of riverine discharges of contaminants to the sea in 2013 showed that for all chemicals studied, the load from the Alna River was highest when given per km^2 of drainage area. Loads for the Drammen and Glomma rivers were generally similar. One major unknown factor in the estimation of fluxes is the concentration of contaminants sorbed to DOC (not quantified here). The variability in SPM-associated contaminants concentrations also adds some uncertainty to the flux estimates. Correlating the continuous turbidity measurements with SPM concentrations could, to an extent, help reduce this uncertainty.

5. References

Ahrens, L., Yeung, L.W., Taniyasu, S., Lam, P.K., Yamashita, N., 2011. Partitioning of perfluorooctanoate (PFOA), perfluorooctane sulfonate (PFOS) and perfluorooctane sulfonamide (PFOSA) between water and sediment. Chemosphere 85, 731–737.

Allan, I., Bæk, K., Kringstad, A., Bratsberg, E., Høgfeldt, A., Ranneklev, S., Harman, C., Garmo, Ø., 2011. RiverPOP 2010. Measurement of trace contaminants in the Glomma River and some recommendations from RiverPOP projects (2008-2011). NIVA Report 6126/2010.

Allan, I., Fjeld, E., Garmo, Ø., Langford, K., Kringstad, A., Bratsberg, E., Kaste, Ø., 2009. RiverPOP: Measuring concentrations of persistent organic pollutants and trace metals in Norwegian rivers RiverPOP: Måle konsentrasjoner av persistente organiske forurensende stoffer og metaller i norske elver. NIVA Report 5815/2009.

Allan, I., Garmo, Ø., Harman, C., Kringstad, A., Bratsberg, E., 2010. RiverPOP 2009: Measuring concentrations of persistent organic pollutants and trace metals in Norwegian rivers. NIVA-Report 5989/2010.

Allan, I.J., Bæk, K., Haugen, T.O., Hawley, K.L., Høgfeldt, A.S., Lillicrap, A.D., 2013a. In Vivo passive sampling of nonpolar contaminants in brown trout (Salmo trutta). Environmental Science & Technology 47, 11660-11667.

Allan, I.J., Harman, C., Ranneklev, S.B., Thomas, K.V., Grung, M., 2013b. Passive sampling for target and nontarget analyses of moderately polar and nonpolar substances in water. Environmental Toxicology and Chemistry 32, 1718-1726.

Allan, I.J., Ranneklev, S.B., 2011. Occurrence of PAHs and PCBs in the Alna River, Oslo (Norway). Journal of Environmental Monitoring 13, 2420-2426.

Andersen, J.R., Bratli, J.L., Fjeld, E., Faafeng, B., Grande, M., Hem, L. Holtan, H., Krogh, T., Lund, V., Rosland, D., Rosseland, B.O. & Aanes, K.J. 1997: Klassifisering av miljøkvalitet i ferskvann. SFT Veiledning 97:04/TA-1468/1997.

Bakken, T. H., Lázár, A., Szomolányi, M., Németh Á., Tjomsland, T., Selvik, J., Borgvang, S., Fehér J. 2006. AQUAPOL-project: Model applications and comparison in the Kapos catchment, Hungary. NIVA-report 5189. 164 pp.

Beldring, S., Engeland, K., Roald, L.A., Sælthun, N.R. and Voksø, A. 2003. Estimation of parameters in a distributed precipitation-runoff model for Norway. Hydrology and Earth System Sciences, 7, 304-316.

Booij, K., Sleiderink, H.M., Smedes, F., 1998. Calibrating the uptake kinetics of semipermeable membrane devices using exposure standards. Environmental Toxicology and Chemistry 17, 1236-1245.

Booij, K., Smedes, F., 2010. An Improved Method for Estimating in Situ Sampling Rates of Nonpolar Passive Samplers. Environmental Science & Technology 44, 6789-6794.

Booij, K., Smedes, F., van Weerlee, E.M., 2002. Spiking of performance reference compounds in low density polyethylene and silicone passive water samplers. Chemosphere 46, 1157-1161.

Cornelissen, G., Gustafsson, Ö., Bucheli, T.D., Jonker, M.T., Koelmans, A.A., van Noort, P.C., 2005. Extensive sorption of organic compounds to black carbon, coal, and kerogen in sediments and soils: mechanisms and consequences for distribution, bioaccumulation, and biodegradation. Environmental Science & Technology 39, 6881-6895.

Eder, A., Strauss, P., Krueger, T., Quinton, J.N. 2010. Comparative calculation of suspended sediment loads with respect to hysteresis effects (in the Petzenkirchen catchment, Austria). J Hydrol. 389:168–176.

EC 2000. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 of establishing a framework for community action in the field of water policy.

EC 2013. Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy.

Hindar, A. and Tjomsland, T. 2007. Beregning av tilførsler og konsentrasjon av N og P i NVEs REGINEfelter i Otra ved hjelp av TEOTIL-metoden. NIVA-rapport – 5490. 55pp.

Hirsch, R.M. and Slack, J.R. 1984. A nonparametric trend test for seasonal data with serial dependence: Water Resources Research v. 20, p. 727–732.

Huckins, J.N., Petty, J.D., Lebo, J.A., Almeida, F.V., Booij, K., Alvarez, D.A., Clark, R.C., Mogensen, B.B., 2002. Development of the permeability/performance reference compound approach for in situ calibration of semipermeable membrane devices. Environmental Science & Technology 36, 85-91.

Jahnke, A., Mayer, P., Adolfsson-Erici, M., McLachlan, M.S., 2011. Equilibrium sampling of environmental pollutants in fish: Comparison with lipid-normalized concentrations and homogenization effects on chemical activity. Environmental Toxicology and Chemistry 30, 1515-1521.

Jahnke, A., McLachlan, M.S., Mayer, P., 2008. Equilibrium sampling: Partitioning of organochlorine compounds from lipids into polydimethylsiloxane. Chemosphere 73, 1575-1581.

Kristiansen, S., Mamen, J., Szewczyk-Bartnicka, H., Tajet, H.T.T. 2013. Været i Norge. Klimatologisk oversikt, Året 2013. MET info no. 13/2013. 24 pp.

Libiseller, C. and Grimvall A. 2002. Performance of Partial Mann Kendall Tests for Trend Detection in the Presence of Covariates, Environmetrics 13, 71-84.

Ranneklev, S., Allan, I., Enge, E., 2009. Kartlegging av miljøgifter i Alna og Akerselva. NIVA-Report 5776/2009;TA 2495-2009.

Rusina, T.P., Smedes, F., Koblizkova, M., Klanova, J., 2010. Calibration of Silicone Rubber Passive Samplers: Experimental and Modeled Relations between Sampling Rate and Compound Properties. Environmental Science & Technology 44, 362-367.

Ruus, A., Allan, I., Beylich, B., Bæk, K., Schlabach, M., Helberg, M., 2014. Environmental contaminants in an urban fjord. Norwegian Environment Agency, Oslo, p. 173.

Selvik, J.R., Tjomsland, T. and Eggestad, H.O. 2007. Tilførsler av næringssalter til Norges kystområder i 2006. beregnet med tilførselsmodellen TEOTIL. Norwegian State Pollution Monitoring Programme. NIVA Rapport 5512-2007.

Smith, H.G., Dragovich, D. 2009. Interpreting sediment delivery processes using suspended sediment-discharge hysteresis patterns from nested upland catchments, south-eastern Australia. Hydrol Process. 23:2415–2426.

Sen, P.K. 1968. Estimates of the regression coefficient based on Kendall's tau. *Journal of the American Statistical Association*, 63, 1379-1389.

Skarbøvik, E., Stålnacke, P., Bogen, J., Bønsnes, T.E. 2012. Impact of sampling frequency on mean concentrations and estimated loads of suspended sediment in a Norwegian river: Implications for water management. Sci. Tot. Env. 433: 462-471.

Skarbøvik, E. Stålnacke, P.G., Kaste, Ø., Selvik, J.R., Borgvang, S.A., Tjomsland, T., Høgåsen, T. and Beldring, S. 2007. Riverine inputs and direct discharges to Norwegian coastal waters – 2006. OSPAR Commission. Norwegian Pollution Control Authority (SFT). TA-2327/2007; NIVA Report 5511/2007. 142 pp.

Skarbøvik, E., Stålnacke, P.G., Kaste, Ø., Selvik, J.R., Tjomsland, T., Høgåsen, T., Aakerøy, P.A., and Beldring, S. 2010. Riverine inputs and direct discharges to Norwegian coastal waters – 2009. Climate and Pollution Agency TA-2726/2010; 75 pp.

Skarbøvik, E., Stålnacke, P., Selvik, J.R., Aakerøy, P.A., Høgåsen, T., and Kaste, Ø. 2011. Elvetilførselsprogrammet (RID) – 20 års overvåking av tilførsler til norske kystområder (1990-2009). NIVA-rapport 6235-2011. Klima- og forurensningsdirektoratet TA-2857/2011; 55 s.

Skarbøvik, E., Stålnacke, P., Austnes, K., Selvik, J.R., Pengerud, A., Tjomsland, T. Høgåsen, T. and Beldring, S. 2013. Riverine inputs and direct discharges to Norwegian coastal waters – 2012. Norwegian Environment Agency. M-80/2013. NIVA-Rapp. 6584-2013. 67 pp.

Smedes, F., Geertsma, R.W., van der Zande, T., Booij, K., 2009. Polymer-Water Partition Coefficients of Hydrophobic Compounds for Passive Sampling: Application of Cosolvent Models for Validation. Environmental Science & Technology 43, 7047-7054.

Stålnacke, P., Haaland, S., Skarbøvik, E., Turtumøygard, S., Nytrø, T.E., Selvik, J.R., Høgåsen, T., Tjomsland, T., Kaste, Ø. and Enerstvedt, K.E. 2009. Revision and assessment of Norwegian RID data 1990-2007. Bioforsk Report Vol. 4 No. 138. SFT report TA-2559/2009. 20p.

Tjomsland, T. and Bratli, J.L. 1996. Brukerveiledning for TEOTIL. Modell for teoretisk beregning av fosfor- og nitrogentilførsler i Norge. (User guideline for TEOTIL. Model for calculation of phosphorus and nitrogen inputs in Norway). NIVA rapport - 3426. 84 s.

Tomy, G., Fisk, A., Westmore, J., Muir, D., 1998. Environmental chemistry and toxicology of polychlorinated n-alkanes. Springer Verlaag.

Warren, N., Allan, I.J., Carter, J.E., House, W.A., Parker, A., 2003. Pesticides and other micro-organic contaminants in freshwater sedimentary environments - a review. Applied Geochemistry 18, 159-194.

Weideborg, M., Arctander Vik, E. and Lyngstad, E. 2004. Riverine inputs and direct discharges to Norwegian coastal waters 2003. Norwegian State Pollution Monitoring Programme. Report number 04-043A. TA 2069/2004.

Appendices

Appendix I The RID objectives

The main objectives of RID are found at www.ospar.org, and listed as follows:

To assess, as accurately as possible, all river-borne and direct inputs of selected pollutants to Convention waters on an annual basis.

To contribute to the implementation of the Joint Assessment and Monitoring Programme (JAMP) by providing data on inputs to Convention waters on a sub-regional and a regional level.

To report these data annually to the OSPAR Commission and:

a. to review these data periodically with a view to determining temporal trends;

b. to review on a regular basis, to be determined by the Hazardous Substances and Eutrophication Committee (HASEC), whether RID requires revision.

Each Contracting Party bordering the maritime area should:

a. aim to monitor on a regular basis at least 90% of the inputs of each selected pollutant. If this is not achievable due to a high number of rivers draining to the sea, modelling/extrapolation can be used to ensure sufficient coverage;

b. provide, for a selection of their rivers, information on the annual mean/median concentration of pollutants resulting from the monitoring according to paragraph 2.4a;

c. as far as possible, estimate inputs from unmonitored areas complementing the percentage monitored (see paragraph 2.4a) towards 100 %;

d. take opportunities to adapt their RID monitoring programmes to progress (cf. Section 12) and keep the monitoring effort proportionate, taking into account changes in risk.

The entire guidelines and principles of the RID Programme are found at www.ospar.org, under Agreements.

Appendix II Water sampling personnel

An overview of the personnel for water sampling in 2013 is given below:

Personnel for water sampling in the rivers monitored monthly or more often:	Personnel for water sampling in the 36 rivers with quarterly sampling:
Nils Haakensen (Glomma) Jarle Molvær og Jan Magnusson (Alna) Vibeke Svenne (Drammenselva) Sverre Holm*/Sigmund Lekven (Numedalslågen) Anette Hardli (Skienselva) Ellen Grethe Ruud Åtland (Otra) Einar Helland (Orre) Geir Ove Henden (Vosso) Joar Skauge (Orkla) Vebjørn Opdahl (Vefsna) Anders Bjordal (Altaelva)	Nils Haakensen Olav Smestad Ellen Grethe Ruud Åtland Jan Stokkeland Einar Helland Svein Gitle Tangen Odd Birger Nilsen Rune Roalkvam Vanessa Venema Leif Magnus Dale Inger Moe Øystein Nøtsund Hallgeir Hansen Bjarne Stangvik Gudmund Kårvatn Daniel Melkersen Asbjørn Bjerkan Vebjørn Opdahl Egil Moen Øystein Iselvmo Einar Pettersen

* Until May 2013.

Appendix III: Catchment information for 47 monitored rivers

Maps of land cover

The main types of land cover in Norway are forest, agriculture and other surfaces impacted by human activities, mountains and mountain plateaus, and lakes and wetlands (Figure A-III-1). Mountains and forests are the most important land cover categories, and this is reflected in the land cover distribution of the 11 rivers monitored monthly (Figure A-III-2).

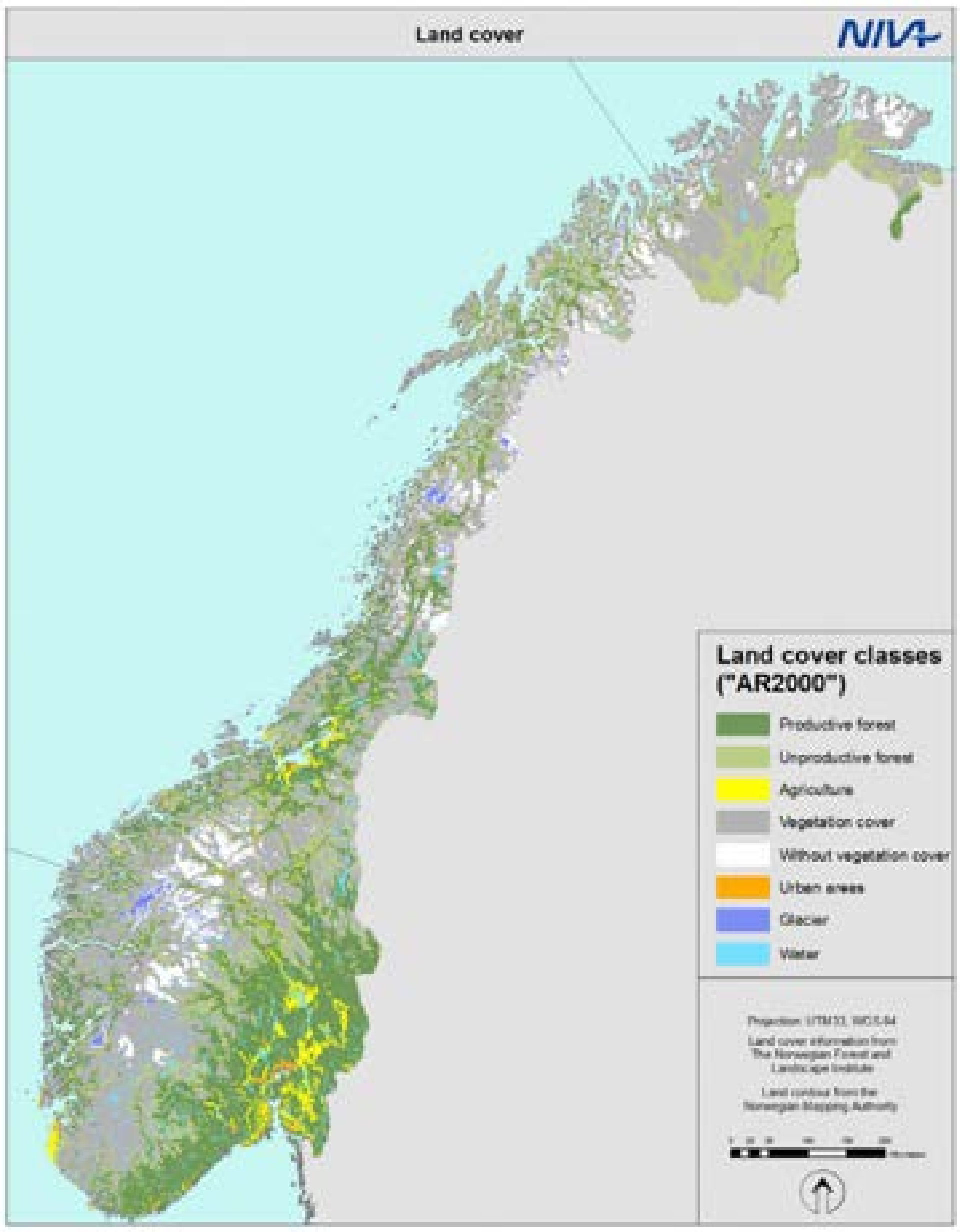


Figure A-III-1. Land cover map of Norway. See also Figure A-III-2 in which the land use in the catchments of the 11 rivers monitored monthly is shown.

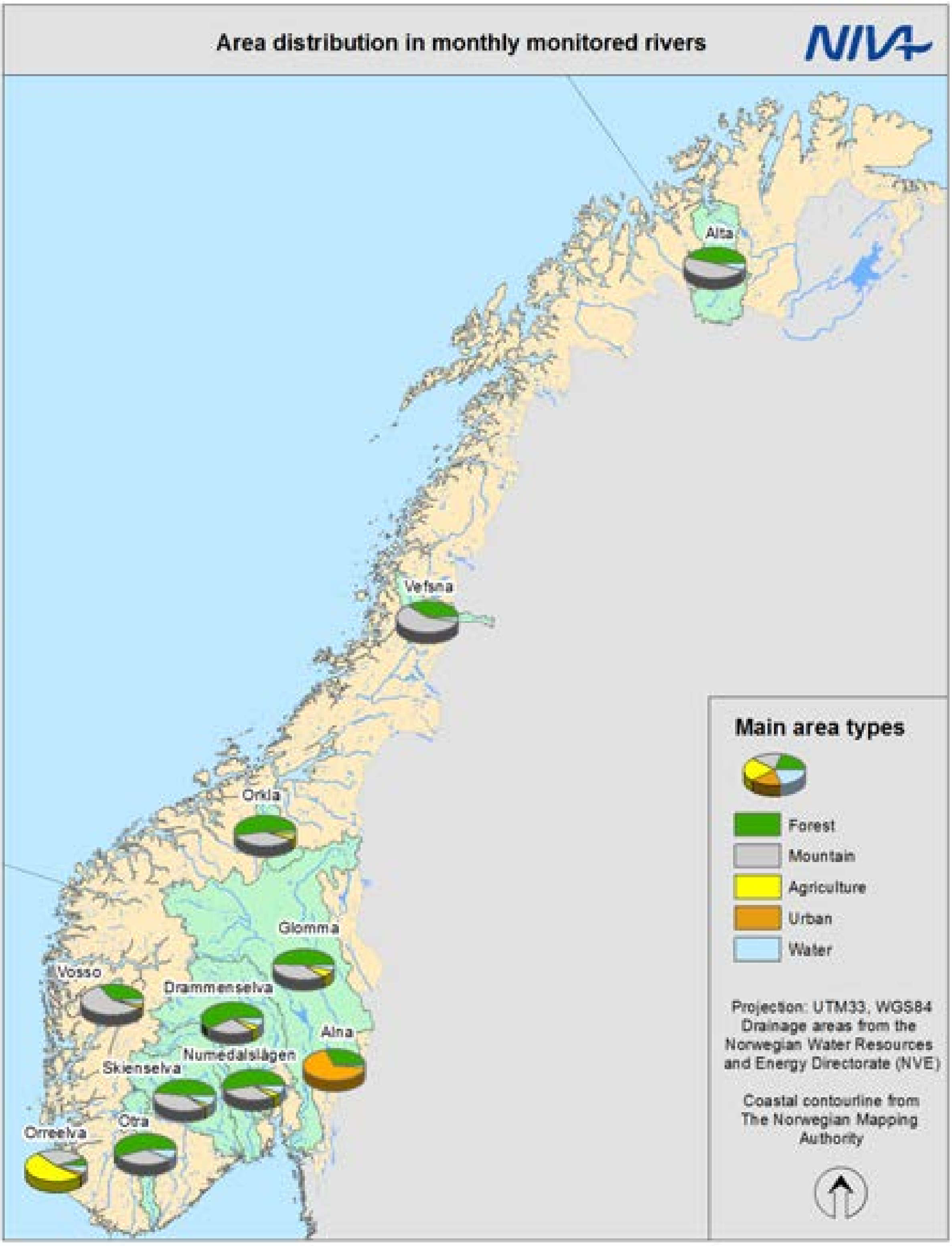


Figure A.III-2. Land use in the catchment areas of the 11 rivers monitored monthly. 'Water' refers to lakes in the catchment; 'Mountain' includes moors and mountain plateaus not covered by forest. Based on data from The Norwegian Forest and Landscape Institute.

Catchment information for rivers monitored monthly

The rivers are listed in Table A-III-1. Rivers Glomma, Alna, Drammenselva, Numedalslågen, Skienselva, and Otra drain into the Skagerrak area, the part of the North Sea which is considered to be most susceptible to pollution. Apart from River Alna, that was added to the programme in 2013, these rivers also represent the major load bearing rivers in Norway. Of these, River Glomma is the largest river in Norway, with a catchment area of about 41 200 km^2, or about 13 % of the total land area in Norway. River Drammenselva has the third largest catchment area of Norwegian rivers with its 17 034 km^2.

Rivers Orreelva and Vosso drain into the coastal area of the North Sea (Coastal area II). River Orreelva is a relatively small river with a catchment area of only 105 km^2, and an average flow of about 4 m^3/s, but it is included in the RID Programme since it drains one of the most intensive agricultural areas in Norway. More than 30% of its drainage area is covered by agricultural land, and discharges from manure stores and silos together with runoff from heavily manured fields cause eutrophication and problems with toxic algal blooms.

River Vosso has been in the RID Programme since its start in 1990. Until 2004 it was sampled once a year, and in the period 2004-2007 four times a year. From 2008 it was exchanged with River Suldalslågen (see below) as a main river with monthly samplings. River Vosso was chosen due to the low levels of pressures in the catchment. It has a low population density of 1.1 persons/km^2, and only 3 % of the catchment area is covered by agricultural land. The rest of the catchment is mainly mountains and forested areas.

River Suldalslågen was sampled as a main river up until 2007, but from 2008 this river has been sampled only four times a year. The reason for this is that the river is heavily modified by hydropower developments, and water from large parts of the catchment has been diverted to an adjacent catchment. The decision to change the sampling here was taken based on a weighing of advantages of long time series and disadvantages of continuing to sample a river which is very uncharacteristic. Since it was one of the main rivers from 1990-2007, its catchment characteristics are nevertheless given here: It has a drainage area of 1457 km^2 and a population density of only 2.4 persons/km^2. There are no industrial units reporting discharges of nitrogen or phosphorus from the catchment. The pressures are, thus, mainly linked to the aforementioned hydropower.

River Alna was sampled monthly for the first time in 2013. This is a relatively small river with only 69 km^2 catchment area, but it drains urban areas and is therefore of interest, not least in terms of metals and organic pollutants. The majority of the catchment area (68%) is urban, the rest is covered by forest. Changes in the rivers monitored monthly have implications for the comparisons of this group of rivers with former years, and for the long-term database. However, most year-to-year comparisons are done on all rivers or all inputs, and will therefore not be much affected by this change.

Rivers Orkla and Vefsna drain into the Norwegian Sea (Coastal area III). Agricultural land occupies 4 and 8 % of their catchment areas, respectively. Farming in this part of the country is less intensive as compared to the Orre area. More important are abandoned mines in the upper part of the River Orkla watercourse. Several other rivers in this area may also receive pollution from abandoned mines (heavy metals). These two rivers have, however, no reported industrial activity discharging nitrogen or phosphorus.

The last of the main rivers, River Alta is with its population density of only 0.3 persons per km^2 and no industrial plants reporting discharges, selected as the second of the two unpolluted river systems, although it is, as River Suldalslågen, affected by hydropower development. The river drains into the Barents Sea.

The ten watercourses represent river systems typical for different parts of the country. As such they are very useful when estimating loads of comparable rivers with less data than the main rivers. All rivers except River Orreelva are to varying degrees modified for hydropower production.

Table A-III-1. The 11 main rivers, their coastal area, catchment size and long-term average flow.			
Discharge area	Name of river	Catchment area (km²)	Long-term average flow (1000 m³/day)*
I. Skagerrak	Glomma	41918	61347
	Alna	69	43**
	Drammenselva	17034	26752
	Numedalslågen	5577	10173
	Skienselva	10772	23540
	Otra	3738	12863
II. North Sea	Orreelva	105	430
	Vosso (from 2008)	1492	2738
III. Norwegian Sea	Orkla	3053	3873
	Vefsna	4122	14255
IV. Barents Sea	Alta	7373	7573

** For the 30-year normal 1961-1990; at the water quality sampling points.*

** 30-year normal is not available, the figure for Alna is therefore based on an annual mean reported by NVE (The Norwegian Water Resources and Energy Directorate).

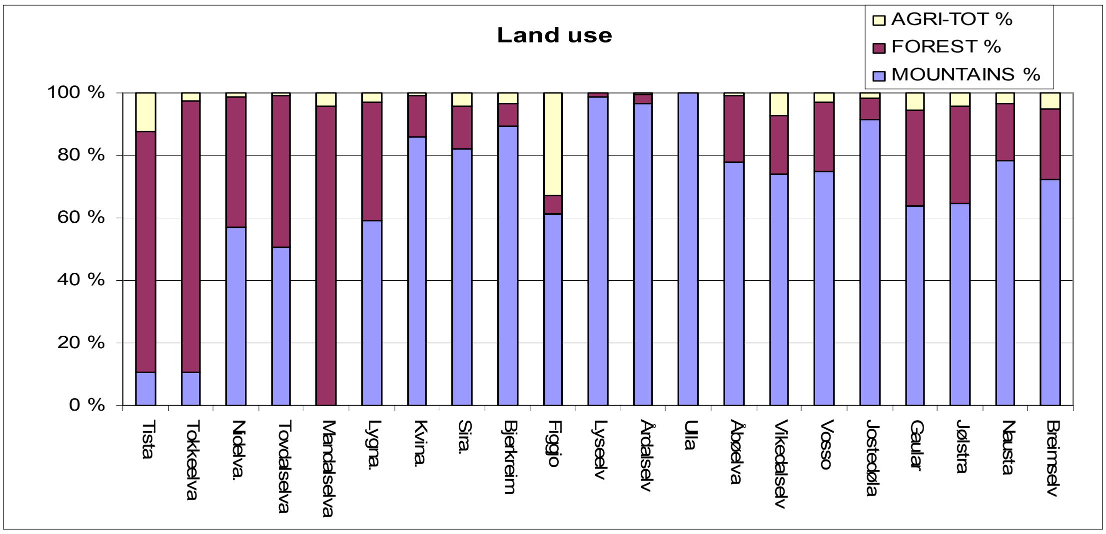
Catchment information for rivers monitored quarterly - Tributary Rivers
A list of the tributary rivers is given in Table A-III-2.

The average size of the catchment area of the tributary rivers[6] is 2380 km², but the size varies from River Vikedalselva with its 118 km², to the second largest drainage basin in Norway, River Pasvikelva with a drainage basin of 18404 km².

Land use varies considerably, as shown in Figure A-III-1. As an example, Rivers Figgjo and Tista have the highest coverage of agricultural land (31[7] and 12%, respectively), whereas some of the rivers have no or insignificant agricultural activities in their drainage basins (e.g. Rivers Ulla, Røssåga, Målselv, Tana and Pasvikelva). Some catchments, such as Rivers Lyseelva, Årdalselva and Ulla in the west; and River Pasvikelva in the north, are more or less entirely dominated by mountains, moors, and mountain plateaus.

There is also considerable variation in population density, from rivers in the west and north with less than one inhabitant per km², to rivers with larger towns and villages with up to 100 or more inhabitants per km². Population density decreases in general from south to north in Norway. The average population density of the 36 river catchments amounts to about 14 inhabitants per km², whereas the average density in the main river catchments is about 20 inhabitants per km².

[6] River Vosso is still included in this figure.
[7] Statistics for River Figgjo also include values from River Orre, as these rivers are adjacent.



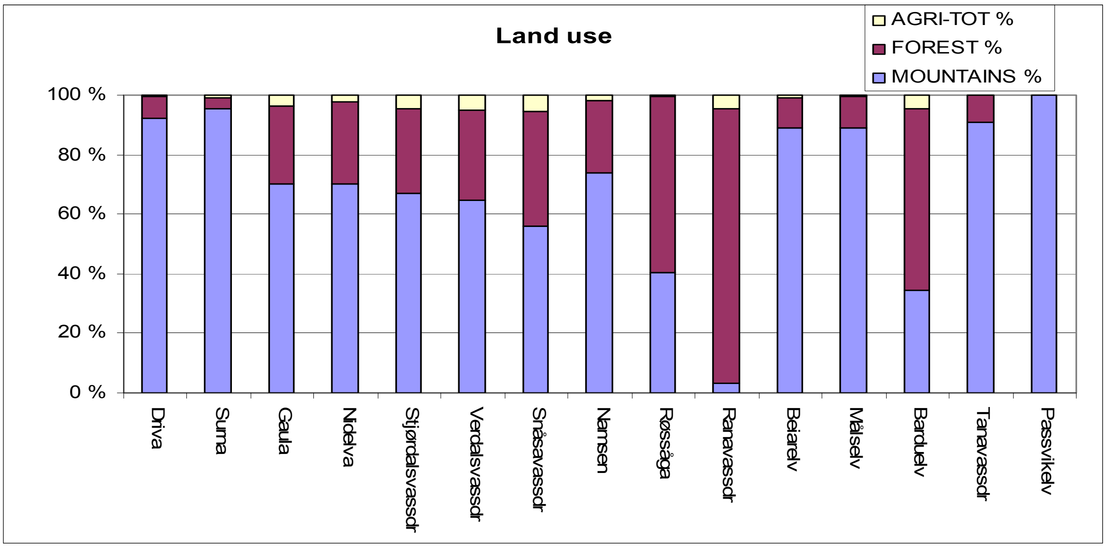


Figure A-III-1. Land use distribution in the catchment areas of the 36 rivers monitored quarterly. "Agri-tot" means total agricultural land. "Mountains" include moors and mountain plateaus not covered by forest.

Table A-III-2. River basin characteristics for the 36 rivers monitored quarterly. Discharge Q is based on the 1961-1990 mean (from NVE).

Official Norwegian river code (NVE)	River	Basin area (km^2)	Area upstream samplings site (km^2)	Normal Q (10^6 m^3/yr)
001	Tista	1588	1582	721
017	Tokkeelva	1238	1200	1042
019	Nidelva	4025	4020	3783
020	Tovdalselva	1856	1854	1984
022	Mandalselva	1809	1800	2624
024	Lygna	664	660	1005
025	Kvina	1445	1140	2625
026	Sira	1916	1872	3589
027	Bjerkreimselva	705	704	1727
028	Figgjo	229	218	361
031	Lyseelva	182	182	425
033	Årdalselva	519	516	1332
035	Ulla	393	393	1034
035	Saudaelva	353	353	946
036	Suldalslågen	1457	1457	6690
038	Vikedalselva	118	117	298
062	Vosso	1492	1465	2738
076	Jostedøla	865	864	1855
083	Gaular	627	625	1568
084	Jølstra	714	709	1673
084	Nausta	277	273	714
087	Breimselva	636	634	1364
109	Driva	2487	2435	2188
112	Surna	1200	1200	1816
122	Gaula	3659	3650	3046
123	Nidelva	3110	3100	3482
124	Stjørdalsvassdraget	2117	2117	2570
127	Verdalsvassdraget	1472	1472	1857
128	Snåsavassdraget	1095	1088	1376
139	Namsen	1124	1118	1376
155	Røssåga	2092	2087	2995
156	Ranavassdraget	3847	3846	5447
161	Beiaren	1064	875	1513
196	Målselv	3239	3200	2932
196	Barduelva	2906	2906	2594
234	Tanavassdraget	16389	15713	5944
244	Pasvikelva	18404	18400	5398

Appendix IV Methodology, supplementary information

Selection of rivers and sampling frequency
For practical and economic reasons it is not possible to monitor all rivers that drain into the coastal waters of Norway. Hence, the Norwegian RID programme operates with three main groups of monitored rivers:

- Rivers monitored monthly or more often;
- Rivers monitored quarterly (since 2004);
- Rivers monitored once a year in the period of 1990-2003.

Ten rivers have been monitored monthly or more often in the entire monitoring period (1990-2013). These include the assumedly eight most load-bearing rivers in the country, which are Rivers Glomma, Drammenselva, Numedalslågen, Skienselva, Otra, Orreelva, Orkla and Vefsna. In addition, two relatively "unpolluted" rivers have been included for comparison purposes. Presently these are Rivers Vosso and Alta. Of these, River Vosso was only included in the 'group' of monthly monitored rivers in 2008/2009, when it replaced River Suldalslågen. In 2013 an additional river, River Alna, was included in this group, as an example of a river draining mainly urban areas. Consequently, 11 rivers were monitored monthly in 2013.

The number of rivers monitored four times a year since 2004 is 36. These rivers have not changed in the period of 2004-2013.

The number of rivers monitored once a year in the period of 1990-2003 varies between 126-145. One of these rivers was River Alna, which was monitored monthly in 2013.

Since it has been of special importance to estimate the major loads to the Skagerrak maritime area, a proportionally higher number of rivers have been chosen for this part of the country.

Sampling methodology and sampling sites
The sites are located in regions of unidirectional flow (no back eddies). In order to ensure as uniform water quality as possible, monitoring is carried out at sites where the water is well mixed, e.g. at or immediately downstream a weir, in waterfalls, rapids or in channels in connection with hydroelectric power stations. Sampling sites are located as close to the freshwater limit as possible, without being influenced by seawater.

Table A-IV-1 gives the coordinates of the sampling stations. For quality assurance reasons, the sampling sites have been documented by use of photographs. This, together with the coordinates, will ensure continuity in the event that sampling personnel changes.

Table A-IV-1. Coordinates of the 47 sampling points.

Regine No	RID-ID	Station name	Latitude	Longitude	RID-Region
002.A51	2	Glomma at Sarpsfoss*	59.27800	11.13400	Skagerrak
006.2Z	8	Alna	59.90461	10.79164	
012.A3	15	Drammenselva*	59.75399	10.00903	
015.A1	18	Numedalslågen	59.08627	10.06962	
016.A221	20	Skienselva	59.19900	9.61100	
021.A11	26	Otra	58.18742	7.95411	
028.4A	37	Orreelva	58.73143	5.52936	North Sea
062.B0	64	Vosso (Bolstadelvi)	60.64800	6.00000	
121.A41	100	Orkla	63.20100	9.77300	Norwegian Sea
151.A4	115	Vefsna	65.74900	13.23900	
212.A0	140	Altaelva	69.90100	23.28700	Barents Sea
Regine No	RID-ID	Station name	Latitude	Longitude	RID-Region
001.A6	1	Tista	59,12783	11.44436	Skagerrak
017.A1	21	Tokkeelva	58.87600	9.35400	
019.A230	24	Nidelv (Rykene)	58.40100	8.64200	
020.A12	25	Tovdalselva	58.21559	8.11668	
022.A5	28	Mandalselva	58.14300	7.54604	
024.B120	30	Lyngdalselva	58.16300	7.08798	North Sea
025.AA	31	Kvina	58.32020	6.97023	
026.C	32	Sira	58.41367	6.65669	
027.A1	35	Bjerkreimselva	58.47894	5.99530	
028.A3	38	Figgjoelva	58.79168	5.59780	
031.AA0	44	Lyseelva	59.05696	6.65835	
032.4B1	45	Årdalselva	59.08100	6.12500	
035.A21	47	Ulladalsåna (Ulla)	59.33000	6.45000	
035.721	49	Saudaelva	59.38900	6.21800	
036.A21	48	Suldalslågen	59.48200	6.26000	
038.A0	51	Vikedalselva	59.49958	5.91030	
076.A0	75	Jostedøla	61.41333	7.28025	
083.A0	78	Gaular	61.37000	5.68800	
084.A2	79	Jølstra	61.45170	5.85766	
084.7A0	80	Nausta	61.51681	5.72318	
087.A221	84	Gloppenelva (Breimselva)	61.76500	6.21300	
109.A0	95	Driva	62.66900	8.57100	Norwegian Sea
112.A0	98	Surna	62.97550	8.74262	
122.A24	103	Gaula	63.28600	10.27000	
123.A2	104	Nidelva(Tr.heim)	63.43300	10.40700	
124.A21	106	Stjørdalselva	63.44900	10.99300	
127.A0	108	Verdalselva	63.79200	11.47800	
128.A1	110	Snåsavassdraget	64.01900	11.50700	
139.A50	112	Namsen	64.44100	11.81900	
155.A0	119	Røssåga	66.10900	13.80700	
156.A0	122	Ranaelva	66.32300	14.17700	
161.B4	124	Beiarelva	66.99100	14.75000	
196.B2	132	Målselv	69.03600	18.66600	
196.AA3	133	Barduelva	69.04300	18.59500	
234.B41	150	Tanaelva	70.23000	28.17400	Barents Sea
246.A5	153	Pasvikelva	69.50100	30.11600	

* Stations for sensors and organic contaminants (only CFC in Drammenselva) have the following co-ordinates: River Drammenselva: 59.75570; 9.99438; River Glomma at Baterød: 59.30725; 11.13475

Analytical methods and detection limits
Table A-IV-3 gives the analytical methods and detection limits used.

Table A-IV-3. Analytical methods and limits of detection for parameters included in the sampling programme in 2013.

Parameter	Detection limit	Analytical Methods (NS: Norwegian Standard)
pH		NS 4720
Conductivity (mS/m)	0.05	NS-ISO 7888
Turbidity (FNU)	0.05	NS-EN ISO 7027
Suspended particulate matter (SPM) (mg/L)	0.2	NS 4733 modified
Total Organic Carbon (TOC) (mg C/L)	0.1	NS-ISO 8245
Total phosphorus (µg P/L)	1	NS 4725 – Peroxidisulphate oxidation method
Orthophosphate (PO4-P) (µg P/L)	1	NS 4724 – Automated molybdate method
Total nitrogen (µg N/L)	10	NS 4743 – Peroxidisulphate oxidation method
Nitrate (NO_3-N) (µg N/L)	1	NS-EN ISO 10304-1
Ammonium (NH_4-N) (µg N/L)	2	NS-EN ISO 14911
Silicate (SiO_2) (Si/ICP; mg Si/L)	0.02	ISO 11885 + NIVA's accredited method E9-5
Silver (Ag) (µg Ag/L)	0.05	NS-EN ISO 17294-1 and NS EN ISO 17294-2
Arsenic (As) (µg As/L)	0.05	NS-EN ISO 17294-1 and NS EN ISO 17294-2
Cadmium (Cd) (µg Cd/L)	0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2
Chromium (Cr) (µg Cr/L)	0.1	NS-EN ISO 17294-1 and NS EN ISO 17294-2
Copper (Cu) (µg Cu/L)	0.01	NS-EN ISO 17294-1 and NS EN ISO 17294-2
Mercury (Hg) (µg Hg/L)	0.001	NS-EN ISO 12846
Nickel (Ni) (µg Ni/L)	0.05	NS-EN ISO 17294-1 and NS EN ISO 17294-2
Lead (Pb) (µg Pb/L)	0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2
Zinc (Zn) (µg Zn/L)	0.05	NS-EN ISO 17294-1 and NS EN ISO 17294-2

Water discharge and hydrological modelling
For the 11 main rivers, daily water discharge measurements were, as in former years, used for the calculation of loads. Since the discharge monitoring stations are not located at the same site as the water sampling is conducted (except in River Alna), the water discharge at the water quality sampling sites were calculated by up- or downscaling, proportional to the drainage areas.

For the 36 rivers monitored quarterly, as well as the remaining 108 rivers from the former RID studies, water discharge was simulated with a spatially distributed version of the HBV-model (Beldring *et al.*, 2003). The use of this model was introduced in 2004. Earlier, the water discharge in the then 145 rivers was calculated based on the 30-year average, and adjusted with precipitation data for the actual year. The results from the spatially-distributed HBV are transferred to TEOTIL for use in the load estimates. Smaller response units ('regine-units') have been introduced in TEOTIL in order to improve load estimates for smaller basins (tributaries).

The gridded HBV-model performs water balance calculations for square grid-cell landscape elements characterised by their altitude and land use. Each grid cell may be divided into two land-use zones with different vegetation cover, a lake area and a glacier area. The model is run with daily time steps, using precipitation and air temperature data as inputs. It has components for accumulation, sub-grid scale distribution and ablation of snow, interception storage, sub-grid scale distribution of soil moisture storage, evapotranspiration, groundwater storage and runoff response, lake evaporation and glacier mass balance. Potential evapotranspiration is a function of air temperature; however, the effects of seasonally varying vegetation characteristics are considered. The algorithms of the model were described by Bergström (1995) and Sælthun (1996). The model is spatially distributed in that every model element has unique characteristics which determine its parameters, input data are distributed, water balance computations are performed separately for each model element, and finally, only those parts of the model structure which are necessary are used for each element. When watershed boundaries are defined, runoff from the individual model grid cells is sent to the respective basin outlets.

The parameter values assigned to the computational elements of the precipitation-runoff model should reflect the fact that hydrological processes are sensitive to spatial variations in topography, soil properties and vegetation. As the Norwegian landscape is dominated by shallow surface deposits overlying rather impermeable bedrock, the capacity for subsurface storage of water is small (Beldring, 2002). Areas with low capacity for soil water storage will be depleted faster and reduced evapotranspiration caused by moisture stress shows up earlier than in areas with high capacity for soil water storage (Zhu and Mackay, 2001). Vegetation characteristics such as stand height and leaf area index influence the water balance at different time scales through their control on evapotranspiration, snow accumulation and snow melt (Matheussen *et al.*, 2000). The following land-use classes were used for describing the properties of the 1-km^2 landscape elements of the model: (i) areas above the tree line with extremely sparse vegetation, mostly lichens, mosses and grasses; (ii) areas above the tree line with grass, heather, shrubs or dwarf trees; (iii) areas below the tree line with sub-alpine forests; (iv) lowland areas with coniferous or deciduous forests; and (v) non-forested areas below the tree line. The model was run with specific parameters for each land use class controlling snow processes, interception storage, evapotranspiration and subsurface moisture storage and runoff generation. Lake evaporation and glacier mass balance were controlled by parameters with global values.

A regionally applicable set of parameters was determined by calibrating the model with the restriction that the same parameter values are used for all computational elements of the model that fall into the same class for land surface properties. This calibration procedure rests on the hypothesis that model elements with identical landscape characteristics have similar hydrological behaviour, and should consequently be assigned the same parameter values. The grid cells should represent the significant and systematic variations in the properties of the land surface, and representative (typical) parameter values must be applied for different classes of soil and vegetation types, lakes and glaciers (Gottschalk *et al.*, 2001). The model was calibrated using available information about climate and hydrological processes from all gauged basins in Norway with reliable observations, and parameter values were transferred to other basins based on the classification of landscape characteristics. Several automatic calibration procedures, which use an optimisation algorithm to find those values of model parameters that minimise or maximise, as appropriate, an objective function or statistic of the residuals between model simulated outputs and observed watershed output, have been developed. The nonlinear parameter estimation method PEST (Doherty *et al*., 1998) was used. PEST adjusts the parameters of a model between specified lower and upper bounds until the sum of squares of residuals between selected model outputs and a complementary set of observed data are reduced to a minimum. A multi-criteria calibration strategy was applied, where the residuals between model simulated and observed monthly runoff from several basins located in areas with different runoff regimes and landscape characteristics were considered simultaneously.

Precipitation and temperature values for the model grid cells were determined by inverse distance interpolation of observations from the closest precipitation stations and temperature stations. Differences in precipitation and temperature caused by elevation were corrected by precipitation-altitude gradients and temperature lapse rates determined by the Norwegian Meteorological Institute. There is considerable uncertainty with regard to the variations of precipitation with altitude in the mountainous terrain of Norway, and this is probably the major source of uncertainty in the stream flow simulations. The precipitation-altitude gradients were reduced above the altitude of the coastal mountain ranges in western and northern Norway, as drying out of ascending air occurs in high mountain areas due to orographically induced precipitation (Daly *et al.,* 1994). These mountain ranges release most of the precipitation associated with the eastward-migrating extra tropical storm tracks that dominate the weather in Norway. Figure A-IV-1 shows the spatial distribution of mean annual runoff (mm/year) for Norway for the period 1961-1990. The Norwegian Water Resources and Energy Directorate (NVE) performs this modelling.

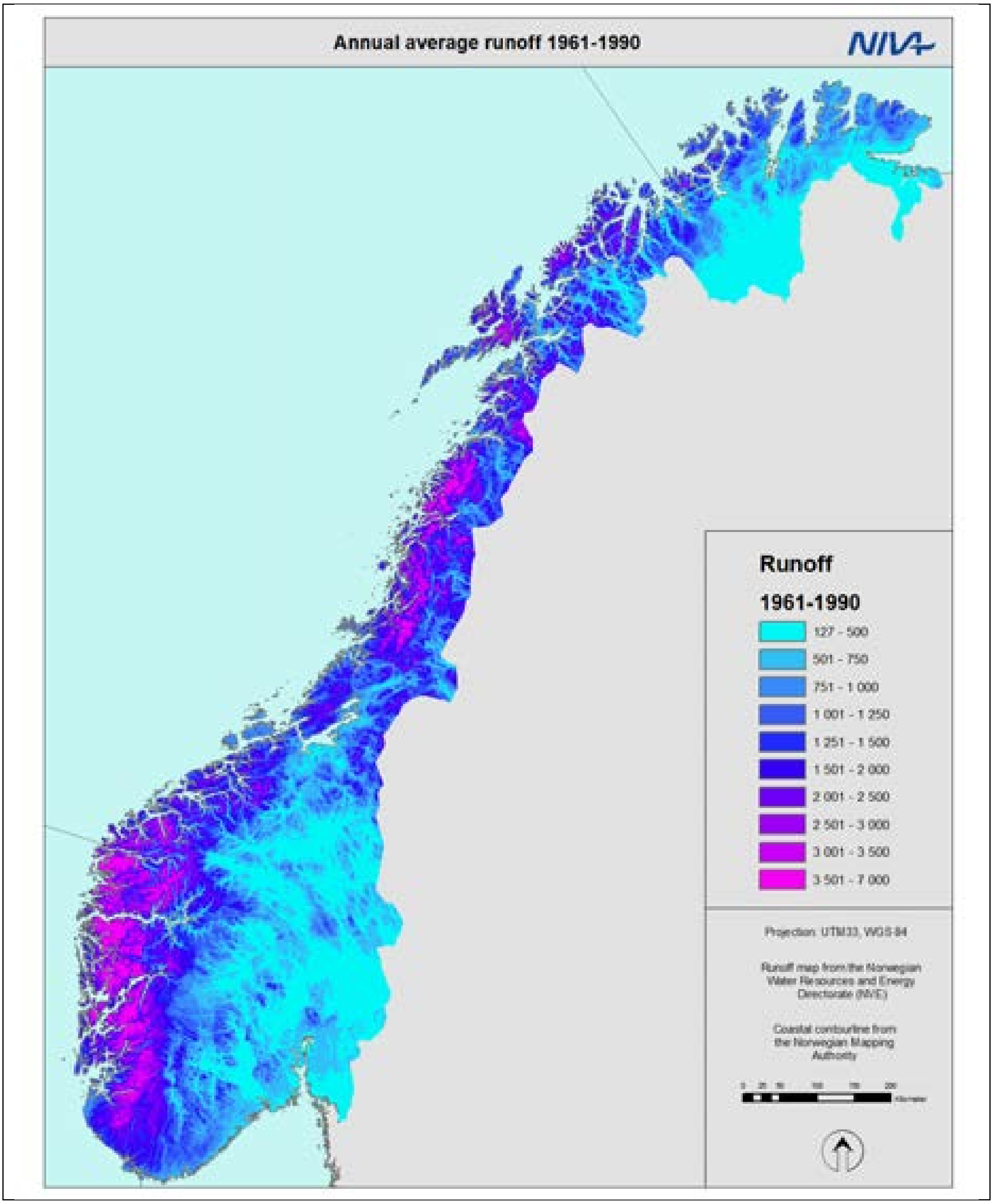


Figure A-IV-1. Average annual runoff (mm/year) for Norway for the period 1961-1990.

Direct discharges to the sea
The direct discharges comprise point source discharges in unmonitored areas. The estimates are based on national statistical information, including:

- Sewage: Municipal wastewater and scattered dwellings (Statistics Norway - SSB / the KOSTRA Database);
- Industry: the database "Forurensning" from the Norwegian Environment Agency.
- Aquaculture: Nutrients (from the Directorate of Fisheries / the ALTINN-database (altinn.no)) and copper (based on sales statistics of antifouling products made available by the Norwegian Environment Agency)

Sewage effluents
Statistics Norway (SSB) is responsible for the annual registration of data from wastewater treatment plants in the country. Approximately 50% of the Norwegian population is connected to advanced treatment plants with high efficiency of phosphorus or both phosphorus and nitrogen treatment. The rest of the population is connected to treatment plants with simpler primary treatment (42%) or no treatment (8%) (SSB, 2002). Most of the treatment plants with only primary treatment serve smaller settlements, while the majority of advanced treatment plants (plants with chemical and/or biological treatment) are found near the larger cities. Of the total hydraulic capacity of 5.74 million p.e. (person equivalent), chemical plants account for 37%, chemical/biological treatment for 27%, primary treatment for 24%, direct discharges for 8%, biological treatment for 2% and others for 2% (2002 data). In the region draining to the North Sea, most of the wastewater (from 83% of the population in the area) is treated in chemical or combined biological-chemical treatment plants, whereas the most common treatment methods along the coast from Hordaland county (North Sea) and northwards are primary treatment or no treatment. The fifty percent reduction target for anthropogenic phosphorus has been met for the Skagerrak coast as a result of increased removal of phosphorus in treatment plants.

Statistics Norway (SSB) and the Norwegian Environment Agency jointly conduct annual registration of data on nutrients from all wastewater treatment plants in the country with a capacity of more than 50 person equivalents (p.e.). The data are reported each year by the municipalities. The electronic reporting system KOSTRA is used for reporting of effluent data from the municipalities directly to SSB. For the plants with no reporting requirements (<50 p.e.), the discharge is estimated by multiplying the number of people with standard Norwegian per capita load figures and then adjusting the estimate according to the removal efficiency of the treatment plants. The "Principles of the Comprehensive Study of Riverine Inputs and Direct Discharges" (PARCOM, 1988) recommends the derived per capita loads listed in the table below. The Norwegian per capita loads are based on studies of Norwegian sewerage districts (Farestveit *et al.*, 1995), and are listed in the same table. The latter are used in the Norwegian reporting.

Table A-IV-4. Per capita loads used for estimation of untreated sewage discharges.

Parameter	OSPAR	Norway
BOD (kg O/person/day)	0.063	0.046
COD (kg O/person/day)		0.094
TOC (kg TOC /person/day)		0.023
SPM (kg SPM./person/day)	0.063	0.042
Tot-N (kg N/person/day)	0.009	0.012
Tot-P (kg P/person/day)	0.0027	0.0016

The metal loads from wastewater treatment plants reflect the sum of the *reported* load from wastewater treatment plants in unmonitored areas and along the coast. Reporting of metals is required only for the largest treatment plants (>20.000 p.e.). No assumptions on loads from other plants than those reporting have been considered.

Industrial effluents
Estimates of discharges from industry are based on data reported to the database "Forurensning" (Norwegian Environment Agency) and the share of municipal wastewater considered to derive from

industry (see above). Sampling frequency for industrial effluents varies from weekly composite samples to random grab samples. Sampling is performed at least twice a year. Nutrient loads from industry in unmonitored areas are estimated using the TEOTIL model, based on the reported data. Metal loads, where reported, are summed.

Fish farming effluents
Fish farmers report monthly data for fish fodder, biomass, slaughtered fish and slaughter offal down to net cage level. These are reported by The Directorate of Fisheries. Raw data are available at altinn.no.

Statistics Norway has sales statistics for farmed trout and salmon. These show an increase in fish farming activities since 1995, which have led to increases in discharges from fish farming despite improvements in treatment yield and production procedures.

The waste from aquaculture facilities is predominantly from feed (De Pauw and Joyce, 1991: Pillay, 1992; Handy and Poxton, 1993), and includes uneaten feed (feed waste), undigested feed residues and faecal/excretion products (Cripps, 1993). The main pollutants from aquaculture are organic matter, nitrogen and phosphorus (Cho and Bureau, 1997).

NIVA estimates nitrogen and phosphorus discharges from fish farming according to the HARP Guidelines (Guideline 2/method 1, see Borgvang and Selvik, 2000). The estimates are based on mass balance equations, i.e. feed used (based on P or N content in feed), and fish production (based on P or N content in produced fish).

For more information about details in data reporting and availability see Selvik *et al.* (2007) and Skarbøvik *et al.* (2011). The total nutrient loads from fish farming are estimated using the TEOTIL model, based on the input data described above.

Organic contaminants, information on uncertainties
The method for estimating loads and concentrations of organic contaminants is described in detail in the main report, chapter 2.6.

Estimates of riverine loads of contaminants are the subject of some uncertainty. The issues listed below are all expected to contribute to the overall uncertainty of the estimates in contaminant loads.

- Water discharge data may suffer from some uncertainty and/or bias
- Measurements of the SPM content of the water are based on monthly spot/bottle sampling. In these circumstances, it is expected that values measured at the time of sampling are representative of a much longer period of time. The SPM content of the water can vary substantially and much higher concentrations can sometimes be expected/observed during periods of high flow, i.e. after heavy rainfall events. The type and amount of particulate organic carbon may also vary substantially with time and river flow and this may induce further uncertainty. The type of particulate organic carbon can affect the sorption of organic contaminant to particulate organic matter in surface waters and impact the freely dissolved concentration. Organic carbon normalisation would tend to reduce the variability in contaminant concentrations in SPM.
- Depending on contaminant exchange kinetics between the sampler and water, the concentration of mildly hydrophobic substances in silicone samplers may reach equilibrium with that in water. This means that sampling for these substances is not time-integrative anymore and concentrations measured are not necessarily representative of the entire passive sampler exposure time
- Sampling rates of passive samplers may not be constant throughout the exposure period. Biofouling layer build-up and changes in water hydrodynamics around the samplers may result in sampling rates that vary over the course of the deployment.
- Passive sampling data is not corrected to account for differences in temperature between exposure periods. Deployment temperatures vary between 0 and 20 °C over the course of a year. Higher polymer-water partition coefficients can be expected at lower temperatures.

- The SPM accumulation/pre-concentration step performed by the continuous flow centrifuge may result in SPM samples with a particle size distribution that deviates from that of the water being sampled. It may be that the smallest particles are not retained as efficiently as larger particles by the CFC. This would induce a slight bias in SPM-associated contaminant concentrations and percentage OC measured in the SPM.
- Particle retention in the CFC may not be constant throughout time
- Uncertainty in the extraction and analysis of SPM and silicone rubber samples
- Uncertainty in the estimation of silicone rubber sampling rates

Changes in the Norwegian RID programme over the years

Since the Norwegian RID Programme started in 1990, several changes have been introduced. For this reason, in 2009 the entire Norwegian database was upgraded in order to better reflect the same methodology (Stålnacke *et al.*, 2009). However, not all methodological changes could be adjusted (such as the changes in LOD values over time). Below is an overview of the main changes in the RID methodology.

Changes in the selection and monitoring frequency of the river s monitored monthly
Up until 2013, 10 rivers were samples mainly monthly. In 2008, River Suldalslågen was removed from this selection of 'main rivers', and instead River Vosso was introduced as a new main river. The main reason was that River Suldalslågen is heavily modified by hydropower developments, and the load in this river does therefore not represent an unmodified watershed in this region. River Vosso, on the other hand, fitted well into the category of 'relatively unpolluted river' with a population density of 1.1 persons/km^2, and only 3% of the catchment area used for agriculture. The river is situated in the same maritime region as River Suldalslågen.

In 2008, data from another sampling programme were included in the database for River Glomma, and the number of samples in this river is therefore increased in some, few years. This parallel dataset contains only data for some nutrients and TOC.

In 2013, River Alna in Southern Norway, draining to the Skagerrak Area (Oslo Fjord) was introduced as the 11th river monitored monthly. This River was previously part of the RID programme under the name River Loelva, monitored once a year from 1990 to 2003.

Changes in the selection and monitoring frequency of the rivers monitored four times a year
The term 'tributary' is only used to signify that these rivers are sampled less frequently than the main rivers, as they all drain directly into the sea.

In the period 1990-2003, 145 'tributary' rivers were sampled once a year only. In 2004, the number of 'tributary rivers' was reduced to 36 rivers which were sampled four times a year. The remaining 109 rivers, formerly monitored once a year since 1990, were no longer sampled. One of these, River Alna, was included again in 2013 as a river monitored monthly.

Changes in load calculation methods
Several changes have been made in the calculation of loads; these are thoroughly described in Stålnacke *et al.* (2009). The present database is now based on a common method that is now the standard method in the Norwegian RID Programme.

The former method multiplied a flow-weighted annual concentration with the total annual discharge (i.e., total annual water volume) in accordance with the OSPAR JAMP Guidelines. For various reasons, the sampling is not always conducted at regular time intervals and in some cases also monthly data are missing. Thus, it was decided that it would be better to weight each sample not only by water discharge but also to the time period the sample represented. These time periods were defined by the midpoints between the samples. Note that the formula is used only within one year, i.e., the time period for a sample is never extended into another year. The modified load calculation formula is shown below.

$$Load = Q_r \frac{\sum_{1}^{n} Q_i \bullet C_i \bullet t_i}{\sum_{1}^{n} Q_i \bullet t_i}$$

where Q_i represents the water discharge at the day of sampling (day i);
C_i the concentration at day i;
t_i the time period from the midpoint between day i-1 and day i to the midpoint between day i and day i+1, i.e., half the number of days between the previous and next sampling;
Q_r is the annual water volume.

Changes in laboratories, parameters, methods and detection limits
During 1990-1998 the chemical analyses for the RID Programme were conducted at the NIVA-lab. In the period 1999-2003 the analyses were carried out by Analycen (now: EuroFins). In 2004 NIVA-lab resumed analysing the samples.

Changes in detection limits and laboratory analysis methods have been reported in each annual report and are not included here. However, changes in detection limits have been duly taken into account in the trend analyses.

In 2013, silver (Ag) was introduced as a new parameter in the programme. The same year, lindane and PCB (which had been monitored in the rivers sampled monthly) were omitted from regular the programme.

From 2013, also, Rivers Alna, Glomma and Drammenselva were monitored for organic contaminants, as well as high-frequency turbidity, conductivity, temperature and pH recordings through sensor data. Temperature monitoring was also started in the remaining 44 rivers, using different types of methodology.

Changes in methods concerning direct discharges
In 2008 a new method to calculate the direct discharges was introduced, and used on all years since 1990, as described in Stålnacke *et al.* (2009). Basically, the new method calculates the discharges from a plant whenever data are lacking and there is no information that the plant has been shut down. This calculation is based on a trend line that is made from data on the former years' discharges. The missing value in the last year will be set equal to the value of the trend line in the former year (or the year with the most recent data).

Several industrial point sources that had huge discharges of sediments were excluded from the reporting in 2008. The reason was that these did not represent particle pollution to the coastal areas since the sediments were disposed of in very restricted dumping tips. This significantly reduced sediment inputs to the Norwegian maritime areas as compared to former years.

The loads from fish farming were first included in the grand total values in 2000, i.e. originally these loads were not included in the input figures for the period 1990-1999. However, in the recalculation project in 2007 a time series for nitrogen, phosphorus and copper from aquaculture, was established, covering the entire period from 1990 to 2007 (see Stålnacke *et al.*, 2009). Then, in 2011 another adjustment was made: Over the years the nutrient content in fish fodder has been reduced. In 2011 a table showing changes in nutrient content over the period 2000-2010 was established (see Skarbøvik *et al.*, 2011). As a result, nutrient loads were adjusted from the year 2000 onwards.

Since organic contaminants is only monitored in three rivers from the 2013, direct discharges of these substances are no longer reported. Previously such estimates were reported for sewage effluents of PCB7, but these were considered highly uncertain, as only the biggest treatment plants (>50.000 p.e.) are required to report this.

References for this Appendix

Beldring, S. 2002. Runoff generating processes in boreal forest environments with glacial tills. Nordic Hydrology, 33, 347-372.

Beldring, S., Engeland, K., Roald, L.A., Sælthun, N.R. and Voksø, A. 2003. Estimation of parameters in a distributed precipitation-runoff model for Norway. Hydrology and Earth System Sciences, 7, 304-316.

Bergström, S. 1995. The HBV model. In: Singh, V.P. (Ed.), Computer Models of Watershed Hydrology. Water Resources Publications, Highlands Ranch, 443-476.

Borgvang, S.A. and Selvik, J.R. 2000. Development of HARP Guidelines; Harmonised Quantification and Reporting Procedures for Nutrients. SFT Report 1759-2000. ISBN 82-7655-401-6. 179 pp.

Cho, C.Y. and Bureau, D.P. 1997. Reduction of waste output from salmonid aquaculture through feeds and feeding. The Progressive Fish Culturist, 59, 155-160.

Cripps, S.J. 1993. The application of suspended particle characterisation techniques to aquaculture systems In: Techniques for Modern Aquaculture (Ed. J-W wang), pp 26-34. Proceedings of an Aquacultural Engineering Conference, 21-23 June, Spokane, Washington, USA.

Daly, C., Neilson. R.P. and Phillips, D.L. 1994. A statistical-topographic model for mapping precipitation over mountainous terrain. Journal of Applied Meteorology, 33, 140-158.

De Pauw, N. and Joyce, J. 1991. Aquaculture and the Environment, AAS Spec. Publication No. 16, Gent, Belgium 53 pp.

Doherty, J., Brebber, L. and Whyte, P. 1998. PEST. Model independent parameter estimation. Watermark Computing, 185 pp.

Farestveit, T., Bratli, J.L., Hoel, T. and Tjomsland, T. 1995. Vurdering av tilførselstall for fosfor og nitrogen til Nordsjøen fra kommunalt avløp beregnet med TEOTIL. Grøner/NIVA-Report no. 171441.

Gottschalk, L., Beldring, S., Engeland, K., Tallaksen, L., Sælthun, N.R., Kolberg, S. and Motovilov, Y. 2001. Regional/macroscale hydrological modelling: a Scandinavian experience. Hydrological Sciences Journal, 46, 963-982.

Handy, R.D. and Poxton, M.G. 1993. Nitrogen pollution in mariculture: toxicity and excretion of nitrogenous compounds by marine fish Reviews in Fish Biology and Fisheries, 3, 205-41.

Matheussen, B., Kirschbaum, R.L., Goodman, I.A., O'Donnel, G.M., Lettenmaier, D.P. 2000. Effects of land cover change on streamflow in the interior Columbia River Basin (USA and Canada). Hydrological Processes, 14, 867-885.

PARCOM 1988. Tenth Meeting of the Paris Commission- PARCOM 10/3/2. Lisbon 15-17 June 1988.

Pillay, T.V.R. 1992. Aquaculture and the Environment Fishing News Book, Oxford.

Selvik, J.R., Tjomsland, T. and Eggestad, H.O. 2007. Tilførsler av næringssalter til Norges kystområder i 2006. beregnet med tilførselsmodellen TEOTIL. Norwegian State Pollution Monitoring Programme. NIVA Rapport 5512-2007.

Skarbøvik, E., Stålnacke, P., Selvik, J.R., Aakerøy, P.A., Høgåsen, T., and Kaste, Ø. 2011. Elvetilførselsprogrammet (RID) – 20 års overvåking av tilførsler til norske kystområder (1990-2009). NIVA-rapport 6235-2011. Klima- og forurensningsdirektoratet TA-2857/2011; 55 s.

Stålnacke, P., Haaland, S., Skarbøvik, E., Turtumøygard, S., Nytrø, T.E., Selvik, J.R., Høgåsen, T., Tjomsland, T., Kaste, Ø. and Enerstvedt, K.E. 2009. Revision and assessment of Norwegian RID data 1990-2007. Bioforsk Report Vol. 4 No. 138. SFT report TA-2559/2009. 20p.

Sælthun, N.R. 1996. The Nordic HBV model. Norwegian Water Resources and Energy Administration Publication 7, Oslo, 26 pp.

Appendix V Long-term trends in riverine loads.

Complementary charts to Chapter 3; and overview of all trend tables for loads (including lower estimates).

Trend charts for loads are shown both for upper and lower estimates. Some of these charts are also shown in the report but they are collated here for the purpose of visualising an overview of the trends.

The charts cover the following substances in consecutive order:

- Water discharge (Q)
- Total-N
- Nitrate-N (NO_3-N)
- Ammonium-N (NH_4-N)
- Total-P
- Orthophosphate (PO_4-P)
- Suspended particulate matter (SPM)
- Copper (Cu)
- Lead (Pb)
- Zinc (Zn)
- Cadmium (Cd)
- Mercury (Hg)
- Arsenic (As)
- PCB7
- Lindane (g-HCH)

Extra- or interpolated values are indicated with different colours. The substances where such extra- or interpolation has been performed include total-P, ammonium-N (NH_4-N), mercury (Hg), arsenic (As) and PCB7.

The common legend for the trend tests in the tables below is shown here:

	Significant downward (p<0.05)
	Downward but not significant (0.05<p<0.1)
	Significant upward (p<0.05)
	Upward but not significant (0.05<p<0.1)

Table A.V.1a. Trends in annual water discharge (Q; estimated from daily measurements), nutrient and particle loads (upper estimates; upper and lower estimates given for orthophosphate) in nine Norwegian main rivers in the last 10 years (2004- 2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS, 10-years

River	Q	NH_4-N	NO_3-N	Tot-N	PO_4-P(1)	PO_4-P(2)	Tot-P	SPM
Glomma	0.0095	0.9462	0.5662	0.6753	0.6042	0.6042	0.4964	0.8009
Drammenselva	0.0397	0.8251	0.8593	0.7943	0.5341	0.5341	0.6458	0.7029
Numedalslågen	0.3252	0.0789	0.3066	0.7106	0.2247	0.2247	0.3424	0.7198
Skienselva	0.2449	0.5065	0.0804	0.5014	0.3203	0.2683	0.6235	0.5899
Otra	0.2449	0.2059	0.0716	0.4489	0.6140	0.8986	0.6878	0.0569
Orreelva	0.3252	0.5034	0.0947	0.2742	0.3398	0.3398	0.2724	0.3569
Orkla	0.5312	0.6289	0.8700	0.1385	0.5213	0.6703	0.3143	0.7348
Vefsna	0.9287	0.0561	0.9740	0.0326	0.9517	0.6576	0.8668	0.9640
Altaelva	0.5312	0.9832	0.2047	0.1951	0.3192	0.2635	0.0720	0.5311

PO_4-P(1) – upper estimates

PO_4-P(2) – lower estimates

Table A.V.1b. Long-term trends in annual water discharge (Q; estimated from daily measurements), nutrient and particle loads (upper estimates; upper and lower estimates given for orthophosphate) in nine Norwegian main rivers 1990- 2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS, long-term

River	Q	NH_4-N	NO_3-N	Tot-N	PO_4-P(1)	PO_4-P(2)	Tot-P	SPM
Glomma	0.0256	0.0007	0.7911	0.4241	0.9597	0.9971	0.2145	0.2484
Drammenselva	0.0064	0.1036	0.9625	0.2747	0.3371	0.2846	0.2464	0.2621
Numedalslågen	0.0530	0.5710	0.8283	0.0230	0.3030	0.3323	0.4647	0.3856
Skienselva	0.0741	0.0431	0.0001	0.0038	0.1897	0.9414	0.3850	0.7546
Otra	0.9210	0.2023	<0.0001	0.1520	0.9966	0.0549	0.1126	0.0308
Orreelva	0.1016	0.0767	0.0570	0.5871	0.7538	0.7538	0.4880	0.2402
Orkla	0.4568	0.0153	0.7090	0.4295	0.4579	0.8826	0.1588	0.4795
Vefsna	0.6198	<0.0001	<0.0001	0.0053	0.0610	0.0225	0.0012	0.1692
Altaelva	0.5516	0.0473	0.0314	0.0695	0.0722	0.0394	0.0441	0.2767

PO_4-P(1) – upper estimates

PO_4-P(2) – lower estimates

Table A.V.2a. Trends for metal loads (upper estimates) in nine Norwegian main rivers in the last 10 years (2004-2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS, 10-years, upper estimates

River	Q	Cd	Cu	Ni	Pb	Zn
Glomma	0.0095	0.6118	0.8540	0.7692	0.6466	0.0716
Drammenselva	0.0397	0.4997	0.4062	0.4715	0.8563	0.0962
Numedalslågen	0.3252	0.7930	0.4219	0.4668	0.8868	0.7524
Skienselva	0.2449	0.7983	0.9041	0.1896	0.2897	0.9789
Otra	0.2449	0.0322	0.0428	0.0411	0.0550	0.0105
Orreelva	0.3252	0.9339	0.9796	0.5541	0.3514	0.7423
Orkla	0.5312	0.2451	0.0380	0.8685	0.0495	0.1802
Vefsna	0.9287	0.4576	0.5312	0.4987	0.8327	0.1364
Altaelva	0.5312	0.2470	0.8643	0.4572	0.7560	0.2635

Table A.V.2b. Trends for metal loads (lower estimates) in nine Norwegian main rivers in the last 10 years (2004-2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS, 10-years, lower estimates

River	Q	Cd	Cu	Ni	Pb	Zn
Glomma	0.0095	0.6118	0.8540	0.7692	0.6466	0.0716
Drammenselva	0.0397	0.4785	0.4062	0.4715	0.8563	0.0962
Numedalslågen	0.3252	0.7299	0.4219	0.4668	0.8868	0.7524
Skienselva	0.2449	0.6494	0.9041	0.1896	0.2897	0.9789
Otra	0.2449	0.0815	0.0428	0.0411	0.0550	0.0105
Orreelva	0.3252	0.9339	0.9796	0.5541	0.3514	0.7423
Orkla	0.5312	0.2451	0.0380	0.8685	0.0495	0.1802
Vefsna	0.9287	0.7890	0.5312	0.3857	0.8327	0.1364
Altaelva	0.5312	0.3410	0.8643	0.4572	0.7560	0.2635

Table A.V.3a. Long-term trends for metal loads (upper estimates) in nine Norwegian main rivers 1990-2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS, long-term, upper estimates						
River	Q	Cd	Cu	Ni	Pb	Zn
Glomma	0.0256	0.0017	0.2215	0.0178	0.0044	0.4650
Drammenselva	0.0064	0.0001	0.9659	0.4653	0.3938	0.2441
Numedalslågen	0.0530	0.0013	0.0205	0.1264	0.0099	0.0116
Skienselva	0.0741	0.0002	0.0128	<0.0001	0.4109	0.0098
Otra	0.9210	<0.0001	0.1800	0.0005	0.0119	0.0029
Orreelva	0.1016	0.0259	0.3716	0.0019	0.1115	0.9460
Orkla	0.4568	0.0002	0.0008	0.0085	0.0082	0.0002
Vefsna	0.6198	<0.0001	0.0005	<0.0001	0.0001	0.0004
Altaelva	0.5516	<0.0001	0.0002	0.0010	0.0077	0.3041

Table A.V.3b. Long-term trends for metal loads (lower estimates) in nine Norwegian main rivers 1990-2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

LOADS, long-term, lower estimates						
River	Q	Cd	Cu	Ni	Pb	Zn
Glomma	0.0256	0.1139	0.2215	0.0178	0.0249	0.4650
Drammenselva	0.0064	0.0015	0.9659	0.8851	0.4498	0.2441
Numedalslågen	0.0530	0.0160	0.0205	0.7687	0.0272	0.0116
Skienselva	0.0741	0.0041	0.0143	0.0153	0.5025	0.0098
Otra	0.9210	0.0386	0.1800	0.0004	0.0303	0.0029
Orreelva	0.1016	0.1464	0.3716	0.0019	0.1501	0.9460
Orkla	0.4568	0.0115	0.0008	0.0085	0.0081	0.0002
Vefsna	0.6198	0.0002	0.0005	0.0003	0.0003	0.0010
Altaelva	0.5516	0.0013	0.0002	0.0022	0.3053	0.2785

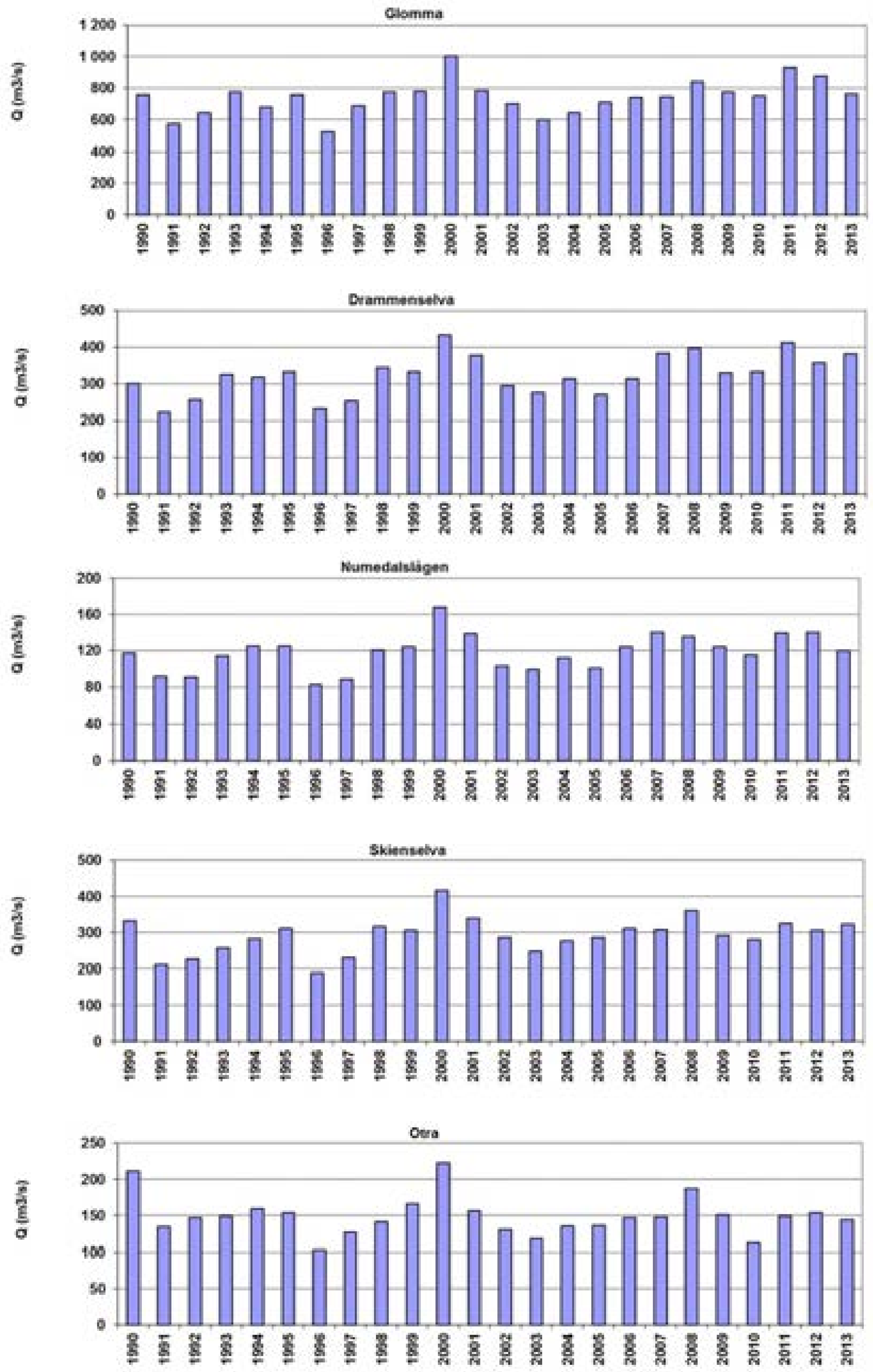


Figure A-V-1a. Annual water discharge (Q) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

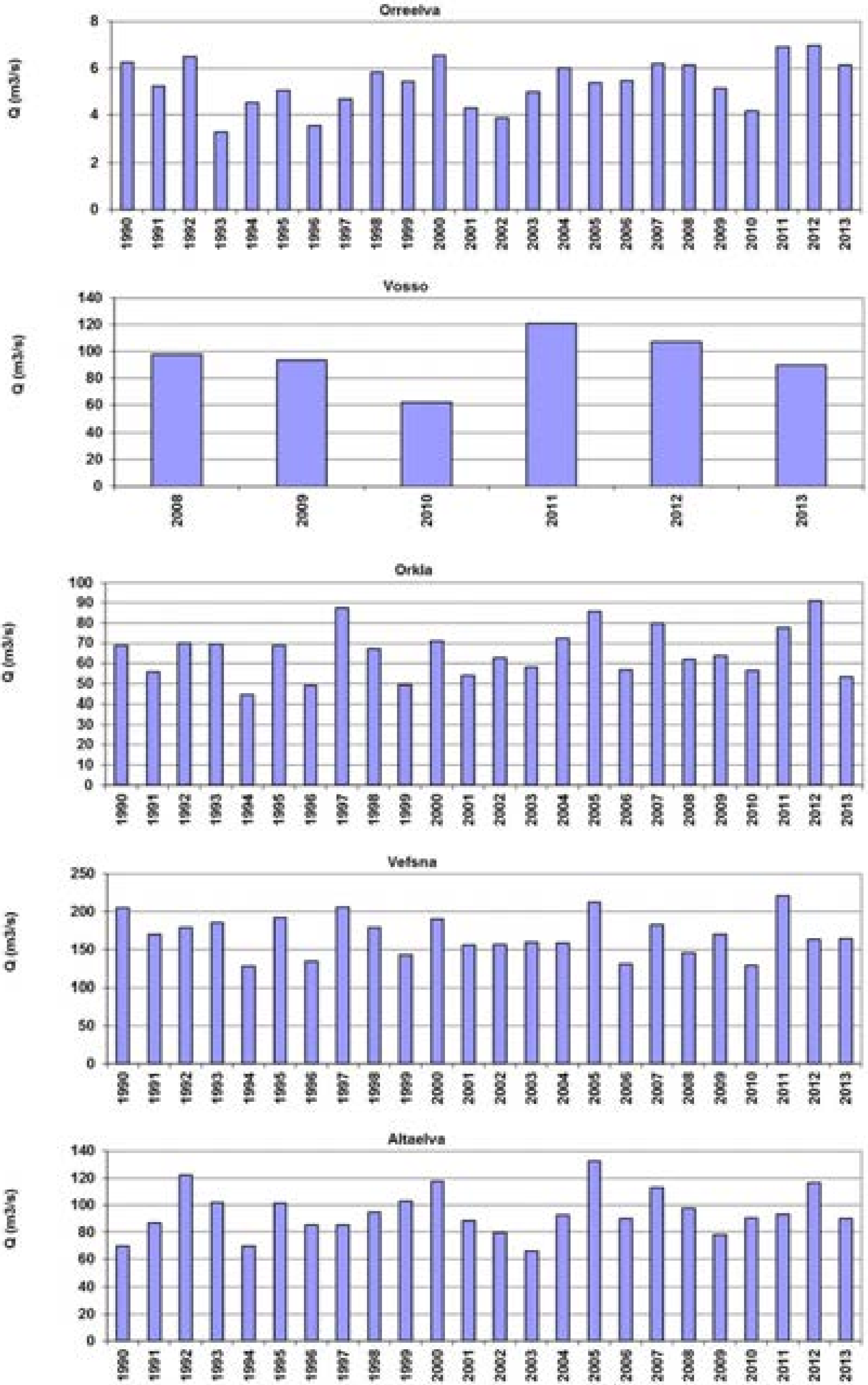


Figure A-V-1b. Annual water discharge (Q) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

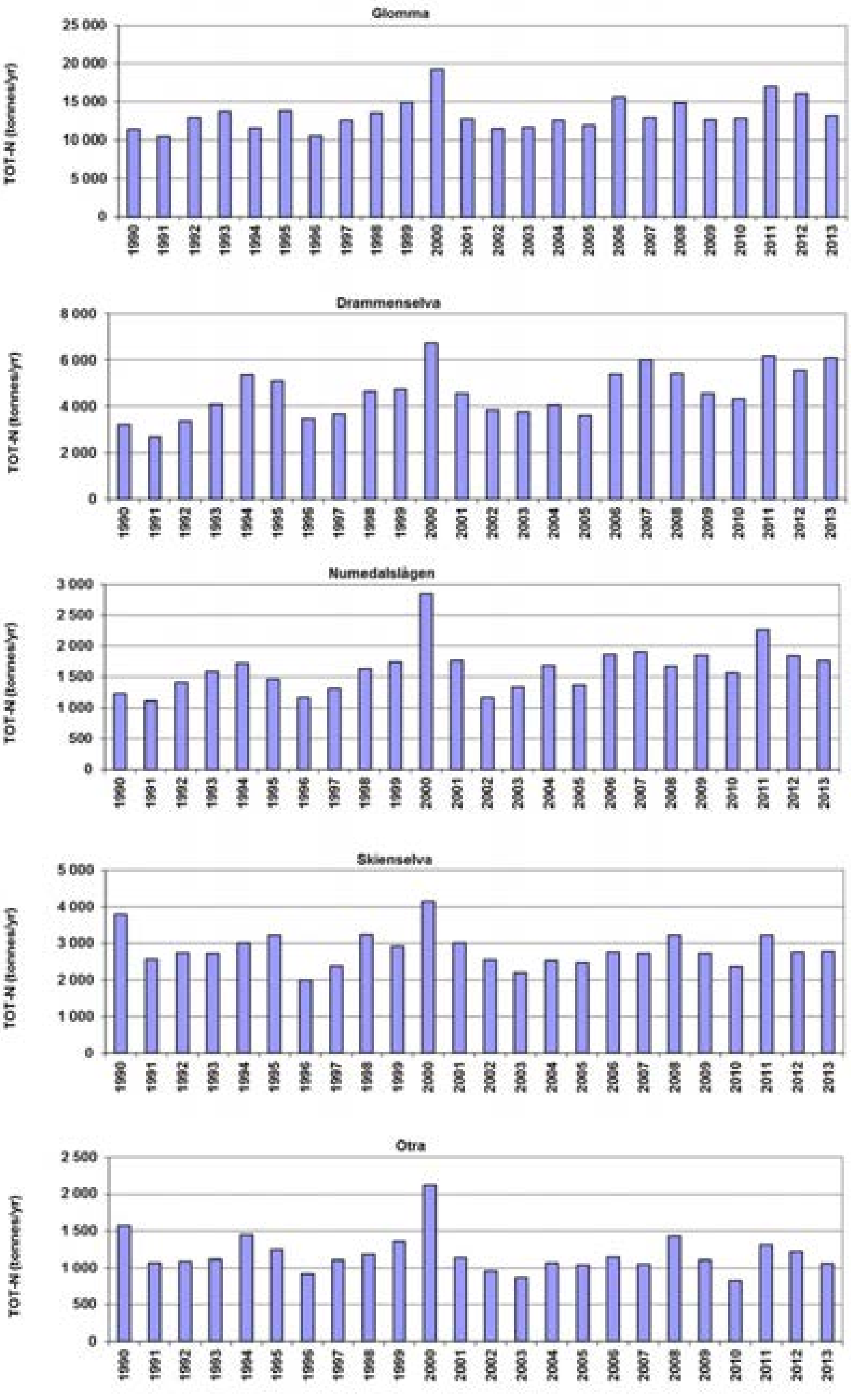


Figure A-V-2a. Annual riverine loads of total nitrogen (Tot-N) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

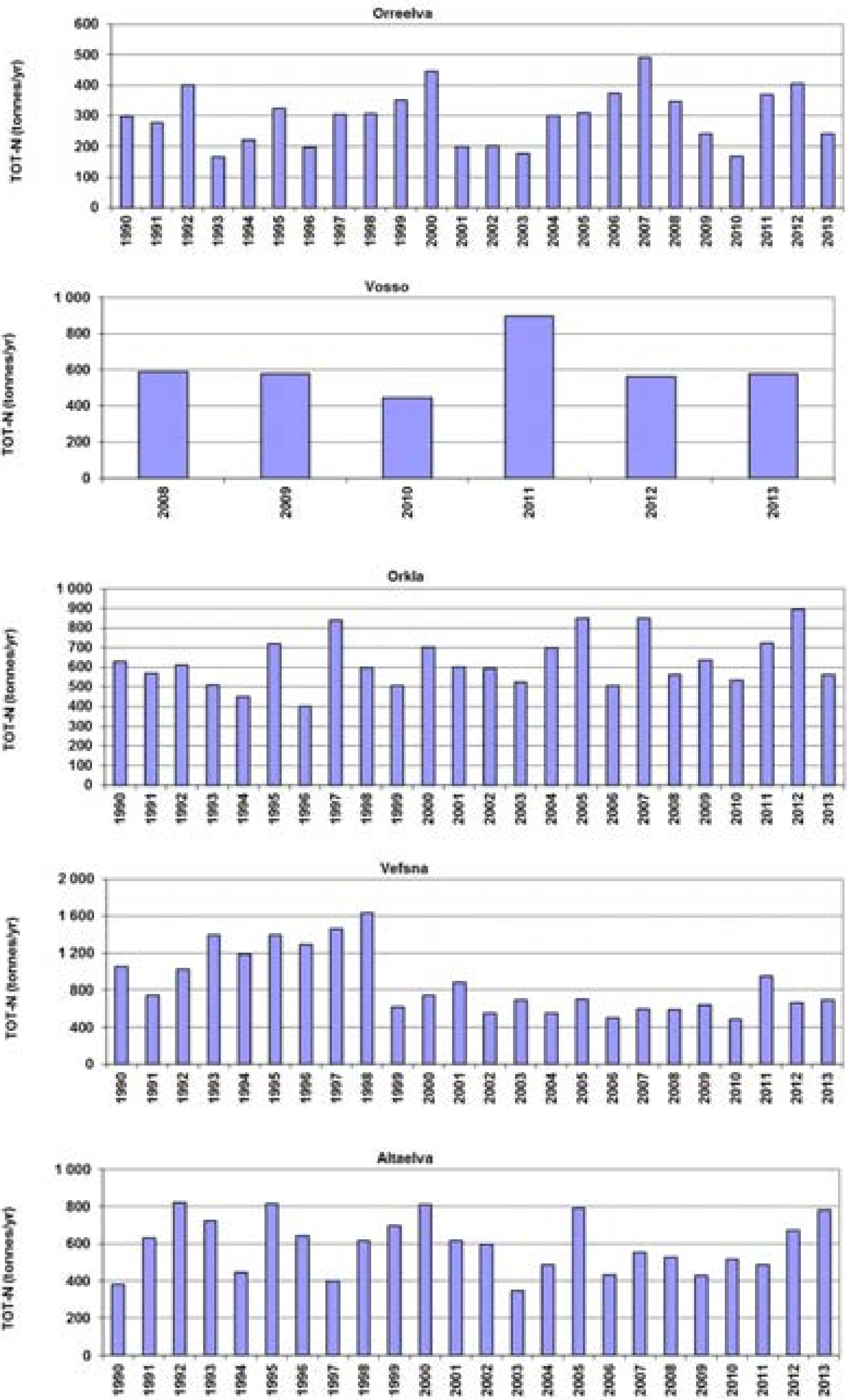


Figure A-V-2b. Annual riverine loads of total nitrogen (Tot-N) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

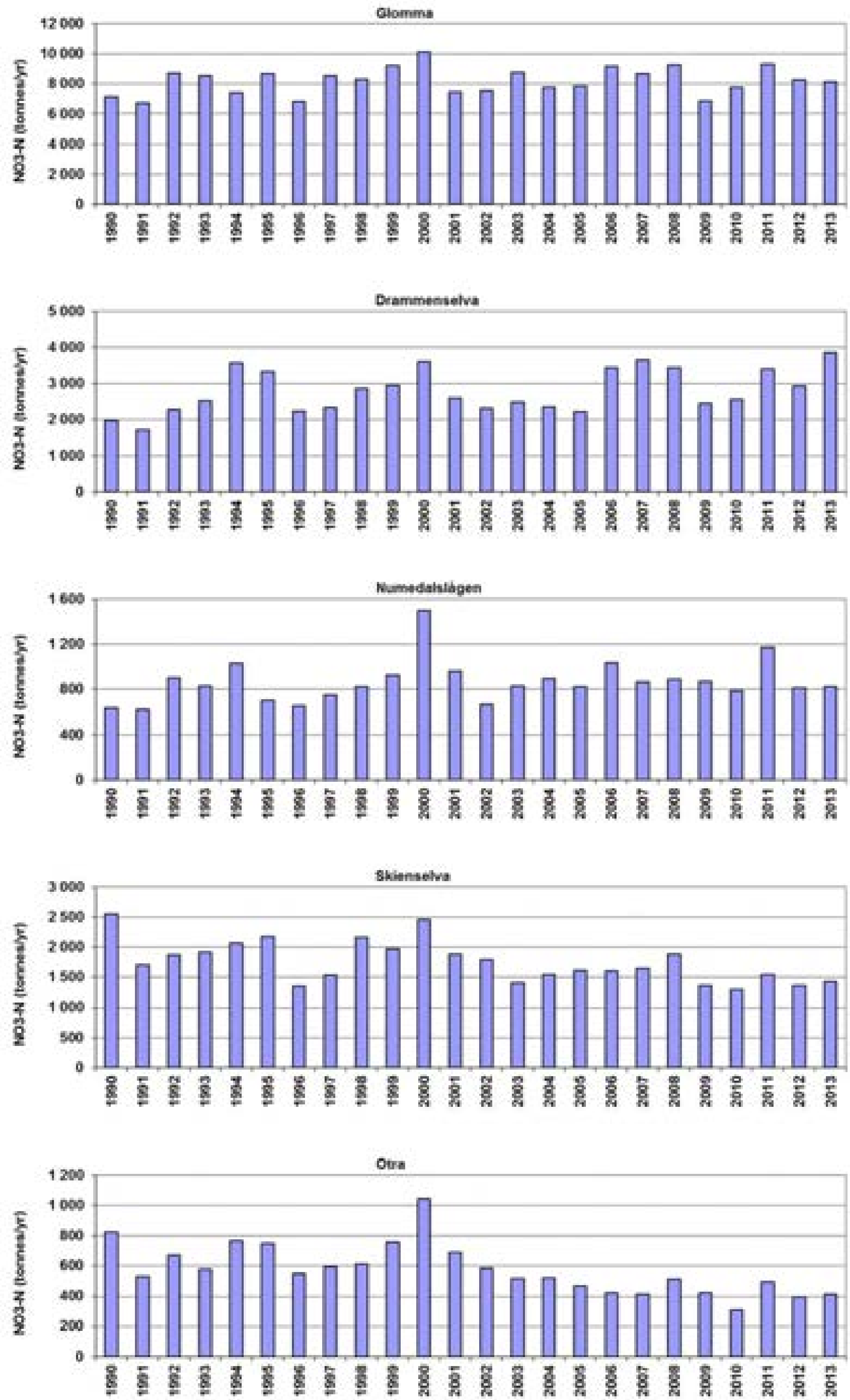


Figure A-V-3a. Annual riverine loads of nitrate-nitrogen (NO_3-N) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

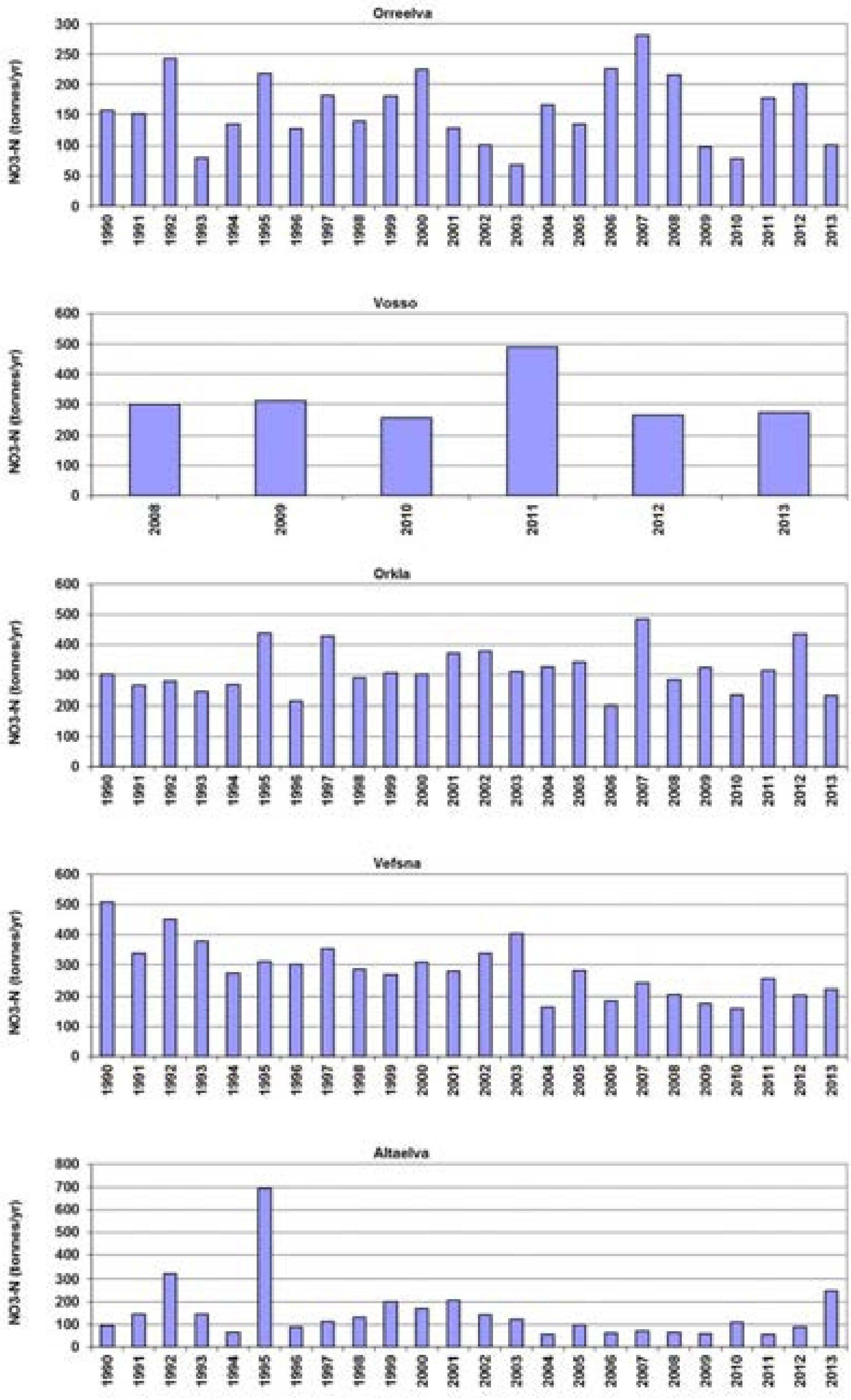


Figure A-V-3b. Annual riverine loads of nitrate-nitrogen (NO_3-N) from four main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

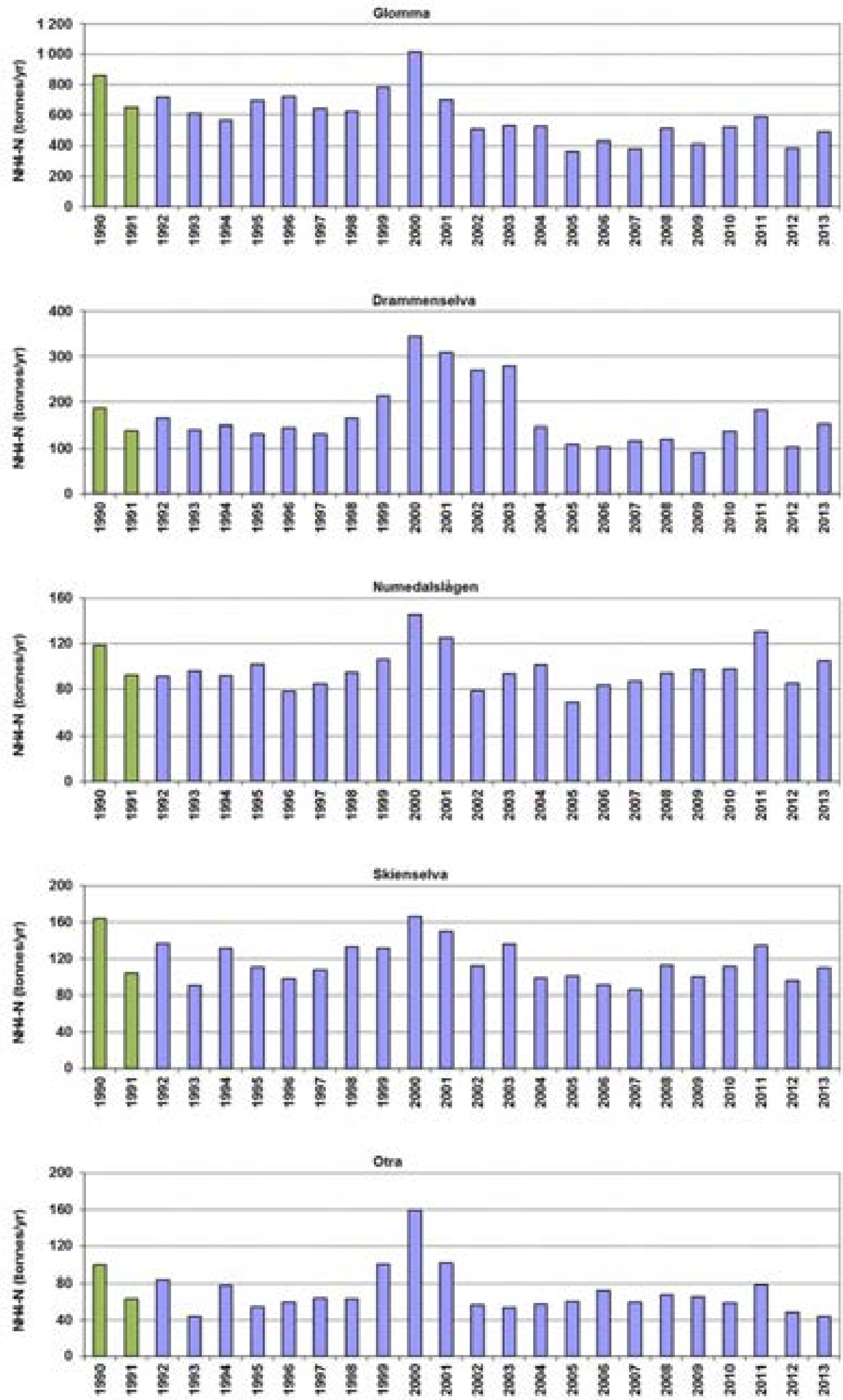


Figure A-V-4a. Annual riverine loads of ammonium-nitrogen (NH_4-N) in the five main rivers draining to Skagerrak, Norway, 1990-2013. Years with extra- or interpolated values are given in green.

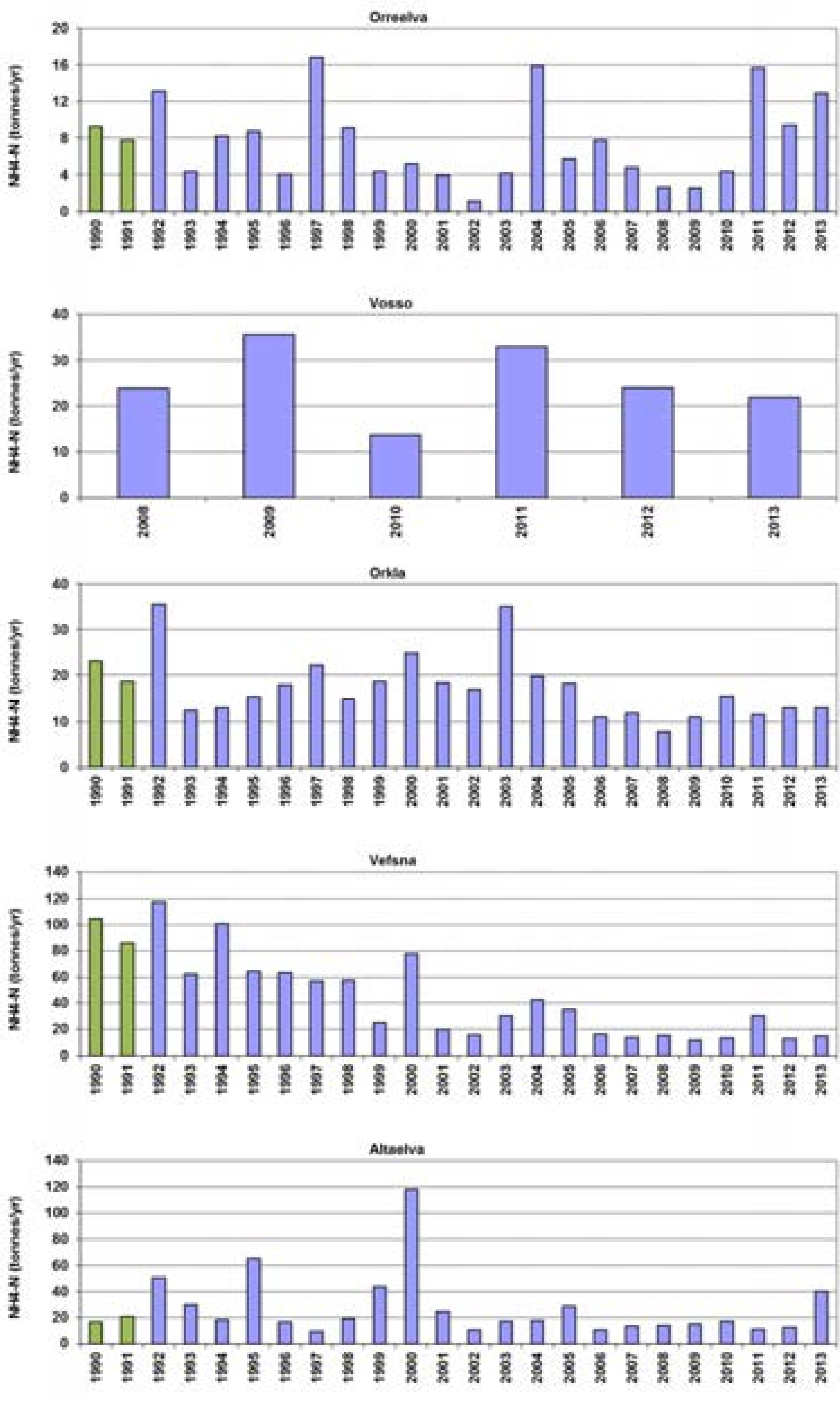


Figure A-V-4b. Annual riverine loads of ammonium-nitrogen (NH_4-N) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso). Years with extra- or interpolated values are given in green.

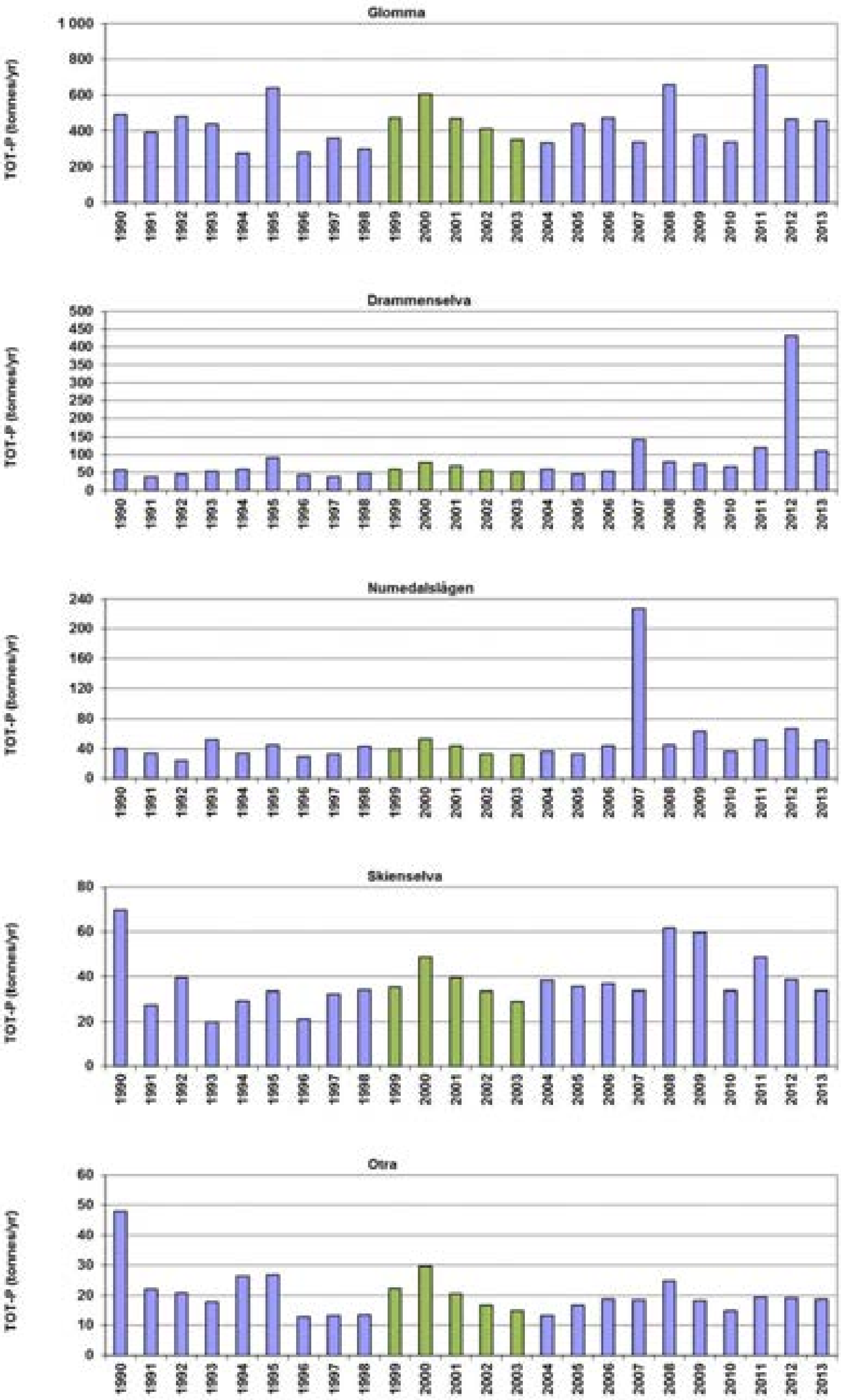


Figure A-V-5a. Annual riverine loads of total phosphorus (Tot-P) in the five main rivers draining to Skagerrak, Norway, 1990-2013. Years with extra- or interpolated values are given in green.

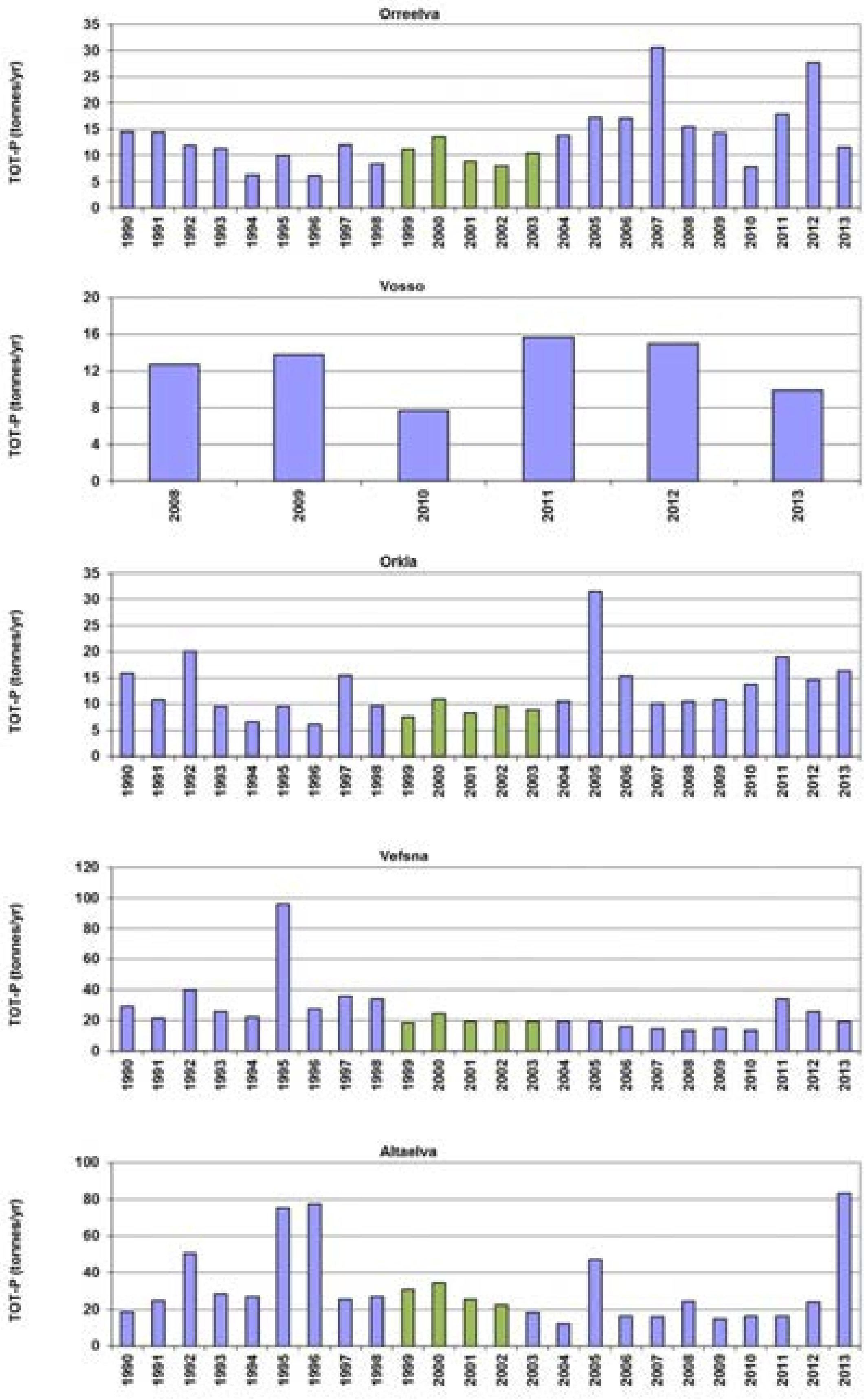


Figure A-V- 5b. Annual riverine loads of total phosphorus (Tot-P) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso). Years with extra- or interpolated values are given in green.

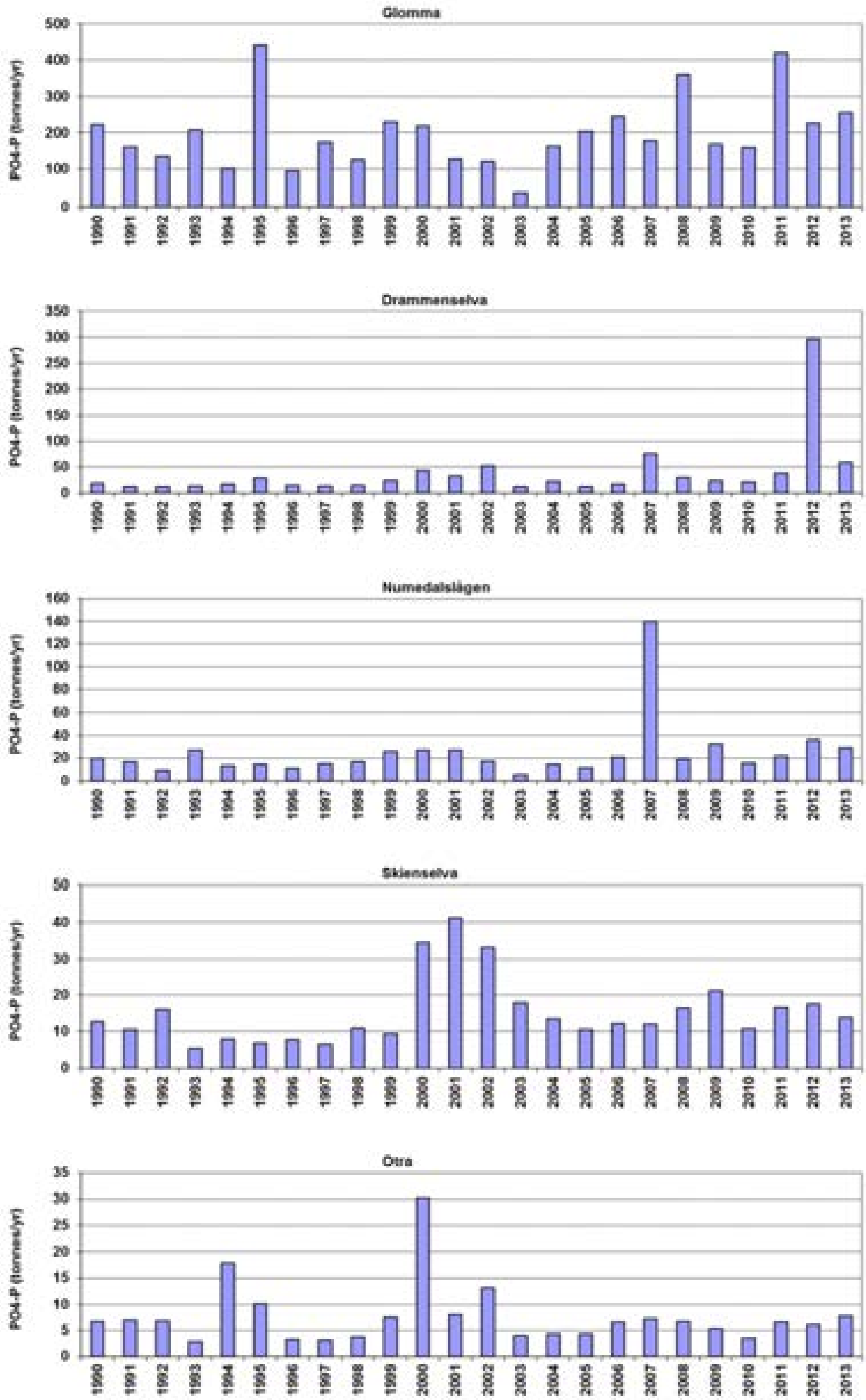


Figure A-V-6a. Annual riverine loads of orthophosphate-phosphorus (PO_4-P) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

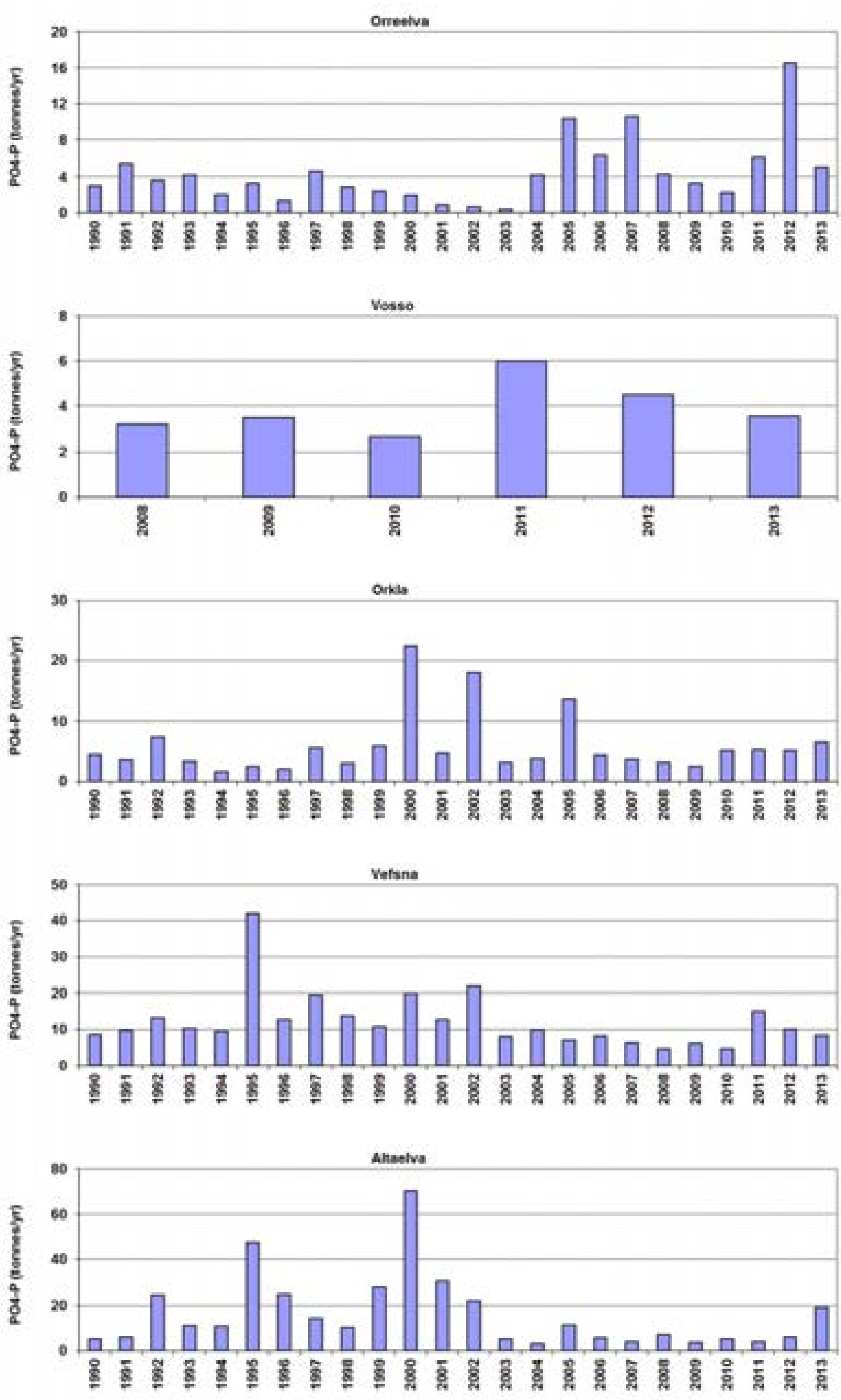


Figure A-V-6b. Annual riverine loads of orthophosphate-phosphorus (PO_4-P) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

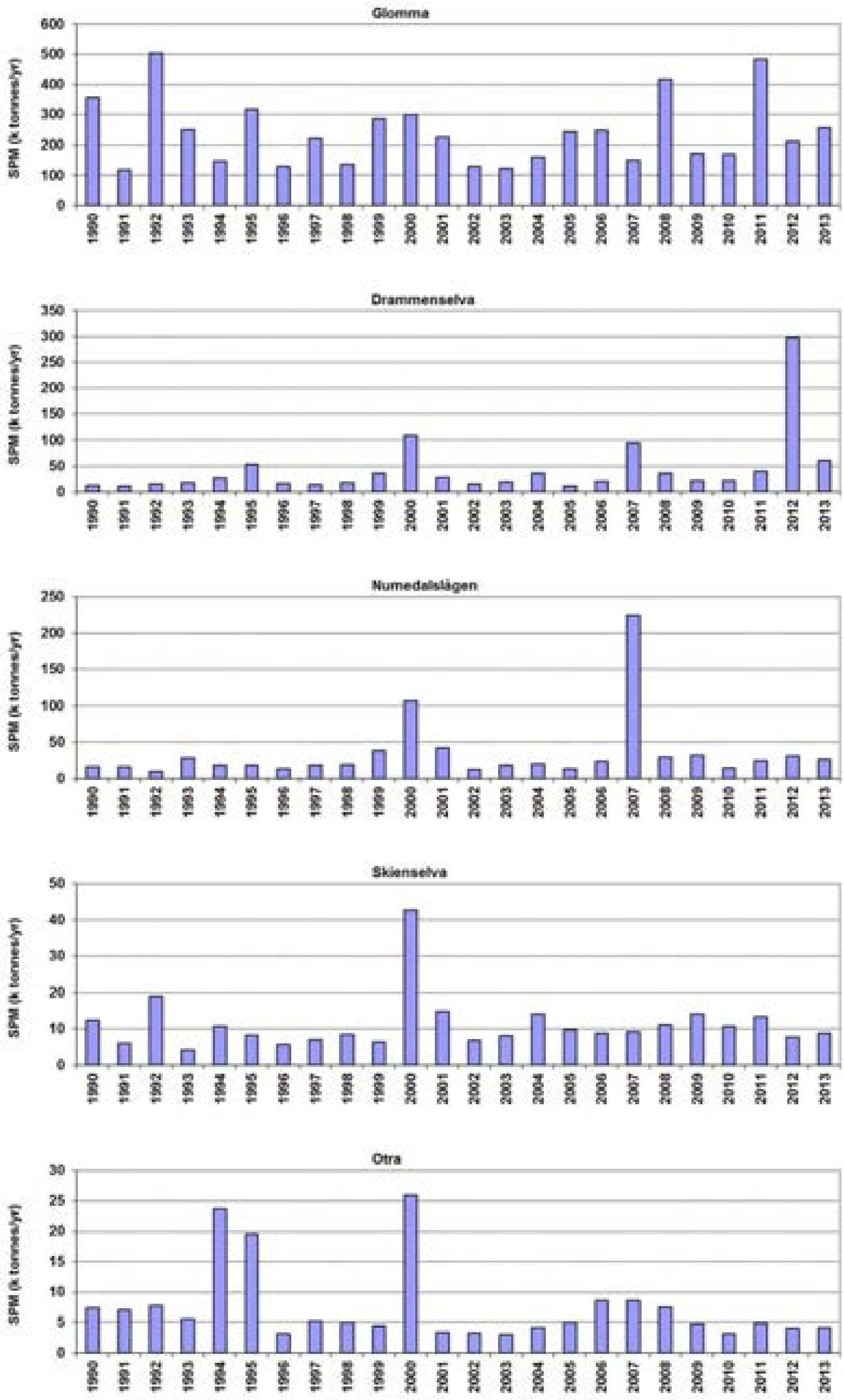


Figure A-V-7a. Annual riverine loads of suspended particulate matter (SPM) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

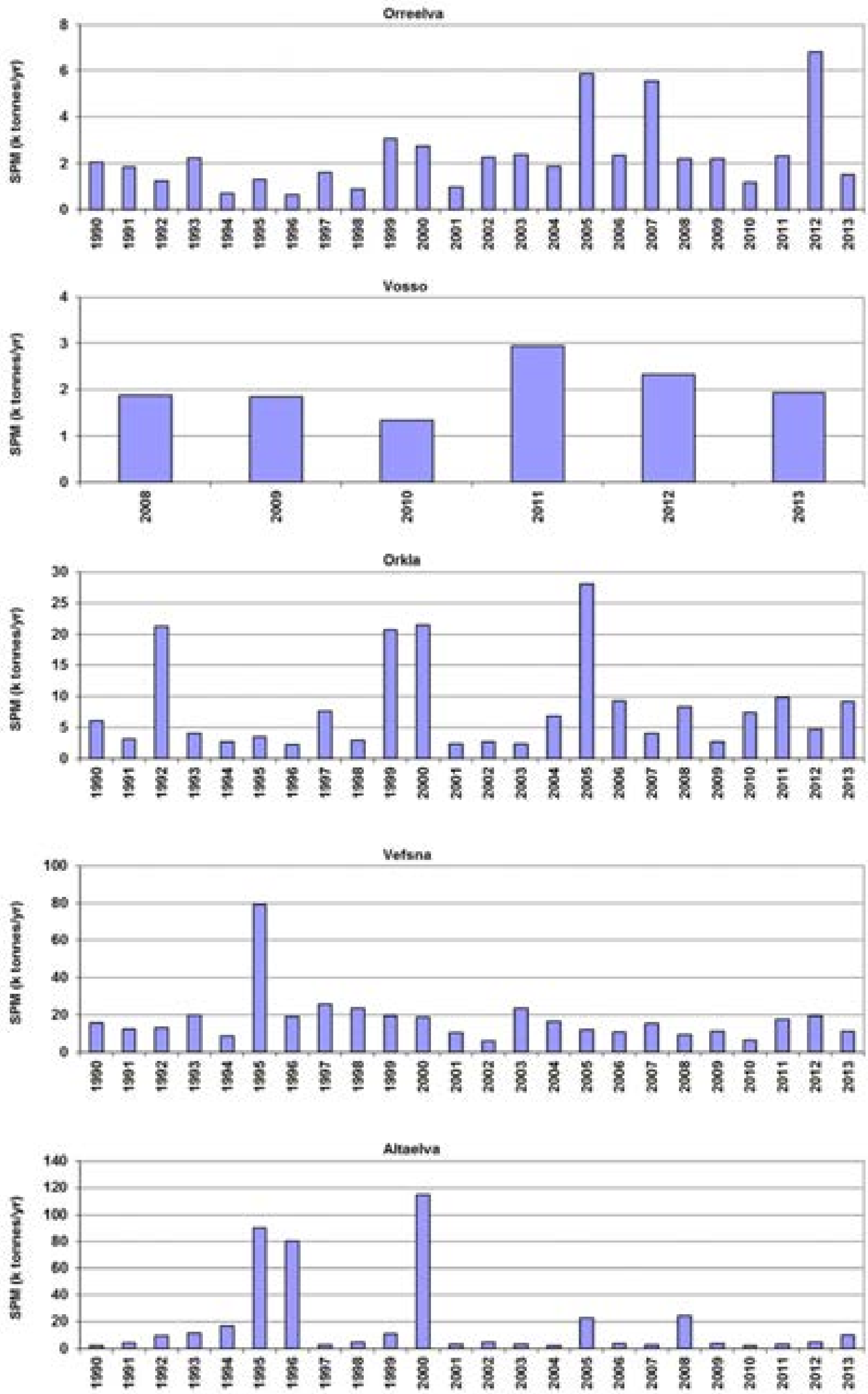


Figure A-V-7b. Annual riverine loads of suspended particulate matter (SPM) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

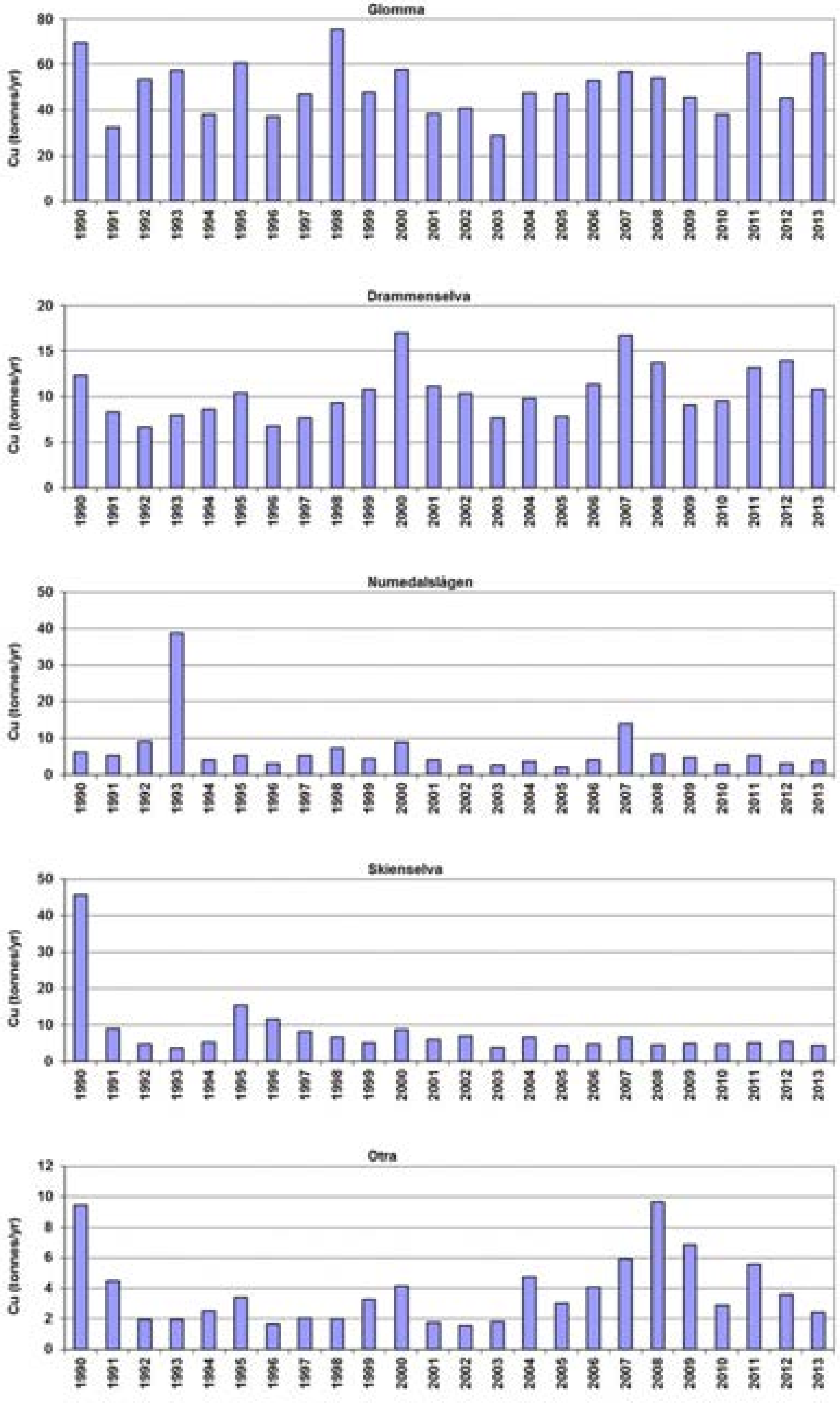


Figure A-V-8a. Annual riverine loads of copper (Cu) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

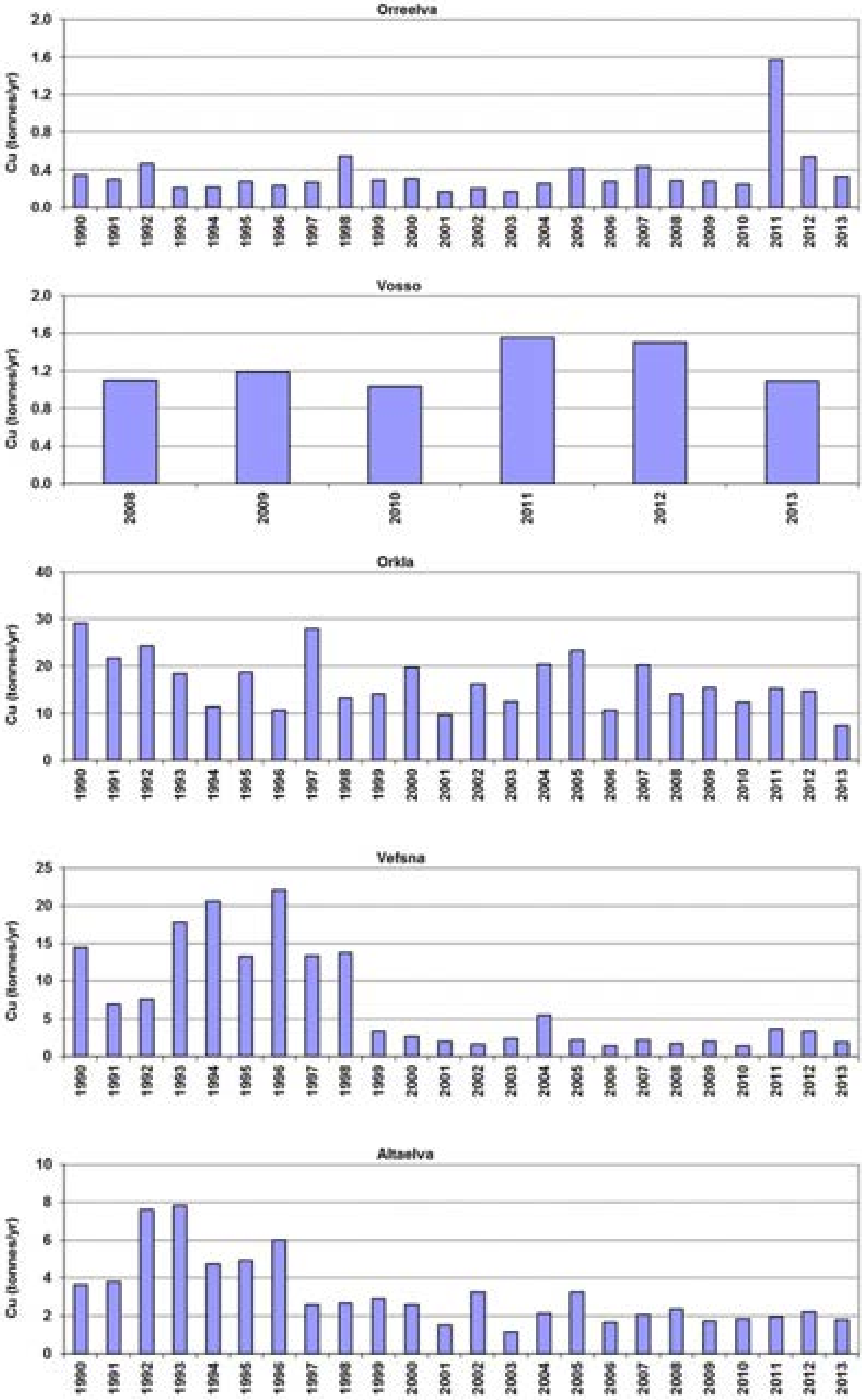


Figure A-V-8b. Annual riverine loads of copper (Cu) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

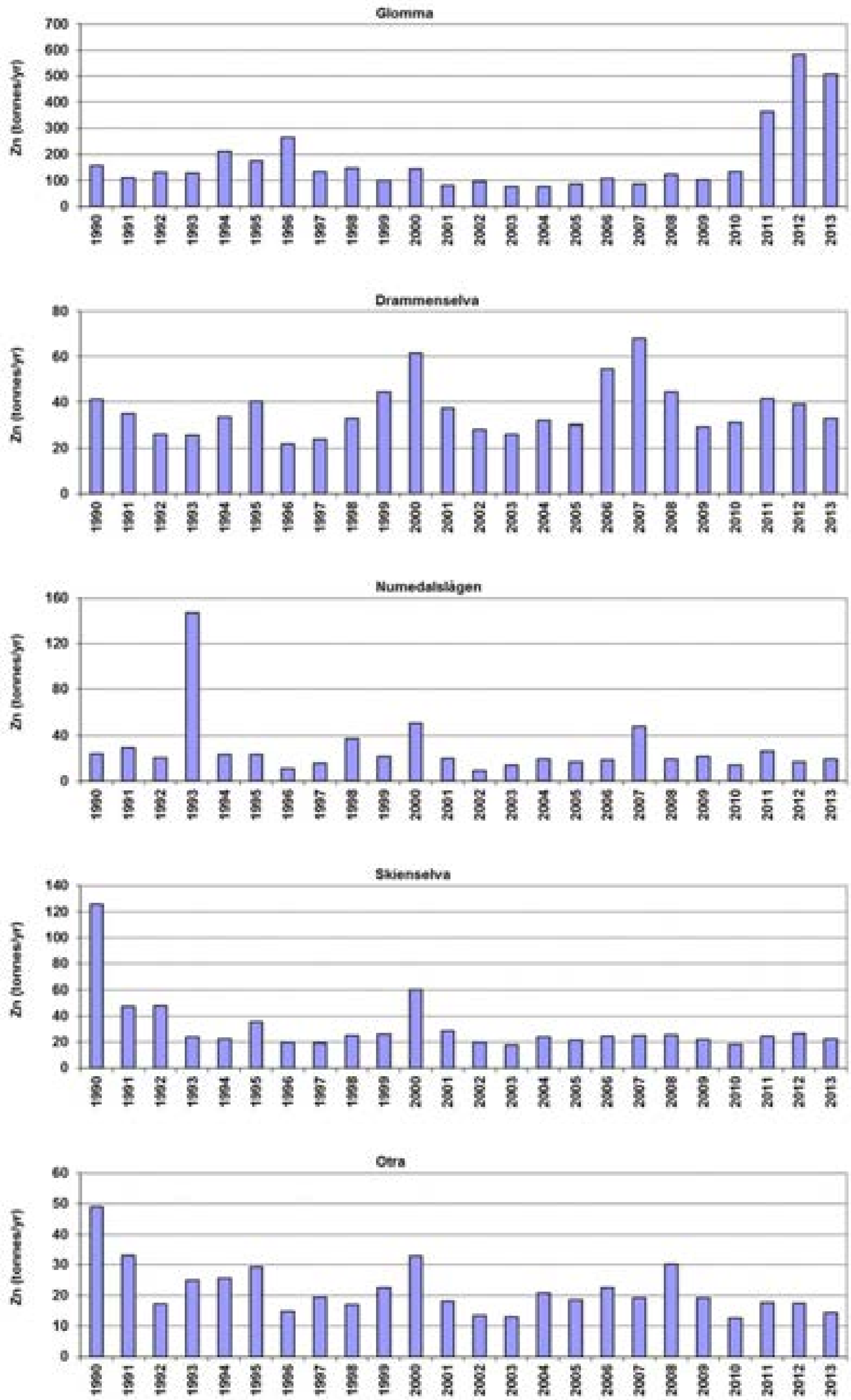


Figure A-V-9a. Annual riverine loads of zinc (Zn) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

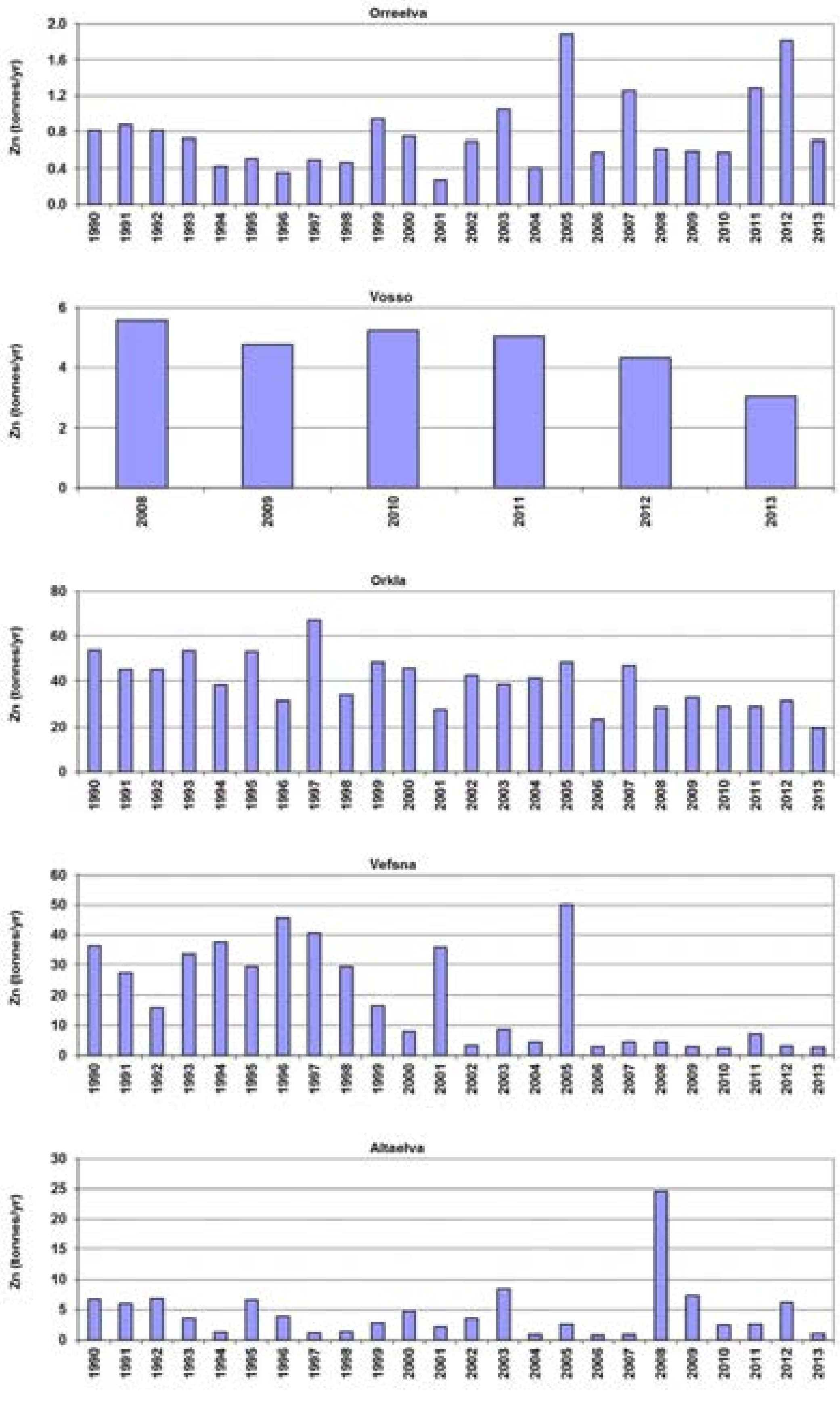


Figure A-V-9b. Annual riverine loads of zinc (Zn) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

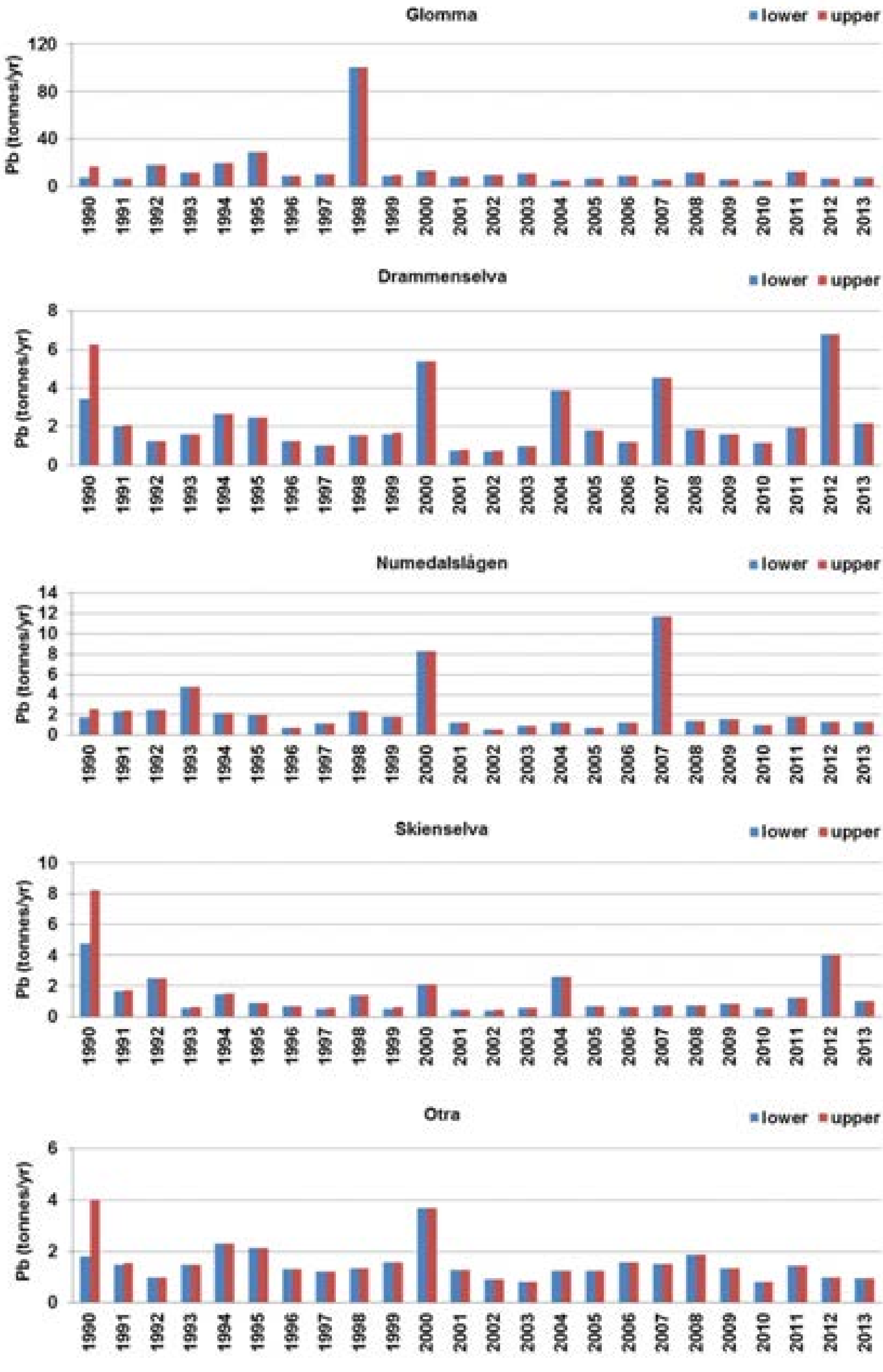


Figure A-V-10a. Annual riverine loads (upper and lower estimates) of lead (Pb) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

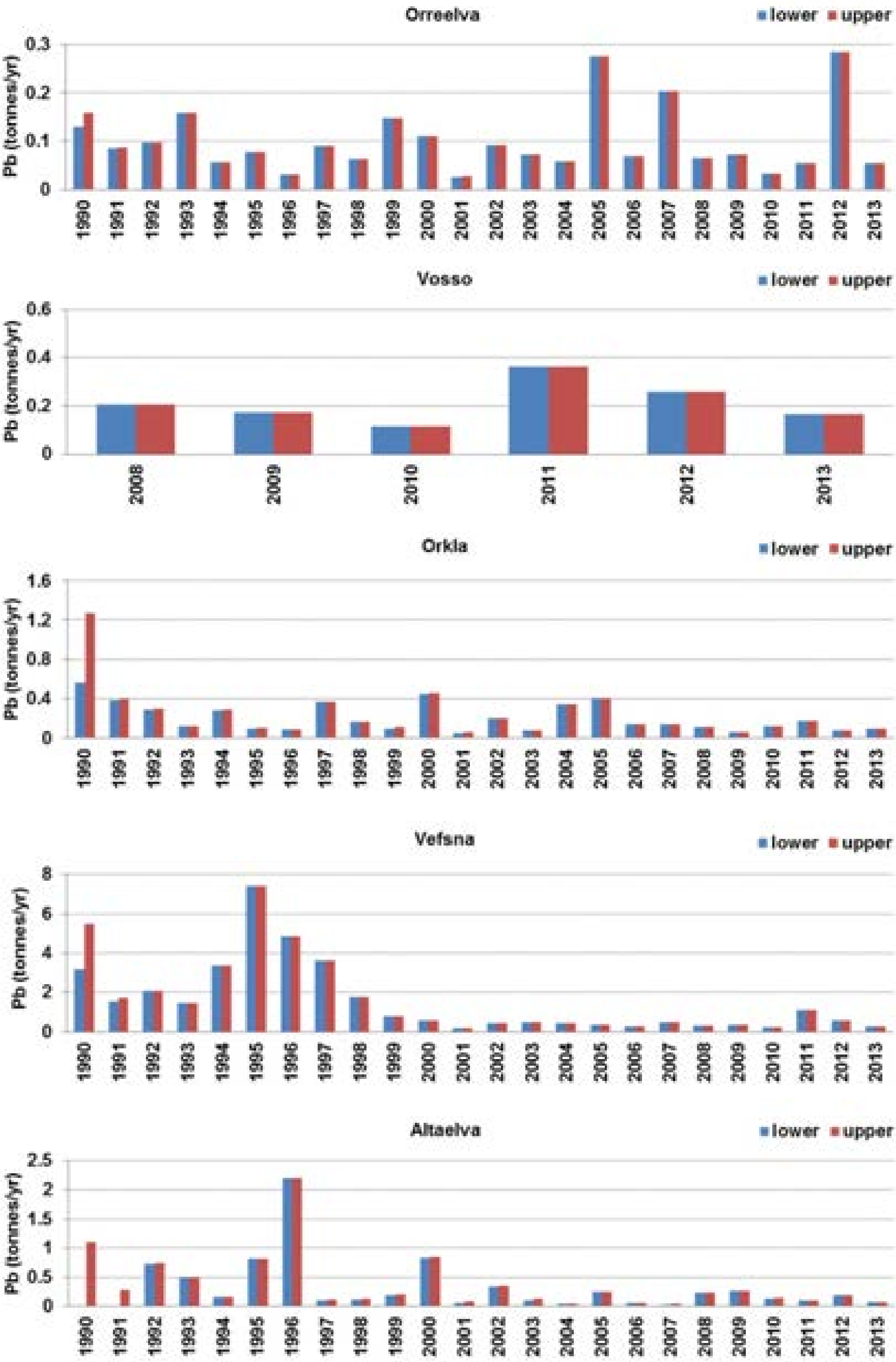


Figure A-V-10b. Annual riverine loads (upper and lower estimates) of lead (Pb) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

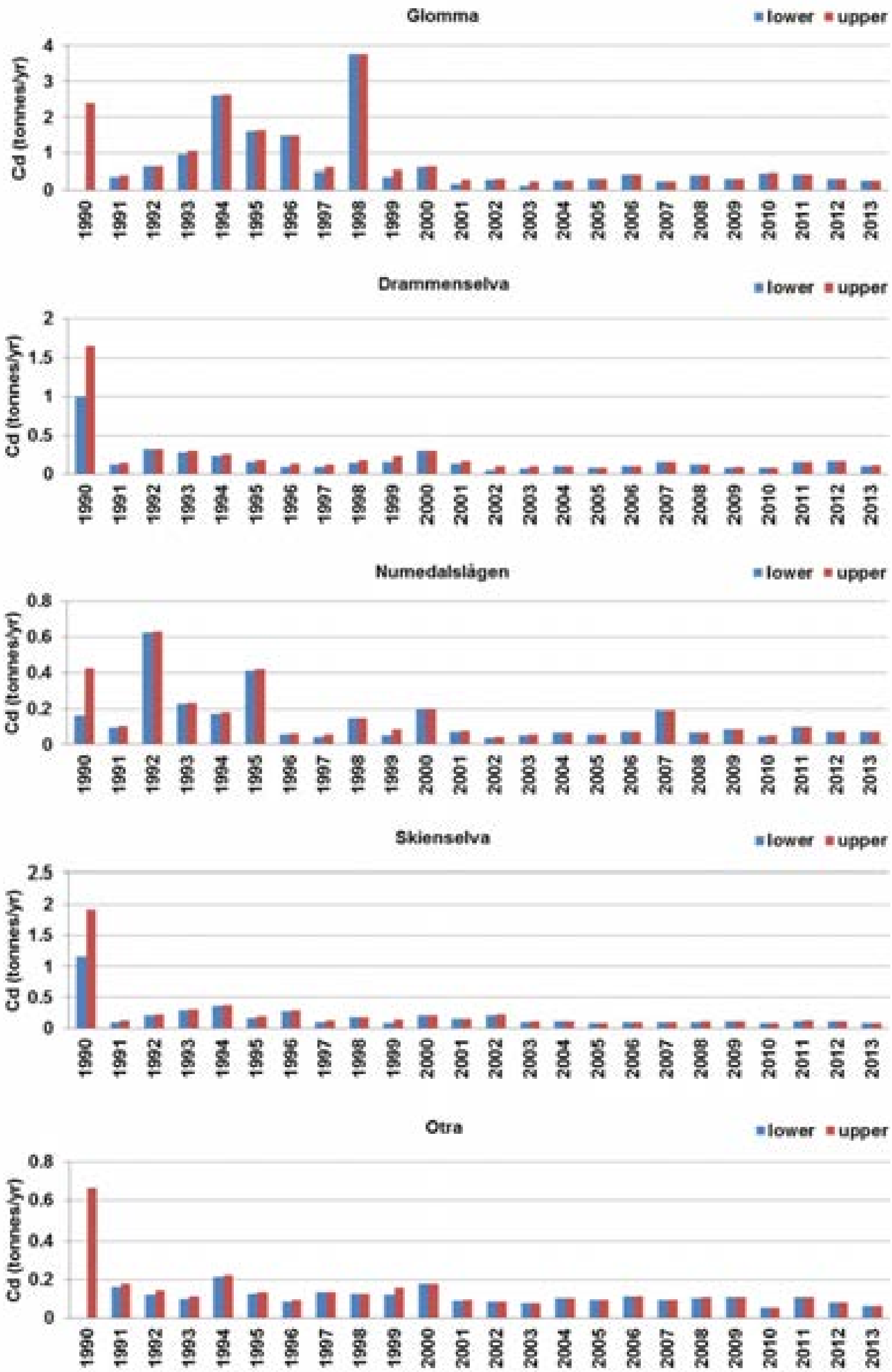


Figure A-V-11a. Annual riverine loads (upper and lower estimates) of cadmium (Cd) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

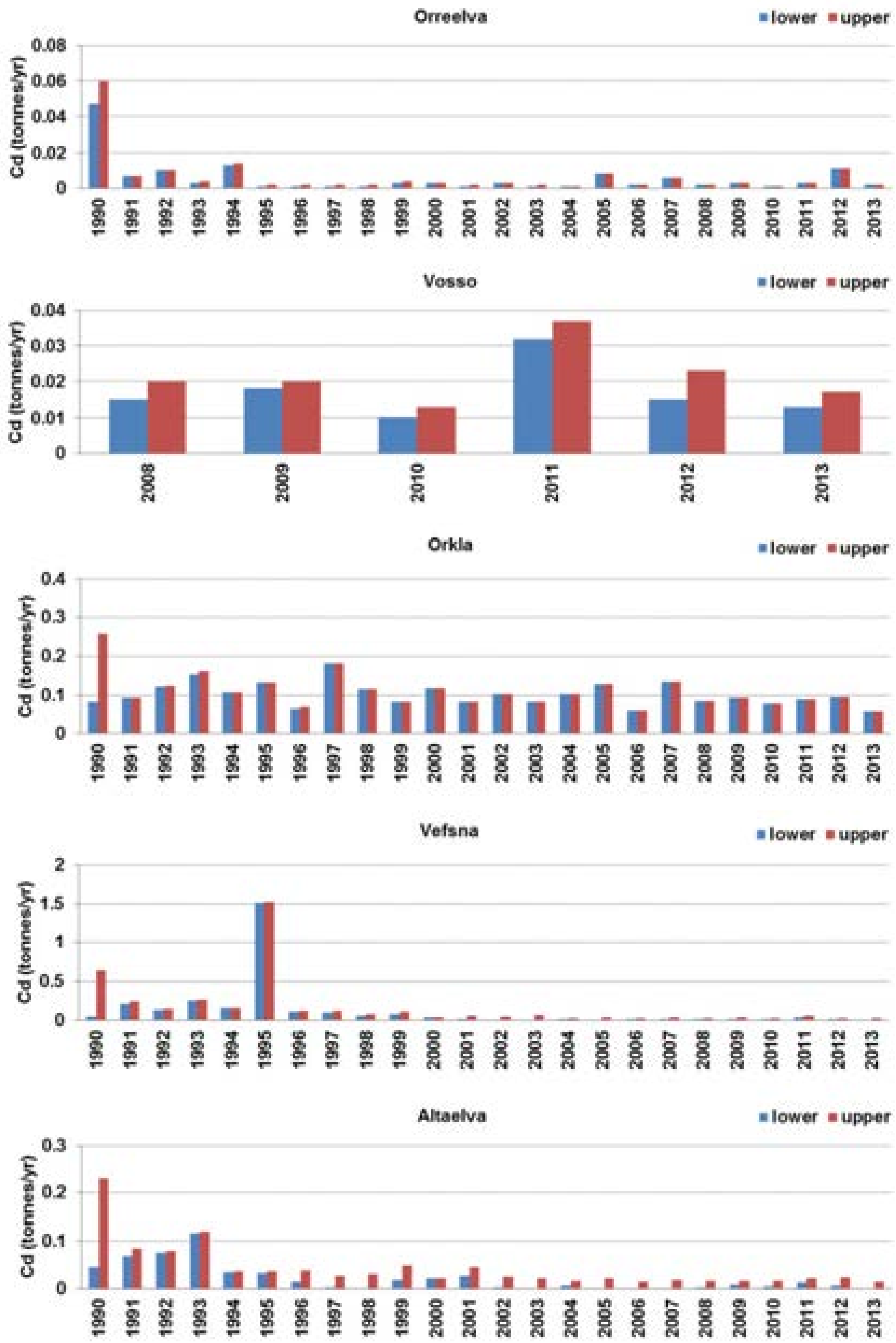


Figure A-V-11b. Annual riverine loads (upper and lower estimates) of cadmium (Cd) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

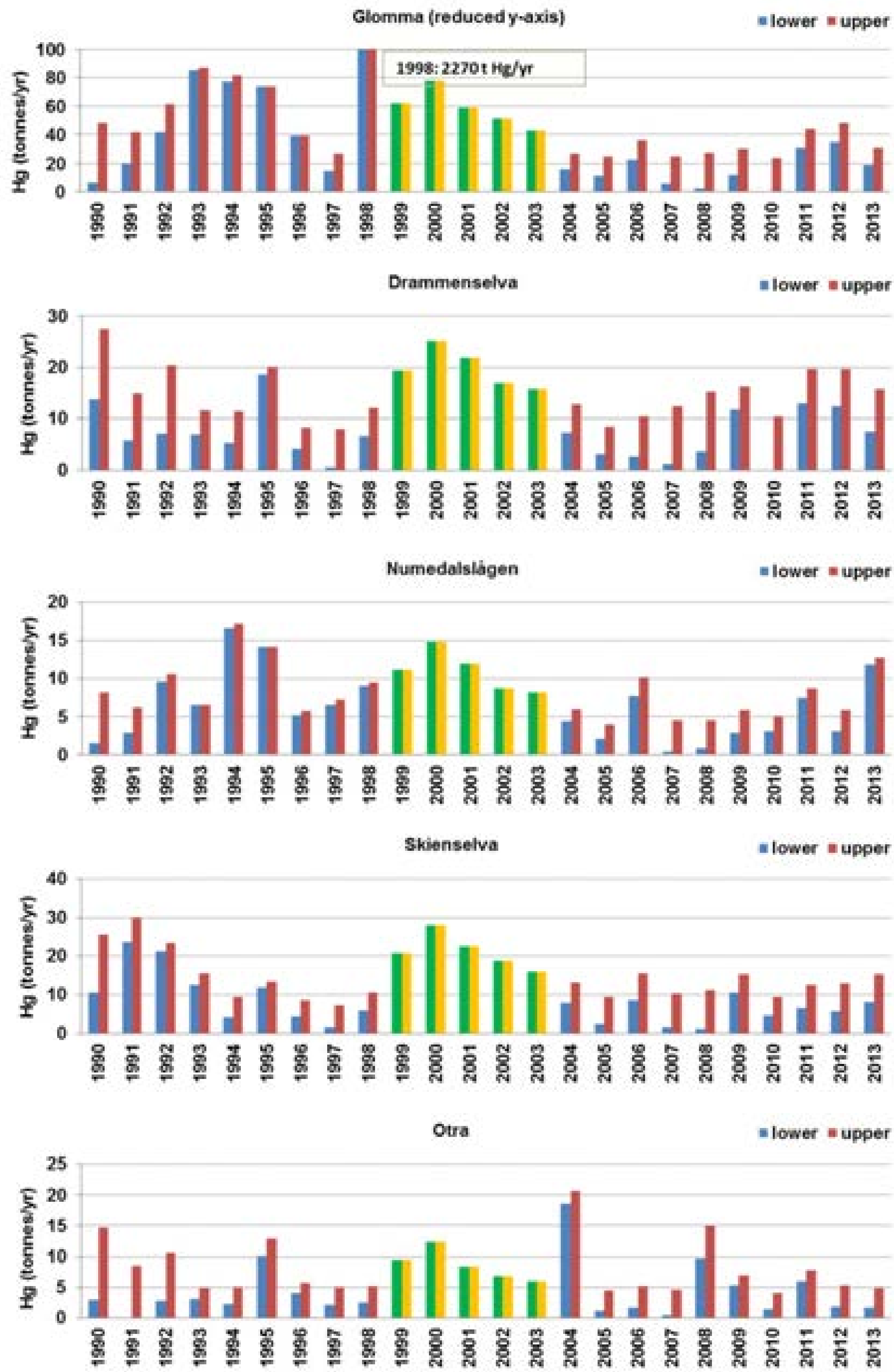


Figure A-V-12a. Annual riverine loads (upper and lower estimates) of mercury (Hg) in the five main rivers draining to Skagerrak, Norway, 1990-2013. Years with interpolated loads are given in green (lower estimates) and yellow (upper estimates). Note Glomma with reduced y-axis.

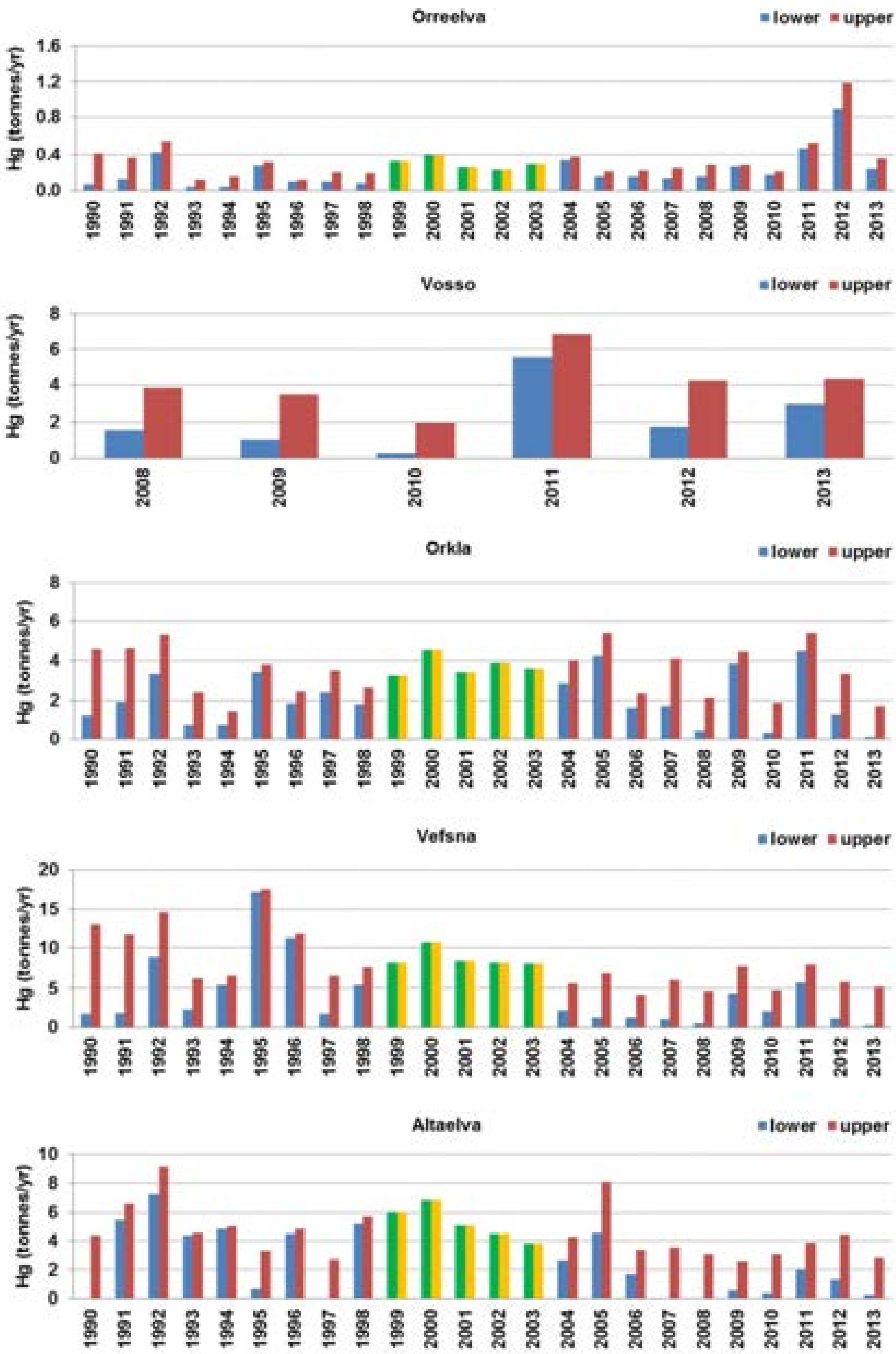


Figure A-V-12b. Annual riverine loads (upper and lower estimates) of mercury (Hg) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso). Years with interpolated loads are given in green (lower estimates) and yellow (upper estimates).

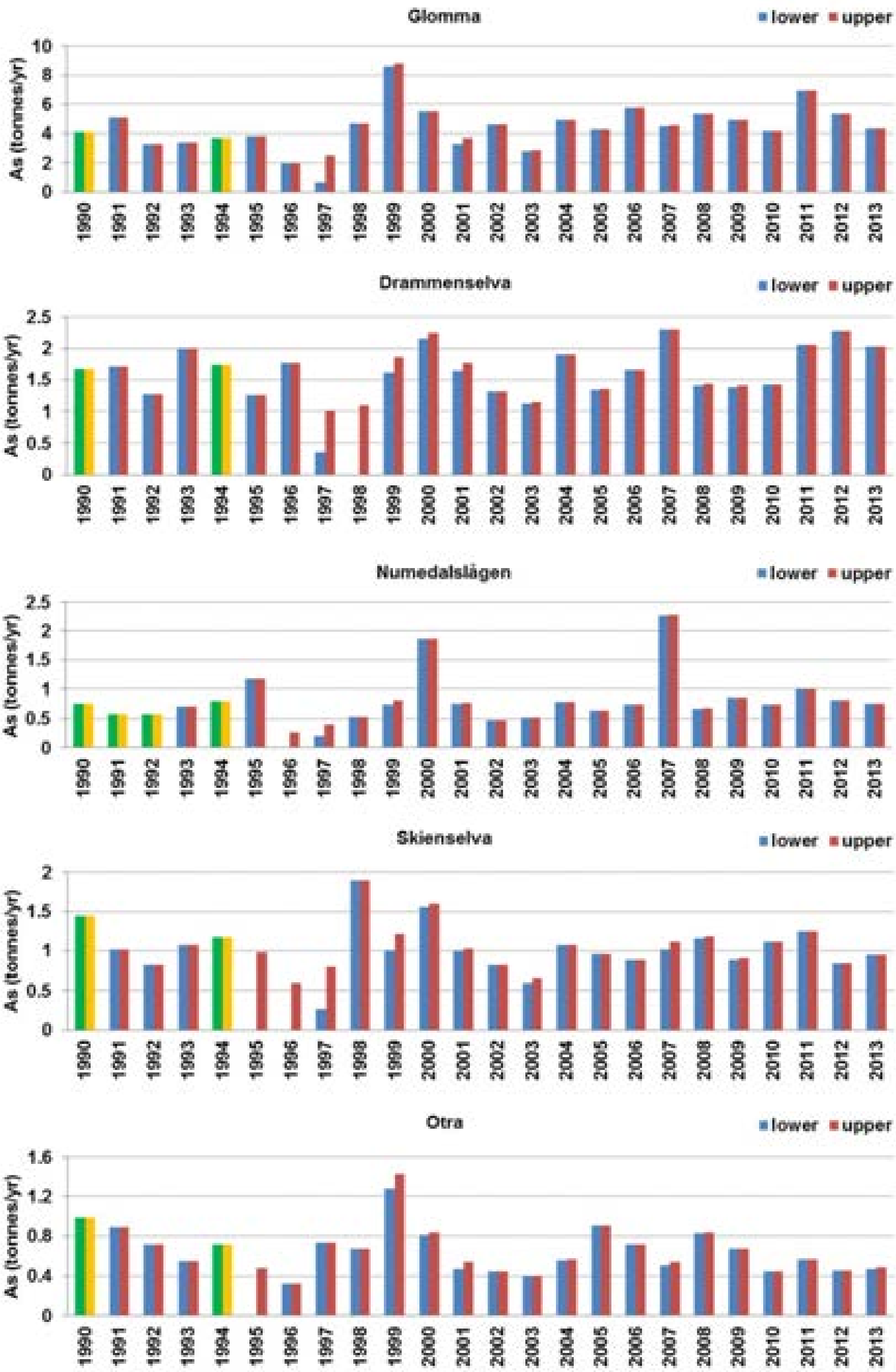


Figure A-V-13a. Annual riverine loads (upper and lower estimates) of arsenic (As) in the five main rivers draining to Skagerrak, Norway, 1990-2013. Years with extra- or interpolated loads are given in green (lower estimates) and yellow (upper estimates).

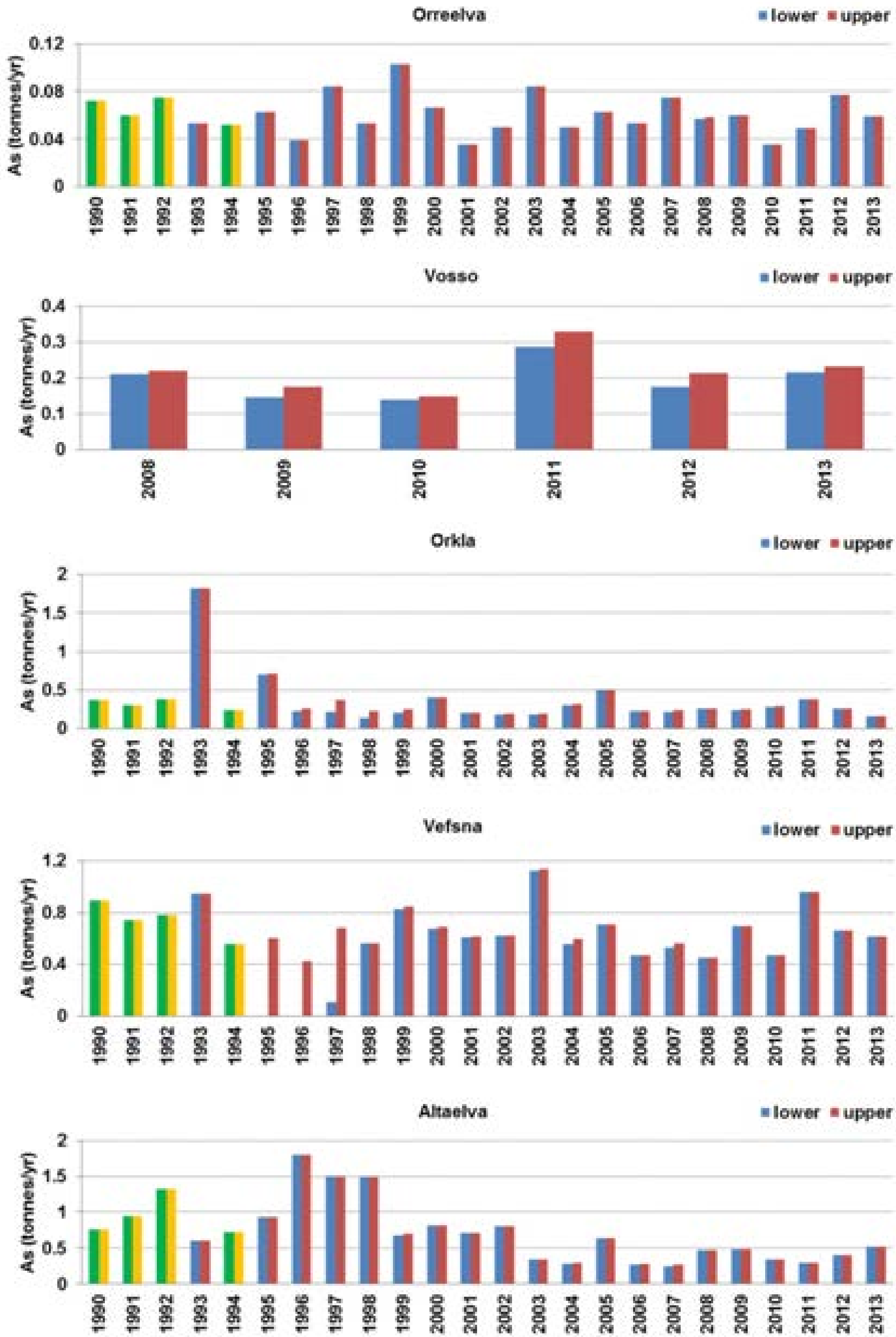


Figure A-V-13b. Annual riverine loads (upper and lower estimates) of arsenic (As) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso). Years with extra- or interpolated loads are given in green (lower estimates) and yellow (upper estimates).

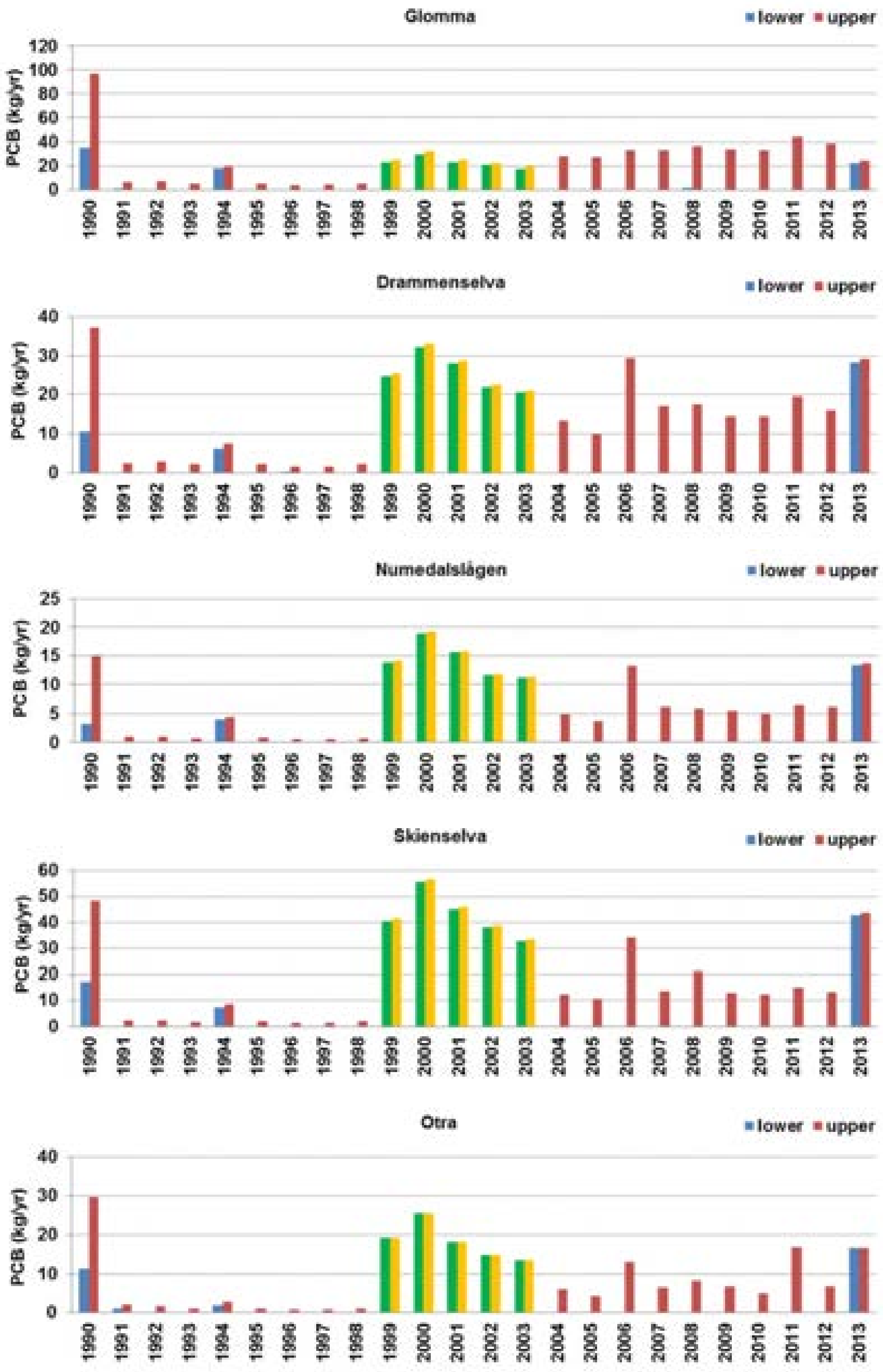


Figure A-V-14a. Annual riverine loads (upper and lower estimates) of PCB7 in the five main rivers draining to Skagerrak, Norway, 1990-2013. Years with extra- or interpolated loads are given in green (lower estimates) and yellow (upper estimates).

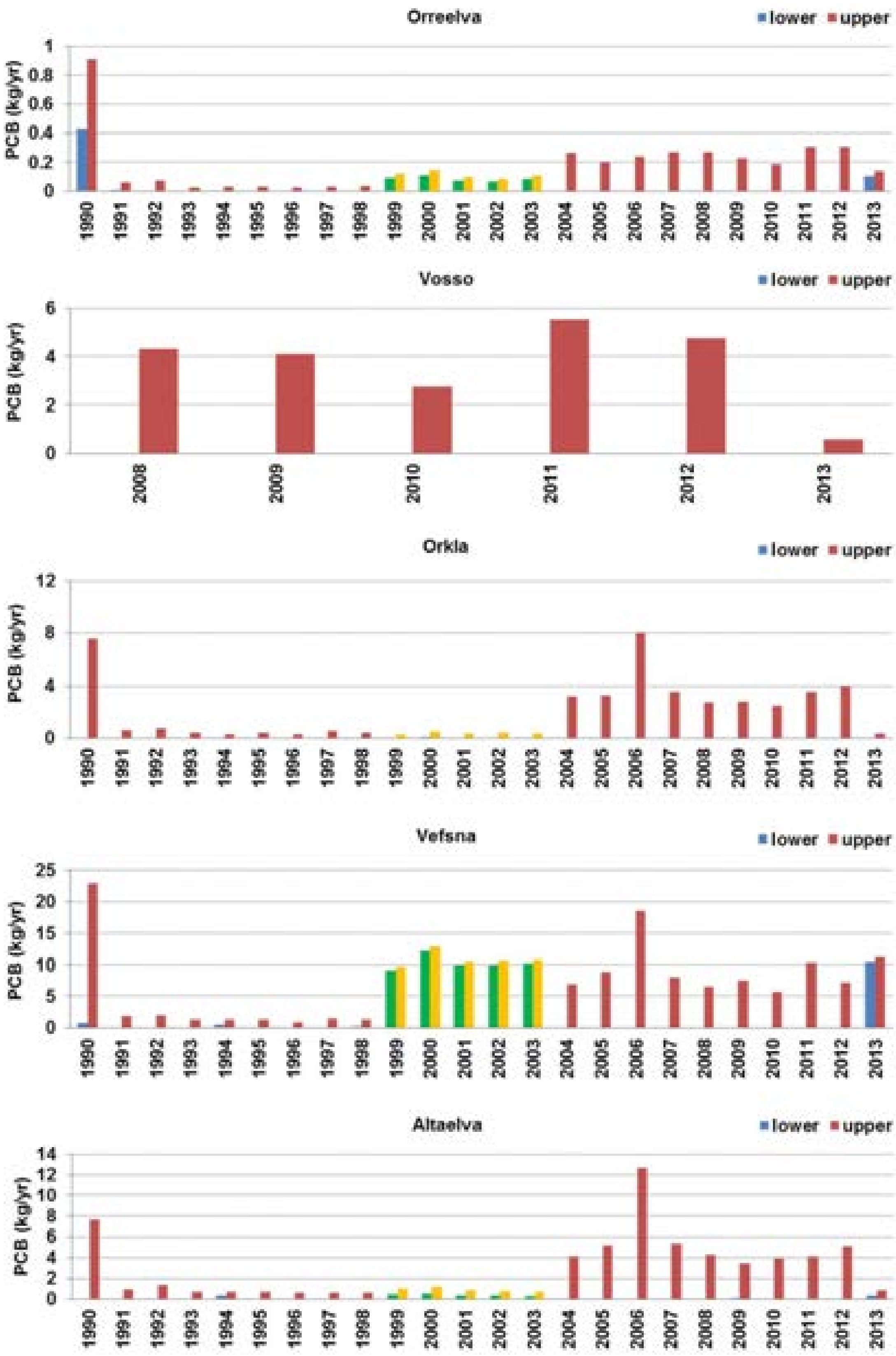


Figure A-V-14b. Annual riverine loads (upper and lower estimates) of PCB7in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso). Years with extra- or interpolated loads are given in green (lower estimates) and yellow (upper estimates).

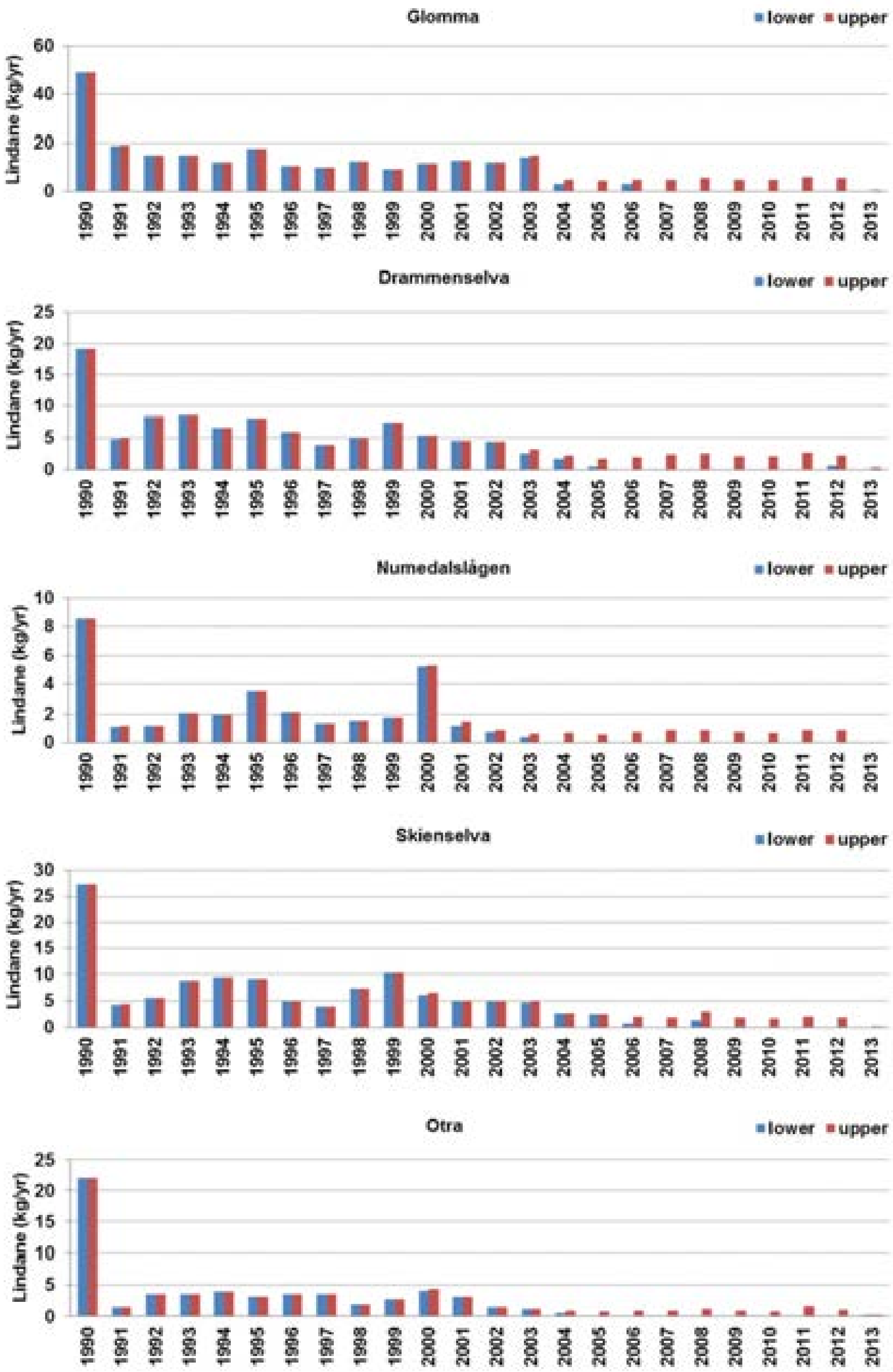


Figure A-V-15a. Annual riverine loads (upper and lower estimates) of lindane in the five main rivers draining to Skagerrak, Norway, 1990-2013.

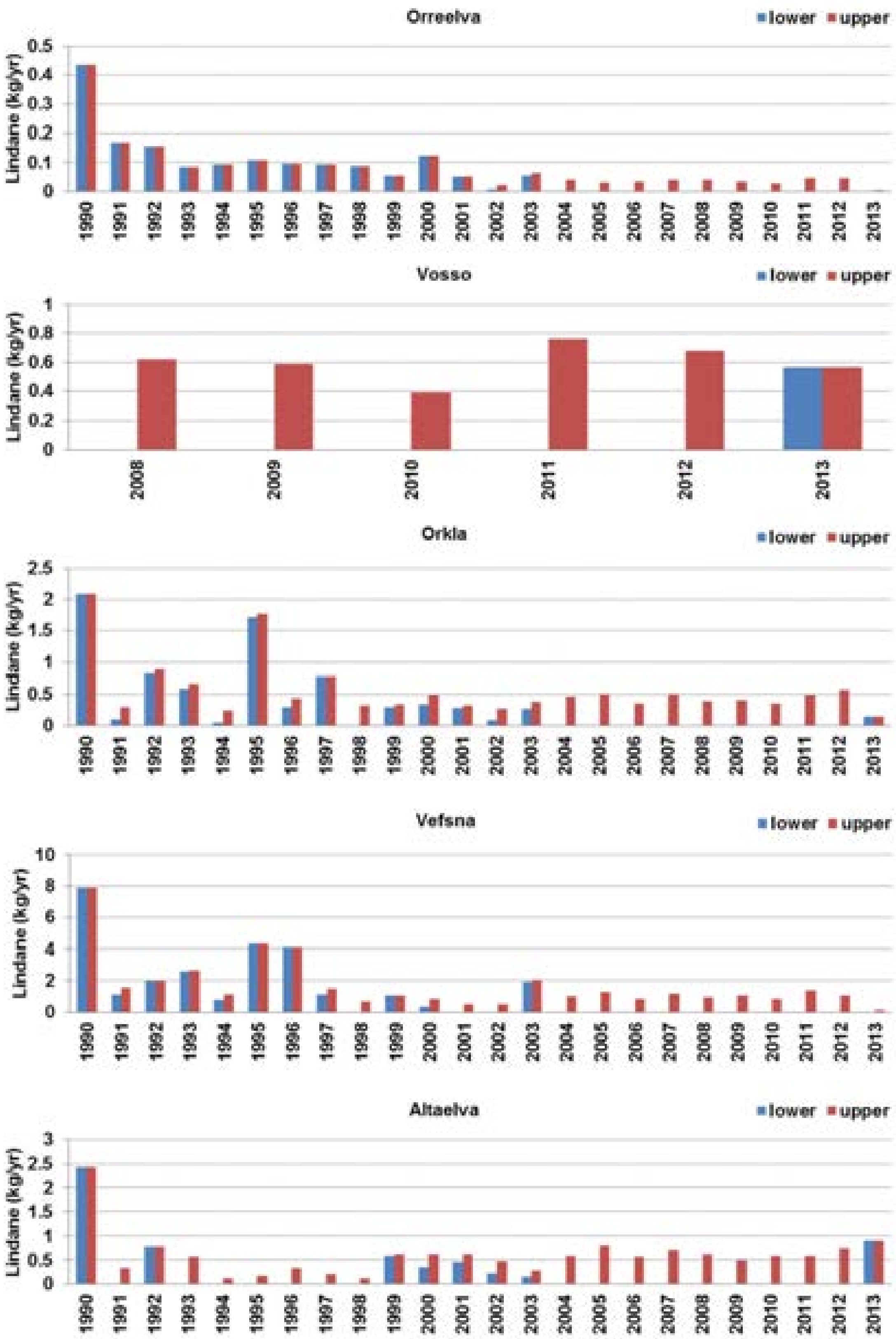


Figure A-V-15b. Annual riverine loads (upper and lower estimates) of lindane in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013 (2008-2013 for River Vosso).

Appendix VI Trend Analyses – Pollutant Concentrations

Complementary charts to Chapter 3, and overview of all trend tables for concentrations (including lower estimates).

Trend charts for concentrations are shown both for upper and lower estimates. Some of these charts are also shown in the report but they are collated here for the purpose of visualising an overview of the trends.

The charts cover the following substances in consecutive order:

- Water discharge (Q)
- Total-N
- Nitrate-N (NO_3-N)
- Ammonium-N (NH_4-N)
- Total-P
- Phosphate-P (PO_4-P)
- Suspended particulate matter (SPM)
- Cadmium (Cd)
- Copper (Cu)
- Nickel (Ni)
- Lead (Pb)
- Zinc (Zn)

The charts in this Appendix are complementary to Chapter 3. The charts show the concentrations in the water samples, and not the volume-weighted monthly concentrations.

The common legend for the trend tests in the tables below is shown here:

	Significant downward ($p<0.05$)
	Downward but not significant ($0.05<p<0.1$)
	Significant upward ($p<0.05$)
	Upward but not significant ($0.05<p<0.1$)

Table VI.1.a. Trends in nutrient and particle concentrations (upper estimates; upper and lower estimates given for orthophosphate) in nine Norwegian main rivers in the last 10 years (2004-2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS, 10-years

River	NH_4-N	NO_3-N	Tot-N	PO_4-P(1)	PO_4-P(2)	Tot-P	SPM
Glomma	0.3507	0.2525	0.9751	0.6971	0.6971	0.5187	0.8610
Drammenselva	0.4552	0.1925	0.9498	0.8163	0.7800	0.0840	0.2566
Numedalslågen	0.8799	0.6033	0.1148	0.0392	0.0424	0.0108	0.7445
Skienselva	0.1921	0.0058	0.9372	0.2293	0.3363	0.9880	0.1245
Otra	0.0575	0.1363	0.4409	0.2148	0.3330	0.1579	0.0699
Orreelva	0.6999	0.1410	0.1195	0.1569	0.1569	0.8896	0.3787
Orkla	0.1299	0.8781	0.0961	0.4743	0.4222	0.1683	0.1762
Vefsna	0.0904	0.1153	0.0065	0.0481	0.3638	0.0574	0.5562
Altaelva	0.4515	0.0902	0.0332	0.1035	0.0837	0.0209	0.6634

PO_4-P(1) – upper estimates

PO_4-P(2) – lower estimates

Table VI.1.b. Long-term trends in nutrient and particle concentrations (upper estimates; upper and lower estimates given for orthophosphate) in nine Norwegian main rivers 1990- 2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS, long-term

River	NH_4-N	NO_3-N	Tot-N	PO_4-P (1)	PO_4-P (2)	Tot-P	SPM
Glomma	0.0085	0.8151	0.1201	0.1107	0.1141	0.3309	0.2977
Drammenselva	0.2372	0.8070	0.1087	0.5875	0.5468	0.1727	0.4126
Numedalslågen	0.3187	0.0554	0.0031	0.2553	0.3079	0.0046	0.3049
Skienselva	0.3235	<0.0001	0.0003	0.0708	0.6520	0.7142	0.7440
Otra	0.1641	0.0007	0.1649	0.0774	0.0025	0.0146	0.0006
Orreelva	0.3754	0.0170	0.0720	0.3996	0.4043	0.7099	0.8620
Orkla	0.0184	0.9139	0.1079	0.0966	0.1229	0.4024	0.1501
Vefsna	0.0000	0.0001	0.0135	0.1111	0.0008	0.0483	0.0119
Altaelva	0.0207	0.0412	0.8524	0.0108	0.0058	0.1358	0.0681

PO_4-P(1) – upper estimates

PO_4-P(2) – lower estimates

Table VI.2.a. Trends for metal concentrations (upper estimates) in nine Norwegian main rivers in the last 10 years (2004-2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS, 10-years, upper estimates					
River	Cd	Cu	Ni	Pb	Zn
Glomma	0.5803	0.3168	0.9459	0.4798	0.0271
Drammenselva	0.8393	0.1088	0.2944	0.0949	0.0598
Numedalslågen	0.4679	0.6372	0.4110	0.6691	0.3173
Skienselva	0.3513	0.1298	0.0596	0.4833	0.2848
Otra	0.1884	0.4741	0.1291	0.7750	0.1025
Orreelva	0.0411	0.0184	0.3364	0.7557	0.0235
Orkla	0.2164	0.0719	0.6699	0.0795	0.1015
Vefsna	0.2045	0.9994	0.1322	0.7544	0.3710
Altaelva	0.2192	0.0691	0.4079	0.7310	0.9854

Table VI.2.b. Trends for metal concentrations (lower estimates) in nine Norwegian main rivers in the last 10 years (2004-2013). The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS, 10-years, lower estimates					
River	Cd	Cu	Ni	Pb	Zn
Glomma	0.5803	0.3168	0.9459	0.4798	0.0271
Drammenselva	0.8368	0.1088	0.2944	0.0949	0.0598
Numedalslågen	0.4679	0.6372	0.4110	0.6691	0.3173
Skienselva	0.3513	0.1298	0.0596	0.4833	0.2848
Otra	0.1884	0.4741	0.1291	0.7750	0.1025
Orreelva	0.0417	0.0184	0.3364	0.7557	0.0235
Orkla	0.2164	0.0719	0.6699	0.0841	0.1015
Vefsna	0.2731	0.9994	0.1280	0.7544	0.3710
Altaelva	0.3137	0.0691	0.3281	0.7058	0.9747

Table VI.2.c. Long-term trends for metal concentrations (upper estimates) in nine Norwegian main rivers 1990-2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS, long-term, upper estimates					
River	Cd	Cu	Ni	Pb	Zn
Glomma	0.0007	0.0427	0.0110	0.0014	0.8351
Drammenselva	0.0004	0.1961	0.1219	0.0621	0.0702
Numedalslågen	0.0005	0.0111	0.0107	0.0209	0.0070
Skienselva	0.0001	0.0146	0.0002	0.1088	0.0005
Otra	0.0003	0.1309	0.0019	0.0010	<0.0001
Orreelva	0.0010	0.6191	0.0013	0.0054	0.5321
Orkla	0.0014	0.0008	0.0029	0.0001	0.0001
Vefsna	<0.0001	0.0001	0.0009	<0.0001	<0.0001
Altaelva	0.0003	0.0004	0.0082	<0.0001	0.0029

Table VI.2.d. Long-term trends for metal concentrations (lower estimates) in nine Norwegian main rivers 1990-2013. The table shows the p-values. The colours indicate the degree of statistical significance (see legend).

CONCENTRATIONS, long-term, lower estimates					
River	Cd	Cu	Ni	Pb	Zn
Glomma	0.4120	0.0427	0.0110	0.0821	0.8351
Drammenselva	0.1441	0.1961	0.2058	0.4885	0.0696
Numedalslågen	0.3788	0.0111	0.3149	0.0704	0.0070
Skienselva	0.0152	0.0146	0.0836	0.9301	0.0005
Otra	0.2192	0.1309	0.0031	0.0505	<0.0001
Orreelva	0.5993	0.6191	0.0013	0.0173	0.5745
Orkla	0.0476	0.0008	0.0029	0.0247	0.0001
Vefsna	0.0008	0.0001	0.0023	0.0020	0.0001
Altaelva	0.0296	0.0005	0.0443	0.0892	0.0240

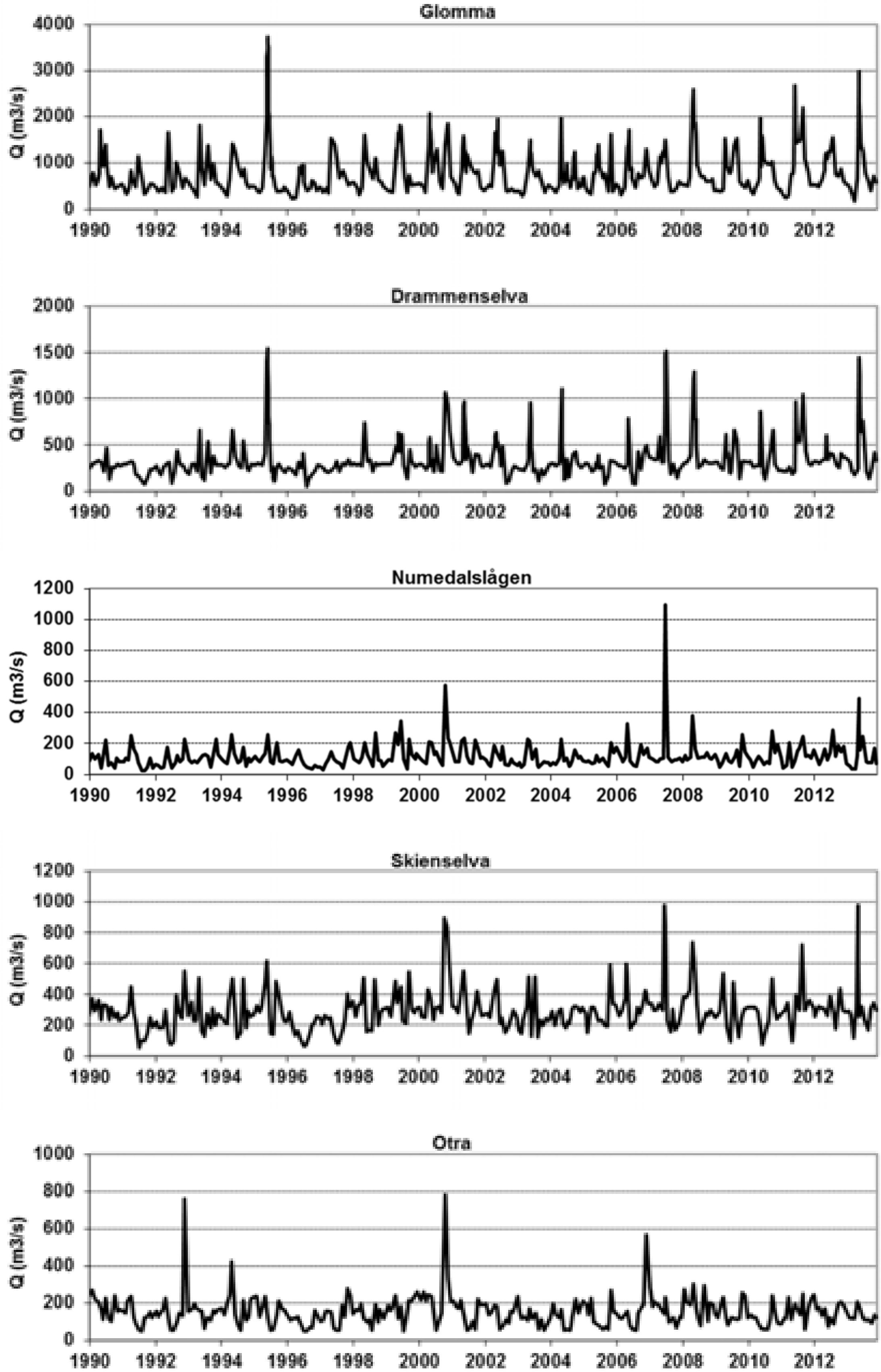


Figure A-VI-1a. Monthly water discharge (Q; based only on data at the day of water quality sampling) for the five main rivers draining to Skagerrak, Norway, 1990-2013.

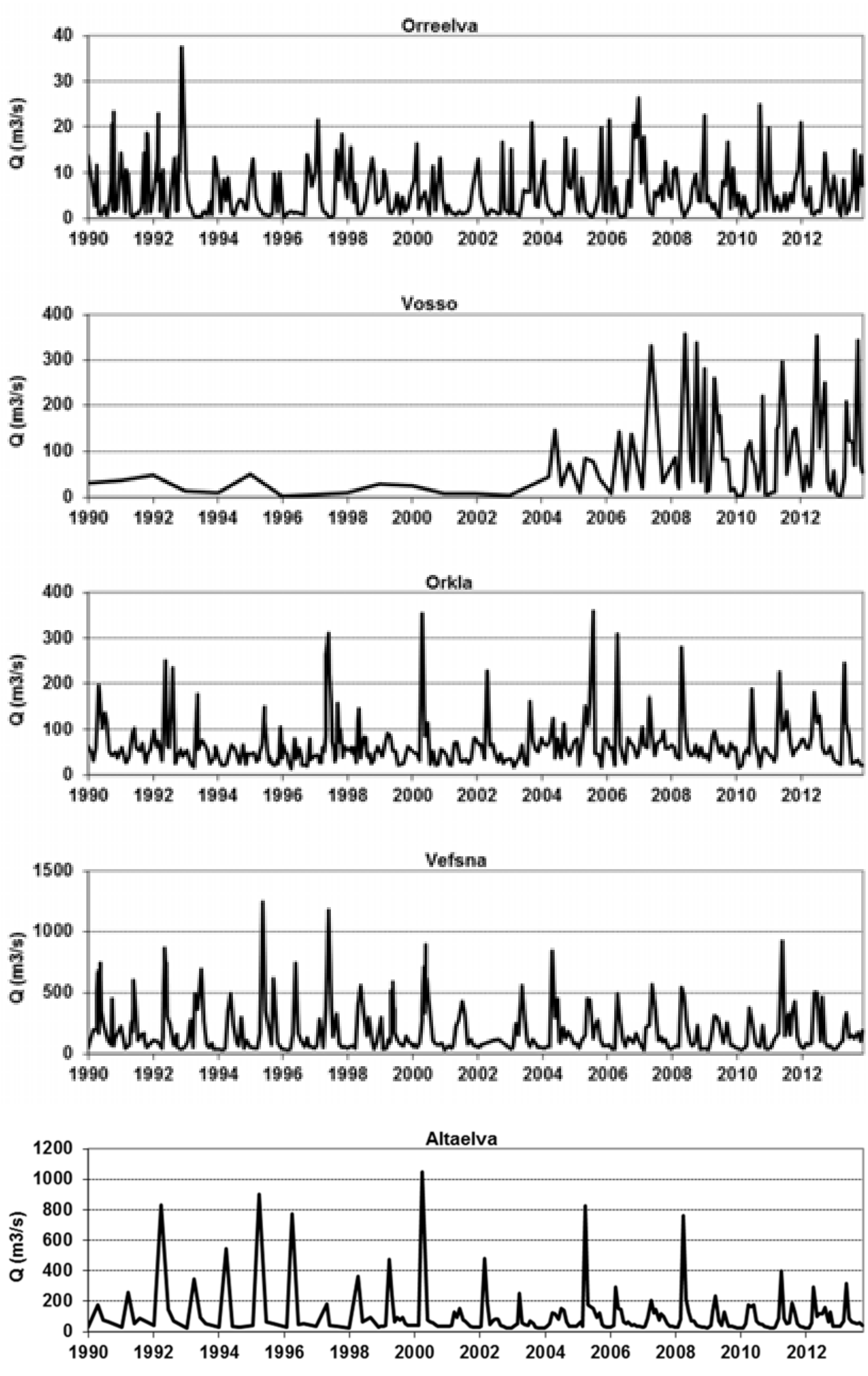


Figure A-VI-1b. Monthly water discharge (Q; based only on data at the day of water quality sampling) for the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

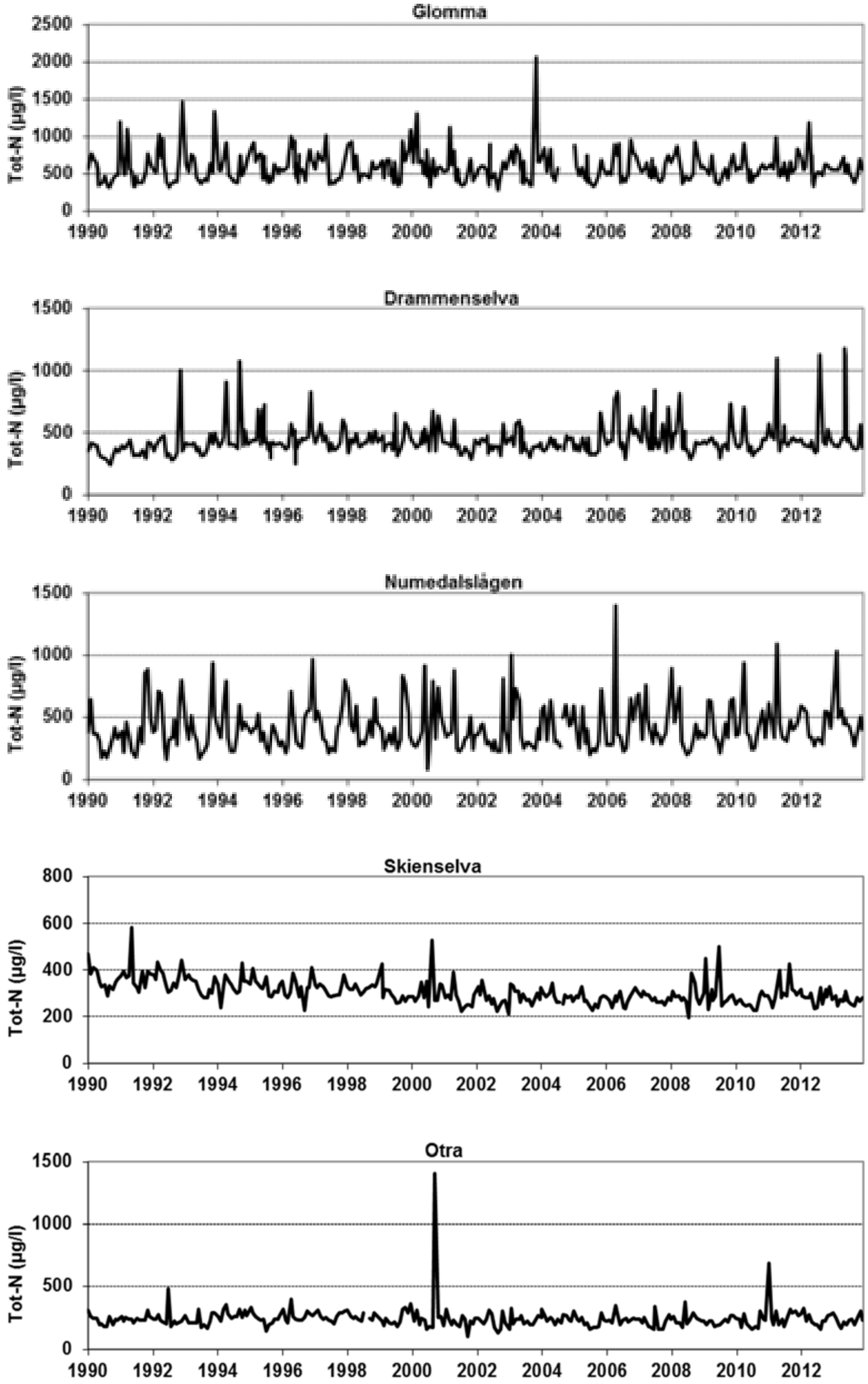


Figure A-VI-2a. Monthly concentrations of total nitrogen (Tot-N) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

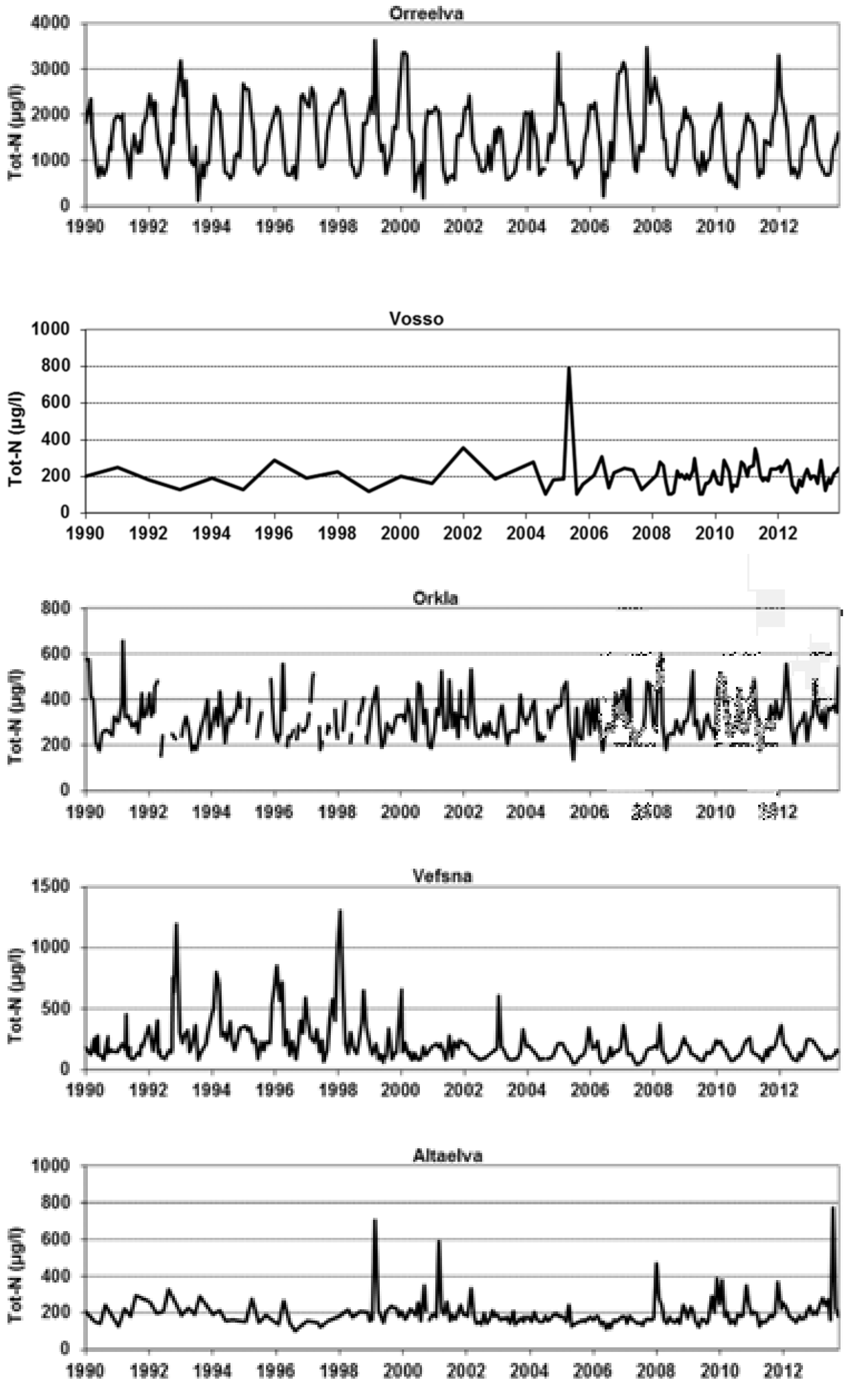


Figure A-VI-2b. Monthly concentrations of total nitrogen (Tot-N) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

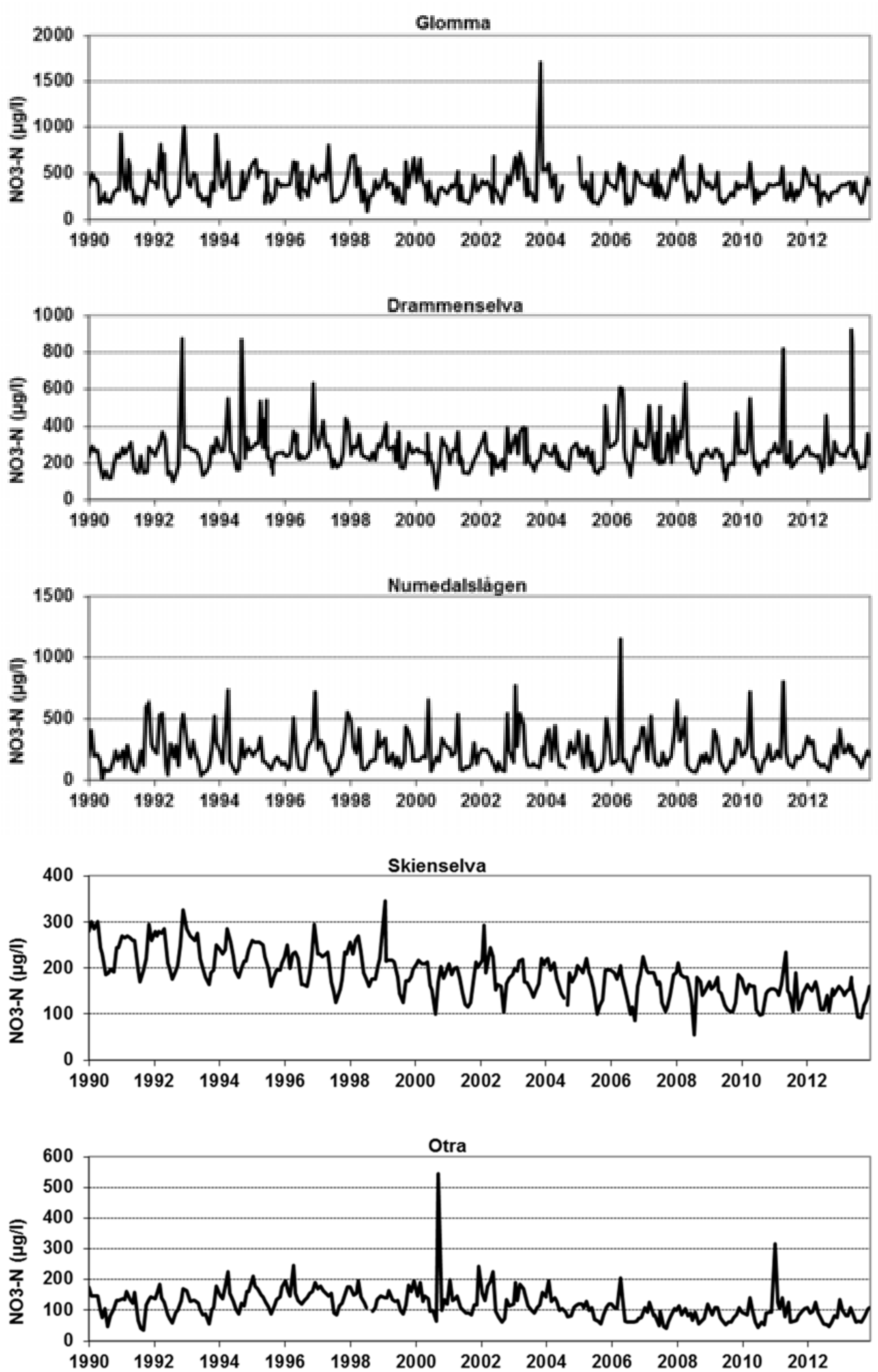


Figure A-VI-3a. Monthly concentrations of nitrate-nitrogen (NO_3-N) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

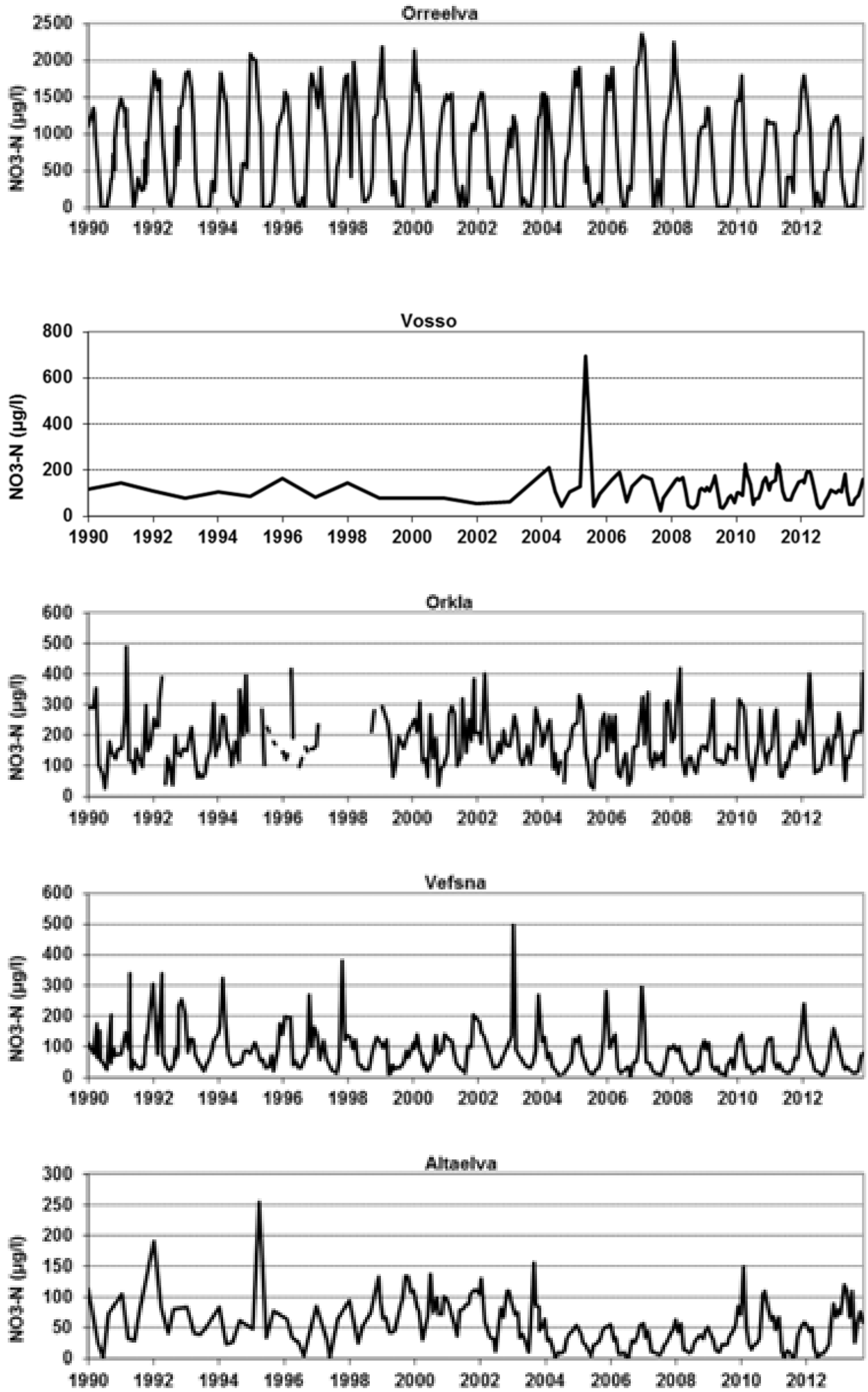


Figure A-VI-3b. Monthly concentrations of nitrate-nitrogen (NO_3-N) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

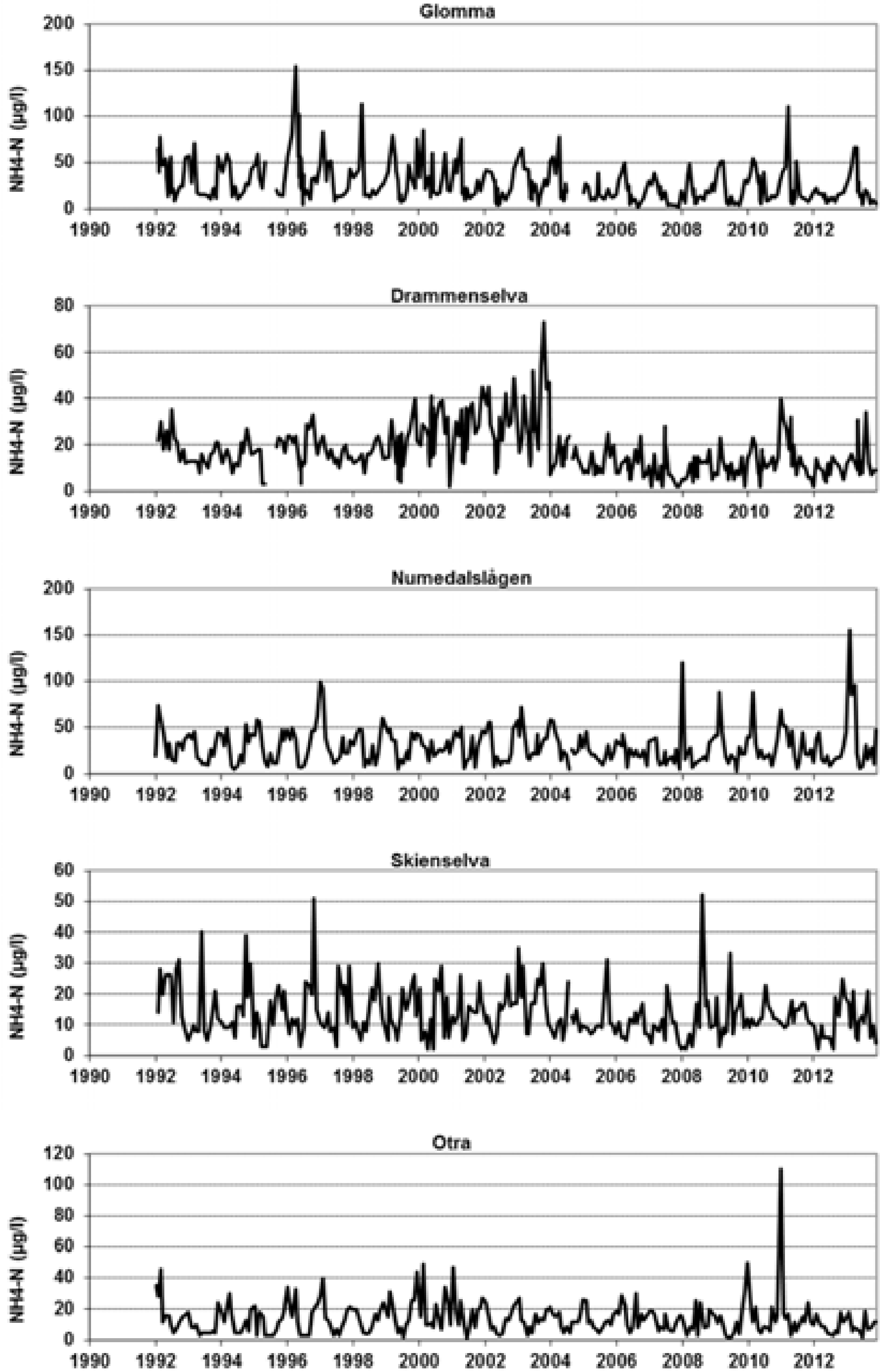


Figure A-VI-4a. Monthly concentrations of ammonium-nitrogen (NH_4-N) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

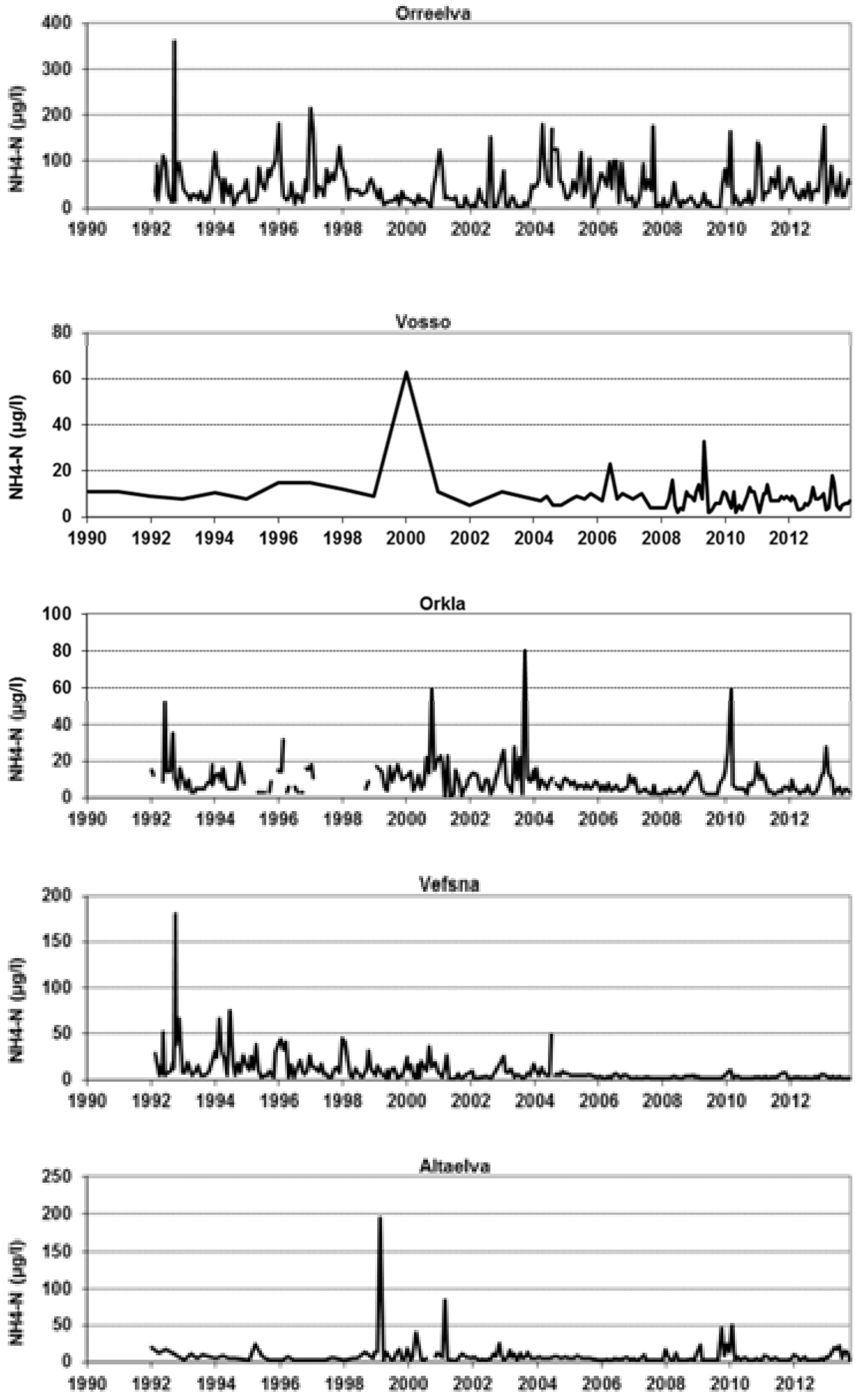


Figure A-VI-4b. Monthly concentrations of ammonium-nitrogen (NH_4-N) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

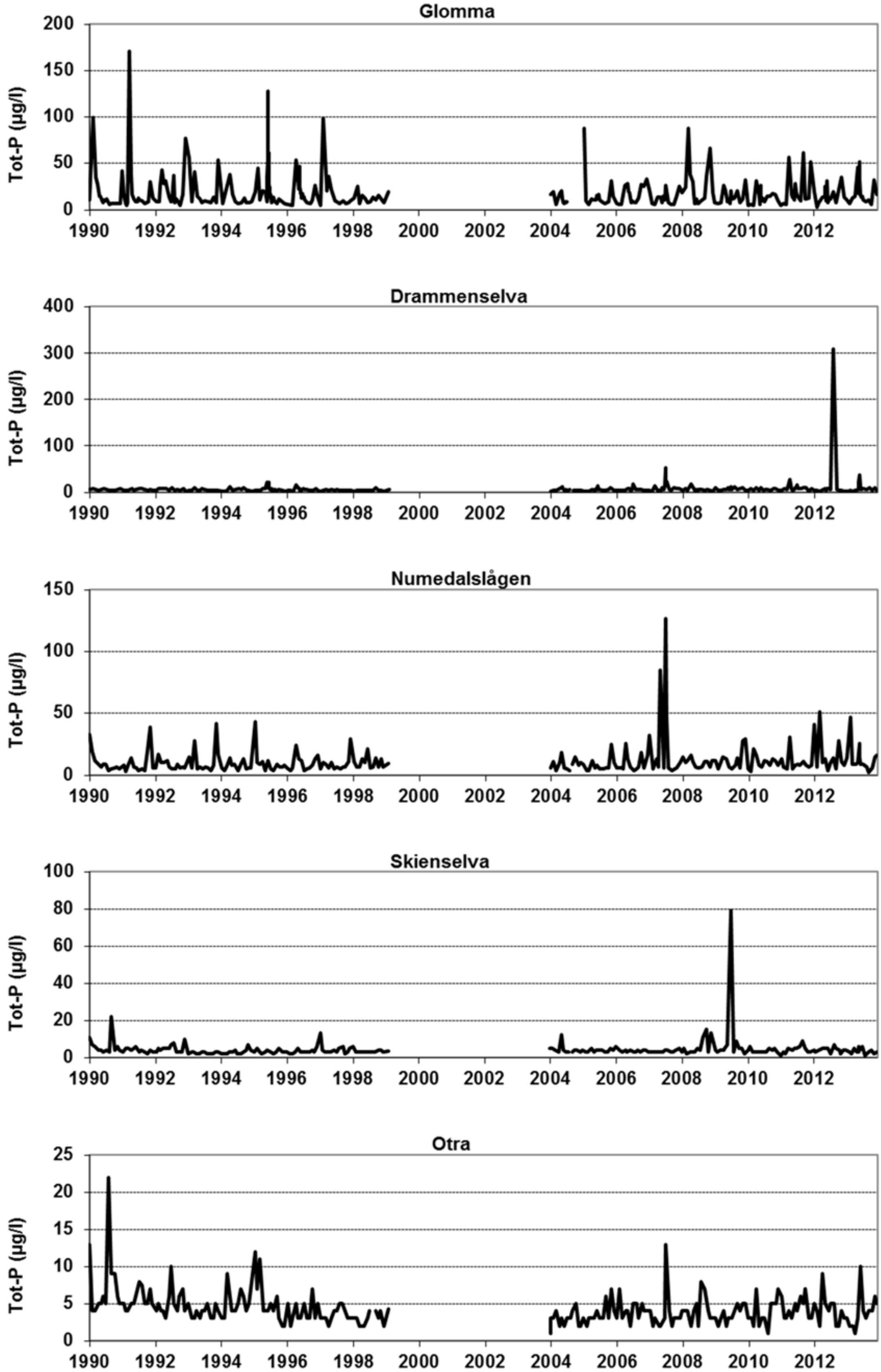


Figure A-VI-5a. Monthly concentrations of total phosphorus (Tot-P) in the five main rivers draining to Skagerrak. Norway, 1990-2013.

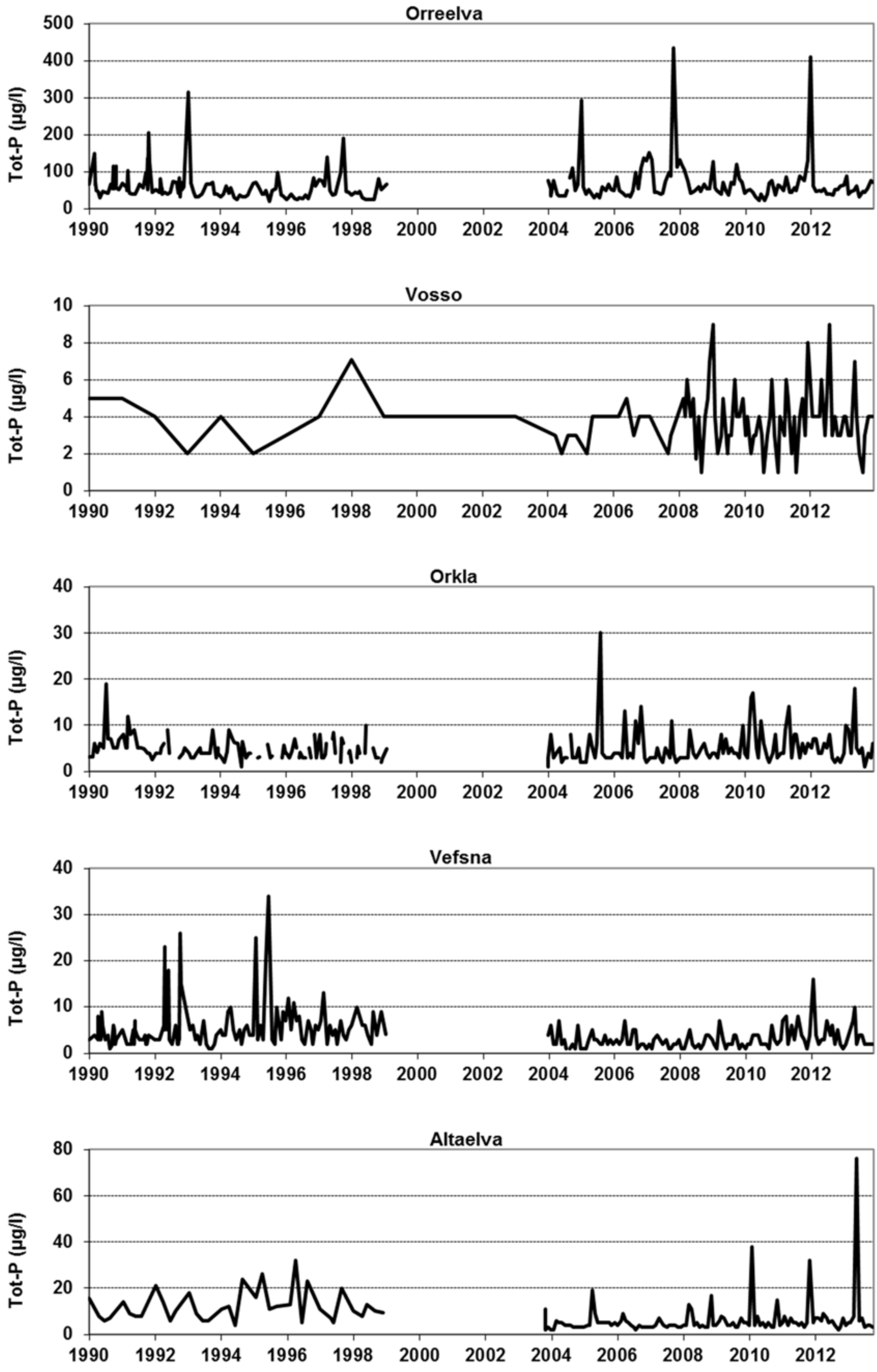


Figure A-VI-5b. Monthly concentrations of total phosphorus (Tot-P) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

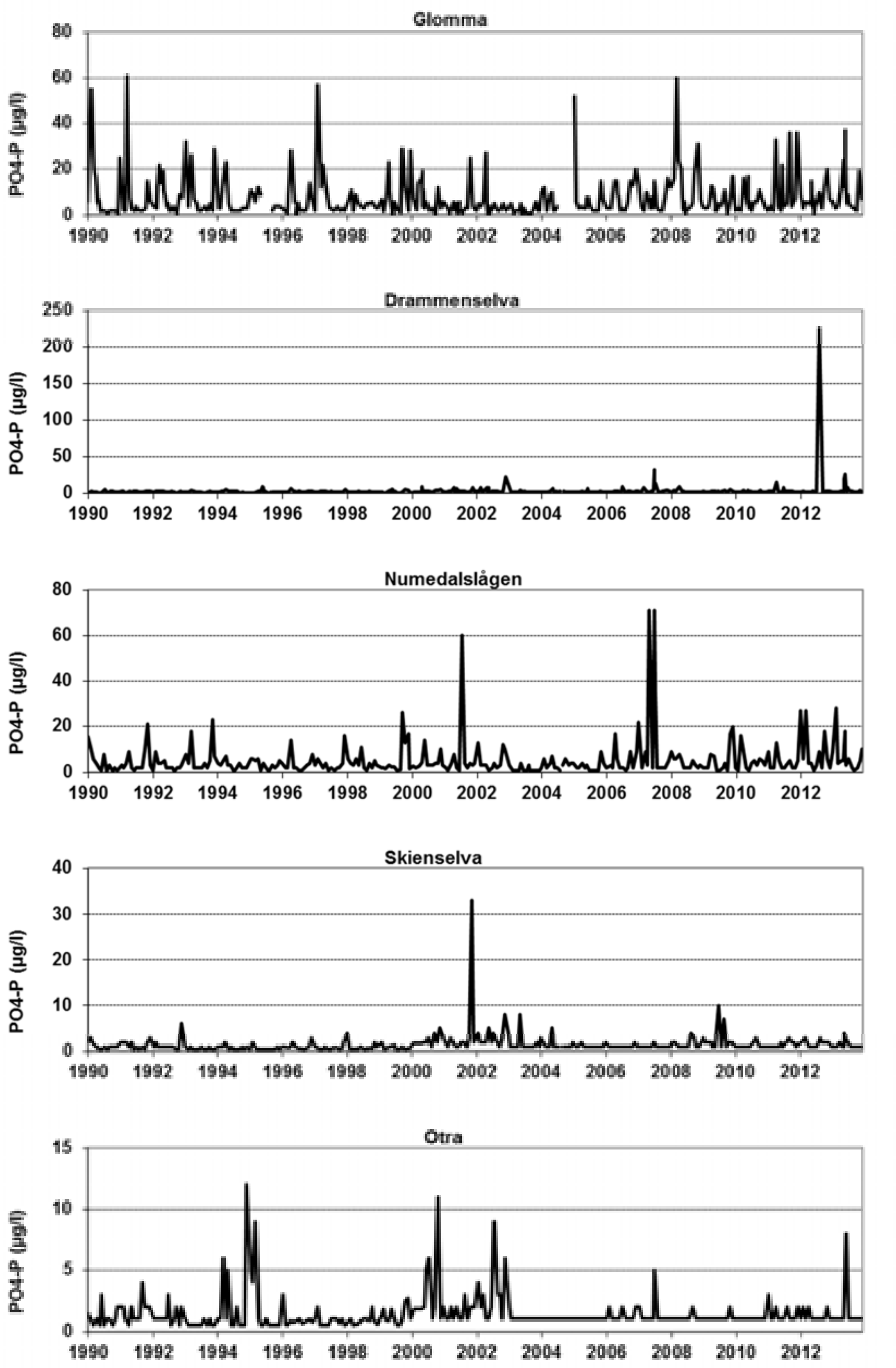


Figure A-VI-6a. Monthly concentrations of orthophosphate-phosphorus (PO_4-P) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

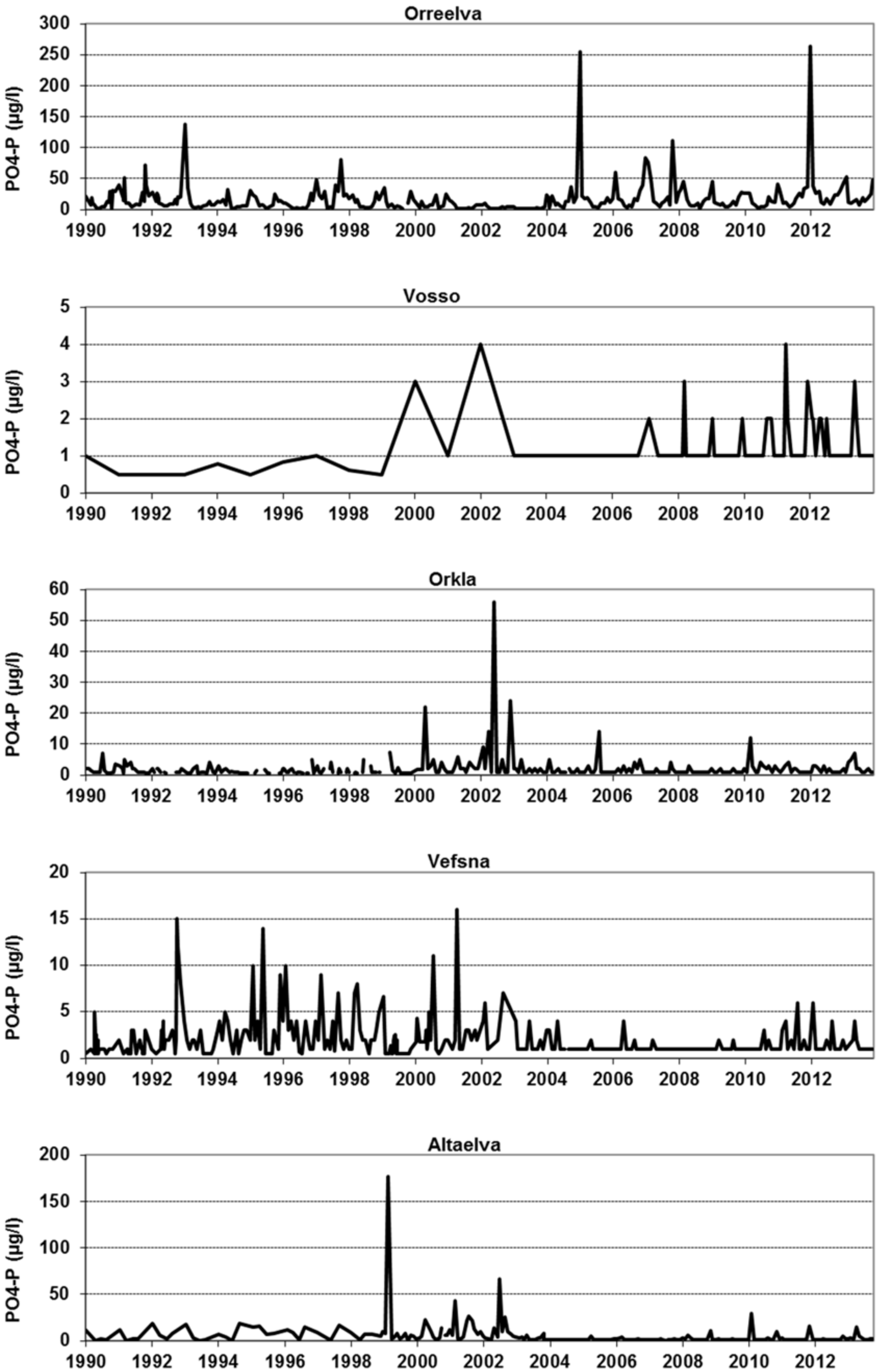


Figure A-VI-6b. Monthly concentrations of otrhophosphate-phosphorus (PO_4-P) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

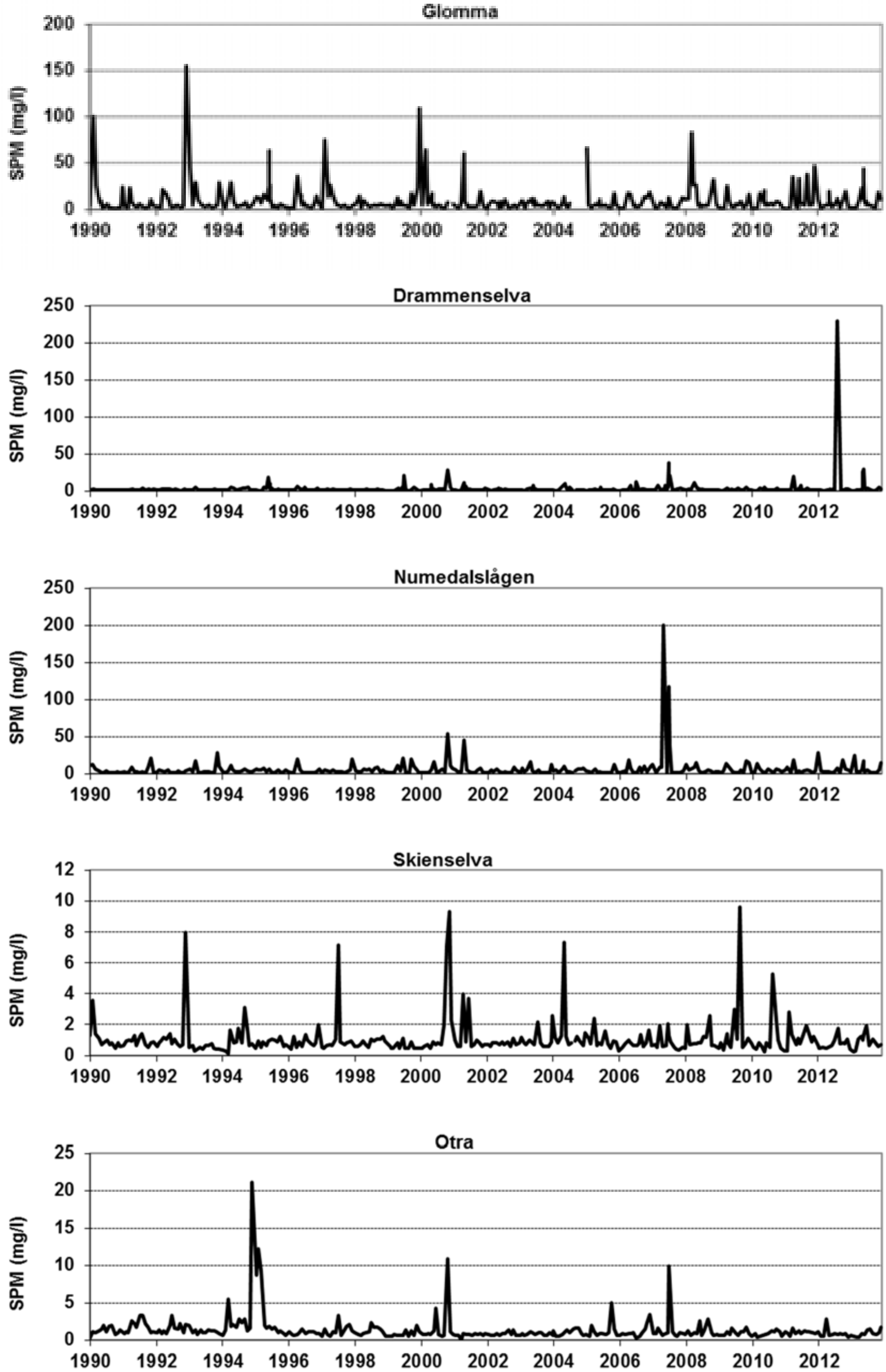


Figure A-VI-7a. Monthly concentrations of suspended particulate matter (SPM) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

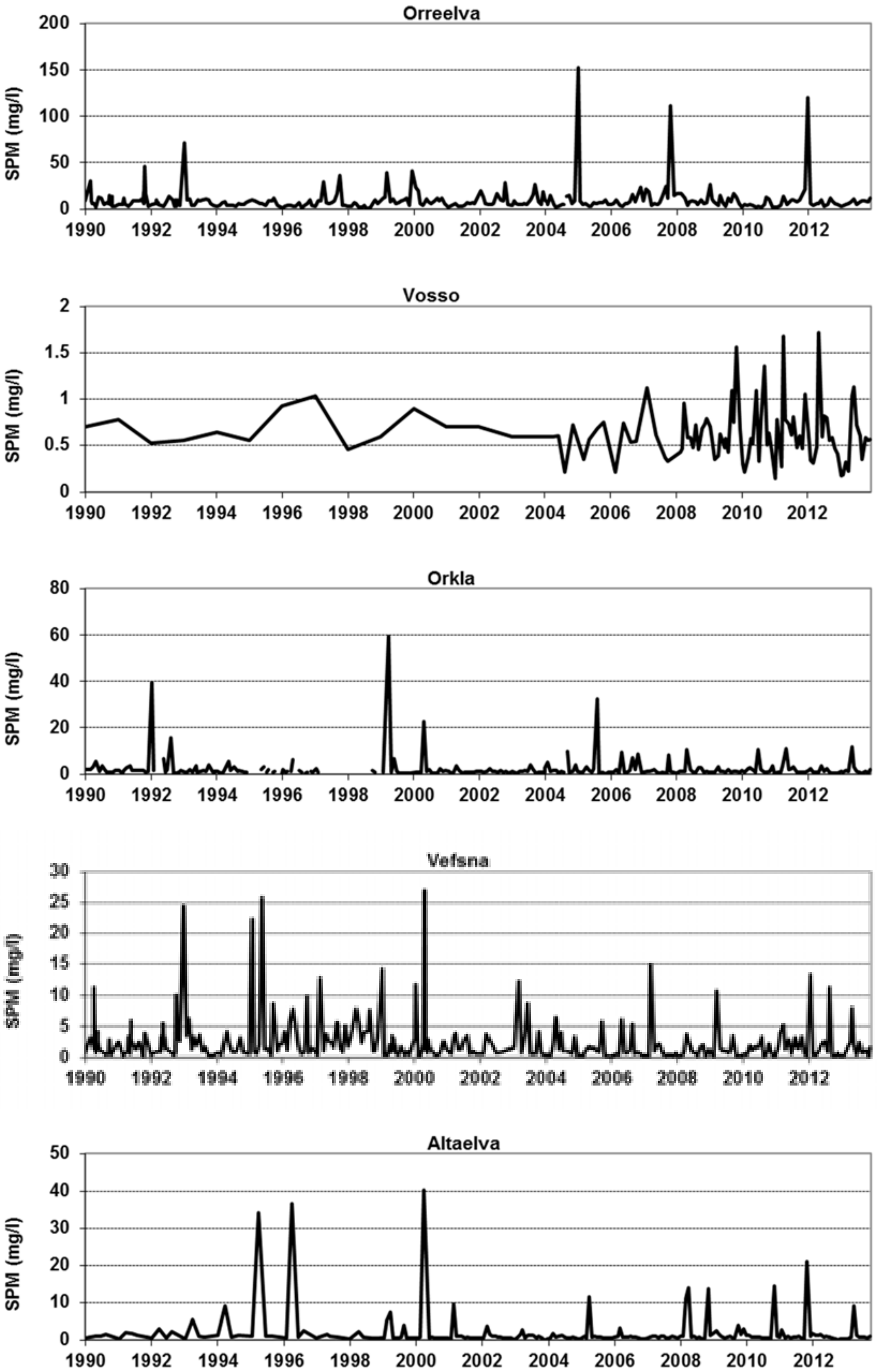


Figure A-VI-7b. Monthly concentrations of suspended particulate matter (SPM) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

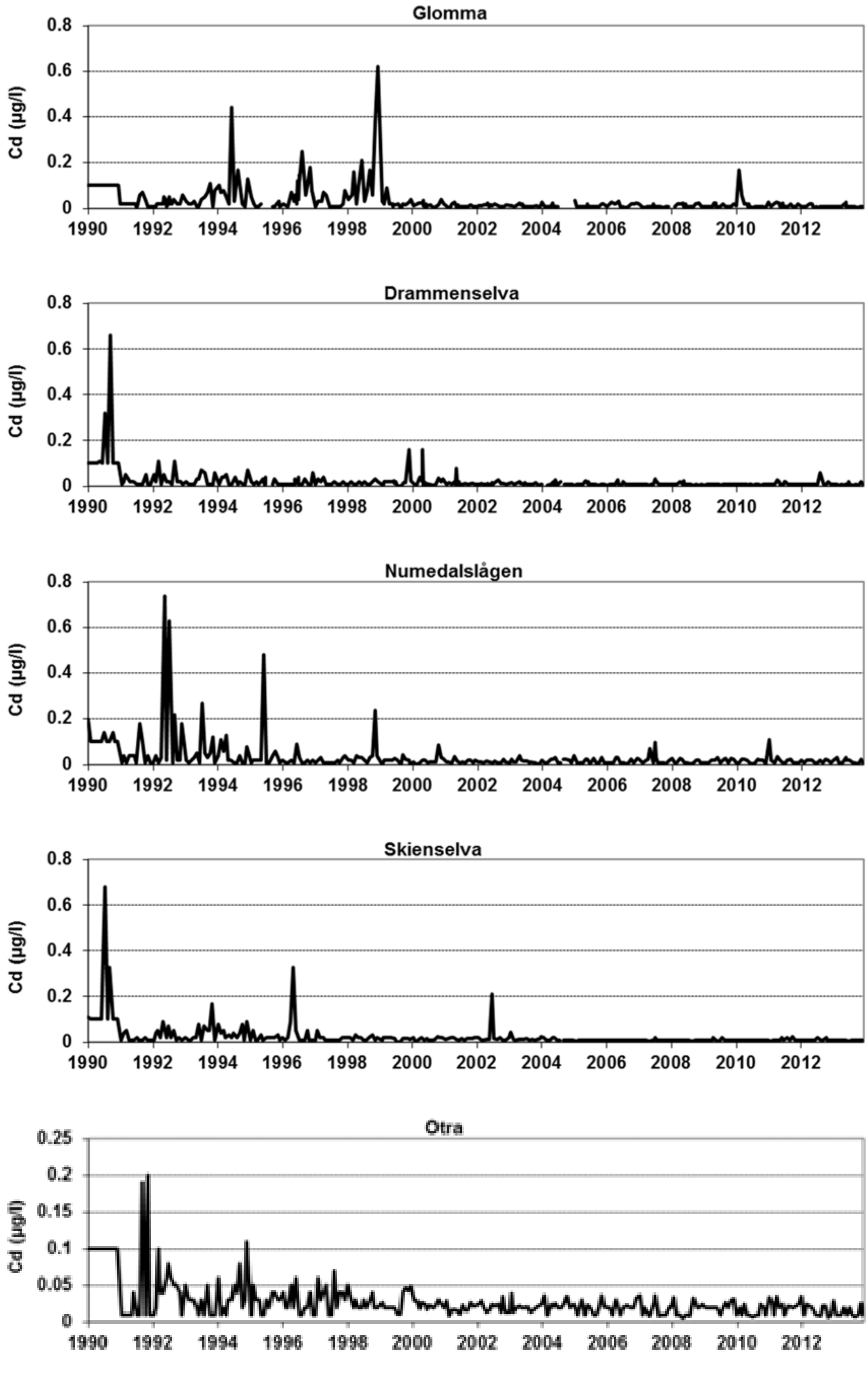


Figure A-VI-8a. Monthly concentrations of cadmium (Cd) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

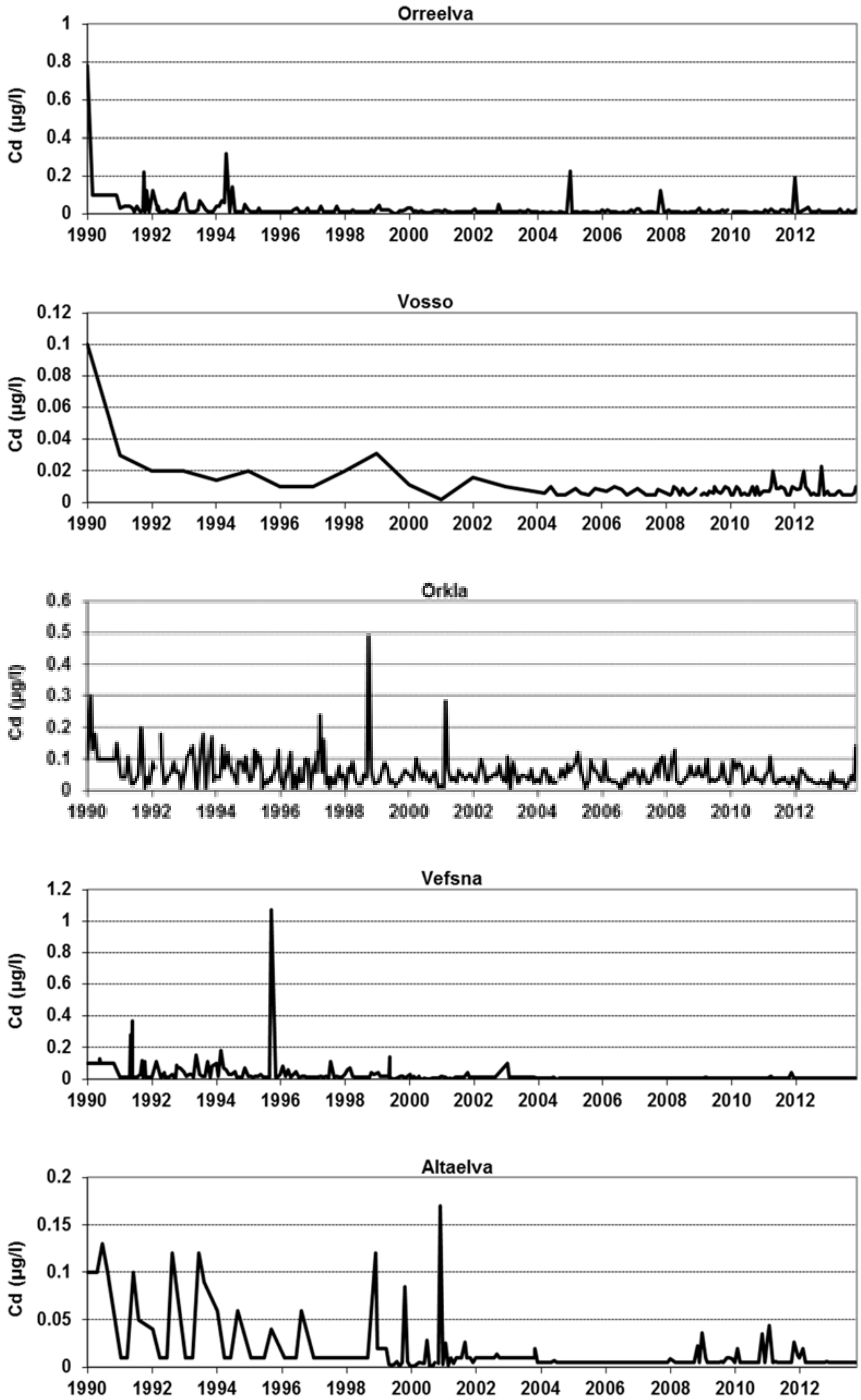


Figure A-VI-8b. Monthly concentrations of cadmium (Cd) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

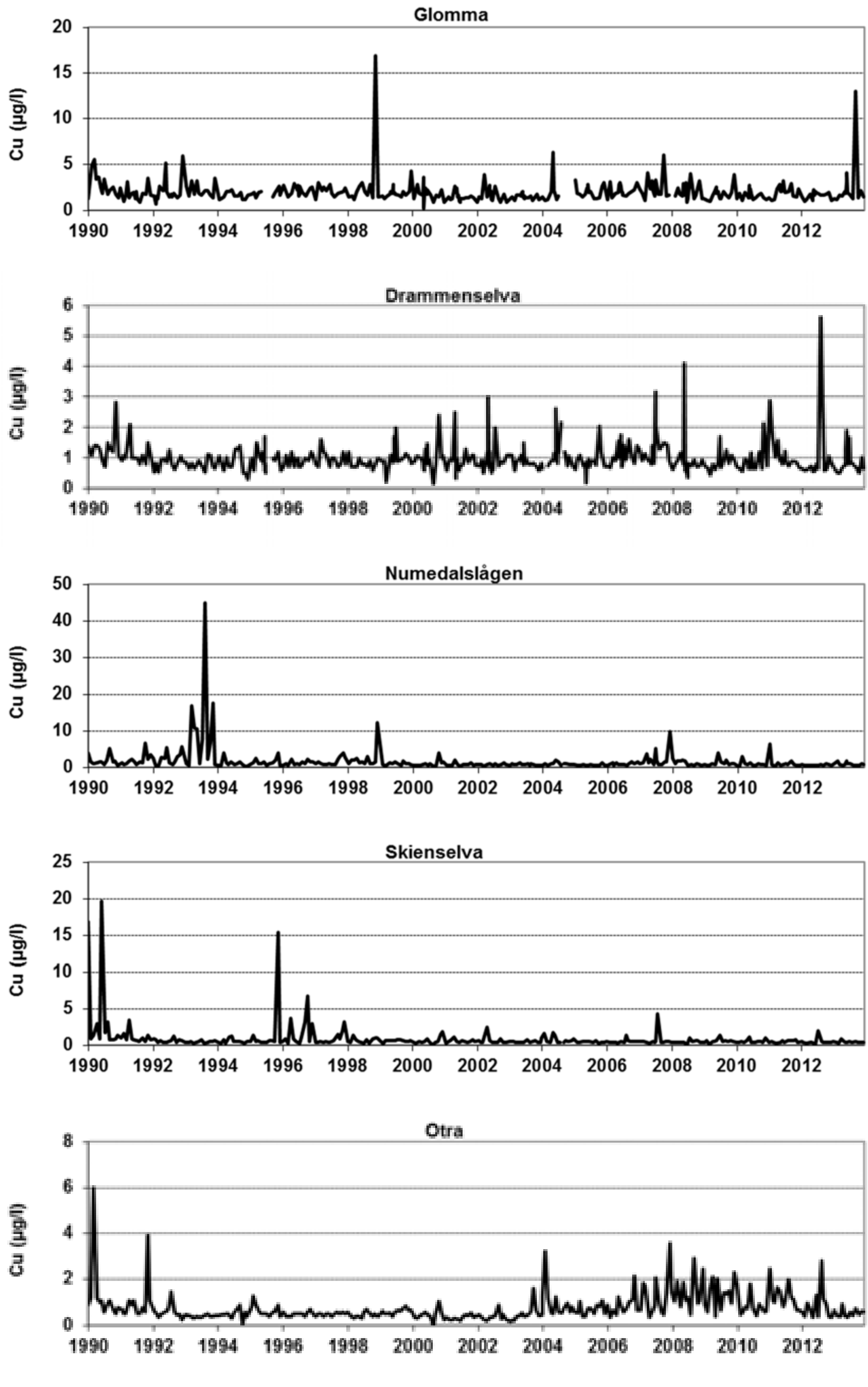


Figure A-VI-9a. Monthly concentrations of copper (Cu) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

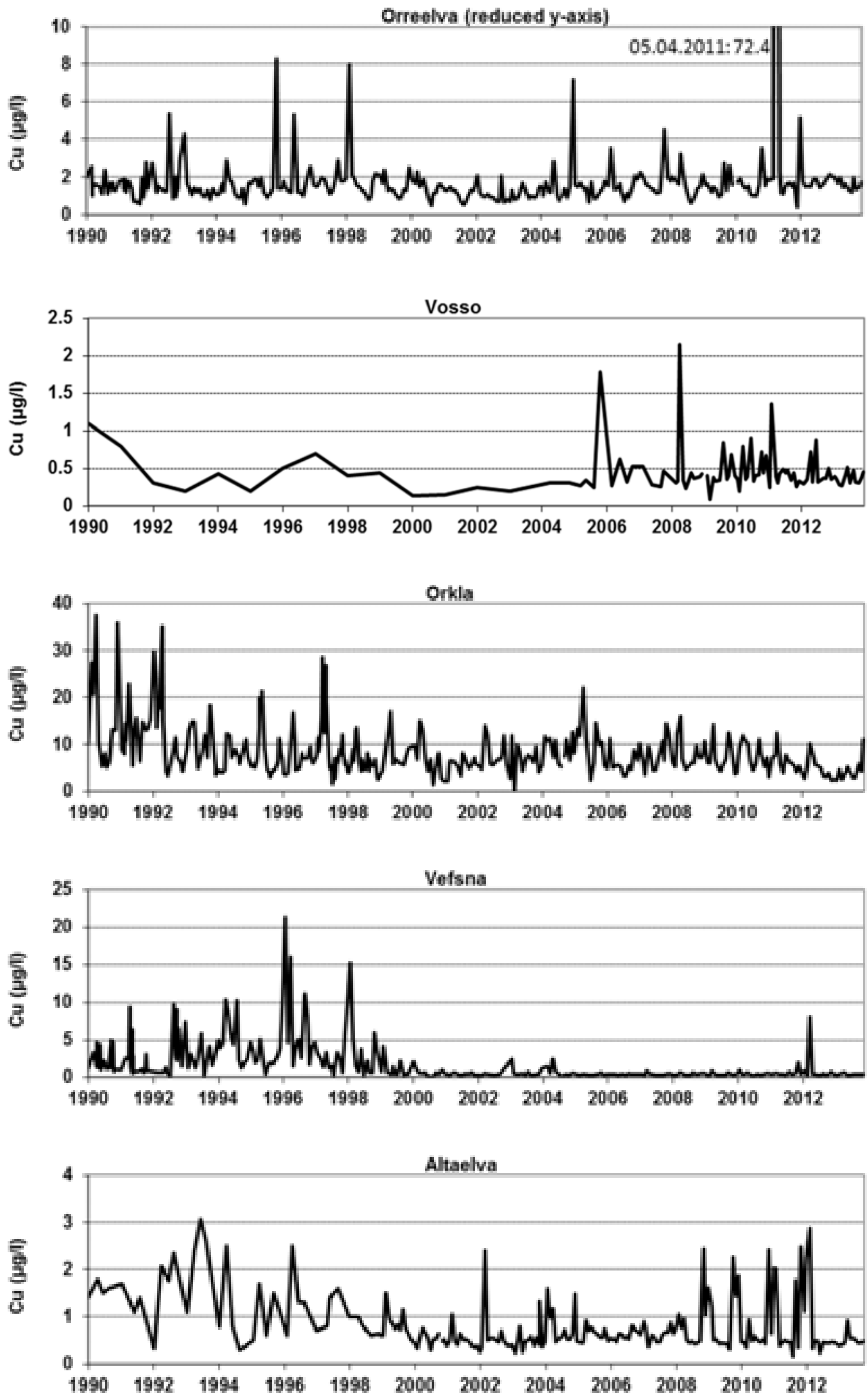


Figure A-VI-9b. Monthly concentrations of copper (Cu) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note Orreelva with reduced y-axis, and only 1-4 samples per year in River Vosso, 1990-2007.

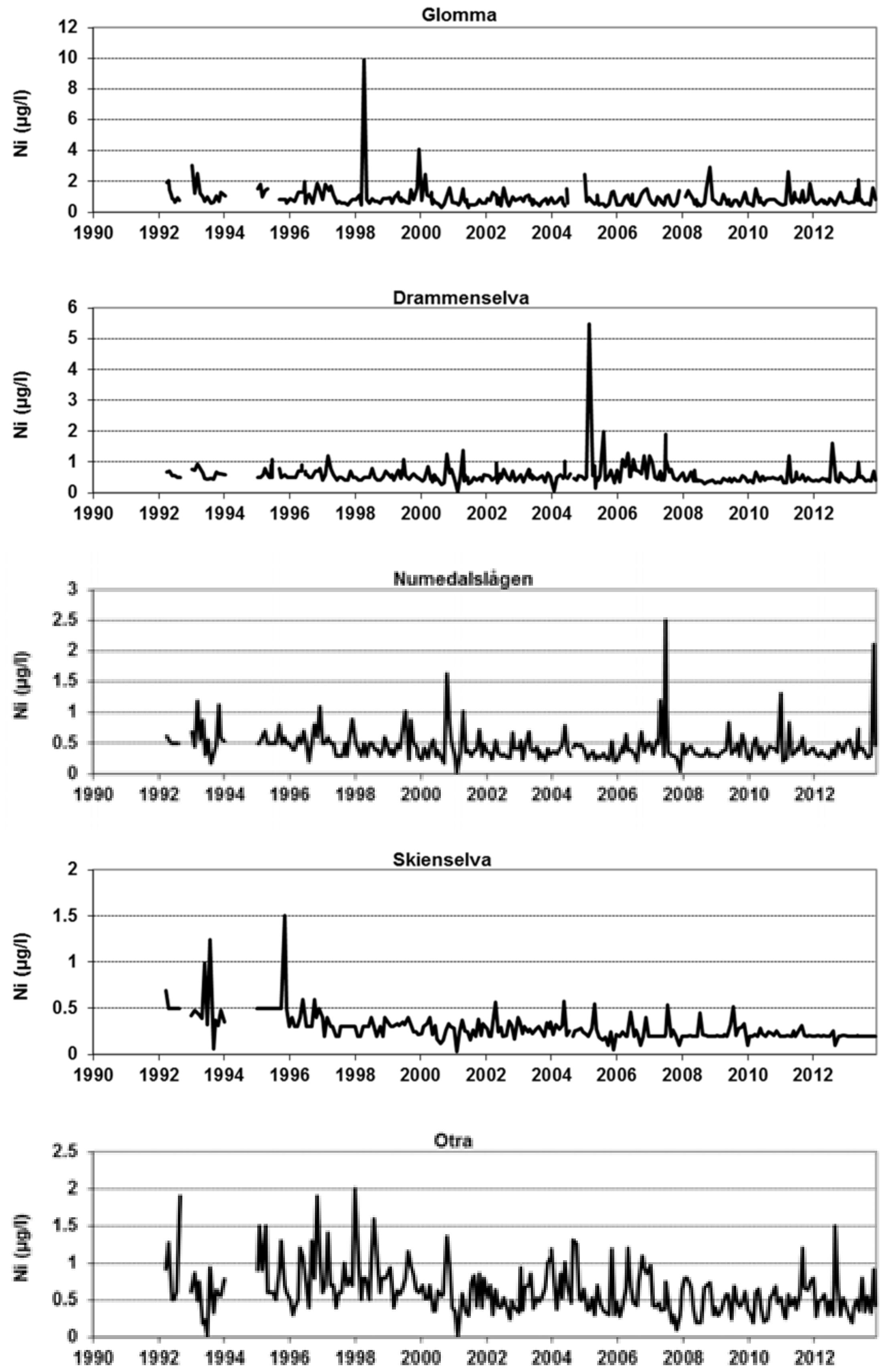


Figure A-VI-10a. Monthly concentrations of nickel (Ni) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

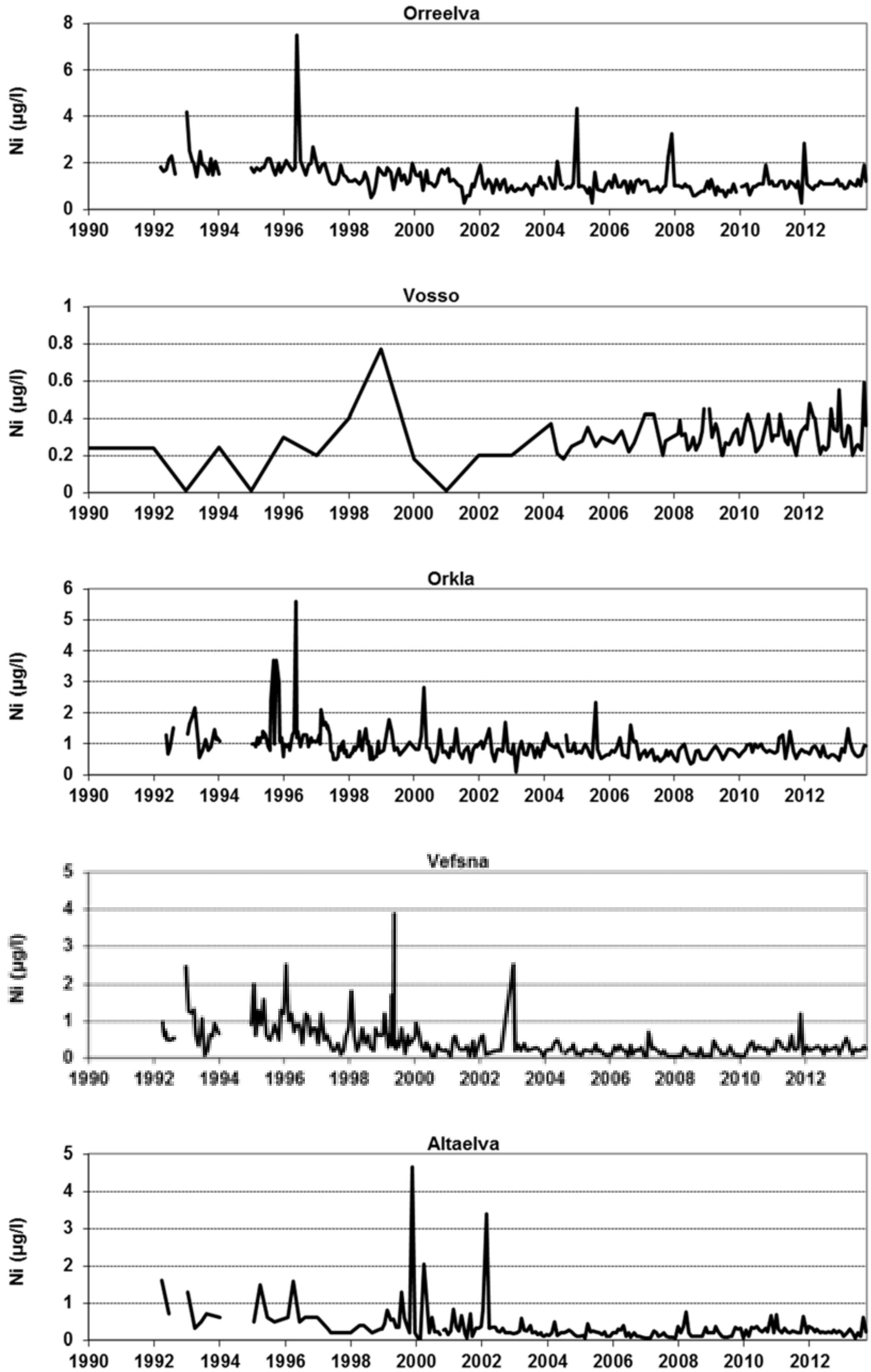


Figure A-VI-10b. Monthly concentrations of nickel (Ni) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

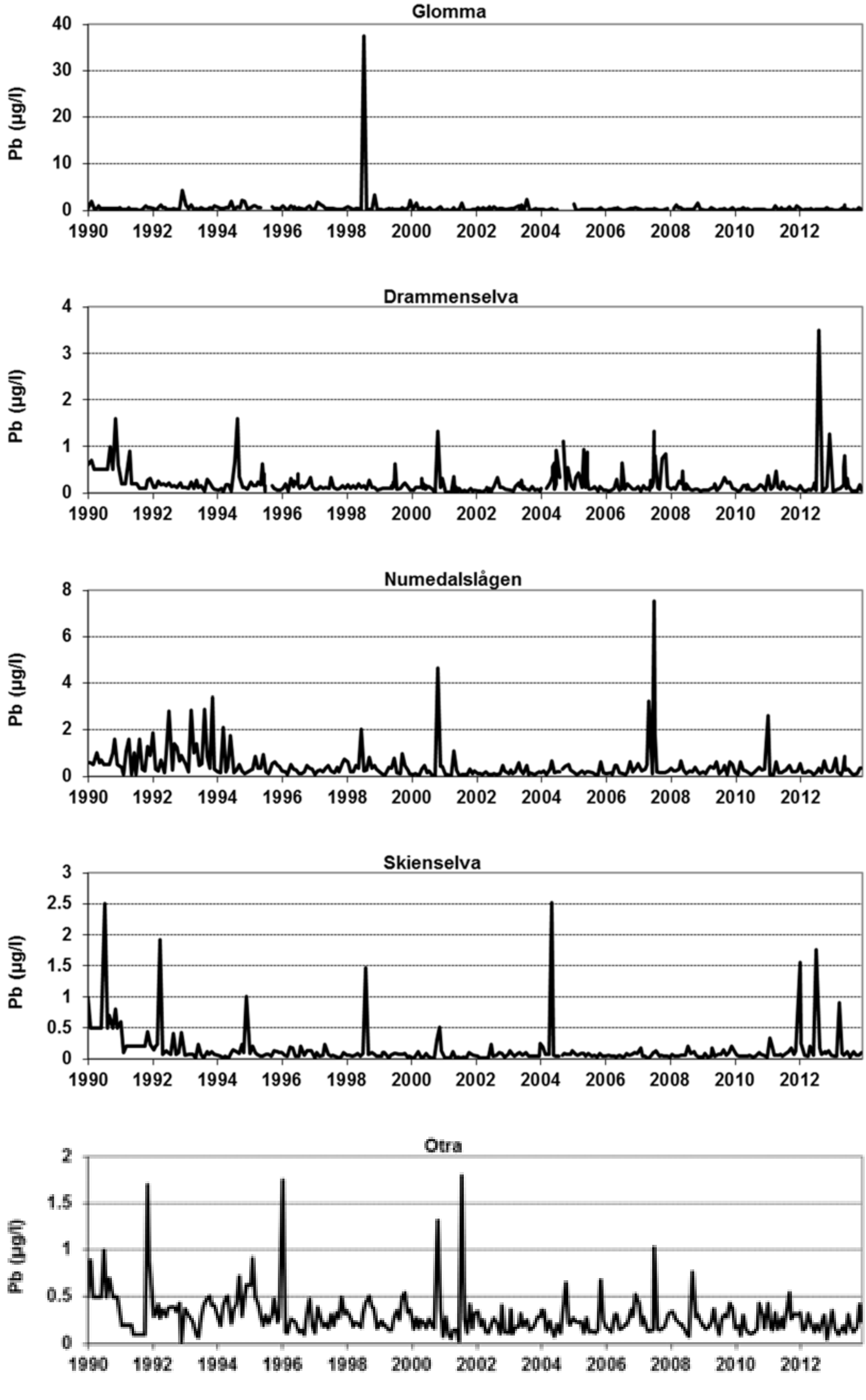


Figure A-VI-11a. Monthly concentrations of lead (Pb) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

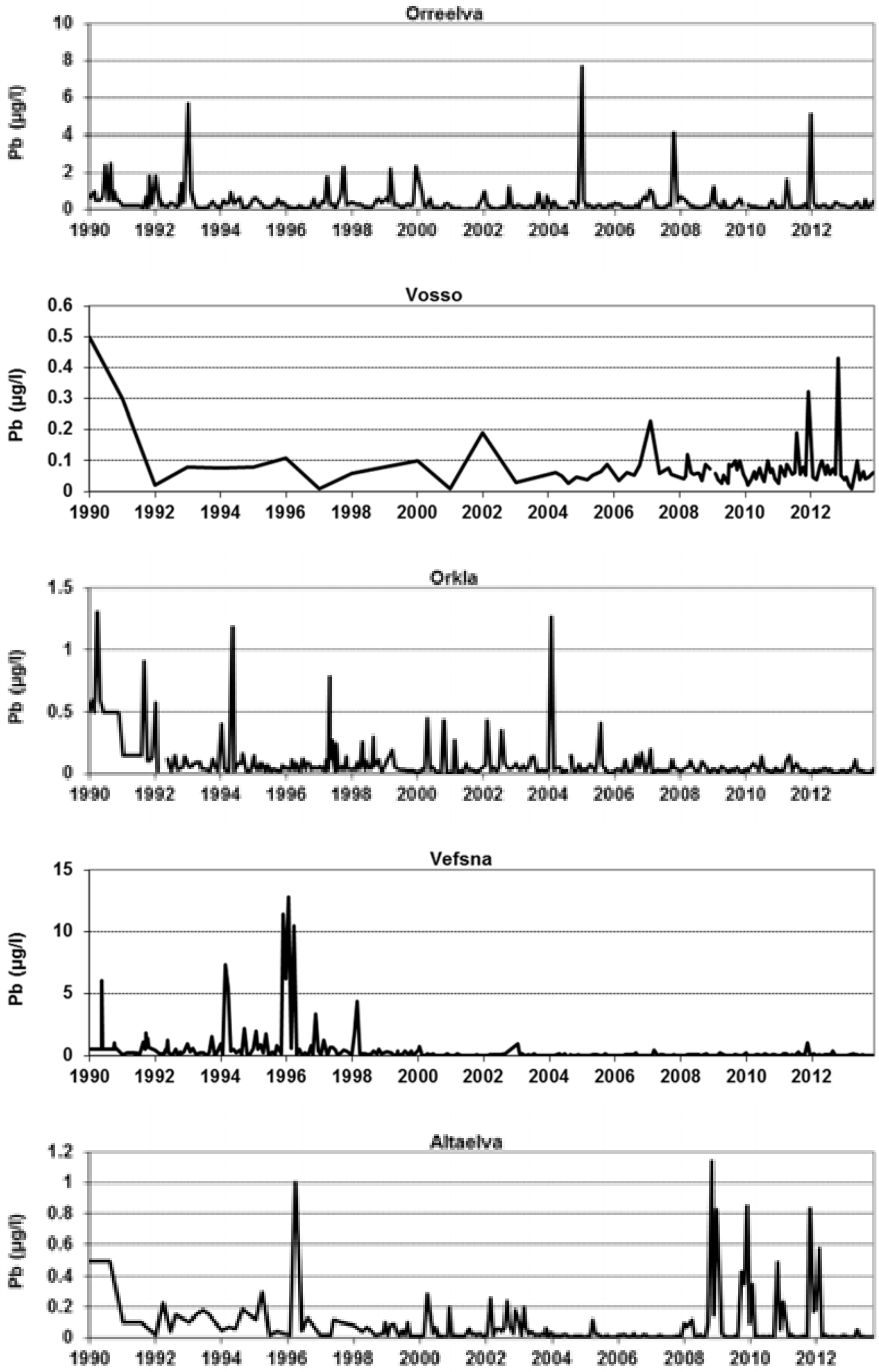


Figure A-VI-11b. Monthly concentrations of lead (Pb) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

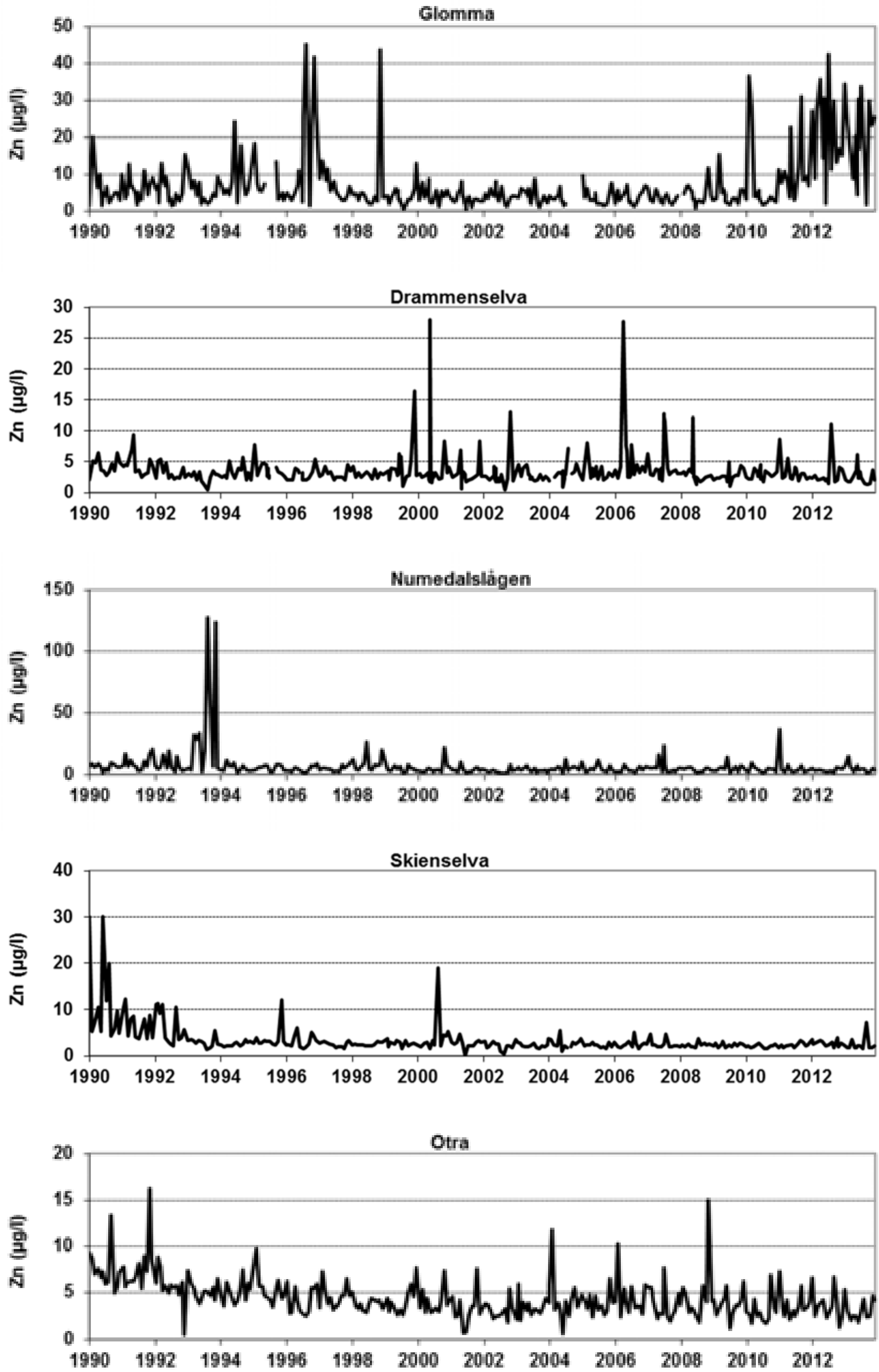


Figure A-VI-12a. Monthly concentrations of zinc (Zn) in the five main rivers draining to Skagerrak, Norway, 1990-2013.

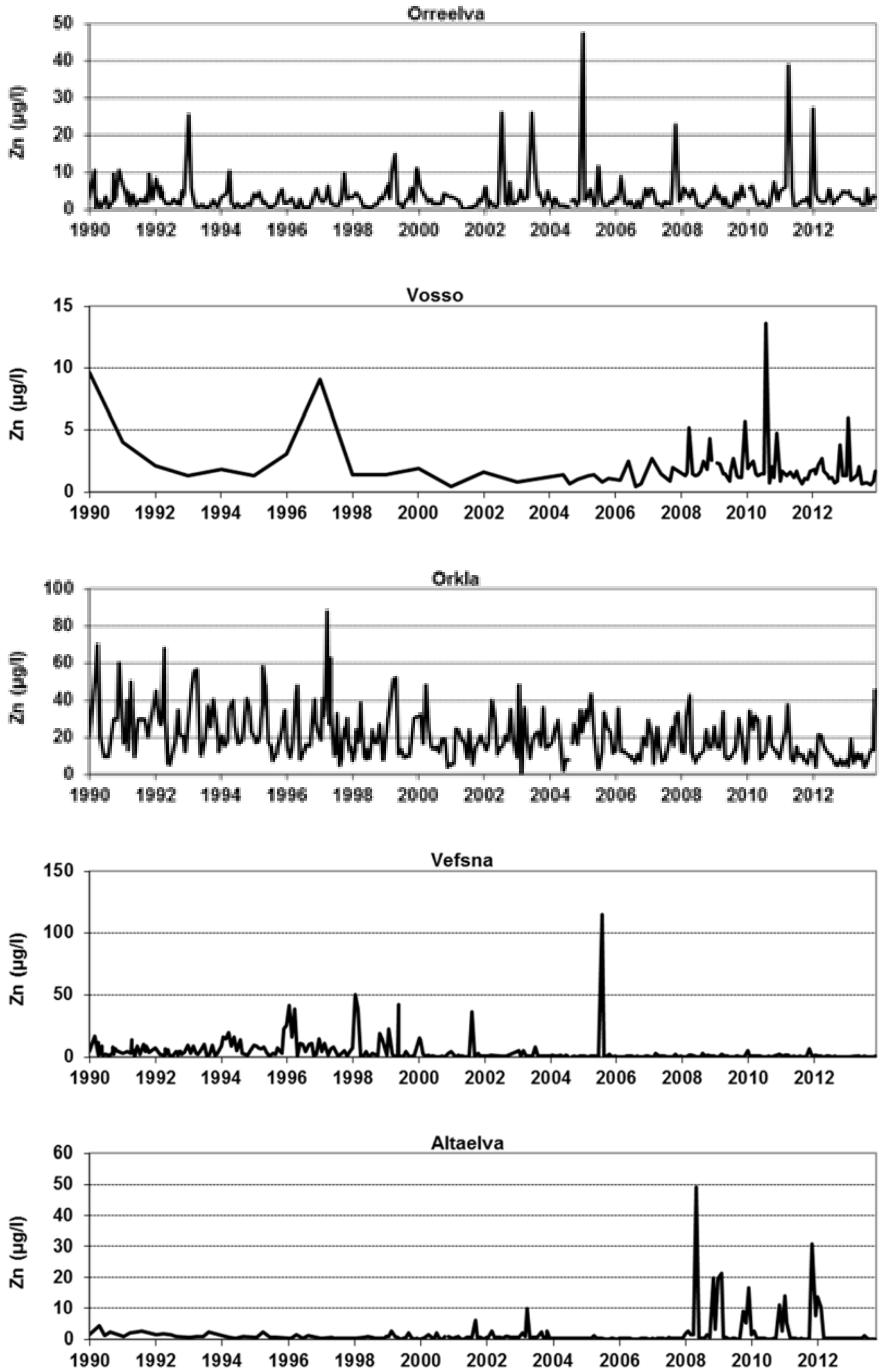


Figure A-VI-12b. Monthly concentrations of zinc (Zn) in the five main rivers draining to the North Sea, the Norwegian Sea and the Barents Sea, Norway, 1990-2013. Note only 1-4 samples per year in River Vosso, 1990-2007.

Appendix VII Passive sampling of trace metals using DGT*

*Diffusive Gradients in Thin-films (DGT)

Introduction

Widespread uses of metals, the legacies of past contamination and new technologies continue to pose ecological risks for aquatic environments across the earth. It can be argued that metal pollution is the most complicated of present contamination issues: Anthropogenic sources, both long range and local, are important, but natural background levels are variable and contribute to the total load. The bioavailability and mobility of metals in the environment also vary depending on the metal and physico-chemical conditions. Moreover, many metals are essential trace nutrients for biota, but highly toxic when concentration and/or speciation change. This window of transition can be narrow. It is therefore important to understand fluxes and mobility of metals in the environment. An important question for a monitoring programme like RID is how well the temporal variation in trace metal concentrations is covered by conventional grab sampling (Horowitz, 2013). The DGT is a robust and user friendly technique for measuring time-averaged concentrations of elements and compounds in surface water, as well as in soils and sediments (see e.g. Davison et al., 2000) and could be a useful supplement to conventional monitoring. The DGT sampler only collects the forms of the component that is able to diffuse through a hydrogel and bind to a sorbent layer. These forms do not include strongly bound metals or particulate metals (van Leeuwen et al., 2005) . The importance attributed to speciation is manifested in EU's Water framework directive (2013/39/EU). Mentioned document does not regulate total concentration of metals in water. Instead the water EQS for metals refer to "the dissolved concentration, i.e. the dissolved phase of a water sample obtained by filtration through a 0,45 µm filter or any equivalent pre-treatment, or, where specifically indicated, to the bioavailable concentration". The DGT can be considered "equivalent pre-treatment" (EC, 2014 draft). The DGT technique has been used extensively for 20 years in research, but much less as a monitoring tool. The reason for this is not quite clear, but two aspects can be confusion concerning the interpretation of the measurements (what is this "concentration of labile metal"), and perhaps an apprehension that, despite the technique's simplicity, it will be hard to obtain good measurements by mailing the sampler between the laboratory and a lay-person as done with bottles for conventional sampling. The aim of the current work was to test if useful and good quality data can be obtained by this approach. The work was a supplementary activity to the RID programme in 2013.

Methods

The DGT samplers used were of the standard open pore type with a hydrophilic polyethersulphone membrane filter (pore size 0.45 µm), agarose-crosslinked polyacrylamide hydrogel and chelex resin gel (www.dgtresearch.com/). Four deployments were made in six rivers draining to the Skagerrak sea (Rivers Glomma, Alna, Drammenselva, Numedalslågen, Skienselva, and Otra). The DGTs were sent by mail from the laboratory to the person doing the sampling (this was the same person who did the regular bottle sampling, appendix II, except in River Glomma) and returned the same way. The DGTs were deployed in a coarse-meshed plastic ham net bound to a rope. The rope had a buoy in one end and a stone in the other in order to hold the DGT(s) approximately half way between the bottom and the surface. The rig was deployed by hand throw from the shore and moored to land allowing easy retrieval. The DGTs were deployed at the same site, or close to the same site, as the bottle samples were collected. The persons doing the sampling were visited by NIVA personnel for exchange of practical information and common inspection of the sampling site. After one week to one month in the water, the DGTs were rinsed with deionised water and returned to the laboratory. The water temperature was measured at the beginning and end of each deployment. These measurements were used to calculate average temperature in rivers where this variable was not measured continuously. In the laboratory, the DGTs were opened in clean room atmosphere, and the resin gels transferred to tubes with subsequent addition of 1 ml of nitric acid (suprapure, 65%). After 24 hours, 9 ml of deionized water was added, the tubes were shaken and the solution decanted to a new tube. Internal standard was added and metal concentrations measured with ICP-MS. All plastic equipment was acid rinsed prior to use.

Usually, the concentration of DGT labile metal ($C_{DGT,\ labile}$) is calculated with the following equation:

$$C_{DGT,labile} = \frac{m\Delta g}{AtD_m},$$

where m is mass of metal extracted from the resin gel, Δg is combined thickness of diffusive gel (0.8 mm) and membrane filter (0.14 mm), A is area of filter exposed to water (3.14 cm^2), t is deployment time and D_m is the diffusion coefficient of the free metal ion at the average temperature. A disadvantage with the equation above is that the metals bound to humic substances, which comprise more than halfof the dissolved concentration for many metals, is not accounted for by $C_{DGT, labile}$. This is not a problem when the objective is to assess bioavailable metal. However, for our purpose here, which is partly comparison with total concentration of metals in grab samples, it is suitable to weigh the diffusion coefficient according to expected binding of various trace metals by humic substances, in order calculate a concentration (let us call it $C_{DGT, dynamic}$) that is closer to the total dissolved concentration:

$$C_{DGT,dynamic} = \frac{\frac{m\Delta g}{At}}{D_{m,fulvic\ acid}\alpha + D_m(1-\alpha)},$$

$D_{m,\ fulvic\ acid}$ is the diffusion coefficient of the metal-fulvic acid complex, here estimated as 20 percent of D_m (Scally et al., 2006), α is the fraction of metal bound by fulvic acid and 1- α is assumed to be the fraction of inorganic species. The latter are usually small and can be expected to diffuse at the same rate as the free metal ion.

Unfortunately, variables such as alkalinity and concentrations of major ions, which are useful for calculation of α, are not part of the RID programme and had to be estimated. This was done in the following way:

1. The electric conductivity (25 degrees C) was assumed to be related to ionic strenth (µ) through the formula:
   $\mu = \Sigma C_i Z_i$ = 0.00016 × conductivity (mS/m)
   where C_i is the concentration of ion i, and Z_i is its charge (Snoeyink and Jenkins, 1980).
2. The pH and measured concentrations of nitrate and ammonium as well as unmeasured concentrations of calcium, magnesium, sodium, potassium, chloride, sulphate and bicarbonate were assumed to be the only determinands of ionic strength
3. The bicarbonate concentration was calculated by assuming that the total dissolved carbonate concentration was in equilibrium with a CO_2 partial pressure of 1,1E-4 (three times the atmospheric pressure) at the measured pH (see Stumm and Morgan, 1996, for an explanation of how this can be done).
4. The ratios between the remaining major ions were in all rivers assumed to be the same as the average ratios found in Glomma 2009 (Allan et al., 2010).

These estimated concentrations and the measured pH, DOC and levels of trace metals in grab samples were used to calculate α. This was done with the geochemical speciation software WHAM, Model VII (Tipping et al., 2011), using the default database. Aluminium and iron concentrations were assumed to be controlled by the solubility product of hydroxides. Fulvic acid was assumed to be the only major binding agent except from inorganic ligands. The ratio of fulvic acid to DOC was assumed to be 1.30 (Bryan et al., 2002). The average value of α for each river was used to calculate $C_{DGT,\ dynamic}$. It should be stated that $C_{DGT,\ dynamic}$ is not very sensitive to α. For example when 50% of the metal is bound to fulvic, $C_{DGT,\ dynamic}$ is 60% of the value when there is no binding to fulvic acid.

Results and discussion

Four samplers were rendered useless or lost because of intervention from passers by during deployments in Rivers Alna and Skienselva. A weakness of passive sampling is lack of control during the sampling process. It can for example be difficult to detect if unauthorised persons have tampered with the equipment and put it back in the water. The equipment has little value except for the value of the sample itself, but could nevertheless attract attention from curious persons. The other sampling events appear to have been completed according to plan.

Extracted mass of metal from all DGTs (including blanks), length of deployment, estimated average temperature during the deployment times, calculated α-values for each river, deployment time spans and calculated $C_{DGT,\ dynamic}$ are tabulated in three tables below (Table AVII-1, Table AVII-2 and Table AVII-3). Below the tables follows 5 multi-panel figures with a graphic comparison of $C_{DGT,\ dynamic}$ with total concentrations measured in grab samples for the metals cadmium, copper, nickel, lead and zinc (Figure AVII-1 – Figure AVII-5).

Table AVII-1. Deployment times, estimated average temperature for the deployment time span and mass of metals extracted from the DGTs.

River	Time	Temp	Ag	Al	Cd	Co	Cr	Cu	Mn	Ni	Pb	Zn
	Days	Deg. C	ng	ng	ng	ng	ng	ng	ng	ng	ng	ng
Glomma	30	13	0.7	422	0.5	1.2	5.9	94	38	41	0.5	209
Glomma	25	17	<0.5	125	0.9	0.5	5.5	127	19	38	1.6	184
Glomma	49	10	<0.5	198	0.5	0.3	8.5	103	30	36	3.3	1214
Glomma	49	10	<0.5	473	0.4	0.3	4.2	82	17	33	0.7	1821
Glomma	49	10	<0.5	396	0.7	0.7	8.5	123	55	41	8.0	910
Alna	29	10	<0.5	3370	3.7	13	13	220	7517	73	24	1036
Alna	29	13	<0.5	537	12.0	83.5	8.3	472	65521	177	40	2954
Alna	36	13	<0.5	2601	3.0	7.6	17.5	341	2976	114	14	1382
Alna	33	9	<0.5	869	8.9	2.8	82.7	335	4229	90	2.4	3033
Alna	33	9	<0.5	561	7.6	22.9	55.1	325	18219	96	2.1	2143
Alna	33	9	<0.5	1206	14.8	83.0	8.3	469	31883	220	5.9	5275
Drammenselva	21	8	<0.5	1520	1.1	7.8	3.4	20	1162	28	2.0	223
Drammenselva	30	12	<0.5	2048	1.3	3.2	5.6	41	528	34	4.8	281
Drammenselva	28	17	<0.5	1461	0.6	2.4	3.0	17	494	19	1.5	118
Drammenselva	20	8	<0.5	1003	0.5	1.8	3.2	20	286	17	1.5	189
Drammenselva	20	8	<0.5	1036	0.5	1.8	6.5	17	248	17	0.8	147
Drammenselva	20	8	<0.5	1020	0.4	1.9	4.8	16	286	18	0.8	182
Numedalslågen	13	4	<0.5	1637	1.6	8.2	3.6	18	2110	13	2.6	449
Numedalslågen	57	10	<0.5	5117	6.6	20.0	<3	67	653	75	7.4	1504
Numedalslågen	35	16	<0.5	2207	2.9	8.9	3.7	42	738	51	1.9	616
Numedalslågen	30	7	<0.5	2963	2.4	6.4	4.9	27	1919	33	2.5	697
Numedalslågen	30	7	<0.5	2716	2.3	6.1	7.3	24	2606	30	2.4	638
Numedalslågen	30	7	<0.5	2716	2.3	5.8	7.3	28	1633	30	2.5	638
Skienselva	14	3	<0.5	597	0.7	0.9	3.7	44	352	10	1.8	234
Skienselva	33	10	<0.5	1379	2.0	0.6	8.6	28	201	21	1.1	483
Skienselva	33	10	<0.5	1701	2.5	1.0	5.8	35	272	23	2.7	517
Skienselva	33	10	<0.5	1525	2.4	0.8	5.8	25	272	23	1.4	517
Skienselva	37	6	<0.5	1361	2.8	1.7	5.7	45	309	30	2.0	681
Skienselva	20	4	<0.5	944	1.3	1.7	7.2	25	753	14	2.4	416
Otra	28	1	<0.5	1799	1.8	6.4	3.5	27	430	36	4.3	414
Otra	28	4	0.6	2580	1.9	8.9	3.9	20	437	37	12.6	397
Otra	33	17	<0.5	3140	3.7	18.1	3.6	37	85	108	9.8	730
Otra	28	9	<0.5	3584	4.2	10.5	4.7	19	582	70	12.0	758
Otra	28	9	<0.5	3823	4.5	11.6	4.7	18	693	76	13.8	842
Otra	28	9	<0.5	3584	5.1	14.1	7.0	17	859	79	12.4	870

River	Time	Temp	Ag	Al	Cd	Co	Cr	Cu	Mn	Ni	Pb	Zn
	Days	Deg. C	ng	ng	ng	ng	ng	ng	ng	ng	ng	ng
Blank			<0.5	11	0.1	0.1	8.2	8	2	5	0.2	52
Blank, Glomma			<0.5	8	<0.15	0.1	8.6	11	1	2	<0.2	57
Blank, Alna			<0.5	9	<0.15	0.1	5.5	3	2	1	<0.2	31
Blank, Drammen.			<0.5	12	<0.15	0.1	6.5	3	3	1	<0.2	39
Blank Numedalsl.			<0.5	7	<0.15	0.1	4.9	3	0	1	0.3	64
Blank, Otra			<0.5	2	<0.15	0.1	7.0	6	9	2	<0.2	31

Table AVII-2. Calculated average fractions (α) of metals bound to fulvic acid.

	Ag	Al	Cd	Co	Cr(III)	Cu	Mn	Ni	Pb	Zn
Glomma	0.07	0.68	0.46	0.19	1.00	0.99	0.71	0.34	0.96	0.65
Alna	0.03	0.01	0.19	0.02	1.00	0.96	0.35	0.05	0.39	0.28
Drammenselva	0.10	0.75	0.52	0.21	1.00	0.99	0.72	0.42	0.97	0.68
Numedalslågen	0.11	0.93	0.50	0.24	1.00	0.99	0.69	0.43	0.97	0.65
Skienselva	0.10	0.94	0.48	0.23	1.00	0.99	0.65	0.41	0.96	0.62
Otra	0.07	0.98	0.26	0.14	1.00	0.98	0.32	0.23	0.81	0.35

Table AVII-2. Time span of deployments in the six rivers and concentrations of DGT dynamic metal ($C_{DGT, dynamic}$)

River	Deployment time span		Ag	Al	Cd	Co	Cr	Cu	Mn	Ni	Pb	Zn
	Start	Stop	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Glomma	05.06.2013	05.07.2013	8.5E-04	2.9	0.002	0.004	0.09	1.2	0.24	0.14	0.004	1.1
Glomma	05.07.2013	30.07.2013	<6.5E-4	0.92	0.004	0.002	0.09	1.7	0.13	0.14	0.012	1.1
Glomma	27.09.2013	15.11.2013	<6.5E-4	0.94	0.001	0.001	0.09	0.90	0.13	0.09	0.016	4.6
Glomma	27.09.2013	15.11.2013	<6.5E-4	2.2	0.001	0.001	0.05	0.72	0.07	0.08	0.004	7.0
Glomma	27.09.2013	15.11.2013	<6.5E-4	1.9	0.002	0.002	0.09	1.1	0.24	0.10	0.039	3.5
Alna	06.05.2013	04.06.2013	<6.5E-4	12	0.013	0.040	0.23	2.8	32	0.22	0.066	4.1
Alna	04.06.2013	02.07.2013	<6.5E-4	1.8	0.039	0.237	0.14	5.5	258	0.50	0.098	11
Alna	02.07.2013	07.08.2013	<6.5E-4	6.9	0.008	0.017	0.23	3.2	9.3	0.25	0.027	4.0
Alna	03.10.2013	05.11.2013	<6.5E-4	2.9	0.030	0.008	1.39	4.0	17	0.25	0.006	11
Alna	03.10.2013	05.11.2013	<6.5E-4	1.9	0.025	0.065	0.93	3.8	72	0.27	0.005	7.8
Alna	03.10.2013	05.11.2013	<6.5E-4	4.0	0.049	0.237	0.14	5.5	126	0.62	0.015	19
Drammenselva	15.05.2013	05.06.2013	<6.5E-4	21	0.009	0.043	0.09	0.44	13	0.18	0.024	2.2
Drammenselva	05.06.2013	05.07.2013	<6.5E-4	17	0.006	0.011	0.09	0.55	3.5	0.13	0.036	1.7
Drammenselva	05.07.2013	02.08.2013	<6.5E-4	11	0.003	0.008	0.05	0.22	3.1	0.07	0.010	0.67
Drammenselva	18.10.2013	07.11.2013	<6.5E-4	14	0.004	0.011	0.09	0.46	3.3	0.12	0.019	2.0
Drammenselva	18.10.2013	07.11.2013	<6.5E-4	15	0.004	0.010	0.19	0.38	2.9	0.12	0.010	1.6
Drammenselva	18.10.2013	07.11.2013	<6.5E-4	15	0.004	0.011	0.14	0.36	3.3	0.12	0.010	1.9
Numedalslågen	23.04.2013	06.05.2013	<6.5E-4	65	0.023	0.087	0.19	0.77	41	0.17	0.062	8.1
Numedalslågen	06.05.2013	02.07.2013	<6.5E-4	36	0.017	0.038	<0.03	0.50	2.3	0.17	0.031	4.8
Numedalslågen	02.07.2013	06.08.2013	<6.5E-4	21	0.010	0.023	0.05	0.43	3.5	0.16	0.011	2.7
Numedalslågen	07.10.2013	06.11.2013	<6.5E-4	43	0.013	0.025	0.09	0.41	14	0.16	0.022	4.7
Numedalslågen	07.10.2013	06.11.2013	<6.5E-4	40	0.012	0.024	0.14	0.38	19	0.14	0.021	4.3
Numedalslågen	07.10.2013	06.11.2013	<6.5E-4	40	0.012	0.023	0.14	0.44	12	0.14	0.021	4.3

River	Deployment time span		Ag	Al	Cd	Co	Cr	Cu	Mn	Ni	Pb	Zn
	Start	Stop	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Skienselva	23.04.2013	07.05.2013	<6.5E-4	24	0.009	0.009	0.19	1.77	6.2	0.12	0.039	3.9
Skienselva	09.10.2013	11.11.2013	<6.5E-4	18	0.009	0.002	0.14	0.37	1.2	0.08	0.008	2.6
Skienselva	09.10.2013	11.11.2013	<6.5E-4	22	0.011	0.003	0.09	0.45	1.6	0.09	0.020	2.8
Skienselva	09.10.2013	11.11.2013	<6.5E-4	20	0.011	0.003	0.09	0.32	1.6	0.09	0.010	2.8
Skienselva	11.11.2013	18.12.2013	<6.5E-4	18	0.013	0.006	0.09	0.59	1.8	0.12	0.014	3.7
Skienselva	18.12.2013	07.01.2014	<6.5E-4	24	0.011	0.011	0.23	0.64	8.6	0.11	0.035	4.5
Otra	11.03.2013	08.04.2013	<6.5E-4	41	0.010	0.030	0.09	0.52	2.5	0.18	0.031	2.4
Otra	08.04.2013	06.05.2013	0.001	56	0.010	0.040	0.09	0.36	2.4	0.17	0.086	2.2
Otra	04.07.2013	06.08.2013	<6.5E-4	37	0.010	0.044	0.05	0.36	0.25	0.27	0.037	2.2
Otra	09.10.2013	06.11.2013	<6.5E-4	64	0.018	0.039	0.09	0.28	2.6	0.27	0.068	3.5
Otra	09.10.2013	06.11.2013	<6.5E-4	68	0.019	0.043	0.09	0.28	3.1	0.30	0.079	3.9
Otra	09.10.2013	06.11.2013	<6.5E-4	64	0.021	0.052	0.14	0.26	3.9	0.31	0.071	4.0

Silver. The concentration of silver was below the detection limit in all grab samples from the six rivers and even in all but two resin gel extracts. This indicates that the concentration of dissolved silver is very low (1 ng/l or lower), i.e. more than 50 times lower than the detection limit in conventional water samples. An alternative explanation could be that the silver is strongly bound by e.g. sulphide containing ligands and therefore not available for uptake in the DGT sampler. A possible way to lower the detection limit of the DGT further could be to deploy more DGTs simultaneously and extract several resin gels together.

Chromium. The level in extracts of field-deployed DGTs were generally not higher than in blank DGTs (Table AVII-1). Time integrated concentrations could therefore not be quantified.

Aluminium. The highest DGT dynamic concentrations were, as expected, found in Otra, the only one of the 6 rivers with pH close to 6.0. River Alna has much higher pH and, as a consequence, much lower accumulation of aluminium in the DGTs. It is not so easy to explain why the DGT dynamic concentration in Glomma is much lower than in rivers Drammenselva, Numedalslågen and Skienselva. Presumably, the humic substances in the former carry lower concentrations of aluminium. Potential differences in fluoride concentration could also affect the results because of its effect on aluminium solubility.

Cobalt. The DGT dynamic concentrations of cobalt are low but vary markedly, about two order of magnitudes, between rivers. Concentrations decline in the order Alna > Otra > Numedalslågen > Drammenselva > Skienselva > Glomma.

Manganese. The DGT dynamic concentration of manganese is high in Numedalslågen and, at times, very high in Alna. The concentration of manganese in the other rivers is relatively low.

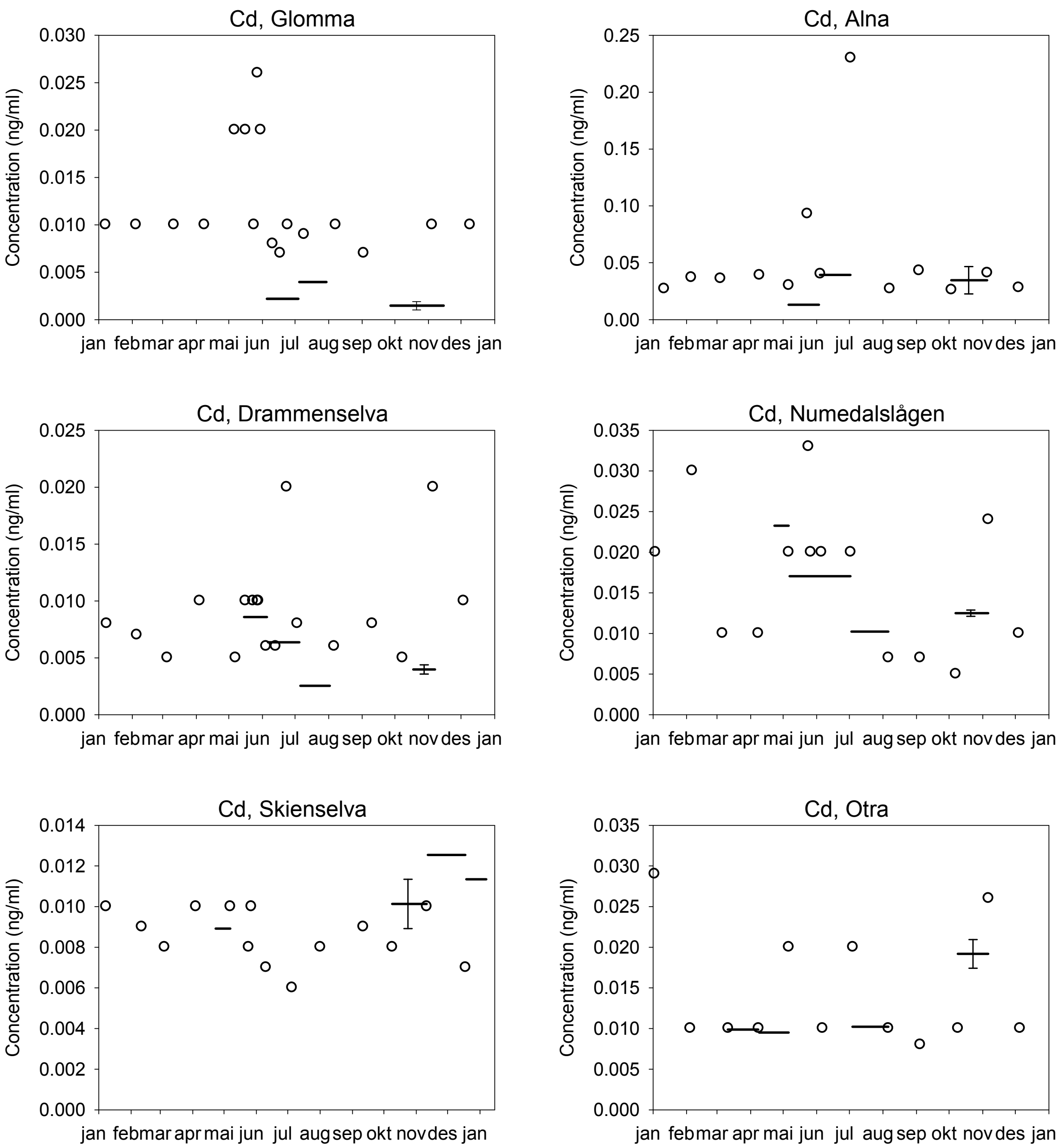


Figure AVII-1. Concentration of cadmium measured in grab samples (circles) and time averaged concentrations of DGT dynamic cadmium (horizontal lines). The line with error bars indicate the average of three parallells +/- half the distance between the maximum and minimum.

Cadmium. The cadmium levels were low, but concentrations in Alna were 2-4 times higher than in the other rivers. The DGT dynamic concentration of Cd was generally close to the concentrations measured in the grab samples. An exception is Glomma where total concentrations were consistently higher than DGT dynamic concentration.

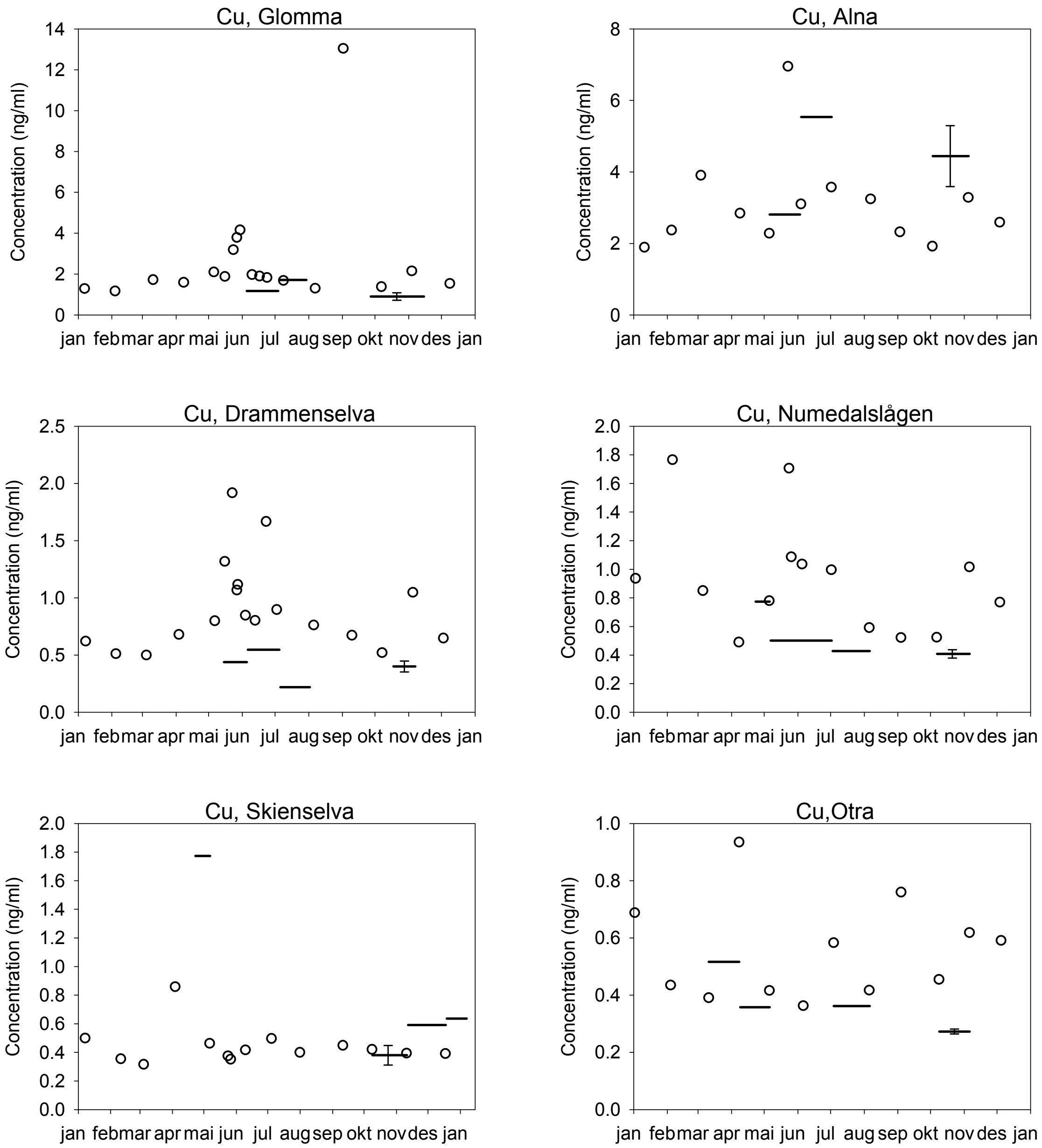


Figure AVII-2. Concentration of copper measured in grab samples (circles) and time averaged concentrations of DGT dynamic copper (horizontal lines). The line with error bars indicate the average of three parallells +/- half the distance between the maximum and minimum.

Copper. There was good agreement between concentrations measured in grab samples and DGT dynamic concentrations. Exceptions were Drammenselva, where $C_{DGT,\ dynamic}$ was consistently lower than the total concentration, and in Alna where the opposite was true during mid summer and autumn. The copper concentration in Alna was variable and monthly grab sampling could miss spikes in copper concentration with appreciable effect on integrated mass transport

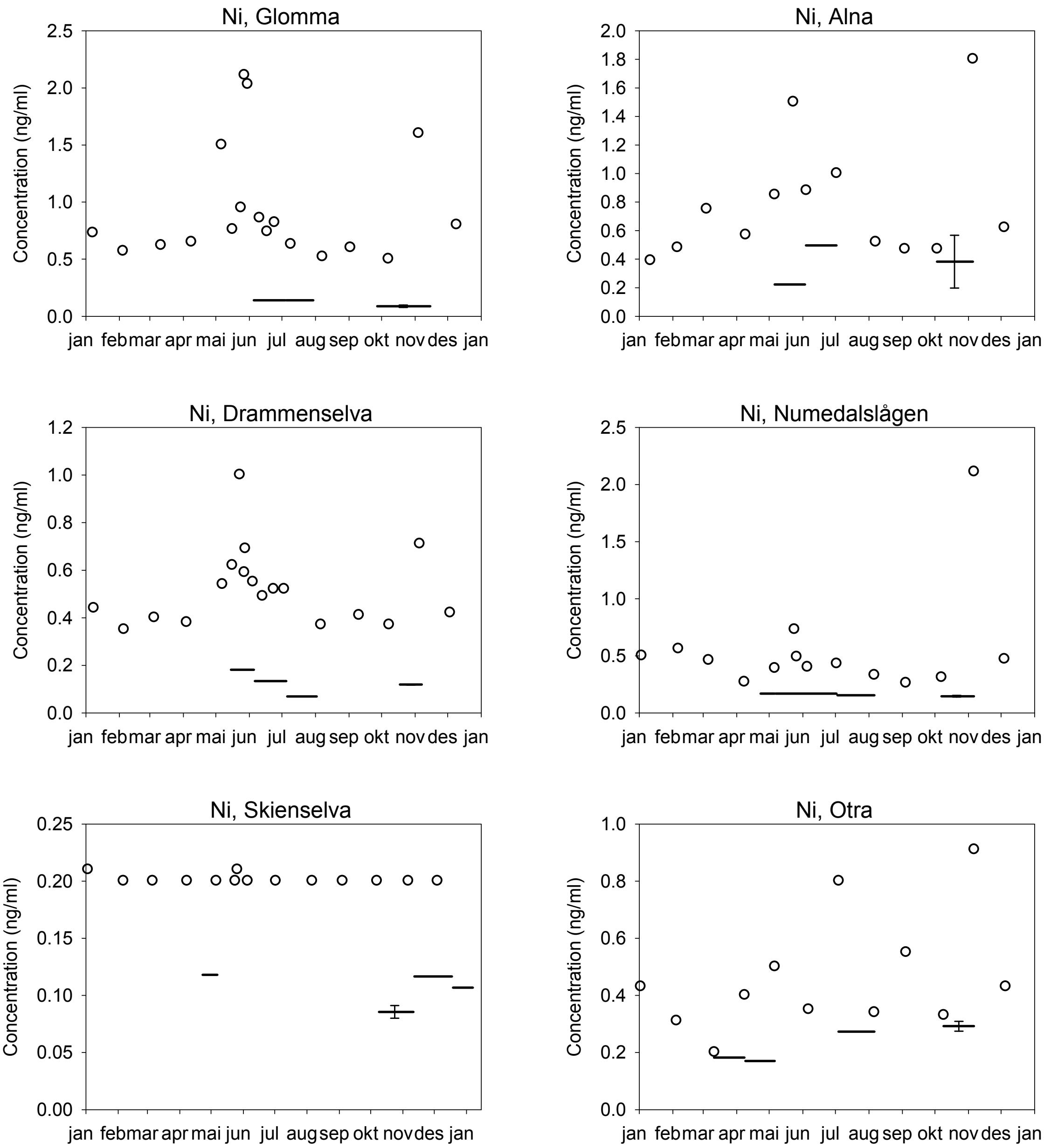


Figure AVII-3. Concentration of nickel measured in grab samples (circles) and time averaged concentrations of DGT dynamic nickel (horizontal lines). The line with error bars indicate the average of three parallells +/- half the distance between the maximum and minimum.

Nickel. The DGT dynamic concentration of nickel was consistently lower than total concentrations in all rivers. There could be several reasons for this: 1) Underestimation of the fraction bound by humic substances (Mueller et al., 2012). 2) Metal-chelating aminopolycarboxylic acids like EDTA and NTA that can occur in considerable concentrations in urbanised rivers (Ahmed et al., 2014), bind nickel so strongly that it is not available for uptake in DGT. 3) Binding to colloidal or particulate matter (see for lead below and also *Figure AVII-6*).

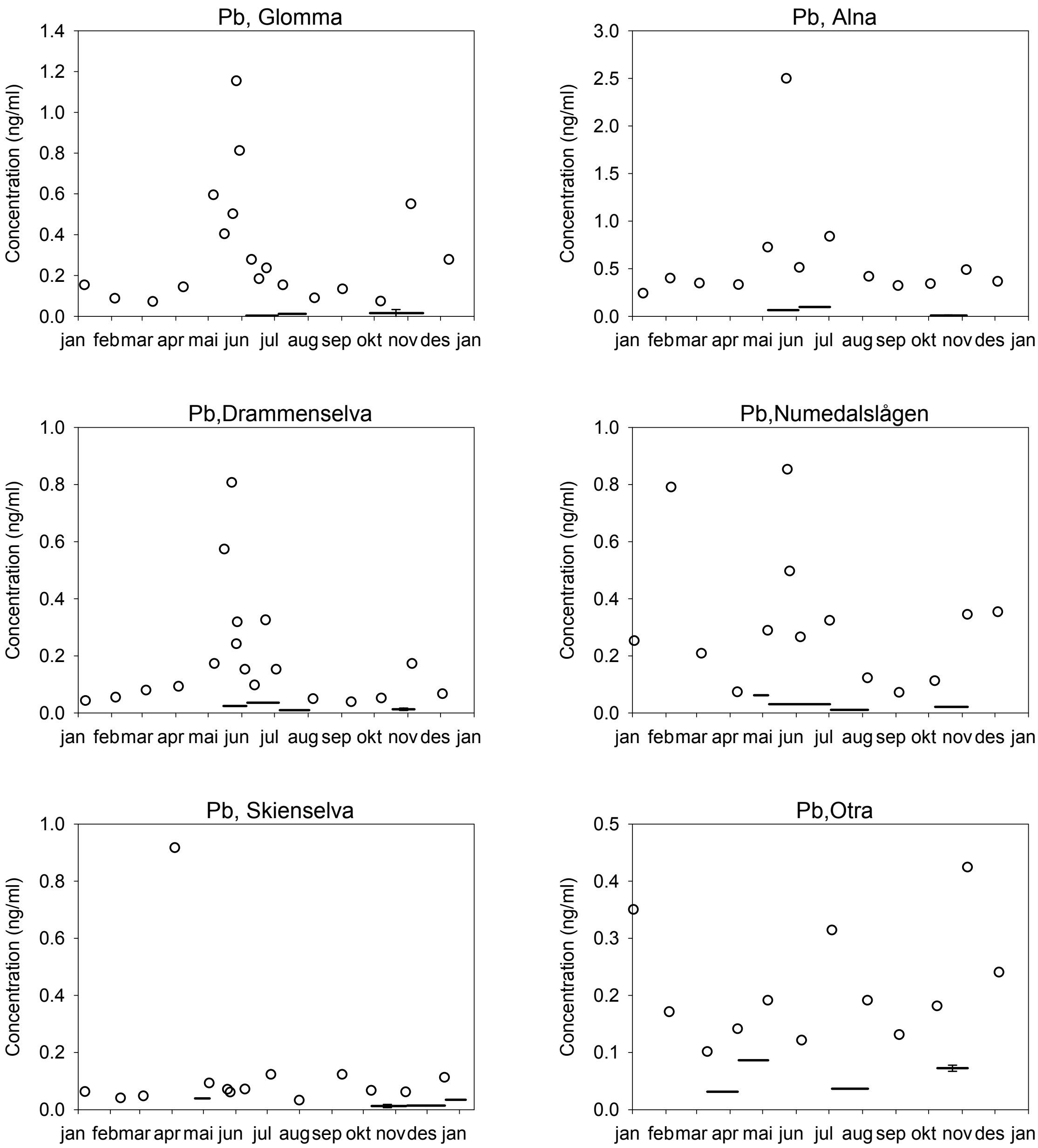


Figure AVII-4. Concentration of lead measured in grab samples (circles) and time averaged concentrations of DGT dynamic lead (horizontal lines). The line with error bars indicate the average of three parallells +/- half the distance between the maximum and minimum.

Lead. The DGT dynamic concentration of lead was low in all rivers and much lower than the total concentrations. The most likely explanation is that most of the lead is not truly dissolved but rather associated with colloids or particles that are not available for uptake in DGT samplers. Lead is highly correlated to suspended particulate matter (and turbidity) in these six rivers (Figure AVII-6), indicating the importance of particles for the mobility of this element. Lead is known to have a high affinity for particles containing iron oxide (Lofts and Tipping, 2011; Lyvén et al., 2003). Interestingly, nickel is the metal that shows the second highest correlation to the SPM concentration (Figure AVII-6) of those determined, suggesting presence of particles with high affinity for this metal as well.

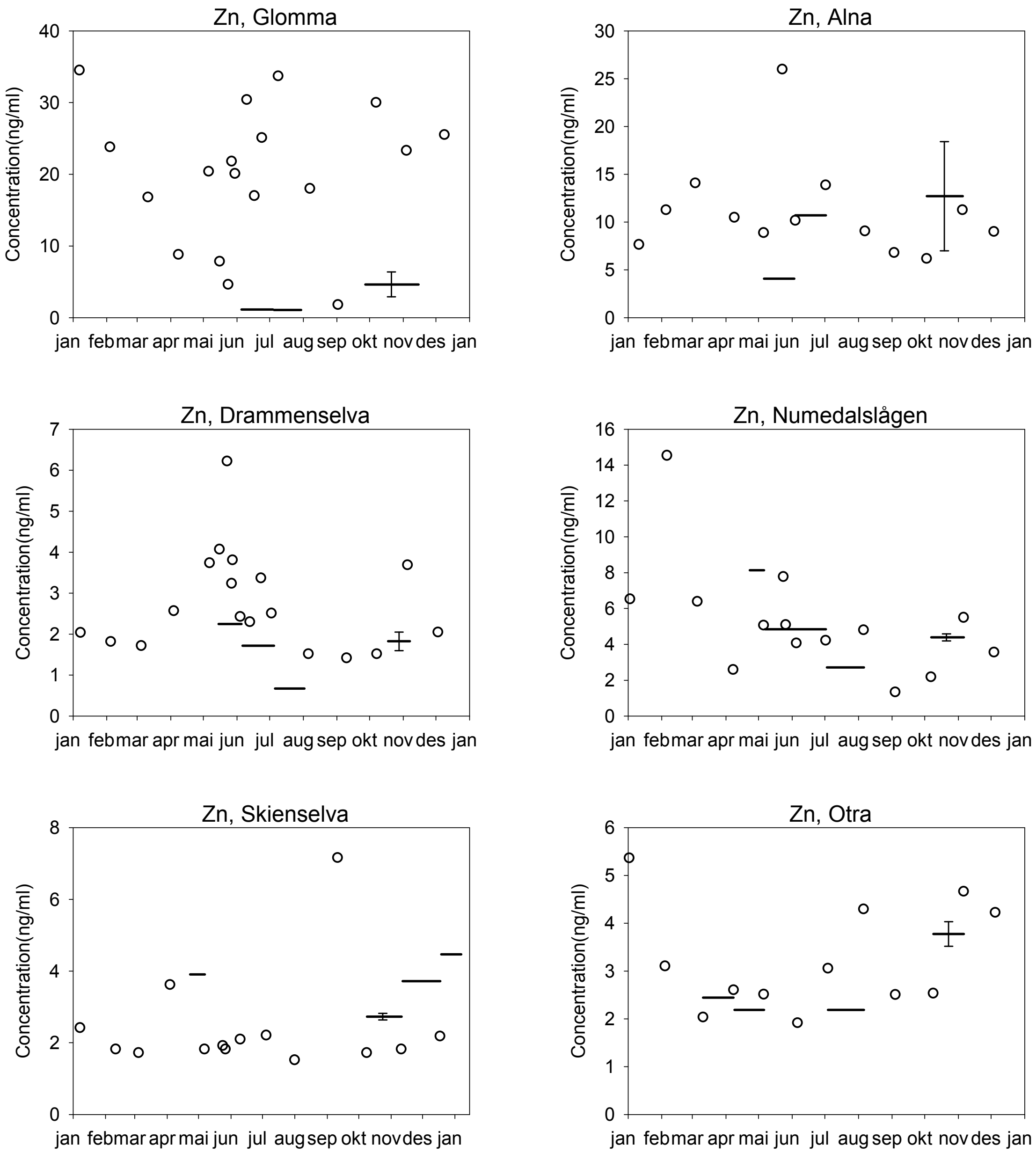


Figure AVII-5. Concentration of zinc measured in grab samples (circles) and time averaged concentrations of DGT dynamic zinc (horizontal lines). The line with error bars indicate the average of three parallells +/- half the distance between the maximum and minimum.

Zinc. There was good agreement between concentrations measured in grab samples and DGT dynamic concentrations. The exceptions were rivers Glomma and Skienselva where DGT dynamic concentrations were lower and higher, respectively, than the total concentration. The total concentration of zinc has increased markedly in Glomma in recent years, and the DGT results indicate that the increase is caused by particles or colloids containing zinc. The zinc concentration in Skienselva was variable and a grab sampling strategy could miss maxima in zinc concentration with appreciable effect on integrated mass transport.

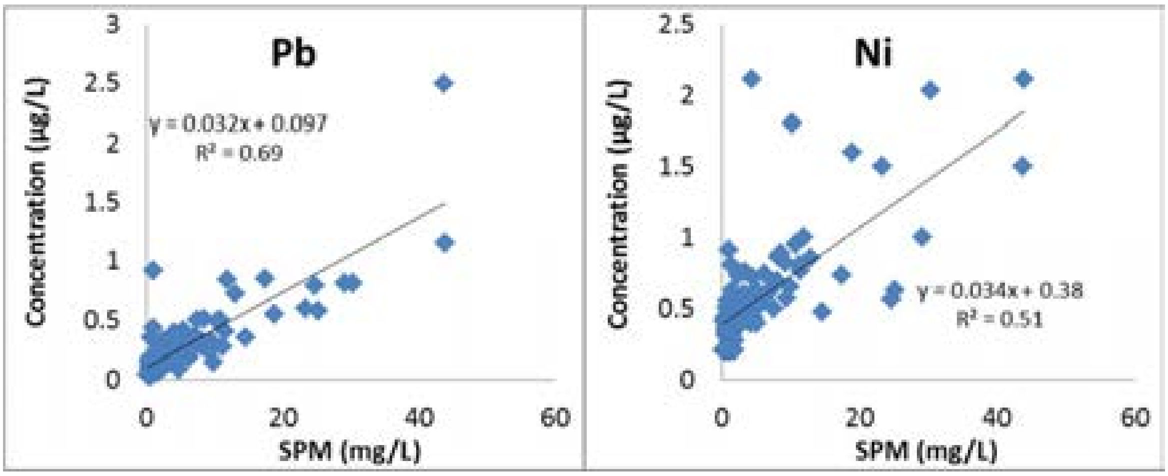


Figure AVII-6. Concentration of lead (left panel) and nickel (right panel) versus concentration of suspended particulate matter. Data from rivers Glomma, Alna, Drammenselva, Numedalslågen, Skienselva and Otra in 2013.

Conclusion

Data of acceptable quality were obtained through deployment and retrieval of DGT samplers by trained, but not expert, personnel, paving the way for use of DGT in large scale monitoring programmes. The results indicate large temporal variation in copper concentrations in Alna and zinc concentrations in Skienselva. and periods with high concentrations were apparently missed by the grab samples. Lead and possibly nickel appear to be largely associated with colloidal or suspended particulate matter and not truly dissolved in the water. This has implications for the bioavailability and mobility of these metals. Cadmium, lead and nickel are on EU WFD's list of priority substances The water EQS values (annual average) are defined as dissolved concentration of cadmium and bioavailable concentration, which is defined as equal to or less than the dissolved concentration, of lead and nickel. In Glomma, the largest of the 6 rivers, total concentrations were 15-25 percent of the respective EQS values for cadmium, nickel and lead. The dissolved concentrations, as estimated with DGT, were less than 3 percent of the EQS values, demonstrating how DGT can be used for compliance monitoring. The concentration of silver appears to be in the sub nanogram per liter range and much lower than the LOD using the conventional procedure.

References

Ahmed, I.A.M., Hamilton-Taylor, J., Bieroza, M., Zhang, H., Davison, W., 2014. Improving and testing geochemical speciation predictions of metal ions in natural waters. Water Res. 67, 276–291.

Allan, I.J., Garmo, Ø.A., Harman, C., Kringstad, A., Bratsberg, E., 2010. RiverPOP 2009: Measuring concentrations of persistent organic pollutants and trace metals in Norwegian rivers (NIVA-rapport OR-5989 No. OR-5989). Norsk institutt for vannforskning (NIVA), Oslo.

Bryan, S.E., Tipping, E., Hamilton-Taylor, J., 2002. Comparison of measured and modelled copper binding by natural organic matter in freshwaters. Comp. Biochem. Physiol. Part C Toxicol. Pharmacol. 133, 37–49. doi:10.1016/S1532-0456(02)00083-2

Davison, W., Fones, G.R., Harper, M., Teasdale, P.R., Zhang, H., 2000. Dialysis, DET and DGT: In situ diffusional techniques for studying water, sediments and soils, in: In Situ Monitoring of Aquatic Systems: Chemical Analysis and Speciation, IUPAC Series on Analytical and Physical Chemistry of Environmental Systems. Wiley, Chichester, U.K., pp. 495–569.

European Commission, 2014. Draft: Technical guidance to implement bioavailability-based environmental quality standards for metals.

Hamilton-Taylor, J., Giusti, L., Davison, W., Tych, W., Hewitt, C.N., 1997. Sorption of trace metals (Cu, Pb, Zn) by suspended lake particles in artificial (0.005 M NaNO3) and natural (Esthwaite

Water) freshwaters. Colloids Surf. Physicochem. Eng. Asp. 120, 205–219. doi:10.1016/S0927-7757(96)03722-3

Horowitz, A.J., 2013. A Review of Selected Inorganic Surface Water Quality-Monitoring Practices: Are We Really Measuring What We Think, and If So, Are We Doing It Right? Environ. Sci. Technol. 47, 2471–2486. doi:10.1021/es304058q

Lofts, S., Tipping, E., 2011. Assessing WHAM/Model VII against field measurements of free metal ion concentrations: model performance and the role of uncertainty in parameters and inputs. Environ. Chem. 8, 501–516.

Lyvén, B., Hassellöv, M., Turner, D.R., Haraldsson, C., Andersson, K., 2003. Competition between iron- and carbon-based colloidal carriers for trace metals in a freshwater assessed using flow field-flow fractionation coupled to ICPMS. Geochim. Cosmochim. Acta 67, 3791–3802. doi:10.1016/S0016-7037(03)00087-5

Mueller, K.K., Lofts, S., Fortin, C., Campbell, P.G.C., 2012. Trace metal speciation predictions in natural aquatic systems: incorporation of dissolved organic matter (DOM) spectroscopic quality. Environ. Chem. 9, 356–368.

Scally, S., Davison, W., Zhang, H., 2006. Diffusion coefficients of metals and metal complexes in hydrogels used in diffusive gradients in thin films. Anal. Chim. Acta 558, 222–229. doi:10.1016/j.aca.2005.11.020

Snoeyink, V.L., Jenkins, D., 1980. Water chemistry. John Wiley, New York.

Stumm, W., Morgan, J.J., 1996. Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters, 3rd ed. John Wiley & Sons.

Tipping, E., Lofts, S., Sonke, J.E., 2011. Humic Ion-Binding Model VII: a revised parameterisation of cation-binding by humic substances. Environ. Chem. 8, 225–235.

Van Leeuwen, H.P., Town, R.M., Buffle, J., Cleven, R.F.M.J., Davison, W., Puy, J., van Riemsdijk, W.H., Sigg, L., 2005. Dynamic speciation analysis and bioavailability of metals in aquatic systems. Environ. Sci. Technol. 39, 8545–8556.

Addendum: Data from the 2013 RID Programme

Table 1 Concentration data in 2013

Table 1a. Concentration data with statistics for the 47 monitored rivers in 2013

Note that values above threshold values (cf. Chapter 3.3.3) are marked with purple (exceeding threshold level) or light pink (almost at threshold level).Threshold levels used are shown in Table 16.

Glomma ved Sarpsfoss

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
07.01.2013 15:40:00	548	7.20	4.66	6.14	2.44	4.10	6	11	360	25	550	4.11	<0.05	0.22	0.15	0.01	1.25	34.40	0.73	0.31	1.00
04.02.2013 16:00:00	501	7.17	5.06	3.02	1.83	3.30	3	7	380	33	555	4.60	<0.05	0.09	0.08	0.01	1.13	23.70	0.57	0.20	<1.00
11.03.2013 14:45:00	345	7.21	5.27	1.77	1.60	2.90	4	13	370	46	555	3.85	<0.05	0.10	0.07	0.01	1.68	16.70	0.62	0.20	1.00
08.04.2013 17:00:00	178	7.20	5.67	12.00	9.91	2.80	11	15	400	66	645	3.81	<0.05	0.10	0.14	0.01	1.55	8.70	0.65	0.30	<1.00
06.05.2013 13:30:00	685	7.11	5.12	36.20	23.40	5.30	24	46	415	66	725	5.16	<0.05	0.20	0.59	0.02	2.06	20.30	1.50	0.77	2.00
16.05.2013 15:45:00	1413	7.12	4.16	9.94	11.50	5.00	12	18	285	19	530	4.34	<0.05	0.20	0.40	0.02	1.84	7.75	0.76	0.54	1.00
24.05.2013 10:30:00	2761	7.20	3.73	29.20	10.80	4.50	22	32	350	19	605	4.45	<0.05	0.26	0.50	0.01	3.15	4.53	0.95	0.73	1.00
27.05.2013 14:50:00	2993	7.06	3.60	54.50	43.90	5.20	37	52	380	29	620	4.54	<0.05	0.32	1.15	0.03	3.75	21.70	2.11	1.20	2.00
30.05.2013 14:15:00	2318	7.00	3.58	34.50	30.30	5.00	23	33	305	24	545	4.11	<0.05	0.28	0.81	0.02	4.12	20.00	2.03	1.30	1.00
10.06.2013 14:00:00	1956	7.21	4.28	9.98	8.34	3.50	10	16	330	14	530	3.51	<0.05	0.20	0.27	0.01	1.93	30.30	0.86	0.56	<1.00
17.06.2013 12:15:00	1474	7.21	4.31	6.30	6.30	3.50	5	14	310	17	515	3.21	<0.05	0.10	0.18	0.01	1.86	16.90	0.74	0.30	<1.00
24.06.2013 11:20:00	1314	7.37	6.45	9.06	9.31	3.50	9	15	410	15	625	3.29	<0.05	0.20	0.23	0.01	1.79	25.00	0.82	0.30	2.00
09.07.2013 13:15:00	1306	7.36	4.32	5.02	4.98	3.60	5	11	325	5	520	3.19	<0.05	0.10	0.15	0.01	1.64	33.60	0.63	0.20	<1.00
07.08.2013 17:30:00	781	7.40	4.61	2.59	4.73	2.60	4	9	250	21	450	2.59	<0.05	0.20	0.09	0.01	1.26	17.90	0.52	<0.10	<1.00
02.09.2013 14:30:00	625	7.28	4.23	3.08	3.27	3.80	3	11	175	18	380	2.31	<0.05	0.10	0.13	0.01	13.00	1.70	0.60	<0.10	2.00
07.10.2013 14:30:00	418	7.21	4.42	1.94	1.80	3.20	2	6	270	6	470	2.52	<0.05	0.10	0.07	<0.01	1.34	29.90	0.50	0.20	<1.00
04.11.2013 14:30:00	725	7.06	5.44	27.30	18.90	4.40	19	32	460	10	695	4.98	<0.05	0.25	0.55	0.01	2.11	23.20	1.60	0.97	<1.00
09.12.2013 14:30:00	582	7.15	4.83	13.30	11.20	4.00	7	17	380	6	550	4.21	<0.05	0.20	0.27	0.01	1.50	25.40	0.80	0.46	2.00
Lower avg.	1162	7.20	4.65	14.77	11.36	3.90	11	20	342	24	559	3.82	0.00	0.18	0.32	0.01	2.61	20.09	0.94	0.47	0.83
Upper avg..	1162	7.20	4.65	14.77	11.36	3.90	11	20	342	24	559	3.82	0.05	0.18	0.32	0.01	2.61	20.09	0.94	0.49	1.28
Minimum	178	7.00	3.58	1.77	1.60	2.60	2	6	175	5	380	2.31	0.05	0.09	0.07	0.01	1.13	1.70	0.50	0.10	1.00
Maximum	2993	7.40	6.45	54.50	43.90	5.30	37	52	460	66	725	5.16	0.05	0.32	1.15	0.03	13.00	34.40	2.11	1.30	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
St.dev	850	0.11	0.75	15.11	11.29	0.84	10	13	69	18	84	0.84	0.00	0.07	0.30	0.01	2.73	9.56	0.51	0.37	0.46

Alna

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
11.01.2013 13:00:00	1	7.91	47.00	4.92	4.31	3.80	42	56	685	225	1370	7.21	<0.05	0.23	0.23	0.03	1.87	7.57	0.39	0.48	1.00
05.02.2013 14:20:00	1	7.88	102.00	5.17	4.08	3.40	23	33	640	340	1280	6.85	<0.05	0.35	0.39	0.04	2.35	11.20	0.48	0.87	<1.00
04.03.2013 10:30:00	1	7.85	81.30	3.92	3.39	3.80	27	43	670	320	1500	6.01	<0.05	0.23	0.34	0.04	3.88	14.00	0.75	2.90	<1.00
09.04.2013 10:30:00	1	7.66	66.10	6.07	9.47	4.10	43	64	885	430	1560	5.52	<0.05	0.07	0.32	0.04	2.82	10.40	0.57	1.50	<1.00
06.05.2013 10:30:00	2	7.82	45.20	10.50	13.00	4.10	29	48	560	140	1070	5.39	<0.05	0.27	0.72	0.03	2.26	8.81	0.85	1.60	<1.00
23.05.2013 14:15:00	6	7.91	35.00	31.50	43.70	6.10	66	91	955	75	1560	7.12	<0.05	0.43	2.49	0.09	6.93	25.90	1.50	6.91	2.00
04.06.2013 12:15:00	1	8.08	36.20	6.50	8.53	4.40	29	39	935	65	1330	6.65	<0.05	0.25	0.51	0.04	3.08	10.10	0.88	0.86	<1.00
02.07.2013 12:00:00	2	8.11	35.70	12.70	11.90	4.70	48	59	945	70	1400	6.91	<0.05	0.10	0.83	0.23	3.55	13.80	1.00	0.34	3.00
07.08.2013 14:00:00	1	8.09	38.10	5.17	5.51	3.90	44	59	210	21	1480	6.46	<0.05	0.09	0.41	0.03	3.22	8.98	0.52	<0.10	<1.00
03.09.2013 12:20:00	1	7.97	30.70	3.15	3.70	4.00	57	71	915	84	1320	5.90	<0.05	0.46	0.31	0.04	2.30	6.72	0.47	0.80	3.00
03.10.2013 11:30:00	0	7.95	29.40	2.44	4.09	4.00	76	97	910	100	1410	5.58	<0.05	0.33	0.33	0.03	1.90	6.11	0.47	0.78	<1.00
05.11.2013 11:35:00	2	7.94	30.20	9.90	10.30	4.90	50	65	901	65	1420	6.70	<0.05	0.26	0.48	0.04	3.26	11.20	1.80	2.10	<1.00
04.12.2013 10:15:00	1	7.97	32.60	2.55	7.15	4.60	167	194	910	1500	2890	6.40	<0.05	0.33	0.36	0.03	2.57	8.93	0.62	0.78	2.00
Lower avg.	1	7.93	46.88	8.04	9.93	4.29	54	71	779	264	1507	6.36	0.00	0.26	0.59	0.05	3.08	11.06	0.79	1.53	0.85
Upper avg..	1	7.93	46.88	8.04	9.93	4.29	54	71	779	264	1507	6.36	0.05	0.26	0.59	0.05	3.08	11.06	0.79	1.54	1.46
Minimum	0	7.66	29.40	2.44	3.39	3.40	23	33	210	21	1070	5.39	0.05	0.07	0.23	0.03	1.87	6.11	0.39	0.10	1.00
Maximum	6	8.11	102.00	31.50	43.70	6.10	167	194	955	1500	2890	7.21	0.05	0.46	2.49	0.23	6.93	25.90	1.80	6.91	3.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
St.dev	1	0.12	22.55	7.73	10.67	0.68	37	41	219	393	435	0.62	0.00	0.12	0.59	0.06	1.31	5.06	0.43	1.79	0.78

Drammenselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
08.01.2013 13:45:00	354	7.20	3.78	1.04	0.58	2.90	<1	3	245	12	395	3.00	<0.05	0.20	0.04	0.01	0.61	2.02	0.44	<0.10	<1.00
05.02.2013 11:00:00	314	7.04	3.63	0.98	0.57	2.60	<1	4	250	14	395	2.93	<0.05	0.09	0.05	0.01	0.50	1.80	0.35	<0.10	<1.00
05.03.2013 11:00:00	224	7.13	3.80	1.38	1.12	2.40	<1	3	235	16	390	2.85	<0.05	0.10	0.08	<0.01	0.49	1.70	0.40	0.20	<1.00
04.04.2013 10:30:00	177	7.22	4.26	1.53	1.37	2.80	2	5	275	13	440	2.78	<0.05	0.10	0.09	0.01	0.67	2.55	0.38	0.20	<1.00
07.05.2013 08:00:00	245	7.28	4.97	4.03	2.83	3.30	3	6	310	9	480	3.29	<0.05	0.20	0.17	<0.01	0.79	3.72	0.54	0.20	<1.00
16.05.2013 12:30:00	762	7.07	5.16	22.80	25.20	3.60	19	24	925	31	1180	3.89	<0.05	0.21	0.57	0.01	1.31	4.05	0.62	0.47	2.00
23.05.2013 10:15:00	1441	7.24	4.77	29.90	29.20	4.30	26	37	845	16	1110	5.24	<0.05	0.36	0.80	0.01	1.91	6.20	1.00	0.82	2.00
27.05.2013 14:30:00	1229	7.20	3.92	7.19	6.67	3.50	7	11	340	8	490	3.04	<0.05	0.21	0.24	0.01	1.06	3.22	0.59	0.20	3.00
28.05.2013 13:00:00	1193	7.16	3.74	8.66	8.14	3.70	7	12	315	9	490	3.17	<0.05	0.23	0.32	0.01	1.11	3.79	0.69	0.33	3.00
04.06.2013 14:00:00	1089	6.99	3.36	4.26	4.09	3.80	4	9	245	7	440	2.95	<0.05	0.10	0.15	0.01	0.84	2.41	0.55	0.20	1.00
13.06.2013 10:30:00	648	7.12	3.84	1.63	2.46	3.60	2	6	255	13	430	2.80	<0.05	0.20	0.10	0.01	0.80	2.28	0.49	0.10	2.00
23.06.2013 15:00:00	644	7.08	3.42	2.56	2.37	4.10	8	7	230	10	460	2.89	<0.05	0.21	0.32	0.02	1.66	3.35	0.52	0.20	2.00
03.07.2013 08:30:00	761	7.13	3.86	3.04	3.22	4.30	4	8	265	8	450	2.91	<0.05	0.20	0.15	0.01	0.89	2.49	0.52	0.10	<1.00
06.08.2013 08:30:00	214	7.21	3.38	1.10	0.92	3.60	2	6	165	34	380	2.35	<0.05	0.10	0.05	0.01	0.75	1.50	0.37	<0.10	<1.00
10.09.2013 10:00:00	141	7.19	3.69	1.00	0.46	3.50	<1	9	180	12	365	2.18	<0.05	0.20	0.04	0.01	0.67	1.40	0.41	<0.10	<1.00
08.10.2013 07:30:00	258	7.12	3.22	0.91	1.02	3.30	1	5	175	7	375	2.25	<0.05	0.10	0.05	<0.01	0.51	1.50	0.37	0.20	<1.00
05.11.2013 15:00:00	424	7.14	4.54	4.45	4.54	4.50	4	10	360	9	565	3.32	<0.05	0.20	0.17	0.02	1.04	3.67	0.71	0.38	<1.00
03.12.2013 15:30:00	331	7.15	3.43	1.63	1.98	3.20	1	5	245	9	380	2.80	<0.05	0.10	0.06	0.01	0.64	2.03	0.42	0.20	<1.00
Lower avg.	581	7.15	3.93	5.45	5.37	3.50	5	9	326	13	512	3.04	0.00	0.17	0.19	0.01	0.90	2.76	0.52	0.21	0.83
Upper avg..	581	7.15	3.93	5.45	5.37	3.50	5	9	326	13	512	3.04	0.05	0.17	0.19	0.01	0.90	2.76	0.52	0.23	1.44
Minimum	141	6.99	3.22	0.91	0.46	2.40	1	3	165	7	365	2.18	0.05	0.09	0.04	0.01	0.49	1.40	0.35	0.10	1.00
Maximum	1441	7.28	5.16	29.90	29.20	4.50	26	37	925	34	1180	5.24	0.05	0.36	0.80	0.02	1.91	6.20	1.00	0.82	3.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
St.dev	414	0.07	0.58	8.01	8.25	0.59	7	8	211	8	236	0.68	0.00	0.07	0.21	0.00	0.39	1.22	0.16	0.18	0.71

Numedalslågen

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
03.01.2013 10:25:00	69	6.85	4.49	6.15	2.37	4.10	9	14	420	46	660	5.09	<0.05	0.55	0.25	0.02	0.93	6.49	0.50	0.20	<1.00
06.02.2013 08:35:00	53	6.91	4.39	9.13	24.70	3.70	28	47	225	155	1030	3.74	<0.05	0.10	0.79	0.03	1.76	14.50	0.56	0.10	27.00
06.03.2013 08:40:00	38	7.02	4.04	1.99	2.72	2.20	4	9	229	86	495	3.40	<0.05	0.10	0.21	0.01	0.84	6.35	0.46	0.20	3.00
08.04.2013 09:00:00	37	7.13	4.98	2.08	1.92	2.00	5	9	295	96	565	3.49	<0.05	0.10	0.07	0.01	0.48	2.55	0.27	0.30	2.00
06.05.2013 09:45:00	121	6.85	2.96	4.17	5.06	5.70	5	10	230	23	445	3.91	<0.05	0.20	0.29	0.02	0.77	5.02	0.39	0.36	1.00
24.05.2013 12:10:00	493	6.72	2.57	15.30	17.50	6.70	18	26	270	12	490	3.74	<0.05	0.27	0.85	0.03	1.70	7.73	0.73	0.58	5.00
26.05.2013 15:15:00	286	6.73	2.56	7.02	7.57	6.00	8	15	250	10	470	3.32	<0.05	0.22	0.49	0.02	1.08	5.05	0.49	0.33	5.00
05.06.2013 12:15:00	160	6.67	2.42	3.02	3.09	6.00	3	9	200	6	450	2.89	<0.05	0.20	0.26	0.02	1.03	4.03	0.40	0.60	4.00
02.07.2013 11:15:00	247	6.80	2.60	3.67	4.78	6.30	6	9	195	8	430	3.14	<0.05	0.20	0.32	0.02	0.99	4.18	0.43	0.20	1.00
06.08.2013 08:15:00	82	7.01	2.64	1.72	1.79	2.70	2	7	140	31	335	2.20	<0.05	0.20	0.12	0.01	0.59	4.76	0.33	<0.10	<1.00
04.09.2013 11:30:00	74	7.00	2.42	1.00	1.06	2.70	1	2	105	16	270	2.04	<0.05	0.10	0.07	0.01	0.52	1.30	0.26	<0.10	<1.00
07.10.2013 11:00:00	76	7.06	3.23	1.79	1.51	3.80	2	6	190	28	405	3.06	<0.05	0.10	0.11	0.01	0.52	2.14	0.31	0.20	<1.00
06.11.2013 11:00:00	169	7.02	3.22	5.07	4.39	6.90	5	15	244	11	505	4.13	<0.05	0.20	0.34	0.02	1.01	5.46	2.11	3.33	2.00
04.12.2013 11:00:00	71	7.02	3.06	3.57	14.60	3.30	10	16	200	48	400	3.34	<0.05	0.20	0.35	0.01	0.76	3.52	0.47	0.30	4.00
Lower avg.	141	6.91	3.26	4.69	6.65	4.44	8	14	228	41	496	3.39	0.00	0.20	0.32	0.02	0.93	5.22	0.55	0.48	3.86
Upper avg..	141	6.91	3.26	4.69	6.65	4.44	8	14	228	41	496	3.39	0.05	0.20	0.32	0.02	0.93	5.22	0.55	0.49	4.14
Minimum	37	6.67	2.42	1.00	1.06	2.00	1	2	105	6	270	2.04	0.05	0.10	0.07	0.01	0.48	1.30	0.26	0.10	1.00
Maximum	493	7.13	4.98	15.30	24.70	6.90	28	47	420	155	1030	5.09	0.05	0.55	0.85	0.03	1.76	14.50	2.11	3.33	27.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
St.dev	127	0.14	0.86	3.83	7.17	1.76	7	11	74	43	180	0.77	0.00	0.12	0.24	0.01	0.40	3.20	0.47	0.83	6.76

Skienselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
08.01.2013 09:30:00	287	6.90	2.19	0.84	0.44	2.50	<1	4	160	19	275	2.40	<0.05	0.20	0.06	0.01	0.49	2.40	0.21	<0.10	<1.00
11.02.2013 12:00:00	291	7.10	2.32	0.71	0.23	2.20	<1	3	150	17	290	2.25	<0.05	0.08	0.04	0.01	0.35	1.80	0.20	<0.10	<1.00
05.03.2013 09:00:00	263	6.83	2.00	0.72	0.28	2.20	<1	2	140	9	245	2.29	<0.05	0.08	0.05	0.01	0.31	1.70	0.20	0.10	<1.00
04.04.2013 10:00:00	116	6.84	2.11	0.80	1.08	2.30	2	5	150	21	275	2.16	<0.05	0.10	0.91	0.01	0.85	3.60	0.20	<0.10	<1.00
07.05.2013 10:00:00	320	6.90	2.07	1.03	1.23	2.20	1	3	155	6	265	2.20	<0.05	0.08	0.09	0.01	0.46	1.80	0.20	0.20	<1.00
24.05.2013 18:00:00	981	6.81	2.07	1.25	1.15	2.50	1	3	180	9	295	2.27	<0.05	0.09	0.07	0.01	0.37	1.90	0.20	0.10	6.00
27.05.2013 08:00:00	624	6.84	2.06	1.63	1.02	2.30	4	6	170	5	270	2.16	<0.05	0.09	0.06	0.01	0.35	1.80	0.21	0.10	2.00
10.06.2013 11:00:00	257	6.74	2.00	1.61	1.37	2.90	3	4	155	11	310	2.31	<0.05	0.10	0.07	0.01	0.41	2.08	0.20	0.30	<1.00
05.07.2013 09:30:00	323	6.92	1.97	1.48	1.91	2.90	2	6	130	13	265	2.16	<0.05	0.08	0.12	0.01	0.49	2.19	0.20	0.10	1.00
01.08.2013 12:00:00	235	6.90	1.85	0.75	0.64	2.90	<1	<1	94	11	255	1.79	<0.05	0.09	0.03	0.01	0.39	1.50	0.20	<0.10	<1.00
11.09.2013 12:00:00	168	6.76	1.80	0.82	1.03	2.60	<1	3	91	21	245	1.77	<0.05	0.10	0.12	0.01	0.44	7.14	0.20	0.10	<1.00
09.10.2013 11:00:00	313	6.82	1.84	0.88	0.83	3.00	1	4	120	6	280	1.91	<0.05	0.09	0.06	0.01	0.41	1.70	0.20	<0.10	<1.00
11.11.2013 09:00:00	345	6.95	1.95	1.16	0.59	2.80	1	2	130	10	265	2.08	<0.05	0.08	0.06	0.01	0.39	1.80	0.20	1.10	<1.00
18.12.2013 11:00:00	299	6.87	2.22	0.83	0.70	2.50	<1	3	160	4	280	2.18	<0.05	0.08	0.11	0.01	0.39	2.16	0.20	0.10	1.00
Lower avg.	345	6.87	2.03	1.04	0.89	2.56	1	3	142	12	273	2.14	0.00	0.10	0.13	0.01	0.44	2.40	0.20	0.16	0.71
Upper avg..	345	6.87	2.03	1.04	0.89	2.56	2	4	142	12	273	2.14	0.05	0.10	0.13	0.01	0.44	2.40	0.20	0.19	1.43
Minimum	116	6.74	1.80	0.71	0.23	2.20	1	1	91	4	245	1.77	0.05	0.08	0.03	0.01	0.31	1.50	0.20	0.10	1.00
Maximum	981	7.10	2.32	1.63	1.91	3.00	4	6	180	21	310	2.40	0.05	0.20	0.91	0.01	0.85	7.14	0.21	1.10	6.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no	no
n	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
St.dev	215	0.09	0.15	0.33	0.46	0.30	1	1	26	6	18	0.19	0.00	0.03	0.23	0.00	0.13	1.46	0.00	0.27	1.34

Otra

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
02.01.2013 14:44:00	156	5.91	2.03	0.70	0.66	3.30	<1	3	135	14	295	2.06	<0.05	0.31	0.35	0.03	0.69	5.35	0.43	<0.10	<1.00
04.02.2013 16:15:00	125	6.26	1.66	0.50	0.52	2.50	<1	2	100	18	260	1.96	<0.05	0.07	0.17	0.01	0.43	3.09	0.31	<0.10	<1.00
11.03.2013 14:45:00	117	6.31	1.39	0.47	0.39	1.50	<1	2	82	6	190	1.56	<0.05	<0.05	0.10	0.01	0.39	2.02	0.20	<0.10	<1.00
08.04.2013 15:50:00	118	6.46	1.40	0.42	0.40	1.30	<1	1	83	8	170	1.41	<0.05	0.08	0.14	0.01	0.93	2.59	0.40	0.20	2.00
06.05.2013 12:50:00	206	6.20	1.46	0.59	0.81	2.40	<1	3	110	7	220	1.41	<0.05	0.10	0.19	0.02	0.41	2.50	0.50	0.20	<1.00
06.06.2013 15:46:00	172	6.27	1.29	0.51	0.75	2.00	8	10	84	6	200	1.24	<0.05	0.10	0.12	0.01	0.36	1.90	0.35	0.31	1.00
04.07.2013 14:48:00	124	6.01	1.37	0.99	1.38	4.30	<1	4	62	<2	235	1.05	<0.05	0.10	0.31	0.02	0.58	3.04	0.80	<0.10	<1.00
06.08.2013 08:15:00	106	6.29	1.25	0.85	1.42	2.50	1	3	66	19	240	0.64	<0.05	0.07	0.19	0.01	0.41	4.28	0.34	<0.10	<1.00
04.09.2013 14:16:00	112	6.22	1.20	0.68	0.91	2.60	<1	4	62	7	195	0.90	<0.05	0.10	0.13	0.01	0.76	2.49	0.55	<0.10	<1.00
09.10.2013 12:20:00	95	6.39	1.44	0.58	0.76	3.20	<1	4	81	8	265	1.24	<0.05	0.10	0.18	0.01	0.45	2.52	0.33	0.10	1.00
06.11.2013 14:45:00	136	6.12	1.80	1.21	0.98	5.00	1	6	104	12	310	2.12	<0.05	0.20	0.42	0.03	0.62	4.65	0.91	0.39	1.00
05.12.2013 16:00:00	123	6.20	1.74	1.56	1.75	2.50	<1	5	110	12	235	1.80	<0.05	0.09	0.24	0.01	0.59	4.21	0.43	0.20	<1.00
Lower avg.	132	6.22	1.50	0.75	0.89	2.76	1	4	90	10	235	1.45	0.00	0.11	0.21	0.01	0.55	3.22	0.46	0.12	0.42
Upper avg..	132	6.22	1.50	0.75	0.89	2.76	2	4	90	10	235	1.45	0.05	0.11	0.21	0.01	0.55	3.22	0.46	0.17	1.08
Minimum	95	5.91	1.20	0.42	0.39	1.30	1	1	62	2	170	0.64	0.05	0.05	0.10	0.01	0.36	1.90	0.20	0.10	1.00
Maximum	206	6.46	2.03	1.56	1.75	5.00	8	10	135	19	310	2.12	0.05	0.31	0.42	0.03	0.93	5.35	0.91	0.39	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no	no
n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
St.dev	31	0.15	0.25	0.34	0.43	1.07	2	2	22	5	43	0.47	0.00	0.07	0.10	0.01	0.18	1.12	0.21	0.10	0.29

Orreelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
07.01.2013 11:00:00	9	7.48	16.00	3.92	3.21	5.90	44	63	1200	110	1950	4.36	<0.05	0.38	0.18	0.01	2.05	4.42	1.30	0.20	<1.00
05.02.2013 14:30:00	5	7.54	17.90	3.62	4.29	6.10	53	88	1250	175	1960	4.73	<0.05	0.25	0.14	0.01	1.99	5.00	1.00	0.78	2.00
05.03.2013 14:50:00	2	7.49	16.90	3.29	4.55	4.90	12	40	1100	11	1530	4.30	<0.05	0.21	0.10	0.01	1.69	3.46	1.10	0.70	<1.00
02.04.2013 13:00:00	1	7.51	17.50	2.46	5.56	5.20	11	47	410	29	1120	2.22	<0.05	0.29	0.13	0.01	1.97	2.84	0.91	0.83	<1.00
06.05.2013 11:00:00	9	7.77	17.80	5.17	7.53	5.10	13	49	185	89	930	0.24	<0.05	0.22	0.19	0.01	1.46	2.56	0.95	0.46	<1.00
03.06.2013 13:30:00	1	7.89	19.00	7.98	10.80	6.90	16	62	2	49	825	0.26	<0.05	0.32	0.41	0.02	1.67	2.89	1.20	0.32	<1.00
01.07.2013 12:30:00	2	8.16	18.80	4.07	4.67	6.60	8	32	<1	27	675	0.58	<0.05	0.20	0.09	0.01	1.37	1.30	1.10	<0.10	3.00
06.08.2013 10:00:00	6	7.73	18.30	3.44	8.18	6.10	19	47	33	73	680	2.50	<0.05	0.24	0.11	0.01	1.22	1.20	1.00	<0.10	<1.00
03.09.2013 11:00:00	15	7.79	20.40	4.82	8.92	6.90	14	44	12	25	760	2.44	<0.05	0.51	0.52	0.02	2.00	5.65	1.30	0.38	2.00
01.10.2013 13:35:00	2	7.89	17.90	7.47	8.88	7.80	17	55	450	28	1230	3.89	<0.05	0.29	0.08	0.01	1.37	1.40	1.00	0.43	<1.00
12.11.2013 13:30:00	14	7.75	18.20	7.83	8.07	6.00	25	76	667	62	1430	4.28	<0.05	0.23	0.24	0.01	1.52	3.57	1.90	1.40	<1.00
03.12.2013 13:30:00	7	7.60	17.60	10.90	11.40	5.90	48	71	945	55	1600	4.77	<0.05	0.28	0.46	0.02	1.74	3.24	1.20	0.46	5.00
Lower avg.	6	7.72	18.02	5.41	7.17	6.12	23	56	521	61	1224	2.88	0.00	0.28	0.22	0.01	1.67	3.13	1.16	0.50	1.00
Upper avg..	6	7.72	18.02	5.41	7.17	6.12	23	56	521	61	1224	2.88	0.05	0.28	0.22	0.01	1.67	3.13	1.16	0.51	1.67
Minimum	1	7.48	16.00	2.46	3.21	4.90	8	32	1	11	675	0.24	0.05	0.20	0.08	0.01	1.22	1.20	0.91	0.10	1.00
Maximum	15	8.16	20.40	10.90	11.40	7.80	53	88	1250	175	1960	4.77	0.05	0.51	0.52	0.02	2.05	5.65	1.90	1.40	5.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
St.dev	5	0.21	1.10	2.55	2.68	0.84	16	16	495	46	469	1.76	0.00	0.09	0.16	0.01	0.29	1.43	0.27	0.37	1.23

Vosso(Bolstadelvi)

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
07.01.2013 13:00:00	58	6.54	1.50	0.60	0.18	0.98	<1	4	105	9	185	0.92	<0.05	0.20	0.04	0.01	0.40	1.30	0.33	<0.10	<1.00
04.02.2013 12:45:00	12	6.62	1.66	0.40	0.19	0.93	1	4	100	10	200	0.86	<0.05	0.05	0.05	0.01	0.35	6.02	0.55	0.20	<1.00
05.03.2013 10:00:00	5	6.78	2.01	0.58	0.32	0.82	<1	3	115	3	200	0.88	<0.05	0.07	0.02	0.01	0.28	0.96	0.30	0.30	<1.00
02.04.2013 12:00:00	4	6.74	1.68	0.51	0.23	0.65	<1	3	105	4	160	0.79	<0.05	0.08	0.01	<0.01	0.27	1.10	0.25	0.10	<1.00
06.05.2013 12:30:00	46	6.55	2.16	1.30	1.04	1.40	3	7	185	18	290	1.13	<0.05	0.10	0.07	0.01	0.42	1.40	0.36	0.35	<1.00
04.06.2013 07:15:00	209	6.42	1.24	0.93	1.13	1.10	2	4	110	15	220	0.86	<0.05	0.08	0.10	0.01	0.51	2.04	0.35	0.20	<1.00
01.07.2013 15:20:00	126	6.41	0.90	0.41	0.72	1.00	<1	2	50	5	124	0.60	<0.05	<0.05	0.04	<0.01	0.30	0.68	0.20	<0.10	<1.00
05.08.2013 11:30:00	121	6.56	0.95	0.58	0.61	1.20	1	<1	52	3	185	0.53	<0.05	0.07	0.07	<0.01	0.48	0.72	0.25	<0.10	<1.00
03.09.2013 13:20:00	71	6.61	1.12	0.41	0.35	1.30	<1	3	76	5	160	0.73	<0.05	0.08	0.04	<0.01	0.32	0.74	0.26	<0.10	1.00
08.10.2013 10:30:00	344	6.54	1.21	0.55	0.59	1.50	<1	4	92	6	215	0.90	<0.05	0.08	0.05	0.01	0.31	0.56	0.23	<0.10	2.00
06.11.2013 11:15:00	74	6.72	1.32	0.76	0.56	1.50	1	4	131	6	225	1.09	<0.05	0.10	0.06	0.01	0.38	0.90	0.59	0.46	1.00
03.12.2013 13:30:00	54	6.72	1.71	0.59	0.57	1.50	1	4	160	7	245	1.18	<0.05	0.08	0.06	0.01	0.45	1.70	0.36	0.20	4.00
Lower avg.	94	6.60	1.46	0.63	0.54	1.16	1	4	107	8	201	0.87	0.00	0.08	0.05	0.00	0.37	1.51	0.34	0.15	0.67
Upper avg..	94	6.60	1.46	0.63	0.54	1.16	1	4	107	8	201	0.87	0.05	0.09	0.05	0.01	0.37	1.51	0.34	0.19	1.33
Minimum	4	6.41	0.90	0.40	0.18	0.65	1	1	50	3	124	0.54	0.05	0.05	0.01	0.01	0.27	0.56	0.20	0.10	1.00
Maximum	344	6.78	2.16	1.30	1.13	1.50	3	7	185	18	290	1.18	0.05	0.20	0.10	0.01	0.51	6.02	0.59	0.46	4.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	no	no
n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
St.dev	98	0.12	0.40	0.26	0.31	0.29	1	1	39	5	43	0.20	0.00	0.04	0.02	0.00	0.08	1.49	0.12	0.12	0.89

Orkla

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
09.01.2013 11:30:00	34	7.47	6.69	1.17	1.11	1.90	2	4	200	12	320	2.93	<0.05	0.09	0.02	0.03	2.64	7.64	0.57	0.10	<1.00
06.02.2013 12:15:00	31	7.45	6.20	0.65	0.98	1.50	<1	10	194	13	325	2.95	<0.05	0.05	0.01	0.01	2.28	4.55	0.47	<0.10	<1.00
06.03.2013 14:00:00	25	7.55	9.72	1.83	1.46	2.30	4	9	272	28	475	3.14	<0.05	0.10	0.02	0.06	4.66	18.90	0.84	0.42	<1.00
03.04.2013 10:20:00	23	7.33	8.10	1.23	1.31	1.40	5	4	205	13	340	3.12	<0.05	0.10	0.03	0.03	2.55	6.55	0.72	0.20	1.00
13.05.2013 09:10:00	244	7.10	3.55	6.27	11.90	4.80	7	18	53	10	300	2.07	<0.05	0.10	0.11	0.03	4.09	11.10	1.50	0.86	<1.00
05.06.2013 11:15:00	113	7.12	4.60	2.33	3.30	4.80	2	5	130	<2	350	2.63	<0.05	0.10	0.03	0.02	5.20	8.13	1.10	0.91	<1.00
04.07.2013 14:00:00	88	7.43	5.11	1.00	1.07	2.90	2	4	125	4	275	2.12	<0.05	0.05	0.02	0.03	4.14	10.90	0.80	0.20	<1.00
05.08.2013 09:15:00	25	7.67	6.56	0.52	0.80	3.70	<1	5	180	6	365	2.42	<0.05	0.20	0.02	0.01	3.00	3.93	0.66	0.10	<1.00
04.09.2013 09:15:00	27	7.58	6.87	0.86	0.55	2.90	<1	<1	215	<2	355	2.50	<0.05	0.10	0.01	0.02	3.00	6.80	0.60	<0.10	<1.00
07.10.2013 10:20:00	34	7.58	7.64	0.66	1.15	2.40	2	4	210	5	375	2.63	<0.05	0.10	0.01	0.05	5.78	12.90	0.66	0.20	<1.00
07.11.2013 09:30:00	21	7.53	6.83	0.71	0.35	2.30	<1	3	212	4	345	3.00	<0.05	0.10	0.01	0.03	4.35	13.40	0.95	1.50	1.00
05.12.2013 12:20:00	22	7.47	8.61	1.34	1.80	3.50	<1	6	405	3	540	3.51	<0.05	0.10	0.04	0.14	11.10	45.30	0.94	0.40	<1.00
Lower avg.	57	7.44	6.71	1.55	2.15	2.87	2	6	200	8	364	2.75	0.00	0.10	0.03	0.04	4.40	12.51	0.82	0.41	0.17
Upper avg..	57	7.44	6.71	1.55	2.15	2.87	2	6	200	9	364	2.75	0.05	0.10	0.03	0.04	4.40	12.51	0.82	0.42	1.00
Minimum	21	7.10	3.55	0.52	0.35	1.40	1	1	53	2	275	2.07	0.05	0.05	0.01	0.01	2.28	3.93	0.47	0.10	1.00
Maximum	244	7.67	9.72	6.27	11.90	4.80	7	18	405	28	540	3.51	0.05	0.20	0.11	0.14	11.10	45.30	1.50	1.50	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
St.dev	66	0.18	1.73	1.58	3.16	1.14	2	4	85	7	74	0.43	0.00	0.04	0.03	0.04	2.39	11.16	0.28	0.44	0.00

Vefsna

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
02.01.2013 10:00:00	39	7.70	10.70	0.22	0.11	1.00	2	<1	160	6	250	2.16	<0.05	0.30	0.01	<0.01	0.41	0.28	0.32	<0.10	<1.00
05.02.2013 10:30:00	37	7.66	9.53	0.33	0.23	1.00	<1	2	130	6	245	2.10	<0.05	0.10	0.01	<0.01	0.29	0.23	0.10	<0.10	1.00
22.04.2013 10:00:00	111	7.55	6.07	4.44	2.52	2.60	2	7	38	<2	160	1.37	<0.05	0.20	0.12	<0.01	0.57	1.00	0.54	0.20	<1.00
10.05.2013 10:30:00	265	7.39	5.36	2.66	8.06	2.50	4	10	26	4	150	1.30	<0.05	0.20	0.11	<0.01	0.47	1.00	0.44	0.10	<1.00
05.06.2013 12:15:00	337	7.21	3.24	1.44	1.93	1.20	2	2	35	3	125	0.96	<0.05	0.10	0.06	<0.01	0.31	0.47	0.24	0.40	<1.00
02.07.2013 12:00:00	134	7.41	3.73	0.53	0.52	0.84	<1	4	28	<2	83	0.83	<0.05	0.07	0.03	<0.01	0.24	0.26	0.10	<0.10	<1.00
05.08.2013 09:30:00	157	7.53	3.82	2.12	2.55	1.60	1	4	17	4	107	1.01	<0.05	0.09	0.08	<0.01	0.43	0.48	0.25	<0.10	<1.00
04.09.2013 10:00:00	126	7.61	4.78	0.82	0.81	1.70	<1	2	16	<2	95	1.30	<0.05	0.10	0.03	<0.01	0.32	0.31	0.20	<0.10	<1.00
10.10.2013 09:00:00	176	7.46	4.87	0.67	1.11	1.80	<1	2	20	<2	115	1.48	<0.05	0.10	0.04	<0.01	0.35	0.26	0.21	0.10	<1.00
05.11.2013 11:00:00	104	7.61	7.03	0.44	0.31	1.80	<1	2	71	<2	160	1.74	<0.05	0.10	0.01	<0.01	0.35	0.25	0.31	0.20	<1.00
05.12.2013 12:00:00	191	7.37	7.24	0.73	1.63	1.70	<1	2	79	<2	145	1.53	<0.05	0.09	0.02	<0.01	0.32	0.52	0.25	0.33	
Lower avg.	152	7.50	6.03	1.31	1.80	1.61	1	3	56	2	149	1.44	0.00	0.13	0.05	0.00	0.37	0.46	0.27	0.12	0.10
Upper avg..	152	7.50	6.03	1.31	1.80	1.61	2	3	56	3	149	1.44	0.05	0.13	0.05	0.00	0.37	0.46	0.27	0.17	1.00
Minimum	37	7.21	3.24	0.22	0.11	0.84	1	1	16	2	83	0.83	0.05	0.07	0.01	0.01	0.24	0.23	0.10	0.10	1.00
Maximum	337	7.70	10.70	4.44	8.06	2.60	4	10	160	6	250	2.16	0.05	0.30	0.12	0.01	0.57	1.00	0.54	0.40	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	no	yes	yes	no	yes	yes	yes	no	no
n	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	10
St.dev	90	0.15	2.41	1.30	2.26	0.58	1	3	49	2	55	0.43	0.00	0.07	0.04	0.00	0.09	0.29	0.13	0.11	0.00

Altaelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
04.01.2013 12:30:00	33	7.47	9.47	0.38	0.24	2.50	5	7	90	5	235	5.56	<0.05	0.20	0.02	0.01	0.47	0.32	0.20	0.10	<1.00
05.02.2013 12:15:00	35	7.50	7.91	0.30	0.28	2.60	2	4	68	<2	190	5.95	<0.05	0.20	0.01	<0.01	0.43	0.20	0.25	0.31	<1.00
08.03.2013 11:20:00	34	7.33	8.17	0.48	0.26	2.50	2	5	81	8	205	6.44	<0.05	0.20	0.01	<0.01	0.40	0.20	0.20	0.20	<1.00
03.04.2013 12:50:00	33	7.55	9.02	0.35	0.24	2.40	3	5	74	5	190	6.23	<0.05	0.10	0.01	<0.01	0.41	0.20	0.10	0.30	<1.00
07.05.2013 11:00:00	68	7.78	10.70	0.87	0.77	2.50	2	8	120	12	245	6.18	<0.05	0.10	0.01	<0.01	0.46	0.21	0.20	0.30	<1.00
07.06.2013 08:50:00	314	7.47	11.40	5.17	9.07	2.70	15	76	110	20	280	5.03	<0.05	0.27	0.05	<0.01	0.92	0.43	0.30	0.53	<1.00
04.07.2013 10:35:00	89	7.64	8.22	0.78	1.24	2.70	5	6	68	17	240	2.85	<0.05	0.10	<0.01	<0.01	0.55	0.20	0.20	0.10	<1.00
07.08.2013 12:30:00	66	7.99	15.40	0.40	0.65	1.90	3	7	110	22	270	4.17	<0.05	0.24	0.01	<0.01	0.54	1.30	<0.05	<0.10	<1.00
05.09.2013 12:30:00	57	7.54	6.50	0.47	0.76	2.80	<1	3	27	5	160	3.21	<0.05	0.10	0.01	<0.01	0.54	0.20	0.20	<0.10	<1.00
07.10.2013 13:05:00	56	7.84	8.78	0.49	0.75	2.60	1	4	58	15	770	3.62	<0.05	0.20	<0.01	<0.01	0.45	0.05	0.10	0.30	<1.00
06.11.2013 10:20:00	60	7.68	7.45	0.88	0.55	2.60	2	4	76	13	225	3.98	<0.05	0.10	<0.01	<0.01	0.46	0.10	0.61	0.78	
09.12.2013 10:15:00	39	7.51	7.38	0.60	0.90	2.40	2	3	59	<2	180	4.54	<0.05	0.10	0.01	<0.01	0.48	0.10	0.23	0.20	1.00
Lower avg.	74	7.61	9.20	0.93	1.31	2.52	4	11	78	10	266	4.81	0.00	0.16	0.01	0.00	0.51	0.29	0.22	0.26	0.09
Upper avg..	74	7.61	9.20	0.93	1.31	2.52	4	11	78	11	266	4.81	0.05	0.16	0.01	0.01	0.51	0.29	0.22	0.28	1.00
Minimum	33	7.33	6.50	0.30	0.24	1.90	1	3	27	2	160	2.85	0.05	0.10	0.01	0.01	0.40	0.05	0.05	0.10	1.00
Maximum	314	7.99	15.40	5.17	9.07	2.80	15	76	120	22	770	6.44	0.05	0.27	0.05	0.01	0.92	1.30	0.61	0.78	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	11
St.dev	78	0.19	2.40	1.35	2.46	0.23	4	21	26	7	163	1.26	0.00	0.07	0.01	0.00	0.14	0.33	0.14	0.20	0.00

Tista utløp Femsjøen

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
11.02.2013 16:00:00	13	6.80	5.00	2.40	2.04	9.70	6	23	435	4	715	4.49	<0.05	0.27	0.23	0.02	1.16	18.10	0.75	0.20	<1.00
16.05.2013 17:00:00	27	6.95	5.02	2.31	2.20	9.00	6	13	400	4	760	4.49	<0.05	0.33	0.23	0.01	1.22	14.90	0.69	0.58	2.00
07.08.2013 15:45:00	7	7.02	5.21	1.68	4.03	8.90	7	18	360	48	755	3.42	<0.05	0.25	0.22	0.01	1.43	24.60	0.72	0.20	1.00
07.10.2013 15:20:00	5	6.99	5.14	3.96	3.16	8.90	12	25	395	11	745	3.23	<0.05	0.30	0.20	0.01	1.19	21.00	0.63	0.33	1.00
Lower avg.	13	6.94	5.09	2.59	2.86	9.12	8	20	398	17	744	3.91	0.00	0.29	0.22	0.01	1.25	19.65	0.70	0.33	1.00
Upper avg..	13	6.94	5.09	2.59	2.86	9.12	8	20	398	17	744	3.91	0.05	0.29	0.22	0.01	1.25	19.65	0.70	0.33	1.25
Minimum	5	6.80	5.00	1.68	2.04	8.90	6	13	360	4	715	3.23	0.05	0.25	0.20	0.01	1.16	14.90	0.63	0.20	1.00
Maximum	27	7.02	5.21	3.96	4.03	9.70	12	25	435	48	760	4.49	0.05	0.33	0.23	0.02	1.43	24.60	0.75	0.58	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	10	0.10	0.10	0.97	0.93	0.39	3	5	31	21	20	0.68	0.00	0.04	0.01	0.01	0.12	4.14	0.05	0.18	0.50

Tokkeelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
13.02.2013 09:00:00	9	6.38	2.26	0.94	0.72	7.10	2	19	160	13	350	3.49	<0.05	0.23	0.25	0.04	0.53	5.73	0.43	0.20	1.00
06.05.2013 09:35:00	62	6.35	2.17	1.18	0.87	5.10	<1	11	190	14	490	3.25	<0.05	0.20	0.37	0.03	0.52	5.92	0.39	0.30	1.00
07.08.2013 09:30:00	32	6.43	1.82	1.03	1.34	6.00	2	7	105	<2	340	2.31	<0.05	0.20	0.16	0.02	0.53	4.17	0.41	0.10	1.00
14.10.2013 13:45:00	20	6.47	1.84	0.63	0.64	5.40	<1	3	110	12	345	2.42	<0.05	0.21	0.15	0.02	0.47	4.06	0.36	0.20	2.00
Lower avg.	31	6.41	2.02	0.94	0.89	5.90	1	10	141	10	381	2.87	0.00	0.21	0.23	0.03	0.51	4.97	0.40	0.20	1.25
Upper avg..	31	6.41	2.02	0.94	0.89	5.90	2	10	141	10	381	2.87	0.05	0.21	0.23	0.03	0.51	4.97	0.40	0.20	1.25
Minimum	9	6.35	1.82	0.63	0.64	5.10	1	3	105	2	340	2.31	0.05	0.20	0.15	0.02	0.47	4.06	0.36	0.10	1.00
Maximum	62	6.47	2.26	1.18	1.34	7.10	2	19	190	14	490	3.49	0.05	0.23	0.37	0.04	0.53	5.92	0.43	0.30	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	23	0.05	0.23	0.23	0.31	0.88	1	7	41	6	73	0.59	0.00	0.01	0.10	0.01	0.03	0.99	0.03	0.08	0.50

Nidelva(Rykene)

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
12.02.2013 11:55:00	57	6.41	2.17	1.26	1.00	3.00	1	3	190	9	310	2.57	<0.05	0.10	0.18	0.02	0.81	3.70	0.23	<0.10	<1.00
06.05.2013 10:40:00	229	6.65	2.39	1.08	1.58	4.30	1	13	200	15	390	2.48	<0.05	0.20	0.35	0.03	0.49	4.62	0.21	<0.10	<1.00
07.08.2013 13:20:00	137	6.57	1.50	0.50	0.75	2.80	<1	<1	125	16	285	1.44	<0.05	0.08	0.12	0.02	0.71	2.74	0.20	<0.10	<1.00
09.10.2013 15:55:00	71	6.55	1.88	0.90	0.83	4.10	1	5	125	8	330	1.98	<0.05	0.20	0.19	0.03	0.69	3.64	0.22	<0.10	<1.00
Lower avg.	123	6.55	1.98	0.94	1.04	3.55	1	5	160	12	329	2.12	0.00	0.15	0.21	0.02	0.68	3.68	0.22	0.00	0.00
Upper avg..	123	6.55	1.98	0.94	1.04	3.55	1	6	160	12	329	2.12	0.05	0.15	0.21	0.02	0.68	3.68	0.22	0.10	1.00
Minimum	57	6.41	1.50	0.50	0.75	2.80	1	1	125	8	285	1.44	0.05	0.08	0.12	0.02	0.49	2.74	0.20	0.10	1.00
Maximum	229	6.65	2.39	1.26	1.58	4.30	1	13	200	16	390	2.57	0.05	0.20	0.35	0.03	0.81	4.62	0.23	0.10	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	79	0.10	0.39	0.33	0.38	0.76	0	5	41	4	45	0.52	0.00	0.06	0.10	0.00	0.13	0.77	0.01	0.00	0.00

Tovdalselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
04.02.2013 14:45:00	46	5.99	2.65	0.70	0.78	4.90	<1	3	230	16	430	3.10	<0.05	0.21	0.51	0.04	0.41	7.12	0.43	0.20	2.00
06.05.2013 14:20:00	137	6.73	2.26	1.17	0.94	4.80	1	4	155	28	375	2.18	<0.05	0.21	0.51	0.03	0.58	5.01	0.37	0.20	1.00
06.08.2013 09:30:00	36	6.66	1.92	0.66	2.12	5.40	<1	4	72	21	335	0.75	<0.05	0.21	0.34	0.03	0.48	3.47	0.34	0.10	2.00
09.10.2013 13:45:00	39	6.54	1.94	0.91	1.56	5.60	<1	4	80	17	345	1.54	0.06	0.30	0.46	0.03	0.62	4.79	0.44	0.20	1.00
Lower avg.	65	6.48	2.19	0.86	1.35	5.18	0	4	134	21	371	1.89	0.02	0.23	0.45	0.03	0.52	5.10	0.40	0.18	1.50
Upper avg..	65	6.48	2.19	0.86	1.35	5.18	1	4	134	21	371	1.89	0.05	0.23	0.45	0.03	0.52	5.10	0.40	0.18	1.50
Minimum	36	5.99	1.92	0.66	0.78	4.80	1	3	72	16	335	0.75	0.05	0.21	0.34	0.03	0.41	3.47	0.34	0.10	1.00
Maximum	137	6.73	2.65	1.17	2.12	5.60	1	4	230	28	430	3.10	0.06	0.30	0.51	0.04	0.62	7.12	0.44	0.20	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	49	0.34	0.34	0.23	0.61	0.39	0	1	74	5	43	1.00	0.01	0.05	0.08	0.01	0.10	1.51	0.05	0.05	0.58

Mandalselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 11:15:00	53	6.22	1.99	0.92	0.55	3.90	<1	4	150	18	320	1.74	<0.05	0.10	0.41	0.02	0.33	3.86	0.20	<0.10	2.00
07.05.2013 11:30:00	118	6.57	2.04	1.35	1.18	3.60	2	5	165	24	355	1.48	<0.05	0.20	0.47	0.02	0.53	3.78	0.20	0.20	<1.00
05.08.2013 10:30:00	49	6.35	1.33	0.75	1.19	2.90	1	4	120	16	305	0.68	<0.05	0.10	0.34	0.02	0.36	2.32	0.10	0.20	2.00
08.10.2013 11:45:00	43	6.27	1.71	1.04	1.36	4.60	1	5	135	15	360	1.28	<0.05	0.21	0.40	0.03	0.34	3.26	0.20	<0.10	2.00
Lower avg.	66	6.35	1.77	1.02	1.07	3.75	1	5	143	18	335	1.30	0.00	0.15	0.40	0.02	0.39	3.30	0.18	0.10	1.50
Upper avg..	66	6.35	1.77	1.02	1.07	3.75	1	5	143	18	335	1.30	0.05	0.15	0.40	0.02	0.39	3.30	0.18	0.15	1.75
Minimum	43	6.22	1.33	0.75	0.55	2.90	1	4	120	15	305	0.69	0.05	0.10	0.34	0.02	0.33	2.32	0.10	0.10	1.00
Maximum	118	6.57	2.04	1.35	1.36	4.60	2	5	165	24	360	1.74	0.05	0.21	0.47	0.03	0.53	3.86	0.20	0.20	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	35	0.16	0.33	0.25	0.36	0.71	1	1	19	4	27	0.45	0.00	0.06	0.05	0.00	0.10	0.71	0.05	0.06	0.50

Lyngdalselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 13:01:00	27	6.28	2.69	1.11	0.87	3.10	<1	4	225	10	370	2.25	<0.05	0.10	0.49	0.04	0.60	6.64	0.23	0.10	<1.00
07.05.2013 16:53:00	45	6.57	2.35	0.85	1.00	3.50	1	5	190	14	365	1.51	<0.05	0.20	0.48	0.02	0.27	4.34	0.10	0.10	2.00
05.08.2013 11:30:00	16	6.85	3.10	1.08	5.66	4.10	3	9	335	4	625	1.39	<0.05	0.22	0.37	0.03	0.39	2.92	0.10	<0.10	2.00
08.10.2013 12:50:00	19	6.29	2.18	0.89	1.29	4.70	1	5	175	<2	385	1.51	<0.05	0.20	0.35	0.03	0.24	5.16	0.10	0.10	2.00
Lower avg.	27	6.50	2.58	0.98	2.20	3.85	1	6	231	7	436	1.66	0.00	0.18	0.42	0.03	0.37	4.77	0.13	0.08	1.50
Upper avg..	27	6.50	2.58	0.98	2.20	3.85	2	6	231	8	436	1.66	0.05	0.18	0.42	0.03	0.37	4.77	0.13	0.10	1.75
Minimum	16	6.28	2.18	0.85	0.87	3.10	1	4	175	2	365	1.39	0.05	0.10	0.35	0.02	0.24	2.92	0.10	0.10	1.00
Maximum	45	6.85	3.10	1.11	5.66	4.70	3	9	335	14	625	2.25	0.05	0.22	0.49	0.04	0.60	6.64	0.23	0.10	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	13	0.27	0.41	0.13	2.31	0.70	1	2	72	6	126	0.39	0.00	0.05	0.07	0.01	0.16	1.56	0.07	0.00	0.50

Kvina

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 14:01:00	48	6.13	2.89	4.16	3.66	3.50	7	14	225	18	435	2.13	<0.05	0.20	0.57	0.03	0.71	8.44	0.24	<0.10	2.00
07.05.2013 13:40:00	63	6.44	2.41	0.95	1.21	3.50	3	8	215	28	430	1.35	<0.05	0.20	0.45	0.03	0.41	3.61	0.10	0.20	<1.00
05.08.2013 14:56:00	32	6.71	1.72	0.78	0.49	2.30	2	6	120	3	295	0.41	<0.05	0.20	0.28	0.01	1.41	1.70	0.10	<0.10	<1.00
08.10.2013 14:00:00	31	6.02	2.00	1.00	2.09	6.90	2	7	150	2	410	1.49	<0.05	0.32	0.69	0.03	0.96	4.06	0.20	0.20	2.00
Lower avg.	44	6.32	2.26	1.72	1.86	4.05	4	9	178	13	393	1.34	0.00	0.23	0.50	0.02	0.87	4.45	0.16	0.10	1.00
Upper avg..	44	6.32	2.26	1.72	1.86	4.05	4	9	178	13	393	1.34	0.05	0.23	0.50	0.02	0.87	4.45	0.16	0.15	1.50
Minimum	31	6.02	1.72	0.78	0.49	2.30	2	6	120	2	295	0.41	0.05	0.20	0.28	0.01	0.41	1.70	0.10	0.10	1.00
Maximum	63	6.71	2.89	4.16	3.66	6.90	7	14	225	28	435	2.13	0.05	0.32	0.69	0.03	1.41	8.44	0.24	0.20	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	15	0.31	0.51	1.63	1.37	1.98	2	4	51	13	66	0.71	0.00	0.06	0.18	0.01	0.43	2.85	0.07	0.06	0.58

Sira

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 15:30:00	124	5.60	1.24	0.64	0.40	1.90	<1	3	77	16	220	0.88	<0.05	0.06	0.23	0.01	0.19	1.90	0.09	<0.10	<1.00
07.05.2013 14:45:00	152	5.85	1.19	0.42	0.44	1.20	1	2	97	14	200	0.79	<0.05	0.06	0.18	0.01	0.16	1.70	0.08	0.10	<1.00
05.08.2013 13:55:00	72	5.64	1.23	0.67	0.62	1.60	<1	1	110	20	250	0.60	<0.05	0.08	0.24	0.02	0.30	2.38	0.10	<0.10	<1.00
08.10.2013 15:00:00	64	5.68	1.19	0.57	0.51	2.30	<1	3	105	30	265	0.77	<0.05	0.10	0.25	0.01	0.26	2.00	0.10	<0.10	<1.00
Lower avg.	103	5.69	1.21	0.57	0.49	1.75	0	2	97	20	234	0.76	0.00	0.08	0.23	0.01	0.23	2.00	0.09	0.02	0.00
Upper avg..	103	5.69	1.21	0.57	0.49	1.75	1	2	97	20	234	0.76	0.05	0.08	0.23	0.01	0.23	2.00	0.09	0.10	1.00
Minimum	64	5.60	1.19	0.42	0.40	1.20	1	1	77	14	200	0.60	0.05	0.06	0.18	0.01	0.16	1.70	0.08	0.10	1.00
Maximum	152	5.85	1.24	0.67	0.62	2.30	1	3	110	30	265	0.88	0.05	0.10	0.25	0.02	0.30	2.38	0.10	0.10	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	42	0.11	0.03	0.11	0.10	0.47	0	1	15	7	29	0.12	0.00	0.02	0.03	0.01	0.06	0.29	0.01	0.00	0.00

Bjerkreimselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.02.2013 10:35:00	51	6.39	3.74	0.58	0.27	1.40	2	6	365	10	465	1.68	<0.05	0.06	0.12	0.02	0.35	3.66	0.20	<0.10	<1.00
06.05.2013 09:00:00	74	6.48	3.25	0.60	0.44	1.30	1	3	370	15	475	1.30	<0.05	0.10	0.13	0.02	0.21	2.65	0.10	0.20	<1.00
20.08.2013 12:00:00	64	6.50	2.79	0.73	0.83	1.80	1	5	305	11	455	1.09	<0.05	0.10	0.21	0.02	0.33	2.45	0.20	0.32	<1.00
02.10.2013 08:30:00	23	6.51	3.11	0.38	0.54	1.80	1	5	395	4	530	1.33	<0.05	0.10	0.13	0.02	0.25	1.90	0.10	0.20	<1.00
Lower avg.	53	6.47	3.22	0.57	0.52	1.58	1	5	359	10	481	1.35	0.00	0.09	0.15	0.02	0.28	2.67	0.15	0.18	0.00
Upper avg..	53	6.47	3.22	0.57	0.52	1.58	1	5	359	10	481	1.35	0.05	0.09	0.15	0.02	0.28	2.67	0.15	0.20	1.00
Minimum	23	6.39	2.79	0.38	0.27	1.30	1	3	305	4	455	1.09	0.05	0.06	0.12	0.02	0.21	1.90	0.10	0.10	1.00
Maximum	74	6.51	3.74	0.73	0.83	1.80	2	6	395	15	530	1.68	0.05	0.10	0.21	0.02	0.35	3.66	0.20	0.32	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	22	0.06	0.40	0.15	0.24	0.26	1	1	38	5	34	0.25	0.00	0.02	0.04	0.00	0.07	0.74	0.06	0.09	0.00

Figgjoelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 11:00:00	9	7.02	10.90	6.03	14.20	3.20	33	54	855	120	1330	3.23	<0.05	0.20	0.56	0.02	1.29	6.86	0.49	0.20	<1.00
06.05.2013 13:00:00	9	7.17	10.10	2.10	5.11	3.60	11	25	1150	44	1550	2.33	<0.05	0.10	0.39	0.01	1.06	5.61	0.50	0.41	<1.00
06.08.2013 10:15:00	10	7.04	8.40	2.54	4.81	3.50	16	28	785	66	1160	1.87	<0.05	0.10	0.41	0.02	1.11	4.32	0.44	0.20	<1.00
01.10.2013 13:00:00	4	7.23	10.90	3.39	3.20	3.80	12	23	1050	31	1390	3.08	<0.05	0.20	0.34	0.01	0.94	3.08	0.51	0.40	<1.00
Lower avg.	8	7.12	10.07	3.52	6.83	3.53	18	33	960	65	1358	2.63	0.00	0.15	0.43	0.02	1.10	4.97	0.48	0.30	0.00
Upper avg..	8	7.12	10.07	3.52	6.83	3.53	18	33	960	65	1358	2.63	0.05	0.15	0.43	0.02	1.10	4.97	0.48	0.30	1.00
Minimum	4	7.02	8.40	2.10	3.20	3.20	11	23	785	31	1160	1.87	0.05	0.10	0.34	0.01	0.94	3.08	0.44	0.20	1.00
Maximum	10	7.23	10.90	6.03	14.20	3.80	33	54	1150	120	1550	3.23	0.05	0.20	0.56	0.02	1.29	6.86	0.51	0.41	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	3	0.10	1.18	1.76	4.98	0.25	10	14	169	39	161	0.64	0.00	0.06	0.09	0.01	0.15	1.63	0.03	0.12	0.00

Lyseelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
17.02.2013 14:30:00	7	6.95	2.88	0.20	<0.10	0.40	1	<1	220	4	285	3.04	<0.05	<0.05	0.05	0.01	0.24	1.50	<0.05	0.20	<1.00
12.05.2013 11:00:00	20	6.48	1.97	0.22	0.32	0.79	<1	1	160	<2	215	0.86	<0.05	<0.05	0.11	0.01	0.14	1.20	0.06	0.20	<1.00
04.08.2013 10:30:00	9	6.80	1.70	0.21	0.22	2.00	<1	<1	140	<2	255	1.35	<0.05	0.08	0.19	0.01	0.60	1.90	0.10	<0.10	1.00
13.10.2013 17:00:00	7	6.79	1.80	0.37	0.14	1.10	<1	1	115	11	235	1.94	<0.05	<0.05	0.07	<0.01	0.23	1.60	<0.05	<0.10	<1.00
Lower avg.	11	6.76	2.09	0.25	0.17	1.07	0	1	159	4	248	1.79	0.00	0.02	0.11	0.01	0.30	1.55	0.04	0.10	0.25
Upper avg..	11	6.76	2.09	0.25	0.20	1.07	1	1	159	5	248	1.79	0.05	0.06	0.11	0.01	0.30	1.55	0.06	0.15	1.00
Minimum	7	6.48	1.70	0.20	0.10	0.40	1	1	115	2	215	0.86	0.05	0.05	0.05	0.01	0.14	1.20	0.05	0.10	1.00
Maximum	20	6.95	2.88	0.37	0.32	2.00	1	1	220	11	285	3.04	0.05	0.08	0.19	0.01	0.60	1.90	0.10	0.20	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	no	no	yes	yes	yes	yes	no	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	6	0.20	0.54	0.08	0.10	0.68	0	0	45	4	30	0.94	0.00	0.02	0.06	0.00	0.20	0.29	0.02	0.06	0.00

Årdalselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
11.02.2013 10:22:00	21	6.56	2.74	0.22	0.30	0.62	<1	3	260	<2	330	2.03	<0.05	<0.05	0.05	0.01	0.10	1.30	0.06	<0.10	<1.00
21.05.2013 09:36:00	79	6.27	1.75	0.38	0.43	1.20	<1	2	100	2	185	0.83	<0.05	<0.05	0.12	0.01	0.23	1.30	0.06	0.20	3.00
19.08.2013 09:43:00	37	6.16	1.58	0.77	0.35	4.90	<1	2	70	<2	260	1.41	<0.05	0.20	0.42	0.01	0.32	1.90	0.10	1.50	2.00
14.10.2013 09:15:00	17	6.51	2.13	0.35	0.31	1.70	<1	2	240	3	355	1.70	<0.05	<0.05	0.10	0.01	0.22	1.50	0.06	0.10	<1.00
Lower avg.	39	6.38	2.05	0.43	0.35	2.10	0	2	168	1	283	1.50	0.00	0.05	0.17	0.01	0.22	1.50	0.07	0.45	1.25
Upper avg..	39	6.38	2.05	0.43	0.35	2.10	1	2	168	2	283	1.50	0.05	0.09	0.17	0.01	0.22	1.50	0.07	0.48	1.75
Minimum	17	6.16	1.58	0.22	0.30	0.62	1	2	70	2	185	0.83	0.05	0.05	0.05	0.01	0.10	1.30	0.06	0.10	1.00
Maximum	79	6.56	2.74	0.77	0.43	4.90	1	3	260	3	355	2.04	0.05	0.20	0.42	0.01	0.32	1.90	0.10	1.50	3.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	no	no	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	28	0.19	0.51	0.24	0.06	1.92	0	1	96	1	76	0.51	0.00	0.08	0.17	0.00	0.09	0.28	0.02	0.69	0.96

Ulladalsåna (Ulla)

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
11.02.2013 12:25:00	18	6.86	3.22	0.24	0.08	0.53	<1	1	130	<2	180	2.48	<0.05	<0.05	0.02	0.01	0.13	1.20	0.20	<0.10	4.00
21.05.2013 11:30:00	54	6.42	1.56	0.32	0.25	1.40	<1	2	41	2	124	0.90	<0.05	0.08	0.08	0.01	0.27	1.40	0.34	0.30	3.00
19.08.2013 12:30:00	38	6.28	1.49	0.52	0.43	6.20	<1	3	46	<2	250	1.65	<0.05	0.20	0.35	0.01	0.53	2.32	0.59	0.57	2.00
14.10.2013 11:20:00	16	6.85	2.19	0.27	0.15	1.90	<1	2	98	<2	205	2.01	<0.05	0.06	0.06	0.01	0.34	1.40	0.42	<0.10	2.00
Lower avg.	32	6.60	2.12	0.34	0.23	2.51	0	2	79	1	190	1.76	0.00	0.08	0.13	0.01	0.32	1.58	0.39	0.22	2.75
Upper avg..	32	6.60	2.12	0.34	0.23	2.51	1	2	79	2	190	1.76	0.05	0.10	0.13	0.01	0.32	1.58	0.39	0.27	2.75
Minimum	16	6.28	1.49	0.24	0.08	0.53	1	1	41	2	124	0.90	0.05	0.05	0.02	0.01	0.13	1.20	0.20	0.10	2.00
Maximum	54	6.86	3.22	0.52	0.43	6.20	1	3	130	2	250	2.48	0.05	0.20	0.35	0.01	0.53	2.32	0.59	0.57	4.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes	yes	no	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	18	0.30	0.80	0.13	0.15	2.53	0	1	43	0	53	0.67	0.00	0.07	0.15	0.00	0.17	0.50	0.16	0.22	0.96

Suldalslågen

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
18.02.2013 09:30:00	44	6.53	1.89	0.31	0.14	0.50	1	1	175	<2	210	0.90	<0.05	0.06	0.02	0.01	0.17	1.20	0.10	<0.10	<1.00
06.05.2013 10:30:00	66	6.50	1.71	0.58	0.80	0.79	<1	2	130	3	185	0.81	<0.05	0.06	0.08	0.01	0.21	1.70	0.10	0.10	<1.00
05.08.2013 10:00:00	130	6.55	1.34	0.38	0.46	1.10	<1	2	97	2	175	0.77	<0.05	0.10	0.07	0.02	0.28	1.20	0.10	<0.10	<1.00
08.10.2013 10:00:00	76	6.55	1.38	0.33	0.38	1.10	<1	2	110	3	195	0.86	<0.05	0.07	0.05	0.01	0.26	1.20	0.10	<0.10	<1.00
Lower avg.	79	6.53	1.58	0.40	0.45	0.87	0	2	128	2	191	0.83	0.00	0.07	0.06	0.01	0.23	1.32	0.10	0.02	0.00
Upper avg..	79	6.53	1.58	0.40	0.45	0.87	1	2	128	3	191	0.83	0.05	0.07	0.06	0.01	0.23	1.32	0.10	0.10	1.00
Minimum	44	6.50	1.34	0.31	0.14	0.50	1	1	97	2	175	0.77	0.05	0.06	0.02	0.01	0.17	1.20	0.10	0.10	1.00
Maximum	130	6.55	1.89	0.58	0.80	1.10	1	2	175	3	210	0.90	0.05	0.10	0.08	0.02	0.28	1.70	0.10	0.10	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	36	0.02	0.27	0.12	0.27	0.29	0	1	34	1	15	0.06	0.00	0.02	0.03	0.01	0.05	0.25	0.00	0.00	0.00

Saudaelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
19.02.2013 09:00:00	14	6.67	8.41	0.48	0.27	0.39	5	8	520	15	650	1.81	<0.05	<0.05	0.06	0.02	0.58	2.33	0.10	0.30	<1.00
22.05.2013 09:00:00	71	6.14	1.17	0.26	0.32	0.55	<1	2	105	<2	165	0.51	<0.05	0.06	0.08	0.01	0.16	0.95	0.09	0.20	<1.00
27.08.2013 09:00:00	18	6.48	1.79	0.21	0.08	0.58	2	3	255	4	325	1.09	<0.05	0.06	0.06	0.01	0.59	1.20	0.10	<0.10	<1.00
22.10.2013 11:00:00	10	6.57	1.78	2.30	1.82	0.77	5	8	285	6	375	1.28	<0.05	0.08	0.13	0.01	0.46	2.00	0.10	0.10	<1.00
Lower avg.	28	6.46	3.29	0.81	0.62	0.57	3	5	291	6	379	1.18	0.00	0.05	0.08	0.01	0.45	1.62	0.10	0.15	0.00
Upper avg..	28	6.46	3.29	0.81	0.62	0.57	3	5	291	7	379	1.18	0.05	0.06	0.08	0.01	0.45	1.62	0.10	0.18	1.00
Minimum	10	6.14	1.17	0.21	0.08	0.39	1	2	105	2	165	0.51	0.05	0.05	0.06	0.01	0.16	0.95	0.09	0.10	1.00
Maximum	71	6.67	8.41	2.30	1.82	0.77	5	8	520	15	650	1.81	0.05	0.08	0.13	0.02	0.59	2.33	0.10	0.30	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	29	0.23	3.43	1.00	0.81	0.16	2	3	172	6	202	0.54	0.00	0.01	0.03	0.01	0.20	0.65	0.01	0.10	0.00

Vikedalselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
19.02.2013 09:20:00	5	7.09	5.08	0.99	0.70	1.20	4	9	475	140	760	1.52	<0.05	0.29	0.09	0.02	0.43	2.11	0.35	0.20	<1.00
06.05.2013 11:30:00	13	6.78	2.90	0.75	0.94	1.10	1	3	265	29	380	0.73	<0.05	0.10	0.19	0.02	0.37	2.32	0.36	0.20	<1.00
02.09.2013 09:30:00	10	6.45	1.88	0.96	1.29	2.60	2	7	185	7	365	0.68	<0.05	0.27	0.24	0.02	1.69	8.28	0.50	<0.10	3.00
07.10.2013 11:00:00	7	6.51	2.07	0.43	1.21	2.30	2	4	245	9	395	0.88	<0.05	0.24	0.12	0.01	0.46	1.70	0.32	0.10	<1.00
Lower avg.	9	6.71	2.98	0.78	1.03	1.80	2	6	293	46	475	0.95	0.00	0.22	0.16	0.02	0.74	3.60	0.38	0.12	0.75
Upper avg..	9	6.71	2.98	0.78	1.03	1.80	2	6	293	46	475	0.95	0.05	0.22	0.16	0.02	0.74	3.60	0.38	0.15	1.50
Minimum	5	6.45	1.88	0.43	0.70	1.10	1	3	185	7	365	0.69	0.05	0.10	0.09	0.01	0.37	1.70	0.32	0.10	1.00
Maximum	13	7.09	5.08	0.99	1.29	2.60	4	9	475	140	760	1.52	0.05	0.29	0.24	0.02	1.69	8.28	0.50	0.20	3.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	3	0.29	1.47	0.26	0.27	0.76	1	3	126	63	190	0.39	0.00	0.09	0.07	0.01	0.64	3.13	0.08	0.06	1.00

Jostedøla

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 10:15:00	14	6.90	26.80	1.23	2.00	0.60	2	3	345	11	430	5.54	<0.05	<0.05	0.01	<0.01	0.53	0.54	<0.05	0.30	<1.00
04.06.2013 11:00:00	125	6.57	1.36	13.20	8.57	0.60	12	13	105	4	150	2.55	<0.05	<0.05	0.19	<0.01	0.97	2.92	0.66	1.30	<1.00
06.08.2013 13:20:00	159	6.50	0.72	55.10	107.00	1.30	240	250	20	5	124	8.19	<0.05	0.08	1.15	0.01	3.43	11.50	2.55	2.60	<1.00
08.10.2013 13:20:00	98	6.52	1.04	175.00	186.00	2.10	202	197	51	3	165	12.19	<0.05	0.10	2.23	0.01	8.62	31.60	7.57	10.80	<1.00
Lower avg.	99	6.62	7.48	61.13	75.89	1.15	114	116	130	6	217	7.12	0.00	0.04	0.90	0.00	3.39	11.64	2.70	3.75	0.00
Upper avg..	99	6.62	7.48	61.13	75.89	1.15	114	116	130	6	217	7.12	0.05	0.07	0.90	0.01	3.39	11.64	2.71	3.75	1.00
Minimum	14	6.50	0.72	1.23	2.00	0.60	2	3	20	3	124	2.55	0.05	0.05	0.01	0.01	0.53	0.54	0.05	0.30	1.00
Maximum	159	6.90	26.80	175.00	186.00	2.10	240	250	345	11	430	12.19	0.05	0.10	2.23	0.01	8.62	31.60	7.57	10.80	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	62	0.19	12.88	79.35	87.72	0.71	125	126	147	4	143	4.10	0.00	0.02	1.02	0.00	3.71	14.12	3.41	4.79	0.00

Gaular

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.02.2013 09:30:00	32	6.13	2.23	0.36	0.21	1.50	2	5	125	5	230	1.28	<0.05	<0.05	0.03	0.01	0.23	1.70	0.10	<0.10	<1.00
03.05.2013 12:20:00	43	6.21	2.47	0.73	0.85	2.30	13	13	200	25	390	1.09	<0.05	<0.05	0.05	<0.01	0.38	1.80	0.21	0.20	<1.00
21.08.2013 08:30:00	75	6.21	1.26	0.68	0.59	2.50	2	7	83	5	200	0.83	<0.05	<0.05	0.07	0.01	0.34	1.10	0.20	<0.10	<1.00
16.10.2013 09:20:00	41	6.43	1.29	0.56	0.60	1.70	2	5	90	4	215	0.90	<0.05	<0.05	0.05	<0.01	0.26	1.00	0.10	<0.10	1.00
Lower avg.	48	6.24	1.81	0.58	0.56	2.00	5	8	125	10	259	1.03	0.00	0.00	0.05	0.00	0.30	1.40	0.15	0.05	0.25
Upper avg..	48	6.24	1.81	0.58	0.56	2.00	5	8	125	10	259	1.03	0.05	0.05	0.05	0.01	0.30	1.40	0.15	0.12	1.00
Minimum	32	6.13	1.26	0.36	0.21	1.50	2	5	83	4	200	0.83	0.05	0.05	0.03	0.01	0.23	1.00	0.10	0.10	1.00
Maximum	75	6.43	2.47	0.73	0.85	2.50	13	13	200	25	390	1.28	0.05	0.05	0.07	0.01	0.38	1.80	0.21	0.20	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	19	0.13	0.63	0.17	0.26	0.48	6	4	54	10	88	0.20	0.00	0.00	0.02	0.00	0.07	0.41	0.06	0.05	0.00

Jølstra

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.02.2013 10:30:00	46	6.33	2.04	0.48	0.24	1.00	3	5	170	6	250	1.28	<0.05	<0.05	0.02	0.01	0.28	1.70	0.09	<0.10	<1.00
03.05.2013 11:00:00	61	6.31	2.27	0.75	0.66	1.50	5	6	170	20	300	1.13	<0.05	<0.05	0.04	0.01	0.29	1.70	0.10	<0.10	<1.00
21.08.2013 09:45:00	79	6.37	1.62	0.55	0.60	1.80	2	6	130	6	230	0.96	<0.05	<0.05	0.03	<0.01	0.28	1.10	0.10	<0.10	<1.00
16.10.2013 11:15:00	48	6.42	1.61	0.56	0.53	1.30	2	4	140	4	255	1.05	<0.05	<0.05	0.04	0.01	0.25	1.40	0.08	<0.10	<1.00
Lower avg.	59	6.36	1.89	0.58	0.51	1.40	3	5	153	9	259	1.11	0.00	0.00	0.03	0.00	0.28	1.48	0.09	0.00	0.00
Upper avg..	59	6.36	1.89	0.58	0.51	1.40	3	5	153	9	259	1.11	0.05	0.05	0.03	0.01	0.28	1.48	0.09	0.10	1.00
Minimum	46	6.31	1.61	0.48	0.24	1.00	2	4	130	4	230	0.96	0.05	0.05	0.02	0.01	0.25	1.10	0.08	0.10	1.00
Maximum	79	6.42	2.27	0.75	0.66	1.80	5	6	170	20	300	1.28	0.05	0.05	0.04	0.01	0.29	1.70	0.10	0.10	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes	yes	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	15	0.05	0.33	0.12	0.19	0.34	1	1	21	7	30	0.14	0.00	0.00	0.01	0.00	0.02	0.29	0.01	0.00	0.00

Nausta

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.02.2013 10:45:00	18	6.37	2.47	0.59	0.60	1.10	3	7	165	21	270	2.09	<0.05	<0.05	0.04	0.01	0.25	1.80	0.10	<0.10	<1.00
03.05.2013 10:00:00	23	6.44	2.92	0.84	1.02	1.90	7	12	270	26	445	1.37	<0.05	<0.05	0.05	0.01	0.30	2.00	0.10	0.20	<1.00
21.08.2013 10:30:00	31	6.23	1.05	1.10	1.51	3.50	4	10	59	<2	205	0.94	<0.05	<0.05	0.16	0.01	0.36	1.10	0.10	0.10	<1.00
16.10.2013 10:20:00	19	6.51	1.46	0.36	0.31	1.70	2	4	135	2	255	1.22	<0.05	<0.05	0.04	<0.01	0.22	0.73	0.05	<0.10	1.00
Lower avg.	23	6.39	1.98	0.72	0.86	2.05	4	8	157	12	294	1.40	0.00	0.00	0.07	0.00	0.28	1.41	0.09	0.08	0.25
Upper avg..	23	6.39	1.98	0.72	0.86	2.05	4	8	157	13	294	1.40	0.05	0.05	0.07	0.01	0.28	1.41	0.09	0.12	1.00
Minimum	18	6.23	1.05	0.36	0.31	1.10	2	4	59	2	205	0.94	0.05	0.05	0.04	0.01	0.22	0.73	0.05	0.10	1.00
Maximum	31	6.51	2.92	1.10	1.51	3.50	7	12	270	26	445	2.09	0.05	0.05	0.16	0.01	0.36	2.00	0.10	0.20	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes	yes	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	6	0.12	0.87	0.32	0.52	1.03	2	4	87	13	105	0.49	0.00	0.00	0.06	0.00	0.06	0.59	0.03	0.05	0.00

Gloppenelva(Breimselva)

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.03.2013 18:00:00	14	6.58	2.34	0.80	0.77	0.92	1	3	240	<2	300	1.66	<0.05	<0.05	0.01	<0.01	0.31	0.75	0.10	<0.10	<1.00
29.05.2013 22:00:00	68	6.73	2.10	0.71	0.73	0.96	1	4	210	6	330	1.28	<0.05	<0.05	0.01	0.01	0.34	0.90	0.20	<0.10	<1.00
15.08.2013 20:00:00	52	6.60	1.60	0.98	0.70	0.92	2	3	130	7	225	1.03	<0.05	0.05	0.04	<0.01	0.40	1.30	0.20	0.86	<1.00
02.11.2013 16:00:00	51	6.84	1.77	1.28	0.85	1.30	2	3	155	5	240	1.35	<0.05	<0.05	0.04	<0.01	0.37	1.00	0.61	0.53	<1.00
Lower avg.	46	6.69	1.95	0.94	0.76	1.02	2	3	184	5	274	1.33	0.00	0.01	0.02	0.00	0.35	0.99	0.28	0.35	0.00
Upper avg..	46	6.69	1.95	0.94	0.76	1.02	2	3	184	5	274	1.33	0.05	0.05	0.02	0.01	0.35	0.99	0.28	0.40	1.00
Minimum	14	6.58	1.60	0.71	0.70	0.92	1	3	130	2	225	1.03	0.05	0.05	0.01	0.01	0.31	0.75	0.10	0.10	1.00
Maximum	68	6.84	2.34	1.28	0.85	1.30	2	4	240	7	330	1.66	0.05	0.05	0.04	0.01	0.40	1.30	0.61	0.86	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	23	0.12	0.33	0.25	0.07	0.18	1	1	50	2	50	0.26	0.00	0.00	0.02	0.00	0.04	0.23	0.23	0.37	0.00

Driva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
11.02.2013 13:00:00	28	7.11	3.26	0.55	0.71	0.84	<1	2	125	3	215	2.50	<0.05	<0.05	0.01	<0.01	0.40	0.20	0.20	0.10	<1.00
13.05.2013 10:00:00	166	7.14	3.13	4.64	17.20	3.70	8	19	110	4	330	2.89	<0.05	<0.05	0.14	<0.01	1.65	1.90	0.71	0.90	<1.00
06.08.2013 11:00:00	65	7.20	2.68	0.72	1.57	0.72	2	7	73	<2	146	2.14	<0.05	<0.05	0.02	0.01	0.56	0.66	0.20	<0.10	<1.00
14.10.2013 11:00:00	35	7.16	3.47	0.49	0.79	0.79	<1	2	125	5	215	2.74	<0.05	<0.05	<0.01	<0.01	0.41	0.32	0.10	<0.10	<1.00
Lower avg.	73	7.15	3.14	1.60	5.07	1.51	3	8	108	3	227	2.57	0.00	0.00	0.04	0.00	0.75	0.77	0.30	0.25	0.00
Upper avg..	73	7.15	3.14	1.60	5.07	1.51	3	8	108	4	227	2.57	0.05	0.05	0.04	0.00	0.75	0.77	0.30	0.30	1.00
Minimum	28	7.11	2.68	0.49	0.71	0.72	1	2	73	2	146	2.14	0.05	0.05	0.01	0.01	0.40	0.20	0.10	0.10	1.00
Maximum	166	7.20	3.47	4.64	17.20	3.70	8	19	125	5	330	2.89	0.05	0.05	0.14	0.01	1.65	1.90	0.71	0.90	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	64	0.04	0.33	2.03	8.10	1.46	3	8	25	1	76	0.33	0.00	0.00	0.07	0.00	0.60	0.78	0.28	0.40	0.00

Surna

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
27.02.2013	15	6.69	2.22	0.62	0.34	1.10	1	<1	47	5	108	1.71	<0.05	<0.05	<0.01	<0.01	0.23	0.25	0.10	<0.10	<1.00
30.05.2013 16:00:00	81	7.09	2.56	0.86	0.88	1.90	<1	2	56	4	200	1.16	<0.05	0.05	0.02	<0.01	0.49	0.40	0.26	0.31	<1.00
28.08.2013 09:20:00	29	6.90	2.29	0.50	0.31	1.70	<1	2	150	5	240	1.18	<0.05	<0.05	0.01	<0.01	0.42	0.38	0.22	<0.10	<1.00
16.10.2013 14:00:00	25	7.11	3.59	0.47	0.38	2.40	<1	2	310	4	435	1.82	<0.05	<0.05	0.01	<0.01	0.55	0.22	0.33	0.20	1.00
Lower avg.	38	6.95	2.66	0.61	0.48	1.78	0	2	141	5	246	1.47	0.00	0.01	0.01	0.00	0.42	0.31	0.23	0.13	0.25
Upper avg..	38	6.95	2.66	0.61	0.48	1.78	1	2	141	5	246	1.47	0.05	0.05	0.01	0.00	0.42	0.31	0.23	0.18	1.00
Minimum	15	6.69	2.22	0.47	0.31	1.10	1	1	47	4	108	1.16	0.05	0.05	0.01	0.01	0.23	0.22	0.10	0.10	1.00
Maximum	81	7.11	3.59	0.86	0.88	2.40	1	2	310	5	435	1.82	0.05	0.05	0.02	0.01	0.55	0.40	0.33	0.31	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	30	0.20	0.63	0.18	0.27	0.54	0	1	122	1	138	0.35	0.00	0.00	0.01	0.00	0.14	0.09	0.10	0.10	0.00

Gaula

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
26.02.2013 09:41:00	21	7.24	12.80	2.15	1.96	2.30	3	4	130	45	295	2.48	<0.05	0.06	0.03	<0.01	0.47	1.00	0.92	0.50	<1.00
14.05.2013 08:30:00	355	6.95	2.99	27.30	53.50	4.20	31	37	32	4	265	4.56	<0.05	0.23	0.54	0.03	2.97	8.02	4.53	3.69	<1.00
29.08.2013 13:30:00	63	7.62	10.30	1.79	2.06	3.30	3	4	165	20	315	2.85	<0.05	0.10	0.06	<0.01	1.33	1.20	1.40	0.35	<1.00
16.10.2013 09:12:00	49	7.45	8.51	2.05	1.79	3.80	1	3	125	27	335	3.14	<0.05	0.10	0.09	0.01	1.15	1.40	1.20	0.51	<1.00
Lower avg.	122	7.32	8.65	8.32	14.83	3.40	10	12	113	24	303	3.26	0.00	0.12	0.18	0.01	1.48	2.90	2.01	1.26	0.00
Upper avg..	122	7.32	8.65	8.32	14.83	3.40	10	12	113	24	303	3.26	0.05	0.12	0.18	0.01	1.48	2.90	2.01	1.26	1.00
Minimum	21	6.95	2.99	1.79	1.79	2.30	1	3	32	4	265	2.48	0.05	0.06	0.03	0.01	0.47	1.00	0.92	0.35	1.00
Maximum	355	7.62	12.80	27.30	53.50	4.20	31	37	165	45	335	4.56	0.05	0.23	0.54	0.03	2.97	8.02	4.53	3.69	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	156	0.29	4.16	12.65	25.78	0.82	14	17	57	17	30	0.91	0.00	0.07	0.24	0.01	1.06	3.41	1.69	1.62	0.00

Nidelva(Tr.heim)

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
26.02.2013	23	7.07	3.40	0.58	0.29	2.10	1	2	82	7	170	1.86	<0.05	0.06	0.01	<0.01	0.51	0.35	0.54	<0.10	<1.00
14.05.2013 09:10:00	279	7.14	3.39	2.50	3.08	2.30	2	4	93	5	200	2.55	<0.05	0.10	0.46	<0.01	2.39	15.10	1.30	0.82	<1.00
29.08.2013 13:00:00	51	7.23	3.15	1.05	4.53	2.90	2	4	64	6	205	1.57	<0.05	0.07	0.01	<0.01	0.78	0.65	0.74	<0.10	<1.00
16.10.2013 10:23:00	43	7.26	3.90	1.32	2.09	2.70	1	4	105	18	280	1.81	<0.05	0.09	0.02	<0.01	0.75	0.59	0.77	0.30	<1.00
Lower avg.	99	7.18	3.46	1.36	2.50	2.50	2	4	86	9	214	1.95	0.00	0.08	0.13	0.00	1.11	4.17	0.84	0.28	0.00
Upper avg..	99	7.18	3.46	1.36	2.50	2.50	2	4	86	9	214	1.95	0.05	0.08	0.13	0.00	1.11	4.17	0.84	0.33	1.00
Minimum	23	7.07	3.15	0.58	0.29	2.10	1	2	64	5	170	1.58	0.05	0.06	0.01	0.01	0.51	0.35	0.54	0.10	1.00
Maximum	279	7.26	3.90	2.50	4.53	2.90	2	4	105	18	280	2.55	0.05	0.10	0.46	0.01	2.39	15.10	1.30	0.82	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	121	0.09	0.32	0.82	1.78	0.37	1	1	17	6	47	0.42	0.00	0.02	0.23	0.00	0.87	7.29	0.33	0.34	0.00

Stjørdalselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
27.02.2013 09:30:00	20	6.86	2.77	6.66	7.89	1.90	5	8	73	68	475	1.20	<0.05	0.07	1.64	0.03	1.75	14.40	0.69	0.37	2.00
14.05.2013 10:15:00	172	6.78	2.41	4.40	9.79	4.40	8	11	38	3	240	1.28	<0.05	0.20	0.17	0.01	1.44	4.91	0.93	0.59	1.00
29.08.2013 13:30:00	31	7.34	4.42	1.04	0.93	3.50	1	3	140	3	285	1.30	<0.05	0.10	0.04	0.01	1.72	2.07	0.45	<0.10	<1.00
16.10.2013 11:55:00	29	7.19	3.79	2.58	1.99	3.60	1	3	120	6	305	1.51	<0.05	0.10	0.06	<0.01	1.31	2.58	0.52	0.36	<1.00
Lower avg.	63	7.04	3.35	3.67	5.15	3.35	4	6	93	20	326	1.32	0.00	0.12	0.48	0.01	1.56	5.99	0.65	0.33	0.75
Upper avg..	63	7.04	3.35	3.67	5.15	3.35	4	6	93	20	326	1.32	0.05	0.12	0.48	0.01	1.56	5.99	0.65	0.36	1.25
Minimum	20	6.78	2.41	1.04	0.93	1.90	1	3	38	3	240	1.20	0.05	0.07	0.04	0.01	1.31	2.07	0.45	0.10	1.00
Maximum	172	7.34	4.42	6.66	9.79	4.40	8	11	140	68	475	1.51	0.05	0.20	1.64	0.03	1.75	14.40	0.93	0.59	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	73	0.27	0.92	2.42	4.35	1.05	3	4	46	32	103	0.13	0.00	0.06	0.78	0.01	0.22	5.74	0.21	0.20	0.50

Verdalselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
27.02.2013	14	7.49	11.10	117.00	95.20	4.60	118	162	500	250	1090	3.87	<0.05	0.71	1.45	0.02	4.77	7.26	3.04	1.40	3.00
14.05.2013 11:40:00	140	6.93	2.43	4.40	14.30	3.30	7	17	29	3	180	1.47	<0.05	0.10	0.21	0.01	0.67	2.41	0.83	0.30	1.00
29.08.2013 12:00:00	22	7.66	6.24	1.23	0.96	3.70	1	3	130	<2	280	1.45	<0.05	0.10	0.04	<0.01	0.74	0.50	0.48	0.20	<1.00
16.10.2013 13:20:00	20	7.31	4.26	1.38	1.17	4.10	1	2	75	3	250	1.70	<0.05	0.10	0.03	<0.01	0.63	0.66	0.51	0.20	<1.00
Lower avg.	49	7.35	6.01	31.00	27.91	3.92	32	46	184	64	450	2.12	0.00	0.25	0.43	0.01	1.70	2.71	1.21	0.52	1.00
Upper avg..	49	7.35	6.01	31.00	27.91	3.92	32	46	184	65	450	2.12	0.05	0.25	0.43	0.01	1.70	2.71	1.21	0.52	1.50
Minimum	14	6.93	2.43	1.23	0.96	3.30	1	2	29	2	180	1.45	0.05	0.10	0.03	0.01	0.63	0.50	0.48	0.20	1.00
Maximum	140	7.66	11.10	117.00	95.20	4.60	118	162	500	250	1090	3.87	0.05	0.71	1.45	0.02	4.77	7.26	3.04	1.40	3.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	61	0.31	3.74	57.35	45.29	0.56	58	78	215	124	429	1.17	0.00	0.31	0.68	0.01	2.05	3.16	1.23	0.59	1.00

Snåsavassdraget

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
28.02.2013	39	6.98	6.63	15.30	12.60	4.30	28	37	205	58	525	1.76	<0.05	0.20	0.24	<0.01	0.99	1.80	0.62	0.43	2.00
14.05.2013 12:45:00	74	7.11	4.51	2.90	4.09	3.90	3	10	150	5	315	1.44	<0.05	0.10	0.07	<0.01	0.50	1.00	0.49	0.20	1.00
29.08.2013 11:00:00	14	7.43	6.05	0.63	0.77	3.90	1	5	105	11	260	1.16	<0.05	0.09	0.05	<0.01	0.70	3.02	0.51	0.20	<1.00
16.10.2013 14:17:00	14	7.21	22.80	0.86	0.90	4.10	2	5	130	25	335	1.22	<0.05	<0.05	0.02	<0.01	0.57	0.51	0.39	0.87	5.00
Lower avg.	35	7.18	10.00	4.92	4.59	4.05	9	14	148	25	359	1.39	0.00	0.10	0.09	0.00	0.69	1.58	0.50	0.43	2.00
Upper avg..	35	7.18	10.00	4.92	4.59	4.05	9	14	148	25	359	1.39	0.05	0.11	0.09	0.00	0.69	1.58	0.50	0.43	2.25
Minimum	14	6.98	4.51	0.63	0.77	3.90	1	5	105	5	260	1.16	0.05	0.05	0.02	0.01	0.50	0.51	0.39	0.20	1.00
Maximum	74	7.43	22.80	15.30	12.60	4.30	28	37	205	58	525	1.76	0.05	0.20	0.24	0.01	0.99	3.02	0.62	0.87	5.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	28	0.19	8.58	6.99	5.56	0.19	13	15	43	24	115	0.27	0.00	0.06	0.10	0.00	0.22	1.10	0.09	0.32	1.89

Namsen

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
12.02.2013 13:15:00	10	7.11	4.01	2.60	2.03	1.70	3	5	94	8	385	1.30	<0.05	0.07	0.05	0.01	1.15	3.45	0.44	0.10	<1.00
13.05.2013 12:40:00	115	6.85	2.38	9.21	15.40	3.50	13	18	31	3	170	1.75	<0.05	0.10	0.25	0.01	0.84	2.34	0.86	0.78	<1.00
05.08.2013 12:45:00	36	7.05	2.86	1.77	1.67	3.90	2	7	24	3	185	1.16	<0.05	0.10	0.06	0.01	0.74	0.86	0.37	0.20	1.00
07.10.2013 18:00:00	35	6.70	2.28	20.50	27.50	7.10	16	23	36	3	280	3.10	<0.05	0.22	0.46	0.01	1.67	3.86	1.60	1.40	2.00
Lower avg.	49	6.93	2.88	8.52	11.65	4.05	9	13	46	4	255	1.83	0.00	0.12	0.20	0.01	1.10	2.63	0.82	0.62	0.75
Upper avg..	49	6.93	2.88	8.52	11.65	4.05	9	13	46	4	255	1.83	0.05	0.12	0.20	0.01	1.10	2.63	0.82	0.62	1.25
Minimum	10	6.70	2.28	1.77	1.67	1.70	2	5	24	3	170	1.16	0.05	0.07	0.05	0.01	0.74	0.86	0.37	0.10	1.00
Maximum	115	7.11	4.01	20.50	27.50	7.10	16	23	94	8	385	3.10	0.05	0.22	0.46	0.01	1.67	3.86	1.60	1.40	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	46	0.19	0.79	8.65	12.35	2.25	7	9	32	3	99	0.89	0.00	0.07	0.19	0.00	0.42	1.34	0.57	0.60	0.50

Røssåga

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.02.2013 09:15:00	25	7.40	3.82	0.22	0.10	0.63	<1	1	56	<2	112	0.83	<0.05	<0.05	<0.01	0.01	0.30	0.62	0.42	<0.10	<1.00
23.05.2013 13:00:00	487	7.30	4.16	1.02	0.85	1.50	1	4	19	12	117	0.62	<0.05	0.06	0.16	0.01	0.42	4.50	0.33	0.20	3.00
05.08.2013 12:00:00	105	7.45	4.02	0.37	0.37	1.00	<1	3	31	4	136	0.71	<0.05	0.09	0.02	<0.01	0.32	0.88	0.40	<0.10	<1.00
08.10.2013 09:30:00	71	7.62	7.12	1.48	1.86	2.80	2	5	34	10	195	1.30	<0.05	0.10	0.23	0.01	0.59	7.36	0.43	0.20	<1.00
Lower avg.	172	7.44	4.78	0.77	0.80	1.48	1	3	35	7	140	0.87	0.00	0.06	0.10	0.01	0.41	3.34	0.39	0.10	0.75
Upper avg..	172	7.44	4.78	0.77	0.80	1.48	1	3	35	7	140	0.87	0.05	0.08	0.10	0.01	0.41	3.34	0.39	0.15	1.50
Minimum	25	7.30	3.82	0.22	0.10	0.63	1	1	19	2	112	0.62	0.05	0.05	0.01	0.01	0.30	0.62	0.33	0.10	1.00
Maximum	487	7.62	7.12	1.48	1.86	2.80	2	5	56	12	195	1.31	0.05	0.10	0.23	0.01	0.59	7.36	0.43	0.20	3.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	212	0.13	1.57	0.59	0.78	0.95	1	2	15	5	38	0.31	0.00	0.02	0.11	0.00	0.13	3.21	0.05	0.06	1.00

Ranaelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.02.2013 11:00:00	37	7.20	2.40	0.35	0.59	0.58	<1	1	43	11	119	2.12	<0.05	0.10	0.10	0.01	0.54	2.61	0.43	0.10	<1.00
15.05.2013 16:30:00	389	7.58	6.08	21.80	21.10	2.50	17	21	42	2	215	1.88	<0.05	0.20	0.29	<0.01	1.03	2.41	0.76	0.64	1.00
05.08.2013 12:50:00	253	7.38	3.62	0.67	0.63	0.67	<1	3	29	<2	90	0.92	<0.05	0.06	0.02	<0.01	0.38	0.59	0.35	0.10	<1.00
08.10.2013 10:30:00	184	7.55	5.12	1.08	0.76	1.50	<1	3	41	2	140	1.35	<0.05	0.06	0.04	<0.01	0.43	0.64	0.34	0.10	<1.00
Lower avg.	216	7.43	4.31	5.98	5.77	1.31	4	7	39	4	141	1.57	0.00	0.11	0.11	0.00	0.60	1.56	0.47	0.24	0.25
Upper avg..	216	7.43	4.31	5.98	5.77	1.31	5	7	39	4	141	1.57	0.05	0.11	0.11	0.01	0.60	1.56	0.47	0.24	1.00
Minimum	37	7.20	2.40	0.35	0.59	0.58	1	1	29	2	90	0.92	0.05	0.06	0.02	0.01	0.38	0.59	0.34	0.10	1.00
Maximum	389	7.58	6.08	21.80	21.10	2.50	17	21	43	11	215	2.12	0.05	0.20	0.29	0.01	1.03	2.61	0.76	0.64	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	146	0.18	1.62	10.55	10.22	0.89	8	9	7	5	53	0.54	0.00	0.07	0.12	0.00	0.30	1.10	0.20	0.27	0.00

Beiarelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
21.03.2013 13:45:00	10	7.68	10.20	0.42	0.23	0.72	<1	4	105	<2	210	4.09	<0.05	0.09	<0.01	<0.01	0.32	0.27	0.41	0.20	<1.00
29.05.2013 13:10:00	133	7.11	2.34	2.74	5.20	0.83	2	5	33	3	95	1.24	<0.05	0.10	0.08	0.01	0.98	1.40	0.53	0.40	<1.00
27.08.2013 14:00:00	50	7.29	2.43	21.90	25.40	0.30	11	12	15	3	59	3.14	<0.05	0.30	0.40	<0.01	2.04	6.77	1.80	1.70	<1.00
04.11.2013 10:30:00	21	7.68	7.57	0.68	0.52	1.60	2	2	78	<2	160	3.38	<0.05	0.10	0.05	<0.01	0.68	1.90	0.77	0.40	<1.00
Lower avg.	54	7.44	5.64	6.44	7.84	0.86	4	6	58	2	131	2.96	0.00	0.15	0.13	0.00	1.00	2.58	0.88	0.68	0.00
Upper avg..	54	7.44	5.64	6.44	7.84	0.86	4	6	58	3	131	2.96	0.05	0.15	0.13	0.01	1.00	2.58	0.88	0.68	1.00
Minimum	10	7.11	2.34	0.42	0.23	0.30	1	2	15	2	59	1.24	0.05	0.09	0.01	0.01	0.32	0.27	0.41	0.20	1.00
Maximum	133	7.68	10.20	21.90	25.40	1.60	11	12	105	3	210	4.09	0.05	0.30	0.40	0.01	2.04	6.77	1.80	1.70	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	56	0.29	3.90	10.36	11.93	0.54	5	4	41	1	67	1.22	0.00	0.10	0.18	0.00	0.74	2.87	0.63	0.69	0.00

Målselv

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 14:00:00	24	7.61	9.30	0.86	0.34	0.70	<1	2	92	5	165	3.00	<0.05	<0.05	0.01	<0.01	0.43	2.36	0.23	<0.10	1.00
14.05.2013 15:10:00	153	7.53	7.51	10.70	11.80	3.10	7	44	80	2	230	3.08	<0.05	0.06	0.15	<0.01	1.10	1.30	0.66	0.66	2.00
04.08.2013 21:30:00	77	7.73	7.92	0.78	1.64	0.81	1	2	21	<2	95	2.31	<0.05	<0.05	0.04	<0.01	0.53	0.32	0.31	<0.10	<1.00
08.10.2013 14:00:00	51	7.75	8.40	0.75	0.91	1.00	<1	2	35	2	111	2.65	<0.05	<0.05	0.01	<0.01	0.46	0.20	0.27	0.10	<1.00
Lower avg.	76	7.66	8.28	3.27	3.67	1.40	2	13	57	2	150	2.76	0.00	0.02	0.05	0.00	0.63	1.04	0.37	0.19	0.75
Upper avg..	76	7.66	8.28	3.27	3.67	1.40	3	13	57	3	150	2.76	0.05	0.05	0.05	0.00	0.63	1.04	0.37	0.24	1.25
Minimum	24	7.53	7.51	0.75	0.34	0.70	1	2	21	2	95	2.31	0.05	0.05	0.01	0.01	0.43	0.20	0.23	0.10	1.00
Maximum	153	7.75	9.30	10.70	11.80	3.10	7	44	92	5	230	3.08	0.05	0.06	0.15	0.01	1.10	2.36	0.66	0.66	2.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	no	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	56	0.10	0.77	4.95	5.44	1.14	3	21	34	2	61	0.35	0.00	0.01	0.07	0.00	0.32	1.01	0.20	0.28	0.50

Barduelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.03.2013 11:00:00	38	7.38	5.66	0.78	0.82	1.10	<1	1	68	3	135	2.40	<0.05	<0.05	0.26	<0.01	0.40	1.10	0.26	0.10	2.00
14.05.2013 14:30:00	139	7.62	8.29	39.90	46.50	2.30	40	42	98	<2	240	4.51	<0.05	0.10	0.39	<0.01	1.66	3.41	1.50	1.50	3.00
04.08.2013 20:30:00	70	7.51	6.27	2.61	5.47	0.87	4	6	5	<2	78	1.91	<0.05	0.05	0.06	<0.01	0.53	0.85	0.45	0.20	<1.00
08.10.2013 13:00:00	46	7.81	9.09	1.76	3.01	1.00	2	3	38	2	115	2.20	<0.05	<0.05	0.03	<0.01	0.46	0.42	0.34	0.20	<1.00
Lower avg.	73	7.58	7.33	11.26	13.95	1.32	12	13	52	1	142	2.76	0.00	0.04	0.18	0.00	0.76	1.44	0.64	0.50	1.25
Upper avg..	73	7.58	7.33	11.26	13.95	1.32	12	13	52	2	142	2.76	0.05	0.06	0.18	0.00	0.76	1.44	0.64	0.50	1.75
Minimum	38	7.38	5.66	0.78	0.82	0.87	1	1	5	2	78	1.91	0.05	0.05	0.03	0.01	0.40	0.42	0.26	0.10	1.00
Maximum	139	7.81	9.09	39.90	46.50	2.30	40	42	98	3	240	4.51	0.05	0.10	0.39	0.01	1.66	3.41	1.50	1.50	3.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	no	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	46	0.18	1.63	19.11	21.78	0.66	19	19	40	1	69	1.19	0.00	0.03	0.17	0.00	0.60	1.34	0.58	0.67	0.96

Tanaelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 14:30:00	45	7.31	6.66	1.01	0.69	1.60	<1	4	85	18	235	10.27	<0.05	<0.05	0.02	<0.01	0.45	1.50	0.27	0.48	<1.00
06.05.2013 12:30:00	172	7.32	5.09	1.93	1.49	2.50	4	7	27	6	149	7.42	<0.05	<0.05	0.08	<0.01	0.74	2.73	0.41	0.44	<1.00
06.08.2013 08:00:00	179	7.49	4.91	0.55	0.63	2.40	1	5	10	9	148	5.41	<0.05	<0.05	<0.01	<0.01	0.40	0.38	0.24	0.10	<1.00
06.10.2013 13:30:00	122	7.51	5.47	0.65	0.81	2.30	<1	3	9	4	132	6.89	<0.05	<0.05	0.02	<0.01	0.33	0.49	0.23	0.30	<1.00
Lower avg.	129	7.41	5.53	1.04	0.90	2.20	1	5	33	9	166	7.50	0.00	0.00	0.03	0.00	0.48	1.28	0.29	0.33	0.00
Upper avg..	129	7.41	5.53	1.04	0.90	2.20	2	5	33	9	166	7.50	0.05	0.05	0.03	0.00	0.48	1.28	0.29	0.33	1.00
Minimum	45	7.31	4.91	0.55	0.63	1.60	1	3	9	4	132	5.41	0.05	0.05	0.01	0.01	0.33	0.38	0.23	0.10	1.00
Maximum	179	7.51	6.66	1.93	1.49	2.50	4	7	85	18	235	10.27	0.05	0.05	0.08	0.01	0.74	2.73	0.41	0.48	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	no	no	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	62	0.11	0.79	0.63	0.40	0.41	2	2	36	6	47	2.03	0.00	0.00	0.03	0.00	0.18	1.09	0.08	0.17	0.00

Pasvikelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mg/l C]	[µg/l P]	[µg/l P]	[µg/l N]	[µg/l N]	[µg/l N]	[mg/l SiO2]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
05.02.2013 09:00:00	49	7.02	3.27	0.37	0.27	2.40	<1	4	52	2	175	5.56	<0.05	0.06	0.01	<0.01	0.48	1.20	0.70	0.30	<1.00
06.05.2013 16:30:00	511	6.83	1.65	1.64	1.76	1.50	3	6	25	8	149	2.44	<0.05	1.10	0.75	0.05	18.70	6.42	8.24	0.10	<1.00
06.08.2013 12:30:00	143	7.33	3.39	0.57	0.73	2.90	1	5	<1	10	170	3.94	<0.05	0.10	0.02	<0.01	1.39	0.66	3.29	<0.10	<1.00
06.10.2013 10:00:00	104	7.30	3.55	0.85	2.83	2.90	2	6	4	5	170	4.49	<0.05	0.09	0.01	<0.01	1.17	0.27	3.31	0.10	<1.00
Lower avg.	202	7.12	2.96	0.86	1.40	2.42	2	5	20	6	166	4.11	0.00	0.34	0.20	0.01	5.44	2.14	3.88	0.12	0.00
Upper avg..	202	7.12	2.96	0.86	1.40	2.42	2	5	21	6	166	4.11	0.05	0.34	0.20	0.02	5.44	2.14	3.88	0.15	1.00
Minimum	49	6.83	1.65	0.37	0.27	1.50	1	4	1	2	149	2.44	0.05	0.06	0.01	0.01	0.48	0.27	0.70	0.10	1.00
Maximum	511	7.33	3.55	1.64	2.83	2.90	3	6	52	10	175	5.56	0.05	1.10	0.75	0.05	18.70	6.42	8.24	0.30	1.00
More than 70%LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
St.dev	210	0.24	0.88	0.56	1.14	0.66	1	1	24	4	12	1.30	0.00	0.51	0.37	0.02	8.85	2.88	3.15	0.10	0.00

Table 1b. Organic contaminants – concentrations

Cw, free: Freely dissolved concentrations estimated from silicone rubber passive samplers
Cspm: contaminant concentrations for compounds associated with SPM
Grey shaded cells are for concentrations below LOD (LOD reported)

GLOMMA RIVER								
Freely dissolved concentrations (mean of replicate measurements, relative percent difference)								
Sample ID	GLOMMA P1		GLOMMA P 2 A		GLOMMA P 3 A		Glomma P4-5 A	
Deployed	no depl		23.04.2013		30.07.2013		10.10.2013	
Retrieved	no depl		30.07.2013		10.10.2013		04.04.2014	
Exposure time(d)			98		72		176	
	MEAN	% RPD	MEAN		MEAN	% RPD	MEAN	% RPD
Cw,free (ng/L)			*no replication*					
NAP			0.298496188		1.9272092	28.5	6.555557056	0.7
ACY			0.119521977		0.4016518	11.9	1.167084247	3.7
ACE			0.545638385		0.8995729	7.7	1.561704936	8.8
FLUE			0.789855104		0.9886765	8.5	3.139159794	1.9
DBTHIO			0.77515798		0.357	6.2	1.29855374	8.2
PHE			2.453098826		3.346031	11.3	8.192754249	5.0
ANT			0.068935776		0.0736858	0.6	0.326517337	6.7
FLUOR			1.446429357		1.7535671	15.7	5.148707478	8.7
PYR			0.815582944		0.8421122	18.5	3.792925725	4.9
BaA			0.058217092		0.0698981	23.7	0.42048206	13.2
CHRY			0.075028331		0.0858792	18.3	0.536472411	3.7
BbjF			0.123873558		0.1803291	24.8	0.511370177	11.8
BkF			0.023338497		0.0362313	21.1	0.135247497	15.0
BeP			0.080647597		0.1119511	25.1	0.23322449	14.1
BaP			0.013191774		0.0163104	29.2	0.106367824	17.0
PER			0.109322298		0.0964301	21.1	0.132961475	14.8
In123cdPYR			0.0113232		0.0183405		0.05738464	18.7
BDahANT			0.009728032		0.0164396		0.011365182	17.0
BghiPER			0.016123274		0.0228936	40.0	0.065625749	19.5
PCB31+28			0.00681186		0.0038849	19.3	0.014126282	7.5
CB52			0.003259982		0.0031431	12.9	0.005274389	9.0
CB101			0.001715314		0.0027086	12.7	0.003554482	14.8
CB118			0.001686516		0.0022326	2.5	0.002533075	6.6
CB153			0.004015514		0.0048975	16.4	0.000926247	
CB105			0.001059225		0.0017925		0.005022872	1.3
CB138			0.002137691		0.0036044	8.7	0.003435452	10.0
CB156			0.001059225		0.0017925		0.000977861	
CB180			0.001112455		0.0018831		0.001609368	24.6
CB209			0.001471153		0.002491		0.002264711	
BDE47			0.00579526		0.0083453	9.9	0.004194559	151.6
BDE99			0.001554817		0.0013602	13.6	0.005141877	181.7
BDE100			0.000350381		0.0004021	8.4	0.003248181	
BDE153			0.000120189		0.0002035		0.00608886	
BDE154			0.000120189		0.0002035		0.003563017	133.7
BDE183			0.000791939		0.0013409		0.00423938	
BDE196			0.000869814		0.0014728		0.003760208	
BDE209			0.004897111		0.0088707		0.003693056	
BDE126			0.000218988		0.0003707		0.003651513	
aHBCD			0.0047596		0.0037123	43.3	0.019474252	
bHBCD			0.001700758		0.0028025		0.005116808	
gHBCD			0.000866922		0.0028966		0.005277601	

ALNA RIVER								
Freely dissolved concentrations (mean of replicate measurements, relative percent difference)								
Sample ID	Alna P1		Alna P2		Alna P3		Alna P4	
Deployed	31.01.2013		11.04.2013		05.07.2013		24.09.2013	
Retrieved	11.04.2013		05.07.2013		24.09.2013		20.12.2013	
Exposure time(d)	70		85		81		87	
	MEAN	% RPD	MEAN	% RPD	MEAN	% RPD	MEAN	% RPD
Cw,free (ng/L)								
NAP	0.6981838	4.2	3.24480754	27.7	26.56668736	2.3	3.784996557	16.4
ACY	0.3498089		0.886298242		0.878967441		0.303831964	
ACE	0.2950879	25.6	3.095803799	4.6	3.915310507	10.9	0.774958363	25.9
FLUE	0.4355352	10.9	2.981842765	1.3	7.527064855	14.0	1.631991978	12.8
DBTHIO	0.4319052	9.7	1.628419438	5.0	3.414583228	7.8	0.54280804	6.7
PHE	1.9126099	16.7	4.132561755	5.2	5.837516086	9.1	2.465004011	16.8
ANT	0.4599775	16.5	0.656522591	5.2	0.562428902	12.1	0.303741587	17.6
FLUOR	3.8056134	0.2	1.905332937	3.5	2.179642736	9.4	1.40830762	16.2
PYR	10.430529	2.7	6.705076867	0.2	5.176486888	14.2	7.96865469	8.6
BaA	0.420683	0.8	0.109950265	6.5	0.153094581	1.1	0.172425888	13.2
CHRY	0.333376	0.1	0.145933789	1.4	0.230647149	1.2	0.558476209	82.5
BbjF	0.3691148	0.3	0.11440273	11.8	0.154857573	4.3	0.151515872	9.6
BkF	0.2138312	62.7	0.025477412	8.8	0.034879618	1.0	0.041748186	9.8
BeP	0.3864621	0.5	0.128152232	13.1	0.167487059	2.6	0.169926092	9.3
BaP	0.1449136	3.5	0.033138111	14.0	0.042710593	0.6	0.058303783	10.3
PER	0.0592583	4.6	0.017372342	16.8	0.019922541	7.8	0.034178452	11.5
In123cdPYR	0.0434636	8.2	0.012603299	25.2	0.017373559	15.5	0.018527073	11.5
BDahANT	0.0159023	0.5	0.004084593	13.1	0.005259023	9.8	0.00688314	13.2
BghiPER	0.0948484	5.8	0.027814563	15.9	0.038393025	14.0	0.047620132	8.8
PCB31+28	0.021033	3.5	0.015724769	6.7	0.017002288	1.6	0.016107933	25.4
CB52	0.0163492	0.6	0.007242954	7.0	0.011256703	1.5	0.008651883	2.4
CB101	0.0080886	11.3	0.00459216	13.5	0.008747193	0.0	0.004119153	51.6
CB118	0.0053376	1.1	0.001961802	12.5	0.003930429	3.2	0.002786749	26.3
CB153	0.0115956	6.9	0.003223512	8.1	0.003930429	3.2	0.000866634	13.7
CB105	0.0012666	9.0	0.000663611	14.9	0.001505097	6.5	0.004454879	33.1
CB138	0.010392	3.3	0.002764729	17.2	0.005351437	3.2	0.003021588	0.4
CB156	0.0010632		0.000181295	2.7	0.000424373	1.5	0.000707115	
CB180	0.0023419	2.8	0.000613976	12.3	0.00127478	1.2	0.001347222	27.4
CB209	0.0014767		0.000144673		0.000183201		0.000979252	
BDE47	0.0030087	3.6	0.001141673	4.6	0.002918007	3.9	0.002434416	1.8
BDE99	0.0019586	9.3	0.000719281	21.7	0.001634409	3.5	0.001798648	9.0
BDE100	0.000575	31.5	0.000144396	26.1	0.000356756	10.1	0.000287809	2.3
BDE153	0.0002413		2.47276E-05	10.7	5.46923E-05	15.0	0.000160083	
BDE154	0.0002413		3.02054E-05	3.9	6.45782E-05	13.4	0.000140295	10.9
BDE183	0.0007949		7.79193E-05		9.86579E-05		0.000175734	
BDE196	0.0008731		0.000110474		0.00010832		0.000192995	
BDE209	0.0047635	26.3	0.000410487	30.3	0.001328932	64.6	0.001640739	81.9
BDE126	0.0002198		2.17146E-05		2.74427E-05		0.000146034	
aHBCD	0.0095753	16.9	0.003377671	17.3	0.005380634	1.0	0.009180161	14.8
bHBCD	0.0017062	3.4	0.000394615	45.8	0.000537323	26.9	0.001290642	6.0
gHBCD	0.0045589	97.0	0.000320744	21.8	0.000608033	36.1	0.00171925	2.8

DRAMMEN RIVER								
Freely dissolved concentrations (mean of replicate measurements, relative percent difference)								
Sample ID	Drammen P1		Drammen P2		Drammen P3		Drammen P4	
Deployed	no depl		17.04.2013		31.07.2013		14.09.2013	
Retrieved	no depl		31.07.2013		14.09.2013		13.12.2013	
Exposure time(d)	0		105		45		90	
			MEAN	% RPD	MEAN	% RPD	MEAN	% RPD
Cw,free (ng/L)								
NAP			3.591933178	23.0	1.802589576	14.3	10.61369935	0.0
ACY			0.294442652	4.2	0.336331735	0.7	3.294980687	2.9
ACE			0.412911764	2.7	0.390349757	3.3	1.359464525	0.7
FLUE			0.713330711	5.0	0.423249536	5.4	1.690525974	2.9
DBTHIO			0.248153192	7.5	0.1486051	7.5	0.254207017	0.3
PHE			1.704881763	1.5	1.350497851	8.8	5.395510129	1.1
ANT			0.071678796	5.1	0.047766592	9.7	0.239607916	2.5
FLUOR			1.07958931	0.9	0.634261122	10.4	2.491442687	2.9
PYR			0.664264389	0.5	0.371083943	10.2	2.02249664	2.9
BaA			0.063088477	1.2	0.035981741	9.6	0.189299578	3.0
CHRY			0.143789093	19.4	0.034917475	3.9	0.287448645	37.6
BbjF			0.14158523	3.6	0.068869701	7.2	0.260039679	3.1
BkF			0.029639444	9.2	0.03560067	90.9	0.066679965	0.8
BeP			0.074753193	0.9	0.042613836	7.8	0.124100181	3.1
BaP			0.010995915	1.1	0.008982707		0.046519525	4.7
PER			0.037733961	2.7	0.013336947	11.4	0.043547882	3.1
In123cdPYR			0.012318941	10.7	0.007867531		0.0347542	7.8
BDahANT			0.007283394		0.008106477		0.012372978	
BghiPER			0.016864776	2.8	0.011737804	11.8	0.043986885	3.1
PCB31+28			0.009745653	4.5	0.00443278	0.8	0.014723764	8.1
CB52			0.00449253	6.9	0.002093731	9.1	0.011427433	
CB101			0.002086123	11.0	0.001190772	18.6	0.012463559	
CB118			0.00315481	2.8	0.001781565	5.2	0.0127865	
CB153			0.003228374	0.3	0.002508729	10.2	0.0127865	
CB105			0.001068522	2.2	0.000882052		0.013509447	
CB138			0.001918204	2.8	0.001561047	13.7	0.013634071	
CB156			0.000792105		0.000882052		0.013509447	
CB180			0.000831702		0.000926242		0.014196694	
CB209			0.001099591		0.001224713		0.018785546	
BDE47			0.009872559	4.8	0.00690214	8.6	0.017814281	3.1
BDE99			0.003849399	5.7	0.003015743	14.0	0.011667489	3.9
BDE100			0.000900865	5.3	0.000666252	11.9	0.004144732	
BDE153			0.000116607	7.4	0.000130864	19.6	0.003068822	
BDE154			0.000179682	2.8	0.000170888	17.4	0.001534411	
BDE183			0.000591934		0.000659285		0.003370668	
BDE196			0.00065013		0.000984437		0.003702284	
BDE209			0.002648961	63.4	0.001570356		0.038471139	88.0
BDE126			0.000163732		0.000182339		0.002794224	
aHBCD			0.001303744		0.002114123	28.4	0.020419774	
bHBCD			0.001301262		0.001435413		0.020550399	
gHBCD			0.001311053		0.006726787		0.021545387	

Concentration of contaminants associated with suspended particulate matter (SPM)

Sample code		Alna SPM 1	Alna SPM 2	Alna SPM 3	Alna SPM 4	Drammen SPM 1	Drammen SPM 2	Drammen SPM 3	Drammen SPM 4	Glomma SPM 1	Glomma SPM 2	Glomma SPM 3	Glomma SPM 4
Deployed		31.01.2013	11.04.2013	17.09.2013	19.12.2013	15.05.2013	02.08.2013	07.09.2013	23.12.2013	23.04.2013	05.06.2013	11.10.2013	22.12.2013
Retrieved		04.02.2013	16.04.2013	24.09.2013	22.12.2013	21.05.2013	10.08.2013	14.09.2013	28.12.2013	30.04.2013	11.06.2013	17.10.2013	31.12.2013
Exposure time(d)		4	5	7	3	6	8	7	5	7	6	6	9
%TTS		34.4	53.1	66.6		54.6	29.3	57.6		49.9	43.4	42.1	
TOC ug/g		69.5	60	77.2	122	33.2	52.2	42.9	30.8	16.4	26.9	45.7	33.8
%OC		6.95	6	7.72	12.2	3.32	5.22	4.29	3.08	1.64	2.69	4.57	3.38
NAP	ng/g dw	35	18	41	50	10	40	32	110	10	10	10	11
ACY	ng/g dw	19	5.9	12	32	2	7.8	9	4.9	2	2	2	2.5
ACE	ng/g dw	36	27	11	38	2	3.8	3.1	7.2	2	2	2	7.2
FLUE	ng/g dw	74	55	24	81	2	10	7.6	4.7	2	2	2	4.5
DBTHIO	ng/g dw				53				7.5				2
PHE	ng/g dw	660	490	240	1000	28	170	120	140	5.4	6.8	3.9	24
ANT	ng/g dw	220	150	71	260	3.4	22	23	13	2	2	2	2.7
FLUOR	ng/g dw	1100	850	580	1600	63	540	490	180	6.2	9.2	6.2	29
PYR	ng/g dw	1100	740	640	1800	52	430	420	170	5.8	7.7	5.7	26
BaA	ng/g dw	450	310	230	590	21	190	290	87	2	2.1	2	12
CHRY	ng/g dw	450	340	270	600	28	190	270	92	2.8	3.1	2.7	21
BbjF	ng/g dw	620	360	440	720	41	310	450	130	3.4	4.9	4.7	32
BkF	ng/g dw	230	120	130	270	14	120	160	45	2	2	2	11
BeP	ng/g dw				540				75				15
BaP	ng/g dw	410	230	260	420	26	220	330	69	2	2.5	2	9.8
PER	ng/g dw				230				29				33
In123cdPY	ng/g dw	260	140	210	320	20	170	210	69	2	2.3	2.1	16
BDahANT	ng/g dw	67	35	52	100	4.2	35	56	18	2	2	2	3.2
BghiPER	ng/g dw	390	180	340	640	23	180	220	86	2	2.8	2.4	20
PCB31+28	ng/g dw	1.9	0.62	1.7	4.7	0.5	0.5	0.5	1	0.5	0.5	0.5	1
CB52	ng/g dw	2	2.1	2.9	4	0.5	0.5	0.5	1	0.5	0.5	0.5	1
CB101	ng/g dw	2.9	1.1	4.4	3.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
CB118	ng/g dw	1.8	0.66	3.2	1.1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
CB153	ng/g dw	4.3	1.4	7.1	4.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
CB105	ng/g dw												
CB138	ng/g dw	4.2	1.3	7.7	3.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
CB156	ng/g dw												
CB180	ng/g dw	2.5	1	4.3	3.5	0.5	3.2	0.5	0.5	0.5	0.5	0.5	0.5

Concentration of contaminants associated with suspended particulate matter (SPM)													
Sample code		Alna SPM 1	Alna SPM 2	Alna SPM 3	Alna SPM 4	Drammen SPM 1	Drammen SPM 2	Drammen SPM 3	Drammen SPM 4	Glomma SPM 1	Glomma SPM 2	Glomma SPM 3	Glomma SPM 4
BDE47	ng/g dw	0.82	0.31	1.4	1.2	0.1	0.21	0.18	0.13	0.05	0.05	0.05	0.17
BDE99	ng/g dw	1.4	0.53	2.8	2.1	0.1	0.32	0.36	0.2	0.05	0.05	0.05	0.1
BDE100	ng/g dw	0.27	0.1	0.48	0.5	0.1	0.1	0.1	0.2	0.05	0.05	0.05	0.2
BDE153	ng/g dw	0.71	0.66	2.7	0.5	0.1	0.16	0.17	0.2	0.1	0.1	0.1	0.2
BDE154	ng/g dw	0.14	0.1	0.44	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
BDE183	ng/g dw	0.3	0.3	0.5	0.5	0.2	0.3	0.2	0.2	0.2	0.3	0.3	0.2
BDE196	ng/g dw	0.5	0.3	0.8	0.5	0.2	0.3	0.2	0.2	0.3	0.3	0.3	0.2
BDE209	ng/g dw	15	11	50	23	0.5	4.7	1.4	6	0.5	0.5	0.5	1.6
BDE126	ng/g dw	0.3	0.3	0.3	0.5	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.2
aHBCD	ng/g dw	5	5	5	i	1	1	1	4	1	1	1	4
bHBCD	ng/g dw	5	5	5	i	1	1	1	2	1	1	1	2
gHBCD	ng/g dw	5	5	5	i	1	1	1	2	1	1	1	2
SCCP	ng/g dw	420	840	220	21.0	5	64	14	236.0	370	4	55	69.0
MCCP	ng/g dw	1100	1540	840	25.0	15	420	83	395.0	5030	130	600	109.0
BPA	ng/g dw	399	0.1	136	11.1	0.1	0.1	0.1	363.4	25	14	0.1	3.1
TBBPA	ng/g dw	30	5	7	2.4	4	7	2	13.1	5	2	1	2.0
PFBA	ng/g dw	1	1	1	1	1	1	1	1	1	1	1	1
PFPA	ng/g dw	1	1	1	0.4	1	1	1	0.4	1	1	1	0.4
PFHxA	ng/g dw	1	1	1	1.36	1	1	1	0.4	1	1	1	0.4
PFHpA	ng/g dw	0.5	0.5	0.5	3.47	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
PFOA	ng/g dw	0.5	0.5	0.5	8.13	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
PFNA	ng/g dw	0.5	0.5	0.5	3.74	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
PFDA	ng/g dw	0.5	0.5	0.5	36.4	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
PFUdA	ng/g dw	0.5	0.5	0.5	4.43	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
PFDoA	ng/g dw	0.5	0.5	0.5	15.85	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
PFTrA	ng/g dw	0.5	0.5	0.5	0.71	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
PFTeA	ng/g dw	0.5	0.5	0.5	1.67	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4
PFBS	ng/g dw	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.05
PFHxS	ng/g dw	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.05
PFOS	ng/g dw	0.11	0.09	0.138	1.475	0.058	0.058	0.057	0.15	0.05	0.05	0.05	0.11
ip-PFNS	ng/g dw	0.1	0.1	0.1		0.1	0.1	0.1		0.1	0.1	0.1	
PFDS	ng/g dw	0.177	0.12	0.169	0.47	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.05
PFDoS	ng/g dw	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.05
PFOSA	ng/g dw	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
me-PFOS/	ng/g dw	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
et-PFOSA	ng/g dw	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
me-PFOSE	ng/g dw	2	2	2	1	2	2	2	1	2	2	2	1
et-PFOSE	ng/g dw	2	2	2	1	2	2	2.3	1	2	2	2	1
6:2 FTS	ng/g dw	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1
4:2 F53B	ng/g dw	0.2	0.2	0.2		0.2	0.2	0.2		0.2	0.2	0.2	
6:2 F53B	ng/g dw	0.2	0.2	0.2		0.2	0.2	0.2		0.2	0.2	0.2	

Table 2 Riverine inputs

Table 2a. Riverine inputs from 155 rivers in Norway in 2013

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
MAIN RIVERS (11)																			
Glomma ved Sarpsfoss	lower avg.	65 667	256 277	93 168	256	457	8 104	487	13 216	90 397	0.000	4.297	7.424	0.264	64.928	505.401	22.241	11.018	19.162
	upper avg.	65 667	256 277	93 168	256	457	8 104	487	13 216	90 397	1.198	4.297	7.424	0.269	64.928	505.401	22.241	11.365	30.714
Alna	lower avg.	116	671	198	2	3	35	9	63	275	0.000	0.011	0.039	0.003	0.157	0.572	0.043	0.099	0.044
	upper avg.	116	671	198	2	3	35	9	63	275	0.002	0.011	0.039	0.003	0.157	0.572	0.043	0.099	0.067
Drammenselva	lower avg.	33 058	61 084	43 173	57	111	3 852	152	6 092	36 723	0.000	2.035	2.177	0.105	10.728	32.747	6.286	2.534	7.446
	upper avg.	33 058	61 084	43 173	59	111	3 852	152	6 092	36 723	0.603	2.035	2.177	0.113	10.728	32.747	6.286	2.780	15.752
Numedalslågen	lower avg.	10 333	26 410	19 327	28	51	826	105	1 770	12 708	0.000	0.753	1.348	0.071	3.712	19.116	2.454	2.457	11.835
	upper avg.	10 333	26 410	19 327	28	51	826	105	1 770	12 708	0.189	0.753	1.348	0.071	3.712	19.116	2.454	2.503	12.643
Skienselva	lower avg.	27 750	8 799	26 158	9	33	1 432	110	2 761	21 594	0.000	0.948	1.015	0.086	4.242	22.653	2.037	1.981	8.258
	upper avg.	27 750	8 799	26 158	14	34	1 432	110	2 761	21 594	0.506	0.948	1.015	0.086	4.242	22.653	2.037	2.325	15.262
Otra	lower avg.	12 418	4 138	12 315	5	19	413	43	1 054	6 615	0.000	0.478	0.944	0.065	2.428	14.260	2.106	0.595	1.761
	upper avg.	12 418	4 138	12 315	8	19	413	44	1 054	6 615	0.227	0.496	0.944	0.065	2.428	14.260	2.106	0.798	4.847
Orreelva	lower avg.	529	1 501	1 180	5	12	101	13	240	616	0.000	0.059	0.054	0.002	0.326	0.700	0.250	0.113	0.246
	upper avg.	529	1 501	1 180	5	12	101	13	240	616	0.010	0.059	0.054	0.002	0.326	0.700	0.250	0.115	0.357
Vosso(Bolstadelvi)	lower avg.	7 773	1 924	3 675	2	10	273	22	575	2 396	0.000	0.215	0.167	0.013	1.089	3.032	0.833	0.263	2.917
	upper avg.	7 773	1 924	3 675	4	10	273	22	575	2 396	0.142	0.231	0.167	0.017	1.089	3.032	0.833	0.446	4.304
Orkla	lower avg.	4 611	9 128	6 253	6	16	231	12	561	4 124	0.000	0.159	0.091	0.059	7.398	19.385	1.799	0.973	0.115
	upper avg.	4 611	9 128	6 253	6	16	231	13	561	4 124	0.084	0.159	0.091	0.059	7.398	19.385	1.799	0.987	1.683
Vefsna	lower avg.	14 207	11 520	8 794	6	19	223	9	696	6 775	0.000	0.617	0.279	0.000	1.910	2.672	1.436	0.887	0.216
	upper avg.	14 207	11 520	8 794	8	19	223	15	696	6 775	0.259	0.617	0.279	0.026	1.910	2.672	1.436	1.046	5.186
Altaelva	lower avg.	7 749	10 078	7 268	19	83	249	40	780	13 209	0.000	0.525	0.063	0.000	1.786	0.978	0.682	0.949	0.226
	upper avg.	7 749	10 078	7 268	19	83	249	40	780	13 209	0.141	0.525	0.066	0.014	1.786	0.978	0.693	0.989	2.828
TRIBUTARY RIVERS (36)																			
Tista utløp Femsjøen	lower avg.	1 790	1 633	5 977	5	12	264	7	488	2 745	0.000	0.197	0.146	0.008	0.801	11.505	0.457	0.268	0.825
	upper avg.	1 790	1 633	5 977	5	12	264	7	488	2 745	0.033	0.197	0.146	0.008	0.801	11.505	0.457	0.268	0.985
Tokkeelva	lower avg.	2 481	837	4 993	1	8	137	9	376	2 607	0.000	0.185	0.241	0.024	0.464	4.637	0.355	0.204	1.087
	upper avg.	2 481	837	4 993	1	8	137	10	376	2 607	0.045	0.185	0.241	0.024	0.464	4.637	0.355	0.204	1.087
Nidelva(Rykene)	lower avg.	10 283	4 411	14 098	3	27	626	50	1 293	8 049	0.000	0.600	0.926	0.096	2.310	14.562	0.794	0.000	0.000

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
	upper avg.	10 283	4 411	14 098	4	28	626	50	1 293	8 049	0.188	0.600	0.926	0.096	2.310	14.562	0.794	0.375	3.753
Tovdalselva	lower avg.	5 352	2 293	9 844	1	8	279	45	729	3 973	0.022	0.443	0.939	0.057	1.068	9.993	0.760	0.367	2.496
	upper avg.	5 352	2 293	9 844	2	8	279	45	729	3 973	0.101	0.443	0.939	0.057	1.068	9.993	0.760	0.367	2.496
Mandalselva	lower avg.	7 204	2 907	9 868	3	12	391	52	899	3 574	0.000	0.442	1.106	0.059	1.123	9.084	0.484	0.321	2.884
	upper avg.	7 204	2 907	9 868	4	12	391	52	899	3 574	0.131	0.442	1.106	0.059	1.123	9.084	0.484	0.423	4.071
Lyngdalselva	lower avg.	2 655	1 571	3 637	1	5	206	8	391	1 614	0.000	0.174	0.426	0.027	0.343	4.725	0.126	0.085	1.492
	upper avg.	2 655	1 571	3 637	1	5	206	9	391	1 614	0.048	0.174	0.426	0.027	0.343	4.725	0.126	0.097	1.715
Kvina	lower avg.	5 557	3 870	8 295	7	18	381	32	823	2 895	0.000	0.461	1.029	0.048	1.549	9.362	0.320	0.241	1.937
	upper avg.	5 557	3 870	8 295	7	18	381	32	823	2 895	0.101	0.461	1.029	0.048	1.549	9.362	0.320	0.323	2.997
Sira	lower avg.	11 190	1 921	6 840	2	9	388	76	924	3 192	0.000	0.290	0.891	0.046	0.856	7.834	0.367	0.152	0.000
	upper avg.	11 190	1 921	6 840	4	9	388	76	924	3 192	0.204	0.290	0.891	0.046	0.856	7.834	0.367	0.408	4.085
Bjerkreimselva	lower avg.	4 106	772	2 276	2	7	533	17	712	2 004	0.000	0.137	0.221	0.030	0.415	4.076	0.221	0.279	0.000
	upper avg.	4 106	772	2 276	2	7	533	17	712	2 004	0.075	0.137	0.221	0.030	0.415	4.076	0.221	0.312	1.499
Figgjoelva	lower avg.	579	1 484	742	4	7	203	14	288	546	0.000	0.031	0.091	0.003	0.235	1.082	0.102	0.063	0.000
	upper avg.	579	1 484	742	4	7	203	14	288	546	0.011	0.031	0.091	0.003	0.235	1.082	0.102	0.063	0.212
Lyseelva	lower avg.	1 250	97	467	0	0	71	1	108	693	0.000	0.007	0.049	0.003	0.119	0.668	0.021	0.055	0.086
	upper avg.	1 250	104	467	0	0	71	2	108	693	0.023	0.025	0.049	0.004	0.119	0.668	0.029	0.073	0.456
Årdalselva	lower avg.	3 640	506	2 522	0	3	179	2	321	1 627	0.000	0.051	0.218	0.011	0.304	1.915	0.090	0.544	2.658
	upper avg.	3 640	506	2 522	1	3	179	3	321	1 627	0.066	0.105	0.218	0.011	0.304	1.915	0.090	0.563	3.015
Ulladalsåna (Ulla)	lower avg.	2 776	258	2 580	0	2	65	1	178	1 503	0.000	0.097	0.135	0.009	0.330	1.622	0.399	0.282	2.784
	upper avg.	2 776	258	2 580	1	2	65	2	178	1 503	0.051	0.104	0.135	0.009	0.330	1.622	0.399	0.312	2.784
Suldalslågen	lower avg.	9 908	1 658	3 465	0	7	427	8	680	2 975	0.000	0.280	0.214	0.047	0.886	4.695	0.362	0.071	0.000
	upper avg.	9 908	1 658	3 465	4	7	427	9	680	2 975	0.181	0.280	0.214	0.047	0.886	4.695	0.362	0.362	3.616
Saudaelva	lower avg.	3 125	492	634	2	4	221	3	305	943	0.000	0.062	0.088	0.011	0.340	1.436	0.107	0.202	0.000
	upper avg.	3 125	492	634	2	4	221	5	305	943	0.057	0.069	0.088	0.011	0.340	1.436	0.107	0.216	1.141
Vikedalselva	lower avg.	871	335	560	1	2	86	11	138	274	0.000	0.064	0.055	0.006	0.232	1.156	0.122	0.040	0.238
	upper avg.	871	335	560	1	2	86	11	138	274	0.016	0.064	0.055	0.006	0.232	1.156	0.122	0.048	0.476
Jostedøla	lower avg.	5 128	180 272	2 443	265	268	134	8	297	14 107	0.000	0.106	2.142	0.012	7.906	27.893	6.535	9.001	0.000

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
	upper avg.	5 128	180 272	2 443	265	268	134	8	297	14 107	0.094	0.141	2.142	0.015	7.906	27.893	6.539	9.001	1.872
Gaular	lower avg.	5 001	1 095	3 842	9	14	218	18	464	1 786	0.000	0.000	0.092	0.005	0.571	2.433	0.297	0.089	0.456
	upper avg.	5 001	1 095	3 842	9	14	218	18	464	1 786	0.091	0.091	0.092	0.010	0.571	2.433	0.297	0.227	1.825
Jølstra	lower avg.	5 378	1 056	2 864	6	11	295	19	508	2 132	0.000	0.000	0.066	0.007	0.541	2.831	0.184	0.000	0.000
	upper avg.	5 378	1 056	2 864	6	11	295	19	508	2 132	0.098	0.098	0.066	0.010	0.541	2.831	0.184	0.196	1.963
Nausta	lower avg.	2 071	704	1 671	3	7	117	9	223	1 001	0.000	0.000	0.060	0.003	0.222	1.046	0.067	0.066	0.179
	upper avg.	2 071	704	1 671	3	7	117	9	223	1 001	0.038	0.038	0.060	0.004	0.222	1.046	0.067	0.097	0.756
Gloppenelva(Breimselva)	lower avg.	3 806	1 061	1 462	2	5	244	7	379	1 771	0.000	0.017	0.036	0.003	0.500	1.414	0.442	0.530	0.000
	upper avg.	3 806	1 061	1 462	2	5	244	8	379	1 771	0.069	0.069	0.036	0.008	0.500	1.414	0.442	0.591	1.389
Driva	lower avg.	6 148	22 798	5 425	11	28	239	7	598	6 026	0.000	0.000	0.186	0.002	2.545	2.833	1.058	1.157	0.000
	upper avg.	6 148	22 798	5 425	12	28	239	8	598	6 026	0.112	0.112	0.188	0.011	2.545	2.833	1.058	1.234	2.244
Surna	lower avg.	3 621	843	2 475	0	2	155	6	317	1 781	0.000	0.036	0.018	0.000	0.611	0.457	0.329	0.274	0.249
	upper avg.	3 621	843	2 475	1	2	155	6	317	1 781	0.066	0.066	0.018	0.007	0.611	0.457	0.329	0.309	1.322
Gaula	lower avg.	7 546	109 654	10 936	64	77	169	28	770	11 345	0.000	0.533	1.143	0.071	6.819	17.139	10.068	7.789	0.000
	upper avg.	7 546	109 654	10 936	64	77	169	28	770	11 345	0.138	0.533	1.143	0.073	6.819	17.139	10.068	7.789	2.754
Nidelva(Tr.heim)	lower avg.	6 636	7 150	5 817	4	9	219	16	505	5 597	0.000	0.226	0.807	0.000	4.610	26.378	2.736	1.499	0.000
	upper avg.	6 636	7 150	5 817	4	9	219	16	505	5 597	0.121	0.226	0.807	0.012	4.610	26.378	2.736	1.539	2.422
Stjørdalselva	lower avg.	4 462	12 570	6 514	10	15	101	14	443	2 129	0.000	0.271	0.427	0.016	2.409	8.298	1.316	0.783	1.386
	upper avg.	4 462	12 570	6 514	10	15	101	14	443	2 129	0.081	0.271	0.427	0.017	2.409	8.298	1.316	0.800	1.762
Verdalselva	lower avg.	2 783	17 933	3 582	14	25	81	22	270	1 700	0.000	0.148	0.270	0.008	0.994	2.434	0.942	0.368	0.958
	upper avg.	2 783	17 933	3 582	14	25	81	22	270	1 700	0.051	0.148	0.270	0.009	0.994	2.434	0.942	0.368	1.169
Snåsavassdraget	lower avg.	2 120	4 574	3 123	8	13	124	18	289	1 150	0.000	0.091	0.084	0.000	0.516	1.045	0.401	0.262	1.267
	upper avg.	2 120	4 574	3 123	8	13	124	18	289	1 150	0.039	0.095	0.084	0.004	0.516	1.045	0.401	0.262	1.333
Namsen	lower avg.	3 565	20 124	5 597	15	22	45	4	271	2 542	0.000	0.164	0.336	0.012	1.340	3.288	1.219	1.044	0.797
	upper avg.	3 565	20 124	5 597	15	22	45	4	271	2 542	0.065	0.164	0.336	0.012	1.340	3.288	1.219	1.044	1.602
Røssåga	lower avg.	8 493	2 795	4 910	3	12	74	32	402	2 263	0.000	0.207	0.457	0.025	1.328	13.381	1.100	0.524	6.619

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
	upper avg.	8 493	2 795	4 910	4	12	74	32	402	2 263	0.155	0.212	0.457	0.026	1.328	13.381	1.100	0.572	7.513
Ranaelva	lower avg.	16 909	60 716	10 582	47	68	239	12	993	9 373	0.000	0.768	0.923	0.002	4.271	9.268	3.297	2.111	2.766
	upper avg.	16 909	60 716	10 582	50	68	239	15	993	9 373	0.309	0.768	0.923	0.031	4.271	9.268	3.297	2.111	6.172
Beiarelva	lower avg.	3 398	11 064	977	5	8	48	3	126	2 595	0.000	0.179	0.178	0.006	1.418	3.217	1.036	0.844	0.000
	upper avg.	3 398	11 064	977	5	8	48	4	126	2 595	0.062	0.179	0.178	0.008	1.418	3.217	1.036	0.844	1.240
Målselv	lower avg.	8 093	19 182	5 890	11	68	174	5	507	8 338	0.000	0.089	0.255	0.000	2.345	2.774	1.392	1.044	3.191
	upper avg.	8 093	19 182	5 890	12	68	174	7	507	8 338	0.148	0.163	0.255	0.015	2.345	2.774	1.392	1.127	4.439
Barduelva	lower avg.	7 349	57 891	4 126	49	53	164	2	438	8 447	0.000	0.141	0.598	0.000	2.606	5.038	2.257	1.971	4.226
	upper avg.	7 349	57 891	4 126	49	53	164	6	438	8 447	0.134	0.191	0.598	0.013	2.606	5.038	2.257	1.971	5.363
Tanaelva	lower avg.	14 665	5 211	12 533	9	27	113	38	804	36 916	0.000	0.000	0.177	0.000	2.649	6.832	1.582	1.617	0.000
	upper avg.	14 665	5 211	12 533	11	27	113	38	804	36 916	0.268	0.268	0.185	0.027	2.649	6.832	1.582	1.617	5.353
Pasvikelva	lower avg.	13 913	8 658	10 091	12	29	98	38	797	16 083	0.000	3.703	2.429	0.154	62.267	21.684	31.935	0.487	0.000
	upper avg.	13 913	8 658	10 091	12	29	99	38	797	16 083	0.254	3.703	2.429	0.164	62.267	21.684	31.935	0.562	5.078
TRIBUTARY RIVERS(108)																			
Mosselva	lower avg.	744	1 827	2 095	1	7	119	4	248	114	0.000	0.102	0.070	0.001	0.407	0.404	0.277	0.000	0.407
	upper avg.	744	1 827	2 095	1	7	119	4	248	114	0.000	0.102	0.070	0.001	0.407	0.404	0.277	0.002	0.407
Hølenelva	lower avg.	102	247	369	1	3	52	2	72	328	0.000	0.025	0.020	0.000	0.090	0.160	0.105	0.000	0.093
	upper avg.	102	247	369	1	3	52	2	72	328	0.000	0.025	0.020	0.000	0.090	0.160	0.105	0.000	0.093
Årungelva	lower avg.	44	46	94	0	1	45	0	55	39	0.000	0.003	0.001	0.000	0.031	0.015	0.019	0.000	0.024
	upper avg.	44	46	94	0	1	45	0	55	39	0.000	0.003	0.001	0.000	0.031	0.015	0.019	0.000	0.024
Gjersjøelva	lower avg.	75	23	197	0	0	31	1	42	136	0.000	0.007	0.001	0.000	0.041	0.011	0.058	0.000	0.062
	upper avg.	75	23	197	0	0	31	1	42	136	0.000	0.007	0.001	0.000	0.041	0.011	0.058	0.000	0.062
Ljanselva	lower avg.	51	112	99	1	2	17	1	23	118	0.000	0.010	0.004	0.000	0.045	0.000	0.047	0.009	0.056
	upper avg.	51	112	99	1	2	17	1	23	118	0.000	0.010	0.004	0.000	0.045	0.000	0.047	0.009	0.056
Akerselva	lower avg.	279	119	417	0	2	22	3	42	362	0.000	0.026	0.064	0.002	0.140	0.509	0.033	0.007	0.434
	upper avg.	279	119	417	0	2	22	3	42	362	0.000	0.026	0.064	0.002	0.140	0.509	0.033	0.007	0.434
Frognerelva	lower avg.	25	28	40	0	0	11	1	15	55	0.000	0.004	0.000	0.000	0.043	0.017	0.014	0.002	0.032
	upper avg.	25	28	40	0	0	11	1	15	55	0.000	0.004	0.000	0.000	0.043	0.017	0.014	0.002	0.032
Lysakerelva	lower avg.	238	90	486	0	0	16	1	26	202	0.000	0.029	0.008	0.000	0.000	0.041	0.004	0.010	0.174

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
	upper avg.	238	90	486	0	0	16	1	26	202	0.000	0.029	0.008	0.000	0.001	0.041	0.004	0.010	0.174
Sandvikselva	lower avg.	249	106	472	0	2	16	1	29	422	0.000	0.033	0.000	0.000	0.053	0.000	0.031	0.043	0.000
	upper avg.	249	106	472	0	2	16	1	29	422	0.000	0.033	0.000	0.000	0.053	0.001	0.031	0.043	0.000
Åroselva	lower avg.	147	677	380	1	1	85	2	97	361	0.000	0.035	0.052	0.002	0.118	0.199	0.059	0.064	0.094
	upper avg.	147	677	380	1	1	85	2	97	361	0.000	0.035	0.052	0.002	0.118	0.199	0.059	0.064	0.094
Lierelva	lower avg.	413	5 586	1 096	2	7	119	0	138	1 074	0.000	0.123	0.211	0.007	0.373	2.033	0.185	0.286	0.538
	upper avg.	413	5 586	1 096	2	7	119	0	138	1 074	0.000	0.123	0.211	0.007	0.373	2.033	0.185	0.286	0.538
Sandeelva	lower avg.	273	832	446	0	1	42	2	65	367	0.000	0.076	0.137	0.012	0.329	3.616	0.125	0.071	0.150
	upper avg.	273	832	446	0	1	42	2	65	367	0.000	0.076	0.137	0.012	0.329	3.616	0.125	0.071	0.150
Aulielva	lower avg.	484	2 469	1 115	8	30	258	19	306	1 503	0.000	0.164	0.091	0.010	0.479	0.890	0.482	0.129	0.773
	upper avg.	484	2 469	1 115	8	30	258	19	306	1 503	0.000	0.164	0.091	0.010	0.479	0.890	0.482	0.129	0.773
Farriselva-Siljanvassdraget	lower avg.	1 188	299	2 067	1	1	146	2	215	1 640	0.000	0.065	0.000	0.019	0.000	4.419	0.037	0.009	0.000
	upper avg.	1 188	299	2 067	1	1	146	2	215	1 640	0.000	0.065	0.002	0.019	0.003	4.419	0.037	0.009	0.434
Gjerstadelva	lower avg.	1 002	441	2 000	0	2	64	10	128	622	0.000	0.088	0.171	0.004	0.185	1.727	0.217	0.022	0.549
	upper avg.	1 002	441	2 000	0	2	64	10	128	622	0.000	0.088	0.171	0.004	0.185	1.727	0.217	0.022	0.549
Vegårdselva	lower avg.	1 039	491	2 059	1	2	52	4	119	372	0.000	0.103	0.106	0.009	0.227	0.083	0.206	0.038	0.379
	upper avg.	1 039	491	2 059	1	2	52	4	119	372	0.000	0.103	0.106	0.009	0.227	0.083	0.206	0.038	0.379
Søgneelva-Songdalselva	lower avg.	768	271	1 234	1	3	110	6	165	179	0.000	0.073	0.110	0.014	0.152	1.500	0.147	0.000	0.280
	upper avg.	768	271	1 234	1	3	110	6	165	179	0.000	0.073	0.110	0.014	0.152	1.500	0.147	0.002	0.280
Audnedalselva	lower avg.	1 308	454	1 743	0	2	144	6	230	436	0.000	0.093	0.205	0.013	0.146	2.737	0.162	0.000	0.597
	upper avg.	1 308	454	1 743	0	2	144	6	230	436	0.000	0.093	0.205	0.013	0.146	2.737	0.162	0.004	0.597
Soknedalselva	lower avg.	1 751	806	1 195	2	5	161	11	227	754	0.000	0.102	0.184	0.015	0.320	2.050	1.538	0.047	0.799
	upper avg.	1 751	806	1 195	2	5	161	11	227	754	0.000	0.102	0.184	0.015	0.320	2.050	1.538	0.047	0.799
Hellelandselva	lower avg.	1 400	550	1 193	1	3	150	8	219	532	0.000	0.077	0.199	0.011	0.189	1.698	0.162	0.040	0.639
	upper avg.	1 400	550	1 193	1	3	150	8	219	532	0.000	0.077	0.199	0.011	0.189	1.698	0.162	0.040	0.639
Håelva	lower avg.	425	415	735	2	5	153	11	265	399	0.000	0.069	0.026	0.002	0.136	0.624	0.084	0.000	0.233
	upper avg.	425	415	735	2	5	153	11	265	399	0.000	0.069	0.026	0.002	0.136	0.624	0.084	0.001	0.233
Imselva	lower avg.	335	115	416	0	1	66	2	89	4	0.000	0.012	0.011	0.001	0.063	0.233	0.059	0.000	0.122
	upper avg.	335	115	416	0	1	66	2	89	4	0.000	0.012	0.011	0.001	0.063	0.233	0.059	0.001	0.122

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
Oltedalselva,utløp Ragsvatnet	lower avg.	723	180	437	0	0	75	3	90	541	0.000	0.018	0.040	0.005	0.106	0.783	0.109	0.029	0.000
	upper avg.	723	180	437	0	0	75	3	90	541	0.000	0.018	0.040	0.005	0.106	0.783	0.109	0.029	0.264
Dirdalsåna	lower avg.	1 132	160	681	0	1	103	1	138	410	0.000	0.044	0.075	0.003	0.109	0.528	0.304	0.000	0.516
	upper avg.	1 132	160	681	0	1	103	1	138	410	0.000	0.044	0.075	0.003	0.109	0.528	0.304	0.003	0.516
Frafjordelva	lower avg.	1 275	230	736	0	1	90	5	116	431	0.000	0.033	0.106	0.005	0.144	0.445	0.023	0.043	0.465
	upper avg.	1 275	230	736	0	1	90	5	116	431	0.000	0.033	0.106	0.005	0.144	0.445	0.023	0.043	0.465
Espedalselva	lower avg.	988	195	502	1	1	63	2	101	515	0.000	0.019	0.046	0.003	0.021	0.244	0.063	0.070	0.361
	upper avg.	988	195	502	1	1	63	2	101	515	0.000	0.019	0.046	0.003	0.021	0.244	0.063	0.070	0.361
Førrelva	lower avg.	1 151	210	739	1	1	26	1	39	678	0.000	0.025	0.060	0.002	0.046	0.179	0.097	0.036	0.000
	upper avg.	1 151	210	739	1	1	26	1	39	678	0.000	0.025	0.060	0.002	0.046	0.179	0.097	0.036	0.841
Åbøelva	lower avg.	726	113	238	0	1	24	0	34	87	0.000	0.019	0.018	0.001	0.035	0.249	0.051	0.072	0.331
	upper avg.	726	113	238	0	1	24	0	34	87	0.000	0.019	0.018	0.001	0.035	0.249	0.051	0.072	0.331
Etneelva	lower avg.	1 402	388	597	1	1	159	2	203	352	0.000	0.089	0.039	0.007	0.198	0.560	0.420	0.588	0.895
	upper avg.	1 402	388	597	1	1	159	2	203	352	0.000	0.089	0.039	0.007	0.198	0.560	0.420	0.588	0.895
Opo	lower avg.	4 189	4 333	1 274	5	4	144	15	242	1 817	0.000	0.308	0.612	0.000	0.384	2.439	0.522	0.000	0.000
	upper avg.	4 189	4 333	1 274	5	4	144	15	242	1 817	0.000	0.308	0.612	0.000	0.384	2.439	0.522	0.012	1.529
Tysso	lower avg.	2 783	385	1 656	2	0	151	5	205	746	0.000	0.113	0.052	0.006	0.860	3.499	0.670	0.130	1.524
	upper avg.	2 783	385	1 656	2	1	151	5	205	746	0.000	0.113	0.052	0.006	0.860	3.499	0.670	0.130	1.524
Kinso	lower avg.	1 172	424	243	1	0	11	4	38	83	0.000	0.043	0.021	0.000	0.000	0.032	0.047	0.117	0.428
	upper avg.	1 172	424	243	1	0	11	4	38	83	0.000	0.043	0.021	0.000	0.000	0.032	0.047	0.117	0.428
Veig	lower avg.	2 070	453	745	2	2	21	2	68	1 010	0.000	0.035	0.035	0.002	0.062	0.000	0.321	0.174	0.755
	upper avg.	2 070	453	745	2	2	21	2	68	1 010	0.000	0.035	0.035	0.002	0.062	0.008	0.321	0.174	0.755
Bjoreio	lower avg.	2 470	645	1 898	1	3	38	5	95	927	0.000	0.083	0.066	0.000	0.317	0.210	0.541	0.000	0.902
	upper avg.	2 470	645	1 898	1	3	38	5	95	927	0.000	0.083	0.066	0.000	0.317	0.210	0.541	0.007	0.902
Sima	lower avg.	605	169	93	0	0	19	1	29	497	0.000	0.016	0.006	0.000	0.022	0.160	0.067	0.010	0.221
	upper avg.	605	169	93	0	0	19	1	29	497	0.000	0.016	0.006	0.000	0.022	0.160	0.067	0.010	0.221
Austdøla	lower avg.	577	135	66	0	0	16	2	24	64	0.000	0.013	0.013	0.001	0.025	0.095	0.023	0.009	0.263
	upper avg.	577	135	66	0	0	16	2	24	64	0.000	0.013	0.013	0.001	0.025	0.095	0.023	0.009	0.263

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
Nordøla /Austdøla	lower avg.	173	63	13	0	0	7	0	9	77	0.000	0.006	0.004	0.000	0.008	0.001	0.031	0.004	0.000
	upper avg.	173	63	13	0	0	7	0	9	77	0.000	0.006	0.004	0.000	0.008	0.001	0.031	0.004	0.063
Tysselvi Samnangervassdraget	lower avg.	1 834	415	1 132	1	2	56	5	118	160	0.000	0.062	0.109	0.009	0.194	0.937	0.161	0.000	0.669
	upper avg.	1 834	415	1 132	1	2	56	5	118	160	0.000	0.062	0.109	0.009	0.194	0.937	0.161	0.005	0.669
Oselva	lower avg.	825	322	987	1	3	43	3	97	285	0.000	0.046	0.078	0.006	0.301	0.000	0.160	0.000	0.000
	upper avg.	825	322	987	1	3	43	3	97	285	0.000	0.046	0.078	0.006	0.301	0.003	0.160	0.002	0.301
DaleelviBergsdalsvassdraget	lower avg.	1 657	418	680	1	1	50	4	106	310	0.000	0.050	0.115	0.007	0.205	1.004	0.148	0.000	0.000
	upper avg.	1 657	418	680	1	1	50	4	106	310	0.000	0.050	0.115	0.007	0.205	1.004	0.148	0.005	0.605
Ekso -Storelvi	lower avg.	3 516	898	1 909	3	5	69	10	205	247	0.000	0.044	0.160	0.013	0.000	0.000	0.218	0.083	0.000
	upper avg.	3 516	898	1 909	3	5	69	10	205	247	0.000	0.044	0.160	0.013	0.009	0.013	0.218	0.083	1.283
Modalselva -Moelvi	lower avg.	3 301	602	1 031	1	4	105	5	156	665	0.000	0.036	0.157	0.012	0.000	0.284	0.251	0.220	0.000
	upper avg.	3 301	602	1 031	1	4	105	5	156	665	0.000	0.036	0.157	0.012	0.008	0.284	0.251	0.220	1.205
Nærøydalselvi	lower avg.	1 637	480	363	1	2	44	4	89	1 432	0.000	0.030	0.000	0.000	0.137	0.516	0.053	0.128	0.597
	upper avg.	1 637	480	363	1	2	44	4	89	1 432	0.000	0.030	0.003	0.000	0.137	0.516	0.053	0.128	0.597
Flåmselvi	lower avg.	862	388	134	0	1	18	2	32	194	0.000	0.031	0.008	0.000	0.034	0.196	0.088	0.060	0.000
	upper avg.	862	388	134	0	1	18	2	32	194	0.000	0.031	0.008	0.000	0.034	0.196	0.088	0.060	0.315
Aurlandselvi	lower avg.	2 505	882	548	2	1	80	4	119	974	0.000	0.073	0.137	0.000	0.303	0.775	0.221	0.045	0.000
	upper avg.	2 505	882	548	2	1	80	4	119	974	0.000	0.073	0.137	0.000	0.303	0.775	0.221	0.045	0.914
Erdalselvi	lower avg.	335	64	117	0	0	0	0	10	71	0.000	0.007	0.005	0.000	0.010	0.010	0.010	0.029	0.000
	upper avg.	335	64	117	0	0	0	0	10	71	0.000	0.007	0.005	0.000	0.010	0.010	0.010	0.029	0.122
Lærdalselva /Mjeldo	lower avg.	2 844	649	820	2	2	88	4	173	1 147	0.000	0.070	0.062	0.000	0.332	0.418	0.225	0.170	0.000
	upper avg.	2 844	649	820	2	2	88	4	173	1 147	0.000	0.070	0.062	0.000	0.332	0.418	0.225	0.170	1.038
Årdalselvi	lower avg.	2 609	648	667	1	3	64	5	108	1 576	0.000	0.038	0.018	0.004	0.952	0.333	0.251	0.000	2.857
	upper avg.	2 609	648	667	1	3	64	5	108	1 576	0.000	0.038	0.018	0.004	0.952	0.333	0.251	0.000	2.857
Fortundalselva	lower avg.	1 917	1 903	318	1	2	63	2	89	1 002	0.000	0.107	0.042	0.008	0.604	0.801	0.185	0.098	1.399
	upper avg.	1 917	1 903	318	1	2	63	2	89	1 002	0.000	0.107	0.042	0.008	0.604	0.801	0.185	0.098	1.399
Mørkrisdalselvi	lower avg.	1 064	1 685	167	1	0	23	2	41	718	0.000	0.027	0.050	0.000	0.213	0.675	0.196	0.138	0.000
	upper avg.	1 064	1 685	167	1	0	23	2	41	718	0.000	0.027	0.050	0.000	0.213	0.675	0.196	0.138	0.388

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
Årøyelva	lower avg.	2 492	1 122	691	1	3	61	5	118	1 310	0.000	0.051	0.069	0.000	0.060	0.648	0.121	0.155	0.000
	upper avg.	2 492	1 122	691	1	3	61	5	118	1 310	0.000	0.051	0.069	0.000	0.060	0.648	0.121	0.155	0.910
Sogndalselva	lower avg.	961	235	423	2	2	29	3	55	143	0.000	0.032	0.036	0.005	0.069	0.571	0.021	0.133	0.000
	upper avg.	961	235	423	2	2	29	3	55	143	0.000	0.032	0.036	0.005	0.069	0.571	0.021	0.133	0.351
Oselva	lower avg.	2 252	559	2 055	0	4	43	12	127	485	0.000	0.136	0.079	0.000	0.263	1.397	0.258	0.000	1.233
	upper avg.	2 252	559	2 055	0	4	43	12	127	485	0.000	0.136	0.079	0.000	0.263	1.397	0.258	0.007	1.233
Hopselva	lower avg.	645	178	165	0	0	21	1	31	57	0.000	0.013	0.021	0.002	0.007	0.244	0.016	0.097	0.236
	upper avg.	645	178	165	0	0	21	1	31	57	0.000	0.013	0.021	0.002	0.007	0.244	0.016	0.097	0.236
Ååelva (Gjengedalselva)	lower avg.	1 485	429	808	1	2	33	3	66	165	0.000	0.045	0.033	0.000	0.100	0.424	0.050	0.103	1.057
	upper avg.	1 485	429	808	1	2	33	3	66	165	0.000	0.045	0.033	0.000	0.100	0.424	0.050	0.103	1.057
Oldenelva	lower avg.	1 213	642	343	0	2	57	5	89	507	0.000	0.093	0.046	0.004	0.133	0.288	0.063	0.048	0.000
	upper avg.	1 213	642	343	0	2	57	5	89	507	0.000	0.093	0.046	0.004	0.133	0.288	0.063	0.048	0.443
Loelvi	lower avg.	1 401	793	256	0	2	44	2	70	704	0.000	0.112	0.037	0.005	0.147	0.075	0.041	0.125	0.000
	upper avg.	1 401	793	256	0	2	44	2	70	704	0.000	0.112	0.037	0.005	0.147	0.075	0.041	0.125	0.511
Stryneelva	lower avg.	2 856	1 337	521	1	4	100	7	183	1 226	0.000	0.115	0.062	0.006	0.631	0.938	0.203	0.181	1.043
	upper avg.	2 856	1 337	521	1	4	100	7	183	1 226	0.000	0.115	0.062	0.006	0.631	0.938	0.203	0.181	1.043
Hornindalselva(Horndøla)	lower avg.	2 331	638	1 021	1	4	103	7	151	988	0.000	0.097	0.025	0.005	0.244	0.684	0.261	0.000	0.851
	upper avg.	2 331	638	1 021	1	4	103	7	151	988	0.000	0.097	0.025	0.005	0.244	0.684	0.261	0.007	0.851
Ørstaelva	lower avg.	776	235	443	3	6	28	4	59	474	0.000	0.026	0.005	0.000	0.091	0.267	0.079	0.000	0.283
	upper avg.	776	235	443	3	6	28	4	59	474	0.000	0.026	0.005	0.000	0.091	0.267	0.079	0.002	0.283
Valldøla	lower avg.	1 775	389	334	0	2	0	4	0	472	0.000	0.033	0.004	0.001	0.123	0.455	0.058	0.036	0.000
	upper avg.	1 775	389	334	0	2	1	4	6	472	0.000	0.033	0.004	0.001	0.123	0.455	0.058	0.036	0.648
Rauma	lower avg.	5 306	1 104	1 172	1	4	33	10	107	1 480	0.000	0.110	0.065	0.000	0.589	0.978	0.328	0.000	0.000
	upper avg.	5 306	1 104	1 172	1	4	33	10	107	1 480	0.000	0.110	0.065	0.000	0.589	0.978	0.328	0.015	1.937
Isa	lower avg.	780	227	155	0	1	4	1	5	446	0.000	0.015	0.000	0.000	0.089	0.010	0.063	0.069	0.285
	upper avg.	780	227	155	0	1	4	1	5	446	0.000	0.015	0.001	0.000	0.089	0.010	0.063	0.069	0.285
Eira	lower avg.	4 598	0	986	1	3	176	8	249	3 345	0.000	0.168	0.021	0.000	0.479	0.445	0.201	0.420	2.518
	upper avg.	4 598	84	986	1	3	176	8	249	3 345	0.000	0.168	0.021	0.000	0.479	0.445	0.201	0.420	2.518
Litledalselva	lower avg.	833	173	182	0	0	42	1	48	1 089	0.000	0.017	0.000	0.000	0.011	0.015	0.201	0.085	0.000

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
	upper avg.	833	173	182	0	0	42	1	48	1 089	0.000	0.017	0.002	0.000	0.011	0.015	0.201	0.085	0.304
Ålvunda	lower avg.	666	353	429	0	1	32	2	56	469	0.000	0.010	0.019	0.000	0.203	0.182	0.048	0.013	0.304
	upper avg.	666	353	429	0	1	32	2	56	469	0.000	0.010	0.019	0.000	0.203	0.182	0.048	0.013	0.304
Toåa	lower avg.	840	178	385	0	1	5	1	29	331	0.000	0.009	0.014	0.000	0.137	0.067	0.014	0.000	0.000
	upper avg.	840	178	385	0	1	5	1	29	331	0.000	0.009	0.014	0.000	0.137	0.067	0.014	0.002	0.307
Bøvra	lower avg.	733	200	683	0	0	33	2	69	361	0.000	0.022	0.007	0.002	0.063	0.062	0.047	0.011	0.000
	upper avg.	733	200	683	0	0	33	2	69	361	0.000	0.022	0.007	0.002	0.063	0.062	0.047	0.011	0.268
Børselva	lower avg.	207	332	419	0	1	24	2	45	102	0.000	0.016	0.004	0.000	0.106	0.000	0.106	0.012	0.264
	upper avg.	207	332	419	0	1	24	2	45	102	0.000	0.016	0.004	0.000	0.106	0.001	0.106	0.012	0.264
Vigda	lower avg.	310	1 191	422	0	1	21	1	41	226	0.000	0.020	0.006	0.000	0.105	0.000	0.000	0.000	0.255
	upper avg.	310	1 191	422	0	1	21	1	41	226	0.000	0.020	0.006	0.000	0.105	0.001	0.001	0.001	0.255
Homla	lower avg.	336	84	822	0	1	5	2	27	196	0.000	0.060	0.002	0.001	0.080	0.000	0.061	0.000	0.245
	upper avg.	336	84	822	0	1	5	2	27	196	0.000	0.060	0.002	0.001	0.080	0.001	0.061	0.001	0.245
Gråe	lower avg.	196	163	392	0	1	32	2	51	14	0.000	0.023	0.000	0.000	0.078	0.000	0.027	0.019	0.000
	upper avg.	196	163	392	0	1	32	2	51	14	0.000	0.023	0.000	0.000	0.078	0.001	0.027	0.019	0.072
Figgja	lower avg.	549	1 272	1 531	1	3	75	1	93	301	0.000	0.057	0.033	0.001	0.220	0.131	0.170	0.074	0.000
	upper avg.	549	1 272	1 531	1	3	75	1	93	301	0.000	0.057	0.033	0.001	0.220	0.131	0.170	0.074	0.200
Årgårdselva	lower avg.	1 585	1 615	3 857	1	10	57	10	215	879	0.000	0.025	0.055	0.000	0.393	0.182	0.259	0.000	1.837
	upper avg.	1 585	1 615	3 857	1	10	57	10	215	879	0.000	0.025	0.055	0.000	0.393	0.182	0.259	0.005	1.837
Moelva(Salsvatenelva)	lower avg.	1 937	365	1 405	1	0	41	4	87	707	0.000	0.071	0.014	0.004	0.000	0.725	0.089	0.000	0.000
	upper avg.	1 937	365	1 405	1	1	41	4	87	707	0.000	0.071	0.014	0.004	0.005	0.725	0.089	0.006	0.707
Åelva(Åbjøra)	lower avg.	2 528	689	948	1	2	28	8	86	372	0.000	0.069	0.042	0.000	0.148	0.600	0.224	0.093	0.000
	upper avg.	2 528	689	948	1	2	28	8	86	372	0.000	0.069	0.042	0.000	0.148	0.600	0.224	0.093	0.923
Skjerva	lower avg.	426	288	521	1	3	15	11	68	205	0.000	0.038	0.048	0.003	0.164	0.313	0.232	0.009	0.311
	upper avg.	426	288	521	1	3	15	11	68	205	0.000	0.038	0.048	0.003	0.164	0.313	0.232	0.009	0.311
Fusta	lower avg.	2 794	902	905	1	4	14	21	116	463	0.000	0.131	0.018	0.020	0.139	0.704	0.229	0.000	1.020
	upper avg.	2 794	902	905	1	4	14	21	116	463	0.000	0.131	0.018	0.020	0.139	0.704	0.229	0.008	1.020
Drevja	lower avg.	906	494	246	1	1	5	2	28	102	0.000	0.009	0.000	0.005	0.076	0.124	0.019	0.000	0.000
	upper avg.	906	494	246	1	1	5	2	28	102	0.000	0.009	0.002	0.005	0.076	0.124	0.019	0.003	0.331

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
Bjerkaelva	lower avg.	1 567	539	1 089	1	0	14	5	58	469	0.000	0.025	0.048	0.001	0.288	0.390	0.362	0.020	1.430
	upper avg.	1 567	539	1 089	1	0	14	5	58	469	0.000	0.025	0.048	0.001	0.288	0.390	0.362	0.020	1.430
Dalselva	lower avg.	928	216	529	0	1	2	2	23	273	0.000	0.000	0.012	0.000	0.127	0.003	0.164	0.027	0.931
	upper avg.	928	216	529	0	1	2	2	23	273	0.000	0.003	0.012	0.000	0.127	0.003	0.164	0.027	0.931
Fykanåga	lower avg.	1 762	1 193	322	1	2	23	5	52	224	0.000	0.122	0.000	0.000	0.073	0.331	0.074	0.000	0.000
	upper avg.	1 762	1 193	322	1	2	23	5	52	224	0.000	0.122	0.003	0.000	0.073	0.331	0.074	0.005	0.643
Saltelva	lower avg.	2 921	4 383	520	2	0	24	5	89	1 999	0.000	0.104	0.000	0.000	0.249	1.238	0.299	2.442	0.000
	upper avg.	2 921	4 383	520	2	1	24	5	89	1 999	0.000	0.104	0.005	0.000	0.249	1.238	0.299	2.442	1.066
SulitjelmavassdragetUtl Øvrevt	lower avg.	2 519	0	966	2	0	10	7	55	593	0.000	0.000	0.000	0.000	0.000	0.000	0.144	5.834	2.069
	upper avg.	2 519	46	966	2	0	10	7	55	593	0.000	0.009	0.005	0.000	0.006	0.009	0.144	5.834	2.069
Kobbelva	lower avg.	1 597	434	233	1	0	16	2	40	631	0.000	0.052	0.003	0.009	0.029	0.007	0.090	0.000	0.000
	upper avg.	1 597	434	233	1	0	16	2	40	631	0.000	0.052	0.003	0.009	0.029	0.007	0.090	0.005	0.583
Elvegårdselva	lower avg.	2 965	2 400	1 201	1	4	10	9	68	1 944	0.000	0.078	0.136	0.015	0.460	0.984	0.676	0.730	1.894
	upper avg.	2 965	2 400	1 201	1	4	10	9	68	1 944	0.000	0.078	0.136	0.015	0.460	0.984	0.676	0.730	1.894
Spanselva	lower avg.	453	103	93	0	0	5	1	15	242	0.000	0.009	0.011	0.002	0.078	0.081	0.165	0.000	0.000
	upper avg.	453	103	93	0	0	5	1	15	242	0.000	0.009	0.011	0.002	0.078	0.081	0.165	0.001	0.165
Salangselva	lower avg.	1 843	352	713	1	1	11	5	41	527	0.000	0.000	0.024	0.013	0.168	0.202	0.305	0.431	0.000
	upper avg.	1 843	352	713	1	1	11	5	41	527	0.000	0.007	0.024	0.013	0.168	0.202	0.305	0.431	0.673
Lakselva(Rossfjordelva)	lower avg.	480	153	306	0	0	0	1	17	107	0.000	0.009	0.007	0.002	0.026	0.032	0.071	0.000	0.351
	upper avg.	480	153	306	0	0	0	1	17	107	0.000	0.009	0.007	0.002	0.026	0.032	0.071	0.001	0.351
Nordkjoselva	lower avg.	466	138	195	0	0	3	1	13	346	0.000	0.020	0.007	0.002	0.044	0.071	0.000	0.127	0.000
	upper avg.	466	138	195	0	0	3	1	13	346	0.000	0.020	0.007	0.002	0.044	0.071	0.002	0.127	0.170
Signaldalselva	lower avg.	1 327	467	896	2	1	9	4	30	1 003	0.000	0.042	0.000	0.005	0.252	0.007	0.199	0.000	0.000
	upper avg.	1 327	467	896	2	1	9	4	30	1 003	0.000	0.042	0.002	0.005	0.252	0.007	0.199	0.004	0.484
Skibotnelva	lower avg.	1 264	324	761	0	0	11	2	28	743	0.000	0.028	0.006	0.007	0.200	0.000	0.478	0.323	1.153
	upper avg.	1 264	324	761	0	0	11	2	28	743	0.000	0.028	0.006	0.007	0.200	0.005	0.478	0.323	1.153
Kåfjordelva	lower avg.	800	117	204	0	0	18	1	33	438	0.000	0.008	0.015	0.004	0.285	0.025	0.190	0.060	0.000
	upper avg.	800	117	204	0	0	18	1	33	438	0.000	0.008	0.015	0.004	0.285	0.025	0.190	0.060	0.292

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
Reisaelva	lower avg.	4 549	1 375	2 859	3	3	60	11	170	4 018	0.000	0.126	0.128	0.019	1.200	1.266	1.150	0.000	5.811
	upper avg.	4 549	1 375	2 859	3	3	60	11	170	4 018	0.000	0.126	0.128	0.019	1.200	1.266	1.150	0.013	5.811
Mattiselva	lower avg.	351	82	458	0	0	1	0	13	188	0.000	0.015	0.000	0.003	0.084	0.025	0.038	0.154	0.000
	upper avg.	351	82	458	0	0	1	0	13	188	0.000	0.015	0.001	0.003	0.084	0.025	0.038	0.154	0.128
Tverrelva	lower avg.	251	92	528	0	0	4	1	19	197	0.000	0.008	0.001	0.001	0.071	0.044	0.032	0.013	0.000
	upper avg.	251	92	528	0	0	4	1	19	197	0.000	0.008	0.001	0.001	0.071	0.044	0.032	0.013	0.092
Repparfjordelva	lower avg.	2 614	563	4 823	1	1	15	10	116	1 104	0.000	0.064	0.000	0.010	1.259	0.302	0.286	0.056	1.908
	upper avg.	2 614	563	4 823	1	1	15	10	116	1 104	0.000	0.064	0.005	0.010	1.259	0.302	0.286	0.056	1.908
Stabburselva	lower avg.	1 540	129	1 349	1	1	10	3	36	1 205	0.000	0.030	0.005	0.003	0.064	0.318	0.056	0.233	0.000
	upper avg.	1 540	129	1 349	1	1	10	3	36	1 205	0.000	0.030	0.005	0.003	0.064	0.318	0.056	0.233	0.562
Lakseelv	lower avg.	1 353	1 387	1 432	0	2	5	4	51	1 019	0.000	0.027	0.019	0.005	0.271	0.000	0.293	0.270	0.000
	upper avg.	1 353	1 387	1 432	0	2	5	4	51	1 019	0.000	0.027	0.019	0.005	0.271	0.005	0.293	0.270	0.494
Børselva	lower avg.	1 241	453	453	0	0	2	6	35	1 286	0.000	0.002	0.050	0.003	0.091	0.239	0.098	0.285	0.000
	upper avg.	1 241	453	453	0	0	2	6	35	1 286	0.000	0.002	0.050	0.003	0.091	0.239	0.098	0.285	0.453
Mattusjåkka	lower avg.	145	26	69	0	0	3	0	4	64	0.000	0.003	0.022	0.002	0.022	0.203	0.043	0.128	0.000
	upper avg.	145	26	69	0	0	3	0	4	64	0.000	0.003	0.022	0.002	0.022	0.203	0.043	0.128	0.053
Stuorrajåkka	lower avg.	992	0	253	0	0	9	1	32	854	0.000	0.033	0.080	0.009	0.000	0.308	0.060	0.157	0.000
	upper avg.	992	18	253	0	0	9	1	32	854	0.000	0.033	0.080	0.009	0.003	0.308	0.060	0.157	0.362
Soussjåkka	lower avg.	132	0	63	0	0	1	0	4	132	0.000	0.001	0.004	0.001	0.004	0.020	0.002	0.035	0.000
	upper avg.	132	2	63	0	0	1	0	4	132	0.000	0.001	0.004	0.001	0.004	0.020	0.002	0.035	0.048
Adamselva	lower avg.	1 053	25	615	0	0	1	2	36	860	0.000	0.048	0.015	0.008	0.041	0.315	0.000	0.000	1.153
	upper avg.	1 053	25	615	0	0	1	2	36	860	0.000	0.048	0.015	0.008	0.041	0.315	0.004	0.003	1.153
Syltefjordelva(Vesterelva)	lower avg.	1 094	0	320	1	1	2	4	24	877	0.000	0.065	0.000	0.006	0.023	0.072	0.000	0.703	0.799
	upper avg.	1 094	20	320	1	1	2	4	24	877	0.000	0.065	0.002	0.006	0.023	0.072	0.004	0.703	0.799
Jakobselv	lower avg.	1 048	139	1 071	1	1	0	2	48	1 356	0.000	0.029	0.000	0.004	0.028	0.000	0.004	0.013	0.000
	upper avg.	1 048	139	1 071	1	1	0	2	48	1 356	0.000	0.029	0.002	0.004	0.028	0.004	0.004	0.013	0.382
Neidenelva	lower avg.	2 999	1 259	5 249	2	2	20	13	208	2 189	0.000	0.071	0.000	0.022	0.569	0.000	0.246	0.635	0.000
	upper avg.	2 999	1 259	5 249	2	2	20	13	208	2 189	0.000	0.071	0.005	0.022	0.569	0.011	0.246	0.635	1.095

River	Estimate	Flow rate	SPM	TOC	PO4-P	TOTP	NO3-N	NH4-N	TOTN	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
		1000 m3/d	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[tonnes]	[kg]
Grense Jakobselv	lower avg.	302	84	399	0	0	0	1	15	329	0.000	0.019	0.007	0.002	0.248	0.210	0.858	0.328	0.331
	upper avg.	302	84	399	0	0	0	1	15	329	0.000	0.019	0.007	0.002	0.248	0.210	0.858	0.328	0.331

Tables 2b. Riverine inputs (loads) of organic contaminants (for three rivers)

Table 2bi. Estimated riverine load for polycyclic aromatic (PAHs) in Rivers Alna, Drammenselva and Glomma for 2013

Compound	River		
	Alna	Drammenselva	Glomma
	Annual load (g year^{-1})	Annual load (kg year^{-1})	Annual load (kg year^{-1})
Naphthalene	276	58.2-58.4	77.8-79.6
Acenaphthylene	9.3-32	12.18-12.23	15.0-15.4
Acenaphthene	102	7.29-7.33	26.8-27.2
Fluorene	144	10.31-10.36	45.9-46.2
Phenanthrene	392	31.10	129.7
Anthracene	92	1.51	4.55-.4.91
Fluoranthene	502	20.59	80.0
Pyrene	706	15.29	54.0
Benz[a]anthracene	164	3.23	6.1
Chrysene	181	4.20	8.0
Benzo[bj]fluoranthene	206	5.44	9.5
Benzo[k]fluoranthene	71	1.75	2.23-2.59
Benzo[a]pyrene	125	2.64	1.93-2.09
Indeno[1,2,3-cd]pyrene	85	2.04-2.05	1.74-1.82
Dibenzo[a,h]anthracene	23	0.43-0.52	0.24-0.80
Benzo[ghi]perylene	137	2.32	2.12-2.20
Note: units are different for the different rivers			

Table 2bii. Estimated riverine load for polychlorinated biphenyls (PCBs) in Rivers Alna, Drammenselva and Glomma for 2013

	River		
	Alna	Drammenselva	Glomma
	Annual load (g year^{-1})	Annual load (g year^{-1})	Annual load (g year^{-1})
PCB31 (+28)	1.40	113-133	245-374
CB52	1.50	32-86	108-237
CB101	1.13	15-69	70-179
CB118	0.63	23-78	57-166
CB153	1.47	42-80	83-192
CB105	0.080	7.1-48	50-71
CB138	1.39	32-72	78-187
CB156	0.006-0.018	< 47	< 32
CB180	0.96	< 49	16-148

Table 2biii. Estimated riverine load for polybrominated diphenyl ethers (PBDEs) in Rivers Alna, Drammenselva and Glomma for 2013

	River		
	Alna	Drammenselva	Glomma
	Annual load (g year^{-1})	Annual load (g year^{-1})	Annual load (g year^{-1})
BDE47	0.378	128-131	160-170
BDE99	0.596	66.5-68.9	80.9-89.9
BDE100	0.05-0.12	19.0-23.0	38.4-55.2
BDE153	0.37-0.41	1.8-14.3	< 89
BDE154	0.035-0.089	1.4-9.4	39.1-59.5
BDE183	< 0.17	< 22	< 116
BDE196	< 0.20	< 24	< 117
BDE209	8.65	183-194	203-292
BDE126	< 0.16	< 14	< 66
*Data for BDE28 not available			

Table 2biv. Estimated riverine load for hexabromoyclododecane (HBCDD) in Rivers Alna, Drammenselva and Glomma for 2013

	River		
	Alna	Drammenselva	Glomma
	Annual load (g year^{-1})	Annual load (g year^{-1})	Annual load (g year^{-1})
α-HBDD	0.24-2.41	2.5-121	270-607
ß-HBCDD	0.032-2.2	< 111	< 343
δ-HBDD	0.047-2.2	8.1-120	< 334

Table 2bv. Estimated riverine load for suspended particulate matter-associated short and medium chain chlorinated paraffins (S/MCCPs), bisphenol A (BPA), tetrabromobisphenol A (TBBPA), PFOS and PFDS in Rivers Alna, Drammenselva and Glomma for 2013

	River		
	Alna	Drammenselva	Glomma
	Annual load (g year^{-1})	Annual load (g year^{-1})	Annual load (kg year^{-1})
SCCPs	239	1547	20.2
MCCPs	472	3962	243
BPA	17.8	1833	2.54
TBBPA	2.7	178	0.575
PFOS	0.17	2.46	4.3-13.3
PFDS	0.09	< 3.2	< 20

Table 3. Total inputs to the sea from Norway in 2013

TOTAL INPUTS

Discharge region	Estimate	Flow rate (km^3/d)	SPM [tonnes]	TOC [tonnes]	PO4-P [tonnes]	TOTP [tonnes]	NO3-N [tonnes]	NH4-N [tonnes]	TOTN [tonnes]	SiO2 [tonnes]	Ag tonnes]	As [tonnes]	Pb [tonnes]	Cd [tonnes]	Cu [tonnes]	Zn [tonnes]	Ni [tonnes]	Cr [tonnes]	Hg [kg]
INPUTS TO OSPAR REGION: TOTAL NORWAY																			
RIVERINE INPUTS																			
Main Rivers	low avg.	184 212	391 530	221 508	395	813	15 738	1 002	27 807	195 432	0.00	10.10	13.60	0.67	98.70	621.52	40.17	21.87	52
	upp avg.		391 530	221 508	410	814	15 738	1 010	27 807	195 432	3.36	10.13	13.60	0.73	98.70	621.52	40.18	23.45	94
Tributary Rivers (36)	low avg.	203 852	570 399	181 657	578	892	7 506	644	18 052	176 298	0.02	10.20	17.46	0.81	117.84	248.04	73.28	34.63	39
	upp avg.		570 406	181 657	599	893	7 507	660	18 052	176 298	3.72	11.14	17.47	0.96	117.84	248.04	73.29	36.68	92
Tributary Rivers (109)	low avg.	142 962	66 058	89 227	95	211	4 980	446	9 329	69 867	0.00	5.47	5.17	0.44	20.39	55.56	19.38	17.71	48
	upp avg.		66 228	89 227	95	215	4 981	446	9 336	69 867	0.00	5.48	5.21	0.44	20.43	55.63	19.39	17.85	73
Total Riverine Inputs	**low avg.**	531 112	1 027 986	492 393	1 068	1 916	28 224	2 092	55 188	441 597	0.02	25.77	36.23	1.92	236.94	925.12	132.82	74.21	139
	upp avg.		1 028 164	492 393	1 105	1 923	28 226	2 115	55 195	441 597	7.09	26.76	36.29	2.13	236.97	925.18	132.86	77.98	259
Sewage Effluents	low avg.		2 324		572	953	624	9 359	12 478			0.21	0.35	0.02	3.54	12.72	1.81		10
	upp avg.		2 324		572	953	624	9 359	12 478			0.21	0.35	0.02	3.54	12.72	1.81		10
Industrial Effluents	low avg.		11 047	12 599	138	230	127	1 903	2 537			1.46	1.09	0.09	5.30	13.80	6.82	1.82	8
	upp avg.		11 047	12 599	138	230	127	1 903	2 537			1.46	1.09	0.09	5.30	13.80	6.82	1.82	8
Fish Farming	low avg.				6 100	8 840	5 751	41 829	52 286						917.57				
	upp avg.				6 100	8 840	5 751	41 829	52 286						917.57				
Total Direct Inputs	**low avg.**		13 371	12 599	6 810	10 023	6 502	53 090	67 301			1.67	1.44	0.10	926.42	26.52	8.63	1.82	18
	upp avg.		13 371	12 599	6 810	10 023	6 502	53 090	67 301			1.67	1.44	0.10	926.42	26.52	8.63	1.82	18
Unmonitored Areas	low avg.	378 172			184	748	24 911	2 192	39 858										
	upp avg.				184	748	24 911	2 192	39 858										
REGION TOTAL	**low avg.**	909 284	1 041357	504 992	8 062	12 688	59 638	57 374	162 348	441 597	0.02	27	38	2	1 163	952	141	76	157
	upp avg.		1 041535	504 992	8 098	12 694	59 640	57 398	162 354	441 597	7.09	28	38	2	1 163	952	141	80	276

TOTAL INPUTS																		
Discharge region	Estimate	Flow rate (km^3/d)	SPM [tonnes]	TOC [tonnes]	PO4-P [tonnes]	TOTP [tonnes]	NO3-N [tonnes]	NH4-N [tonnes]	TOTN [tonnes]	SiO2 [tonnes]	Ag tonnes]	As [tonnes]	Pb [tonnes]	Cd [tonnes]	Cu [tonnes]	Zn [tonnes]	Ni [tonnes]	Cr [tonnes]	Hg [kg]
INPUTS TO OSPAR REGION: Skagerak																			
RIVERINE INPUTS																			
Main Rivers	low avg.	149 342	357 379	194 338	357	673	14 662	906	24 955	168 312	0.00	8.52	12.95	0.59	86.19	594.75	35.17	18.68	49
	upp avg.		357 379	194 338	367	674	14 662	907	24 955	168 312	2.73	8.54	12.95	0.61	86.19	594.75	35.17	19.87	79
Tributary Rivers (36)	low avg.	27 110	12 080	44 779	12	67	1 697	163	3 785	20 948	0.02	1.87	3.36	0.24	5.77	49.78	2.85	1.16	7
	upp avg.		12 080	44 779	15	68	1 697	163	3 785	20 948	0.50	1.87	3.36	0.24	5.77	49.78	2.85	1.64	12
Tributary Rivers (109)	low avg.	8 431	14 117	16 408	19	68	1 349	65	2 014	8 330	0.00	1.06	1.25	0.09	2.86	18.36	2.21	0.69	5
	upp avg.		14 117	16 408	19	68	1 349	65	2 014	8 330	0.00	1.06	1.26	0.09	2.86	18.36	2.21	0.70	5
Total Riverine Inputs	**low avg.**	184 884	383 576	255 525	388	808	17 707	1 134	30 754	197 590	0.02	11.45	17.56	0.93	94.82	662.89	40.22	20.53	60
	upp avg.		383 576	255 525	401	810	17 707	1 135	30 754	197 590	3.22	11.47	17.56	0.94	94.82	662.89	40.22	22.20	97
Sewage Effluents	low avg.		47		60	100	245	3 675	4 900			0.12	0.17	0.01	2.42	8.54	1.14		6
	upp avg.		47		60	100	245	3 675	4 900			0.12	0.17	0.01	2.42	8.54	1.14		6
Industrial Effluents	low avg.		2 010	3 535	37	62	47	711	948			0.18	0.34	0.03	4.83	6.11	2.55	1.12	4
	upp avg.		2 010	3 535	37	62	47	711	948			0.18	0.34	0.03	4.83	6.11	2.55	1.12	4
Fish Farming	low avg.				4	6	4	28	35						0.62				
	upp avg.				4	6	4	28	35						0.62				
Total Direct Inputs	**low avg.**		2 057	3 535	101	168	296	4 414	5 883			0.30	0.51	0.04	7.87	14.65	3.70	1.12	10
	upp avg.		2 057	3 535	101	168	296	4 414	5 883			0.30	0.51	0.04	7.87	14.65	3.70	1.12	10
Unmonitored Areas	low avg.	8 065			20	82	1 993	175	3 188										
	upp avg.				20	82	1 993	175	3 188										
REGION TOTAL	**low avg.**	192 949	385 633	259 060	510	1 058	19 996	5 723	39 825	197 590	0.02	12	18	1	103	678	44	22	71
	upp avg.		385 633	259 060	523	1 059	19 996	5 724	39 825	197 590	3.22	12	18	1	103	678	44	23	107

TOTAL INPUTS																		
Discharge region	**Estimate**	**Flow rate (km^3/d)**	**SPM [tonnes]**	**TOC [tonnes]**	**PO4-P [tonnes]**	**TOTP [tonnes]**	**NO3-N [tonnes]**	**NH4-N [tonnes]**	**TOTN [tonnes]**	**SiO2 [tonnes]**	**Ag tonnes]**	**As [tonnes]**	**Pb [tonnes]**	**Cd [tonnes]**	**Cu [tonnes]**	**Zn [tonnes]**	**Ni [tonnes]**	**Cr [tonnes]**	**Hg [kg]**
INPUTS TO OSPAR REGION: North Sea																			
RIVERINE INPUTS																			
Main Rivers	low avg.	8 302	3 425	4 855	7	21	374	35	815	3 013	0.00	0.27	0.22	0.01	1.41	3.73	1.08	0.38	3
	upp avg.		3 425	4 855	9	21	374	35	815	3 013	0.15	0.29	0.22	0.02	1.41	3.73	1.08	0.56	5
Tributary Rivers (36)	low avg.	67 041	197 154	44 300	303	368	3 768	234	6 738	39 066	0.00	1.78	5.81	0.27	15.35	74.19	9.76	11.70	10
	upp avg.		197 161	44 300	313	368	3 768	241	6 738	39 066	1.22	2.18	5.81	0.29	15.35	74.19	9.77	12.89	30
Tributary Rivers (109)	low avg.	65 891	25 254	28 612	41	79	2 670	174	4 464	24 290	0.00	2.44	2.96	0.15	7.98	25.25	8.33	3.18	18
	upp avg.		25 254	28 612	41	80	2 670	175	4 464	24 290	0.00	2.44	2.96	0.15	8.00	25.27	8.33	3.23	29
Total Riverine Inputs	**low avg.**	141 234	225 833	77 766	351	468	6 812	444	12 017	66 369	0.00	4.49	8.99	0.44	24.75	103.17	19.18	15.26	31
	upp avg.		225 840	77 766	362	469	6 812	450	12 017	66 369	1.38	4.90	9.00	0.46	24.77	103.19	19.19	16.68	64
Sewage Effluents	low avg.		191		223	372	186	2 788	3 717			0.05	0.14	0.01	0.79	2.82	0.46		3
	upp avg.		191		223	372	186	2 788	3 717			0.05	0.14	0.01	0.79	2.82	0.46		3
Industrial Effluents	low avg.		5 591	8 322	49	82	23	350	466			1.27	0.41	0.05	0.33	7.50	4.12	0.67	3
	upp avg.		5 591	8 322	49	82	23	350	466			1.27	0.41	0.05	0.33	7.50	4.12	0.67	3
Fish Farming	low avg.				1 999	2 897	1 891	13 752	17 190						301.22				
	upp avg.				1 999	2 897	1 891	13 752	17 190						301.22				
Total Direct Inputs	**low avg.**		5 782	8 322	2 271	3 351	2 100	16 890	21 374			1.32	0.55	0.06	302.34	10.32	4.58	0.67	6
	upp avg.		5 782	8 322	2 271	3 351	2 100	16 890	21 374			1.32	0.55	0.06	302.34	10.32	4.58	0.67	6
Unmonitored Areas	low avg.	125 837			58	237	9 909	872	15 854										
	upp avg.				58	237	9 909	872	15 854										
REGION TOTAL	**low avg.**	267 071	231 616	86 089	2 681	4 055	18 821	18 205	49 245	66 369	0.00	6	10	0	327	113	24	16	37
	upp avg.		231 623	86 089	2 692	4 057	18 821	18 212	49 245	66 369	1.38	6	10	1	327	114	24	17	70

TOTAL INPUTS

Discharge region	Estimate	Flow rate (km³/d)	SPM [tonnes]	TOC [tonnes]	PO4-P [tonnes]	TOTP [tonnes]	NO3-N [tonnes]	NH4-N [tonnes]	TOTN [tonnes]	SiO2 [tonnes]	Ag tonnes]	As [tonnes]	Pb [tonnes]	Cd [tonnes]	Cu [tonnes]	Zn [tonnes]	Ni [tonnes]	Cr [tonnes]	Hg [kg]
INPUTS TO OSPAR REGION: Norwegian Sea																			
RIVERINE INPUTS																			
Main Rivers	low avg.	18 819	20 648	15 047	12	36	454	21	1 257	10 899	0.00	0.78	0.37	0.06	9.31	22.06	3.24	1.86	0
	upp avg.		20 648	15 047	15	36	454	28	1 257	10 899	0.34	0.78	0.37	0.09	9.31	22.06	3.24	2.03	7
Tributary Rivers (36)	low avg.	81 124	347 296	69 955	242	401	1 831	170	5 929	63 285	0.00	2.85	5.68	0.14	31.81	95.55	27.15	19.67	21
	upp avg.		347 296	69 955	249	401	1 831	179	5 929	63 285	1.48	3.13	5.68	0.24	31.81	95.55	27.15	19.97	39
Tributary Rivers (109)	low avg.	53 523	22 448	27 125	28	57	887	158	2 211	25 587	0.00	1.55	0.76	0.12	6.77	9.90	6.82	10.84	21
	upp avg.		22 578	27 125	28	59	887	158	2 218	25 587	0.00	1.57	0.78	0.12	6.78	9.91	6.83	10.91	31
Total Riverine Inputs	**low avg.**	153 466	390 392	112 128	282	494	3 172	349	9 397	99 772	0.00	5.18	6.81	0.32	47.89	127.50	37.21	32.36	43
	upp avg.		390 522	112 128	292	496	3 172	365	9 403	99 772	1.82	5.48	6.83	0.44	47.90	127.52	37.21	32.91	77
Sewage Effluents	low avg.		2 065		268	447	180	2 700	3 599			0.03	0.04	0.00	0.34	1.36	0.21		1
	upp avg.		2 065		268	447	180	2 700	3 599			0.03	0.04	0.00	0.34	1.36	0.21		1
Industrial Effluents	low avg.		3 445	696	51	85	55	827	1 103			0.01	0.34	0.01	0.13	0.19	0.14	0.02	0
	upp avg.		3 445	696	51	85	55	827	1 103			0.01	0.34	0.01	0.13	0.19	0.14	0.02	0
Fish Farming	low avg.				3 591	5 204	3 382	24 594	30 742						540.19				
	upp avg.				3 591	5 204	3 382	24 594	30 742						540.19				
Total Direct Inputs	**low avg.**		5 510	696	3 910	5 736	3 617	28 120	35 444			0.04	0.38	0.01	540.66	1.55	0.35	0.02	1
	upp avg.		5 510	696	3 910	5 736	3 617	28 120	35 444			0.04	0.38	0.01	540.66	1.55	0.35	0.02	1
Unmonitored Areas	low avg.	201 939			95	388	11 490	1 011	18 383										
	upp avg.				95	388	11 490	1 011	18 383										
REGION TOTAL	**low avg.**	355 405	395 902	112 824	4 287	6 618	18 278	29 480	63 224	99 772	0.00	5	7	0	589	129	38	32	44
	upp avg.		396 032	112 824	4 297	6 620	18 278	29 496	63 231	99 772	1.82	6	7	0	589	129	38	33	78

TOTAL INPUTS

Discharge region	Estimate	Flow rate (km^3/d)	SPM [tonnes]	TOC [tonnes]	PO4-P [tonnes]	TOTP [tonnes]	NO3-N [tonnes]	NH4-N [tonnes]	TOTN [tonnes]	SiO2 [tonnes]	Ag tonnes]	As [tonnes]	Pb [tonnes]	Cd [tonnes]	Cu [tonnes]	Zn [tonnes]	Ni [tonnes]	Cr [tonnes]	Hg [kg]
INPUTS TO OSPAR REGION: Barents Sea																			
RIVERINE INPUTS																			
Main Rivers	low avg.	7 749	10 078	7 268	19	83	249	40	780	13 209	0.00	0.53	0.06	0.00	1.79	0.98	0.68	0.95	0
	upp avg.		10 078	7 268	19	83	249	40	780	13 209	0.14	0.53	0.07	0.01	1.79	0.98	0.69	0.99	3
Tributary Rivers (36)	low avg.	28 577	13 869	22 624	21	56	211	76	1 601	52 998	0.00	3.70	2.61	0.15	64.92	28.52	33.52	2.10	0
	upp avg.		13 869	22 624	23	56	211	76	1 601	52 998	0.52	3.97	2.61	0.19	64.92	28.52	33.52	2.18	10
Tributary Rivers (109)	low avg.	15 116	4 238	17 082	7	8	74	48	640	11 659	0.00	0.42	0.20	0.08	2.78	2.06	2.02	3.01	4
	upp avg.		4 279	17 082	7	9	74	48	640	11 659	0.00	0.42	0.22	0.08	2.78	2.08	2.02	3.01	8
Total Riverine Inputs	**low avg.**	51 442	28 186	46 974	47	147	533	165	3 021	77 866	0.00	4.64	2.87	0.23	69.48	31.55	36.21	6.06	4
	upp avg.		28 226	46 974	50	148	534	165	3 021	77 866	0.66	4.91	2.90	0.28	69.48	31.57	36.23	6.18	21
Sewage Effluents	low avg.		21		21	34	13	196	262										
	upp avg.		21		21	34	13	196	262										
Industrial Effluents	low avg.			46	1	1	1	15	20					0.00			0.00	0.00	0
	upp avg.			46	1	1	1	15	20					0.00			0.00	0.00	0
Fish Farming	low avg.				506	733	475	3 455	4 319						75.54				
	upp avg.				506	733	475	3 455	4 319						75.54				
Total Direct Inputs	**low avg.**		21	46	527	768	489	3 667	4 601					0.00	75.54		0.00	0.00	0
	upp avg.		21	46	527	768	489	3 667	4 601					0.00	75.54		0.00	0.00	0
Unmonitored Areas	low avg.	42 331			10	42	1 520	134	2 433										
	upp avg.				10	42	1 520	134	2 433										
REGION TOTAL	**low avg.**	93 773	28 207	47 019	585	957	2 543	3 965	10 054	77 866	0.00	5	3	0	145	32	36	6	5
	upp avg.		28 247	47 019	587	958	2 544	3 966	10 054	77 866	0.66	5	3	0	145	32	36	6	22

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Statlig program for forurensningsovervåking omfatter overvåking av forurensningsforholdene i luft og nedbør, skog, vassdrag, fjorder og havområder. Overvåkingsprogrammet dekker langsiktige undersøkelser av:

- overgjødsling
- forsuring (sur nedbør)
- ozon (ved bakken og i stratosfæren)
- klimagasser
- miljøgifter

Overvåkingsprogrammet skal gi informasjon om tilstanden og utviklingen av forurensningssituasjonen, og påvise eventuell uheldig utvikling på et tidlig tidspunkt. Programmet skal dekke myndighetenes informasjonsbehov om forurensningsforholdene, registrere virkningen av iverksatte tiltak for å redusere forurensningen, og danne grunnlag for vurdering av nye tiltak. Miljødirektoratet er ansvarlig for gjennomføringen av overvåkingsprogrammet.