REPORT SNO. 7738-2022
Revised version of report sno. 7675-2021

The Norwegian river monitoring programme 2020 – water quality status and trends

Photo: Målselva by Odd Arne Skogan

CORRIGENDUM

Corrections in electronic version of NIVA report 7675-2021 «The Norwegian river monitoring programme 2020 – water quality status and trends», issued in November 2021.

Page 7 (Summary), last paragraph:

Old text:
Drammenselva was the only river showing increased loads of all elements included in the trend analysis (SPM, silica, TOC, Tot-P, PO_4, Tot-N) apart from inorganic nitrogen (NO_3, NH_4). Other rivers with many increasing trends were *Glomma* (silica, PO_4, Tot-N), *Numedalslågen* (silica, Tot-P, PO_4, Tot-N) and *Orreelva* (SPM, silica, Tot-P, PO_4). The nitrogen species NO_3 and NH_4 were the only elements that only showed decreasing trends, mainly due to reduced air pollution in Europe since the 1990s and possibly also increased vegetation uptake due to longer growing season as an effect of global warming.

New text:
Drammenselva was the only river showing increased loads of all elements included in the trend analysis (SPM, silica, TOC, Tot-P, PO_4, Tot-N, NO_3) apart from ammonium (NH_4). Other rivers with many increasing trends were *Glomma* (silica, PO_4, Tot-N, NO_3), *Numedalslågen* (silica, Tot-P, PO_4, Tot-N) and *Orreelva* (SPM, silica, Tot-P, PO_4). Decreasing trends in NH_4 and also NO_3 in some rivers are probably due to reduced air pollution in Europe since the 1990s and possibly also increased vegetation uptake due to longer growing season as an effect of global warming.

Page 10 (Sammendrag), last paragraph:

Old text:
Drammenselva var den eneste av elvene som viste en signifikant økning i transport av alle stoffer som var inkludert i trendanalysen (SPM, silisium, TOC, Tot-P, PO_4, Tot-N), bortsett de uorganiske nitrogenforbindelsene NO_3 og NH_4. Andre elver med økende trender i stofftranport flere ulike forbindelser var *Glomma* (silisium, PO_4, Tot-N), *Numedalslågen* (silisium, Tot-P, PO_4, Tot-N) og *Orreelva* (SPM, silisium, Tot-P, PO_4). Nitrogenforbindelsene NO_3 og NH_4 var de eneste stoffene som kun viste nedadgående trender i elvetransport, sannsynligvis som følge av redusert tilførsel av langtransportert forurenset luft og nedbør siden 1990-årene og muligens også økt opptak i vegetasjon som følge av varmere klima og lengre vekstsesong.

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Drammenselva var den eneste av elvene som viste en signifikant økning i transport av alle stoffer som var inkludert i trendanalysen (SPM, silisium, TOC, Tot-P, PO_4, Tot-N, NO_3), bortsett fra ammonium (NH_4). Andre elver med økende trender i transport av flere ulike forbindelser var *Glomma* (silisium, PO_4, Tot-N, NO_3), *Numedalslågen* (silisium, Tot-P, PO_4, Tot-N) og *Orreelva* (SPM, silisium, Tot-P, PO_4). Nedadgående trender i NH_4 og dels også NO_3 i noen elver skyldes sannsynligvis redusert tilførsel av langtransportert forurenset luft og nedbør siden 1990-årene og muligens også økt opptak i vegetasjon som følge av varmere klima og lengre vekstsesong.

Page 53, last two paragraphs:

Old text:
Within this area, Drammenselva is the only river that show increasing loads of all elements, except for inorganic nitrogen. On the other side, Otra is lacking significant trends overall, except for nitrate (decreasing). It is also worth noting that Vefsna in northern Norway show decreasing trends in several elements, including SPM and all N and P species.

Ammonium (NH_4) and nitrate (NO_3) are the only elements that show only decreasing trends, probably due to reduced deposition of inorganic nitrogen from long-range transported air pollution and possibly also increased uptake by vegetation due to longer growing season. On the other hand, total nitrogen shows an increase in Glomma, Drammenselva and Numedalslågen, which are the largest rivers that discharges into the outer Oslofjord and the Skagerrak Sea. This implies an increase in organic nitrogen that more than compensates for the decrease in inorganic nitrogen.

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Decreasing trends in ammonium (NH_4) and also nitrate (NO_3) in some rivers are probably due to reduced deposition of inorganic nitrogen from long-range transported air pollution, and possibly also increased uptake by vegetation due to longer growing season as an effect of global warming. Total nitrogen shows an increase in Glomma, Drammenselva and Numedalslågen, which are the largest rivers that discharges into the outer Oslofjord and the Skagerrak Sea.

Table 18

Old version:

Table 18. P-values for long-term trends (1990-2020) in water discharge (Q) and loads (transport) of suspended particulate matter (SPM), silica (SiO_2), total organic carbon (TOC), total phosphorus (Tot-P), and phosphate (PO_4), total nitrogen (Tot-N), ammonium (NH_4), nitrate (NO_3), in rivers.

River	Q	SPM	SiO_2	TOC*	Tot-P	PO_4	Tot-N	NH_4	NO_3
Glomma	0.013	0.395	0.019	0.057	0.359	0.016	0.004	0.000	0.023
Drammenselva	0.004	0.013	0.000	0.001	0.003	0.003	0.005	0.001	0.025
Numedalslågen	0.072	0.057	0.001	0.735	0.010	0.003	0.000	0.096	0.053
Skienselva	0.049	0.919	0.002	0.398	0.208	0.234	0.262	0.002	0.000
Otra	0.208	0.377	0.163	0.234	0.634	0.497	0.786	0.062	0.000
Orreelva	0.027	0.030	0.021	0.195	0.023	0.049	0.144	0.126	0.475
Orkla	0.786	0.946	0.708	0.708	0.541	0.865	0.708	0.000	0.865
Vefsna	0.659	0.006	0.497	1.000	0.001	0.006	0.001	0.000	0.000
Altaelva	0.153	0.541	0.587	0.735	0.292	0.415	0.610	0.019	0.587

Red – significantly increasing $p<0.05$, green – significantly decreasing $p<0.05$

*Trend analysis started in 1999 due to limited data in the period from 1990

New version: Colour for NO_3 in Glomma and Drammenselva changed from green to red.

Table 18. P-values for long-term trends (1990-2020) in water discharge (Q) and loads (transport) of suspended particulate matter (SPM), silica (SiO_2), total organic carbon (TOC), total phosphorus (Tot-P), and phosphate (PO_4), total nitrogen (Tot-N), ammonium (NH_4), nitrate (NO_3), in rivers.

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*Trend analysis started in 1999 due to limited data in the period from 1990

Grimstad, 4 April 2022

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Summary

In the Norwegian River Monitoring Programme (in Norwegian: Elveovervåkingsprogrammet) 20 rivers along the Norwegian coastline are monitored for chemical and hydrological parameters. It is a continuation of the RID programme (Riverine inputs and direct discharges to Norwegian coastal waters) that started in 1990. This report presents the current status (2020) and long-term (1990-2020) water quality trends.

Four keywords	Fire emneord
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This report is quality assured in accordance with NIVA's quality system and approved by:

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The Norwegian river monitoring programme 2020
–
water quality status and trends

Preface

The Norwegian river monitoring programme is a main component of the Norwegian water authorities' surveillance monitoring in rivers, according to the requirements set by the EU Water Framework Directive (WFD). The monitoring also fulfils Norway's obligations under the Oslo-Paris Convention (OSPAR). Results from the 2020 monitoring activities are presented in three thematic reports, where this report includes results from the basic monitoring of 20 rivers across Norway. The 20 rivers are selected to represent the variability in river water quality and fluxes, and to cover a substantial fraction of the riverine flux from mainland Norway to the sea.

In 2020, the work presented in this report was a collaboration between NIVA, the Norwegian Water Resources and Energy Directorate (NVE), and Eurofins Environment Testing Norway AS.

Hans Fredrik Veiteberg Braaten (NIVA) was project lead for the river monitoring programme in 2020, whereas Øyvind Kaste has been project lead in 2021 and lead author of this report. Other co-authors and contributors to the report include Cathrine Brecke Gundersen (climate status, water quality status, quality of dissolved organic matter), Amanda Poste (quality of dissolved organic matter, evaluation of sensor data), James Sample (databases, calculation of riverine loads, trends in water temperature, water discharge and water chemistry), Dag Ø. Hjermann (climate data, trends in air temperature and precipitation), Liv Bente Skancke (coordination of local field work personnel, quality assurance of sampling and chemical analyses), Rolf Høgberget (sensor monitoring in Storelva), Odd Arne Skogan (sensor monitoring in Målselva), Jan Karud (development of maps), and Elisabeth Lie and Marit Villø (contact persons at the NIVA chemical laboratory). Quality assurance of the report has been carried out by Hans Fredrik Veiteberg Braaten.

At NVE, Trine Fjeldstad has been responsible for the local sampling personnel and provision of hydrological data, Stein Beldring has carried out the hydrological modelling, and Morten N. Due has been the administrative contact. In 2020, Eurofins carried out the total nitrogen and parts of the mercury analyses.

Contact persons at The Norwegian Environment Agency have been Gunn Lise Haugestøl and Preben Danielsen. Thanks to all involved for a good collaboration.

Grimstad, November 2021

Øyvind Kaste

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Summary

The **Norwegian River Monitoring Programme** includes monitoring of various chemical, physical, and hydrological parameters in 20 rivers distributed along the Norwegian coast. The programme is a main component of the Norwegian environmental authorities' surveillance of rivers according to the requirements set by the EU Water Framework Directive (WFD), and it also forms the basis for the fulfilment of Norway's obligations under the Oslo-Paris Convention (OSPAR). This report presents the water quality status in 2020 and long-term trends in the monitored rivers from the program start in 1990 until 2020. Additionally, data from six rivers in the national monitoring program for limed rivers are included in the assessment.

For Norway as a whole, **2020 was the warmest and second wettest year on record since the Norwegian meteorological institute started the measurements in 1900**. Air temperatures were 2.4°C above the 1961-1990 normal. The south-eastern parts of Norway contributed most to the increased temperature (+3-4°C), whereas northern Norway had annual average temperatures 1-1.5°C above normal. All meteorological stations nearby the 20 rivers show a statistically significant increase in air temperatures over the period 1980-2020. Precipitation in 2020 was 125% of the normal, and the increase was relatively evenly distributed across the country. Five of the evaluated stations show a significant increase in precipitation during the 1980-2020 period. Large year-to-year variation in precipitation can potentially explain the relatively low number of stations with significant trends.

The general increase in air temperatures also affects **water temperature** in the rivers. Among 13 rivers with long-term data (>20 years) six showed a significant increase in water temperature. In most rivers, mean **water discharges** in 2020 were relatively similar to – or a bit higher – than the preceding five-year mean (2015-2019). Among nine rivers with long-term data back to 1990, *Glomma*, *Drammenselva*, *Skienselva* and *Orreelva* showed significant increasing trends in water discharge.

pH and **calcium** (Ca) concentrations follow a clear geographical pattern in Norway. The most acidic rivers are found in the south and in south-west due to a combination of acid deposition and slow weathering bedrock. In the south-east, where the catchments typically are more forested and receive less acid deposition, pH is often weakly acidic to neutral. In mid- and northern Norway pH is generally close to neutral. In 2020, many rivers had slightly lower pH compared to the preceding five-year mean. One exception was *Otra*, where a new liming program was initiated in 2020.

Turbidity and **suspended particulate matter** (SPM) are important for the water quality by influencing light conditions and transport of metals and nutrients in water. The particle load is highly correlated with precipitation and water discharge, which have showed increasing trends in large parts of Norway. The most particle-rich rivers (*Glomma*, *Alna*, *Numedalslågen*, *Orreelva*) had slightly higher turbidity in 2020 compared to the five-year mean. The same pattern was to a large degree evident also for SPM. Both turbidity and SPM are highly correlated with water discharge, and with monthly grab samples one can easily miss significant peaks in particle concentrations during floods.

Also, **total organic carbon** (TOC) vary regionally with concentrations generally decreasing from east towards the west in southern Norway. In northern Norway, concentrations are generally lower than in south-eastern Norway, but higher than in western Norway. In 2020, TOC levels followed the typical geographical pattern with highest levels in rivers dominated by forest or

agriculture, and the lowest levels in catchments dominated by thin soils and exposed bedrock. The largest relative deviation in TOC concentration compared to the five-year mean was found in *Målselva*. The most likely explanation for this was an additional sampling campaign conducted during a large snowmelt flood in May-June 2020. This clearly demonstrates the importance of frequent sampling in order to capture variation in parameters that are highly correlated with water discharge.

Concentrations of **total phosphorous** (Tot-P) and **total nitrogen** (Tot-N) are much higher in *Alna* and *Orreelva* compared to the other rivers, due to urban runoff and intensive agriculture in the respective catchments. *Numedalslågen*, *Driva*, *Bjerkreimselva*, and *Nidelva* showed a modest Tot-P increase (19-31%) compared to the five-year mean. In *Målselva*, the 2020 average Tot-P concentration was twice as high as the five-year mean. As noted for TOC, this was mainly caused by more frequent sampling during the snowmelt flood in 2020. The other northern rivers, *Pasvikelva*, *Altaelva*, and *Tana* had 17-26% lower Tot-P concentrations in 2020 than the five-year mean. For most of the rivers, the annual average Tot-N concentrations were slightly lower in 2020 compared to the five-year mean. The largest relative decrease (27-34%) was observed in *Nausta*, *Pasvikelva*, *Vefsna*, and *Alna*.

The urban river Alna had the highest total **metal** concentrations, including arsenic (As), lead (Pb), cadmium (Cd), copper (Cu), zinc (Zn), and chromium (Cr). However, the mean 2020 concentrations in the river were lower than the five-year mean for all metals, except for Cr. Highest nickel (Ni) concentrations in 2020 were found in *Pasvikelva* (together with elevated Cu), whereas the highest mercury (Hg) concentrations were found in *Numedalslågen*. The elevated metal concentrations in *Numedalslågen* in 2020 were mainly caused by an erosion event with high concentrations of SPM and particle-bound metals in October. With only four metal samples per year it had a big influence on the annual mean and does not indicate any changes in local pollution inputs. Among other rivers with elevated metal concentrations were *Orkla* (Cd, Cu, Zn, Ni), *Orreelva* (As, Pb, Ni), *Pasvikelva* (Cu, Ni) and *Storelva* (As, Pb, Cd, Hg). The Ni concentration in *Pasvikelva* was about half of the five-year mean, indicating lower emissions from the nickel smelter on the Russian side of the border. The factory was shut down in December 2020. Nearly all sites had metal concentrations that were below EQS values set for Norwegian surface waters. The only exceptions were Zn in *Alna* and Ni in *Pasvikelva*. However, these are total concentrations that cannot be compared directly with the standard threshold values, which are based on dissolved concentrations (filtered samples).

There is a close connection between rivers with significant increasing water discharge and rivers with significant increasing **loads of nutrients and particulate matter** since 1990. This implies that rivers with increasing loads are located along the coastline from *Glomma* in south-east to *Orreelva* in south-west. *Drammenselva* was the only river showing increased loads of all elements included in the trend analysis (SPM, silica, TOC, Tot-P, PO_4, Tot-N, NO_3) apart from ammonium (NH_4). Other rivers with many increasing trends were *Glomma* (silica, PO_4, Tot-N, NO_3), *Numedalslågen* (silica, Tot-P, PO_4, Tot-N) and *Orreelva* (SPM, silica, Tot-P, PO_4). Decreasing trends in NH_4 and also NO_3 in some rivers are probably due to reduced air pollution in Europe since the 1990s and possibly also increased vegetation uptake due to longer growing season as an effect of global warming. In northern Norway, *Vefsna* show decreasing trends for several elements, including SPM and all the N and P species. The trends are mainly caused by elevated concentrations during the 1990s, while the levels have been relatively stable since then.

When looking at riverine **concentrations of nutrients and particulate matter**, there were fewer increasing trends and more decreasing trends than seen for riverine loads. The elements that show increasing trends in concentrations were SPM (*Glomma*), silica (*Drammenselva*, *Numedalslågen*, *Skienselva*, *Orkla*), PO_4 (*Glomma*, *Numedalslågen*, *Orreelva*) and Tot-N (*Orkla*). Again, the increasing trends are mainly associated with rivers that discharges to the Skagerrak coast.

All rivers show either no trend or decreasing **trends in metal loads** (Pb, Cd, Cu, Zn, Ni) from 2004 to 2020. Elements that show significant downward trends in riverine loads are Cu (*Glomma*, *Otra*, *Orkla*), Zn (*Otra*, *Orkla*, *Vefsna*) and Pb (*Orkla*). Regarding **metal concentrations**, there were either no trend or decreasing trends for Pb, Cd, Cu and Ni in the rivers. Nickel was the only element showing increasing trends (*Orreelva*, *Vefsna*, *Altaelva*).

In 2020, the mean **seasonal TOC concentration** was at its lowest during winter before increasing through spring and summer. During late summer, the **aromaticity of the DOM** (expressed by sUVa) dropped in all regions across the country. This indicated a shift in the quality of the riverine DOM towards more biodegradable material. The late summer was also distinct when comparing the 2020 national averages with those from the three previous years (UV absorption measurements started in 2017): during late summer the 2020 TOC concentration was higher while the DOM aromaticity (sUVa) was lower. This was likely caused by differences in summer weather between the years. Perhaps the observed low aromaticity was caused by a high input of freshly organic material that had been produced during summer. Regional trends in relationships between TOC, DOM quality and river discharge in 2020 were similar to previous years.

Short-term effects of climate variability on water chemistry were studied **using high-frequency sensor data** (hourly time steps) in *Storelva* and *Målselva*, including water temperature, pH, conductivity, turbidity and fluorescent dissolved organic matter (FDOM). Data from *Storelva* show that flood characteristics (i.e. type, magnitude, timing) largely influenced short-time variation in concentrations of dissolved ions (conductivity), suspended particles (turbidity) and organic matter (FDOM). In *Storelva*, the winter in 2020 was mild and instead of a distinct snowmelt flood in spring, several small floods occurred between January and March. The autumn was characterised by repeating high flow events, which ended with a large, five-year flood in late December. In *Målselva*, where the climate is much colder, the water discharge is highly seasonal with low flow during the entire winter and a distinct snowmelt flood in May-June. In 2020, very high snow accumulation in the catchment led to a pronounced snowmelt flood which resulted in significant riverine loads of particulate and organic matter that ultimately ended up in the downstream coastal fjord system (Målselvfjorden and Malangen).

Sammendrag

Tittel: Elveovervåkningsprogrammet 2020 – vannkvalitetsstatus og trender
År: 2020
Forfatter(e): Øyvind Kaste, Cathrine Brecke Gundersen, Amanda Poste, James Sample, og Dag Øystein Hjermann
Utgiver: Norsk institutt for vannforskning, 978-82-577-7474-5

Elveovervåkingsprogrammet omfatter månedlig overvåking av ulike kjemiske, fysiske, og hydrologiske parametere i 20 elver fordelt geografisk langs norskekysten. Programmet er en viktig del av norske myndigheters basisovervåking av elver i henhold til vannforskriften, i tillegg til at programmet oppfyller Norges forpliktelser i henhold til Oslo-Paris konvensjonen (OSPAR). Denne rapporten presenterer status for 2020 og langtidstrender i vannkvalitet i overvåkingselvene fra programmet startet i 1990 og fram til i dag. I tillegg er data for seks elver fra *Tiltaksovervåkingen av kalkede laksevassdrag i Norge* inkludert.

For Norge som helhet var 2020 **det varmeste og det nest våteste året siden Meteorologisk institutt startet målingene** i 1900. Den gjennomsnittlige lufttemperaturen var 2.4^{o} C over normalen for perioden 1961-1990. Det var de sør-østlige delene av Norge som bidro mest til den økte årstemperaturen (+3-4°C), mens de nordlige delene av landet hadde en årstemperatur som lå 1-1.5^{o}C over normalen. Nedbøren i 2020 var 125% av normalen, og økningen var forholdsvis jevnt fordelt over landet. Alle de nærliggende meteorologiske stasjonene til de 20 hovedelvene har hatt en statistisk signifikant økning i lufttemperaturen siden 1980. Fem av stasjonene har hatt en signifikant økning i nedbørmengde i løpet av den samme tidsperioden. Stor år-til-år variasjon er trolig årsak til at ikke flere stasjoner viser en signifikant økende trend.

Den generelle økningen i lufttemperatur har også påvirket **vanntemperaturen** i elvene. Blant 13 elver hvor det foreligger lange dataserier (>20 år) viser seks av dem en statistisk signifikant økende trend i vanntemperatur. I de fleste av de 20 hovedelvene var gjennomsnittlig vannføring i 2020 omtrent på nivå med – eller litt høyere – enn gjennomsnittet for de fem siste årene (2015-2019). I de ni elvene der det foreligger tidsserier tilbake til 1990 har *Glomma*, *Drammenselva*, *Skienselva* og *Orreelva* hatt en signifikant økende vannføringstrend.

pH og kalsium i vann viser tydelige geografiske gradienter i Norge. De surest og mest kalkfattige elvene finnes i sør og sørvest, noe som skyldes en kombinasjon av sure avsetninger fra langtransporterte luftforurensninger og harde/kalkfattige bergarter. I sørøst, hvor det ofte er mer skogdekte arealer og lavere avsetning av sure forbindelse fra luft og nedbør, er elvene gjerne svakt sure eller med en pH nær nøytralpunktet (pH 7). I Midt- og Nord-Norge er pH i elvene ofte enda litt høyere og omkring nøytralpunktet. I 2020 hadde de fleste av hovedelvene litt lavere pH enn gjennomsnittet for de fem siste årene. Ett unntak var *Otra*, hvor det ble satt i gang nye kalkingstiltak i 2020.

Turbiditet og suspenderte partikler (SPM) har stor betydning for vannkvaliteten ved at det påvirker lysforholdene under vann og transporten av næringsstoffer og metaller. Partikkeltransporten i elvene er sterkt korrelert til nedbør og vannføring, som viser økende trender i store deler av Norge. Elvene med mest partikler (*Glomma, Alna, Numedalslågen, Orreelva*) hadde noe høyere turbiditet i 2020 sammenlignet med gjennomsnittet for de fem siste årene. Omtrent det samme mønsteret ble funnet for SPM. Både turbiditet og SPM er

sterkt korrelert til vannføring, og med kun månedlige vannprøver er det høy sannsynlighet for å gå glipp av topper som opptrer i samband med flom i elvene.

Også **totalt organisk karbon** (TOC) viser en sterk regional variasjon, med konsentrasjoner som oftest avtar fra øst til vest i Sør-Norge. I Nord-Norge er TOC-konsentrasjonene gjennomgående lavere enn på Østlandet, men høyere enn på Vestlandet. I 2020 fulgte TOC-konsentrasjonene det typiske geografiske mønsteret med høyest nivåer i nedbørfelter som er dominert av skog eller jordbruk, og de laveste nivåene i elver med tynt jordsmonn og mye bart fjell i nedbørfeltet. Det største relative avviket i TOC-konsentrasjon i forhold til siste femårs gjennomsnitt ble funnet i *Målselva*. Hovedårsaken til dette var sannsynligvis at det ble foretatt hyppigere prøvetaking i løpet av en stor snøsmeltingsflom i mai-juni 2020. Dette demonstrerer viktigheten av prøvetakingsfrekvens i forhold til å kunne dokumentere variasjon i vannkvalitetsparametere som viser sterk korrelasjon med vannføring i elvene.

Konsentrasjonene av **total fosfor** (Tot-P) og total nitrogen (Tot-N) er mye høyere i *Alna* og *Orreelva* enn i de andre elvene på grunn av avrenning fra hhv. urbane områder og intensivt jordbruk. *Numedalslågen*, *Driva*, *Bjerkreimselva* og *Nidelva* viste en moderat økning (19-31%) i Tot-P sammenlignet med middelet for de fem siste årene. I *Målselva* var gjennomsnittlig Tot-P i 2020 dobbelt så høy som den siste femårs-perioden. Som bemerket for TOC, skyldtes dette hovedsakelig at det ble tatt flere prøver enn vanlig under snøsmeltingsflommen dette året. De andre elvene i Nord-Norge, *Pasvikelva*, *Altaelva* og *Tana* hadde 17-26% lavere Tot-P i 2020, sammenlignet de fem siste årene. I de fleste av de 20 hovedelvene var middelkonsentrasjonen av Tot-N noe lavere i 2020, sammenlignet med den siste femårs-perioden. Det største avtaket (27-34% reduksjon) ble observert i *Nausta*, *Pasvikelva*, *Vefsna* og *Alna*.

Den urbane elven *Alna* hadde de høyeste konsentrasjonene av **tungmetallene** arsen (As), bly (Pb), kadmium (Cd), kobber (Cu), sink (Zn) og krom (Cr). Likevel var konsentrasjonene i 2020, med unntak av Cr, gjennomgående lavere enn gjennomsnittet for de fem siste årene. De høyeste konsentrasjonene av nikkel (Ni) i 2020 ble funnet i *Pasvikelva* (sammen med forhøyet Cu), mens *Numedalslågen* hadde den høyeste kvikksølv-konsentrasjonen blant elvene. Det sistnevnte skyldes hovedsakelig én høy verdi som ble målt under en flomepisode i oktober, hvor det var svært stor partikkeltransport i elva. Det er derfor ingen indikasjoner på at den forhøyede middelverdien for Hg skyldes lokale utslipp eller forurensninger. Blant andre elver med forhøyete metallkonsentrasjoner var *Orkla* (Cd, Cu, Zn, Ni), *Orreelva* (As, Pb, Ni), *Pasvikelva* (Cu, Ni) og *Storelva* (As, Pb, Cd, Hg). Nikkelkonsentrasjonen i Pasvikelva i 2020 var bare om lag halvparten av gjennomsnittsnivået for de siste fem årene. Dette indikerer lavere utslipp fra nikkelverket på den russiske siden av grensen som ble stengt helt ned i desember 2020. Nesten alle elvene hadde metallkonsentrasjoner som lå under EQS-verdiene for prioriterte og vannregionspesifikke metaller. De enste unntakene var Zn i *Alna* og Ni i *Pasvikelva*. Her må det imidlertid legges til at metaller i hovedelvene er analysert på ufiltrerte prøver (som inneholder både løste og partikkelbundne forbindelser), mens grenseverdiene er basert på løste konsentrasjoner (filtrerte prøver).

Det er en nær sammenheng mellom elver som viser en signifikant økning i vannføring og elver som viser en signifikant økning i **transportert mengde av næringsstoffer og partikulært materiale** siden 1990. Det innebærer at vi finner de fleste av elvene med økende trender i stofftransport langs kyststrekningen mellom *Glomma* i sørøst og *Orreelva* i sørvest. *Drammenselva* var den eneste av elvene som viste en signifikant økning i transport av alle stoffer som var inkludert i trendanalysen (SPM, silisium, TOC, Tot-P, PO_4, Tot-N, NO_3), bortsett fra ammonium (NH_4). Andre elver med økende trender i transport av flere ulike forbindelser var *Glomma* (silisium, PO_4, Tot-N, NO_3), *Numedalslågen* (silisium, Tot-P, PO_4, Tot-N) og

Orreelva (SPM, silisium, Tot-P, PO_4). Nedadgående trender i NH_4 og dels også NO_3 i noen elver skyldes sannsynligvis redusert tilførsel av langtransportert forurenset luft og nedbør siden 1990-årene og muligens også økt opptak i vegetasjon som følge av varmere klima og lengre vekstsesong. I Nord-Norge viste Vefsna avtakende trender i transport av SPM samt alle fosfor- og nitrogen-forbindelser. Trendene skyldes hovedsakelig forhøyete konsentrasjoner av disse stoffene på 1990-tallet, mens nivåene har vært relativt stabile siden da.

Når det gjelder **konsentrasjoner av næringsstoffer og partikulært materiale** var det færre oppadgående og flere nedadgående trender enn det som var tilfellet for transportert mengde av de samme stoffene i elvene. Stoffene som viste en signifikant økende trend i konsentrasjoner var SPM (*Glomma*), silisium (*Drammenselva*, *Numedalslågen*, *Skienselva*, *Orkla*), PO_4 (*Glomma*, *Numedalslågen*, *Orreelva*) og Tot-N (*Orkla*). Igjen så var de økende trendene hovedsakelig knyttet til elver langs Skagerrak-kysten.

Alle elvene viste enten ingen trend eller en avtakende trend i **transport av metaller** (Pb, Cd, Cu, Zn, Ni) fra 2004 til 2020. Elementer som viste en nedadgående trend i elvetransport var Cu (*Glomma*, *Otra*, *Orkla*), Zn (*Otra*, *Orkla*, *Vefsna*) og Pb (*Orkla*). Når det gjelder **konsentrasjoner av metaller** var det enten ingen trend eller nedadgående trender for Pb, Cd, Cu og Ni i elvene. Nikkel var det eneste av metallene som viste signifikant økende trend i konsentrasjon (i *Orreelva*, *Vefsna* og *Altaelva*).

I 2020 var den gjennomsnittlige månedlige **TOC-konsentrasjonen** lavest om vinteren, før den økte gradvis i løpet av våren og sommeren. Aromatisiteten av det organiske materialet (uttrykt ved sUVa-indeksen) avtok i alle regioner på slutten av sommeren i 2020. Dette indikerer at det løste organiske materialet (DOM) endret seg i retning av å bli lettere biologisk nedbrytbart. Sammenlignet med de tre foregående årene (målingene av UV-absorbsjon startet i 2017) var TOC-konsentrasjonen på slutten av sommeren høyere mens sUVa var lavere. Sannsynligvis skyldes dette år-til-år variasjoner i værforholdene om sommeren. Muligens skyldes den lave aromatisiteten høy tilførsel av ferskt organisk materiale som ble produsert i løpet av sommeren. Regionale trender i forholdet mellom TOC, DOM-kvalitet og vannføring i elvene var konsistente med tidligere år.

Korttidseffekter av klimavariasjon på vannkjemi ble studert ved bruk av **høyoppløselige sensordata** (timesverdier) fra *Storelva* og *Målselva*, inkludert målinger av vanntemperatur, pH, konduktivitet, turbiditet og løst organisk materiale (FDOM). Data fra Storelva viste at flommer har stor innvirkning på vannkvaliteten i elva, men responsen på de ulike vannkvalitets-parameterne varierer med flomtype, flomstørrelse og tidspunkt på året flommene inntreffer. I Storelva var vinteren 2020 mild, og istedenfor en markert vårflom oppsto det flere mindre flommer fra januar til mars. Høsten 2020 var preget av flere store flommer, hvorav den største var en fem-års flom i slutten av desember. I Målselva, hvor klimaet er betydelig kaldere, er vannføringen sterkt sesongpreget med lav vannføring gjennom hele vinteren og en markert snøsmeltingsflom i mai-juni. I 2020 var det mye snø i området, noen som resulterte i en stor snøsmeltingsflom med meget stor transport av partikulært og organisk materiale som etter hvert endte opp i fjordsystemet nedstrøms (Målselvfjorden og Malangen).

1. Introduction

The river monitoring programme (Elveovervåkingsprogrammet) was established in 2017, replacing the former RID programme (Riverine inputs and direct discharges to Norwegian coastal waters) that had been running since 1990. The programme includes monitoring of 20 rivers (Table 1, Figure 1) for various physical, chemical, and hydrological parameters. The main features of the programme are: 1) relatively high sampling frequency (monthly at all sites and for all parameters, except for metals), 2) an extended list of chemical variables (including emerging contaminants and priority substances), and 3) sensor monitoring in selected rivers determining water temperature, pH, conductivity, turbidity and fluorescent dissolved organic matter (FDOM).

The 20 monitored rivers were all part of the RID programme, but the monitoring frequency has changed: minimum monthly since 1990 for 11 of the rivers (with two exceptions where monitoring started later); quarterly since 1990 for 8 of the rivers; and annually from 1990 to 2003 for one river (Stålnacke et al. 2009). For more information on the differences between the current and the past programme, see Kaste et al. (2018).

1.1 Monitoring objectives

The Norwegian river monitoring programme is the basis for fulfilment of Norway's obligations under the Oslo-Paris Convention (OSPAR) and is also a main component of the Norwegian water authorities' surveillance monitoring in rivers, according to the requirements set by the EU Water Framework Directive (WFD).

The main objectives of the river monitoring programme, formulated by the Norwegian Environment Agency, are to:

1. document status and long-term trends for nutrient and contaminant concentrations in Norwegian rivers
2. obtain data for classification of Norwegian rivers according to the requirements of the WFD
3. reveal water quality changes that can be attributed to climate change or other human influences
4. increase the knowledge base on climate processes affecting water
5. increase current knowledge related to the fates of emerging contaminants in aquatic ecosystems
6. provide data that may explain changes in eutrophication and contaminant levels along the Norwegian coast
7. estimate riverine inputs and direct discharges of nutrients and contaminants to Norwegian coastal waters (for reporting under the OSPAR Convention)

Data collected as part of the river monitoring programme in 2020 are presented in three separate reports. The present report addresses objectives 1, 3, 4, and partly 6 and 7 by providing the current status (2020) and long-term water quality trends (1990-2020) for 20 rivers selected to represent most of the Norwegian drainage area. The other reports include classification of biological quality elements (Kile et al. 2021) addressing objective 2, and assessment of priority substances and emerging contaminants (Allan et al. 2021) addressing objectives 1, 5, 6 and 7.

1.2 Main rivers

The 20 rivers sampled within this monitoring programme discharge to (from south to north) Skagerrak, the North Sea, the Norwegian Sea and the Barents Sea (Table 1). The rivers are selected based on geographical location (Table 1, Figure 1), availability of historical data, relevance in relation to land-use (Figure 2), pollution pressure, and access to existing infrastructure for sampling.

Table 1. Rivers included in the programme.

River name	UTM (east)	UTM (north)	UTM zone	Catchment (km²)	Waterbody code ID	Drainage basin
Glomma*	621600	6573156	32	41918	002-1519-R	Skagerrak
Alna*	600213	6642144	32	69	006-71-R	Skagerrak
Drammenselva*	556636	6624287	32	17034	012-2399-R	Skagerrak
Numedalslågen*	561346	6551822	32	5577	015-33-R	Skagerrak
Skienselva*	534726	6562938	32	10772	016-769-R	Skagerrak
Storelva**	498897	6503307	32	408	018-127-R	Skagerrak
Otra*	438737	6449755	32	3738	021-28-R	Skagerrak
Bjerkreimselva	325246	6487028	32	705	027-92-R	North Sea
Orreelva*	299152	6515475	32	105	028-16-R	North Sea
Vikedalselva	325319	6599745	32	118	038-11-R	North Sea
Vosso*	336048	6727293	32	1492	062-219-R	North Sea
Nausta	327402	6826450	32	277	084-218-R	North Sea
Driva	477383	6948637	32	2487	109-54-R	Norwegian Sea
Orkla*	237185	7018935	33	3053	121-56-R	Norwegian Sea
Nidelva	569352	7030201	32	3110	123-29-R	Norwegian Sea
Vefsna*	418710	7292351	33	4122	151-36-R	Norwegian Sea
Målselva	406570	7660047	34	3239	196-275-R	Barents Sea
Altaelva*	586586	7759686	34	7373	212-63-R	Barents Sea
Tana	543964	7791926	35	16389	234-124-R	Barents Sea
Pasvikelva	386937	7709634	36	18404	246-65242-L	Barents Sea

* "Main rivers" in the previous RID programme, monthly monitoring since 1990 (except Rivers Vosso and Alna, monthly from 2008 and 2013, respectively)

** Also denoted "Vegårdselva" in the RID database

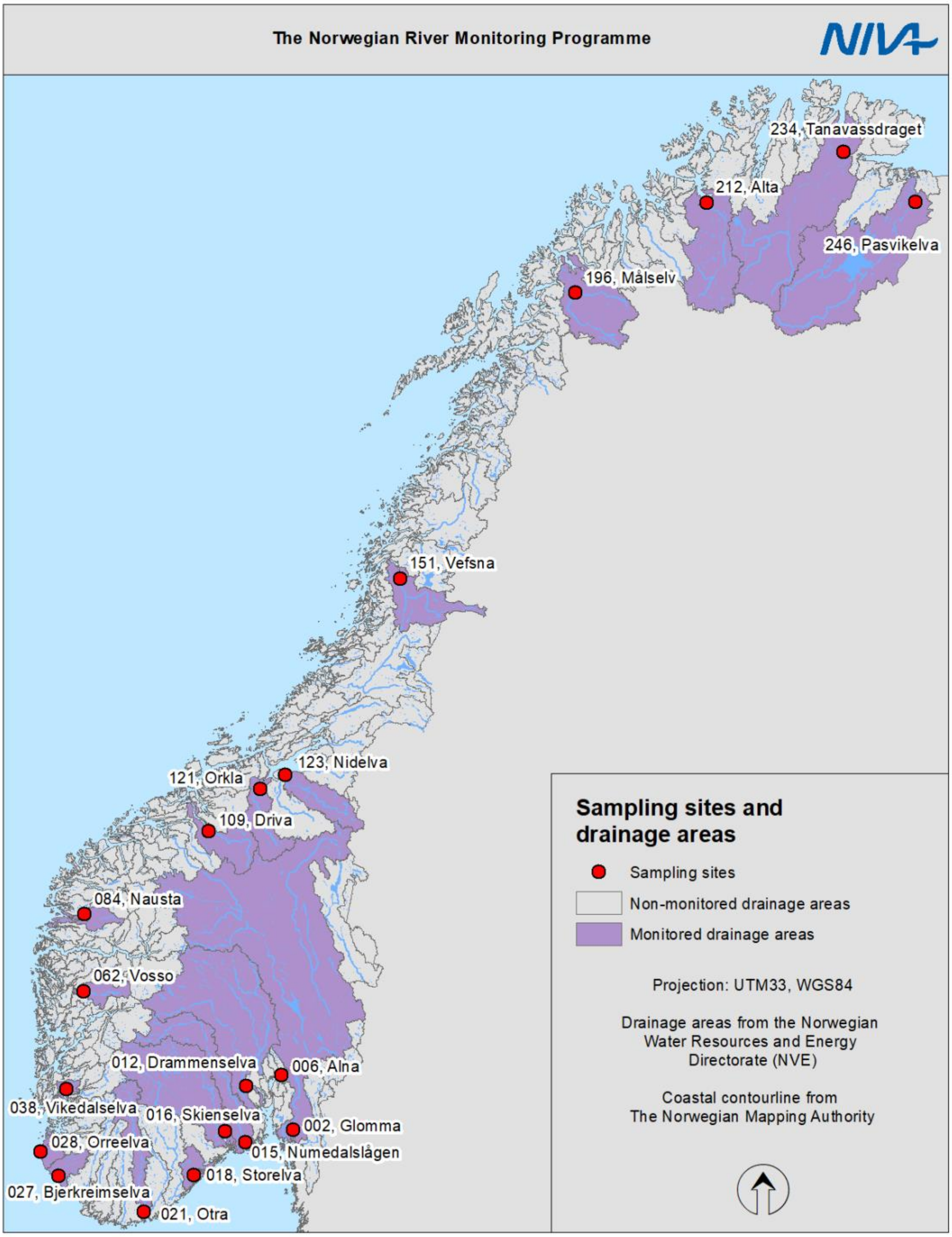

Figure 1. Map showing the location of the rivers in the Norwegian river monitoring programme, including drainage areas (purple) and the sampling sites (red dots).

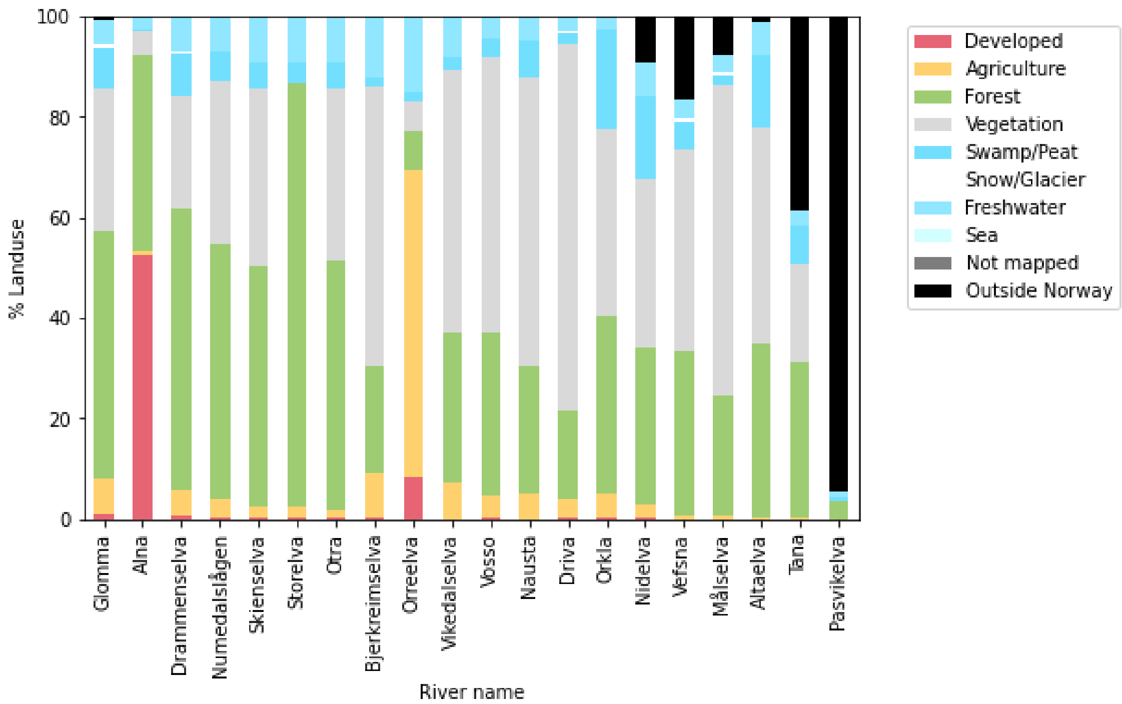

Figure 2. Land use for the 20 rivers included in the monitoring programme. Source: nevina.nve.no.

1.3 Additional Rivers

The report also includes water chemistry data for six additional rivers (Table 2 and Figure 3) which are part of the National monitoring program for limed rivers (Miljødirektoratet 2020). The program included rivers in southern and western Norway that are limed to counter the effects from acid deposition. Although acid deposition has decreased since the 1970s, the critical load for acid deposition is still exceeded in many catchments in this region.

Table 2. Additional rivers included in the report

River name	UTM (east)	UTM (north)	UTM zone	Catchment (km²)	Waterbody ID
Nidelva	478798	6474111	32	4025	019-398-R
Tovdalselva	449503	6456437	32	1885	020-183-R
Mandalselva	413351	6453264	32	1809	022-654-R
Lygna	390778	6454254	32	663	024-412-R
Suldalslågen	344680	6596924	32	1463	036-92-R
Ekso	325747	6737576	32	414	063-181-R

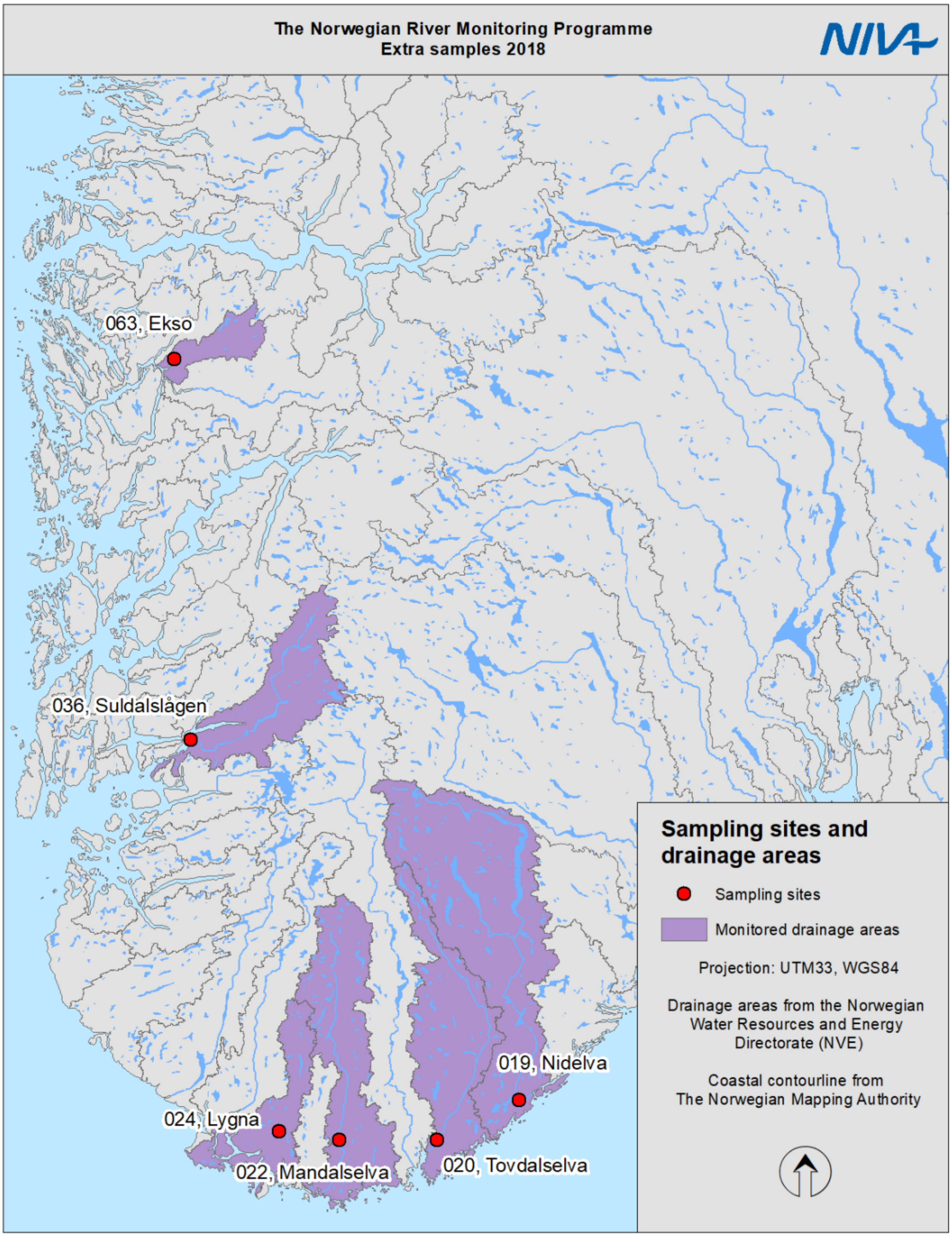

Figure 3. Map showing the location of the additional rivers from the liming program. Drainage areas are illustrated with purple shading and the sampling sites are indicated by red dots.

2. Methods

2.1 Water discharge

For the 11 "main rivers" of the previous RID programme (Table 1) discharge data is obtained from hydrological stations operated by NVE – the Norwegian Water Resources and Energy Directorate (Table 3). The data were downloaded from NVE's Hydra-II database. Since the hydrological stations are usually not located exactly at the same place where the water samples are collected, the water discharge has been re-calculated by up- or downscaling, proportional to the respective drainage area.

For the remaining 9 rivers, 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, and Skarbøvik et al. (2017) gives more information on the methodology.

Table 3. Hydrological stations assigned to the 11 "main rivers" from the former RID programme. All stations are operated by NVE.

River name	NVE station	Station id
Glomma	Solbergfoss	2.605.0
Alna	Alna v/Kvernerbyen	6.78.0
Drammenselva	Døvikfoss	12.285.0
Numedalslågen	Holmfoss i Numedalslågen	15.61.0
Skienselva	Skotfoss	16.133.0*
Otra	Heisel	21.11.0
Orreelva	Haugland	28.7.0
Vosso	Bulken (Vangsvatnet)	62.5.0
Orkla	Syrstad	121.22.0
Vefsna	Laksfors	151.28.0
Altaelva	Kista	212.11.0

* Should be station 16.133 + station 16.153 (Totalavløp Norsjø), but 16.153 is no longer monitored. To compensate for this, the long-term average for station 16.153 (10 m^3/s) is added to the measured discharge at station 16.133

2.2 Water temperature

Data on water temperature is acquired from four different sources (Table 4): Sensor monitoring (hourly time-step, see section 2.6), TinyTag temperature loggers (hourly time-step), manual measurements with a thermometer in connection with the monthly water quality sampling, and NVE temperature logging (daily averages from bi-hourly measurements). For the first three, measurements are done at the water quality sampling sites, while the NVE data are from NVE stations located in close vicinity to the sampling sites. The TinyTag loggers were routinely replaced each autumn to ensure enough battery capacity.

Since temperature measurements have only been part of the river monitoring programme since 2013, data from NVE has been used for long-term trend analysis. Details on the time series from the closest NVE station in each river are presented in Table 5. Long-term data series of water temperature typically contain some missing data. Prior to trend analysis, the data was filtered to remove years for which >10% of the daily observations were missing.

Table 4. Sources for water temperature data in monitored rivers

Data source	Sites
Sensor-based	Storelva, Målselva
TinyTag loggers	Skienselva, Otra, Numedalslågen, Vefsna, Orreelva* and Vosso
NVE station	Orkla, Vikedalselva and Altaelva
Manual measurement	Drammenselva, Driva, Glomma, Alna, Bjerkreimselva, Nausta, Nidelva, Tana, Pasvikelva

* The TinyTag logger in Orreelva was not found during field work in June 2020. Data prior to this date are missing.

Table 5. Stations with available long-term data on water temperature. The stations are operated by the Norwegian Water Resources and Energy Directorate (NVE).

St. ID	River name	Water temperature station	Start	End
29617	Glomma	2.1078.0.1003.1 Glomma ovf. Sarpefossen	2007	2020
36225	Alna	n.a.		
29612	Drammenselva	12.298.0.1003.4 Drammenselva v/Døvikfoss	1986	2020
29615	Numedalslågen	15.115.0.1003.1 Numedalslågen v/Brufoss	1984	2020
29613	Skienselva	16.207.0.1003.2 Skienselva ndf. Norsjø	1989	2020
30019	Storelva	n.a.		
29614	Otra	21.79.0.1003.1 Otra v/Mosby	1986	2020
29832	Bjerkreimselva	27.29.0.1003.1 Bjerkreimselvi v/Bjerkreim	1986	2019*
29783	Orreelva	n.a.		
29837	Vikedalselva	38.2.0.1003.1 Vikedalselva utløp	1985	2020
29821	Vosso	62.30.0.1003.3 Vosso ovf. Evangervatnet	1987	2020
29842	Nausta	84.23.0.1003.3 Nausta v/Hovefossen	1989	2018*
29822	Driva	109.44.0.1003.2 Driva ndf. Grøa	2000	2020
29778	Orkla	121.62.0 Orkla v/Merk Bru	1989	2020
29844	Nidelva	n.a.		
29782	Vefsna	151.32.0.1003.3 Vefsna v/Laksfors	1993	2020
29848	Målselv	196.43.0.1003.1 Malangfoss	1989	2020
29779	Altaelva	212.68.0.1003.1 Alta v/Gargia	1980	2020
29820	Tanaelva	234.19.0.1003.1 Tana ovf. Polmakelva	1990	2020
29819	Pasvikelva	246.11.0.1003.1 Pasvikelva v/Skogfoss kraftstasjon	1991	2020

*Updated temperature data was not available in time for this report.

2.2 Water quality sampling and analyses

2.2.1 Sampling methodology

Monthly sampling was conducted by grab sampling, undertaken by local fieldworkers. In Glomma and Drammenselva, both receiving a substantial part of their water discharge from high-elevation areas, additional sampling was conducted during May and June to get a better representation of the high-flow period following snowmelt.

In 2019, the monitoring station in Målselva was moved approximately 17 km downstream (Table 1). Prior to 2017, two stations were monitored in this region: Målselva and Barduelva, the latter being a major tributary. Barduelva was removed from the monitoring programme in 2017 and the station at Målselva has now been shifted to a location downstream of the confluence, in order to integrate discharges from both river systems.

2.2.2 Chemical parameters – detection limits and analytical methods

The parameters monitored in 2020, including information on methodology and limits of detection (LOD) and quantification (LOQ) are given in Table 6. The metals, including silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), and zinc (Zn) were analysed every three months (i.e. four times per year).

Since 2019, mercury (Hg) has been analysed with two different methods. The samples collected every three months were analysed by atomic absorption spectrometry (AAS) with a limit of quantification (LOQ) of 1.0 ng/L (hereafter: the AAS method). Additionally, separate samples were collected and analysed every month using USEPA method 1631, oxidation, purge and trap, and cold vapor atomic fluorescence spectrometry (CVAFS) with a LOQ of 0.2 ng/L (hereafter: the CVAFS method) (Table 6).

Table 6. Analytical methods, limits of detection (LOD) and quantification (LOQ)

Parameter	LOD/LOQ	Analytical Method
pH	n.a.	NS-EN ISO 10523
Conductivity (mS/m)	0.03/0.1	NS-ISO 7888
Turbidity (FNU)	0.1/0.3	NS-EN ISO 7027
Suspended particulate matter (SPM) (mg/L)	0.1 mg/l when 1 L is filtered	NS 4733 modified
Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) (mg C/L)	0.03/0.1 0.17/0.5	NS 1484 modified – UV peroxodisulphate NS 1484 modified – catalytic combustion
Total phosphorus (Tot-P) and total dissolved phosphorus (TDP) (µg P/L)	0.3/1	NS 4725 – Peroxodisulphate oxidation method modified (automated)
Orthophosphate (PO4-P) (µg P/L)	0.3/1	NS 4724 – Automated molybdate method modified (automated)
Total nitrogen (Tot-N) (µg N/L)	3.3/10	NS 4743 – Peroxodisulphate oxidation method
Nitrate (NO_3-N) (µg N/L)	0.7/2	NS-EN ISO 10304-1
Ammonium (NH_4-N) (µg N/L)	0.7/2	NS-EN ISO 14911
Calcium (mg/L)	0.0017/0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified

Particulate Organic Carbon (POC) and particulate Nitrogen (PN)	Dep. on blank & vol. filtered	Internal method, combustion at 1800°C
UV-visible absorbance spectrum	n.a.	Internal method (900 nm – 200 nm)
Silicone (Si) (Si/ICP; mg Si/L)	0,0017/0,005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Silver (Ag) (µg Ag/L)	0.0007/0.0020	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Arsenic (As) (µg As/L)	0.008/0.025	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Cadmium (Cd) (µg Cd/L)	0.0010/0.0030	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Chromium (Cr) (µg Cr/L)	0.008/0.025	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Copper (Cu) (µg Cu/L)	0.013/0.040	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Mercury (Hg) (ng Hg/L)	0.3/1.0 0.1/0.2	NS-EN ISO 12846 modified (AAS method) USEPA 1631 (CVAFS method)
Nickel (Ni) (µg Ni/L)	0.013/0.040	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Lead (Pb) (µg Pb/L)	0.0017/0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Zinc (Zn) (µg Zn/L)	0.05/0.15	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified

2.2.3 Quality assurance and direct on-line access to data

Data from the chemical analyses were transferred to the NIVA 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, or data removed from the final dataset. The data are available on-line at www.aquamonitor.no/RID, where users can view values and graphs for each of the monitored rivers. In Table 7, information on the total number of samples analysed and the fraction of measurements below the LOQ for the various parameters are summarised.

Table 7. Proportion of analyses below limits of quantification (LOQ) in 2020

Parameter	Number of samples	Number below LOQ	% below LOQ
Conductivity	248	0	0
pH	248	0	0
Ca	248	0	0
SiO_2	248	1	0
SPM	247	33	13
TOC	248	0	0
TOT-P	247	3	1
PO_4-P	248	34	14
TOT-N	248	0	0

NO_3-N	248	9	4
NH_4-N	248	114	46
As	80	3	4
Pb	80	3	4
Cd	79	23	29
Cu	80	0	0
Zn	79	3	4
Cr	80	0	0
Ni	80	1	1
Hg (AAS method)	76	64	84
Hg (CVAFS method)	219	0	0
Ag	80	67	84

2.2.4 Sampling and analyses in additional rivers

The additional rivers from the National monitoring program for limed rivers were sampled in the same way as the main rivers, by monthly grab samples. The samples were analysed for the same substances as in the main programme (Table 6), by Vestfold-LAB from January through August 2020, and by Eurofins from September through December 2020.

2.3 Calculation of riverine loads

Estimates of annual riverine loads were done according to the formula below, which follows recommendations in OSPAR Agreement 2014:04; §6.13b. The method handles irregular sampling frequency and allows flood samples to be included in the annual load calculations.

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

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.

When the results recorded were less than the limits of detection (LOD) the following estimate of the concentration has been used:

Estimated concentration = ((100%-A) • LOD)/100

Where A = percentage of samples below LOD. This procedure is in accordance with OSPAR Agreement 2014:04 (the updated RID Principles). According to these principles (http://www.ospar.org/documents?d=33689) no more than 30% of the samples should be below the LOQ). In 2020, NH_4, Hg and Ag did not reach this requirement.

2.4 Trend analyses and data comparison

Trend analysis has been conducted both for air temperature, precipitation, water temperature, water discharge, and water chemical parameters. Since the location of weather stations usually differs from the water sampling sites, trends in weather data are presented together with information on stations and time ranges used. Details for water chemistry and water discharge trend analysis are given below. The general trend analysis methodology described is applied also for the weather data.

When monitoring data collected in 2020 is presented, results are compared with the preceding five-year mean (2015-2019). The 2020 data are presented as annual mean (based on monthly values) ± one standard deviation, while 2015-2019 data are presented as five-year mean (based on annual values) ± one standard deviation.

2.4.1 Trend analysis methodology

Trend analyses in this report describe overall loads to the sea but are less suited to discuss changes in upstream sources, because inter-annual variability in water discharge strongly affects fluxes and might therefore mask changes in source emissions. The Mann-Kendall test (Hirsch and Slack, 1984) has been used to test for monotonic trends (including linear trends; Sen slope) in annual riverine inputs and concentrations. Trends are regarded as statistically significant at the 95% significance level ($p < 0.05$, double-sided test).

2.4.2 Selection of rivers

Trend analysis for water chemical parameters was conducted for nine of the former "main rivers" where monthly monitoring data are available since 1990 (Table 8). The remaining two rivers included as "main rivers" in the former RID programme, Alna and Vosso, did not have enough years with monthly monitoring. Alna also had a shift in monitoring methodology for water discharge. Storelva was not monitored at the current sampling site during 2004-2016, and only once a year from 1990-2003. The remaining rivers all had lower than monthly sampling frequency during 1990-2016. Trend analysis for water discharge was conducted for the nine rivers listed in Table 8, and for an additional nine rivers with modelled discharge data since 2004.

2.4.3 Selection of parameters and time-periods

The water chemical parameters included in the trend analyses were suspended particulate matter (SPM), silica (SiO_2), total organic carbon (TOC), total nitrogen (Tot-N), ammonium (NH_4-N), nitrate (NO_3-N), total phosphorus (Tot-P), orthophosphate (PO_4-P), Cu, Pb, Zn, Cd, and Ni. Trends for the remaining metals have not been calculated due to the combination of a large proportion of the samples having levels below LOQ and changes in the analytical methods during the monitoring period, see Skarbøvik et al. (2010) for details.

Trend analyses for water chemical parameters cover the period 1990-2020, while the analyses for metals are only based on short-term (2004-2020) data, because changes in the analytical methods led to successive reductions in LOQ levels from 1990 until 2003 (i.e. a false declining trend). Another change in the monitoring of metals is that the sampling frequency was reduced from monthly to quarterly (4 times per year) from 2017 and onwards.

Note that the trend analysis for TOC started in 1999 for Numedalslågen, Orreelva, Altaelva, Vefsna, and Skienselva, due to infrequent measurement in the early years of the monitoring. The statistical power of the trend analysis decreases when applied to shorter time-series.

Table 8. An overview over the rivers, parameters, and historical frequency of measurement for the nine rivers included in the trend analysis.

Short name	Rivers/parameters	Parameters***	Sampling frequency (times yr^{-1})		
			1990-2003	2004-2016	2017-2020
"Monthly monitored since 1990"	Glomma*, Drammenselva*, Numedalslågen, Skienselva, Otra, Orreelva, Orkla, Vefsna and Altaelva**	Nutrient fractions, SPM, TOC, silicate	12	12	12
-«-	-«-	Metals	12	12	4

* Glomma and Drammenselva sampled 16 times per year, or even more frequently (e.g. during the 1995-flood).

** In Altaelva, the sampling was less frequent during 1990-1998.

*** In 1999-2003 samples were analysed at a different laboratory, and for this reason, concentrations of total phosphorus and mercury in 1999-2003 are excluded from the time series, whereas the loads are modelled. A more detailed overview of excluded data from historical records is given in Skarbøvik et al. (2010).

2.5 Comparison of metals data with EU WFD environmental quality standards (EQS)

Samples for metals determination were analysed unfiltered (section 2.2.2) and results cannot be compared directly with the EU WFD environmental quality standards (EQS) for priority substances and river basin-specific pollutants in freshwater. This requires analyses of filtered samples (Direktoratsgruppen 2018, Table 9) which is carried out in a subset of rivers and reported separately (e.g. Allan et al. 2019). Given that unfiltered samples often have higher concentrations (dissolved + particulate fractions) it implies that it is possible to state if the annual mean concentrations are below – but not above - the threshold concentrations. Unfiltered samples were analysed to capture the total metal export to the oceans, in accordance with OSPAR RID. Moreover, by analysing unfiltered samples the recent data can be compared with long time series (back to 1990) that have been obtained on unfiltered samples, e.g. to evaluate possible effects of climate change.

Table 9: Threshold concentrations (AA-EQS) for metals in Norwegian surface waters (annual averages, filtered samples) (Direktoratsgruppen 2018)

Metal	As	Pb	Cd	Cu	Zn	Cr	Ni	Hg
AA-EQS (µg/L)	0.5	1.2	0.08[1]	7.8	11	3.4	4	0.047

Note that the annual mean values in 2020 are based on quarterly samples, whereas the five-year means presented in Chapter 3.2.5 are partly based on monthly samples (2015-2016) and quarterly samples (2017-2019). In general, less frequent sampling is associated with higher uncertainty. An exception here is the Hg data, which have been collected monthly both in 2019 and 2020.

[1] For water with calcium concentration <16 mg/l. In more alkaline waters, the threshold value is higher (cf. Direktoratsgruppen 2018)

2.6 Sensor monitoring in Rivers Storelva and Målselva

In Storelva and Målselva, sensor stations are located at the same spot as the manual sampling sites (Table 1). Water from the river is pumped a few meters to an instrument container with flow cells equipped with sensors that measure water temperature, pH, conductivity, turbidity and fluorescent dissolved organic matter (FDOM). Data are recorded on an hourly basis, transferred to NIVA's server and made available online.

Water discharge data are obtained from NVE's real-time stations, 18.4.0. Lundevann, which is located close to the sensor station in Storelva, and 196.35.0 Målselvfossen, which is located 15 km upstream of the NIVA station in Målselva.

A QA routine has been set up by flagging data that are obviously wrong, e.g. due to interrupted power supply, clogging, etc. Flagged data are not visible online or downloadable but are kept in the database. To ensure good and continuous data, the stations are visited at regular intervals for service and maintenance. Temperature correction of the FDOM data was done in accordance with Ryder et al. (2012). The intercept constant was set to 100, and the slope intercept was chosen as to give the best correlation between temperature corrected FDOM and dissolved organic carbon (DOC) concentration for the given time period.

3. Results and Discussions

3.1 Climate and hydrology: status and trends

Long-term data collected by the monitoring programme since 1990 makes it highly suitable for documenting effects of global warming on Norwegian rivers. To perform such analyses, it is important to integrate the river data with long-term meteorological and hydrological data, as displayed in the following sub-chapters. These types of integrated datasets are highly valuable for research and assessments on effects of global change on aquatic ecosystems.

3.1.1 Air temperature and precipitation in 2020

Year 2020 was the warmest and second wettest in Norway on record, dating back to year 1900 (Grinde et al. 2021). The annual average temperature was +2.4°C above the normal (Figure 4, left) and precipitation 125% of the normal (Figure 4, right).

Regions in south-east (counties *Innlandet* and *Viken*) contributed most to the increased temperature (3-4°C above normal), whereas *Troms and Finnmark* had annual average temperatures 1-1.5°C above normal. Stations all over the country attributed to the increased precipitation, and the wettest stations had 150-200% of the normal precipitation.

The **winter** season (Dec 2019 – Feb 2020) was both the warmest (+4.5°C) and the second wettest (170%) on record. Several stations in *Innlandet* and *Viken* had temperatures 7-8°C above normal, while stations in *Troms and Finnmark* had average temperatures up to 2°C above normal. Several stations in *Vestland*, *Innlandet*, and *Troms and Finnmark* reported precipitation that was 250-300% of the normal for the season.

The **spring** average temperature in Norway was close to normal (+0.8°C), but with 140% of normal precipitation. The warmest stations were in *Innlandet* and *Viken* (2-2.5°C above normal), the coolest in *Nordland* county (0.5°C below normal). Northern Norway was wettest (up to 200-300% of the normal), while some stations in *Innlandet* and *Viken* received less than 50% of normal precipitation.

The **summer** season was on average 1.3°C warmer than normal, and particularly warm in middle Norway (*Trøndelag* county), with stations measuring 2-3°C above normal. Average summer precipitation in Norway was close to normal (105%), but with highs in the south-west (175-200% at stations in *Agder* and *Rogaland*) and lows in the north (50-65% at stations in *Nordland*).

The **autumn** was 2.6°C warmer than the normal and with 115% of the normal precipitation. Northern Norway (*Troms and Finnmark*) was warmest relative to the normal (+3-4°C). The elevated precipitation was mainly contributed to by eastern (*Innlandet*) and south-western regions (*Rogaland*) with 150 to 200% of the normal.

For more information on the 2020 weather in Norway, see Grinde et al. (2021).

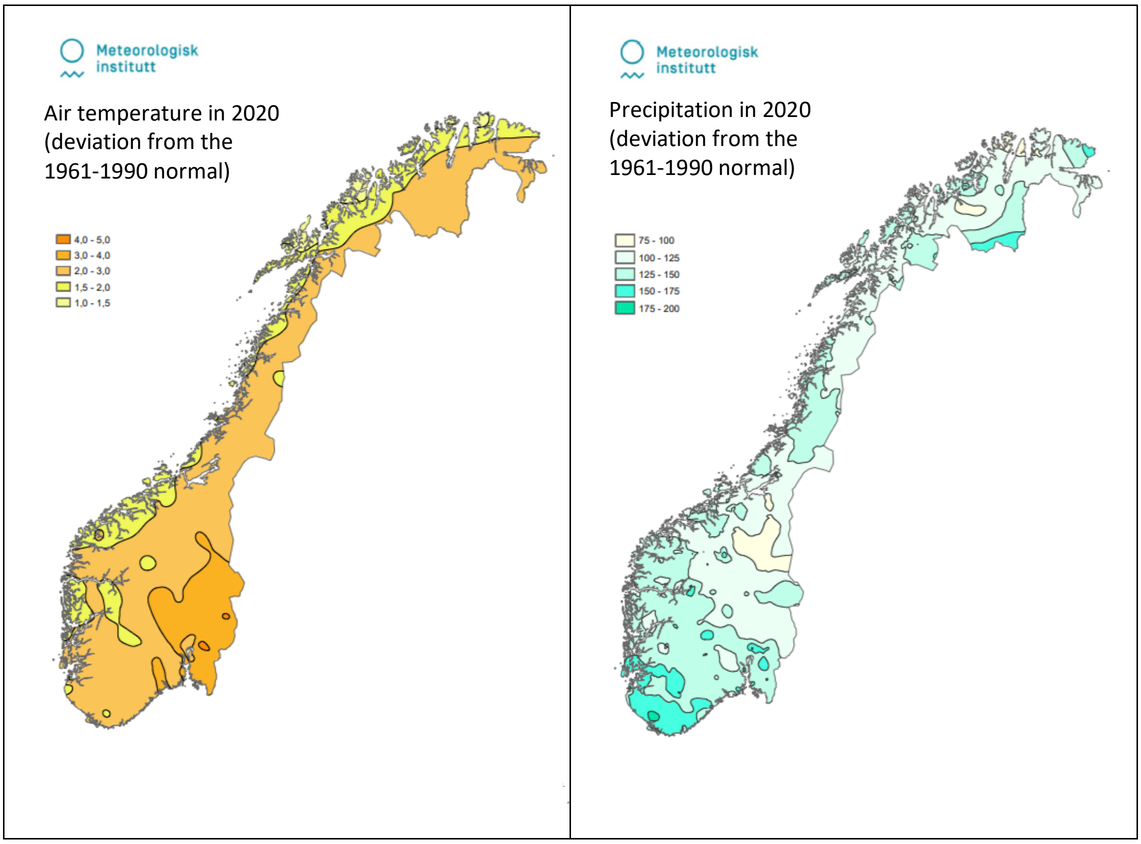

Figure 4. Air temperature (°C) and precipitation (mm) in Norway in 2020 as deviation from- or percentage of the normal values (1961-1990), respectively. Maps from Grinde et al. (2021).

3.1.2 Trends in air temperature and precipitation 1980-2020

Table 13 shows trends in air temperature and precipitation since 1980[2] at meteorological stations located in the near vicinity of the river monitoring sites. The results show a significant increase in air temperature at all stations.

For precipitation, only five stations (near Alna, Storelva, Otra, Vikedalselva and Altaelva) showed a significantly increasing trend. Large year-to-year variation in precipitation could potentially explain the lack of significant trends at the other stations. There were more stations with significant trends in air temperature and precipitation in 2020 compared with 2018 and 2019 (Gundersen et al. 2019, Braaten et al. 2020).

[2] Since 1981 for Vosso and 1983 for Drammenselva

Table 13. ***Trends in air temperature and precipitation 1980-2020. Data from the Norwegian Meteorological Office (met.no).***

River name	Temperature				Precipitation			
	St.no	Years	Temp. trend (p-value)	Temp change (°C)*	St. no	Years	Precip. trend (p-value)	Precip. change (mm)*
Glomma	SN700	1980-2020	0.002	+0.9	SN3780	1980-2020	0.07	+99
Alna	SN18700	1980-2020	<0.001	+1.0	SN18700	1980-2020	0.03	+98
Drammenselva	SN19710	1983-2020	0.009	+0.7	SN19710	1983-2020	0.07	+94
Numedalslågen	SN27450	1980-2020	0.004	+0.8	SN30000	1980-2020	0.87	+5
Skienselva	SN27450	1980-2020	0.004	+0.8	SN30260	1980-2015	0.15	+76
Storelva	SN36560	1980-2020	<0.001	+0.9	SN36560	1980-2020	0.008	+248
Otra	SN39040	1980-2020	<0.001	+0.7	SN39040	1980-2020	0.032	+214
Bjerkreimselva	SN44560	1980-2020	<0.001	+0.9	SN43360	1980-2017	0.29	+87
Orreelva	SN44560	1980-2020	<0.001	+0.9	SN44080	1980-2020	0.47	+61
Vikedalselva	SN46910	1980-2011	<0.001	+1.0	SN46850	1980-2020	0.047	+340
Vosso	SN52290	1981-2007	0.024	+0.7	SN51250	1980-2020	0.2	+244
Nausta	SN58070	1980-2017	0.001	+0.7	SN57480	1980-2020	0.33	+120
Driva	SN64550	1980-2007	0.003	+0.9	SN63530	1980-2020	0.82	-10
Orkla	SN69100	1980-2020	0.004	+0.7	SN66210	1980-2009	0.91	+26
Nidelva	SN69100	1980-2020	0.004	+0.7	SN68270	1980-2020	0.18	+71
Vefsna	SN85380	1980-2020	<0.001	+0.9	SN78850	1980-2007	0.24	+181
Målselva	SN89350	1980-2020	0.032	+0.6	SN89350	1980-2020	0.19	+44
Altaelva	SN93140	1980-2020	<0.001	+0.8	SN93140	1980-2020	0.013	+78
Tana	SN96800	1980-2012	0.005	+1.1	SN96970	1980-2018	0.7	+13
Pasvikelva	SN99370	1980-2020	<0.001	+1.0	SN99500	1980-2020	0.36	+14

Red – significantly increasing trend, p<0.05. There were no significantly decreasing trends.
* Change in temperature and precipitation is the total change for the whole period.

3.1.3 Water temperature – status 2020 and trends

Monthly water temperatures in the monitored rivers are showed in Table 14. Generally, water temperatures show a strong seasonal pattern (Figure 5) which gradually changes when moving from the south towards the north in Norway.

The stations included in the trend analysis are given in Table 15 and with details on the time series in Table 5. Note that eight of the rivers are not included in the trend analysis due to incomplete long-term data, or long distance to the nearest temperature station with appropriate data. According to the trend analysis, six of the 13 rivers showed a significant increase in water temperatures. This was two more than in 2019 (Braaten et al. 2020) and three more than in 2018 (Gundersen et al. 2019).

Table 14. Monthly water temperature measured in the monitored rivers in 2019

River name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Glomma	1.5	2.3	1.8	4.0	8.3	15.5	14.0	15.0	14.4	11.9	6.5	4.2
Alna		2.9	3.5	4.8	8.4	14.4	13.2	14.1	11.5	11.5	7.2	5.4
Drammenselva	1.8	1.2	1.7	3.7	7.1	15.5	16.3	17.2	15.9	12.0	8.5	4.6
Numedalslågen	0.7	0.9	2.2	5.2	8.8	15.6	15.6	17.6	13.7	8.4	4.9	2.2
Skienselva	3.7	3.1	3.2	3.9	5.8	10.3	15.0	16.5	15.6	11.5	8.1	5.7
Storelva	4.4	4.2	4.1	9.0	13.8	20.4	21.3	22.3	17.4	13.3	11.5	10.8
Otra	2.9	2.6	2.8	5.1	8.1	14.4	15.6	17.7	14.8	10.2	6.9	4.5
Bjerkreimselva	5.8	5.3	4.2	5.4	12.0	13.4	13.4	18.9	14.5		8.6	6.4
Orreelva	*	*	*	*	*	18.8	16.5	18.0	13.7	10.3	9.4	7.6
Vikedalselva	3.8	3.0	3.1	4.9	7.7	15.0	14.0	16.7	12.5	9.2	7.1	4.8
Vosso	2.5	1.9	1.9	3.3	5.6	7.7	9.3	12.2	10.3	8.6	6.4	4.0
Nausta	2.0	0.8	1.3	5.4	5.7	7.5	9.9	15.3	10.2		6.3	3.3
Driva	1.0	1.0	1.0	1.0	1.0	2.0	7.0	11.0	8.0	8.0	6.8	1.0
Orkla	0.4	0.8	1.6	1.9	3.5	10.3	9.7	11.6	8.3	5.7	2.5	0.7
Nidelva	3.2	3.1	3.0	3.1	3.8	9.9	13.4	15.8	15.1	10.8	6.5	2.8
Vefsna	0.5	0.0	0.0	1.9	4.2	5.9	10.1	12.2	8.5	5.0	2.8	0.4
Målselva	0.1	0.1	0.1	0.1	2.9	6.1	9.8	11.3	7.7	3.8	0.7	0.0
Altaelva	0.2	0.2	-0.1	0.2	1.6	6.9	12.6	14.5	11.4	6.8	2.0	0.3
Tana	0.3		0.9	0.4	1.5	8.8		14.2	12.2	7.2	0.1	0.0
Pasvikelva	3.1	3.0	3.1	0.2	0.2	9.2	13.0	15.4	14.1	8.6	3.6	3.1

* TinyTag logger lost (replaced by new device in June)

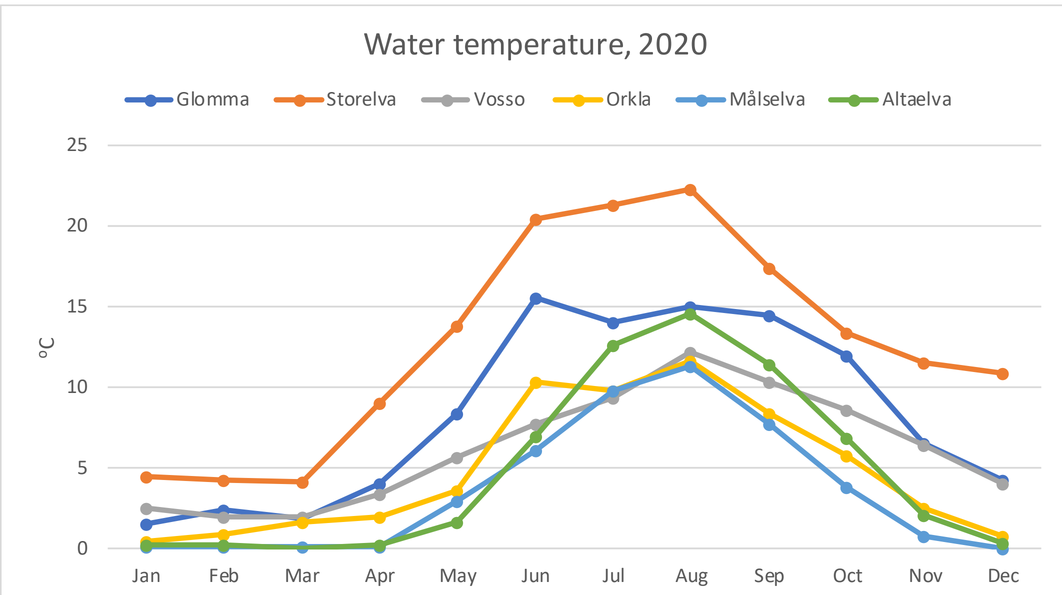

Figure 5. Monthly measured water temperature in rivers representing different regions in Norway. Based on data presented in Table 14.

Table 15. Trends in annual mean water temperature until 2020, in rivers with available long-term data.

River name	Years with data	Annual change*	p-value
Drammenselva	23	0.03	0.011
Numedalslågen	14	0.00	1.000
Skienselva	24	0.02	0.031
Otra	25	0.02	0.072
Bjerkreimselva	28	0.03	0.019
Vikedalselva	31	0.02	0.035
Vosso	21	0.01	0.319
Nausta	15	-0.03	0.276
Orkla	23	0.01	0.224
Målselv	15	0.03	0.138
Altaelva	27	0.02	0.000
Tanaelva	18	0.01	0.405
Pasvikelva	24	0.04	0.014

Red – significantly upward $p<0.05$. There were no significantly decreasing trends.
* calculated as [total temperature change]/[years with data]

3.1.4 Water discharge – status 2020 and trends

Figure 6 illustrates the large gradients in annual runoff across Norway. The area-specific runoff (in mm/yr) increases from east to west in southern Norway and decreases towards the north. Vefsna and Målselva have a slightly higher annual runoff than their "neighbour" rivers due to higher percentage of mountainous areas within the catchments.

In most rivers the annual runoff values in 2020 were relatively similar or a bit higher than 2015-2019 mean (Figure 6). This coincides well with the precipitation patterns displayed in Figure 4. The only exceptions were Vikedalselva and Nausta, both having lower runoff in 2020 than the preceding five-year mean. Given that both rivers have a five-year mean of more than 3000 mm/yr, the year-to-year variation can be substantial and potentially explain why the rivers behaved differently from other rivers in the region.

It should also be noted that most of the rivers included in the program are regulated (listed in Braaten et al. 2020). This will affect water discharge data and may clarify why water discharge not always follow the precipitation patterns. Another factor is that precipitation data are from local stations and do not cover whole catchments.

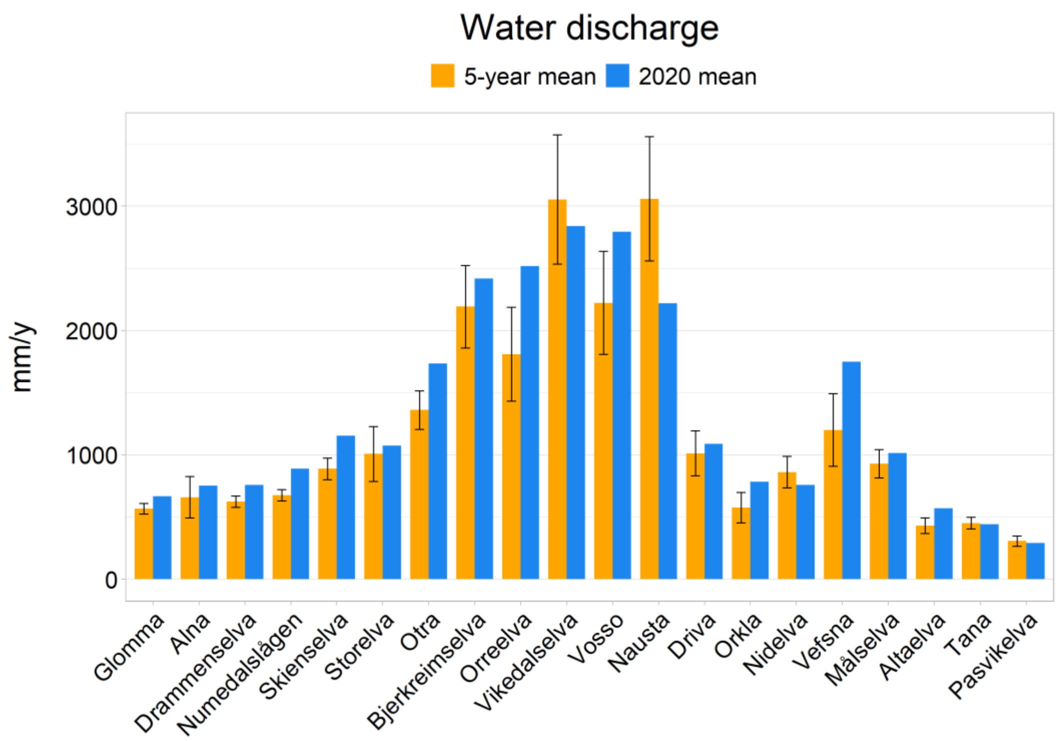

Figure 6. Annual average water discharge in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

Long-term trend analysis (1990-2020) of water discharge for the rivers with monthly monitoring since 1990 is presented in Table 16. Four rivers, from Glomma in south-east to Orreelva in south-west show significant increasing trends. This was two more rivers than in 2019, when only Glomma and Drammenselva showed significant trends. None of the rivers in western-, middle- and northern Norway showed significant trends, not even Tana where a significant upward trend was noted both in 2018 and 2019.

Table 16. Trends in annual water discharge. Showing p-values

River	Long-term 1990-2020	River	Short-term 2004-2020
Glomma	0.013	Bjerkreimselva	0.484
Drammenselva	0.004	Vikedalselva	0.592
Numedalslågen	0.072	Vosso	0.387
Skienselva	0.049	Nausta	0.837
Otra	0.208	Driva	0.967
Orreelva	0.027	Nidelva	0.232
Orkla	0.786	Målselva	0.711
Vefsna	0.659	Tana	0.077
Altaelva	0.153	Pasvikelva	0.174

Red – significantly increasing p<0.05. There were no significantly decreasing trends.

3.2 Water quality status 2020

The Norwegian river monitoring programme is designed so that the results can be used for classification of ecological and chemical status according to the principles in the EU WFD (Chapter 2.5). Thresholds for achieving good ecological status for individual quality elements (and underlying parameters) and good chemical status are given in the Norwegian classification guidance (Direktoratsgruppen 2018). Throughout this chapter the results will be evaluated with respect to these thresholds. The classification is only relevant for the water body where the monitoring site is located (Table 1).

For a description of the typical geographical distribution of the various chemical parameters, please see previous monitoring reports, e.g. Gundersen et al. (2019). Here, we will focus mainly on the 2020 observations and on potential deviations from the previous years.

3.2.1 pH and calcium

Levels of pH and calcium (Ca) typically covariate in river water (i.e. elevated Ca gives elevated pH). In 2020, many rivers had slightly lower pH compared to the preceding five-year mean. (Figure 7). The highest absolute decrease was observed in Vikedalselva (-0.3 pH units), and followed by Numedalslågen, Nausta, and Driva (-0.2 pH units). The only river showing no decrease in pH was Otra, where a new liming program was initiated in 2020.

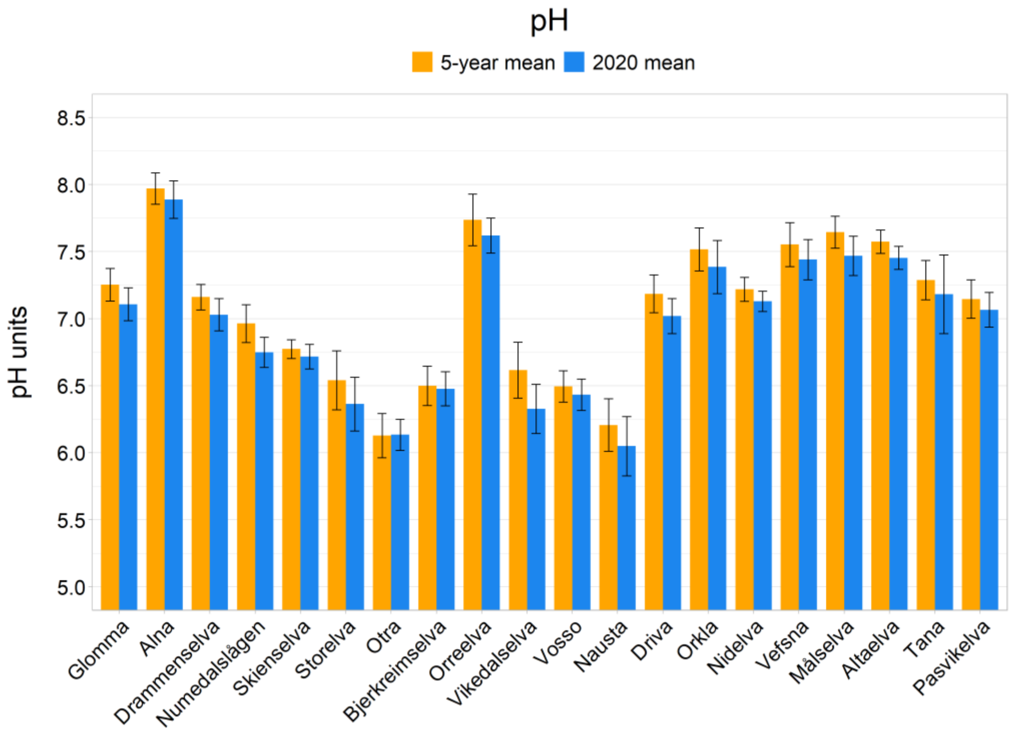

Figure 7. Annual average pH in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean. Mean values are based on pH, not the H^+ concentration, which represents a negligible error when pH values are above 6.0.

A decreasing tendency was also evident for Ca in several of the rivers (Figure 8), particularly in the most calcareous rivers, Alna, Orreelva, Vefsna, and Målselva. The WFD categorization of water types based on their Ca levels were in 2020 almost the same as in 2019 (Braaten et al. 2020). One exception was Drammenselva, which moved from being calcium-poor (1-4 mg Ca/L) to moderately calcium-rich Ca (4-20 mg/L). For more information on the WFD classification of the rivers and for an overview of river liming programmes we refer to the monitoring report by Gundersen et al. (2019). Note that Ca is a relatively new parameter in the river monitoring programme (introduced in 2017).

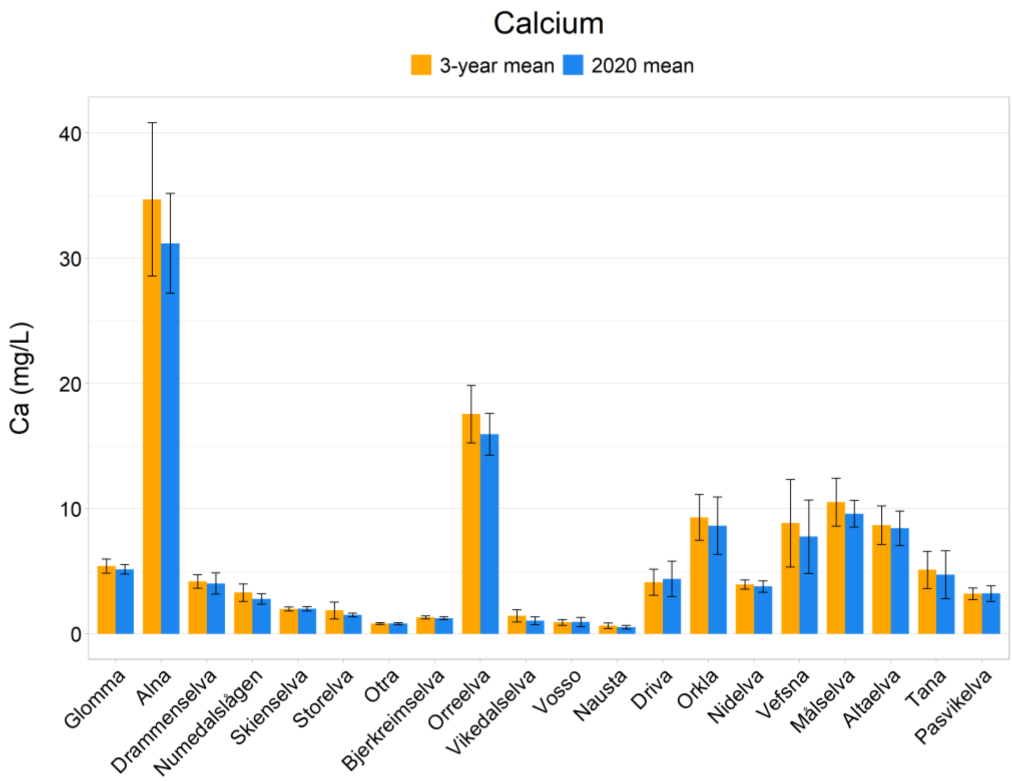

Figure 8. Annual average Ca concentrations in 2020, compared with the preceding three-year mean (2017-2019). Error bars indicate standard deviation from the mean.

3.2.2 Suspended matter (turbidity, SPM, and silica)

Turbidity is an optical measure of material in the water that can scatter light. Turbidity covers both suspended particulate matter (0.4 µm < SPM < 2 µm) and colloidal material (<0.4 µm, e.g. SiO_2). These parameters are important for the water quality by influencing processes such as light penetration and transport of metals and nutrients. The level is generally the result of soil and bedrock type, hydrological conditions, as well as being influenced by anthropogenic activities. Turbidity and SPM are typically very dependent on the intensity of water discharge and will thus typically display high seasonal variation.

In most rivers, turbidity levels in 2020 were rather consistent with results from the five preceding years. The particle-rich rivers (Glomma, Alna, Numedalslågen, Orreelva), were slightly higher in turbidity compared to the five-year mean (Figure 9). This was also reflected in the SPM for Glomma, Numedalslågen and Orreelva (Figure 10), and in silica for Orreelva (Figure 11). Orkla, on the other hand, was lower in both turbidity and SPM in 2020 compared to the five-year mean. Noteworthy, Driva experienced some very high SPM concentrations in 2020, reaching as high as 54.7 mg/L in July. This was not reflected in the turbidity data.

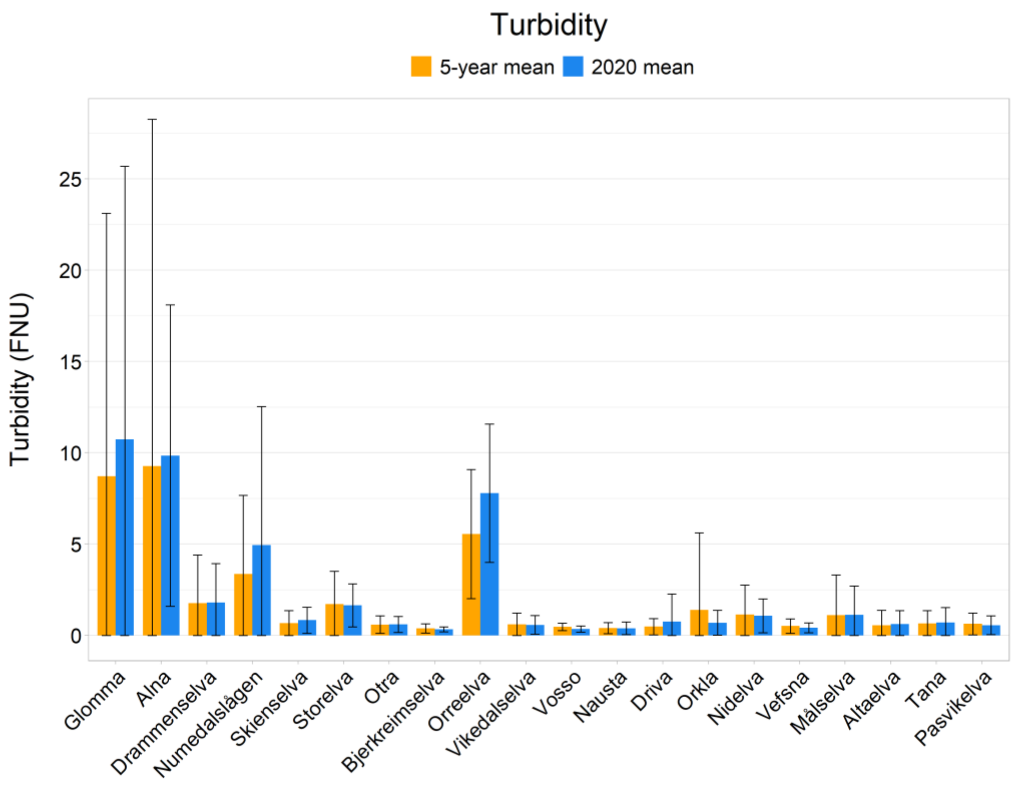

Figure 9. Annual average turbidity in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

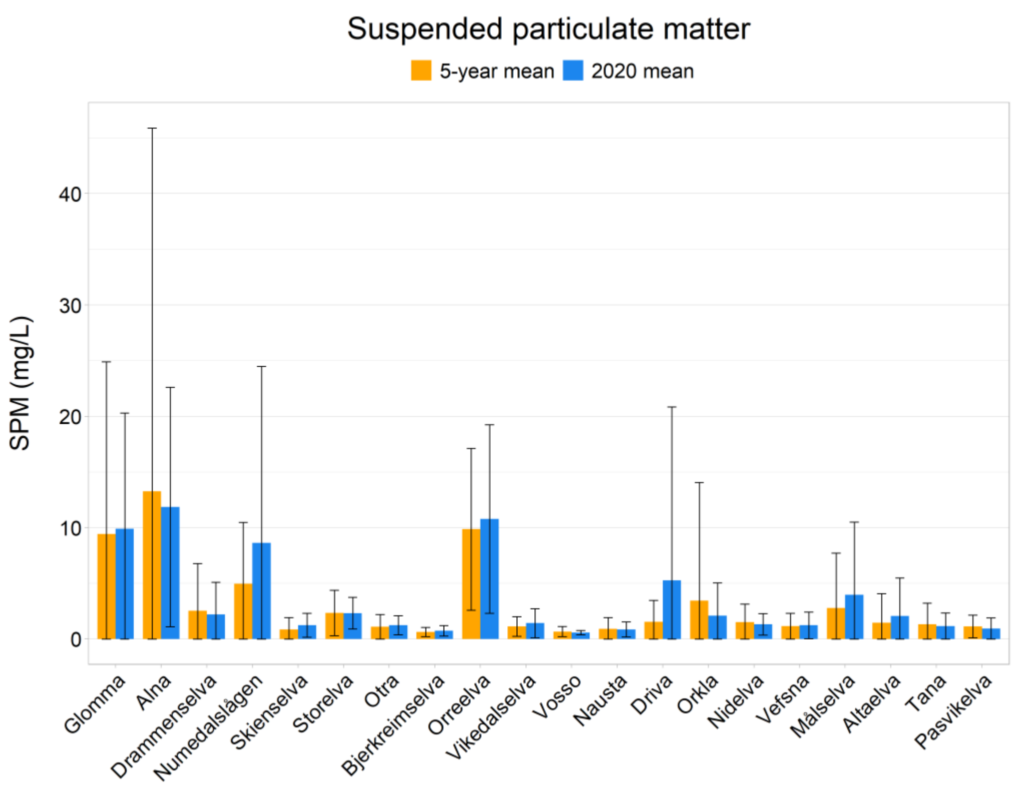

Figure 10. Annual average SPM concentration in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

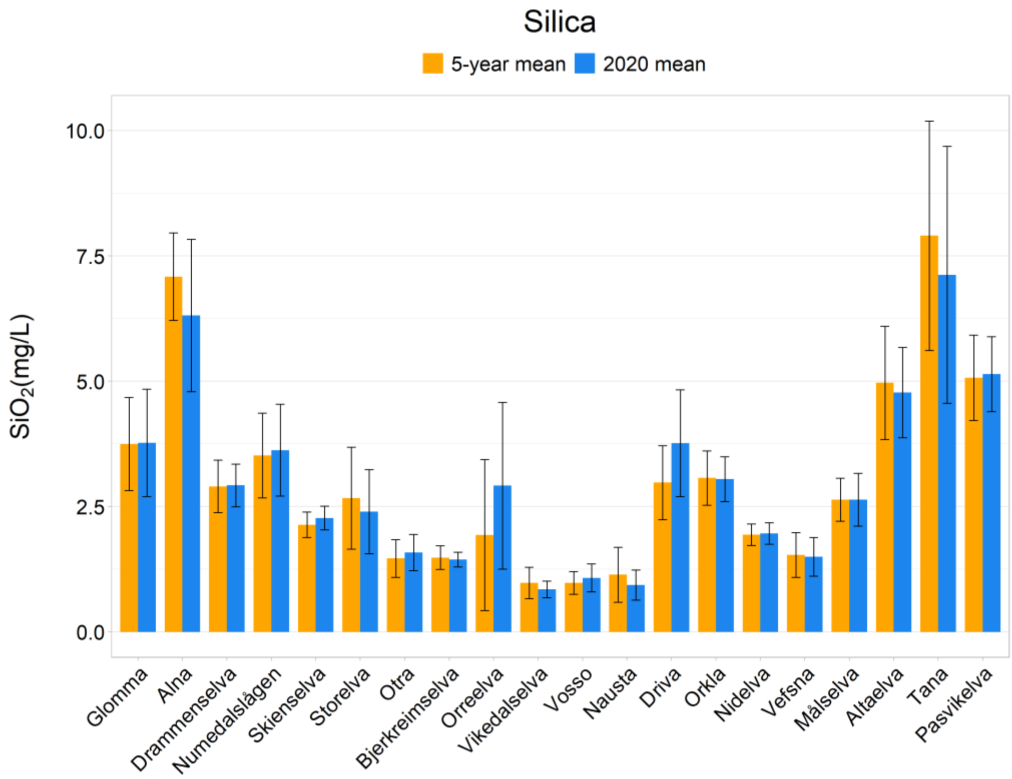

Figure 11. Annual average silica concentrations in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

3.2.3 Organic carbon

Organic carbon in river water is of interest for several reasons, including its role as a transport vector for both nutrients and metals, for being the primary food source for the lower trophic levels, and for contributing to the observed browning of freshwaters and coastal waters. The 2020 levels of TOC followed the typical geographical pattern in which the highest levels were found in the rivers draining catchments dominated by forest (e.g. Glomma, Drammenselva, Numedalslågen) or agriculture (Orreelva), and with the lowest levels in the river catchments with thin soils and exposed bedrock (e.g. Vikedalselva, Vosso, Driva) (Figure 12).

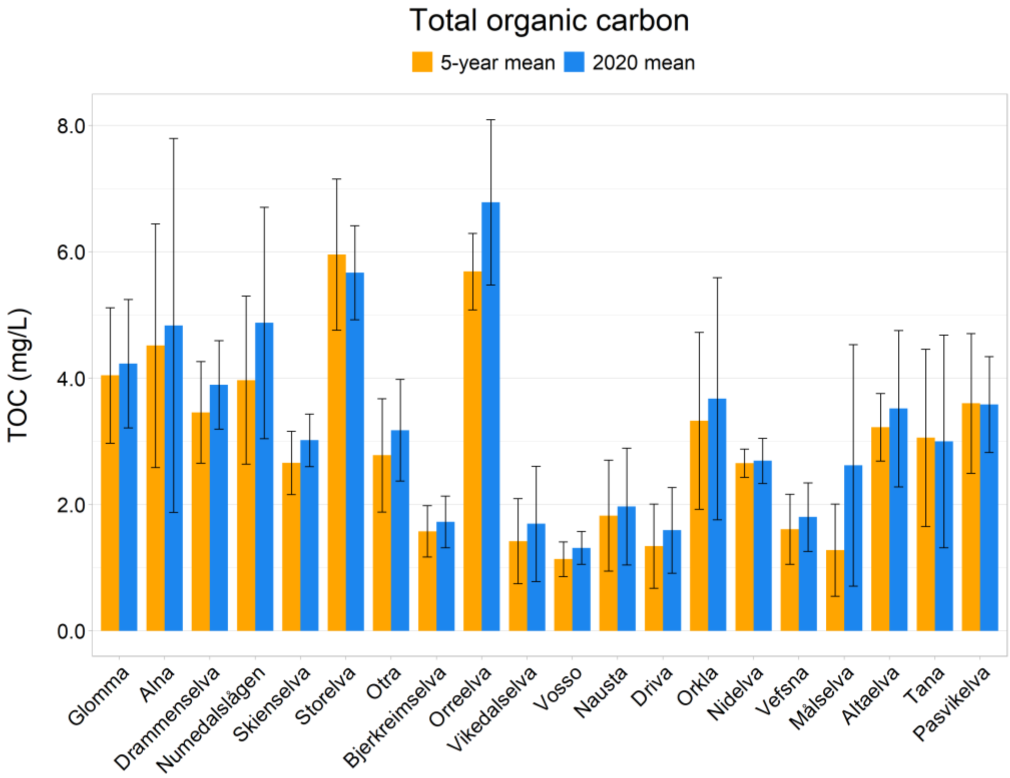

Figure 12. Annual average TOC concentrations in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

Målselva had the largest relative increase in TOC in 2020 compared to the five-year mean. The most likely explanation for this was an additional sampling campaign conducted in the river during a large snowmelt flood in May-June this year (Poste et al. 2021). This captured elevated levels of various parameters, including TOC, being transported from the terrestrial parts of the catchment during the high flow event. By including these additional samples into the 2020 annual average, the river changed from being classified as very clear (TOC < 2 mg/L) to clear (2 mg/L < TOC < 5 mg/L), with an annual average of 2.6 mg/L. The additional samples reached TOC levels as high as 8.3 mg/L, being eight times as high as the average of the five preceding years (1.2 mg/L). This clearly demonstrates the importance of frequent seasonal sampling to be able to capture the totality in parameters heavily driven by seasonal hydrological events.

Also, Driva could in 2020 make the same category change as Målselva but resulting from only a modest increase in TOC (~ 1% of the five-year mean). All other rivers were in the same categories as described in previous reports (Braaten et al. 2020, Gundersen et al. 2019).

TOC is analysed both as dissolved (< 0.45 µm: DOC) and particulate organic carbon (> 0.45 µm: POC). Most of the TOC in the rivers was, in accordance with previous years, in the dissolved size fraction (Figure 13). River Orreelva showed the lowest content of DOC, 78%, followed by River Målselva at 87%. All other rivers had DOC fractions higher than 90%.

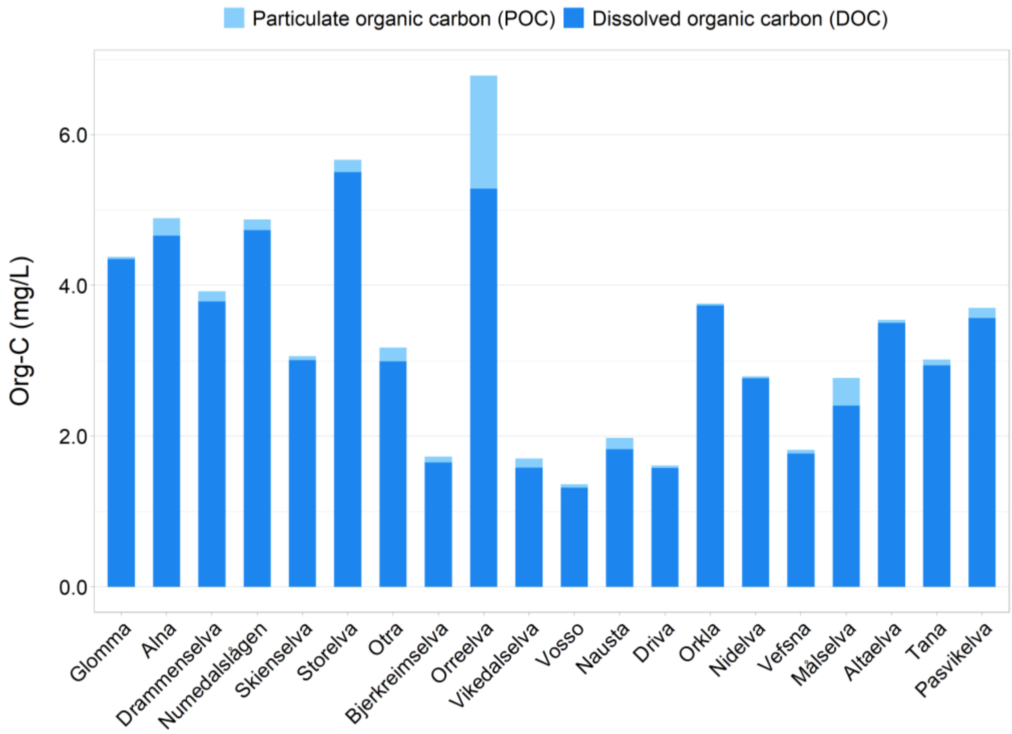

Figure 13. Average particulate (POC) and dissolved (DOC) organic carbon concentration in 2020. The sum of POC and DOC equals to TOC.

3.2.4 Nutrients

Nutrients in this chapter cover various fractions of phosphorous (P) and nitrogen (N). The bioavailability of both P and N is higher when freely dissolved in the water phase, in contrast to being associated with particles. Also, the bioavailability depends on the chemical form of the nutrient. In Norway, growth in freshwater is typically limited by P, and thus systems are more sensitive towards excess P with regards to eutrophication. Excess N, on the other hand, can lead to negative effects such as acidification in freshwaters and eutrophication in marine waters.

Phosphorus

Mean concentrations of total phosphorus (Tot-P) in 2020 were in most rivers relatively close to the preceding five-year mean (Figure 14). Many rivers have large seasonal variations since a large fraction of P is typically associated with particles (Figure 15).

Numedalslågen, Driva, Bjerkreimselva, and Nidelva showed a modest Tot-P increase (19-31%) compared to the five-year mean. In Orkla the mean Tot-P concentration decreased (-27%) likely as a result of reduced particle concentration in the river (see chapter 3.2.2). Another noteworthy observation was the elevated Tot-P in the northern river Målselva, being twice as high as the five-year mean. The explanation for the elevated Tot-P was, like for TOC (chapter 3.2.3) attributed to the additional sampling conducted during spring freshet. The other northern rivers, Pasvikelva, Altaelva, and Tana had 17-26% lower Tot-P concentrations in 2020 than the five-year mean.

According to the WFD classification (Direktoratsgruppen 2018), Alna and Orreelva were in very bad status with regard to Tot-P (> 65 µg/L). The high Tot-P concentrations in these rivers is attributed to urban and agricultural runoff, respectively. The other rivers were all in good or very good status based on measured Tot-P levels in 2020.

In river water the bioavailability of P will depend on whether it is freely dissolved or associated with particles or organic matter. For example, dissolved PO_4 is more bioavailable than P bound to particles or organic matter. While the two rivers Alna and Orreelva were similarly high in Tot-P, they differed regarding bioavailable fractions. Alna was relatively low in both particulate (57%) and organic P (26%), indicating a high bioavailability, while the opposite was the case for Orreelva, being dominated by particulate (85%) and organically bound P (64%). In the rest of the rivers, particulate P dominated over the dissolved fraction (from 50% in Orkla to 76% in Numedalslågen), while the distribution between organic- and inorganic-P was more variable (Figure 16).

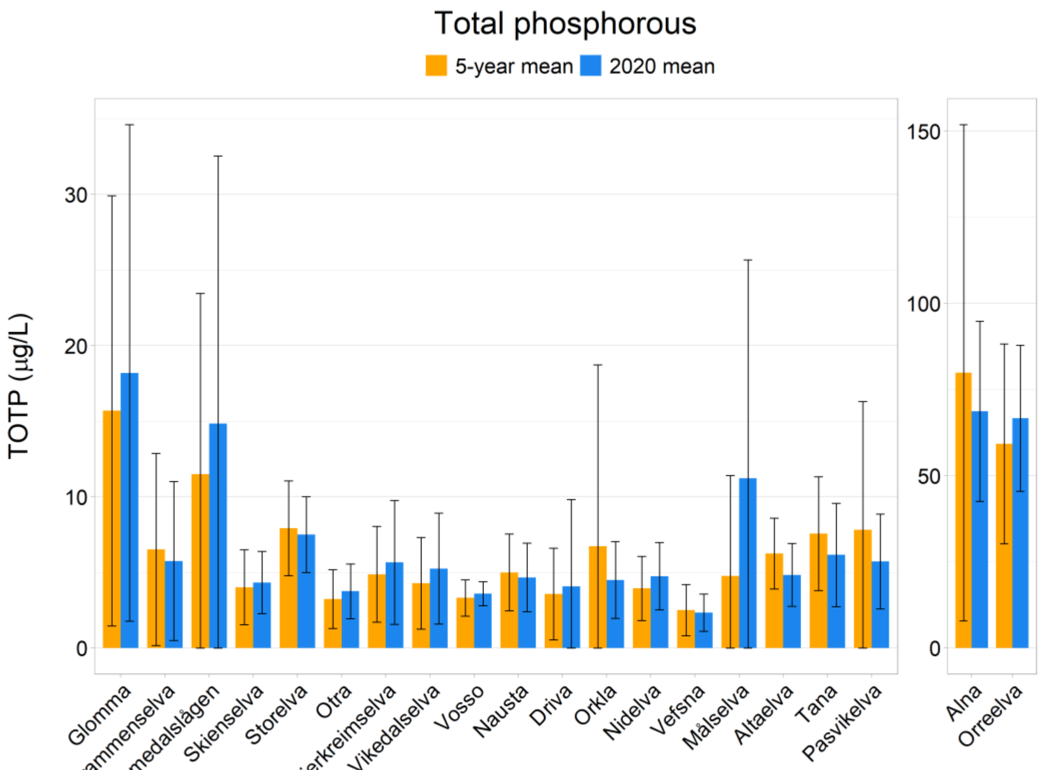

Figure 14. Annual average Tot-P concentrations in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean. Note different y-scale on the right-side panel.

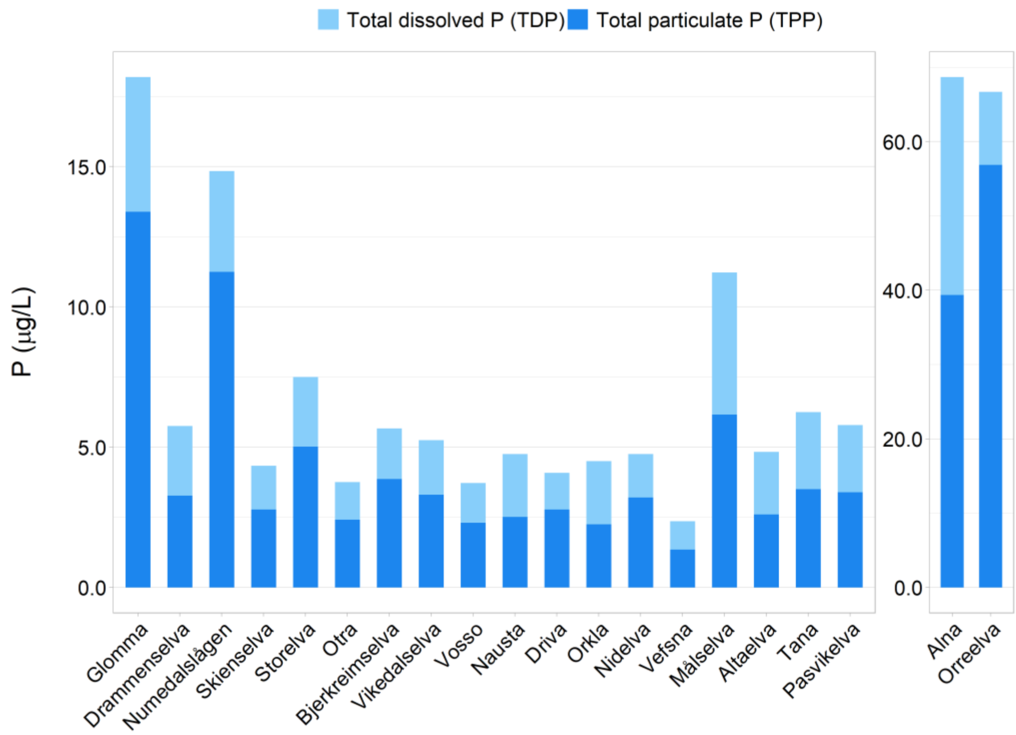

Figure 15. Average concentrations of total dissolved (TDP) and total particulate (TPP) phosphorus in 2020. The sum of TDP and TPP equals to Tot-P. The TPP was calculated as the difference between Tot-P and the TDP. Note different y-scale on the right-side panel.

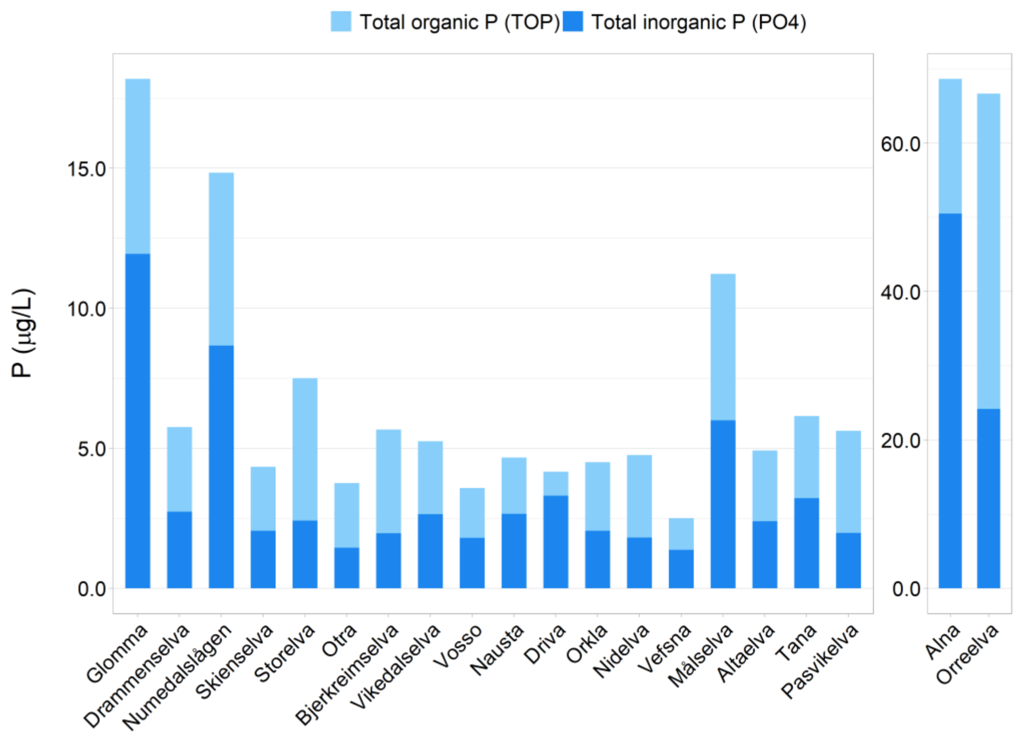

Figure 16. Average concentration of inorganic and organic phosphorus in 2020. Organic P has been calculated as the difference between Tot-P and PO_4 and can also include tightly bound inorganic P. Note different y-scale on the right-side panel.

Nitrogen
Concentrations of total nitrogen (Tot-N) are presented in Figure 17. For most of the rivers, the annual average was slightly lower in 2020 compared to the five-year mean. The largest relative decrease was observed in the River Nausta (-34%), followed Rivers Pasvikelva -29%), Vefsna (-28%), and Alna (-27%). The two rivers with the highest Tot-N, Rivers Alna and Orreelva, can be described as having bad status with regard to tot-N (Direktoratsgruppen 2018). The other rivers were all in good or very good status based on measured Tot-N levels in 2020.

In all rivers, tot-N was mainly present in dissolved form, ranging from 70 to 94% (Figure 18). This was in accordance with the findings from previous years (Braaten et al. 2020, Gundersen et al. 2019) and is caused by the inherently high water solubility of N. Moreover, Tot-N can be divided into the two bioavailable fractions of nitrate (NO_3) and ammonium (NH_4), in addition to the lesser bioavailable organically bound N (Figure 19). Looking at the two rivers with the highest Tot-N, Alna and Orreelva, the urban river Alna contained the most bioavailable N by having higher percentages of nitrate and ammonium, while the agricultural river Orrelva was dominated by organically bound N. Ammonium is typically low in Norwegian surface waters, except if sites are highly polluted or have low oxygen content.

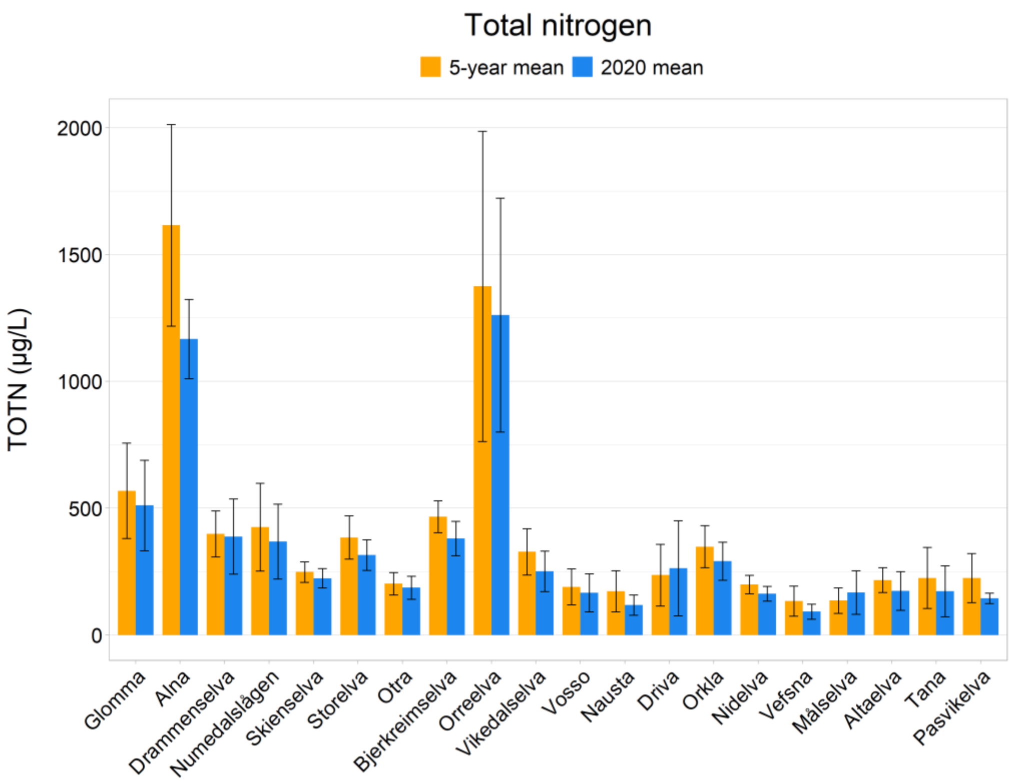

Figure 17. Annual average Tot-N concentrations in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

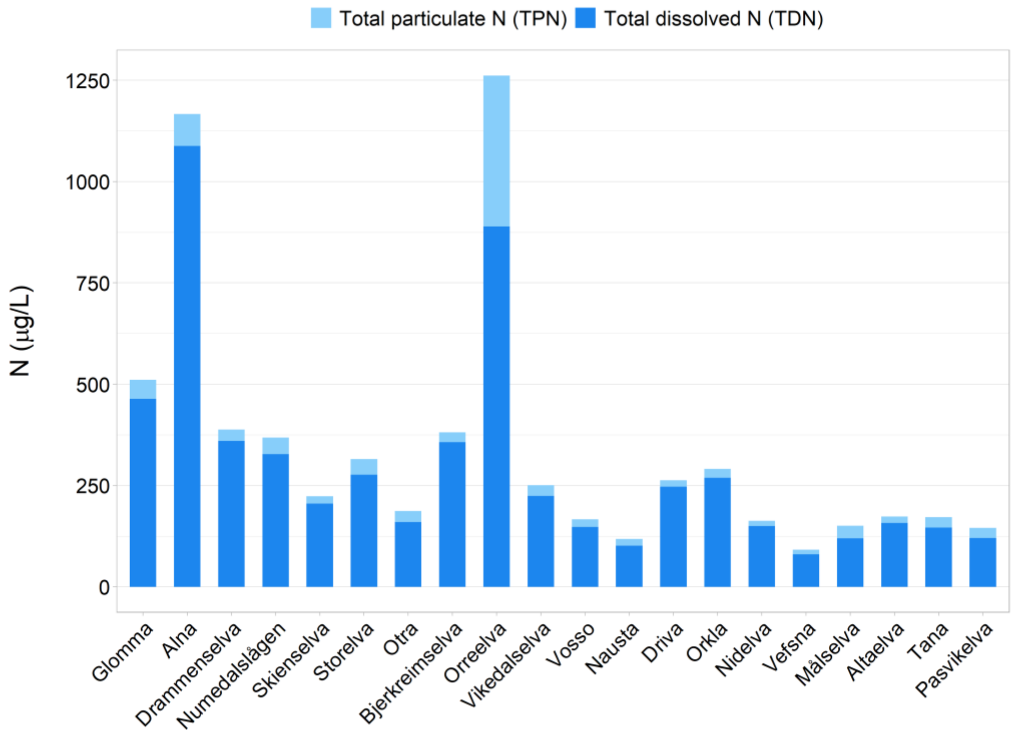

Figure 18. Average concentration of total particulate nitrogen (TPN) and dissolved nitrogen (TDN) in 2020. TDN was calculated as the difference between Tot-N and TPN.

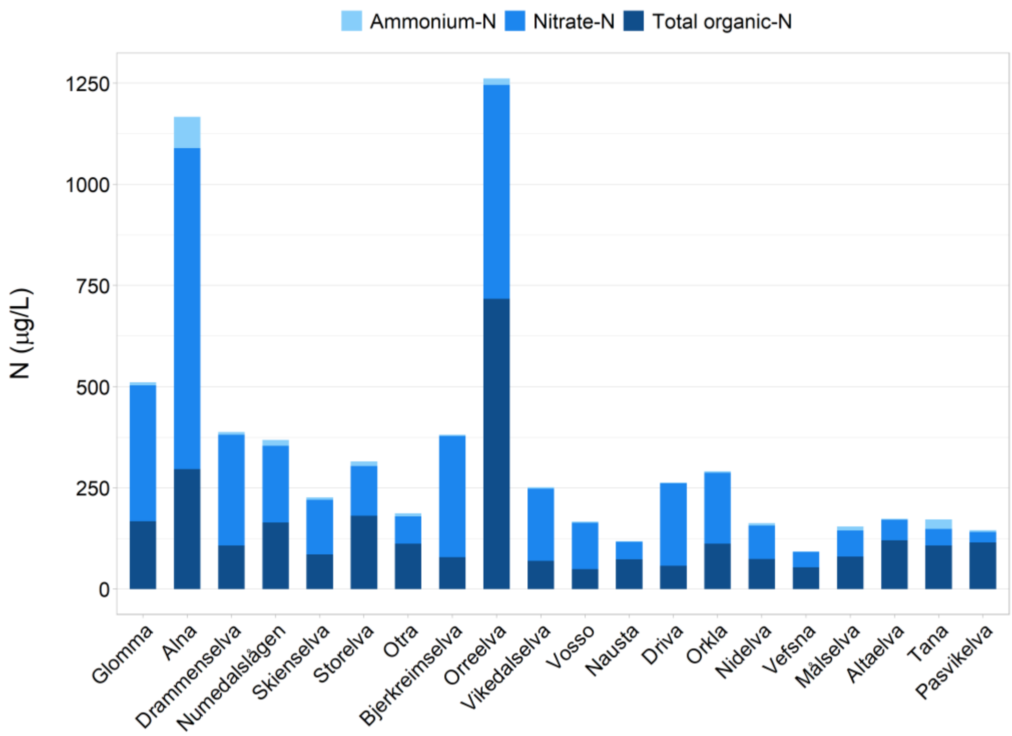

Figure 19. Average concentration of NH_4, NO_3 and total organic N in 2020. Organic N was calculated as the difference between Tot-N and the sum of NH_4 and NO_3.

3.2.5 Metals

Low levels of metals in river water can come from natural deposits, while elevated levels most often result from anthropogenic activities. Examples include mining and metallurgical activities, vehicular traffic, other types of industries, etc. Metals are not readily soluble in water and are thus typically transported with particles of colloidal material.

Note that while the results will be discussed in relation to the WFD standards (Chapter 2.5), the standards apply to filtered samples (i.e. dissolved metal concentration) while the samples in this monitoring programme were unfiltered (i.e. covering both dissolved and particulate metal concentrations).

Arsenic (As)

The highest As levels resided in the urban river, Alna, the historical mining-influenced river Storelva, the agricultural river Orreelva, and in the mining and metallurgical-influenced river Pasvikelva (Figure 20). In 2020, higher levels were also seen in Numedalslågen, with the annual average being 50% higher than the five-year mean. This was mainly due to high As in the October sample (0.57 µg/L) which was accompanied by elevated turbidity and SPM (chapter 3.2.2) during a flood/erosion event. On the contrary, the annual average in Pasvikelva was only about 40% of the five-year mean. The river has historically received pollution from a nickel smelter on the Russian side of the border. However, the emission might have dropped during 2020 in connection with a shutdown of the smelter in December 2020. All the 2020 averages for As were below the WFD environmental quality standard (0.5 µg/L, Table 9).

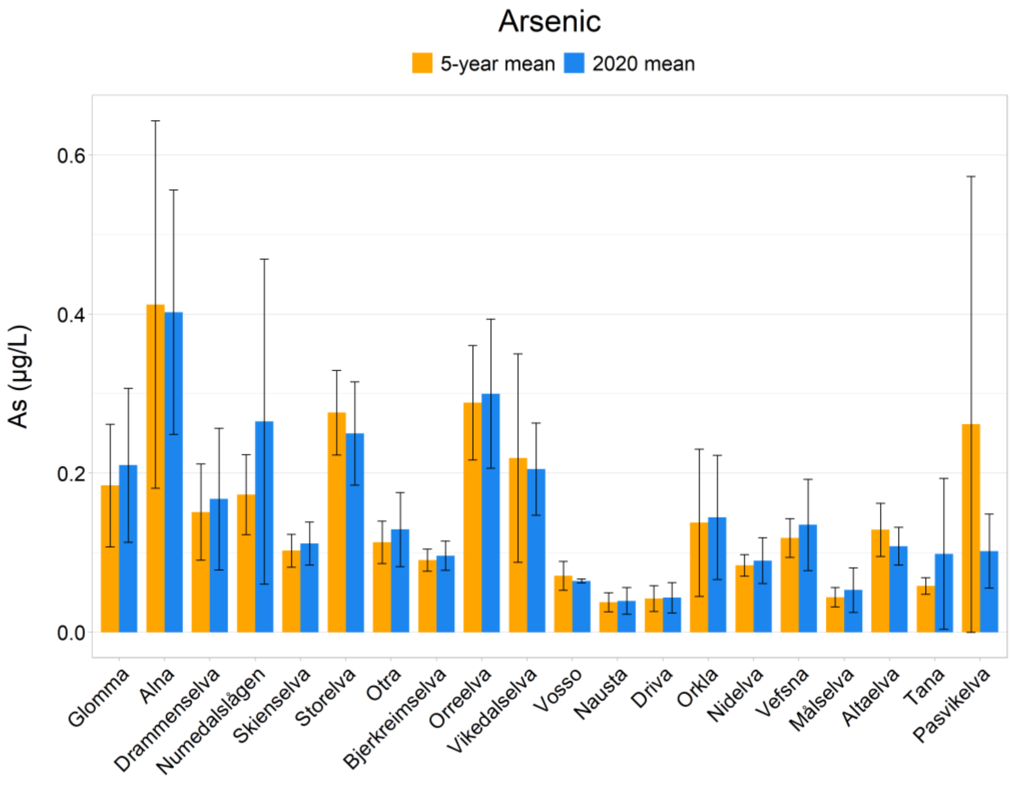

Figure 20. Annual average concentrations of arsenic (As) in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

Lead (Pb)

In 2020, several of the rivers showed decreased annual average Pb concentrations (Figure 21). The largest decrease was seen in Drammenselva with Pb constituting only 30% of the five-year mean. Also, noteworthy, was the decrease observed in Alna (74% of five-year mean) and Pasvikelva (55% of five-year mean). The decline in the urban rivers Drammenselva and Alna could be the result of general reductions of Pb in consumer products. In River Pasvikelva the decrease was probably attributed to gradually reduced production until the Russian smelter was shut down in December. On the contrary, Pb in Numedalslågen in 2020 was 244% higher than the five-year mean. The increase was caused by a high October value (1.8 µg/L), as described above for As. All rivers had annual average Pb levels below the WFD standard in 2020 (1.2 µg/L, Table 9).

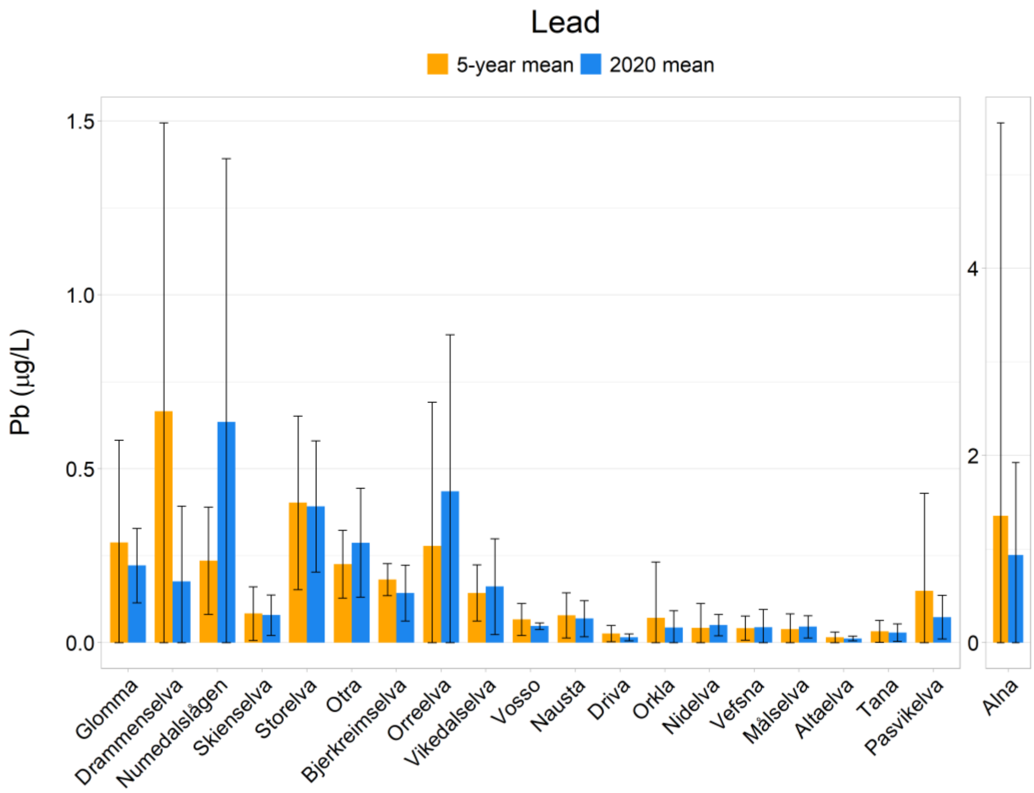

Figure 21. Annual average concentrations of lead (Pb) in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean. Note different y-scale on the right-side panel.

Cadmium (Cd)

For all rivers, Cd levels in 2020 were close to the mean of the five preceding years (Figure 22). A slight decrease was observed for Alna (78% of the five-year mean) and Pasvikelva (64% of the five-year mean), while Numdelaslågen showed a marked increase (192% of the five-year mean). The likely explanations for these trends are described above for As and Pb. Note that Orkla is typically high in Cd, due to an abandoned copper (Cu) mine in the catchment (Gundersen et al. 2019). Cd is typically found alongside with Cu in mineral deposits. All rivers had annual average Cd levels below the WFD standard in 2020 (0.08 µg/L, Table 9).

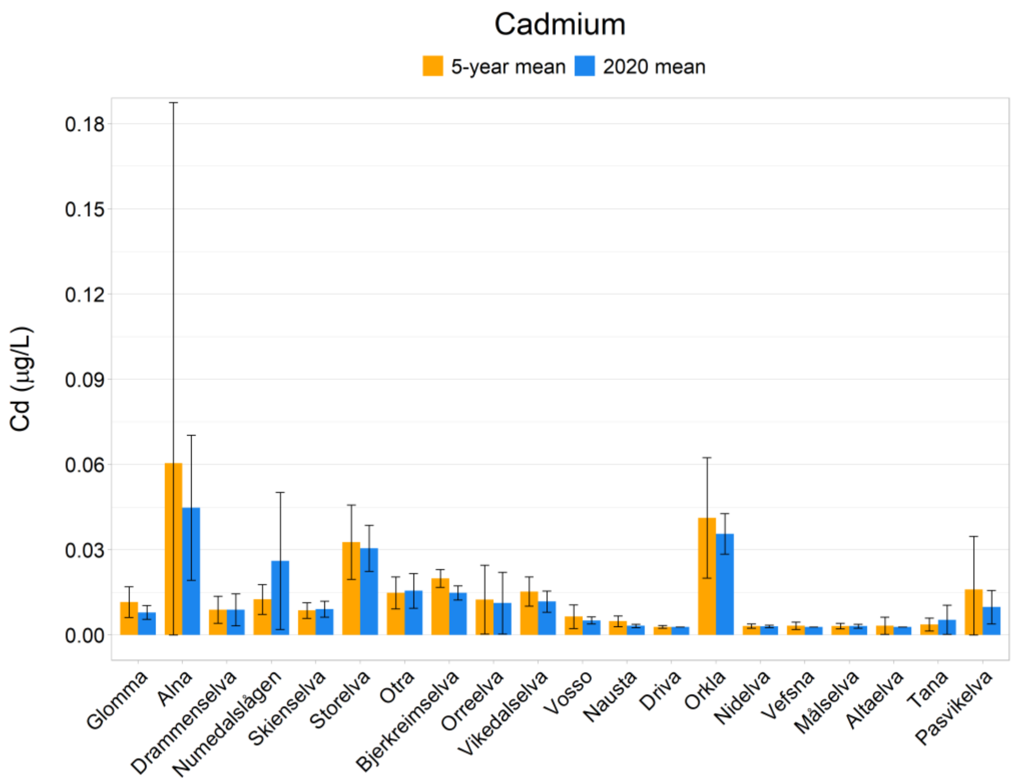

Figure 22. Annual average concentrations of cadmium (Cd) in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

Copper (Cu)

Overall, Cu concentrations in 2020 corresponded to the five-years mean in all rivers (Figure 23). Four of the rivers were typically higher in Cu; Alna, Orreelva, Orkla, and Pasvikelva. The highest annual average was in Orkla (4.3 µg/L), due to influences from the previously active copper mine in catchment. All rivers were below the WFD standard for Cu (7.8 µg/L, Table 9).

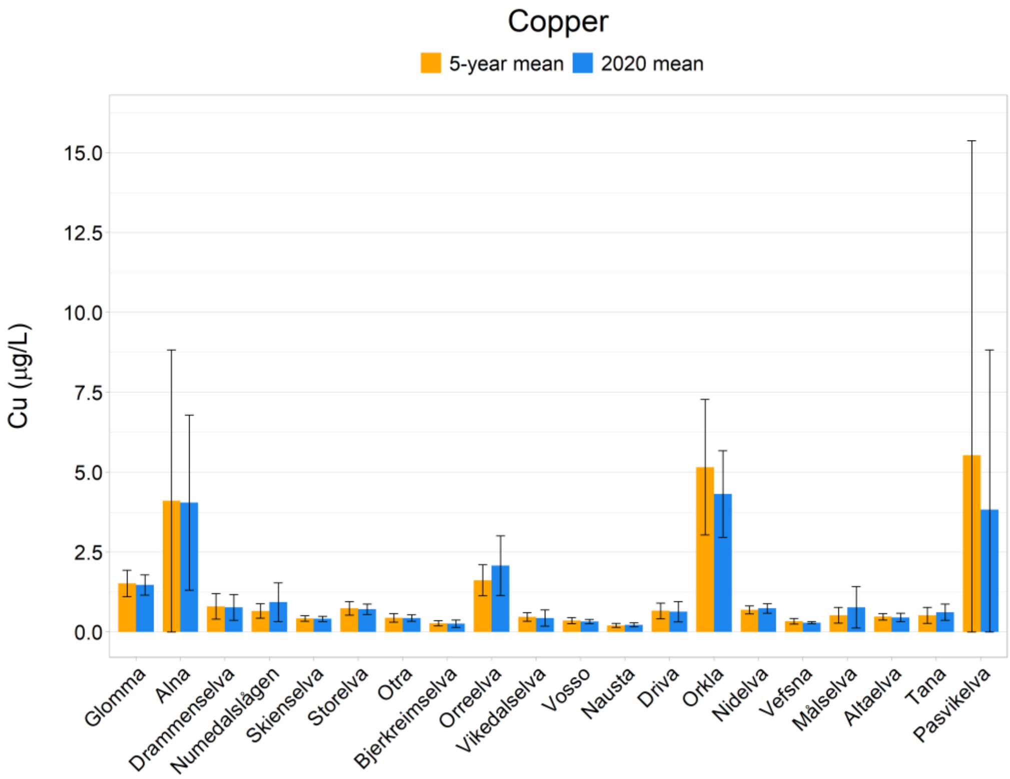

Figure 23. Annual average concentrations of copper (Cu) in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

Zinc (Zn)

The 2020 annual average Zn concentrations were below the WDF limit (11 µg/L, Table 9) for all rivers, except from Alna (15 µg/L) (Figure 24). However, Alna has relatively high content of particulate matter (Chapter 3.2,2), and thus the level of dissolved Zn was likely below the limit. A few of the rivers showed lower 2020 annual averages compared to their respective five-years means; Glomma (33%), Orkla (67%), and Pasvikelva (63%). The reason for the decline in Glomma and Orkla is not known, while the decrease in Pasvikelva was probably related to the imminent shutdown of the Russian metal smelter right across the river. As noted for other metals, Numedalslågen had elevated levels of Zn in 2020 (155% of five-year mean), due to unusually high concentrations in October.

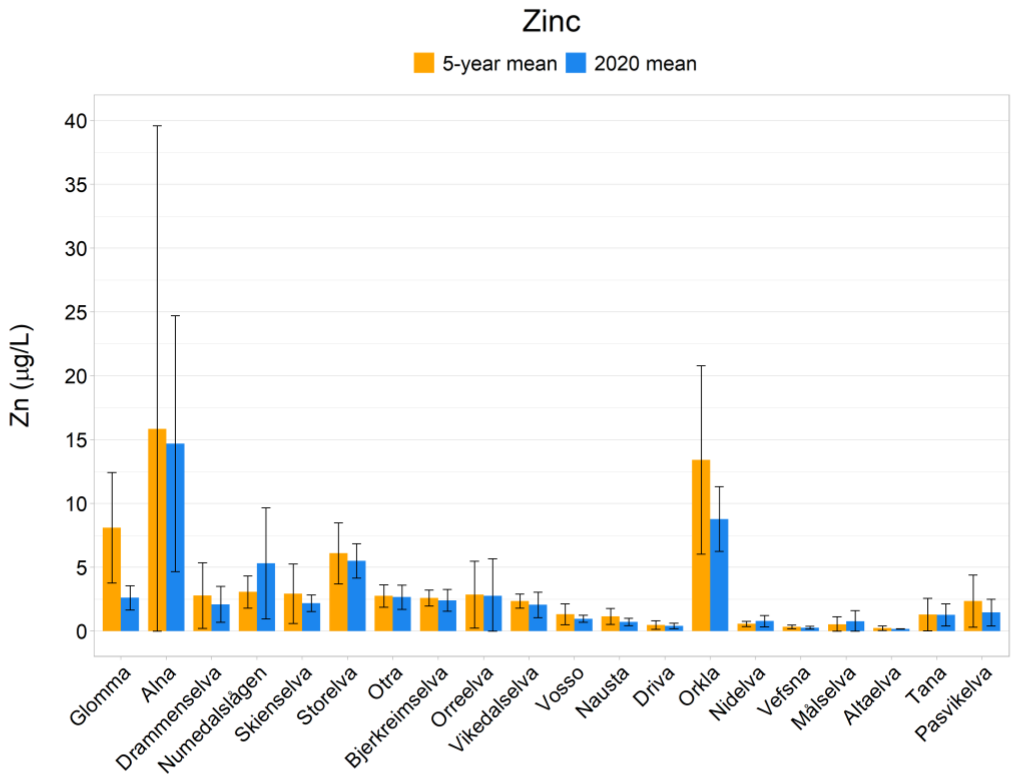

Figure 24. Annual average concentrations of zinc (Zn) in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

Chromium (Cr)

Mean annual Cr concentrations in 2020 were low in all rivers (Figure 25), and well below the WFD threshold of 3.4 µg/L (Table 9). Compared to the mean of the five preceding years, Numedalslågen and Nidelva were clearly higher in 2020. For Numedalslågen the cause was the before-mentioned erosion event in October. For River Nidelva the mean value was affected by an elevated value in August, but the reason for the increase is not known.

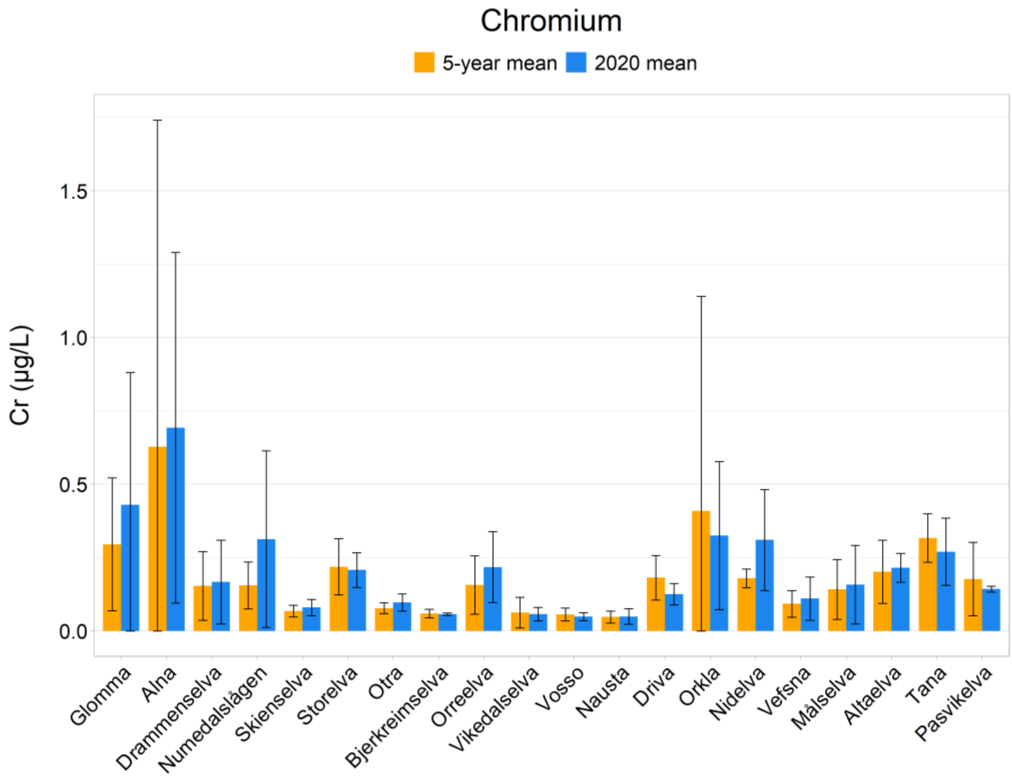

Figure 25. Annual average concentrations of chromium (Cr) in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean.

Nickel (Ni)

Levels of Ni were much higher in Pasvikelva than in any of the other rivers (Figure 26). The river receives pollution from the nickel smelter located just across the river, on the Russian side of the border. However, in 2020, the annual average constituted only 49% of the five-year mean. This was probably due to decreasing emissions from the smelter during 2020, in anticipation of a final shutdown of the smelter in December 2020. As a result, the Ni level in 2020 was only slightly higher than the WFD threshold for dissolved Ni (4 µg/L, Table 9). It is expected that the Ni levels in Pasvikelva will continue to decline throughout 2021 due to the closure of the factory. Most of the other rivers had Ni levels that were close to their five-year means (± 15%). Again, one noteworthy exception was Numedalslågen, which had an elevated concentration (145% of the five-year mean) due to the before-mentioned erosion event in October 2020.

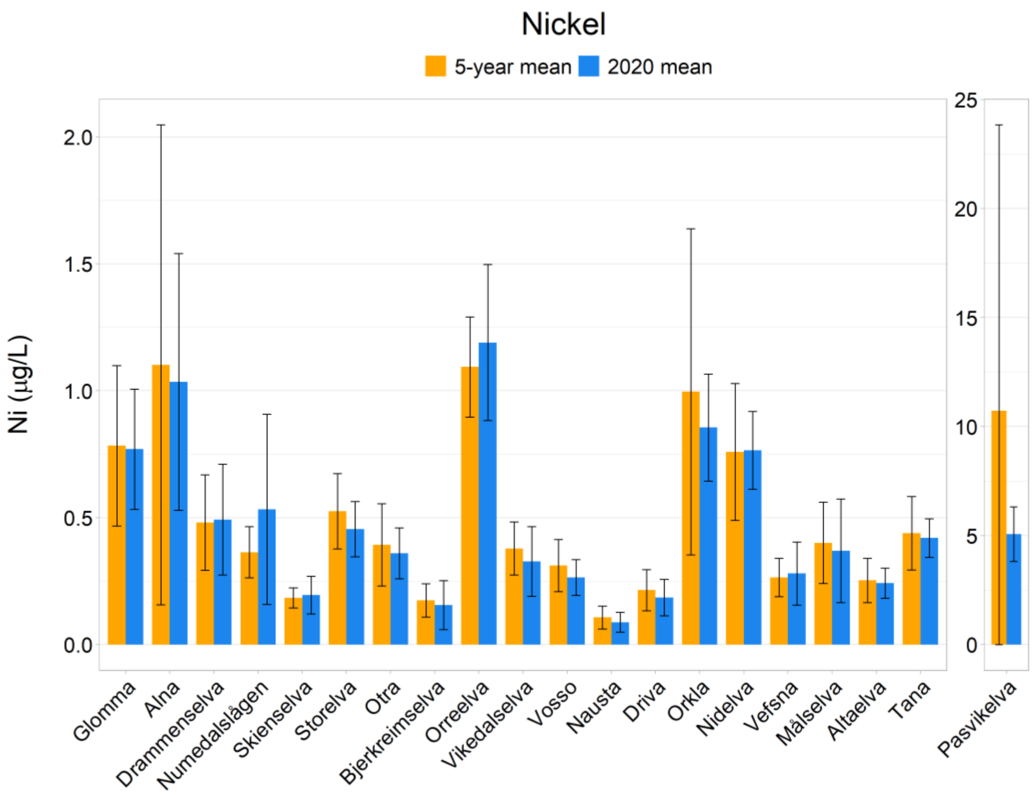

Figure 26. Annual average concentrations of nickel (Ni) in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean. Note different y-scale on the right-side panel.

Mercury (Hg)
2020 was the second year on record determining Hg in the Norwegian River Monitoring Programme using a method with increased sensitivity. The method that had previously been used was associated with a quantification limit not able to capture the actual levels in most rivers, and therefore resulted in large uncertainties when calculating annual loads and annual mean concentrations. For more details on the methods, see Chapter 2.2.2 and Braaten et al. (2018).

Hg is very toxic and has a high potential for bioaccumulation. Correspondingly, it has the lowest WFD threshold among the metals (0.047 µg/L, Table 9). In all rivers, the 2020 annual mean Hg concentrations were close to the 2019 mean, and below the WFD threshold concentration (Figure 27).

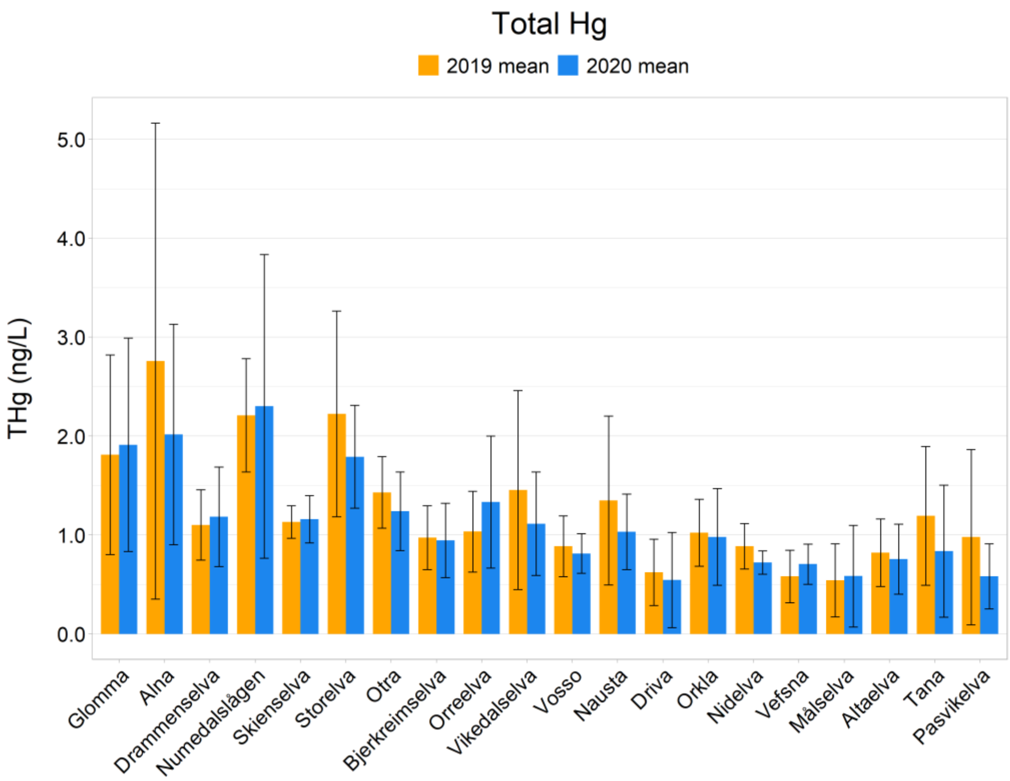

Figure 27. Annual average concentrations of total mercury (THg) in 2020, compared with the preceding five-year mean (2015-2019). Error bars indicate standard deviation from the mean. Note that data for December 2020 was only included for the following rivers due to analytical problems: *Glomma*, *Alna*, *Drammenselva*, *Numedalslågen*, *Skienselva*, and *Storelva*.

3.3 Additional Rivers - Water quality status 2020

As in the two previous years, water chemistry from a selection of rivers from the National monitoring program for limed rivers (Miljødirektoratet 2020) has been included to compliment data from the 20 main rivers in the regular programme. Data for 2020 covers six rivers in southern and western Norway: Nidelva (at Arendal), Tovdalselva, Mandalselva, Lygna, Suldalslågen, and Ekso (Table 2, Figure 3).

Since these samples have been analysed at different laboratories (Vestfold lab and Eurofins), with different LOQs from the main rivers, results for the limed rivers have been plotted separately. The 2020 levels are compared with the mean of the two preceding years (2018 and 2019). For information on geographical distribution of the parameter values, see previous reports by Braaten et al. (2020) and Gundersen et al. (2019).

3.3.1 pH and calcium

Concentrations of pH and calcium (Ca) showed close similarities to the mean of the two preceding years (Figure 28). However, there was a tendency of slightly decreasing levels while still being within the variation of the 2-year mean (± stdev). For pH, the decrease was -0.1 to 0.2 pH units and for Ca the 2020 levels were from 76 to 102% of the 2-year mean. This tendency of slightly lower pH and Ca levels in 2020 was also described for the main rivers (chapter 3.2.1). Based on the calcium levels, all rivers could be described as calcium-poor (1-4 mg/L) according to the WFD classification.

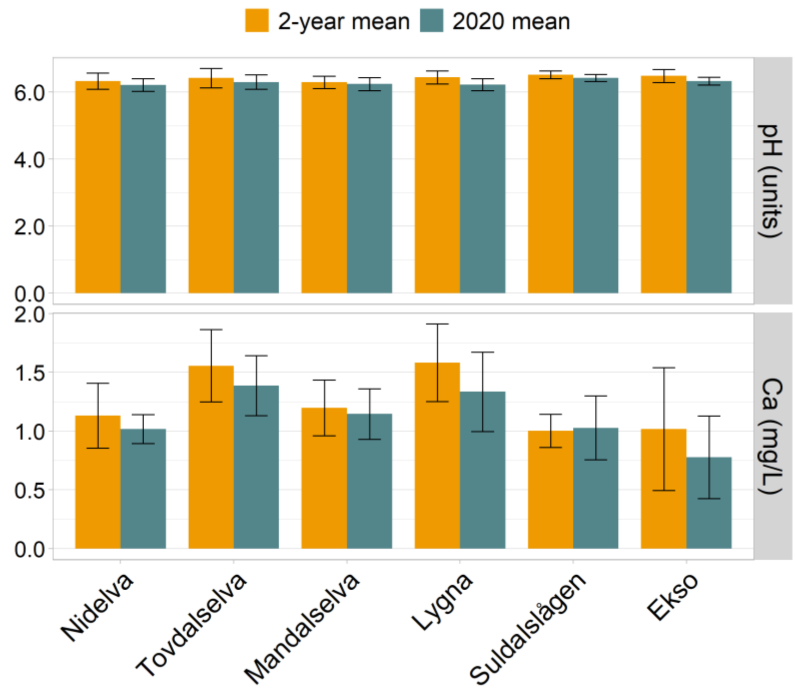

Figure 28. Annual average pH and calcium concentrations in the additional rivers from the liming program in 2020, compared with the preceding two-year mean (2018-2019). Error bars indicate standard deviation from the mean. Mean values are based on pH, not the H^+ concentration, which represents a negligible error when pH values are above 6.0.

3.3.2 Turbidity and silica

Most rivers had levels of turbidity and silica that were close to the 2-year mean (Figure 29). Three of the rivers, Tovdalselva, Lygna, and Suldalslågen showed a slight turbidity increase in 2020, while for Ekso the opposite was the case. For Lygna, the increased turbidity was accompanied by a decrease in silica. These modest changes, constituting mainly an increase in turbidity, was also described for the main rivers in the programme (Chapter 3.2.2). Note that data on SPM from the limed rivers was limited and has thus not been included here.

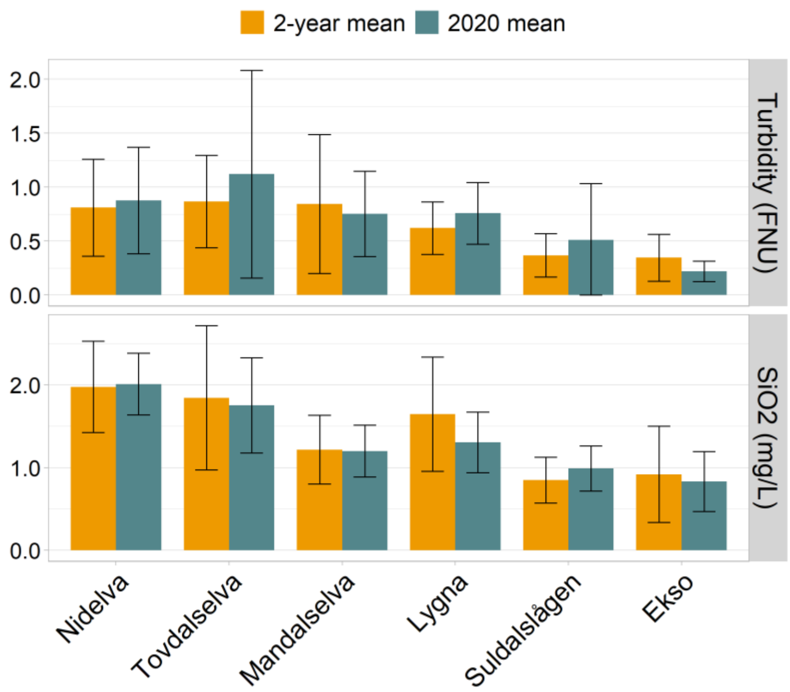

Figure 29. Annual average turbidity and silica concentrations in the additional rivers from the liming program in 2020, compared with the preceding two-year mean (2018-2019). Error bars indicate standard deviation from the mean.

3.3.3 Organic carbon

Levels of total organic carbon (TOC) in 2020 were of the same order of magnitude, but slightly lower compared to the 2-year mean (Figure 30). Based on the WFD classification, Tovdalselva can be described as humic (> 5 mg/L), Nidelva, Mandalselva, and Lygna as clear (2- 5 mg/L), while Suldalslågen and Ekso as very clear (< 2 mg/L). These levels corresponded to the data reported by (Gundersen et al. 2019), while the 2019 data was somewhat higher in mean TOC concentrations (Braaten et al. 2020). In all rivers, the dissolved fraction (DOC) dominated over the particulate (POC), constituting 88 to 95% of TOC (Figure 31). This agreed well with corresponding data from the main rivers (Chapter 3.2.3).

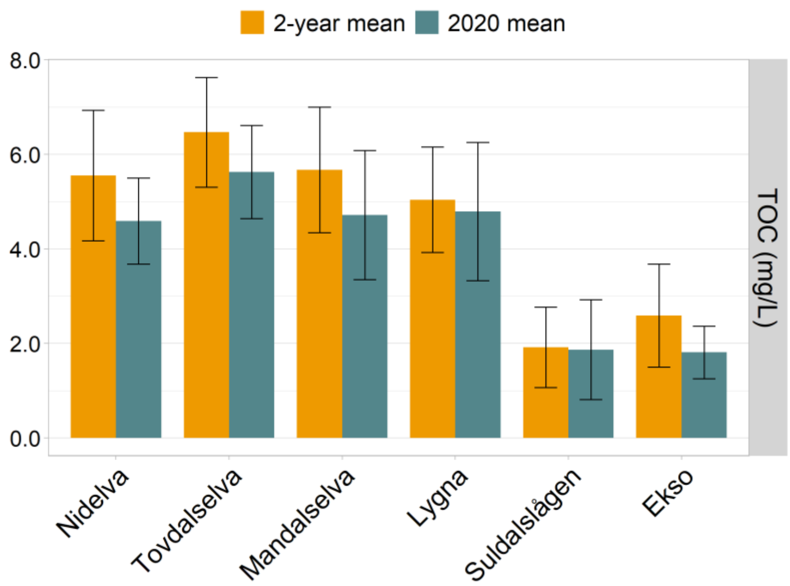

Figure 30. Annual average TOC concentrations in the additional rivers from the liming program in 2020, compared with the preceding two-year mean (2018-2019). Error bars indicate standard deviation from the mean.

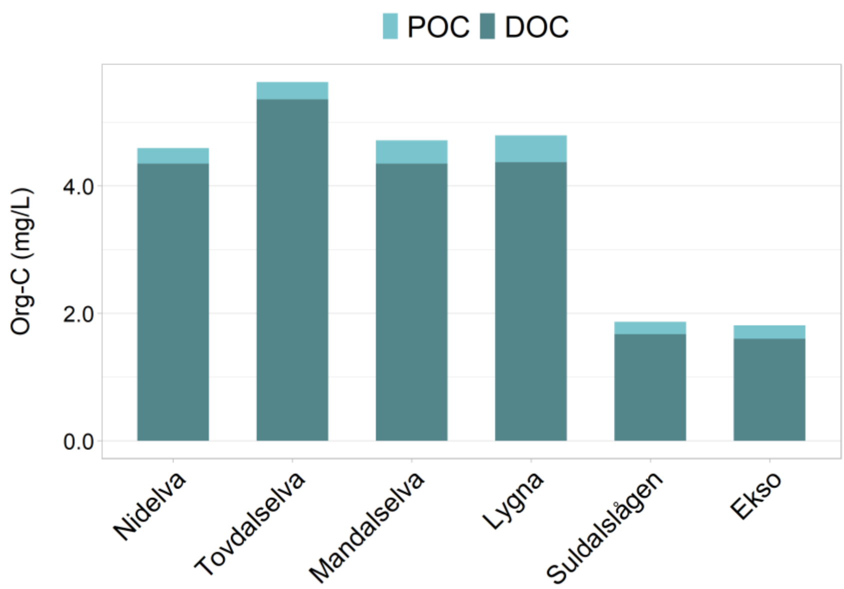

Figure 31. Average particulate (POC) and dissolved (DOC) organic carbon concentration in the additional rivers from the liming program in 2020.

3.3.4 Nutrients

Tot-P and Tot-N levels were low in the additional rivers, which was in accordance with the previous years (Figure 32). For Suldalslågen and Ekso, annual averages were not calculated due to few measurements above the limit of detection for Tot-P (2 µg/L). For the other rivers, the Tot-P annual averages in 2020 were very similar to the 2-year mean. For Tot-N, slightly lower 2020 levels were evident in all rivers, but while still being within the variation of the 2-year mean (± stdev). Distribution of the N species, nitrate, ammonium, and organic nitrogen varied among the rivers (Figure 33) In Nidelva, Tovdalselva, and Mandalselva organic N contributed around half of the Tot-N, nitrate-N with 40%, and ammonium with the final 10%. In Lygna, Suldalslågen, and Ekso nitrate dominated (63 to 75% of Tot-N), followed by organic N (25-37%). In these rivers, ammonium was not determined above its detection limit.

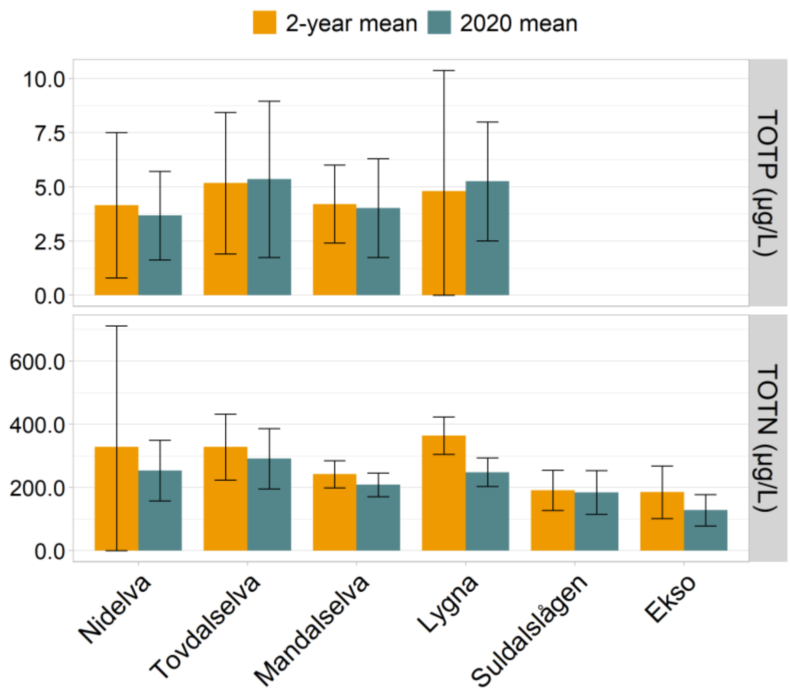

Figure 32. Annual average Tot-P and Tot-N concentrations in the additional rivers from the liming program in 2020, compared with the preceding two-year mean (2018-2019). Error bars indicate standard deviation from the mean.

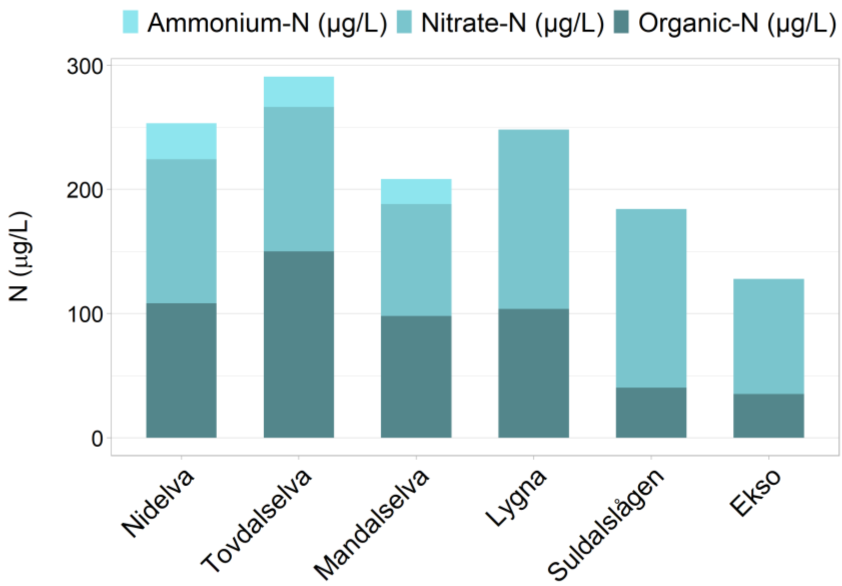

Figure 33. Average concentration of ammonium, nitrate and organic nitrogen in the additional rivers from the liming program in 2020.

3.3.5 Metals

Annual average concentrations for the metals arsenic (As), lead (Pb), cadmium (Cd), copper (Cu), zinc (Zn), and chromium (Cr) in additional rivers from the liming programme are presented in Table 17. Data on nickel (Ni) and mercury (Hg) are not presented, whereas Cd, Cu, and Cr are only presented for some of the rivers. The reason for this is that more than 30% of the measurements were below the limit of quantification for the method used.

Overall, metal concentrations in the rivers were low, and all annual average were below the WDF thresholds (Table 9). This was in accordance with the findings from the main rivers in southern and western regions of Norway (chapter 3.2.5).

Table 17. Average metal concentrations ± stdev for additional rivers in 2020. All data in µg/L.

River	As	Pb	Cd	Cu	Zn	Cr
Nidelva	0.16 ± 0.07	0.5 ± 0.4	0.02 ± 0.02	0.8 ± 0.5	7 ± 3	0.13 ± 0.04
Tovdalselva	0.17 ± 0.05	0.4 ± 0.2	0.04 ± 0.03	0.6 ± 0.3	8 ± 3	0.23 ± 0.14
Mandalselva	0.14 ± 0.03	0.5 ± 0.3	--	0.3 ± 0.2	6 ± 2	0.16 ± 0.09
Lygna	0.17 ± 0.05	0.7 ± 0.2	0.03 ± 0.02	--	6 ± 2	0.10 ± 0.06
Suldalslågen	0.06 ± 0.01	0.2 ± 0.1	--	0.4 ± 0.3	5 ± 2	--
Ekso	0.05 ± 0.04	0.3 ± 0.4	--	0.3 ± 0.2	3 ± 2	--

3.4 Trends in riverine loads and concentrations

The trend analyses include an evaluation of both riverine loads and concentrations. Loads are important for assessing total transport of elements to coastal waters, whereas concentrations will give an indication of the water quality. By evaluating trends in loads in combination with water discharge, it is possible to reveal whether trends are related to changes in mobilisation of chemical substances or in water discharge. Trends in water discharge (Q) are discussed in more detail in Chapter 3.1.4.

3.4.1 Loads and concentrations of SPM, silica, TOC, and nutrients (1990-2020)

Loads

As can be expected, there is a close connection between rivers with significant increasing water discharge and rivers with significant increasing loads of dissolved and particulate matter (Table 18). This implies that rivers with increasing loads are restricted to an area ranging from Glomma in south-east to Orreelva in south-west. Within this area, Drammenselva is the only river that show increasing loads of all elements, except for ammonium. On the other side, Otra is lacking significant trends overall, except for nitrate (decreasing). It is also worth noting that Vefsna in northern Norway show decreasing trends in several elements, including SPM and all N and P species.

Decreasing trends in ammonium (NH_4) and also nitrate (NO_3) in some rivers are probably due to reduced deposition of inorganic nitrogen from long-range transported air pollution, and possibly also increased uptake by vegetation due to longer growing season as an effect of global warming. Total nitrogen shows an increase in Glomma, Drammenselva and Numedalslågen, which are the largest rivers that discharges into the outer Oslofjord and the Skagerrak Sea.

Glomma, Drammenselva, Numedalslågen and Orreelva show increasing loads of phosphate, which together with nitrogen is a primary element for plant growth in freshwater and marine waters. The same rivers, except Glomma, also had significant increasing trends in total phosphorus loads.

Many lakes and streams, especially in south-eastern Norway, have experienced increased concentrations and loads of total organic carbon (TOC) over the past 30 years (de Wit et al., 2007, Garmo and Skancke 2020). The trends are in correspondance with similar trends in nort-western Europe and North America (Monteith et al. 2007). The penomenon is also accompanid with increased colur (browning) and has been explained by a reduction of acid deposition (de Wit et al. 2007, Evans et al. 2012, Monteith et al. 2007) and to climate change (de Wit et al., 2016).

In contrast to TOC trends seen at many upland lakes and streams in southern Norway, only Drammenselva show a significant increase in TOC loads. One possible explanation might be that the trend analysis for TOC started in 1999, due to limited data from 1990 through 1998. From other studies it is known that the steepest increase in TOC took place between 1990 and 2005 (Garmo and Skancke 2020). In addition, many of the large river catchments contain large lakes, which can be a significant sink for TOC due to photo-oxidation, sedimentation and mineralisation by microbes (Köhler et al. 2013). Inputs of organic matter from anthropogenic sources might also have an influence on TOC trends in rivers affected by runoff from agriculture, urban areas or industry.

Table 18. P-values for long-term trends (1990-2020) in water discharge (Q) and loads (transport) of suspended particulate matter (SPM), silica (SiO_2), total organic carbon (TOC), total phosphorus (Tot-P), and phosphate (PO_4), total nitrogen (Tot-N), ammonium (NH_4), nitrate (NO_3), in rivers.

River	Q	SPM	SiO_2	TOC*	Tot-P	PO_4	Tot-N	NH_4	NO_3
Glomma	0.013	0.395	0.019	0.057	0.359	0.016	0.004	0.000	0.023
Drammenselva	0.004	0.013	0.000	0.001	0.003	0.003	0.005	0.001	0.025
Numedalslågen	0.072	0.057	0.001	0.735	0.010	0.003	0.000	0.096	0.053
Skienselva	0.049	0.919	0.002	0.398	0.208	0.234	0.262	0.002	0.000
Otra	0.208	0.377	0.163	0.234	0.634	0.497	0.786	0.062	0.000
Orreelva	0.027	0.030	0.021	0.195	0.023	0.049	0.144	0.126	0.475
Orkla	0.786	0.946	0.708	0.708	0.541	0.865	0.708	0.000	0.865
Vefsna	0.659	0.006	0.497	1.000	0.001	0.006	0.001	0.000	0.000
Altaelva	0.153	0.541	0.587	0.735	0.292	0.415	0.610	0.019	0.587

Red – significantly increasing $p<0.05$, green – significantly decreasing $p<0.05$

*Trend analysis started in 1999 due to limited data in the period from 1990

Concentrations

Increased transport of suspended particles, silica, and nutrients – as was seen in many of the southern rivers – can have a negative impact on coastal ecosystems as e.g. the Oslo fjord and other freshwater-affected fjords along the Skagerrak coast (Deininger et al. 2020, Frigstad et al. 2020ab, Staalstrøm et al. 2021). Particles and organic matter can influence light conditions in the water column (darkening) whereas silica and nutrient can promote increased phytoplankton growth and eutrophication. Particles and organic matter can also increase the microbial biomass and thereby affect the food web structure (McGovern et al. 2019).

When looking at trends in riverine concentrations (Table 19), it gives a different picture from the riverine loads (Table 18). In general, there are more decreasing than increasing trends among the selected substances. The elements that show increasing trends are SPM (one river), silica (four rivers), phosphate (four rivers) and total nitrogen (one river). Again, the increasing trends are mainly associated with rivers that discharges to the Skagerrak coast. The only exceptions are Orreelva (Tot-N) and Orkla (silica and Tot-N). Interestingly, Tot-P show either no trend or decreasing trends in all rivers. The same applies to Tot-N, except in Orkla, where a significant increasing trend is detected.

Table 19. Long-term trends (1990-2020) in concentrations of suspended particulate matter (SPM), silicate (SiO_2), total organic carbon (TOC), total nitrogen (Tot-N), ammonium (NH_4), nitrate (NO_3), total phosphorus (Tot-P), and phosphate (PO_4) in rivers. p-values are shown.

River	SPM	SiO_2	TOC*	Tot-P	PO_4	Tot-N	NH_4	NO_3
Glomma	0.022	0.217	0.520	0.740	0.000	0.905	0.000	0.358
Drammenselva	0.066	0.009	0.074	0.665	0.066	0.919	0.000	0.029
Numedalslågen	0.051	0.002	0.381	0.064	0.012	0.092	0.358	0.932
Skienselva	0.045	0.002	0.082	0.689	0.104	0.000	0.000	0.000
Otra	0.014	0.843	0.380	0.004	0.593	0.004	0.024	0.000
Orreelva	0.185	0.332	0.592	0.251	0.041	0.587	0.049	0.030
Orkla	0.000	0.001	0.385	0.205	0.856	0.007	0.000	0.106
Vefsna	0.001	0.071	0.734	0.001	0.031	0.017	0.000	0.000
Altaelva	0.069	0.708	0.493	0.048	0.052	0.377	0.003	0.634

Red – significantly increasing $p<0.05$, green – significantly decreasing $p<0.05$

*Trend analysis started in 1999 due to limited data in the period from 1990

3.4.2 Loads and concentrations of metals (2004-2020)

For the metals Pb, Cd, Cu, Zn, and Ni time series exist from 2004. The shorter time period was selected due to an increase in the sensitivity of the analytical methods (lower LOQ) over time, i.e. it has become possible to detect lower concentrations. As discussed in last year's report, if data prior to 2004 were not excluded, the trend analysis could potentially have showed false decreasing trends (Gundersen et al. 2019, Skarbøvik et al. 2007, Stålnacke et al. 2009). Additionally, caution should be paid when evaluating the data as the sampling frequency has been reduced from monthly to quarterly since 2017. This can introduce uncertainty to the trend analysis, especially for polluted rivers where the seasonal variability is expected to be substantial.

Loads

All rivers show either no trend or decreasing trends in metal loads from 2004 to 2020 (Table 20). The only change from last year's analysis (Braaten et al. 2020), is that nickel no longer declines in Otra. Elements that show significant downward loads are copper (three rivers), zinc (three rivers) and lead (one river).

Table 20. Short-term trends (2004-2020) in metal loads in rivers monitored monthly since 1990. p-values are shown.

River	Pb	Cd	Cu	Zn	Ni
Glomma	0.592	0.091	0.029	0.592	0.650
Drammenselva	0.967	0.537	0.149	0.108	0.266
Numedalslågen	0.484	1.000	0.484	0.902	0.650
Skienselva	0.967	0.537	0.303	0.773	0.266
Otra	0.967	0.711	0.012	0.023	0.064
Orreelva	0.592	0.967	0.711	0.303	0.537
Orkla	0.019	0.077	0.012	0.012	0.711
Vefsna	0.174	0.934	0.149	0.001	0.434
Altaelva	0.232	0.304	0.108	0.064	0.537

Red – significantly upward p<0.05, green – significantly downward p<0.05.

Concentrations

There are either no trend or decreasing trends for concentrations of lead, cadmium, copper and nickel in all rivers (Table 21). Nickel show increasing trends in three rivers; Orreleva, Vefsna and Altaelva. There are only a few changes compared to last year's analysis: shift from downward to no trend for copper in Numedalslågen, shift from no trend to downward trend for nickel in Drammenselva, and shift from no trend to upward trend for nickel in Orreelva.

Table 21. Short-term trends (2004-2020) in metal concentrations in rivers monitored monthly since 1990. P-values are shown.

River	Pb	Cd	Cu	Zn	Ni
Glomma	0.967	0.165	0.003	0.484	1.000
Drammenselva	0.098	0.002	0.000	0.000	0.028
Numedalslågen	0.902	0.934	0.053	0.032	0.649
Skienselva	0.083	0.000	0.002	0.011	0.001
Otra	0.902	0.113	0.003	0.000	0.026
Orreelva	0.536	0.512	0.083	0.680	0.025
Orkla	0.069	0.187	0.003	0.006	0.216
Vefsna	0.083	0.002	0.011	0.000	0.008
Altaelva	0.672	0.001	0.000	0.001	0.007

Red – significantly upward p<0.05, green – significantly downward p<0.05.

3.5 Quality of dissolved organic matter

Dissolved organic matter (DOM) is a complex and heterogenous material, being formed from decaying organics, e.g. plants and organisms, once living in the area. DOM can be quantified by the concentration of dissolved organic carbon (DOC <0.45 µm), since DOM typically consists of 60% carbon (followed by oxygen, hydrogen, and nitrogen). DOM plays an important role in various processes in the catchment. For example, its mobilization and downstream transport is closely linked to transport of organic nutrients and/or pollutants, and DOM is the primary C-substrate for bacterial and other heterotrophic microbes. DOM can also play a key role in shaping the light environment in downstream freshwater and coastal ecosystems, with high amounts of DOM (especially highly coloured DOM) leading to reduced light availability in impacted aquatic systems. The quality of the DOM plays a key role in governing the physical, chemical and ecological effects of DOM in freshwater and coastal systems. It is possible to gain insight into the molecular structure of DOM based on its ability to absorb light at different wavelengths, with light absorption at a specific wavelength known to be correlated with specific molecular structures. Based on these relationships, several spectral indices have been defined to describe the DOM in terms of e.g. the degree of aromaticity (sUVa, positively correlated) and molecular size (E2_E3, negatively correlated) (Peuravuori and Pihlaja 1997, Weishaar et al. 2003) (Table 22).

Herein, the quantity and quality of DOM will be investigated in terms of TOC[2], sUVa, and E2_E3, and will be assessed in relation to seasonal and regional differences among the rivers. The rivers have been grouped geographically according to the four major drainage basins in Norway (*Barents Sea, Norwegian Sea, North Sea,* and *Skagerrak*, see Chapter 1.2).

Table 22. Overview of the absorbance indices used to describe DOM quality

	Name	Definition	Characteristic
sUVa	Specific UV absorbance	(Abs 254nm / DOC[3])*100	Aromaticity (positive relationship)
E2_E3		250 nm /365nm	Aromaticity (negative relationship) Molecular size (negative relationship)

Seasonal variation

There is often a strong seasonal influence on both the quantity and quality of the DOM in the rivers. Typically, levels of DOM peak during spring and autumn resulting from increased transport of organic material from the forest floor with the snow melt and intense autumn precipitation, respectively. During autumn, high flow events can transport fresh organic matter that has been produced during the warm summer months downstream. Meanwhile, during spring snowmelt, frozen soils can restrict flow to the uppermost organic-rich soil layers, leading to mobilization and transport of high amounts of DOM downstream, including DOM associated with leaf litter from the previous autumn. In Figure 34, monthly averages of TOC, sUVa, and E2_E3 are presented, grouping the rivers into the four geographical regions. The national average is included by a dotted line.

Overall, TOC levels were at their lowest during winter before increasing through spring and summer. However, for the *Barents Sea* region, peak levels were evident in spring, likely due to increased transport to the river with the melting snow. With monthly sampling, the effect from spring freshet is not always captured, which was likely the case for the three remaining regions. Furthermore, the magnitude of the spring freshet signal will vary depending on the amount of snow that has accumulated over the winter and on how quickly the snow melt progresses.

The aromaticity of the DOM, here presented by sUVa (positively correlated), showed a drop during late summer, which was evident in all four regions. The drop in DOM aromaticity indicated a shift in the quality of the riverine DOM that could have resulted from at least to different processes: One being the contribution of freshly produced organic matter during summer (e.g. from terrestrial and/or aquatic primary production), which is typically associated with lower aromaticity. Second, during summer, sunlight driven photodegradation of the DOM will break down aromatic molecular structures, producing DOM of reduced aromaticity. Regardless of the cause, one likely consequence of reduced aromaticity is that the DOM may be expected to be more highly biodegradable (i.e. more bioavailable to microbes). Levels of the E2_E3 ratio, expected to be negatively associated with molecular size showed less clear trends. Overall, the relative spread in the data was low. Interestingly, region Skagerrak peaked in E2_E3 in July, indicating increased content of DOM with lower molecular sized materials.

[3] TOC has been used instead of DOC (< 0.45 µm) due to the increased amount of data available.

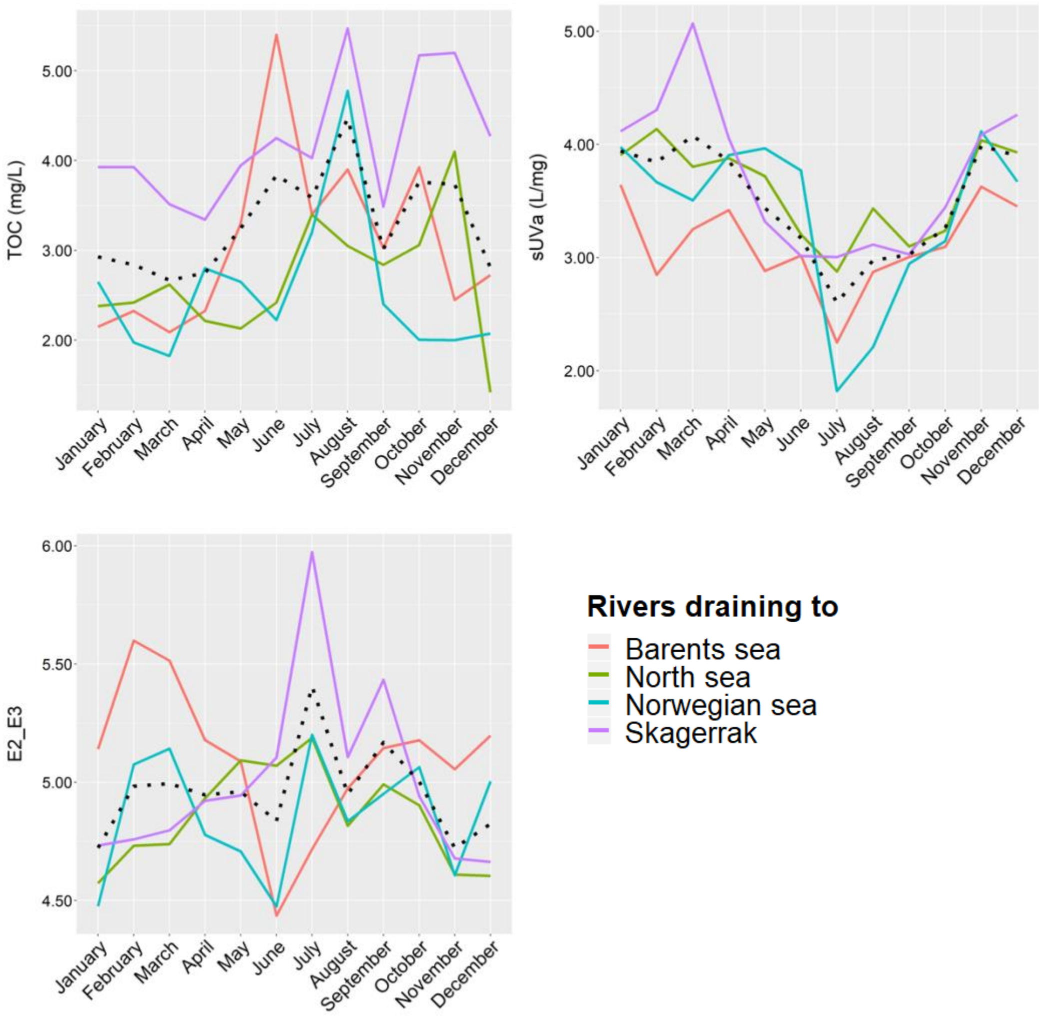

Figure 34. Monthly average values of TOC concentration, aromaticity (sUVa), and molecular size (E2_E3) for rivers in the four regions Barents Sea (n = 4), North Sea (n = 5), Norwegian Sea (n = 4), and Skagerrak (n = 7). The black dashed line shows monthly averages for all rivers (n = 20).

The 2020 national monthly averages of TOC, sUVa (positively correlated to aromaticity), and E2_E3 (negatively correlated to molecular size) are in Figure 35 compared with those from the three previous years (2017, 2018, and 2019). The interannual variation is typically high (error bars, ± stdev), illustrating large variability among the rivers each month. This can be expected given the large differences in e.g. climate between the south, west, and northern regions of the country. Interestingly, year 2020 differs from the rest by being higher in TOC in august and by having the least aromatic DOM in July. This was likely caused by differences in the summer weather between the years. However, a thorough investigation of this relationship between the weather data and the DOM quantity and quality in the rivers is outside the scope of this report. For E2_E3, the 2020 data could not be separated from that of the three previous years.

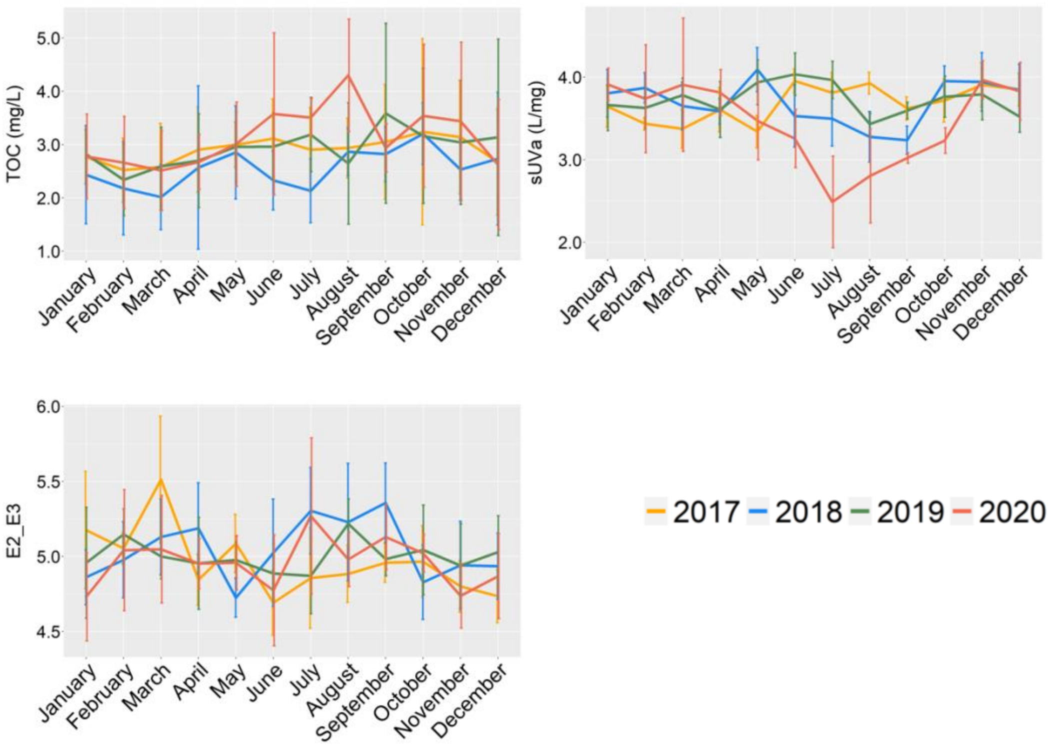

Figure 35. Monthly averages values of TOC concentration, aromaticity (sUVa), and molecular size (E2_E3) for 2017, 2018, 2019, and 2020 for all 20 rivers in the monitoring programme. Error bars illustrate the variability in the data (± stdev).

Regional variation

Using monthly averages, the relationships between i) TOC concentration and river discharge, ii) DOM aromaticity (sUVa) and TOC concentration, and iii) DOM molecular size (E2_E3) and TOC concentration are explored (Figure 36). Note that Rivers Alna and Orreelva have been excluded from this analysis since these are atypical of their regions.

Overall, the 2020 data showed similar regional trends to those observed in previous years (Braaten et al. 2020, Gundersen et al. 2019). Briefly, the DOM in the rivers draining to the *North Sea* (green) was most distinct. The combination of low TOC with high water discharge is typical for the thin soils and intense precipitation in this region. Moreover, the *North Sea* region showed DOM of higher aromaticity (sUVa, positively correlated) and size (E2_E3, negatively correlated) in relation to its TOC levels, when compared to the other regions. All four regions showed DOM quality parameter values (sUVa and E2_E3) within similar ranges, while the regional ranges in TOC were more distinct. This indicates that while the variation in the TOC concentrations was more regionally-dependent (*Skagerrak* > *Barents Sea* > *Norwegian Sea* > *North Sea*), variability in DOM aromaticity and molecular size was mainly driven by seasonality, with seasonal changes in the source of DOM (e.g. from surface soils during snow melt, from fresh terrestrial and/or aquatic primary production, from sub-surface flow through soils) as well as upstream processing of DOM (e.g. through photochemical degradation). For more information on the cause for the regional differences, see (Braaten et al. 2020, Gundersen et al. 2019).

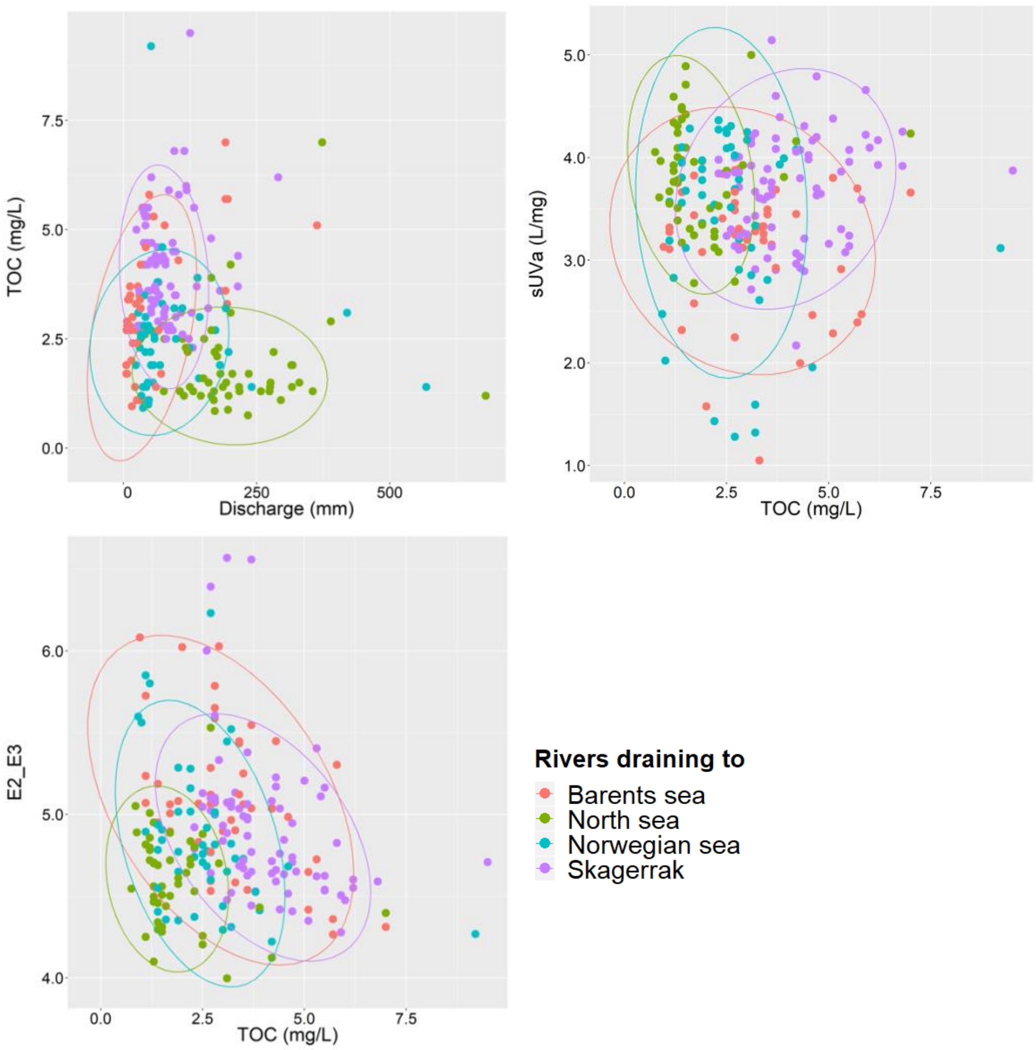

Figure 36. Relation between monthly TOC concentration and discharge (top left), aromaticity (sUVA) and TOC concentration (top right), and molecular size (E2_E3) and TOC concentration (bottom left) for rivers draining to the Barents Sea (n = 4), the North Sea (n = 4), the Norwegian Sea (n = 4), and Skagerrak (n = 6). Note that Rivers Alna (Skagerrak) and Orreelva (North Sea) have been excluded from the figures.

3.6 High-frequency monitoring in Rivers Storelva and Målselva

3.6.1 River Storelva

Water flow

The flow dynamics in River Storelva are characterized by rapid responses to precipitation events with a relatively quick return to baseline levels after flood peaks. There are no strong seasonal patterns in water flow, and flood events occur during all seasons, also during winter. In 2020, the winter was mild in southern Norway and there were several small high flow events linked to snowmelt and/or rainfall in Storelva from mid-January to the end of March (Figure 37). There were only two minor flow peaks from late March until early October, whereas the rest of the year was characterised by repeating large high flow events. The largest one occurred on 29 December, with a peak water flow of 157 m^3/s, which corresponds to a five-year flood.

Water temperature

The water temperature in 2020 first exceeded 10°C on April 19th, which was one day earlier than in 2019 and nearly 3 weeks earlier than in 2018 (Figure 37). The water temperature first exceeded 20°C on June 2nd but did not reach its maximum until mid-August. The water temperature remained above 10°C until December 3rd, which was nearly two months later than in 2019 and about one month later than in 2017 and 2018. Hence, the autumn in 2020 was both unusually mild and unusually wet.

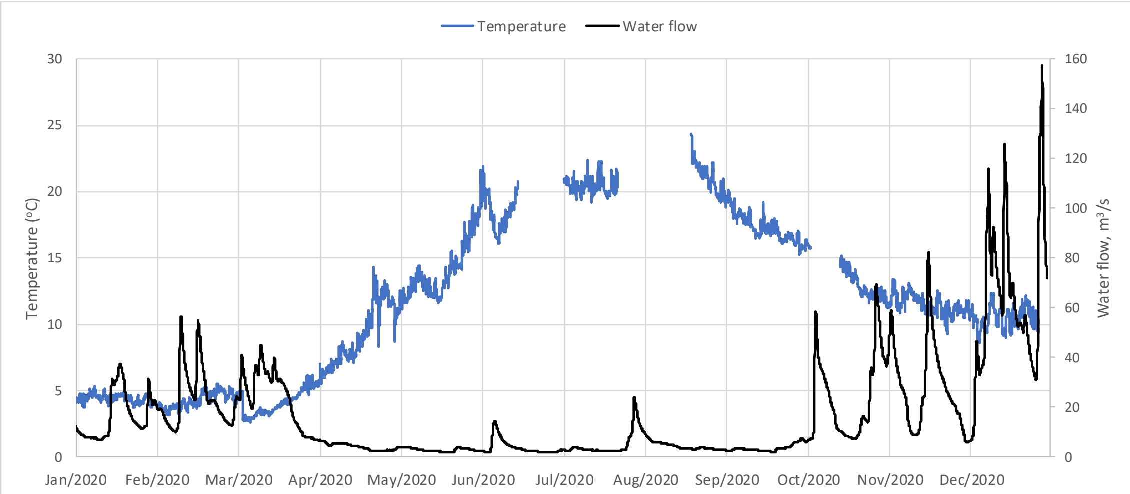

Figure 37. Water temperature and water flow at the outlet of River Storelva in 2020. The water flow data (daily mean values) are from NVE's hydrologic monitoring station 18.4.0 (Lundevann).

pH

River Storelva has been heavily affected by acidification from long-range transported air pollution, and since the 1990s the river has been limed[4] to protect the salmon and sea trout populations. The target pH value for the liming is 6.4 all year round, to protect salmon, sea trout and the freshwater pearl mussel. The continuous pH monitoring in 2020 shows that pH values varied between 6.0 and 6.4 until late April and thereafter increased to levels around 6.5 (Figure 38). Floods from October and onwards caused pH to drop below 6.0 on several occasions, reaching a minimum of 5.5 for a short time during the flash flood in December 2020. Hence, it seems difficult to keep pH above 6.4 all the way down to the river outlet during flood events. The distinct pH drop observed in December, could potentially have had negative impacts on fish and other freshwater biota during the episode. Detection of short-term episodes like the one in December demonstrates the usefulness of continuous sensor-based monitoring. It would have been very unlikely to capture this with regular monthly sampling.

[4] Crushed limestone ($CaCO_3$) added from a lime dozer located about 20 km upstream the river outlet

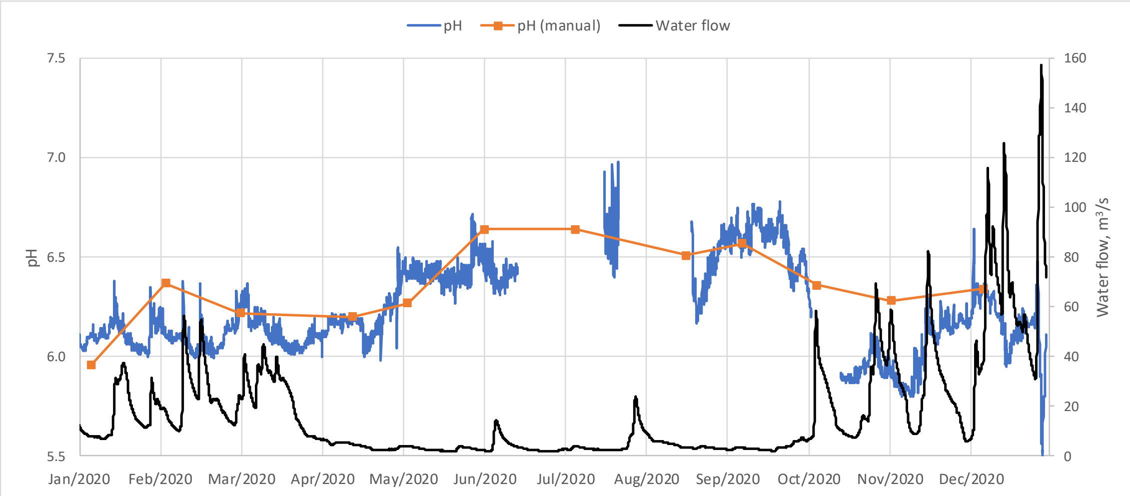

Figure 38. pH and water flow at the outlet of River Storelva in 2020. The water flow data (daily mean values) are from NVE.

Conductivity

Conductivity, which is a measure of water's ability to transmit an electrical current and is correlated with the concentration of ions in water, was relatively stable throughout the year with values typically ranging from 3-6 mS/m (Figure 39). Conductivity responds differently to high flow events during different seasons. For example, conductivity often peaks during the early phases of spring snowmelt, and then decreases throughout the remainder of the high-flow period. This phenomenon has been widely observed for catchments that experience snow accumulation during winter where high-frequency sensor-based monitoring is carried out and is attributed to the elution of ions from the seasonal snowpack and sub-surface lateral flow during the early stages of spring snow melt. As the snowmelt proceeds, conductivity decreases due to dilution with low-ionic strength water from the remaining snowpack. Due to very little snow accumulation in 2020[5], only a minor snowmelt flood occurred in early March. Nevertheless, the small flood was preceded by a slight increase in conductivity around March 1st. During most rainfall floods later in the year, conductivity peaked just before or simultaneously with the flood peak. The most pronounced increase in conductivity was seen in association with a large flood in December, where conductivity increased rapidly from a base level around 3 mS/m to nearly 6 mS/m before quickly returning to the base level again.

[5] Short period with snow cover at Nelaug (SN36560) from 25 February to 17 March. Max depth: 36 cm

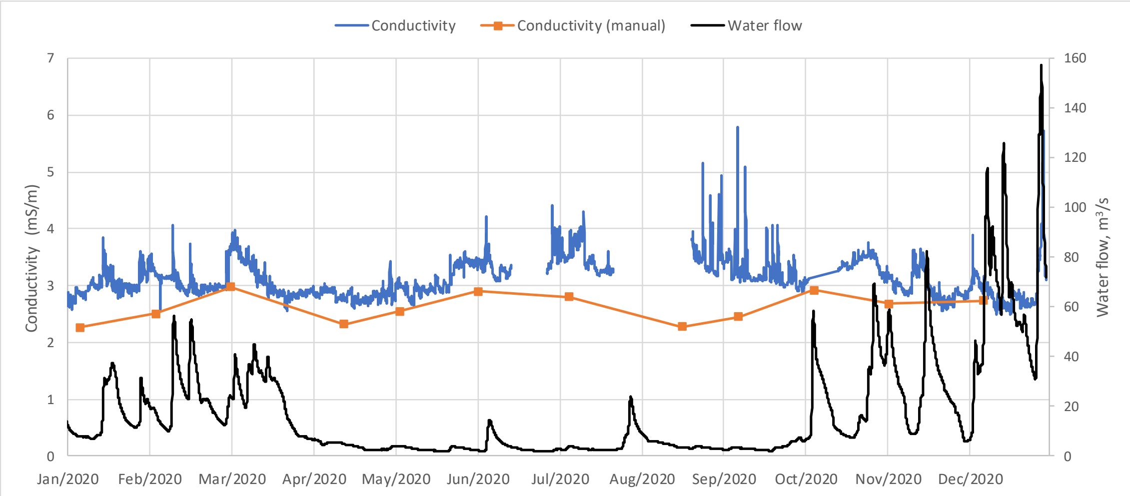

Figure 39. Conductivity and water flow at the outlet of River Storelva in 2020. The water flow data (daily mean values) are from NVE.

Turbidity

Turbidity is related to suspended particulate matter that affect the clarity of water. In River Storelva, with clay soils in the lower parts of the catchment, the turbidity increases quickly during periods of high flow (Figure 40). This is nicely illustrated during the small floods that occurred between January and March, and especially during the relatively large flood in late October / early November when turbidity increased rapidly to levels around 25-30 NTU. Interestingly, the particle loads associated with the floods later in autumn were less pronounced. The underlying mechanisms for this are not clear, but variability in particle loads during floods might be related to hydrological processes (e.g., rainfall intensity) or land management (e.g., tillage on agricultural fields). Another possibility is that previous flood events may have depleted the available pool of sediments that could be easily mobilized and transported downstream during subsequent high flow events. The sensor data were typically higher than turbidity values that were measured in grab samples. One possible reason for this is that monthly grab samples tend to miss flood events and often underestimate the total particle load throughout the year. Since phosphate and total phosphorus are often strongly correlated with particle concentrations, high-frequency turbidity data can also be used to improve estimates of riverine phosphorus loads, and to provide estimates over shorter temporal scales (e.g. loads associated with single flood events).

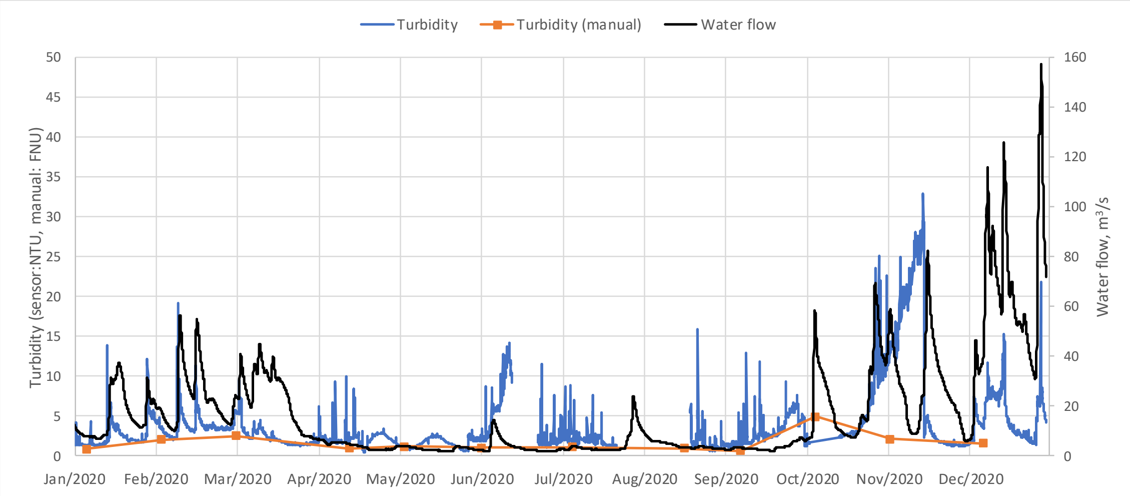

Figure 40. Turbidity and water flow at the outlet of Storelva in 2020. The water flow data (daily mean values) are from NVE.

FDOM

Fluorescent dissolved organic matter (the fraction of CDOM that fluoresces) can be used as proxy for DOC concentrations in water. As can be seen in Figure 41, DOC measured in grab samples largely follows the seasonal pattern observed in the high-frequency data. In general, FDOM in River Storelva follow a seasonal pattern with the highest concentrations during the autumn and winter period (60-80 QSU[6]) and lowest concentrations (40-50 QSU) throughout the summer period. The highest FDOM values in 2020 (70-80 QSU) were recorded during the high-flow period from October until end of December. The post-summer increase in FDOM was almost identical to the patterns observed in 2018 and 2019, where concentrations suddenly increased from around 40 to 70-80 QSU as a response to increased water flow. Late in autumn there is a tendency towards dilution of the FDOM signal during floods, suggesting that earlier floods may have already ‘flushed out’ the easily mobilizable fraction of the soil DOM pool.

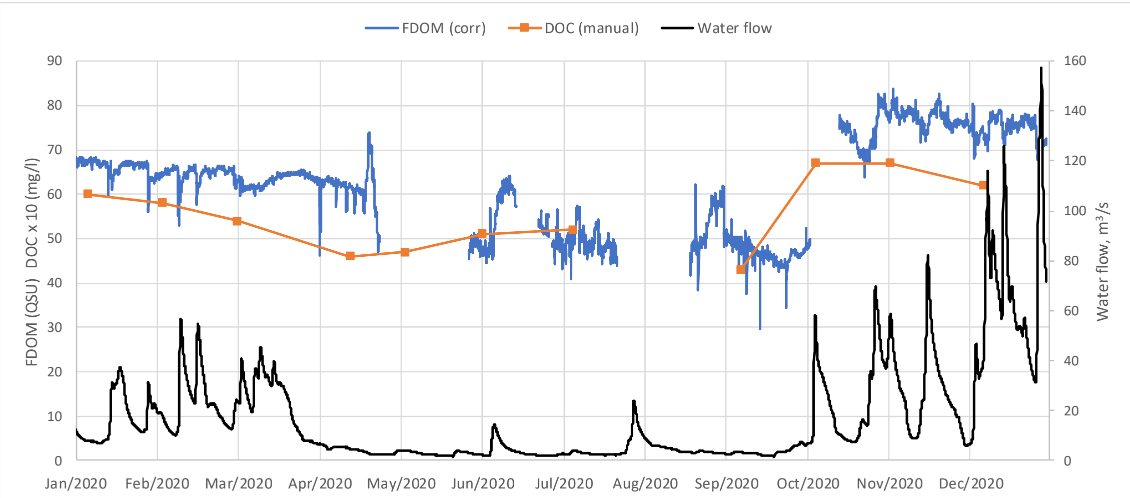

Figure 41. FDOM and water flow at the outlet of Storelva in 2020. The water flow data (daily mean values) are from NVE.

[6] Quinine Sulphate Units

3.6.2 River Målselva

Water flow

The flow in River Målselva is highly seasonal (Figure 42). During winter, practically all precipitation accumulates as snow in the catchment, with the low river discharge supported primarily by groundwater. The highest water flow is usually associated with snowmelt, which often takes place in a two-stage process, with snow melting first in the lower parts of the catchment and then melting later in the upper, mountainous parts of the catchment. In 2020, very high snow accumulation in the catchment led to a pronounced snowmelt flood that progressed rapidly from low-flow conditions of approximately 30 m^3/s on May 20th to nearly 640 m^3/s on June 8th. The flood peak corresponded to a level between an average flood (562 m^3/s) and a five-year flood (674 m^3/s). After culmination of the snowmelt peak, five smaller flood peaks occurred between June and September, alongside a gradual decrease in discharge that continued for the remainder of the year, without any significant flood peaks after September.

Water temperature

The water temperature was approximately zero until the first week of May (Figure 42). The water temperature first exceeded 10°C on July 12th and reached a maximum of 13.7°C on August 9th. The temperature fell below 10°C on two occasions after August 16th, and then fell below 10°C for the last time in 2020 on September 7th, reaching near-zero temperatures around November 22nd. In general, water temperatures were lower in 2020 compared to the previous year.

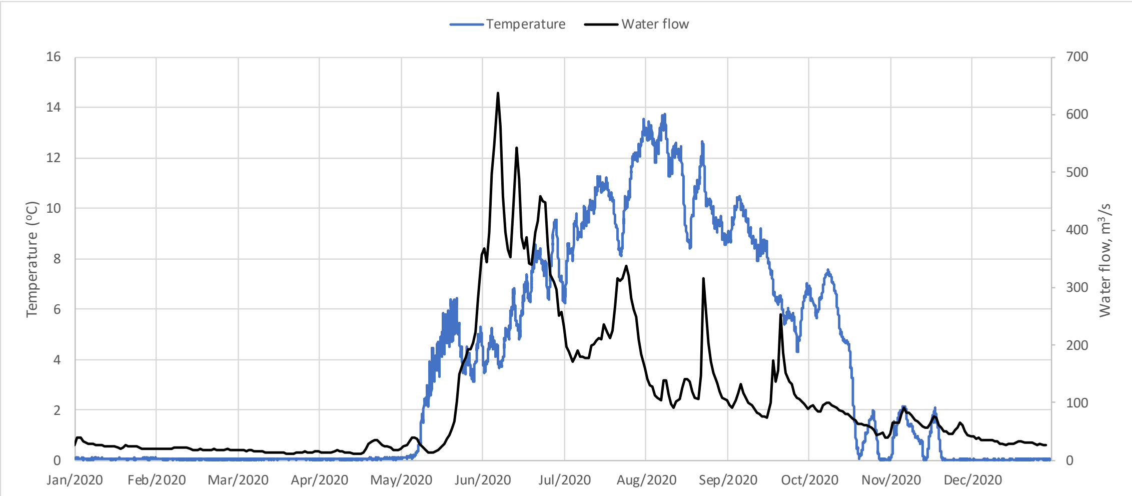

Figure 42. Water temperature and water flow at the outlet of River Målselva in 2020. The water flow data (daily mean values) are from NVE's station 196.35.0 Målselvfossen.

pH

River Målselva is well-buffered and not strongly affected by long-range transported air pollution. The pH-values are relatively stable around 7.5 with small seasonal variations (Figure 43). River ice can cause challenges with maintaining the calibration routines during the cold season. Calibration in late May showed that the pH signal had drifted downwards during winter, and the green line in Figure 43 show pH after slope correction. The short-term pH drops that were observed during flood events in August and September were likely due to dilution of base cations. This is described in more detail below when discussing conductivity.

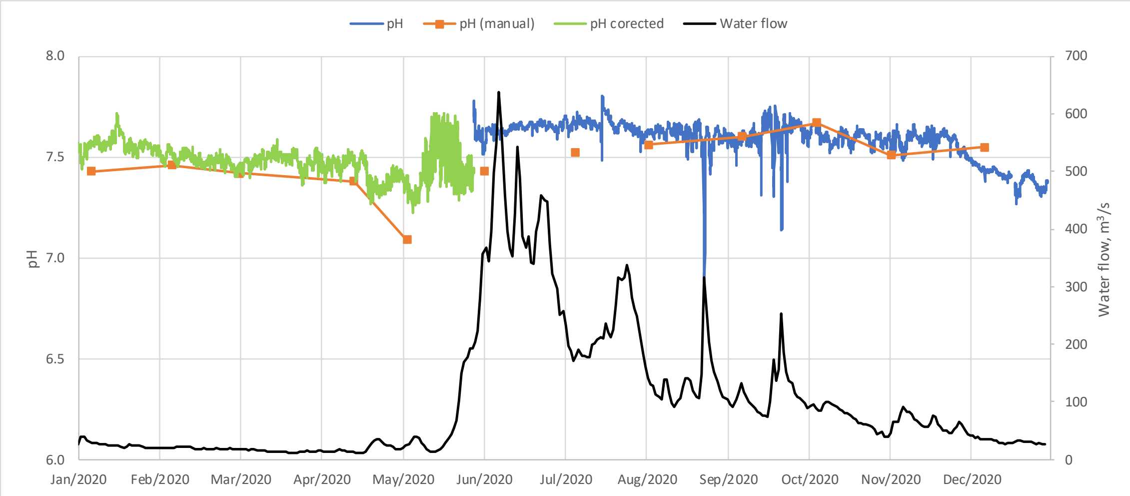

Figure 43. pH and water flow at the outlet of River Målselva in 2020. The water flow data (daily mean values) are from NVE.

Conductivity

The conductivity in River Målselva typically follows a pattern that is opposite to water flow, with higher conductivity during periods of low flow and lower conductivity during periods of high flow. This is especially evident during the snowmelt flood (Figure 44). As also described in the presentation of the River Storelva results, during the early stages of snowmelt, conductivity tends to increase due to elution of ions from the seasonal snowpack and the snow-soil interface. However, as water flow increases, the conductivity declines due to dilution by meltwater with lower ionic strength. Similar dilution effects can also be seen during the smaller floods that occurred later in the year. On some occasions, large rainfall floods in this river can lead to erosion and increased solute concentrations in the water, however this was not seen in 2020. There was generally good accordance between the sensor data and conductivity measured in grab samples.

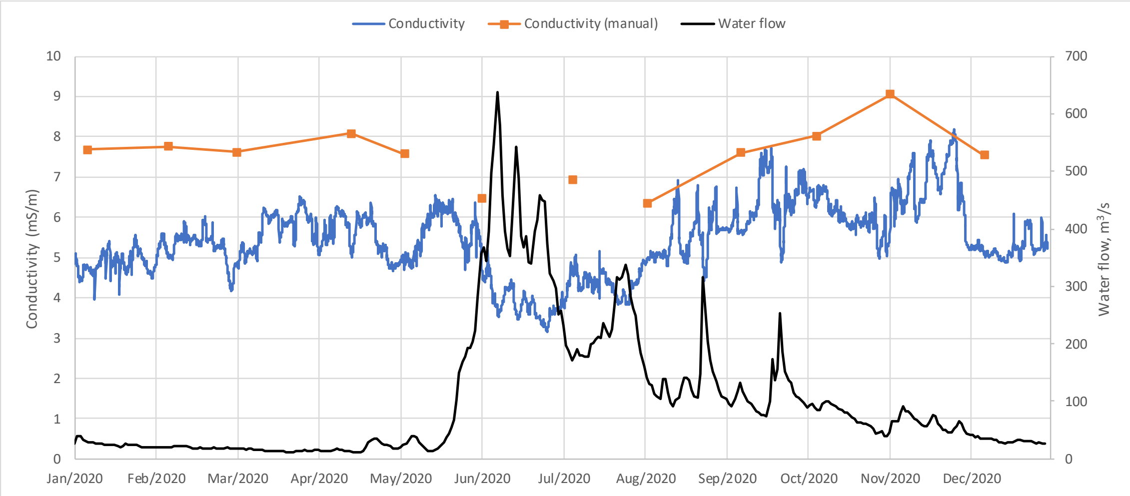

Figure 44. Conductivity and water flow at the outlet of River Målselva in 2020. The water flow data (daily mean values) are from NVE.

Turbidity

Since the lower parts of the river are relatively flat with several meandering bends, sediment is easily resuspended during high-flow events. Higher up in the catchment, mountainous areas that are poorly vegetated can also be important sites for erosion and transport of particulate matter downstream. Flood peaks are therefore usually accompanied by significant turbidity peaks in this river. In 2020, the turbidity was high (10-40 NTU) during the entire snowmelt flood, from the last week of May and throughout June (Figure 45). Combined with high water discharges, this results in a significant transport of particulate matter that ultimately ends up in the downstream coastal fjord system (Poste et al. 2021). The highest turbidity peak in 2020 (90 NTU) occurred during the rainfall flood in late August. None of these turbidity peaks were captured by the manual sampling, which highlights that monthly sampling often misses short-term episodes in rivers. The samples taken during the snowmelt flood in June show increased turbidity, but do not capture the highest levels recorded through the sensor-based monitoring.

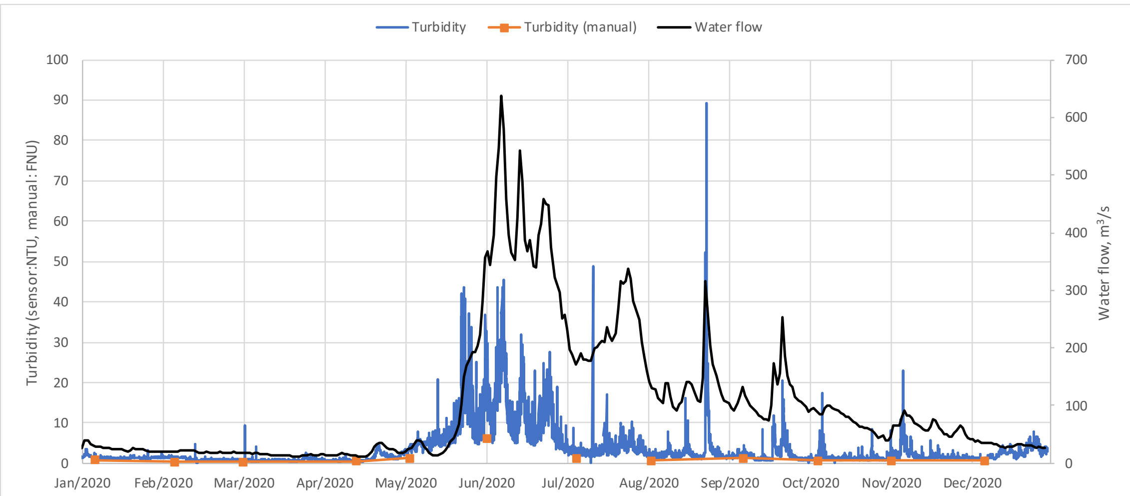

Figure 45. Turbidity and water flow at the outlet of Målselva in 2020. The water flow data (daily mean values) are from NVE.

FDOM

The fluorescent dissolved organic matter (FDOM) signal is also closely connected to water flow in River Målselva (Figure 46). Even small floods that occurred during the winter and spring period resulted in distinct FDOM peaks. During the snowmelt period, FDOM largely follows the same pattern as conductivity; increasing values during the early melting phase and decreasing values as the spring flood progresses with successively increasing inputs of dilute meltwater. As noted under the turbidity section (and in the discussion of FDOM in Storelva), significant amounts of particulate and organic matter (DOM) can be transported via the river to the downstream fjord system during floods (Poste et al. 2021). This is especially evident during the snowmelt flood, when frozen ground in the catchment can restrict water flow to the uppermost organic matter rich surface-soils, leading to mobilization and transport of large amounts of dissolved organic matter downstream over a period of several weeks. In July 2020, the FDOM sensor was sent to the instrument manufacturer in Germany for routine service and calibration. Technical problems during re-installation of the sensor two months later caused erroneous data which unfortunately had to be discarded.

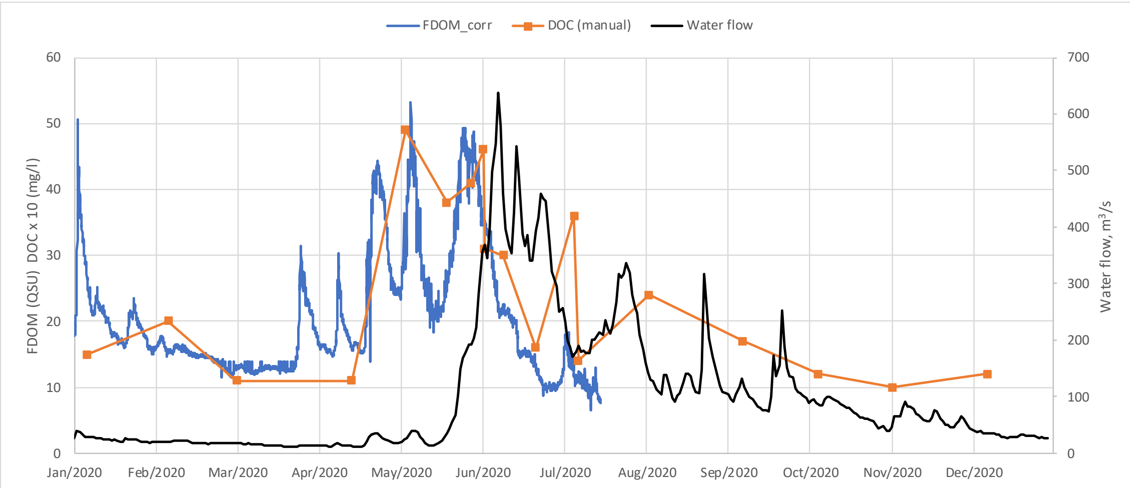

Figure 46. FDOM and water flow at the outlet of Målselva in 2020. The water flow data (daily mean values) are from NVE.

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5. Appendix A

5.1 Riverine concentrations in 2020

Glomma ved Sarpsfoss

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
13.01.2020	694.99	7.09	5.86	31.00	13.30	5.30	5.30	567.00	24.00	42.00	7.00	570.00	8.00	800.00	51.50	4.74									
10.02.2020	678.90	7.05	5.43	56.00	44.90	5.50	5.40	1201.00	54.00	66.00	8.00	500.00	<2.0	740.00	115.00	6.45	0.01	0.35	0.36	0.00	1.57	2.70	1.03	1.10	6.00
02.03.2020	681.49	7.01	4.95	20.00	14.10	5.10	5.00	409.00	16.00	19.00	8.00	400.00	16.00	630.00	30.70	4.76									
14.04.2020	590.77	6.95	4.93	6.30	5.34	4.20	4.10	263.00	8.00	11.00	3.00	400.00	12.00	650.00	26.30	4.14									
11.05.2020	617.60	7.12	4.44	2.80	3.93	4.20	4.20	445.00	5.00	9.00	2.00	260.00	16.00	780.00	35.70	3.34	<0.002	0.15	0.14	0.01	1.20	2.60	0.59	0.17	<1.0
18.05.2020	574.51	7.21	4.53	1.90	4.26	3.60	4.50	334.00	4.00	7.00	4.00	250.00	5.00	320.00	35.20	3.36									
25.05.2020	798.52	7.04	4.43	2.10	2.99	5.50	5.50	266.00	3.00	6.00	<1.0	270.00	9.00	330.00	30.00	3.30									
02.06.2020	1249.37	6.95	3.64	2.70	5.94	4.50	5.30	353.00	5.00	12.00	7.00	190.00	<2.0	310.00	51.80	3.04									
15.06.2020	1668.01	6.91	3.53	3.70	6.63	3.50	3.50	485.00	6.00	13.00	1.00	220.00	12.00	330.00	51.00	3.06									
24.06.2020	1645.52	7.15	4.23	3.10	6.94	3.30	3.50	389.00	6.00	9.00	3.00	240.00	6.00	350.00	39.10	3.00									
06.07.2020	1537.15	7.23	4.41	3.90	8.19	3.10	3.10	420.00	9.00	13.00	3.00	370.00	3.00	450.00	53.10	3.26									
04.08.2020	1017.20	7.17	4.78	4.50	7.71	3.60	3.90	306.00	8.00	15.00	5.00	220.00	<2.0	460.00	47.20	3.17	<0.002	0.20	0.25	0.01	1.87	3.70	0.91	0.29	<1.0
07.09.2020	417.92	7.33	4.59	1.40	3.09	2.80	2.80	322.00	3.00	5.00	1.00	220.00	2.00	350.00	39.00	2.44									
05.10.2020	920.58	7.30	5.02	2.80	3.61	2.90	3.00	242.00	5.00	10.00	4.00	360.00	21.00	440.00	29.70	2.70	<0.002	0.14	0.13	0.01	1.23	1.40	0.55	0.16	<1.0
02.11.2020	1561.94	7.12	5.02	23.00	19.80	5.90	5.80	827.00	27.00	37.00	13.00	490.00	<2.0	680.00	79.50	5.08									
07.12.2020	651.79	7.09	4.62	6.50	7.58	4.70	4.70	345.00	8.00	17.00	7.00	420.00	4.00	550.00	36.40	4.61									
Lower avg.	956.64	7.11	4.65	10.73	9.89	4.23	4.35	448.38	11.94	18.19	4.75	336.25	7.12	510.62	46.95	3.78	0.00	0.21	0.22	0.01	1.47	2.60	0.77	0.43	1.50
Upper avg..	956.64	7.11	4.65	10.73	9.89	4.23	4.35	448.38	11.94	18.19	4.81	336.25	7.62	510.62	46.95	3.78	0.00	0.21	0.22	0.01	1.47	2.60	0.77	0.43	2.25
Minimum	417.92	6.91	3.53	1.40	2.99	2.80	2.80	242.00	3.00	5.00	1.00	190.00	2.00	310.00	26.30	2.44	0.00	0.14	0.13	0.00	1.20	1.40	0.55	0.16	1.00
Maximum	1668.01	7.33	5.86	56.00	44.90	5.90	5.80	1201.00	54.00	66.00	13.00	570.00	21.00	800.00	115.00	6.45	0.01	0.35	0.36	0.01	1.87	3.70	1.03	1.10	6.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	431.97	0.12	0.59	14.96	10.40	1.02	0.98	246.36	13.29	16.42	3.31	118.54	6.12	178.42	22.46	1.08	0.00	0.10	0.11	0.00	0.32	0.94	0.24	0.45	2.50

Alna

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
15.01.2020	2.13	7.67	51.00	30.00	29.40	2.80	2.50	1769.00	63.00	91.00	20.00	740.00	18.00	1200.00	94.40	7.11									
04.02.2020	1.38	7.78	56.50	5.60	5.60	2.40	2.30	421.00	23.00	45.00	13.00	630.00	62.00	1000.00	46.80	7.03	0.01	0.28	0.40	0.03	2.51	9.90	0.79	0.41	<1.0
04.03.2020	1.65	7.67	136.00	16.00	20.30	1.80	1.70	1819.00	51.00	81.00	12.00	590.00	85.00	1200.00	159.00	6.73									
14.04.2020	0.54	7.87	43.10	5.90	5.53	2.60	2.50	780.00	27.00	41.00	16.00	650.00	120.00	1100.00	29.00	5.34									
04.05.2020	1.76	7.87	38.60	7.50	6.66	2.80	2.70	431.00	26.00	39.00	15.00	660.00	64.00	1000.00	46.00	5.16	0.01	0.31	0.46	0.02	3.07	9.60	0.84	0.49	<1.0
03.06.2020	0.38	7.92	40.70	2.80	5.35	8.00	8.70	527.00	49.00	61.00	31.00	1140.00	12.00	1400.00	73.00	2.49									
02.07.2020	0.75	8.08	41.30	5.10	7.26	6.10	4.70	566.00	48.00	68.00	44.00	1120.00	83.00	1400.00	55.30	6.92									
04.08.2020	0.80	7.96	33.80	4.70	1.21	12.00	12.00	548.00	52.00	66.00	40.00	720.00	<2.0	1100.00	62.20	6.13	0.01	0.40	0.46	0.04	2.46	9.50	0.72	0.29	<1.0
02.09.2020	0.35	8.11	40.50	3.10	2.66	3.60	3.40	433.00	56.00	62.00	39.00	1040.00	110.00	1400.00	28.70	6.47									
06.10.2020	2.31	7.92	27.90	15.00	32.20	6.60	6.10	2294.00	96.00	130.00	51.00	680.00	84.00	1000.00	163.00	6.36	0.01	0.62	2.42	0.08	8.14	29.70	1.79	1.58	<1.0
10.11.2020	0.79	7.98	34.30	4.40	5.68	4.30	4.30	1472.00	40.00	50.00	32.00	880.00	129.00	1100.00	54.00	7.50									
07.12.2020	3.30	7.82	34.10	18.00	20.40	5.00	5.00	2276.00	75.00	90.00	39.00	670.00	161.00	1100.00	137.00	8.64									
Lower avg.	1.34	7.89	48.15	9.84	11.85	4.83	4.66	1111.33	50.50	68.67	29.33	793.33	77.33	1166.67	79.03	6.32	0.01	0.40	0.93	0.04	4.04	14.68	1.03	0.69	0.00
Upper avg..	1.34	7.89	48.15	9.84	11.85	4.83	4.66	1111.33	50.50	68.67	29.33	793.33	77.50	1166.67	79.03	6.32	0.01	0.40	0.93	0.04	4.04	14.68	1.03	0.69	1.00
Minimum	0.35	7.67	27.90	2.80	1.21	1.80	1.70	421.00	23.00	39.00	12.00	590.00	2.00	1000.00	28.70	2.49	0.01	0.28	0.40	0.02	2.46	9.50	0.72	0.29	1.00
Maximum	3.30	8.11	136.00	30.00	32.20	12.00	12.00	2294.00	96.00	130.00	51.00	1140.00	161.00	1400.00	163.00	8.64	0.01	0.62	2.42	0.08	8.14	29.70	1.79	1.58	1.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.91	0.14	28.73	8.26	10.75	2.96	3.04	755.83	21.08	26.17	13.59	199.51	49.15	155.70	48.35	1.52	0.00	0.15	0.99	0.03	2.74	10.02	0.51	0.60	0.00

Drammenselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	294.51	6.93	4.08	0.69	0.79	3.20	3.20	129.00	<1.0	4.00	2.00	280.00	18.00	420.00	11.60	2.91									
03.02.2020	356.41	6.91	3.84	2.10	0.97	3.40	3.30	132.00	1.00	3.00	2.00	260.00	17.00	410.00	30.90	3.19	<0.002	0.11	0.07	0.01	0.59	2.00	0.39	0.10	<1.0
02.03.2020	380.34	7.06	4.06	1.80	1.33	3.30	3.30	142.00	2.00	5.00	2.00	260.00	20.00	420.00	16.20	3.11									
14.04.2020	328.60	7.09	3.59	1.00	1.03	3.10	3.20	135.00	2.00	5.00	1.00	270.00	6.00	360.00	<1.0	2.85									
04.05.2020	386.91	6.91	3.37	0.70	1.27	3.60	3.70	200.00	3.00	4.00	2.00	250.00	5.00	350.00	16.90	2.83	<0.002	0.12	0.08	0.01	0.56	1.30	0.39	0.11	7.00
11.05.2020	375.00	7.04	3.54	0.94	1.16	4.40	3.80	323.00	3.00	4.00	2.00	220.00	3.00	360.00	31.40	2.89									
25.05.2020	404.05	6.81	3.30	0.79	1.40	4.20	4.10	193.00	2.00	3.00	2.00	220.00	2.00	250.00	22.90	2.87									
02.06.2020	537.17	6.92	3.08	0.79	1.66	4.20	4.20	217.00	2.00	4.00	3.00	220.00	<2.0	300.00	24.40	2.72									
15.06.2020	491.47	7.01	3.03	0.88	1.05	3.20	3.20	312.00	2.00	3.00	<1.0	170.00	9.00	270.00	28.90	2.66									
22.06.2020	490.17	6.93	2.86	0.89	1.58	4.30	4.50	287.00	3.00	4.00	2.00	170.00	5.00	360.00	31.20	2.57									
06.07.2020	408.96	7.10	3.14	1.40	1.58	3.70	3.60	249.00	2.00	4.00	2.00	190.00	<2.0	290.00	31.70	2.55									
03.08.2020	491.52	7.06	2.96	1.20	1.27	4.30	3.50	225.00	1.00	4.00	2.00	140.00	3.00	270.00	33.00	2.40	<0.002	0.14	0.06	0.01	0.55	0.97	0.37	0.08	<1.0
07.09.2020	161.85	7.13	3.10	0.61	0.85	3.60	3.50	589.00	<1.0	3.00	<1.0	130.00	3.00	240.00	54.10	2.34									
05.10.2020	610.53	7.17	4.97	9.30	12.70	5.80	5.50	821.00	11.00	24.00	6.00	700.00	9.00	810.00	60.70	3.69	<0.002	0.30	0.50	0.02	1.37	4.10	0.82	0.38	<1.0
02.11.2020	700.53	7.27	5.14	3.50	4.09	4.50	4.50	265.00	5.00	11.00	7.00	500.00	<2.0	610.00	30.00	3.75									
07.12.2020	382.48	7.13	4.14	2.10	2.23	3.50	3.50	211.00	3.00	7.00	3.00	410.00	5.00	490.00	24.10	3.51									
Lower avg.	425.03	7.03	3.64	1.79	2.19	3.89	3.79	276.88	2.62	5.75	2.38	274.38	6.56	388.12	28.00	2.93	0.00	0.17	0.18	0.01	0.77	2.09	0.49	0.17	1.75
Upper avg..	425.03	7.03	3.64	1.79	2.19	3.89	3.79	276.88	2.75	5.75	2.50	274.38	6.94	388.12	28.06	2.93	0.00	0.17	0.18	0.01	0.77	2.09	0.49	0.17	2.50
Minimum	161.85	6.81	2.86	0.61	0.79	3.10	3.20	129.00	1.00	3.00	1.00	130.00	2.00	240.00	1.00	2.34	0.00	0.11	0.06	0.01	0.55	0.97	0.37	0.08	1.00
Maximum	700.53	7.27	5.14	9.30	12.70	5.80	5.50	821.00	11.00	24.00	7.00	700.00	20.00	810.00	60.70	3.75	0.00	0.30	0.50	0.02	1.37	4.10	0.82	0.38	7.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	127.73	0.12	0.69	2.14	2.91	0.70	0.63	183.05	2.44	5.26	1.67	147.92	6.10	148.38	14.47	0.43	0.00	0.09	0.22	0.01	0.40	1.41	0.22	0.14	3.00

Numedalslågen

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
13.01.2020	126.69	6.73	3.09	2.50	3.80	4.30	4.20	241.00	2.00	7.00	2.00	210.00	42.00	400.00	20.10	3.71									
03.02.2020	114.78	6.72	3.51	3.60	6.58	4.30	4.20	493.00	10.00	11.00	4.00	280.00	17.00	460.00	29.50	4.22	<0.002	0.14	0.26	0.02	0.62	3.70	0.37	0.20	1.00
02.03.2020	132.65	6.71	3.95	4.70	4.31	3.40	3.20	380.00	8.00	11.00	2.00	340.00	26.00	530.00	<1.0	4.03									
13.04.2020	140.45	6.68	2.43	0.87	<0.5	3.80	3.70	209.00	3.00	5.00	2.00	140.00	14.00	260.00	12.10	3.06									
04.05.2020	137.63	6.80	2.38	0.98	1.66	4.60	4.60	225.00	3.00	5.00	2.00	110.00	9.00	270.00	21.40	2.96	0.03	0.16	0.22	0.01	0.53	2.60	0.28	0.11	<1.0
02.06.2020	153.56	6.75	2.00	1.20	2.81	4.40	4.10	341.00	2.00	5.00	3.00	71.00	<2.0	180.00	31.50	2.66									
06.07.2020	266.66	6.81	2.10	3.90	10.80	4.70	4.60	576.00	7.00	14.00	5.00	65.00	<2.0	240.00	47.70	3.26									
03.08.2020	147.24	6.64	2.33	1.80	3.58	6.20	6.10	498.00	5.00	12.00	3.00	48.00	<2.0	270.00	59.60	2.79	0.00	0.19	0.29	0.01	0.74	3.10	0.39	0.18	<1.0
07.09.2020	78.20	6.94	2.44	0.90	1.48	2.80	2.50	356.00	1.00	4.00	1.00	74.00	6.00	200.00	27.60	2.40									
05.10.2020	424.28	6.53	2.83	28.00	58.20	9.50	9.20	2468.00	44.00	68.00	10.00	330.00	10.00	600.00	167.00	5.29	0.01	0.57	1.77	0.06	1.83	11.80	1.09	0.76	1.00
02.11.2020	305.49	6.75	3.38	8.50	6.26	6.80	6.70	591.00	14.00	25.00	5.00	330.00	5.00	530.00	53.00	4.71									
07.12.2020	127.65	6.92	3.50	2.30	3.59	3.70	3.70	279.00	5.00	11.00	4.00	280.00	43.00	480.00	22.60	4.50									
Lower avg.	179.61	6.75	2.83	4.94	8.59	4.87	4.73	554.75	8.67	14.83	3.58	189.83	14.33	368.33	41.01	3.63	0.01	0.27	0.63	0.03	0.93	5.30	0.53	0.31	0.50
Upper avg..	179.61	6.75	2.83	4.94	8.63	4.87	4.73	554.75	8.67	14.83	3.58	189.83	14.83	368.33	41.09	3.63	0.01	0.27	0.63	0.03	0.93	5.30	0.53	0.31	1.00
Minimum	78.20	6.53	2.00	0.87	0.50	2.80	2.50	209.00	1.00	4.00	1.00	48.00	2.00	180.00	1.00	2.40	0.00	0.14	0.22	0.01	0.53	2.60	0.28	0.11	1.00
Maximum	424.28	6.94	3.95	28.00	58.20	9.50	9.20	2468.00	44.00	68.00	10.00	340.00	43.00	600.00	167.00	5.29	0.03	0.57	1.77	0.06	1.83	11.80	1.09	0.76	1.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	100.23	0.11	0.64	7.58	15.85	1.83	1.81	617.02	11.76	17.71	2.39	117.01	14.73	147.45	43.07	0.92	0.01	0.20	0.76	0.02	0.61	4.36	0.37	0.30	0.00

Skienselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
14.01.2020	301.40	6.67	2.12	0.86	2.10	2.80	2.90	165.00	2.00	5.00	1.00	160.00	8.00	270.00	16.20	2.25									
04.02.2020	280.71	6.48	2.04	0.42	<0.67	2.80	2.80	113.00	<1.0	3.00	<1.0	160.00	<2.0	250.00	8.03	2.46	<0.002	0.10	0.05	0.01	0.35	3.00	0.10	0.07	1.00
09.03.2020	380.69	6.71	2.13	1.20	1.06	2.80	2.80	78.30	2.00	4.00	1.00	150.00	<2.0	260.00	20.90	2.51									
14.04.2020	316.65	6.65	2.02	0.45	<0.25	2.70	2.60	87.60	2.00	3.00	<1.0	170.00	<2.0	240.00	4.41	2.44									
04.05.2020	345.51	6.70	1.99	<0.3	0.37	2.70	2.70	161.00	3.00	3.00	1.00	140.00	<2.0	240.00	30.90	2.36	<0.002	0.09	0.04	0.01	0.36	1.60	0.21	0.07	<1.0
02.06.2020	322.87	6.74	1.90	<0.3	<0.5	2.50	2.90	127.00	<1.0	3.00	2.00	160.00	<2.0	200.00	3.03	2.21									
06.07.2020	515.82	6.81	1.89	0.61	1.00	2.70	2.70	176.00	2.00	3.00	3.00	120.00	<2.0	190.00	19.60	1.96									
03.08.2020	438.53	6.73	1.68	0.71	0.98	3.20	3.10	154.00	1.00	4.00	1.00	83.00	<2.0	190.00	33.60	1.94	<0.002	0.11	0.07	0.01	0.38	1.70	0.19	0.06	<1.0
07.09.2020	197.09	6.79	1.67	0.42	0.68	3.60	3.40	192.00	<1.0	3.00	1.00	70.00	8.00	140.00	20.80	1.89									
05.10.2020	982.82	6.77	2.05	2.70	3.30	3.60	3.50	313.00	5.00	9.00	3.00	140.00	15.00	250.00	27.50	2.27	<0.002	0.15	0.16	0.01	0.53	2.40	0.28	0.12	1.00
02.11.2020	664.32	6.74	2.07	1.60	3.25	3.70	3.70	261.00	4.00	8.00	2.00	150.00	8.00	260.00	26.00	2.57									
07.12.2020	321.95	6.82	2.03	0.59	0.78	3.10	3.00	139.00	1.00	4.00	2.00	120.00	25.00	240.00	10.60	2.46									
Lower avg.	422.36	6.72	1.97	0.80	1.13	3.02	3.01	163.91	1.83	4.33	1.42	135.25	5.33	227.50	18.46	2.28	0.00	0.11	0.08	0.01	0.40	2.17	0.20	0.08	0.50
Upper avg..	422.36	6.72	1.97	0.85	1.24	3.02	3.01	163.91	2.08	4.33	1.58	135.25	6.50	227.50	18.46	2.28	0.00	0.11	0.08	0.01	0.40	2.17	0.20	0.08	1.00
Minimum	197.09	6.48	1.67	0.30	0.25	2.50	2.60	78.30	1.00	3.00	1.00	70.00	2.00	140.00	3.03	1.89	0.00	0.09	0.04	0.01	0.35	1.60	0.10	0.06	1.00
Maximum	982.82	6.82	2.13	2.70	3.30	3.70	3.70	313.00	5.00	9.00	3.00	170.00	25.00	270.00	33.60	2.57	0.00	0.15	0.16	0.01	0.53	3.00	0.28	0.12	1.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	214.45	0.09	0.15	0.70	1.06	0.42	0.35	67.71	1.31	2.06	0.79	31.59	7.15	38.88	10.21	0.24	0.00	0.03	0.06	0.00	0.08	0.66	0.07	0.03	0.00

Vegårdselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	16.96	5.96	2.26	0.89	1.07	6.00	6.00	273.00	1.00	5.00	3.00	140.00	21.00	340.00	15.20	2.83									
03.02.2020	16.83	6.37	2.50	2.00	3.09	5.90	5.80	289.00	2.00	6.00	2.00	150.00	25.00	350.00	21.60	3.19	<0.002	0.22	0.44	0.03	0.64	6.00	0.45	0.23	<1.0
02.03.2020	39.25	6.22	2.97	2.50	2.12	5.50	5.40	279.00	3.00	8.00	3.00	150.00	17.00	350.00	27.60	3.13									
13.04.2020	7.92	6.20	2.32	0.92	0.60	4.70	4.60	297.00	2.00	8.00	1.00	140.00	12.00	300.00	35.00	2.68									
04.05.2020	6.71	6.27	2.55	1.20	1.80	4.70	4.70	376.00	3.00	5.00	2.00	150.00	<2.0	310.00	33.70	2.34	<0.002	0.18	0.27	0.03	0.61	4.90	0.38	0.17	<1.0
02.06.2020	4.92	6.64	2.90	1.00	1.66	5.40	5.10	400.00	2.00	7.00	3.00	98.00	<2.0	250.00	38.20	1.40									
06.07.2020	6.45	6.64	2.80	1.10	2.20	5.30	5.20	449.00	2.00	6.00	<1.0	60.00	9.00	280.00	63.70	1.02									
17.08.2020	4.22	6.51	2.27	0.92	2.02	5.50	5.30	534.00	2.00	7.00	1.00	24.00	9.00	230.00	57.60	1.49	<0.002	0.27	0.22	0.02	0.62	4.00	0.38	0.15	<1.0
07.09.2020	4.25	6.57	2.45	0.63	1.53	5.00	4.30	322.00	1.00	5.00	2.00	40.00	<2.0	220.00	34.50	1.53									
05.10.2020	18.24	6.36	2.92	4.90	6.24	7.00	6.70	638.00	6.00	13.00	5.00	160.00	21.00	370.00	61.60	2.51	<0.002	0.33	0.64	0.04	0.95	7.10	0.61	0.28	<1.0
02.11.2020	28.22	6.28	2.68	2.10	2.90	6.80	6.70	422.00	3.00	11.00	4.00	140.00	7.00	370.00	42.40	3.26									
07.12.2020	23.45	6.34	2.73	1.60	2.57	6.20	6.20	390.00	2.00	9.00	3.00	220.00	17.00	410.00	34.80	3.47									
Lower avg.	14.79	6.36	2.61	1.65	2.32	5.67	5.50	389.08	2.42	7.50	2.42	122.67	11.50	315.00	38.83	2.40	0.00	0.25	0.39	0.03	0.71	5.50	0.45	0.21	0.00
Upper avg..	14.79	6.36	2.61	1.65	2.32	5.67	5.50	389.08	2.42	7.50	2.50	122.67	12.00	315.00	38.83	2.40	0.00	0.25	0.39	0.03	0.71	5.50	0.45	0.21	1.00
Minimum	4.22	5.96	2.26	0.63	0.60	4.70	4.30	273.00	1.00	5.00	1.00	24.00	2.00	220.00	15.20	1.02	0.00	0.18	0.22	0.02	0.61	4.00	0.38	0.15	1.00
Maximum	39.25	6.64	2.97	4.90	6.24	7.00	6.70	638.00	6.00	13.00	5.00	220.00	25.00	410.00	63.70	3.47	0.00	0.33	0.64	0.04	0.95	7.10	0.61	0.28	1.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	11.19	0.20	0.26	1.18	1.43	0.74	0.79	111.40	1.31	2.50	1.24	56.50	8.11	60.38	15.25	0.84	0.00	0.06	0.19	0.01	0.16	1.34	0.11	0.06	0.00

Otra

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
07.01.2020	95.14	6.03	1.51	<0.3	0.51	3.10	3.00	170.00	<1.0	3.00	1.00	89.00	24.00	230.00	14.20	1.85									
03.02.2020	169.47	6.11	1.56	0.33	0.71	3.20	3.10	127.00	<1.0	4.00	<1.0	85.00	21.00	210.00	12.40	1.92	<0.002	0.12	0.26	0.02	0.42	2.60	0.41	0.09	2.00
02.03.2020	251.67	6.28	1.85	0.46	0.72	2.70	2.60	183.00	2.00	4.00	<1.0	76.00	11.00	170.00	14.70	1.83									
14.04.2020	186.89	6.33	1.29	<0.3	<0.29	2.30	2.20	271.00	<1.0	2.00	<1.0	66.00	<2.0	140.00	30.30	1.62									
04.05.2020	186.49	6.17	1.32	<0.3	0.59	2.30	2.20	296.00	2.00	2.00	<1.0	75.00	<2.0	170.00	27.50	1.56	<0.002	0.08	0.13	0.01	0.32	1.90	0.21	0.08	<1.0
02.06.2020	92.30	6.03	1.26	<0.3	0.75	2.50	2.40	231.00	1.00	2.00	2.00	64.00	<2.0	150.00	23.70	1.29									
06.07.2020	117.66	6.20	1.31	0.92	1.17	2.60	2.50	220.00	1.00	2.00	<1.0	47.00	<2.0	130.00	25.50	1.10									
03.08.2020	221.25	6.24	1.21	1.00	2.71	3.50	3.10	493.00	1.00	5.00	2.00	32.00	<2.0	210.00	49.30	1.15	<0.002	0.13	0.25	0.01	0.43	2.10	0.41	0.08	<1.0
07.09.2020	101.57	6.17	1.16	0.37	1.10	3.00	2.60	242.00	<1.0	4.00	<1.0	30.00	<2.0	120.00	9.48	1.02									
05.10.2020	286.89	5.97	1.67	1.30	2.37	4.80	4.40	591.00	3.00	7.00	2.00	59.00	18.00	250.00	51.20	1.68	<0.002	0.19	0.51	0.02	0.56	4.00	0.41	0.14	<1.0
02.11.2020	439.46	6.02	1.65	1.40	2.59	4.40	4.20	473.00	2.00	7.00	2.00	72.00	3.00	230.00	40.40	2.04									
07.12.2020	280.31	6.06	1.55	0.58	1.27	3.70	3.60	280.00	2.00	3.00	2.00	110.00	10.00	230.00	23.00	1.99									
Lower avg.	202.43	6.13	1.45	0.53	1.21	3.18	2.99	298.08	1.17	3.75	0.92	67.08	7.25	186.67	26.81	1.59	0.00	0.13	0.29	0.02	0.43	2.65	0.36	0.10	0.50
Upper avg..	202.43	6.13	1.45	0.63	1.23	3.18	2.99	298.08	1.50	3.75	1.42	67.08	8.25	186.67	26.81	1.59	0.00	0.13	0.29	0.02	0.43	2.65	0.36	0.10	1.25
Minimum	92.30	5.97	1.16	0.30	0.29	2.30	2.20	127.00	1.00	2.00	1.00	30.00	2.00	120.00	9.48	1.02	0.00	0.08	0.13	0.01	0.32	1.90	0.21	0.08	1.00
Maximum	439.46	6.33	1.85	1.40	2.71	4.80	4.40	591.00	3.00	7.00	2.00	110.00	24.00	250.00	51.20	2.04	0.00	0.19	0.51	0.02	0.56	4.00	0.41	0.14	2.00
More than 70% >LOD	yes	yes	yes	no	yes	yes	yes	yes	no	yes	no	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	102.13	0.12	0.22	0.41	0.85	0.80	0.74	144.01	0.67	1.82	0.51	23.15	8.41	45.19	13.94	0.36	0.00	0.05	0.16	0.01	0.10	0.95	0.10	0.03	0.50

Bjerkreimselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]
08.01.2020	62.71	6.37	3.34	0.35	0.45	1.50	1.50	207.00	<1.0	5.00	<1.0	310.00	20.00	450.00	23.30	1.56
17.02.2020	99.26	6.55	3.08	0.56	0.52	1.40	1.30	194.00	3.00	18.00	1.00	250.00	2.00	330.00	17.40	1.48
03.03.2020	65.45	6.51	3.90	0.42	1.45	1.30	1.30	367.00	3.00	6.00	1.00	330.00	3.00	430.00	27.40	<1.6542857143960001
16.04.2020	41.45	6.31	3.24	<0.3	1.85	1.20	1.20	142.00	1.00	2.00	<1.0	290.00	4.00	400.00	22.00	1.47
05.05.2020	32.32	6.63	3.18	<0.3	0.42	1.20	1.20	162.00	2.00	3.00	1.00	250.00	<2.0	330.00	16.40	1.37
02.06.2020	72.38	6.48	3.22	<0.3	0.45	1.70	1.50	158.00	<1.0	4.00	3.00	280.00	<2.0	300.00	23.70	1.23
06.07.2020	60.69	6.47	3.79	0.52	0.96	2.20	2.00	376.00	3.00	7.00	4.00	340.00	<2.0	490.00	47.00	1.37
10.08.2020	32.26	6.46	3.25	0.39	0.64	2.30	2.20	222.00	3.00	5.00	2.00	250.00	<2.0	330.00	29.80	1.20
07.09.2020	36.57	6.54	3.13	0.35	0.61	2.20	2.20	198.00	<1.0	4.00	2.00	240.00	<2.0	340.00	24.30	1.38
07.10.2020	29.27	6.73	3.14	0.36	<0.5	2.10	2.00	159.00	2.00	5.00	1.00	260.00	<2.0	300.00	21.00	1.40
10.11.2020	42.60	6.32	3.21	<0.3	0.51	1.90	1.80	273.00	2.00	5.00	3.00	400.00	<2.0	470.00	15.10	1.59
07.12.2020	49.89	6.35	3.17	<0.3	0.53	1.70	1.60	207.00	2.00	4.00	2.00	390.00	<2.0	400.00	17.00	1.63
Lower avg.	52.07	6.48	3.30	0.25	0.70	1.72	1.65	222.08	1.75	5.67	1.67	299.17	2.42	380.83	23.70	1.31
Upper avg..	52.07	6.48	3.30	0.37	0.74	1.72	1.65	222.08	2.00	5.67	1.83	299.17	3.75	380.83	23.70	1.44
Minimum	29.27	6.31	3.08	0.30	0.42	1.20	1.20	142.00	1.00	2.00	1.00	240.00	2.00	300.00	15.10	1.20
Maximum	99.26	6.73	3.90	0.56	1.85	2.30	2.20	376.00	3.00	18.00	4.00	400.00	20.00	490.00	47.00	1.65
More than 70% >LOD	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
St.dev	20.79	0.13	0.26	0.09	0.46	0.41	0.38	78.17	0.85	4.10	1.03	55.51	5.15	67.62	8.61	0.15

Date	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng
08.01.2020									
17.02.2020	<0.002	0.08	0.03	0.01	0.12	1.60	0.06	0.05	<1
03.03.2020									
16.04.2020									
05.05.2020	0.00	0.09	0.16	0.01	0.22	2.10	0.10	0.06	
02.06.2020									
06.07.2020									
10.08.2020	<0.002	0.10	0.22	0.02	0.38	3.60	0.28	0.06	<1
07.09.2020									
07.10.2020	<0.002	0.12	0.17	0.01	0.31	2.30	0.18	0.06	<1
10.11.2020									
07.12.2020									
Lower avg.	0.00	0.10	0.14	0.01	0.26	2.40	0.16	0.06	0.0
Upper avg..	0.00	0.10	0.14	0.01	0.26	2.40	0.16	0.06	1.0
Minimum	0.00	0.08	0.03	0.01	0.12	1.60	0.06	0.05	1.0
Maximum	0.00	0.12	0.22	0.02	0.38	3.60	0.28	0.06	1.0
More than 70% >LOD	no	yes	yes	yes	yes	yes	yes	yes	n
n	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.0
St.dev	0.00	0.02	0.08	0.00	0.11	0.85	0.10	0.00	0.0

Orreelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	11.18	7.58	17.90	15.00	11.30	6.40	4.60	2515.00	31.00	100.00	9.00	1140.00	10.00	1800.00	433.00	4.52									
04.02.2020	11.43	7.42	17.00	4.40	5.28	5.00	4.60	1162.00	20.00	53.00	16.00	1100.00	<2.0	1800.00	151.00	3.36	<0.002	0.18	<0.005	<0.003	1.34	0.34	0.76	0.15	<1.0
03.03.2020	9.46	7.45	16.20	7.50	9.60	5.60	4.20	1809.00	28.00	68.00	10.00	1300.00	2.00	1900.00	257.00	2.79									
14.04.2020	1.35	7.45	18.30	15.00	35.60	6.40	4.00	6029.00	72.00	110.00	7.00	600.00	24.00	1700.00	906.00	0.48									
04.05.2020	0.87	7.65	18.90	3.80	5.96	4.90	4.30	1488.00	11.00	38.00	6.00	200.00	25.00	800.00	232.00	0.59	<0.002	0.40	1.01	0.03	2.04	6.00	1.39	0.39	4.00
02.06.2020	1.36	7.82	19.30	6.60	6.11	7.00	5.40	1677.00	6.00	41.00	6.00	<2.0	23.00	710.00	255.00	0.32									
06.07.2020	17.59	7.78	20.50	8.70	16.60	9.40	5.00	4675.00	22.00	60.00	4.00	3.00	22.00	1000.00	605.00	2.72									
03.08.2020	6.98	7.66	17.90	8.40	8.03	6.70	4.90	2745.00	9.00	60.00	7.00	120.00	3.00	850.00	376.00	2.96	<0.002	0.28	0.16	0.01	1.51	1.90	1.18	0.12	<1.0
07.09.2020	8.56	7.67	19.50	7.50	7.24	8.40	6.30	2508.00	15.00	61.00	7.00	<2.0	<2.0	680.00	338.00	4.95									
05.10.2020	6.08	7.55	17.80	6.90	9.27	7.70	6.90	2395.00	19.00	66.00	7.00	430.00	55.00	1200.00	356.00	4.95	<0.002	0.34	0.56	0.01	3.40		1.43	0.21	<1.0
02.11.2020	31.39	7.71	17.00	6.50	9.89	7.00	6.90	3083.00	22.00	79.00	9.00	500.00	<2.0	1200.00	453.00	3.62									
07.12.2020	9.87	7.69	16.40	3.20	4.48	6.90	6.30	902.00	35.00	64.00	30.00	940.00	31.00	1500.00	113.00	3.81									
Lower avg.	9.68	7.62	18.06	7.79	10.78	6.78	5.28	2582.33	24.17	66.67	9.83	527.75	16.25	1261.67	372.92	2.92	0.00	0.30	0.43	0.01	2.07	2.75	1.19	0.22	1.00
Upper avg..	9.68	7.62	18.06	7.79	10.78	6.78	5.28	2582.33	24.17	66.67	9.83	528.08	16.75	1261.67	372.92	2.92	0.00	0.30	0.43	0.01	2.07	2.75	1.19	0.22	1.75
Minimum	0.87	7.42	16.20	3.20	4.48	4.90	4.00	902.00	6.00	38.00	4.00	2.00	2.00	680.00	113.00	0.32	0.00	0.18	0.01	0.00	1.34	0.34	0.76	0.12	1.00
Maximum	31.39	7.82	20.50	15.00	35.60	9.40	6.90	6029.00	72.00	110.00	30.00	1300.00	55.00	1900.00	906.00	4.95	0.00	0.40	1.01	0.03	3.40	6.00	1.43	0.39	4.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00
St.dev	8.40	0.13	1.31	3.79	8.47	1.31	1.06	1478.24	17.42	21.19	7.02	484.87	16.40	460.96	216.08	1.67	0.00	0.09	0.45	0.01	0.93	2.92	0.31	0.12	1.50

Vikedalselva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
07.01.2020	18.41	6.14	2.27	0.35	0.83	1.30	1.10	173.00	<1.0	3.00	1.00	170.00	13.00	270.00	12.90	0.90									
03.02.2020	11.06	6.34	2.23	<0.3	<0.36	1.10	1.00	102.00	1.00	3.00	<1.0	130.00	11.00	200.00	8.84	0.92	<0.002	0.15	0.13	0.01	0.30	1.80	0.23	0.04	<1.0
02.03.2020	11.28	6.44	4.04	1.80	3.82	1.10	0.90	496.00	11.00	13.00	5.00	230.00	5.00	340.00	58.00	0.98									
14.04.2020	8.45	6.35	2.78	<0.3	<0.3	0.88	0.90	216.00	<1.0	2.00	<1.0	150.00	5.00	200.00	20.80	0.89									
04.05.2020	6.40	6.49	2.81	<0.3	<0.48	0.85	0.85	88.20	1.00	2.00	<1.0	140.00	<2.0	160.00	8.56	0.85	<0.002	0.16	0.07	0.01	0.23	1.70	0.27	0.04	1.00
08.06.2020	8.92	6.12	2.39	<0.3	<0.25	1.10	1.20	180.00	2.00	4.00	<1.0	120.00	<2.0	110.00	12.10	0.69									
06.07.2020	11.85	6.08	2.12	1.10	3.37	2.70	2.40	441.00	5.00	11.00	3.00	200.00	<2.0	350.00	52.70	0.68									
27.07.2020	7.18	6.31	2.13	1.10	2.05	3.90	3.80	571.00	2.00	7.00	3.00	170.00	<2.0	330.00	56.90	0.63	<0.002	0.25	0.36	0.02	0.80	3.50	0.53	0.09	<1.0
07.09.2020	8.64	6.31	1.89	0.42	1.14	2.30	2.00	324.00	2.00	3.00	2.00	99.00	<2.0	180.00	17.70	0.65									
05.10.2020	4.70	6.68	2.69	<0.3	<1.0	1.70	1.70	161.00	2.00	3.00	3.00	270.00	8.00	310.00	15.60	1.04	<0.002	0.26	0.09	0.01	0.40	1.20	0.28	0.05	<1.0
02.11.2020	14.18	6.16	2.03	0.72	2.98	2.10	1.90	477.00	2.00	8.00	2.00	160.00	<2.0	250.00	43.70	0.83									
07.12.2020	9.54	6.52	2.57	0.35	0.70	1.30	1.20	168.00	2.00	4.00	1.00	300.00	<2.0	310.00	14.40	1.16									
Lower avg.	10.05	6.33	2.50	0.49	1.24	1.69	1.58	283.10	2.50	5.25	1.67	178.25	3.50	250.83	26.85	0.85	0.00	0.21	0.16	0.01	0.43	2.05	0.33	0.06	0.25
Upper avg..	10.05	6.33	2.50	0.61	1.44	1.69	1.58	283.10	2.67	5.25	2.00	178.25	4.67	250.83	26.85	0.85	0.00	0.21	0.16	0.01	0.43	2.05	0.33	0.06	1.00
Minimum	4.70	6.08	1.89	0.30	0.25	0.85	0.85	88.20	1.00	2.00	1.00	99.00	2.00	110.00	8.56	0.63	0.00	0.15	0.07	0.01	0.23	1.20	0.23	0.04	1.00
Maximum	18.41	6.68	4.04	1.80	3.82	3.90	3.80	571.00	11.00	13.00	5.00	300.00	13.00	350.00	58.00	1.16	0.00	0.26	0.36	0.02	0.80	3.50	0.53	0.09	1.00
More than 70% >LOD	yes	yes	yes	no	no	yes	yes	yes	yes	yes	no	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	3.68	0.18	0.57	0.48	1.28	0.91	0.86	170.19	2.84	3.67	1.28	61.14	3.94	79.60	19.77	0.16	0.00	0.06	0.14	0.00	0.25	1.00	0.14	0.02	0.00

Vosso (Bolstadelvi)

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	111.76	6.30	1.66	0.48	0.93	1.40	1.40	172.00	5.00	5.00	<1.0	160.00	2.00	240.00	12.60	1.29									
03.02.2020	61.09	6.43	1.90	0.45	0.47	1.30	1.30	68.30	1.00	4.00	2.00	140.00	<2.0	220.00	8.50	1.28	<0.002	0.07	0.06	0.01	0.37	1.20	0.28	0.06	<1.0
02.03.2020	24.86	6.57	2.02	<0.3	<0.4	1.30	1.20	131.00	2.00	4.00	1.00	150.00	7.00	220.00	3.28	1.32									
14.04.2020	60.10	6.45	2.27	<0.3	0.39	1.20	1.20	92.70	<1.0	3.00		210.00	<2.0	260.00	11.90	1.39									
04.05.2020	51.44	6.56	2.41	<0.3	<0.5	1.20	1.30	119.00	3.00	3.00	1.00	210.00	5.00	250.00	17.30	1.40	<0.002	0.06	0.04	0.01	0.39	1.20	0.34	0.06	<1.0
02.06.2020	314.36	6.46	1.92	<0.3	0.72	1.20	1.40	165.00	<1.0	4.00	2.00	130.00	<2.0	190.00	23.40	1.23									
06.07.2020	254.70	6.37	0.95	0.71	0.80	1.40	1.40	157.00	1.00	2.00	3.00	34.00	2.00	49.00	20.50	0.69									
03.08.2020	180.73	6.25	0.80	<0.3	0.41	0.75	1.00	110.00	2.00	3.00	<1.0	26.00	<2.0	58.00	51.70	0.63	<0.002	0.06	0.05	0.00	0.24	0.66	0.17	0.04	<1.0
21.09.2020	62.25	6.30	1.01	0.40	0.49	1.90	1.60	133.00	1.00	4.00	1.00	55.00	<2.0	110.00	14.60	0.85									
06.10.2020	43.78	6.60	1.10	0.34	0.53	1.30	1.20	168.00	2.00	3.00	1.00	66.00	8.00	100.00	16.00	0.78	<0.002	0.06	0.05	0.00	0.30	0.79	0.27	0.04	<1.0
02.11.2020	247.11	6.38	1.20	<0.3	<0.5	1.50	1.50	201.00	<1.0	4.00	2.00	92.00	6.00	140.00	34.00	1.05									
08.12.2020	25.66	6.53	1.43	0.52	0.76	1.30	1.30	181.00	2.00	4.00	1.00	96.00	4.00	160.00	9.25	1.02									
Lower avg.	119.82	6.43	1.56	0.24	0.46	1.31	1.32	141.50	1.58	3.58	1.27	114.08	2.83	166.42	18.59	1.08	0.00	0.06	0.05	0.01	0.33	0.96	0.27	0.05	0.00
Upper avg..	119.82	6.43	1.56	0.39	0.57	1.31	1.32	141.50	1.83	3.58	1.45	114.08	3.67	166.42	18.59	1.08	0.00	0.06	0.05	0.01	0.33	0.96	0.27	0.05	1.00
Minimum	24.86	6.25	0.80	0.30	0.39	0.75	1.00	68.30	1.00	2.00	1.00	26.00	2.00	49.00	3.28	0.63	0.00	0.06	0.04	0.00	0.24	0.66	0.17	0.04	1.00
Maximum	314.36	6.60	2.41	0.71	0.93	1.90	1.60	201.00	5.00	5.00	3.00	210.00	8.00	260.00	51.70	1.40	0.00	0.07	0.06	0.01	0.39	1.20	0.34	0.06	1.00
More than 70% >LOD	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	11.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	102.11	0.12	0.55	0.13	0.18	0.26	0.16	39.25	1.19	0.79	0.69	62.89	2.27	74.67	13.10	0.28	0.00	0.00	0.01	0.00	0.07	0.28	0.07	0.01	0.00

Nausta

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
08.01.2020	39.63	5.69	1.81	0.44	0.89	1.30	1.20	116.00	2.00	4.00	2.00	37.00	3.00	97.00	<1.0	0.85									
11.02.2020	28.32	5.74	1.91	<0.3	0.31	1.50	1.50	101.00	3.00	4.00	2.00	74.00	<2.0	150.00	9.81	1.23	<0.002	<0.025	0.01	<0.003	0.15	0.36	<0.04	0.03	2.00
10.03.2020	19.28	5.97	2.20	<0.3	0.42	1.50	1.50	148.00	3.00	5.00	2.00	<2.0	<2.0	120.00	22.70	1.26									
23.04.2020	26.02	6.46	2.08	<0.3	0.38	1.40	1.40	148.00	2.00	3.00	<1.0	23.00	<2.0	75.00	13.20	0.95									
06.05.2020	13.23	5.83	1.83	<0.3	0.91	2.50	2.50	251.00	3.00	4.00	2.00	59.00	8.00	140.00	23.70	0.95	0.00	0.05	0.10	0.00	0.25	1.00	0.12	0.05	
08.06.2020	27.73	6.15	1.32	<0.3	<0.28	1.30	1.10	205.00	<1.0	3.00	3.00	22.00	<2.0	86.00	11.50	0.57									
06.07.2020	20.09	6.11	0.95	0.47	0.84	1.30	1.20	160.00	1.00	<1.0	2.00	27.00	<2.0	51.00	29.40	0.45									
12.08.2020	14.77	6.31	1.08	<0.3	0.56	1.60	1.50	151.00	3.00	4.00	1.00	39.00	<2.0	100.00	11.10	0.51	<0.002	<0.025	0.04	0.00	0.19	0.57	0.07	0.03	<1.0
08.09.2020	18.81	6.05	1.05	0.54	1.46	4.20	2.90	307.00	4.00	8.00	4.00	37.00	<2.0	170.00	28.00	0.92									
01.10.2020	16.23	6.12	1.07	1.40	2.70	2.50	2.60	453.00	4.00	9.00	2.00	45.00	3.00	94.00	20.70	1.00	<0.002	0.05	0.13	<0.003	0.29	0.91	0.12	0.09	<1.0
16.11.2020	11.27	6.04	1.15	0.31	1.13	3.10	3.10	301.00	4.00	7.00	4.00	57.00	<2.0	170.00	18.30	1.32									
02.12.2020	17.18	6.12	1.74	<0.3	<0.5	1.40	1.40	123.00	2.00	4.00	2.00	93.00	<2.0	160.00	9.07	1.24									
Lower avg.	21.05	6.05	1.52	0.26	0.80	1.97	1.83	205.33	2.58	4.58	2.17	42.75	1.17	117.75	16.46	0.94	0.00	0.03	0.07	0.00	0.22	0.71	0.08	0.05	0.67
Upper avg..	21.05	6.05	1.52	0.44	0.86	1.97	1.83	205.33	2.67	4.67	2.25	42.92	2.67	117.75	16.54	0.94	0.00	0.04	0.07	0.00	0.22	0.71	0.09	0.05	1.33
Minimum	11.27	5.69	0.95	0.30	0.28	1.30	1.10	101.00	1.00	1.00	1.00	2.00	2.00	51.00	1.00	0.45	0.00	0.03	0.01	0.00	0.15	0.36	0.04	0.03	1.00
Maximum	39.63	6.46	2.20	1.40	2.70	4.20	3.10	453.00	4.00	9.00	4.00	93.00	8.00	170.00	29.40	1.32	0.00	0.05	0.13	0.00	0.29	1.00	0.12	0.09	2.00
More than 70% >LOD	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	no	yes	no	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00
St.dev	8.04	0.22	0.45	0.31	0.68	0.92	0.73	104.51	1.07	2.27	0.97	24.83	1.72	39.76	8.61	0.30	0.00	0.02	0.05	0.00	0.06	0.30	0.04	0.03	0.58

Driva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	40.88	6.76	5.85	<0.3	<0.28	1.90	1.90	80.60	2.00	3.00	<1.0	370.00	<2.0	500.00	<1.0	5.42									
03.02.2020	37.63	6.91	4.00	<0.3	<0.51	1.10	1.10	51.70	<1.0	3.00	2.00	190.00	2.00	260.00	2.23	3.79	<0.002	0.05	0.01	<0.003	0.56	0.40	0.17	0.11	<1.0
02.03.2020	31.45	6.93	4.91	<0.3	<0.25	1.20	1.10	72.00	2.00	2.00	1.00	260.00	4.00	340.00	6.49	4.11									
14.04.2020	40.56	6.94	7.89	<0.3	<0.33	2.20	2.20	113.00	4.00	4.00	<1.0	680.00	<2.0	700.00	13.70	5.55									
04.05.2020	39.88	7.12	5.00	<0.3	0.94	1.90	1.90	177.00	4.00	3.00	1.00	260.00	<2.0	370.00	16.90	2.94	<0.002	0.07	0.03	<0.003	1.10	0.71	0.29	0.18	
02.06.2020	338.41	6.95	2.65	5.50	54.70	3.10	3.00	838.00	16.00	22.00	3.00	49.00	<2.0	150.00	69.70	4.35									
06.07.2020	215.07	7.02	2.82	0.80	1.48	2.20	2.10	121.00	2.00	2.00	1.00	81.00	<2.0	100.00	14.60	2.72									
02.08.2020	110.79	6.99	2.36	<0.3	1.57	1.50	1.60	136.00	1.00	1.00	1.00	35.00	<2.0	76.00	21.70	2.16	<0.002	<0.025	0.01	<0.003	0.40	0.18	0.13	0.11	<1.0
07.09.2020	42.09	7.20	3.73	<0.3	0.43	1.00	1.10	107.00	<1.0	<1.0	1.00	95.00	<2.0	130.00	9.24	3.13									
05.10.2020	34.74	7.17	3.60	<0.3	0.52	0.92	0.87	160.00	2.00	2.00	1.00	80.00	8.00	110.00	16.20	3.06	<0.002	0.03	0.01	<0.003	0.47	0.31	0.15	0.10	<1.0
02.11.2020	30.78	7.08	4.86	0.89	1.60	1.10	1.10	160.00	3.00	4.00	2.00	180.00	<2.0	220.00	18.00	4.63									
07.12.2020	26.40	7.16	3.75	<0.3	0.75	0.97	0.93	82.00	2.00	2.00	1.00	170.00	2.00	200.00	5.63	3.36									
Lower avg.	82.39	7.02	4.28	0.60	5.17	1.59	1.58	174.86	3.17	4.00	1.17	204.17	1.33	263.00	16.20	3.77	0.00	0.04	0.02	0.00	0.63	0.40	0.18	0.12	0.00
Upper avg..	82.39	7.02	4.28	0.82	5.28	1.59	1.58	174.86	3.33	4.08	1.33	204.17	2.67	263.00	16.28	3.77	0.00	0.04	0.02	0.00	0.63	0.40	0.18	0.12	1.00
Minimum	26.40	6.76	2.36	0.30	0.25	0.92	0.87	51.70	1.00	1.00	1.00	35.00	2.00	76.00	1.00	2.16	0.00	0.03	0.01	0.00	0.40	0.18	0.13	0.10	1.00
Maximum	338.41	7.20	7.89	5.50	54.70	3.10	3.00	838.00	16.00	22.00	3.00	680.00	8.00	700.00	69.70	5.55	0.00	0.07	0.03	0.00	1.10	0.71	0.29	0.18	1.00
More than 70% >LOD	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00
St.dev	97.01	0.13	1.55	1.49	15.57	0.68	0.66	212.41	4.12	5.73	0.65	180.23	1.78	187.26	18.05	1.07	0.00	0.02	0.01	0.00	0.32	0.23	0.07	0.04	0.00

Orkla

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	31.38	7.26	7.40	0.54	0.86	4.20	4.20	214.00	1.00	4.00	2.00	230.00	9.00	380.00	14.90	3.36									
03.02.2020	52.22	7.34	8.13	0.43	0.41	2.70	2.70	82.50	<1.0	3.00	1.00	270.00	10.00	410.00	6.80	3.60	<0.002	0.09	0.01	0.04	5.36	11.70	0.72	0.19	<1.0
02.03.2020	59.46	7.41	7.41	<0.3	0.28	2.20	2.10	112.00	2.00	3.00	2.00	200.00	6.00	260.00	20.70	3.06									
14.04.2020	64.42	7.30	7.77	0.61	1.09	3.80	3.80	224.00	1.00	4.00	2.00	260.00	<2.0	370.00	30.80	3.58									
04.05.2020	112.68	7.40	6.78	0.41	1.72	3.90	3.80	331.00	3.00	4.00	3.00	190.00	<2.0	330.00	20.10	2.87	<0.002	0.12	0.04	0.04	5.59	9.50	0.83	0.29	
02.06.2020	331.30	6.99	3.01	2.10	7.51	3.00	3.80	417.00	5.00	8.00	4.00	41.00	<2.0	150.00	35.20	2.23									
06.07.2020	96.56	7.40	5.09	0.77	2.13	4.60	4.50	283.00	2.00	5.00	4.00	110.00	<2.0	190.00	31.30	2.53									
04.08.2020	124.58	7.15	4.21	2.10	9.01	9.20	9.20	540.00	5.00	11.00	3.00	23.00	<2.0	270.00	43.40	2.59	<0.002	0.26	0.11	0.03	2.95	5.60	1.16	0.69	<1.0
07.09.2020	23.62	7.69	7.68	<0.3	0.59	2.80	2.80	137.00	<1.0	2.00	1.00	210.00	<2.0	290.00	15.40	2.79									
05.10.2020	24.94	7.63	8.39	0.34	0.38	2.80	2.80	143.00	2.00	4.00	2.00	200.00	10.00	270.00	15.10	3.24	<0.002	0.11	0.01	0.04	3.36	8.30	0.71	0.13	<1.0
02.11.2020	48.23	7.47	7.01	0.33	0.54	3.00	3.10	164.00	<1.0	3.00	2.00	210.00	<2.0	300.00	20.10	3.49									
07.12.2020	63.95	7.58	6.69	<0.3	0.61	1.90	2.00	124.00	1.00	3.00	1.00	160.00	7.00	270.00	13.30	3.28									
Lower avg.	86.11	7.38	6.63	0.64	2.09	3.67	3.73	230.96	1.83	4.50	2.25	175.33	3.50	290.83	22.26	3.05	0.00	0.14	0.04	0.04	4.31	8.77	0.85	0.32	0.00
Upper avg..	86.11	7.38	6.63	0.71	2.09	3.67	3.73	230.96	2.08	4.50	2.25	175.33	4.67	290.83	22.26	3.05	0.00	0.14	0.04	0.04	4.31	8.77	0.85	0.32	1.00
Minimum	23.62	6.99	3.01	0.30	0.28	1.90	2.00	82.50	1.00	2.00	1.00	23.00	2.00	150.00	6.80	2.23	0.00	0.09	0.01	0.03	2.95	5.60	0.71	0.13	1.00
Maximum	331.30	7.69	8.39	2.10	9.01	9.20	9.20	540.00	5.00	11.00	4.00	270.00	10.00	410.00	43.40	3.60	0.00	0.26	0.11	0.04	5.59	11.70	1.16	0.69	1.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	3.00
St.dev	83.83	0.20	1.66	0.66	2.95	1.92	1.90	138.78	1.51	2.54	1.06	79.03	3.47	75.25	10.67	0.45	0.00	0.08	0.05	0.01	1.35	2.54	0.21	0.25	0.00

Nidelva (Tr.heim)

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	57.46	7.07	3.94	1.40	1.10	2.60	2.70	113.00	1.00	4.00	2.00	100.00	11.00	200.00	8.01	2.03									
03.02.2020	54.73	7.02	3.69	2.50	2.42	2.60	2.60	94.60	2.00	4.00	1.00	92.00	8.00	200.00	8.42	2.27	<0.002	0.06	0.04	<0.003	0.73	0.78	0.83	0.35	<1.0
02.03.2020	38.57	7.11	3.59	1.20	1.01	2.50	2.50	65.10	2.00	4.00	3.00	120.00	10.00	180.00	9.32	2.07									
14.04.2020	51.47	7.10	4.00	1.60	0.63	2.50	2.50	76.20	1.00	4.00	<1.0	120.00	<2.0	190.00	6.54	2.25									
04.05.2020	75.79	7.19	3.50	0.60	1.22	2.50	2.50	131.00	3.00	3.00	<1.0	80.00	<2.0	160.00	9.28	2.07	<0.002	0.09	0.03	<0.003	0.63	0.47	0.66	0.23	<1.0
02.06.2020	480.04	7.06	3.16	0.99	2.75	2.70	3.50	132.00	2.00	5.00	3.00	90.00	<2.0	140.00	15.80	1.97									
06.07.2020	119.89	7.13	2.90	0.52	0.82	3.30	3.10	135.00	1.00	4.00	2.00	57.00	26.00	120.00	20.10	1.70									
03.08.2020	63.58	7.06	3.11	3.00	3.33	3.50	3.80	229.00	4.00	7.00	1.00	47.00	<2.0	160.00	27.70	2.00	<0.002	0.13	0.10	0.00	0.94	1.40	0.95	0.53	<1.0
07.09.2020	31.66	7.16	2.77	<0.3	0.57	2.60	2.50	154.00	<1.0	11.00	<1.0	37.00	<2.0	110.00	16.80	1.58									
05.10.2020	33.56	7.29	3.70	0.39	0.59	2.80	2.80	150.00	2.00	4.00	1.00	67.00	10.00	150.00	15.80	1.71	<0.002	0.08	0.03	<0.003	0.63	0.46	0.62	0.13	<1.0
02.11.2020	40.60	7.18	3.45	<0.3	0.70	2.30	2.30	113.00	<1.0	4.00	2.00	80.00	3.00	170.00	10.80	1.91									
07.12.2020	27.57	7.19	4.68	<0.3	0.51	2.40	2.40	98.00	2.00	3.00	1.00	98.00	<2.0	170.00	7.22	2.05									
Lower avg.	89.58	7.13	3.54	1.02	1.30	2.69	2.77	124.24	1.67	4.75	1.33	82.33	5.67	162.50	12.98	1.97	0.00	0.09	0.05	0.00	0.73	0.78	0.77	0.31	0.00
Upper avg..	89.58	7.13	3.54	1.09	1.30	2.69	2.77	124.24	1.83	4.75	1.58	82.33	6.67	162.50	12.98	1.97	0.00	0.09	0.05	0.00	0.73	0.78	0.77	0.31	1.00
Minimum	27.57	7.02	2.77	0.30	0.51	2.30	2.30	65.10	1.00	3.00	1.00	37.00	2.00	110.00	6.54	1.58	0.00	0.06	0.03	0.00	0.63	0.46	0.62	0.13	1.00
Maximum	480.04	7.29	4.68	3.00	3.33	3.50	3.80	229.00	4.00	11.00	3.00	120.00	26.00	200.00	27.70	2.27	0.00	0.13	0.10	0.00	0.94	1.40	0.95	0.53	1.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	125.51	0.08	0.53	0.90	0.97	0.36	0.47	43.03	0.94	2.22	0.79	26.52	7.14	28.96	6.39	0.21	0.00	0.03	0.03	0.00	0.15	0.44	0.15	0.17	0.00

Vefsna

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
14.01.2020	126.73	7.36	7.12	0.66	1.14	1.90	1.90	65.90	<1.0	3.00	<1.0	43.00	5.00	110.00	1.99	1.65									
07.02.2020	89.21	7.45	8.06	<0.3	<0.4	1.50	1.50	36.60	2.00	1.00	1.00	59.00	2.00	120.00	<1.0	1.97	<0.002	0.10	<0.005	<0.003	0.25	<0.15	0.14	0.05	<1.0
02.03.2020	56.14	7.61	9.32	<0.3	<0.37	1.40	1.40	36.00	1.00	5.00	<1.0	70.00	3.00	130.00	6.13	2.07									
14.04.2020	69.84	7.51	8.67	<0.3	0.49	1.80	1.70	50.70	<1.0	2.00		52.00	<2.0	100.00	7.36	1.64									
05.05.2020	94.31	7.48	8.65	<0.3	0.74	2.30	2.50	179.00	3.00	2.00	<1.0	34.00	<2.0	110.00	7.25	1.54	<0.002	0.10	0.03	<0.003	0.33	0.31	0.29	0.12	<1.0
02.06.2020	796.05	7.31	5.00	0.60	4.47	1.40	1.30	259.00	3.00	4.00	2.00	27.00	<2.0	80.00	29.80	1.30									
06.07.2020	225.43	7.28	3.48	0.43	0.92	2.20	2.20	170.00	<1.0	<1.0	<1.0	18.00	<2.0	51.00	14.20	0.97									
03.08.2020	263.41	7.20	2.67	1.10	2.46	1.40	1.30	280.00	1.00	3.00	1.00	4.00	<2.0	43.00	32.60	0.84	<0.002	0.22	0.12		0.27	0.39	0.44	0.21	<1.0
07.09.2020	163.88	7.41	3.68	0.48	1.48	3.20	3.00	187.00	<1.0	2.00	<1.0	9.00	<2.0	92.00	15.40	1.16									
05.10.2020	98.54	7.58	5.80	0.30	0.61	1.50	1.40	87.90	1.00	2.00	1.00	32.00	4.00	67.00	9.06	1.40	<0.002	0.12	0.02	<0.003	0.30	0.20	0.25	0.06	<1.0
02.11.2020	159.94	7.37	5.19	0.35	1.39	1.60	1.60	129.00	1.00	2.00	1.00	41.00	<2.0	93.00	11.40	1.57									
07.12.2020	64.11	7.72	7.64	<0.3	<0.4	1.40	1.40	40.00	1.00	1.00	1.00	70.00	2.00	130.00	3.96	1.92									
Lower avg.	183.97	7.44	6.27	0.33	1.14	1.80	1.77	126.76	1.08	2.25	0.64	38.25	1.33	93.83	11.60	1.50	0.00	0.14	0.04	0.00	0.29	0.22	0.28	0.11	0.00
Upper avg..	183.97	7.44	6.27	0.45	1.24	1.80	1.77	126.76	1.42	2.33	1.09	38.25	2.50	93.83	11.68	1.50	0.00	0.14	0.04	0.00	0.29	0.26	0.28	0.11	1.00
Minimum	56.14	7.20	2.67	0.30	0.37	1.40	1.30	36.00	1.00	1.00	1.00	4.00	2.00	43.00	1.00	0.84	0.00	0.10	0.01	0.00	0.25	0.15	0.14	0.05	1.00
Maximum	796.05	7.72	9.32	1.10	4.47	3.20	3.00	280.00	3.00	5.00	2.00	70.00	5.00	130.00	32.60	2.07	0.00	0.22	0.12	0.00	0.33	0.39	0.44	0.21	1.00
More than 70% >LOD	yes	yes	yes	no	yes	yes	yes	yes	no	yes	no	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	11.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	4.00
St.dev	203.38	0.15	2.28	0.24	1.19	0.54	0.54	87.44	0.79	1.23	0.30	21.93	1.00	28.91	10.13	0.39	0.00	0.06	0.05	0.00	0.04	0.11	0.12	0.07	0.00

Målselva v/gml E6-brua

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	44.43	7.43	7.69	0.71	0.75	1.40	1.50	116.00	1.00	3.00	1.00	78.00	21.00	200.00	15.20	2.46									
06.02.2020	35.88	7.46	7.76	<0.3	<0.25	2.00	2.00	85.50	2.00	4.00	<1.0	77.00	6.00	200.00	8.40	2.64	<0.002	0.04	<0.005	<0.003	0.29	<0.15	0.12	0.04	<1.0
02.03.2020	30.28	7.42	7.62	<0.3	2.33	0.96	1.10	65.70	2.00	2.00	<1.0	71.00	10.00	130.00	9.69	2.53									
14.04.2020	42.24	7.38	8.09	0.39	6.87	1.10	1.10	227.00	4.00	7.00	2.00	90.00	7.00	180.00	27.40	2.55									
04.05.2020	77.35	7.09	7.58	1.30	1.48	5.10	4.90	188.00	4.00	5.00	3.00	130.00	5.00	300.00	13.30	3.56	<0.002	0.09	0.07	0.00	1.71	2.00	0.62	0.35	1.00
02.06.2020	701.36	7.43	6.47	6.00	23.90	5.10	4.60	1110.00	18.00	22.00	3.00	65.00	<2.0	170.00	142.00	3.69									
06.07.2020	459.47	7.52	6.93	1.00	2.21	3.30	3.60	205.00	2.00	2.00	<1.0	37.00	<2.0	84.00	17.50	2.14									
03.08.2020	297.27	7.56	6.36	0.63	2.05	2.30	2.40	222.00	2.00	3.00	1.00	18.00	<2.0	63.00	17.20	1.90	<0.002	0.03	0.04	<0.003	0.41	0.29	0.37	0.12	<1.0
07.09.2020	148.51	7.60	7.60	1.20	3.74	1.70	1.70	187.00	1.00	2.00	<1.0	20.00	<2.0	71.00	21.20	2.25									
05.10.2020	134.84	7.67	8.03	0.65	0.95	1.30	1.20	96.20	2.00	3.00	1.00	33.00	5.00	68.00	8.98	2.40	<0.002	0.05	0.08	<0.003	0.66	0.62	0.37	0.12	<1.0
02.11.2020	73.31	7.51	9.05	0.56	1.06	1.10	1.00	140.00	2.00	3.00	2.00	93.00	5.00	190.00	37.20	2.85									
07.12.2020	73.78	7.55	7.54	0.62	2.10	1.10	1.20	348.00	2.00	3.00	1.00	63.00	11.00	150.00	51.50	2.72									
Lower avg.	176.56	7.47	7.56	1.09	3.95	2.21	2.19	249.20	3.50	4.92	1.17	64.58	5.83	150.50	30.80	2.64	0.00	0.05	0.04	0.00	0.77	0.73	0.37	0.16	0.25
Upper avg..	176.56	7.47	7.56	1.14	3.97	2.21	2.19	249.20	3.50	4.92	1.50	64.58	6.50	150.50	30.80	2.64	0.00	0.05	0.05	0.00	0.77	0.77	0.37	0.16	1.00
Minimum	30.28	7.09	6.36	0.30	0.25	0.96	1.00	65.70	1.00	2.00	1.00	18.00	2.00	63.00	8.40	1.90	0.00	0.03	0.01	0.00	0.29	0.15	0.12	0.04	1.00
Maximum	701.36	7.67	9.05	6.00	23.90	5.10	4.90	1110.00	18.00	22.00	3.00	130.00	21.00	300.00	142.00	3.69	0.00	0.09	0.08	0.00	1.71	2.00	0.62	0.35	1.00
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	208.96	0.15	0.73	1.56	6.51	1.51	1.40	282.05	4.66	5.57	0.80	33.07	5.49	71.15	37.26	0.53	0.00	0.03	0.03	0.00	0.65	0.85	0.20	0.13	0.00

Altaelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
07.01.2020	96.14	7.35	7.25	<0.3	0.95	2.70	2.80	68.20	<1.0	3.00	2.00	49.00	7.00	160.00	7.02	4.97									
05.02.2020	96.19	7.35	8.28	<0.3	<0.53	2.70	2.60	49.00	1.00	4.00	4.00	69.00	9.00	170.00	3.82	5.68	0.01	0.14	0.01	<0.003	0.37	0.16	0.22	0.16	<1.0
03.03.2020	81.21	7.44	8.01	<0.3	<0.33	2.70	2.70	67.20	2.00	4.00	2.00	65.00	<2.0	160.00	5.60	6.04									
14.04.2020	66.49	7.46	7.94	<0.3	0.56	2.70	2.70	105.00	2.00	3.00	<1.0	44.00	<2.0	130.00	12.00	4.86									
04.05.2020	61.22	7.52	9.64	<0.3	0.91	2.40	2.40	127.00	4.00	3.00	2.00	81.00	<2.0	170.00	8.36	6.21	<0.002	0.08	0.01	<0.003	0.35	<0.15	0.18	0.27	<1.0
02.06.2020	429.42	7.32	7.07	2.50	12.40	5.70	5.80	534.00	6.00	10.00	4.00	80.00	<2.0	410.00	44.20	4.69									
06.07.2020	199.15	7.38	5.63	1.80	1.13	6.00	5.70	266.00	5.00	7.00	3.00	<2.0	<2.0	160.00	29.00	3.90									
03.08.2020	146.60	7.51	6.25	0.54	4.31	4.60	4.70	302.00	2.00	6.00	2.00	38.00	<2.0	140.00	25.20	3.58	<0.002	0.11	0.02	<0.003	0.63	0.19	0.32	0.24	<1.0
07.09.2020	78.13	7.55	6.41	0.36	1.07	3.40	3.40	112.00	<1.0	6.00	1.00	32.00	<2.0	130.00	15.90	3.79									
05.10.2020	87.72	7.58	6.47	0.39	0.87	3.50	3.40	120.00	2.00	4.00	2.00	37.00	6.00	130.00	11.90	4.01	<0.002	0.10	0.01	<0.003	0.46	0.16	0.25	0.19	<1.0
02.11.2020	67.97	7.50	6.98	0.37	1.00	2.80	2.80	140.00	1.00	4.00	2.00	55.00	<2.0	160.00	19.00	4.24									
07.12.2020	70.83	7.48	6.96	0.31	0.66	3.00	3.00	129.00	2.00	4.00	2.00	55.00	<2.0	160.00	13.70	5.40									
Lower avg.	123.42	7.45	7.24	0.52	1.99	3.52	3.50	168.28	2.25	4.83	2.17	50.42	1.83	173.33	16.31	4.78	0.00	0.11	0.01	0.00	0.45	0.13	0.24	0.22	0.00
Upper avg..	123.42	7.45	7.24	0.65	2.06	3.52	3.50	168.28	2.42	4.83	2.25	50.58	3.33	173.33	16.31	4.78	0.00	0.11	0.01	0.00	0.45	0.17	0.24	0.22	1.00
Minimum	61.22	7.32	5.63	0.30	0.33	2.40	2.40	49.00	1.00	3.00	1.00	2.00	2.00	130.00	3.82	3.58	0.00	0.08	0.01	0.00	0.35	0.15	0.18	0.16	1.00
Maximum	429.42	7.58	9.64	2.50	12.40	6.00	5.80	534.00	6.00	10.00	4.00	81.00	9.00	410.00	44.20	6.21	0.01	0.14	0.02	0.00	0.63	0.19	0.32	0.27	1.00
More than 70% >LOD	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	104.21	0.09	1.09	0.72	3.42	1.24	1.21	137.90	1.68	2.08	0.97	22.30	2.50	76.08	11.64	0.90	0.00	0.02	0.01	0.00	0.13	0.02	0.06	0.05	0.00

Tanaelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
06.01.2020	42.86	7.17	6.64	<0.3	<0.27	1.70	1.90	87.60	1.00	4.00	2.00	76.00	6.00	160.00	11.20	9.49									
04.02.2020	37.43	7.14	6.92	<0.3	<0.33	1.70	1.60	74.50	3.00	5.00		47.00	<2.0	160.00	10.50	9.92	<0.002	0.24	0.01	<0.003	0.52	1.40	0.47	0.41	<1.0
09.03.2020	31.20	7.19	8.52	<0.3	1.38	1.90	1.90	293.00	3.00	6.00	3.00	110.00	250.00	480.00	27.80	10.99									
14.04.2020	30.73	7.28	8.05	<0.3	<0.25	1.40	1.40	66.80	5.00	7.00	3.00	99.00	<2.0	180.00	8.82	10.14									
04.05.2020	54.13	7.12	6.62	0.38	1.01	1.40	1.20	353.00	4.00	6.00	1.00	68.00	37.00	220.00	45.20	4.67	<0.002	0.07	0.07	0.01	0.99	2.40	0.50	0.13	<1.0
02.06.2020	2420.60	6.73	2.56	2.60	3.51	7.00	7.00	584.00	5.00	15.00	7.00	<2.0	<2.0	190.00	59.10	4.29									
24.06.2020	512.75	7.14	3.31	0.50	<0.33	3.60	3.40	166.00	3.00	4.00	3.00	7.00	2.00	96.00	23.70	4.07									
10.08.2020	193.85	7.32	4.54	0.67	0.83	3.20	2.80	159.00	3.00	4.00	2.00	<2.0	<2.0	100.00	17.20	5.85	<0.002	0.04	0.01	<0.003	0.46	0.41	0.35	0.28	<1.0
07.09.2020	155.19	7.43	4.82	0.31	0.59	3.30	3.30	138.00	<1.0	2.00	2.00	10.00	<2.0	110.00	14.00	6.11									
05.10.2020	112.28	7.58	4.90	0.40	0.55	3.00	3.00	212.00	2.00	4.00	2.00	12.00	4.00	90.00	22.90	6.51	<0.002	0.04	0.03	<0.003	0.49	0.83	0.36	0.26	<1.0
02.11.2020	86.29	7.29	5.20	0.44	1.44	2.40	2.40	356.00	3.00	6.00	2.00	26.00	<2.0	140.00	42.00	7.35									
08.12.2020	88.22	7.49	12.90	0.43	0.62	2.70	2.60	209.00	4.00	6.00	4.00	69.00	<2.0	160.00	11.10	9.41									
Lower avg.	313.79	7.24	6.25	0.48	0.83	2.77	2.71	224.91	3.00	5.75	2.82	43.67	24.92	173.83	24.46	7.40	0.00	0.10	0.03	0.00	0.61	1.26	0.42	0.27	0.00
Upper avg..	313.79	7.24	6.25	0.58	0.93	2.77	2.71	224.91	3.08	5.75	2.82	44.00	26.08	173.83	24.46	7.40	0.00	0.10	0.03	0.01	0.61	1.26	0.42	0.27	1.00
Minimum	30.73	6.73	2.56	0.30	0.25	1.40	1.20	66.80	1.00	2.00	1.00	2.00	2.00	90.00	8.82	4.07	0.00	0.04	0.01	0.00	0.46	0.41	0.35	0.13	1.00
Maximum	2420.60	7.58	12.90	2.60	3.51	7.00	7.00	584.00	5.00	15.00	7.00	110.00	250.00	480.00	59.10	10.99	0.00	0.24	0.07	0.01	0.99	2.40	0.50	0.41	1.00
More than 70% >LOD	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	11.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	676.77	0.22	2.76	0.65	0.91	1.54	1.54	150.59	1.31	3.22	1.60	39.33	71.22	104.66	16.26	2.49	0.00	0.09	0.03	0.01	0.25	0.86	0.08	0.11	0.00

Pasvikelva

Date	Qs	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	TDP	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[m3/s]	[]	[mS/m]	[FNU]	[mg/l]	[mgC/l]	[mgC/l]	[µgC/l]	[µgP/l]	[µgP/l]	[µgP/l]	[µgN/l]	[µgN/l]	[µgN/l]	[µgN/l]	[mgSiO2/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[µg/l]	[ng/l]
15.01.2020	53.75	6.90	3.19	<0.3	<0.4	2.80	2.80	120.00	<1.0	2.00	1.00	38.00	13.00	140.00	20.80	5.83									
03.02.2020	50.98	6.94	3.41	<0.3	0.39	2.90	2.80	132.00	<1.0		3.00	48.00	11.00	170.00	14.10	6.11	0.01	0.07	0.11	0.01	1.82	1.90	4.17	0.15	<1.0
03.03.2020	46.15	6.95	3.41	<0.3	0.38	2.80	2.80	115.00	1.00	3.00	3.00	55.00	<2.0	150.00	2.13	5.98									
13.04.2020	60.69	7.03	3.33	<0.3	<0.25	2.80	2.70	114.00	1.00	3.00	<1.0	51.00	<2.0	120.00	11.90	5.68									
03.05.2020	132.92	7.01	3.44	<0.3	0.43	4.30	3.30	260.00	3.00	4.00	1.00	48.00	<2.0	170.00	19.20	5.01	0.01	0.17	0.14	0.02	11.30	2.70	6.92	0.14	3.00
01.06.2020	1011.11	6.97	5.57	1.70	1.19	5.30	5.20	289.00	5.00	10.00	7.00	<2.0	<2.0	170.00	32.80	5.08									
06.07.2020	314.50	7.03	3.64	0.59	1.87	4.20	5.20	390.00	2.00	8.00	4.00	<2.0	<2.0	150.00	38.20	3.54									
10.08.2020	143.31	7.17	3.19	0.83	1.12	3.90	4.20	239.00	1.00	6.00	<1.0	<2.0	<2.0	140.00	31.90	4.56	<0.002	0.08	0.03	0.01	1.18	0.71	4.44	0.15	<1.0
07.09.2020	89.71	7.26	3.13	0.47		3.70	3.50	182.00	2.00	6.00	2.00	5.00	4.00	110.00	22.20	4.71									
05.10.2020	82.19	7.29	3.34	0.45	0.58	3.40	3.50	203.00	2.00	5.00	2.00	11.00	11.00	120.00	26.20	4.80	<0.002	0.09	0.01	0.00	0.98	0.47	4.74	0.13	<1.0
01.11.2020	86.12	7.06	4.05	1.40	3.36	3.50	3.40	694.00	3.00	12.00	2.00	12.00	<2.0	160.00	62.30	4.74									
06.12.2020	66.25	7.18	3.32	<0.3	<0.5	3.40	3.40	187.00	2.00	4.00	2.00	34.00	11.00	140.00	15.10	5.76									
Lower avg.	178.14	7.07	3.59	0.45	0.85	3.58	3.57	243.75	1.83	5.73	2.25	25.17	4.17	145.00	24.74	5.15	0.00	0.10	0.07	0.01	3.82	1.44	5.07	0.14	0.75
Upper avg..	178.14	7.07	3.59	0.60	0.95	3.58	3.57	243.75	2.00	5.73	2.42	25.67	5.33	145.00	24.74	5.15	0.00	0.10	0.07	0.01	3.82	1.44	5.07	0.14	1.50
Minimum	46.15	6.90	3.13	0.30	0.25	2.80	2.70	114.00	1.00	2.00	1.00	2.00	2.00	110.00	2.13	3.54	0.00	0.07	0.01	0.00	0.98	0.47	4.17	0.13	1.00
Maximum	1011.11	7.29	5.57	1.70	3.36	5.30	5.20	694.00	5.00	12.00	7.00	55.00	13.00	170.00	62.30	6.11	0.01	0.17	0.14	0.02	11.30	2.70	6.92	0.15	3.00
More than 70% >LOD	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no
n	12.00	12.00	12.00	12.00	11.00	12.00	12.00	12.00	12.00	11.00	12.00	12.00	12.00	12.00	12.00	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	272.46	0.13	0.67	0.48	0.94	0.76	0.87	164.14	1.21	3.13	1.73	21.81	4.62	20.67	15.51	0.75	0.00	0.05	0.06	0.01	5.00	1.04	1.26	0.01	1.00

5.2 Riverine loads in 2020

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]
Glomma ved Sarpsfoss	avg.	76214.38	311167.39	120149.51	384.06	576.49	10136.08	192.45	15006.97	109859.48	0.04	5.53	5.83	0.22	40.52	68.48	20.71	10.57	38.46
Alna	avg.	141.57	907.76	238.92	3.11	4.19	37.17	4.74	57.91	359.62	0.00	0.02	0.07	0.00	0.27	0.97	0.06	0.05	0.00
Drammenselva	avg.	35276.58	39068.00	51950.15	43.75	97.48	4267.63	90.68	5745.43	39910.28	0.00	2.56	3.20	0.14	11.64	32.43	7.30	2.76	20.86
Numedalslågen	avg.	13516.43	72447.57	27825.59	66.31	110.56	1050.71	62.31	2001.29	19411.92	0.05	2.03	5.79	0.21	6.70	41.32	3.93	2.58	4.24
Skienselva	avg.	33909.56	19765.04	38707.69	30.91	63.45	1680.80	88.12	2876.54	28423.04	0.00	1.59	1.44	0.13	5.70	27.64	2.91	1.20	10.44
Vegårdselva	avg.	1257.03	1203.38	2736.21	1.25	3.90	69.09	6.79	161.23	1329.15	0.00	0.12	0.23	0.02	0.36	2.85	0.23	0.11	0.00
Otra	avg.	17700.83	9640.81	22296.76	10.72	28.01	460.28	48.60	1289.61	11006.80	0.00	0.92	2.17	0.11	2.98	19.02	2.39	0.69	3.48
Bjerkreimselva	avg.	4649.90	1266.75	2879.45	3.42	11.28	517.21	5.26	656.21	2454.48	0.00	0.15	0.18	0.02	0.36	3.59	0.21	0.09	0.00
Orreelva	avg.	721.74	2593.31	1877.05	6.15	18.19	151.26	3.14	342.74	922.15	0.00	0.07	0.07	0.00	0.55	0.38	0.29	0.05	0.10
Vikedalselva	avg.	907.43	509.02	553.49	0.96	1.89	59.72	1.32	84.64	285.26	0.00	0.07	0.05	0.00	0.14	0.67	0.10	0.02	0.14
Vosso (Bolstadelvi)	avg.	11183.71	2376.09	5195.38	5.58	14.10	378.32	10.79	565.84	4077.28	0.00	0.26	0.19	0.02	1.22	3.53	0.96	0.18	0.00
Nausta	avg.	1653.78	467.79	1076.37	1.49	2.65	25.07	0.79	68.29	562.61	0.00	0.02	0.04	0.00	0.13	0.41	0.05	0.03	0.72
Driva	avg.	7227.19	52335.62	5728.72	18.15	23.97	319.38	2.96	484.03	9591.85	0.00	0.09	0.04	0.00	1.51	0.90	0.45	0.32	0.00
Orkla	avg.	6527.91	9847.61	9307.54	7.45	14.25	291.66	5.89	584.45	6607.50	0.00	0.39	0.14	0.08	10.45	19.88	2.19	0.95	0.00
Nidelva (Tr.heim)	avg.	6404.09	4550.88	6452.51	4.45	11.17	196.53	12.24	353.24	4600.06	0.00	0.21	0.12	0.00	1.70	1.78	1.78	0.72	0.00
Vefsna	avg.	19679.76	17328.46	12317.54	12.59	20.20	208.05	9.40	587.70	9565.84	0.00	1.12	0.44	0.00	2.05	2.06	2.31	0.96	0.00
Målselva v/gml E6-brua	avg.	15794.70	54876.48	18940.08	42.72	53.40	294.46	16.39	735.39	16001.80	0.00	0.27	0.30	0.01	3.87	3.65	2.26	0.86	2.06
Altaelva	avg.	11460.11	19367.58	18163.20	14.44	26.77	221.44	6.67	959.01	19389.94	0.01	0.46	0.05	0.00	2.00	0.68	1.07	0.89	0.00
Tanaelva	avg.	18915.87	15723.70	37120.53	28.37	72.91	69.36	29.01	1123.29	34491.32	0.00	0.44	0.17	0.02	3.81	6.40	2.66	1.82	0.00
Pasvikelva	avg.	14561.43	6385.49	23881.32	17.92	42.46	54.37	11.42	835.01	25863.35	0.02	0.60	0.38	0.05	24.60	7.72	28.38	0.75	6.28

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