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Proceedings of the 34th Task Force meeting of the ICP Waters Programme in Warsaw, May 7-9, 2018

International Cooperative Programme on Assessment and Monitoring Effects of Air Pollution on Rivers and Lakes

Convention on Long-Range Transboundary Air Pollution

Norwegian Institute for Water Research

REPORT

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CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

INTERNATIONAL COOPERATIVE PROGRAMME ON ASSESSMENT AND MONITORING EFFECTS OF AIR POLLUTION ON RIVERS AND LAKES

Proceedings of the 34th Task Force meeting of the ICP Waters Programme in Warsaw, May 7-9, 2018

Prepared at the ICP Waters Programme Centre
Norwegian Institute for Water Research
Oslo, September 2018

Preface

The international cooperative programme on assessment and monitoring of air pollution on rivers and lakes (ICP Waters) was established under the Executive Body of the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP) in July 1985. Since then ICP Waters has been an important contributor to document the effects of implementing the Protocols under the Convention. Numerous assessments, workshops, reports and publications covering the effects of long-range transported air pollution has been published over the years.

The ICP Waters Programme Centre is hosted by the Norwegian Institute for Water Research (NIVA), while the Norwegian Environment Agency leads the programme. The Programme Centre's work is supported financially by the Norwegian Environment Agency.

The main aim of the ICP Waters Programme is to assess, on a regional basis, the degree and geographical extent of the impact of atmospheric pollution, in particular acidification, on surface waters. More than 20 countries in Europe and North America participate in the programme on a regular basis.

ICP Waters is based on existing surface water monitoring programmes in the participating countries, implemented by voluntary contributions. The ICP Waters site network is geographically extensive and includes long-term data series (more than 25 years) for many sites. The programme conducts annual chemical intercomparison and biological intercalibration exercises.

At the annual Programme Task Force, national ongoing activities in many countries are presented. This report presents national contributions from the 34th Task Force meeting of the ICP Waters Programme, held in Warsaw, Poland, May 7-9, 2018.

Heleen de Wit

ICP Waters Programme Centre
Oslo, October 2018

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1. Introduction

The International Cooperative Programme on Assessment and Monitoring of Rivers and Lakes (ICP Waters) is a programme under the Executive Body of the Convention on Long-Range Transboundary Air Pollution. The main aims of the programme are:

- To assess the degree and geographic extent of the impact of atmospheric pollution, in particular acidification, on surface waters;
- To collect information to evaluate dose/response relationships;
- To describe and evaluate long-term trends and variation in aquatic chemistry and biota attributable to atmospheric pollution.

The national contributions on ongoing activities that were presented during the ICP Waters Task Force meeting in Warsaw, Poland, May 7-9, 2018 were grouped thematically. A short summary of each presentation is given in the Minutes (Chapter 4). Selected presentations are reported more extensively in the Proceedings.

Acidification and recovery

- Regional assessment of current extent of acidification of surface waters in Europe and North America (Kari Austnes, ICP Waters Programme Centre).
- Regional assessment of freshwater acidification in Poland. Rafał Ulańczyk, Poland.
- Acidification and recovery in Swedish lakes and streams – application of GAMM-models on multiple time series (Jens Fölster, Sweden).
- An update of the acidification and nitrogen status of high altitude lakes in the Alps: 2017 vs. 1980s (Michela Rogora, Italy).

Heavy metals and POPs

- 30 years of integrated POPs monitoring at the background observatory Kosetice (Roman Prokes, Czech Republic)
- Pollution and anthropogenic-induced processes impact on lakes quality of Russian Arctic region (Marina Dinu, Russia)
- Temporal trends in heavy metals across IM sites (Staffan Åkerblom, Sweden)
- The mercury in fish report – key findings and policy relevance (Staffan Åkerblom, Sweden)

Climate (and land use)

- Developing capacity to predict DOC response to reductions in atmospheric deposition (Don Monteith, UK)
- Climate-driven changes in removal of DOC in a small boreal lake: a 30-year time series (Heleen de Wit, ICP Waters Programme Centre)

The NEC directive. Status and progress

- National emission ceiling – an opportunity for WGE? (Salar Valinia, ICP IM).
- Spanish aquatic ecosystem monitoring programs: possibilities to comply with requirements of NEC Directive and ICP Waters / Integrated Monitoring (Manuel Toro Velasco, Spain).

Biodiversity

- Observed and modelled trends in forest vegetation in ICP Integrated Monitoring, Forests, and LTER sites in Europe (Gisela Pröll, Austria).
- Assessment of accumulation and spatial distribution of nitrogen and sulfur dioxides in atmosphere of lori region of Armenia (including debed river basin) and potential population health risk (Marine Nalbanyan, Armenia).

Nitrogen

- Nitrogen and phosphorus at Lysina CZ02 (Pavel Krám, Czech Republic)
- Long-term changes in the inorganic nitrogen output fluxes in European ICP Integrated Monitoring catchments - an assessment of the role of internal nitrogen parameters (Jussi Vuorenmaa)
- Reactive nitrogen in freshwaters – the 2019 ICP Waters report (Heleen de Wit, ICP Waters Programme Centre)
- Nitrogen budget at the IM station "Puszcza Borecka" (Rafał Ulańczyk, Poland)

2. Assessment of spatial distribution of sulfur dioxides in atmosphere of the northern part of Armenia and potential population health risk

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The main atmosphere pollutants in urbanized and industrial territories include carbonic acid, carbonic monoxide, nitrogen, sulphur and bromine oxides, as well as methane, ammonia, volatile chlorides and various aerosols. This pollution can lead to deterioration of other components of the geo-economic system (soil, water, plants) through precipitations.

Suspended solids like a dust, ashes, soot, smoke, sulfates, nitrates, depending on the content, may promote development of various diseases, in particular respiratory system and malignancies. It disturbs breathing and blood circulation when penetrating into the respiratory tract. Inhaled particles directly affect the respiratory and other systems due to their toxic impact. Combinations of high concentrations of suspended solids and sulfur dioxide are very dangerous. People with chronic lung and cardiovascular conditions, asthma, frequent influenza and cold, as well as elderly and children are especially sensitive to fine suspended solids.

Given that the Alaverdi copper smelting plant, which is a source of air pollution with sulfur dioxide, is situated in one of the northern regions, there is an urgent need of determining the polluted air migration patterns, as well as assessing the potential health impact of the pollutant on population of this region and those in the vicinity.

Hence, main objectives of the survey are as follows:

- ✓ To analyze time-series of the main atmospheric pollutants spatial distributions, particularly sulfur dioxides, within the territory of Debed River catchment basin.
- ✓ To identify directions of migration of pollutions in the studies layers of atmosphere.
- ✓ Preliminary study of potential correlation of air pollution with sulfur dioxides and the prevalence of cancers in the population of respected regions of Armenia.

The survey baseline materials include data on the air content of nitrogen and sulfur dioxides between 2004 and 2014, both in surface and upper layers; data on total morbidity due to malignancies between 2007 and 2014, as well as data on lung cancer morbidity for the year 2014.

Materials and Methods: The main object of the study is the Debed River basin, which flows from an absolute height of 870 m and continues his way in the territory of Georgia, where its name is Khrami River (Figure 1). Until the Ayrum the river flows through the deep valley, it passes through the mountain gorges, which names are Somkheti and Gugarats. The river’s regime is characterized by spring and fall high waters (Nazaryan, 2009). The increases in the level of water start in spring, from April, reach their maximum in May and continue till the first half of June. The river is fed from ground waters, melting and rains.

The area is rich with copper-sulfur volcanic rock, gypsum and stone reserves. The highland zoning reflects the city area, by stretching from arid to forested areas. Forest soils are usual, as well as carbonated and black soils. Alaverdi landscape (basically in Debed Valley) consists of sloped ridges, except for Sanahin lowland. The left bank slopes descent to the river abruptly, whereas the right bank slopes gradually. Alaverdi copper mine has been systematically studied since 1929. By its origin it is a hydrothermal mine of small depths and average temperatures. The mine area consists of volcanic tuff-basalts, conglomerates, high thickness sandstone layers. Alaverdi copper processing (smelting) plant and Akhtala ore dressing plant are operated here now (Nazaryan, 2009).

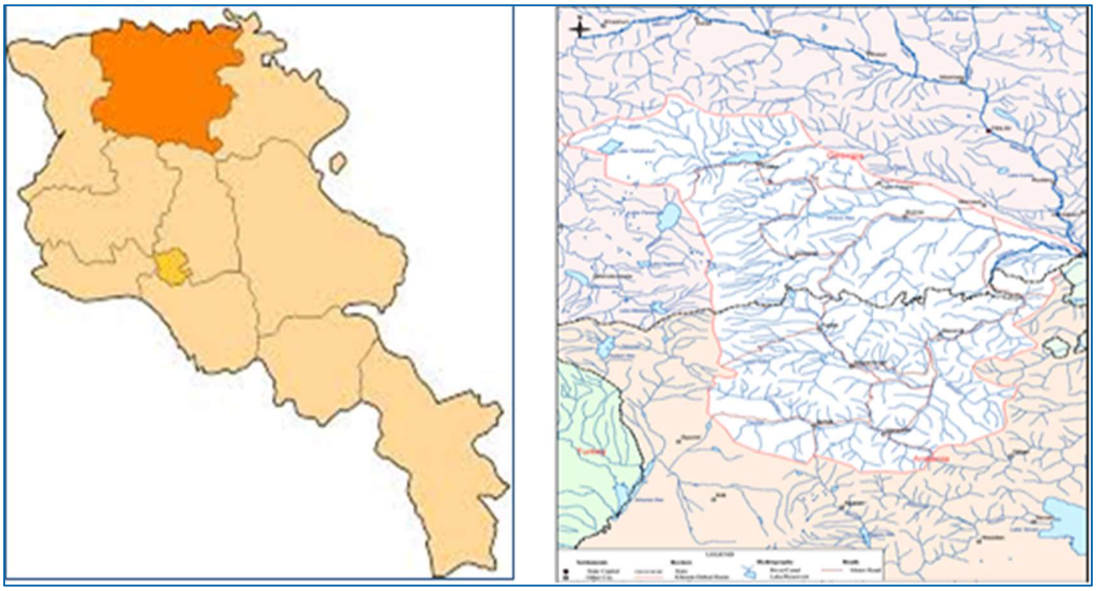

Figure 1. Location of the Debed River Basin in limits of Armenia and Full Basin location included territory of Georgia.

Earth atmosphere parameters were measured with satellite remote sensing systems, which are equipped with special optical or microwave sensors. Currently, a number of static atmospheric remote sensing satellite systems function globally, namely the European Envisat and MetOp, American EOS and NPOESS, Japanese GOSAT and several others. The latter is furnished with ultraviolet, visible and infrared spectrometers, while some have also microwave band spectro-radiometer (Kokhanovsky & de Leeuw, 2013).

Spatial distribution of air pollution within the studied territory was built on data of satellite spectrometer EOS/OMI, which runs within the range of 0.27-0.5 km, has spectral resolution of 0.45-1.0 nm and enables measuring the atmosphere content in wide range of 2,600 km with spatial resolution of 13×24 km (Levelt et al., 2006).

Land verification metering of the atmosphere surface layer was performed in two sites near the city of Alaverdi and passive monitoring data on monthly basis between 2004 and 2014 (Environmental Impacts Monitoring Center reports for 2004-2014).

Reduction of satellite data to the surface atmosphere was based on average monthly variables of nitrogen and sulfur dioxides concentrations in mg/m3. Values of satellite measuring on the uniform grid underwent inverse square interpolation with points of ground-based measurements. Based on those data, the nonlinear robust regression was done using the method of optimal spline interpolation (Kobza, 2000). Afterward, the measuring of the regression equations was converted to concentration in the surface atmosphere for the entire study area.

The maps of average monthly concentrations of sulfur dioxides drafted as a result of this work enabled performing analysis of observation time-series. Analysis of time series helped to define the average variables for the reference period, the average annual increment, and the characteristic period of the oscillatory constitutive.

Results and Discussion: The study territory covers the Debed River catchment area, which comprises the overwhelming part of Lori province and the small part of Tavush province, including Stepanavan, Vanadzor, Spitak and Alaverdi towns in particular.

Analysis of the maps on the distribution of parameters of time-series of sulfur dioxide concentrations in surface-atmosphere for the studied territory enables identifying high contents of sulfur dioxide, exceeding the maximum acceptable concentration (MAC). The revealed risk contents of sulfur dioxide in the air can cause soil and plant contamination, pollution of surface waters, and can lead to increased risk of population morbidity.

Analysis of the maps on the spatial distribution of dynamics of sulfur dioxide in the ambient air led to a number of conclusions. In some areas, the average value of the concentration of sulfur dioxide in the surface air layer exceeds MAC 10-11 times reaching 570 µg/m3. In addition, concentration growth tendency is observed towards the western direction from the town of Alaverdi, i.e. west from main pollution sources, including Alaverdi copper processing (smelting) plant. This pattern is the result of systematic air shift mostly to the south-west (Stankevich et al., 2017).

During our previous investigations, we registered the impact of air pollution on the Debed river water and acidification processes. (Nalbandyan, 2015).

The indirect influence of the sulfur dioxide on the development of cancers, in particular lung cancer, using 2007-2014 morbidity indicators with regional breakdown were investigated. The latter was based on data provided by the Analytical Center of the Ministry of Health (MoH IAC) of Armenia (Health System Performance Assessment, MoH RA 2007-2014).

Comparison of data pinpoints that the high lung cancer morbidity rate detected in Lori region is consistent with relatively high concentrations of sulfur dioxide, which show similar growth tendency to the west from the source of pollution -Alaverdi town. Thus, analysis of spatial distribution of the studied indicators makes believe that there is the correlation between the distribution of sulfur dioxide in the air and cancer morbidity in Armenia.

We are planning to continue the in-depth study of the issue in the future and to conduct a follow-up multifactoral analysis of correlations and the degree of influence of the air polluted with sulfur dioxide on the incidence of malignancies.

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3. Pollution impact on lake water quality of Russian Arctic region

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The Russian part of the Euro-Arctic region (ER), Kola North, is the most densely populated and industrially developed. The spectrum of anthropogenic impacts on the lakes is wide: mining, metallurgy, refineries and chemical industries, nuclear power plants, etc. For more than 70 years the lakes are used as a source of technical and drinking water supply, for recreation, tourism and fishery. Considerable industrial expansion in the early 1900s resulted in building of large industrial enterprises in the region. Industrial development of copper-nickel, rich apatite-nephelinite and iron deposits in the Kola Peninsula began in the 1930s. Large amounts of pollutants entered the lakes between 1940 and 1990; the catchment areas were also polluted by airborne contaminants. The main pollutants were heavy metals (predominantly nickel and copper), sulphates, chlorides and nutrients. The main pollution occurred in the northern and central parts of the region.

Western Siberia (WS) ranges from the tundra of the Yamal Peninsula in the north to the steppe zone of the Kurgan Region to the south. The area consists of monomineral Quaternary deposits with a predominance of quartz sand and loose silicate rocks, with widespread in the tundra and taiga zones of WS. In the northern and middle parts of WS rainfall dominates over evaporation and there is extensive development of wetlands (Khrenov et al., 2011). WS is a region dominated by the oil industry producing 60 % oil and 90 % gas (310 million tonnes of oil and 500 billion m3 of natural gas) (Moiseenko et al., 2013).

The main feature of both regions is an increase of cations and alkalinity concentrations in water towards the south: for ER - 55-60 °, for WS - 55-60 ° North latitude. The lakes of forest-steppe zones in ER and WS are highly resistant to acidification. This means significant protection of water bodies of these areas to anthropogenic impact.

Buffer capacity is an important characteristic of the stability of water systems to anthropogenic influence. Buffer capacity of northern and middle taiga region of ER and WS connect with the features of geology were found (Figure 2).

An anionic composition is an obvious indicator of water pollution, water acidification. Water acidification due to anthropogenic sulfate is characterized of ER. In the acidic lakes of WS the water contained: chlorides, nitrates and sulfates. Chlorides are dominated in a majority of the lakes. Sulfates dominate in some of the lakes. Concentration of nitrates in water WS are higher in compared to the waters of ER as was found.

In addition, the contribution of nitrates, chlorides and organic matter to the total composition of anions is higher for waters of Western Siberia than for European Russia (Figure 3).

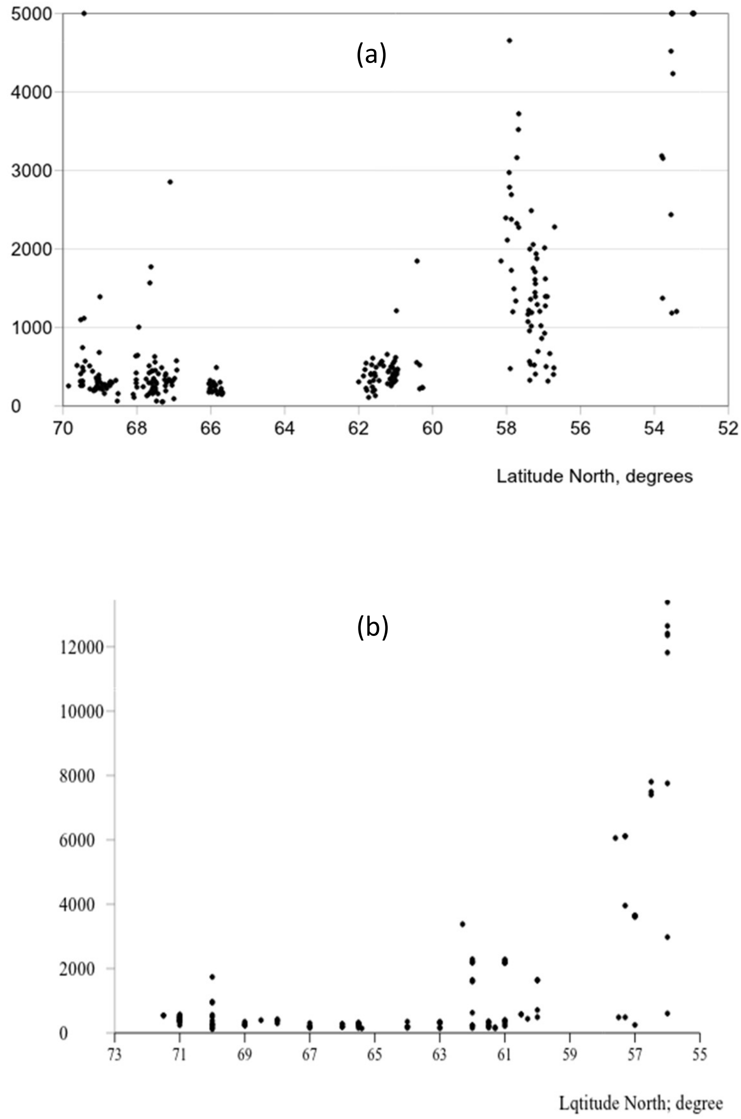

Figure 2. Concentration of cations (Ca+Mg+K+Na), µeq/l, in smalls lakes. a) ER, b) WS

This is due to the following features:

<u>NO_3^-</u>

1. delivery with the marsh waters, wetland and marsh is widely developed in the WS (Norg = 49.7·DOC – 114. (r=0.87. n=120);
2. the gas flaring forms the nitrogen oxides

<u>Cl^-</u>

1. WS is located on the site of paleosee area and Quaternary rocks contain an amount of chloride (Moiseenko et al., 2013).
2. The chlorides are present in the waters of WS as part of pollution of the oil and gas fields development (Moiseenko et al., 2013).

<u>Organic compound (A^-)</u>

Natural humus acids enter with the marsh waters.

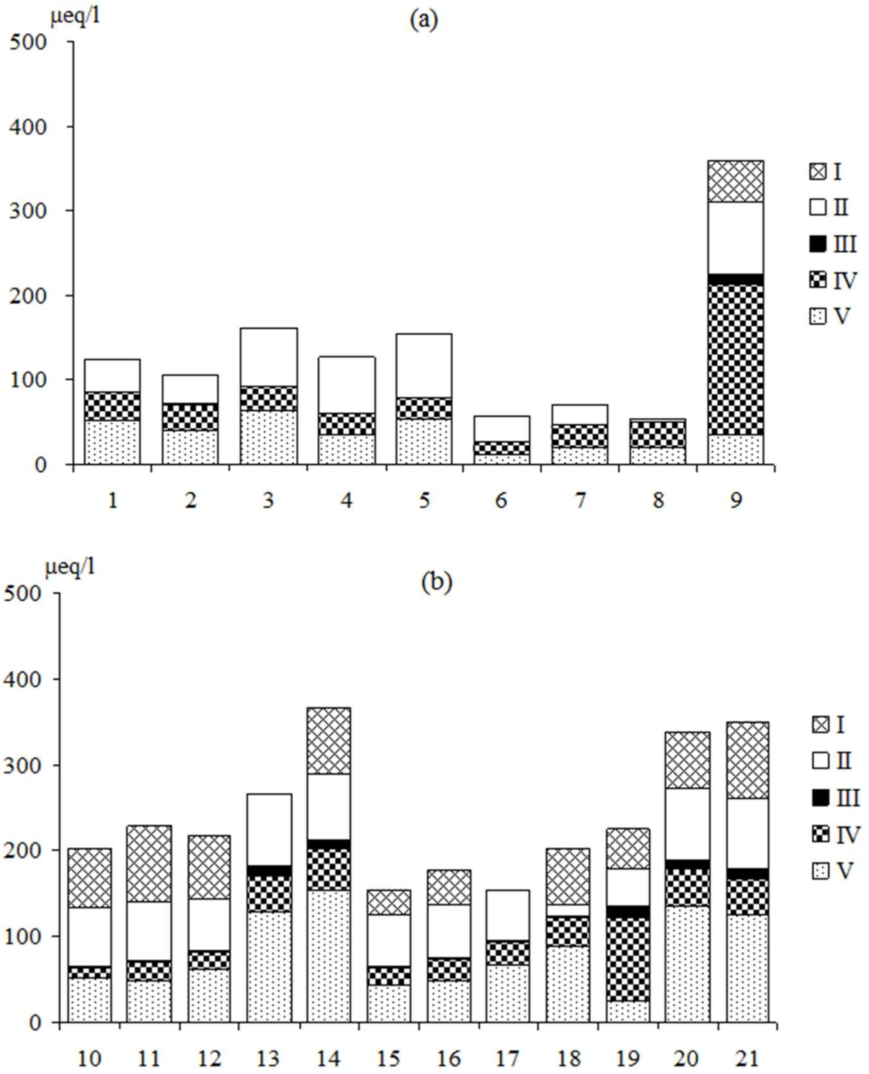

Figure 3. The anionic composition (I – Alk. II - A^{n-}. III – NO_3^-. IV – SO_4^{2-}. V – Cl^-) of the water lakes with pH <5 on the ER (a) (1 - in the tundra, 2-8 - in the northern taiga, 9 - in the middle taiga) and WS (b) (10-12 in the tundra, 13-14 - in the northern taiga, 15-21 - in the middle taiga).

<u>Some conclusions:</u>

On the European territory of Russia, lakes with high buffer capacity are located in the taiga climatic zones, in Siberia - in the tundra regions. This is due to geochemical factors (geological rocks).
High anthropogenic influence (in the European territory of Russia - copper-nickel production, in Western Siberia - oil refining complexes, in Eastern Siberia - Norilsk Nickel) determines the various chemical equilibria in natural waters. The greater content of anions in the waters of Western Siberia is associated with territorial features. The calculated critical loads and their exceedances for the European territory of Russia and Western Siberia showed the differences in the parameters for the climatic zones of the territories.

<u>References:</u>

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4. Minutes of the 34th Task Force meeting of the ICP Waters programme held in Warsaw, Poland, 7-9 May 2018

CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Working Group on Effects

International Cooperative Programme

on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes

MINUTES

of the 34th meeting of the Programme Task Force
the Joint ICP IM and ICP Waters TF meeting in Warsaw, May 7-9, 2018

KEY MESSAGES OF ICP WATERS 2018 TASK FORCE MEETING

Policy developments regarding air pollution: The EU NEC Directive

In the updated EU National Emission Ceilings (NEC) Directive, monitoring effects of air pollution on freshwaters, semi-natural habitats and forest ecosystems is made mandatory (Article 9). Currently, the monitoring system is being developed and will be reported by Member States to the Commission by July 2018. Many national focal centres (NFCs) from ICP Waters are involved national work to prepare their countries in implementation of the NEC Directive. During the Task Force meeting, NFCs expressed that activities under the NEC Directive make use of, and reinforce, the work of long-monitoring on ecosystem effects and the Convention. ICP Waters has contributed to the guidance document describing monitoring of effects in surface waters for compliance with the NEC Directive. A higher level of detail on monitoring effects of air pollution on freshwater ecosystems is found in the ICP Waters manual. Monitoring under the Water Framework Directive does usually not provide sufficient information to reliably assess possible impacts of air pollution of acidification.

Acidification

Monitoring data from water bodies in acid-sensitive regions indicate that a significant proportion of acid-sensitive lakes remains acidified (i.e., has an ANC below the critical limit) in North America and in European countries, despite considerable reductions in sulfur deposition. However, there is considerable variation between countries. In some countries where no water chemical monitoring data were available, a potential risk of acidified surface waters was indicated but could not be substantiated because of the lack of monitoring data.

Current monitoring programs are supplying sufficient information for a reliable assessment in some countries, while other countries appear to lack suitable monitoring programs for surface water acidification status. Monitoring and reporting under the WFD in Europe is currently not a reliable source of information on air pollution effects on surface waters.

Mercury

The fish Hg database is a valuable source of information for continued monitoring of impacts of Hg in the environment. In particular, lakes that are primarily impacted by atmospheric sources of Hg will be relevant for documentation of effects of reduced air pollution on fish Hg. The entire database has a large potential for evaluation of effectiveness of past and future policy to reduce Hg in the environment, including the global Minamata Convention on Mercury (entered into force in August 2017). Results from the report were contributed to Chapter 7 (Mercury concentrations in biota) of the Global Mercury Assessment Draft Report, which was presented at the COP-1 meeting of the Minamata Convention on Mercury (September 2017). A general recommendation for monitoring of mercury in freshwater fish was to include repeated sampling of the same water body over time.

EECCA countries

In Western Siberia in the Russian Federation, oil and gas extraction lead to emissions of sulfur, chloride and nitrogen to the atmosphere, and low pH in precipitation. However, only part of the region is acid-sensitive. In the European part of Russia, there are also some large emissions of acidifying components to the atmosphere. In both regions, there are areas where critical loads for acidification are exceeded and there is evidence of acidified lakes. In addition, there is evidence of enhanced concentrations of nickel and copper in lakes located in close proximity to smelters on the Kola Peninsula.

In Armenia, elevated atmospheric concentrations of nitrogen and sulfur-oxides are found, where the likely sources are industrial plants, for instance a copper smelter. The atmospheric concentrations pose a health risk to the population, as suggested by national statistics on lung cancer mortality.

The meeting of the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution on Rivers and Lakes (ICP Waters) organized jointly with the International Cooperative Programme on Assessment and Monitoring of the Effects of Air Pollution Ecosystems (ICP Integrated Monitoring), was attended by 46 experts from the following 14 Parties to the Convention on Long-range Transboundary Air Pollution (CLRTAP): Armenia, Austria, the Czech Republic, Finland, Germany, Ireland, Italy, Norway, Poland, Russia, Spain, Sweden, Switzerland, and the United Kingdom. The Convention Secretariat was also represented. A complete list of participants can be found in Annex I.

Introductions

1. Mr. Gunnar Skotte (Chair ICP Waters) and Mr. Salar Valinia (Co-Chair ICP IM) opened the meeting with a few introductory words and welcomed the representative from the Polish Ministry of Environment.
2. Ms. Kinga Majewska from the Polish Ministry of Environment, welcomed the parties to the meeting. She wished the participants a fruitful meeting and a good excursion to Kampinos national park.
3. Mr. Skotte thanked Ms. Majewska for the warm and welcoming words and asked whether the agenda could be adopted.
4. The agenda for the meeting was adopted.
5. Mr. Rafał Ulańczyk (Poland) gave brief information about the excursion to Kampinos national park.
6. Mr. Krzysztof Olendrzyński (Secretariat of the CLRTAP) presented news from the Executive Body and updates from the CLRTAP. He started by acknowledging Norwagian funding of the Secretariats participation at the meeting. He described recent scientific developments of relevance for EMEP and WGE. He emphasized some of the main messages from the scientific assessment report "Towards cleaner air" from 2016 and how it has been received, and went on to inform about recent policy developments of importance. He finished by describing recent and coming capacity building and outreach activities.
7. Mr. Valinia (Co-Chair ICP IM) presented ongoing activities in the WGE. He reported some of the key messages from the joint EMEP/WGE meeting held in September 2017 and the joint meeting of the Extended Bureaux of EMEP-SB and WGE in February 2018. He summarized the policy review groups' recommendations for WGE/EMEP. The most relevant for ICP Waters is perhaps the effect focused topics concerning: 1) airborne effects of HMs and POPs, taking into account

work under related global conventions, 2) empirical ecosystem research on dose-response functions for ozone and nitrogen, 3) investigating the links between climate change, carbon and nitrogen biogeochemistry and POP/HM biogeochemistry that are most policy relevant, 4) implementation of strategies for cooperation on modelling and mapping between MSC-E and –W with ICPs, 5) keep up or extend monitoring activities, and 6) Cooperation with priority regions and working with international bodies. He finished by asking the ICPs how they could adapt to the recommendations and if there was a need to adjust ICP's work plans for 2019/2020. Germany will be the new Programme Centre of CCE.

8. Ms. Heleen de Wit (ICP Waters Programme Centre) asked if ICP IM already had any plans for adapting to the recommendations, and Mr. Valinia mentioned a few potential lines of action. Ms. Maria Holmberg, (ICP IM Programme Centre) mentioned that her presentation later in the meeting would be of some relevance for this question.

9. More cooperation is one of the recommendations, and Ms. de Wit said that she considered heavy metals and nitrogen as suitable topics for cooperation.

10. Mr. Martin Forsius (ICP IM Programme Centre) reported from the sixth Saltsjöbaden workshop. This is an international science-policy workshop of major importance for work under the Convention. It is held under the Chatham House rule which allows people to express views that may not be those of their organizations or countries. The workshop is directed towards policymakers, scientists, and other stakeholders active in supporting air pollution awareness and control on an international scale. The main theme in 2018 was "Clean air for a sustainable future – goals and challenges" and this was further divided into many subtopics. The workshops outcome will be a series of recommendations, of which Mr. Forsius went through quite a few.

11. Mr. Olendrzyński (Secretariat of the CLRTAP) mentioned that the number of participants this year was the highest ever (200), and that it is one of the most important meetings for the Convention. It is very important for development of the long-term strategy, with major implications for the ICPs among others. The ICPs have an opportunity to influence the strategy now before the recommendations are finalized. Mr. Valinia (Co-Chair ICP IM) offered to circulate the relevant papers to interested parties.

12. Mr. Ulf Grandin (Co-Chair ICP IM) presented current issues for ICP IM. He gave a brief introduction of the ICP IM, its key tasks, monitoring network and activities. He provided highlights from recent studies and described work in progress. He mentioned perceived threats and areas for improvement that had been presented at the WGE Extended Bureaux meeting in February. A key question that he asked the audience to consider, was how ICP IM monitoring sites could be used for future policy development. He finished by saying a few words about the revised mandate for ICP IM. The most important change was that mandatory yearly activities had been moved from the work plan to the mandate.

13. Mr. Skotte (Chair ICP Waters) presented current issues from ICP Waters. He started by welcoming Spain as new participant. He briefly introduced the reports from 2017 with additional detail on the follow-up of the mercury report. He went on to describe recent developments concerning the NEC Directive. He gave a summary of the draft report on regional acidification assessment that was sent out just before the meeting, and encouraged the audience to provide feedback. Mr. Skotte introduced the upcoming report assessing reactive nitrogen. Finally, he suggested that a trend report, possibly with a chapter on the impact of changed land use on recovery, could be a suitable topic for the 2020 ICP Waters report, since it then would be 6 years since the last trend report. He emphasized that this was still just a suggestion and encouraged the audience to come up with alternative ideas.

14. Mr. Walter Seidling (ICP Forests) reported on the activities of ICP Forests. It now has 42 participating countries. Mr. Seidling described the extensive and intensive network of stations that ICP Forests has. Some are not active, but may reopen because of the requirements of the NECD. He described overlaps with the network of other ICPs and said that mutual benefits from this could be expected. He went on to present recent reports. The manual was revised in

2016/2017. Next TF meeting will be held in Riga. The 2018/2019 workplan includes work on effects of ground level ozone, N deposition and heavy metals. Mr. Seidling emphasized two recent scientific outputs concerning the effect of N on foliar N/P concentrations and soil acidity on DOC in soil water. He described joint IM/Forests monitoring projects and presented a number of graphs showing trends in important parameters. He finished by giving a list of ongoing activities and coming events, and showing how ICP Forest had contributed to the NECD guidance document.

15. Mr. Forsius (ICP IM Programme Centre) agreed that the co-location of sites was very important. The Finns have good experience with co-location of different types of monitoring, and he described some of the major benefits.

16. Ms. de Wit (ICP Waters Programme Centre) commended ICP Forests for their web page and asked how the sub groups interacted with the web page of ICP Forests. Mr. Seidling gave a brief description.

Introduction to the thematic sessions

17. Ms. Anna Katarzyna Wiech (Poland) gave a presentation entitled “State Environmental Monitoring in Poland - Organization of Integrated Monitoring of Natural Environment in Poland”. She started by describing the structure of the monitoring (i.e. what is monitored). She gave an overview of how the monitoring system was organized with more detail on air, surface water quality and integrated monitoring, including the objectives of these activities. She briefly described how they intended to meet the requirements of the NECD. She described some the future priorities for the IMNE and finished by listing some of the research interests of the Chief Inspectorate of Environmental Protection.

18. Mr. Valinia asked how suitable the WFD sites were for the NECD which require reference sites with no local pollution. Ms. Wiech answered that there was a need for some adjustments/extensions to the WFD monitoring and mentioned that the Polish IM monitoring sites would be used for the purpose of NECD monitoring.

19. Ms. de Wit asked if the old ICP Waters sites in the Tatras mountains could be reopened. Ms. Wiech answered that they were giving this option serious consideration because these sites are very suitable for the monitoring of effects of air pollution.

20. Mr. Forsius asked how the base monitoring stations were selected and defined. Mr. Andrzej Kostrzewski (Poland) answered that the criteria were the same as the selection of the IM stations with the aim of covering a wide range of ecosystem types.

Acidification and recovery

21. Ms. Kari Austnes (ICP Waters Programme Centre) presented the regional assessment of current extent of acidification of surface waters in Europe and North America. A draft was sent out before the meeting. Ms. Austnes started by giving the outline of the report and displaying the most important maps. She explained how she had approached the project using geological maps and monitoring data, including WFD classification data. She proceeded to show some examples from the national chapters. She gave a summary and explained that this was challenging due to the difference in approaches. She said that the information covered in the report is not sufficient to give a clear picture, and that the NECD could result in improved information. She finished with an outlook and conclusions. Surface water acidification is still an issue in Europe and North America. Acidification is likely to occur also in countries not covered by the national chapters. WFD data can assist in assessing acidification status, but can never fully replace other monitoring data. NEC Directive monitoring can address some of the current shortcomings of the monitoring programmes. Further emission reductions are needed to speed up recovery. She specifically requested feedback on the draft. The deadline for comments is June 1.

22. Mr. Pavel Kram (Czech Republic) pointed out that it was strange that the sensitivity map in some parts of Europe (around Hungary) followed the national borders.

23. Mr. Valinia pointed out that emissions have been cut and are already quite low. What else can be done? Ms. Austnes mentioned liming.

24. Mr. Jussi Vuorenmaa (ICP IM Programme Centre) said that delayed release of sulphate from soil was an additional factor that could affect time needed for recovery.

25. Ms. de Wit asked Mr. Olendrzyński (Secretariat of the CLRTAP) how the impact of the report could be increased. He answered that this was a tricky question. He said that the formulation of the resulting recommendation was a delicate matter that needed careful consideration. The promotion of the report to the target audience should be discussed later.

26. Mr. Ulańczyk gave a presentation entitled "Regional assessment of freshwater acidification in Poland". He started by stating that acidification of surface waters was not considered a significant pressure in Poland. He described how Poland had produced its map of acid sensitive regions. He went on to briefly describe the monitoring that had been presented in more detail by Ms. Wiech earlier in the meeting, and how the monitoring had changed after the implementation of the WFD. There are now few active monitoring stations that are suitable for assessment of acidification, but he concluded that some areas are sensitive.

27. Ms. Austnes (ICP Waters Programme Centre) commented that the criteria for acid sensitive was very different in different countries – 25 mg Ca/l in Poland and 1 mg/l in Norway.

28. Mr. Jens Fölster (Sweden) gave a presentation entitled "Acidification and recovery in Swedish lakes and streams – application of GAMM-models on multiple time series". He started by describing the advantages of GAMM for trend analysis, including its ability to detect changing points and reveal large scale patterns in time series that in turn can be used to generate hypotheses. He showed some nice graphs with aggregated trends for lakes and streams in various parts of Sweden.

29. Mr. Don Monteith (UK) asked what might be behind decreasing ANC trends in streams. Mr. Fölster could not give a definitive answer, but mentioned a few hypotheses.

30. Ms. Michela Rogora (Italy) presented an update of the acidification and nitrogen status of high altitude lakes in the Alps: 2017 vs 1980s. She started by describing the background of the first surveys conducted in the 70s. N deposition is much higher than critical levels. A survey of 30+ lakes was conducted in 2017 when remote lakes surveyed in the 1980s were resampled. This indicated significant recovery. N deposition is still important and nitrate is at present the main lake acidifying agent. She also emphasized the significance of inter-annual variability and climate drivers in the overall assessment of acidification status.

31. Ms. de Wit praised the high frequency monitoring approach and asked about effects of nitrogen other than acidification. Ms. Rogora did not have data to answer this question.

32. Mr. Luca Colombo (Switzerland) described more high frequency monitoring of temperature and conductivity in Swiss sites.

Heavy metals and POPs

33. Mr. Roman Prokes (Czech Republic) presented 30 years of integrated POPs monitoring at the background observatory Kosetice, which is a relatively remote reference station. Here integrated POP monitoring has been conducted since 1988. Both active and passive sampling of air have been used. He showed time trends for PAHs, PCBs, HCHs, DDD, DDE, DDT. Most compounds show decreasing trends, but not CUPs. He went on to display the results from monitoring of plants, sediments, soils and surface waters. All data are available from the web site www.genasis.cz.

34. Mr. Staffan Åkerblom (Sweden) asked if emerging compounds were measured. Mr. Prokes answered yes, but concentrations were low.

35. Mr. Forsius asked which of the compounds were now most important from a policy point of view. Mr. Prokes answered PAHs especially benzo(a)pyrene.

36. Ms. Marina Dinu (Russia) presented pollution impacts on lake water quality of the Russian Arctic region. Gas flaring during extraction of oil in Western Siberia leads to air pollution by oxides of nitrogen, sulfur, chlorine. There are clear regional trends in acid sensitivity. She gave an overview of the anthropogenic and natural factors affecting acidification parameters as well as speciation of aluminium, iron and trace metals. She went on to describe critical load calculations and their exceedance with respect to acids. She finished by presenting some trends showing decreasing trends in nickel, copper and sulphur dioxide from the Kola smelters since the 1990s.

37. Ms. de Wit (ICP Waters Programme Centre) asked about Russian policy to reduce emissions in these regions. Ms. Dinu answered that there were decreasing trends.

38. Mr. Åkerblom (Sweden) gave a presentation entitled "Temporal trends in heavy metals across IM sites". He started with an outline of the hypotheses for the study and went on to present the most important trends in concentrations and fluxes. He asked for input on how to proceed with scientific publication. Next, was a description of a study of the importance of land-atmosphere exchange for the mass balance of mercury at a research station in Northern Sweden. A conclusion was that peatland is a net Hg source and land atmosphere transport should be accounted for in mass balances.

39. Mr. Forsius (ICP IM Programme Centre) asked where the reemission of mercury was going. Mr. Åkerblom answered that he did not know. One possibility could be that the Hg is deposited again in the forest on the edge of the site.

40. Mr. Åkerblom gave another presentation entitled "The mercury in fish report – key findings and policy relevance". Here he showed the most important findings from the report that was published last year.

41. Mr. Monteith (UK) asked if the few lakes included in the earliest period could have biased the trends. Mr. Åkerblom answered that it was possible, but that he assumed that it did not.

Climate (and land use)

42. Mr. Monteith (UK) gave a presentation entitled "Developing capacity to predict DOC response to reductions in atmospheric deposition". Upland catchments provide 70 % of UK drinking water. DOC increase is therefore of major importance for costs involved in treating water. There is a mixed pattern of trends in monitoring stations. Treatment plant operators need to know what will happen with DOC in coming years, including the effect of measures taken in the catchment (e.g. forestry, burning, drainage). The best single predictor of DOC change turned out to be solution ionic strength. What is needed to predict developments at water treatment works is short term runs of ionic strength or conductivity and current non-marine sulphate.

43. Mr. Forsius (ICP IM Programme Centre) asked about the effects of hydrology. Mr. Monteith agreed that this could be important because dilution would also influence ionic strength.

44. Ms. de Wit, (ICP Waters Programme Centre) gave a presentation entitled "Climate-driven changes in removal of DOC in a small boreal lake: a 30-year time series". This is an unknown quantity in the global carbon cycle. The question is whether boreal lakes are passive pipes for terrestrial DOM or if they contribute significantly to conversion of DOM to atmospheric CO2. A mass balance study for Lake Langtjern indicate that DOC removal is low. Of the DOC that was removed, 67% is metabolized by microbial activity, 33% is removed sedimented while photo-oxidation was negligible (Langtjern is a brown lake with 6 months' ice cover, little UV penetration and only 2 months residence time). She finished by describing contrasting conclusions regarding the impact of a wetter climate on DOC removal from a time series study and a space-for-time study. She suggested that this was an example where a space-for-time approach might give misleading results.

45. Mr. Monteith (UK) asked if a hydrology change could change the quality of the DOC. Ms. de Wit answered that it was possible, but not likely in this case.

The NEC directive. Status and progress

46. Mr. Valinia (Co-Chair ICP IM) gave a presentation entitled “National emission ceiling – an opportunity for WGE?”. He explained the background and went through the most important content of the directive, including the MAES terrestrial and freshwater ecosystem types that are covered by the requirement for monitoring. This spurred a lively discussion about whether reservoirs, croplands and cultivated forests are or should be included or not. The directive suggests some monitoring parameters in its annexes and the guidance document includes a few more. Mr. Valinia gave a brief presentation of the latter. There was an expert group meeting in April. Many member states were positive to ecosystem monitoring. The draft template of the guidance document has been accepted. This contains many references to monitoring methods by ICPs and could fill many gaps. A technical expert group has been nominated. Here nations are represented as well as the ICPs.

47. Mr. Jakub Hruška (Czech Republic) said that Natura 2000 was in focus in the Czech Republic.

48. Mr. Monteith (UK) asked about the attitude to biological parameters, observing that only chemical parameters are mentioned in the text of the directive. Ms. de Wit answered that biological parameters are listed in the guidance document as optional parameters.

49. Mr. Manuel Toro Velasco (Spain) gave a presentation entitled “Spanish aquatic ecosystem monitoring programs: possibilities to comply with requirements of NEC Directive and ICP Waters / Integrated Monitoring”. He introduced the Spanish institutions involved in this work. Spanish rivers and lakes show large diversity. Most of them are in the Mediterranean region where ICP Waters has no stations. There are 9 bioclimatic regions, 35 river and 30 lake types in Spain according to the WFD categorization. There are currently two main monitoring networks in Spain: WFD and Natura 2000, and a few differences between them was listed. What are the possibilities to comply with NECD, ICPW, ICP IM? Monitoring of reference sites under the WFD can be adapted to NECD monitoring. DOC is the only parameter missing. The monitoring frequency must be increased. Mr. Velasco presented a couple of suggested stations: Penalara Lake north of Madrid and Sanabria Lake (large). He finished the presentation by mentioning that he wanted to include phosphorous because of the importance of transport of sand from the Sahara.

50. Mr. Forsius commented that the approach used by Spain was similar to the Finnish strategy that also is aimed at co-location of ICP IM, ICP W, and WFD reference sites with NECD sites.

51. Ms. Austnes (ICP Waters Programme Centre) asked if reliance on WFD reference sites might miss the headwater sites required by the NECD.

52. Mr. Thomas Cummins (Ireland) said that effects monitoring and the funding thereof was very limited in Ireland. He requested clear advice on selection of monitoring stations and parameters.

53. Mr. Valinia (Co-chair ICP IM) said that Sweden had invited experts from the WGE and they together design the program based on sites reported to the CLRTAP convention

54. Mr. Thomas Scheuschner (Germany) said that Germany intended to use ICP networks and pointed out that having monitoring stations is mandatory, but all the parameters are optional.

55. Mr. Hruška (Czech Republic) said that authorities in the Czech Republic have ordered a review on stations and parameters. The Czechs intend to use the guidance in combination with manuals of ICP Waters, IM and Forests. Discussions were mainly concerned with the selection of terrestrial sites (Natura 2000).

56. Mr. Forsius (ICP IM Programme Centre) mentioned that research infrastructure, especially the LTER network should be considered when selecting stations.

57. Upon a question to the audience, all representatives from the participating countries mentioned that they have been contacted by their respective ministries or relevant authorities to contribute with knowledge and expertise in ecosystem monitoring. Most delegates could also confirm that they had been involved in the design of the monitoring.

58. Ms. de Wit (ICP Waters Programme Centre) asked if Russia and Armenia had heard about this. Ms. Ekaterina Pozdnyakova (Russia) answered that there was some problem with funding. This was not related to the NECD. Ms. Marine Nalbandyan Armenia answered that direct contact with the department had been established on this topic.

59. Ms. Austnes (ICP Waters Programme Centre) asked how the requirement for a representative network of stations should be understood. What is meant? Is it spatial gradients or just ecosystem types represented? The latter would require less stations.

Biodiversity

60. Ms. Gisela Pröll (Austria) presented observed and modelled trends in forest vegetation in ICP Integrated Monitoring, Forests, and LTER sites in Europe. The trends indicate decrease in oligotrophic species and increase in nitrophytic species. The species richness gradients depend on other factors than N deposition. She presented an example showing how limed and unlimed grassland biodiversity had recovered after decrease in N deposition, indicating that ecosystems have some resilience. The aim of the study was to assess future impacts of N deposition on forest vegetation. In total 26 forest sites across Europe (ICP IM and LTER sites) were included. Models used were VSD+ (acidity and nutrients) and PROPS (forest response). The models indicate increase in soil pH in year 2100 compared to 2000. They also indicate increasing N/P ratios for about half of the sites. A decrease in acidophilic plant species is predicted.

61. Ms. Nalbandyan, (Armenia) gave a presentation entitled “Assessment of accumulation and spatial distribution of nitrogen and sulfur dioxides in atmosphere of the Lori region of Armenia (including debed river basin) and potential population health risk”. The Lori region is in the northern part of Armenia close to the border with Armenia and Georgia. The spatial distribution of air pollution was based on satellite spectrometer, i.e. remote sensing. SO2 was highest in the western part. The Lori region has high prevalence of some cancer forms and it was suggested that this was linked to high levels of SO2.

Nitrogen

62. Mr. Krám (Czech Republic) presented “Nitrogen and phosphorus at Lysina CZ02”. He described the catchment. The station has time series on input and output since 1991. pH has increased from around 4.0 to 4.5, but with a large difference between base flow and high flow conditions. The total dissolved nitrogen budget at Lysina is incomplete without consideration the dissolved organic nitrogen (DON) fraction, especially for the runoff. Very high concentrations and fluxes of phosphorus in drainage waters at Lysina are generated by elevated content of phosphorus in the granitic bedrock. A soluble reactive phosphorus fraction available for biota prevailed at Lysina. He finished by drawing the attention to discontinued time series in Latvia and UK. He encouraged the ICPs to do something about this.

63. Mr, Valinia asked if nitrogen in Lysina had reached a new steady state. Mr. Kram answered that this was likely.

64. Mr. Vuorenmaa (Finland) gave a presentation entitled “Long-term changes in the inorganic nitrogen output fluxes in European ICP Integrated Monitoring catchments - an assessment of the role of internal nitrogen parameters”. He claimed that routine monitoring variables do not explain variation/change in TIN output satisfactorily and pointed out the need for data mapping on internal catchment N-related parameters at IM sites. He requested data mapping of internal catchment N-related parameters at IM catchments. Call for data will be sent out.

65. Ms. de Wit (ICP Waters Programme Centre) commented that some of the terrestrial monitoring has stopped. She also said that this could be a good topic for cooperation between ICPs and possibly LTER. Mr. Martin Forsius (ICP IM Programme Centre) supported this. A more detailed plan will be prepared.

66. Ms. de Wit (ICP Waters Programme Centre) gave a talk on the suggested topic for the 2019 thematic report on reactive nitrogen in freshwaters. She showed results from a preliminary study of Norwegian data. This study did not produce convincing evidence that N had a decisive effect on lake productivity or species diversity. She asked the TF what data were available to explore this topic further and if there was interest in contributing. The most interesting path of enquiry is possibly to look for co-limitation at low concentrations.

67. Mr. Hruška (Czech Republic) mentioned that pH could also be a co-limiting factor.

68. Mr. Monteith (UK) asked if it was possible to go beyond algae. Ms. de Wit answered yes.

69. Mr. Ulańczyk (Poland) presented the nitrogen budget for the IM station "Puszcza Borecka". A wide range of monitoring data are available for the "Puszcza Borecka" station (since early 1990's). The impact of atmospheric deposition of nitrogen on ecosystems and water quality cannot be assessed based on monitoring data only. A SWAT model was used to simulate the nitrogen cycle in the area under consideration. An AEM3D model was used to simulate the lake's hydrodynamics and thermodynamics and to give a basis for the assessment of impact of the deposition on water quality and aquatic ecosystems.

70. Mr. Scheuschner (Germany), gave a brief presentation with news from ICP Modelling and Mapping. The CCE will be transferred from the Netherlands to Germany.

Issues common for both ICPs

71. Mr. Anker Halvorsen (ICP Waters Programme Sub-centre) presented the report "Biological intercalibration: Invertebrates 2017". He started by going through the objectives and methods, and the way the results were assessed. The published report is available on the website http://www.icp-waters.no. Laboratories from Estonia, Germany, Sweden and Switzerland participated in 2017, and 3 of 4 laboratories achieved the target level of 80 % accuracy. The average Quality index was excellent for two of the laboratories, acceptable for one and unacceptable for one. He stressed the importance of identifying mayflies, caddisflies and stoneflies (i.e. the EPT) to species level because of the way the quality index is calculated. One of the laboratories failed to achieve the target accuracy because they had only identified stoneflies to genus level. Laboratories from Norway, Sweden, Czech Republic, Ireland, Estonia, and Latvia will participate in the 2018 Intercomparison.

72. Mr. Toro Velasco (Spain) asked about how southern European laboratories could participate. Mr. Halvorsen answered that it would be possible to participate in 2019 but not this year.

73. Mr. Fölster (Sweden) asked if phytoplankton also should be intercalibrated. The answer was that this would be a challenge and probably not feasible.

74. Mr. Øyvind Garmo (ICP Waters Programme Centre) presented the results from last years' chemical intercomparison (1731). A total of 88 laboratories were invited to participate. Of these, 38 laboratories from 21 countries accepted the invitation and submitted results for one or more parameters. Mr. Garmo described how the samples had been prepared and distributed. Accuracy in determination of major ions, trace metals and TOC was very good (> 80 % had target accuracy < 20 %). Accuracy for alkalinity, NO3+NO2-N and total P was poor (32 % or less had acceptable target accuracy).

75. Mr. Hruška (Czech Republic) suggested to send more acidic samples this year in order to verify that the relative accuracy for pH would improve and that there was not an inherent problem. Better reporting of methods from the labs to improve ability to assess results was requested. It was also asked whether there was a need to improve the form that went with the samples in order to improve the description of procedures used for alkalinity and pH. Next year the concentration of trace metals should be a factor 5-10 lower.

76. Mr. Fölster (Sweden) pointed out that a problem for the intercalibrations has always been alkalinity and pH, where the variability between labs mainly shows the differences in methods. In order to further improve the report from the intercalibration he suggested to ask for more information on methods, and on reporting according to the submitted information:

- **i.** Alkalinity, select method from the following list - End point titration; Two point titration; Gran-titration. When applicable: supply end pH(s) for titration
- **ii.** pH: select method from list: -Measurement in an open system; measurement in a closed flow-through system; Stirring; No stirring.
- **iii.** Based on the answers the labs can be grouped, and given different symbols in the plots. It will then be easier to see whether the distribution depends on difference in method or to errors.

77. Ms. de Wit, (ICP Waters Programme Centre) presented current issues and future plans for ICP Waters. She went through the update of the long-term strategy and the recommendations from the policy review group. She repeated the aims of ICP Waters and gave an overview of participation.

78. Next Ms. de Wit gave a list of recommendations addressed to ICP Waters from the review of ICPs. The recommendations for ICP Waters should a) shift the focus of activity from acidification to more comprehensively assess the impacts of nitrogen, heavy metals and POPs; b) maintain periodic trend assessments, c) Pursue interaction with other international waters monitoring programmes e.g. UNEP, GEMS, etc.; d) consider stronger links with the river sites monitored as part of ICP Integrated Monitoring; and e) explore ways to combine/merge the activities of some of the ICPs (e.g., ICP Integrated Monitoring, ICP Forests, ICP Waters), improve integrated working and reporting and explore possibility of joint meetings. General recommendations aimed at all ICPs concerned a desire for a common data portal and open access to data, and a call for more active involvement in data interpretation and preparation of assessment reports from other Parties than the Programme Centres.

79. The key items in the 2018/2019 workplan for ICP Waters are a follow-up of the mercury report with ICP IM, completing the report on regional acidification with CCE, prepare for coming thematic reports on reactive nitrogen and trend assessments. She repeated a few points from the mercury report and described the follow-up studies. A mass balance study in Norway will be conducted. This will involve comparing EMEP modelled estimates of Hg deposition with empirical estimates. Ms. de Wit asked how we could increase the impact of the regional acidification report. She then asked for advice on how to proceed with the planned report on reactive nitrogen. The aim here is to assess how nutrient-nitrogen from air pollution impacts freshwater ecosystem functioning. This is difficult to demonstrate in acid-sensitive freshwaters. Trends in water chemistry was proposed as a topic for 2020, but could be moved forward if it was decided that more time is needed for the nitrogen report.

80. Mr. Forsius (ICP IM Programme Centre) presented future plans ICP IM. He went through the draft work plan for 2018-19. There are plans to cooperate with other ICPs and LTER on reports and scientific papers. The latter include papers on dynamic modeling of impacts of future deposistion scenarios, critical load exceedances and empirical indicators, heavy metal trends, and impacts of catchment characteristics, climate and hydrology on nitrogen processes. The latter is a possible topic for cooperation between ICP IM and ICP Waters. He explained the scientific strategy of ICP IM and described possibilities for cooperation with LTER. He described the eLTER research infrastructure timeline plan as a possibility for accessing funds. He mentioned that ICP IM and ICP Waters provided data for the Minimata convention (data from the common report on mercury).

81. Mr. Valinia (Co-chair ICP IM) urged the focal centers to keep communicating with the respective national representatives in the NECD expert group.

Separate ICP Waters TF meeting

82. Ms. de Wit (ICP Waters Programme Centre) went back to her presentation of current issues and future plans of ICP Waters. She showed a table with overview of participation. The table apparently contained two errors concerning Ireland's and Sweden's submission of biological data, and these were commented. There was discussion about the possibility to submit data on benthic diatoms. Some countries do it, including UK and Sweden (streams), but not Norway. Ms. de Wit presented a list of meetings attended and reports produced since May 2017. She explained the difference between ICP Waters' mandate (i.e. general description of what we do) and work plan which is more specific.

83. Ms. Austnes (ICP Waters Programme Centre) revisited the regional assessment report and suggested some points for discussion. There were no objections to the proposed timeline and group of reviewers. Mr. Monteith (UK) found the suggested approach/focus/structure sensible. Mr. Fölster (Sweden) suggested a minor change in the order of chapters, which involved text on critical loads. Ms. Austnes will consider.

84. Ms. Austnes asked if there was a need for more detailed overview of data. Mr. Monteith (UK) suggested at least to include an overview of number of sites. Mr. Ulańczyk (Poland) mentioned that it was important to state if it was only sensitive sites that had been submitted or not. Ms. Austnes asked if the thresholds/critical limits used were OK. Ms. Rogora (Italy) suggested to maybe focus more on sensitivity than thresholds. Mr. Monteith (UK) commented that the use of the ANC/ANCoaa limit made the UK look worse than the biology suggests. Ms. Rogora suggested to show the percentage of ANC levels that fall in various groups. Mr. Velle (ICP Waters Progamme Sub-centre) requested an explanation on the lack of labile aluminium. There was consensus that it was OK to use the % above and below threshold as suggested, if explained properly in the text. The graph showing distribution of ANCoaa was approved, but again the importance of explaining that it is hard to compare across borders was stressed. This is mainly because of the different approaches to monitoring. It was concluded that Sweden should resubmit data that was more comparable with other countries. Mr. Hruška (Czech Republic) commented that it would be good to distinguish between stream and lake stations. A problem with this is that countries have submitted one or the other. Ms. Austnes asked if there was any chance that we can say more about extent (%) of acidified water bodies. Mr. Monteith commented that it would be good to have relative contribution of acid anions.

85. Ms. Austnes encouraged participants to have a look at the part about WFD data to see if it made sense. She asked the participants with their own chapters to carefully read the summary for countries. She asked for information about potentially acidified regions. Regarding additional topics/literature, Mr. Monteith (UK) mentioned that a link to biodiversity was lacking. Mr. Fölster suggested that a discussion about the impact of forestry would be appropriate. Ms. Austnes asked if the suggested conclusions were OK. This spurred a discussion about how to formulate the need for emission reduction to speed up recovery. The statement that WFD data can assist in assessing acidification status must be reworded because it was deemed too generous towards the WFD data. On the topic of recommendations, Ms. Rogora suggested that the need for sampling/monitoring frequency should be commented. The need for larger surveys and the need for WFD to include monitoring of headwaters was also mentioned. It was said that base cations should be included in WFD monitoring (even though this is currently decided on the national level).

86. Mr. Fölster (Sweden) presented the Nordic database on water chemistry and biology. He went through the background of the database and its benefits. The strategy was to take advantage of earlier experiences from data compilations. The database involves few countries, should be multi-purpose and need no long-term maintenance. He went through the site characterization and data template. He presented the number of sites delivered and said a little about what kind of sites this was. The database is almost ready for use.

87. Ms. de Wit (ICP Waters Programme Centre) brought up the topic of the planned nitrogen assessment report. As mentioned earlier, this is a challenging task and good quality data are needed. It was suggested that ICP Waters as a start should consider opening for submission of Chl a data. Mr. Monteith (UK) and Mr. Hruška (Czech Republic) could possibly provide data of relevance to this exercise. Mr. Hruška pointed out that it would be useful to have data from a large region. Ms. de Wit agreed, but mentioned the commitment and effort needed to build a database.

88. Ms. de Wit suggested that a trend analysis could also be the topic of the next thematic report, as the last trend evaluation considered data upto 2011. She also suggested to include the extended selection of sites, rather than the core sites, as basis for the trend analysis. This suggestion received support. It was mentioned that a more advanced statistical method, such as the GAMM models presented by Mr. Fölster, should be considered for this exercise.

89. Mr. Skotte mentioned that recent research indicates that changes in land use, in particular forest management, can delay recovery and impact nutrient runoff, and suggested to address this topic in the trend report.

90. Ms. de Wit proposed to make the 'trend analysis' the topic for the thematic report in 2019, and to also address land use as a confounding factor for chemical recovery. The Task Force approved.

91. It was suggested that the report on reactive nitrogen would be moved to 2020, particularly in the light that the Nordic database (presented by Mr. Fölster) would have be ready for use.

92. Publication of a scientific paper on the biodiversity report was discussed. Mr. Velle (ICP Waters Programme Sub-centre) said that there was a need to go deeper into functional groups and maybe include more recent data. Mr. Velle suggested to do a preliminary analysis on functions based on data from the Norwegian database.

93. Next topic was the NEC Directive. It is not yet clear how much funding will be available. The importance of communicating with the national representatives nominated to the expert group was stressed. Most of the ICP Waters and ICP IM sites fulfill the requirements of the NECD.

94. Ms. de Wit said that there was a pressure to have a WGE data portal to improve data access. She anticipated that there would be questions for the focal centres about how to proceed with this.

95. Parties who want to publish in the proceedings are encouraged to contact oyvind.garmo@niva.no in June and deliver their contributions by August 1.

96. There was consensus that ICP Waters attendants were satisfied with the meeting format and that ICP Waters should continue holding joint Task Force meetings with ICP IM.

97. The next meeting will probably be held in Finland in early June 2019.

98. The minutes of the meeting were adopted.

5. Annex I: Participants at the Joint ICP IM and ICP Waters TF meeting

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6. Annex II: Agenda for the joint ICP IM and ICP Waters Task Force meeting in Warsaw, Poland, 7-9 May 2018

1. **Introductions** (Chairs ICP IM and ICP Waters)

2. **Meeting welcome** (Mrs. Kinga Majewska, Polish Ministry of Environment)
3. **Adoption of the agenda** (Chairs ICP Waters and ICP IM)

4. **General information about the meeting and excursion** (Rafal Ulańczyk, Tomasz Pecka)

5. **Reports**

   a. Executive Body and updates from the CLRTAP (Krzysztof Olendrzynski)
   b. Reports from Working Group on Effects and the Bureau (Salar Valinia, Gunnar Skotte)
   c. Saltsjöbaden VI (Martin Forsius)
   d. Current issues ICP IM (Chair ICP IM)
   e. Current issues ICP Waters (Chair ICP Waters)

6. **Reports from other ICPs** (Chaired by ICP IM)

   a. ICP Forests (Walter Seidling)

7. **Thematic sessions I** (Chaired by ICP Waters)

   a. **Introduction to the thematic sessions**
   State Environmental Monitoring in Poland - Organisation of Integrated Monitoring of Natural Environment in Poland NEC Directive (Anna Katarzyna Wiech, Andrzej Kostrzewski)

   b. **Acidification and recovery**
      I. ICP Waters regional acidification assessment (Kari Austnes)
      II. Regional assessment of freshwater acidification in Poland (Rafał Ulańczyk)
      III. Acidification and recovery in Swedish lakes and streams (Jens Fölster)
      IV. Recovery, Reforestation and Carbon Capture in the industrial watersheds of Sudbury, Canada: once the site of the world largest SO_2 point source (John Gunn).
      V. Assessment of accumulation and spatial distribution of nitrogen and sulfur dioxides in atmosphere of lori region of armenia (including debed river basin) and potential population health risk (Marine Nalbandyan)
      VI. An update of the acidification and nitrogen status of high altitude lakes in Alps: 2017 vs 1980s (Michela Rogora)

c. **Heavy metals and POPs**
   I. 30 years of integrated POPs monitoring at the background observatory Kosetice (Roman Prokes)
   II. Pollution and anthropogenic-induced processes impact on lakes quality of Russian Arctic region (Marina Dinu)
   III. Temporal trends in heavy metals across IM sites (Staffan Åkerblom)
   IV. The mercury in fish report – key findings and policy relevance (Staffan Åkerblom)

d. **Climate (and land use)**
   I. Developing capacity to predict DOC response to reductions in atmospheric deposition (Don Monteith)
   II. Are boreal lakes pipes or chimneys in the global carbon cycle? Long-term monitoring of DOC & process-based modelling in a lake catchment (Heleen de Wit)

Thematic sessions II (Chaired by ICP IM)

e. **Biodiversity**
   I. Observed and modelled trends in forest vegetation in ICP Integrated Monitoring, Forests, and LTER sites in Europe (Gisela Pröll)

f. **Nitrogen**
   I. Nitrogen and phosphorus at Lysina CZ02 (Pavel Krám)
   II. Long-term changes in the inorganic nitrogen output fluxes in European ICP Integrated Monitoring catchments - an assessment of the role of internal nitrogen parameters (Jussi Vuorenmaa)
   III. Reactive nitrogen in freshwaters – the 2019 ICP Waters report (Heleen de Wit)
   IV. Nitrogen budget at the IM station "Puszcza Borecka" (Rafał Ulańczyk)

g. **The NEC directive. Status and progress**
   I. Introduction/background NEC Directive (Salar Valinia)
   II. Spanish aquatic ecosystem monitoring programs: possibilities to comply with requirements of NEC Directive and ICP Waters / Integrated Monitoring (Manuel Toro Velasco)

8. **Common sessions of ICP Waters and ICP Integrated Monitoring for report and discussion of work plan items** (Chaired by ICP Waters)

a. Chemical and biological inter-calibration (ICP Waters)
   I. Biological intercalibration 2017 (Anker Halvorsen)
   II. Chemical intercalibration (Øyvind Garmo)

b. Thematic reports of common interest
   I. Status and future plans ICP Waters (Heleen de Wit)
   II. Future plans ICP IM (Martin Forsius)

9. **Separate Task Force meetings**

Separate IM agenda

1. Opening of the meeting
2. Approval of the agenda
3. Approval of the minutes from the 25th ICP IM Task Force, Uppsala 2017.
4. Activities during 2017/18
5. Work plan and future work priorities
   a. Reports to be prepared /finalized in 2018/19
   b. Co-operation with other ICPs and organisations: e.g. LTER-Europe
   c. Ongoing and future research projects and cooperation
   d. **General discussion**: Future work under the Convention (Salar Valinia)
6. Financing/external applications
7. Data submission and database status
8. Next Task Force meeting
9. Other business
10. End of meeting

Separate ICP Waters agenda

1. Status and progress ICP Waters
2. Reminder of priorities under Convention
3. Workplan
   a. Current and planned reports
      - Regional assessment on surface water acidification status
      - 2019-report on reactive nitrogen
      - 2020-report.
   b. Database - 2018 call for data
      - DOC database
   c. Biological intercalibration, chemical intercomparison
   d. NEC Directive
   e. Data portal – presentation of data on ICP Waters homepage
   f. Proceedings
4. Other issues
5. Adoption of the Minutes

10. TF meeting 2019 (Chaired by ICP IM)

11. Other Business (Chaired by ICP IM)

12. Closing of meeting (Chairs ICP Waters and ICP IM)

7. Annex III: Status participation in the ICP Waters programme as of May 2018

	Chemical data (last year of delivery)	Biological data	Participation in TF meetings 2015-2018	Participation in chemical intercomparison 2015-2017	Participation in biological intercalibration 2015-2018
Armenia	2012		●		
Austria	2015		●	●	
Belarus	2015				
Belgium				●	
Canada	2017		●	●	●
Czech Rep.	2017	2017	●	●	●
Estonia	2017		●	●	●
Finland	2017		●	●	
France				●	
Germany	2017	2016	●	●	●
Ireland	2017		●	●	●
Italy	2017		●	●	
Latvia	2018	2017		●	●
Lithuania				●	
Moldova	2016		●	●	
Montenegro	2012				
Netherlands	2016		●	●	
Norway	2017	2017	●	●	●
Poland	2017		●	●	
Russia	2016		●	●	
Serbia				●	
South Africa			●		
Spain	2014		●	●	
Sweden	2017	2016	●	●	●
Switzerland	2017	2016	●	●	●
UK	2017	2013	●	●	●
USA	2016		●	●	
Total	**21**	**7**	**19**	**23**	**10**

8. Annex IV: ICP Waters workplan for 2018–2020

2018

- Arrange thirty-fourth meeting of the Programme Task Force in spring of 2018
- Prepare proceedings from the 34th Task Force meeting
    - abstracts (2-6 pages) by **August 1, 2018** to oyvind.garmo@niva.no
    - Report delivered in S**eptember 2018**

- Finalize report on regional assessment of surface water acidification in **September 2018**
- Arrange and report chemical intercomparison 1832
    - Laboratories are invited in March and confirm their participation in May. Samples are sent in June. Laboratories submit results in September. Contact person is carlos.escudero@niva.no
    - Report will be delivered in November 2018
- Arrange and report biological intercalibration 2218
    - Report will be delivered in November 2018. Contact person is Gaute Velle (Gaute.Velle@uni.no).
- Prepare new thematic report for 2019, which will present a trend analysis of water chemistry, to assess chemical recovery of acid-sensitive surface waters, with possible contributions from other bodies under the Convention. The topic 'land use as a confounding factor for chemical recovery' will be addressed.
    - Call for data: August 30. A draft analysis will be presented at the 2019 Task Force meeting. The final report will be available in the autumn of 2019.
- Run the Programme Centre in Oslo and the Subcentre in Bergen, including:
    - maintenance of web-pages
    - An overview of the layout and functioning of the web page, including publication list
    - Increase visibility of activity of Focal Centres on the web-page
    - maintenance of database of chemical and biological data
    - Report to UNECE
- Submission of data to the Programme Centre by all Focal centres**.**
- Participation in meetings of relevance for the ICP Waters programme.
- Contribute to implementation of NEC Directive, together with other bodies under WGE
- Cooperation with other bodies within and outside the Convention
- Consider availability other water databases and cooperation with other water monitoring programmes (UNEP, GEMS, EEA)
- Cooperation with ECCCA countries (East Central Caucasus and Central Asian countries)

2019

- Arrange thirty-fifth meeting of the Programme Task Force in spring of 2019
- Finalize new thematic report (a trend analysis of water chemistry, to assess chemical recovery of acid-sensitive surface waters)
- Arrange and report chemical intercomparison 1933
- Arrange and report biological intercalibration 2319

- Run the Programme Centre in Oslo and the Subcentre in Bergen, including:
- Submission of data to the Programme Centre by all Focal centres**.**
- Participation in meetings of relevance for the ICP Waters programme. Contribute to implementation of NEC Directive, together with other bodies under WGE
- Cooperation with other bodies within and outside the Convention
- Consider availability other water databases and cooperation with other water monitoring programmes (UNEP, GEMS, EEA)
- Cooperation with ECCCA countries (East Central Caucasus and Central Asian countries)

2020

- Arrange thirty-fifth meeting of the Programme Task Force in spring of 2020
- Write new thematic report (theme to be discussed – possibly reactive nitrogen)

9. Reports and publications from the ICP Waters programme

All reports from the ICP Waters programme from 2000 up to present are listed below. Reports before year 2000 can be listed on request. All reports are available from the Programme Centre. Reports and recent publications are also accessible through the ICP Waters website; http://www.icp-waters.no/

Austnes, K. Aherne, J., Arle, J., Čičendajeva, M., Couture, S., Fölster, J., Garmo, Ø., Hruška, J., Monteith, D., Posch, M., Rogora, M., Sample, J., Skjelkvåle, B.L., Steingruber, S., Stoddard, J.L., Ulańczyk, R., van Dam, H., Velasco, M.T., Vuorenmaa, J., Wright, R.F., de Wit, H. 2018. Regional assessment of the current extent of acidification of surface waters in Europe and North America. NIVA report SNO 7268-2018. **ICP Waters report 135/2018**

Escudero-Oñate, C. 2017. Intercomparison 1731: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA report SNO7207-2017. **ICP Waters report 134/2017**.

Halvorsen, G.A., Johannessen, A. and Landås, T.S. 2017. Biological intercalibration: Invertebrates 2017. NIVA report SNO 7198-2017. **ICP Waters report 133/2017**.

Braaten, H.F.V., Åkerblom, S., de Wit, H.A., Skotte, G., Rask, M., Vuorenmaa, J., Kahilainen, K.K., Malinen, T., Rognerud, S., Lydersen, E., Amundsen, P.A., Kashulin, N., Kashulina, T., Terentyev, P., Christensen, G., Jackson-Blake, L., Lund, E. and Rosseland, B.O. 2017. Spatial and temporal trends of mercury in freshwater fish in Fennoscandia (1965-2015). NIVA report SNO 7179-2017. **ICP Waters report 132/2017**.

Garmo, Ø., de Wit, H. and Fölster, J. (eds.) 2017. Proceedings of the 33rd Task Force meeting of the ICP Waters Programme in Uppsala, May 9-11, 2017. NIVA report SNO 7178-2017. **ICP Waters report 131/2017**.

Anker Halvorsen, G., Johannessen, A. and Landås, T.S. 2016. Biological intercalibration: Invertebrates 2016. NIVA report SNO 7089-2016. **ICP Waters report 130/2016**.

Escudero-Oñate, C. 2016. Intercomparison 1630: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA report SNO 7081-2016. **ICP Waters report 129/2016.**

De Wit, H. and Valinia, S. (eds.) 2016. Proceedings of the 32st Task Force meeting of the ICP Waters Programme in Asker, Oslo, May 24-26, 2016. NIVA report SNO 7090-2016. **ICP Waters report 128/2016**.

Velle, G., Mahlum, S., Monteith, D.T., de Wit, H., Arle, J., Eriksson, L., Fjellheim, A., Frolova, M., Fölster, J., Grudule, N., Halvorsen, G.A., Hildrew, A., Hruška, J., Indriksone, I., Kamasová, L., Kopáček, J., Krám, P., Orton, S., Senoo, T., Shilland, E.M., Stuchlík, E., Telford, R.J., Ungermanová, L., Wiklund, M.-L. and Wright, R.F. 2016. Biodiversity of macro-invertebrates in acid-sensitive waters: trends and relations to water chemistry and climate. NIVA report SNO 7077-2016. NIVA report SNO 7077-2016. **ICP Waters report 127/2016**.

De Wit, H., Valinia, S. and Steingruber, S. 2015. Proceedings of the 31st Task Force meeting of the ICP Waters Programme in Monte Verità, Switzerland 6th –8th October, 2015. NIVA report SNO 7003-2016. **ICP Waters report 126/2015**.

De Wit, H., Hettelingh, J.P. and Harmens, H. 2015. Trends in ecosystem and health responses to long-range transported atmospheric pollutants. NIVA report SNO 6946-2015. **ICP Waters report 125/2015**.

Fjellheim, A., Johannessen, A. and Landås, T.S. 2015. Biological intercalibration: Invertebrates 1915. NIVA report SNO 6940-2015. **ICP Waters report 124/2015**.

Escudero-Oñate, C. 2015 Intercomparison 1529: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA report SNO 6910-2015. **ICP Waters report 123/2015**.

de Wit, H., Wathne, B. M. (eds.) 2015. Proceedings of the 30th Task Force meeting of the ICP Waters Programme in Grimstad, Norway 14th –16th October, 2014. NIVA report SNO 6793-2015. **ICP Waters report 122/2015**.

Fjellheim, A., Johannessen, A. and Landås, T.S. 2014. Biological intercalibration: Invertebrates 1814. NIVA report SNO 6761-2014. **ICP Waters Report 121/2014**.

Escuedero-Oñate. 2014. Intercom¬parison 1428: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA report SNO 6718-2014. **ICP Waters Report 120/2014**.

De Wit, H. A., Garmo Ø. A. and Fjellheim A. 2014. Chemical and biological recovery in acid-sensitive waters: trends and prognosis. **ICP Waters Report 119/2014**.

Fjellheim, A., Johannessen, A. and Landås, T.S. 2013. Biological intercalibration: Invertebrates 1713. NIVA report SNO 6662-2014. **ICP Waters Report 118/2014**.

de Wit, H., Bente M. Wathne, B. M. and Hruśka, J. (eds.) 2014. Proceedings of the 29th Task Force meeting of the ICP Waters Programme in Český Krumlov, Czech Republic 1st –3rd October, 2013. NIVA report SNO 6643-2014. **ICP Waters report 117/2014**.

Escuedero-Oñate, C. 2013. Intercomparison 1327: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA report SNO 6569-2013. **ICP Waters Report 116/2013**.

Holen, S., R.F. Wright and Seifert, I. 2013. - Effects of long-range transported air pollution (LTRAP) on freshwater ecosystem services. NIVA report SNO 6561-2013. **ICP Waters Report 115/2013**.

Velle, G., Telford, R.J., Curtis, C., Eriksson, L., Fjellheim, A., Frolova, M., Fölster J., Grudule N., Halvorsen G.A., Hildrew A., Hoffmann A., Indriksone I., Kamasová L., Kopáček J., Orton S., Krám P., Monteith D.T., Senoo T., Shilland E.M., Stuchlík E., Wiklund M.L., de Wit, H. and Skjelkvaale B.L. 2013. Biodiversity in freshwaters. Temporal trends and response to water chemistry. NIVA report SNO 6580-2013. **ICP Waters Report 114/2013**.

Fjellheim, A., Johannessen, A. and Landås, T.S. 2013. Biological intercalibration: Invertebrates 1612. **ICP Waters Report 113/2013**.

Skjelkvåle, B.L., Wathne, B.M., de Wit, H. and Rogora, M. (eds.) 2013. Proceedings of the 28th Task Force meeting of the ICP Waters Programme in Verbania Pallanza, Italy, October 8 – 10, 2012. NIVA report SNO 6472-2013. **ICP Waters Report 112/2013**.

Dahl, I. 2012. Intercomparison 1226: pH, Conductivity, Alkalinity, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni and Zn. NIVA report SNO 6412-2012. **ICP Waters report 111/2012**.

Skjelkvåle, B.L., Wathne B. M. and Moiseenko, T. (eds.) 2012. Proceedings of the 27th meeting of the ICP Waters Programme Task Force in Sochi, Russia, October 19 – 21, 2011. NIVA report SNO 6300-2012. **ICP Waters report 110/2012**.

Fjellheim, A., Johannessen, A., Svanevik Landås, T. 2011. Biological intercalibration: Invertebrates 1511. NIVA report SNO 6264-2011. **ICP Waters report 109/2011**.

Wright, R.F., Helliwell, R., Hruska, J., Larssen, T., Rogora, M., Rzychoń, D., Skjelkvåle, B.L. and Worsztynowicz, A. 2011. Impacts of Air Pollution on Freshwater Acidification under Future Emission Reduction Scenarios; ICP Waters contribution to WGE report. NIVA report SNO 6243-2011. **ICP Waters report 108/2011**.

Dahl, I and Hagebø, E. 2011. Intercomparison 1125: pH, Cond, HCO3, NO3-N, Cl, SO4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA report SNO 6222-2011. **ICP Waters report 107/2011**.

Skjelkvåle B.L. and de Wit, H. (eds.) 2011. Trends in precipitation chemistry, surface water chemistry and aquatic biota in acidified areas in Europe and North America from 1990 to 2008. NIVA report SNO 6218-2011. **ICP Waters report 106/2011**.

ICP Waters Programme Centre 2010. ICP Waters Programme manual. NIVA SNO 6074-2010. **ICP Waters report 105/2010**.

Skjelkvåle, B.L., Wathne B. M. and Vuorenmaa J. (eds.) 2010. Proceedings of the 26th meeting of the ICP Waters Programme Task Force in Helsinki, Finland, October 4 – 6, 2010. NIVA report SNO 6097-2010. **ICP Waters report 104/2010**.

Fjellheim, A. 2010. Biological intercalibration: Invertebrates 1410. NIVA report SNO 6087-2010. NIVA report SNO 6087-2010. **ICP Waters report 103/2010**.

Hovind, H. 2010. Intercomparison 1024: pH, Cond, HCO_3, NO_3-N, Cl, SO_4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA report SNO 6029-2010. **ICP Waters report 102/2010**.

De Wit, H.A. and Lindholm M. 2010. Nutrient enrichment effects of atmospheric N deposition on biology in oligotrophic surface waters – a review. NIVA report SNO 6007 - 2010. **ICP Waters report 101/2010**.

Skjelkvåle, B.L., De Wit, H. and Jeffries, D. (eds.) 2010. Proceedings of presentations of national activities to the 25th meeting of the ICP Waters Programme Task Force in Burlington, Canada, October 19-21 2009. NIVA report SNO 5995 - 2010. **ICP Waters report 100/2010**.

Fjellheim, A. 2009. Biological intercalibration: Invertebrates 1309. NIVA report SNO 5883-2009, **ICP Waters report 99/2009**.

Hovind, H. 2009. Intercomparison 0923: pH, Cond, HCO_3, NO_3-N, Cl, SO_4, Ca, Mg, Na, K, TOC, Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn. NIVA report SNO 5845-2009. **ICP Waters report 98/2009**.

Ranneklev, S.B., De Wit, H., Jenssen, M.T.S. and Skjelkvåle, B.L. 2009. An assessment of Hg in the freshwater aquatic environment related to long-range transported air pollution in Europe and North America. NIVA report SNO 5844-2009. **ICP Waters report 97/2009**.

Skjelkvåle, B.L., Jenssen, M. T. S. and De Wit, H (eds.) 2009. Proceedings of the 24th meeting of the ICP Waters Programme Task Force in Budapest, Hungary, October 6 – 8, 2008. NIVA report SNO 5770-2009. **ICP Waters report 96/2009**.

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