REPORT SNO. 7760-2022

The Norwegian river monitoring programme 2021 – water quality status and trends

Elveovervåkningsprogrammet 2021 – vannkvalitetsstatus og -trender

Photo: Marthe T.S. Jenssen

Norwegian Institute for Water Research

REPORT

Main Office
Økernveien 94
NO-0579 Oslo, Norway
Phone (47) 22 18 51 00

NIVA Region South
Jon Lilletuns vei 3
NO-4879 Grimstad, Norway
Phone (47) 22 18 51 00

NIVA Region East
Sandvikaveien 59
NO-2312 Ottestad, Norway
Phone (47) 22 18 51 00

NIVA Region West
Thormøhlensgate 53 D
NO-5006 Bergen Norway
Phone (47) 22 18 51 00

NIVA Denmark
Njalsgade 76, 4th floor
DK 2300 Copenhagen S, Denmark
Phone (45) 39 17 97 33

Internet: www.niva.no

Title	Serial number	Date
The Norwegian river monitoring programme 2021 – water quality status and trends Elveovervåkningsprogrammet 2021 – vannkvalitetsstatus og -trender	7760-2022	27 June 2022
Author(s) Øyvind Kaste, Cathrine Brecke Gundersen, James Sample, Dag Øystein Hjermann, Liv Benthe Skancke, Ian Allan, Marthe Torunn Solhaug Jenssen, Kine Bæk, Amanda Poste.	Topic group Environmental monitoring	Distribution Open
	Geographical area Norway	Pages 45 + appendices

Client(s)	Client's reference
Norwegian Environment Agency	Gunn Lise Haugestøl
Client's publication: M-2323 | 2022	Printed NIVA Project number 200310

Summary

In the Norwegian River Monitoring Programme (in Norwegian: Elveovervåkingsprogrammet) 20 rivers along the Norwegian coast are monitored for physical and chemical parameters. This report presents the current status (2021) and long-term (1990-2021) trends in suspended particles, organic matter, nutrients, and metals. EU Water Framework Directive priority substances and river basin-specific pollutants (trace metals and organic pollutants) from five rivers are compared with annual average environmental quality standards (AA-EQS). The report also presents light absorbance indices for characterisation of dissolved organic matter (DOM) quality in the rivers, and high-frequency measurements of water temperature, pH, conductivity, turbidity and fluorescent DOM (fDOM) in two rivers; Storelva (southern Norway) and Målselva (northern Norway).

Four keywords	Fire emneord
1. Rivers	1. Elver
2. Monitoring	2. Overvåking
3. Water quality	3. Vannkvalitet
4. Trends	4. Trender

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

Øyvind Kaste	*Hans Fredrik Veiteberg Braaten*	*Sondre Meland*
Project Manager	Quality Assurance	Research Manager

ISBN 978-82-577-7496-7
NIVA-report ISSN 1894-7948

The Norwegian river monitoring programme 2021 – water quality status and trends

Elveovervåkningsprogrammet 2021 – vannkvalitetsstatus og -trender

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 2021 monitoring activities are presented in two 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 along the Norwegian coast.

The work presented in this report is a collaboration between NIVA, the Norwegian Water Resources and Energy Directorate (NVE), Norwegian Institute of Bioeconomy Research (NIBIO), Eurofins Environment Testing Norway AS, and ALS Laboratory Group Norway AS.

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), Ian Allan (assessment of priority substances), Marthe Torunn Solhaug Jenssen (sampling of priority substances), Kine Bæk (chemical analysis of priority substances), 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 Morten N. Due has been the administrative contact.

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

Grimstad, June 2022

Øyvind Kaste

Table of contents

Summary

The Norwegian River Monitoring Programme includes analysis of various chemical, physical, and hydrological parameters in 20 rivers along the Norwegian coast.

Weather in 2021
For Norway as a whole, the average temperature in 2021 was equal to the 1991-2020 normal and the precipitation was 10% lower than normal. Regionally, the average temperature was at- or slightly above the normal (+0.0-0.5°C) in southern Norway and the region furthest north, and slightly below the normal (-0.5-0.0°C) in middle- and northernmost Norway. Counties that received more precipitation than normal were Trøndelag (middle Norway) and Troms and Finnmark (northern Norway) (+20-30%), while Innlandet (eastern Norway) and Vestland (western Norway) received less precipitation than normal (-30-50%).

Altogether, 19 of 20 meteorological stations nearby the monitoring rivers showed a statistically significant increase in air temperatures during 1980-2021. Only two of 20 stations showed a significantly increasing trend in annual precipitation over the same time span. This was less than the previous year, when five stations showed an increasing long-term trend.

Water quality status 2021
Orreelva, Nidelva and Altaelva had higher concentrations of suspended particulate matter (SPM) and higher turbidity in 2021 compared with the preceding five-year mean (2016-2020). In the latter two rivers, the high annual means were mainly due to very high concentration in single samples (during a flood event in Altaelva, the reason is more unclear in Nidelva). The increase in Orreelva was caused by elevated concentrations in several samples. The high particle concentrations also affected other water quality parameters, e.g. different nutrient fractions and concentrations of certain metals.

The highest concentrations of total phosphorus (Tot-P) and phosphate (PO_4) were found in Orreelva, Alna and Glomma. A high fraction of particulate (TPP) compared to dissolved phosphorus (TDP) indicate that the Tot-P and PO_4 in many rivers are associated with SPM and bioavailability is limited. The total nitrogen (Tot-N) concentrations recorded in 2021 showed little deviation from the preceding five-year mean. The urban river Alna and the agricultural river Orreelva generally have much higher Tot-N concentrations than the other rivers. Silica concentrations in the rivers were generally a bit higher in 2021 compared with five-year mean, especially in Altaelva (high values during the snowmelt flood) and Tana (high values during the winter months).

Orreelva showed elevated concentrations of arsenic (As), lead (Pb), cadmium (Cd), zinc (Zn) and chromium (Cr) in 2021 compared to the previous five-year period, probably as a result of the high SPM-concentrations that were recorded this year. Alna had an opposite pattern, with reduced concentrations of all analysed metals, except for mercury (Hg). Pasvikelva showed a large reduction in concentrations of copper (Cu) and nickel (Ni) which can be linked to the shutdown of the nickel smelter on the Russian side of the border in December 2020. Most rivers had slightly higher mean Hg concentrations in 2021 compared to the previous five-year mean. The largest increases were found in Alna and Numedalslågen.

Priority substances
Priority substances were analysed in Glomma, Alna, Drammenselva, Numedalslågen and Skienselva in 2021. None of the rivers had annual mean concentrations of priority metals (Cd,

Hg, Ni or Pb) that were above the annual average environmental quality standards (AA-EQS) of the Water Framework Directive. Four rivers (Glomma, Alna, Drammenselva, Numedalslågen) exceeded the AA-EQS for the PAH[1] congener benzo[a]pyrene. Alna also exceeded the AA-EQS for the PAH congener fluoranthene. None of the rivers had annual concentrations of other priority substances that were above the AA-EQS.

Long-term trends
Glomma, Drammenselva, Numedalslågen, Orreelva showed significant increases in concentrations of PO_4 since 1990, but not for Tot-P. On the other hand, three rivers had decreasing Tot-P trends (Otra, Vefsna, Altaelva). All rivers showed either no trends or downward trends in the inorganic N species ammonium and nitrate. The same pattern was seen for Tot-N – except in Orkla, which has a significantly increasing trend.

There were either no trend or decreasing trends for concentrations of Pb, Cd, and Zn in all rivers from 2004 to 2021. Most rivers also show downward trends in Cu, except for Orreelva that has a significant upward trend. Ni show increasing trends in Orreleva, Vefsna and Altaelva.

Quality of dissolved organic matter (DOM)
DOM is usually quantified by measuring the concentration of dissolved organic carbon (DOC), since DOM typically consists of 60% carbon. The molecular structure of DOM is challenging to describe accurately, and instead it is characterized based on its ability to absorb light at different wavelengths. Two indices are used in this report; sUVa (positively correlated with aromaticity) and E2_E3 (negatively correlated with aromaticity and molecular size). Natural DOM dominated by humic substances are often characterised by high sUVa and low E2_E3, whereas anthropogenic-derived or highly degraded DOM show the opposite pattern. The agricultural river Orreelva and the urban river Alna confirmed this by having lower sUVa and higher E2_E3 than the other rivers. Besides that, there was no clear regional patterns in DOM quality on an annual basis. This is in accordance with findings from previous years, which stated that seasonal variations within the rivers were greater than differences between the rivers on an annual basis.

High-frequency monitoring
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 DOM (fDOM). In Storelva, the hydrological pattern in 2021 was characterised by several small floods during winter and spring, no distinct snowmelt flood, and two larger autumn floods in early October and November. In Målselva, there are usually very low water levels during winter and spring, but in 2021 there was a mild period and a small flood in late January. As usual, there was a large snowmelt flood in May/June, but no major floods occurred during autumn in 2021. The sensor-based water quality parameters, especially turbidity and fDOM, are closely connected to the water flow pattern in both rivers. These are often short-term dynamics that are very difficult to document in regular monitoring which is often based on monthly manual samples.

[1] PAH: Polycyclic Aromatic Hydrocarbons

Sammendrag

Tittel: Elveovervåkningsprogrammet 2021 – vannkvalitetsstatus og trender
År: 2022
Forfatter(e): Øyvind Kaste, Cathrine Brecke Gundersen, James Sample, Dag Øystein Hjermann, Liv Benthe Skancke, Ian Allan, Marthe Torunn Solhaug Jenssen, Kine Bæk, Amanda Poste.
Utgiver: Norsk institutt for vannforskning, 978-82-577-7496-7

Elveovervåkingsprogrammet omfatter månedlig overvåking av ulike kjemiske, fysiske, og hydrologiske parametere i 20 elver langs norskekysten.

Været i 2021
For Norge som helhet var gjennomsnittstemperaturen i 2021 lik 1991-2020 normalen og nedbøren var 10% lavere enn normalt. Regionalt var gjennomsnittstemperaturen på eller litt over normalen (+0,0-0,5°C) i Sør-Norge og lengst i nord, og litt under normalen (-0,5-0,0°C) i Midt-Norge og det meste av Nord-Norge. Regioner som fikk mer nedbør enn normalt var Trøndelag og Troms og Finnmark (+20-30%), mens Innlandet og Vestland fikk mindre nedbør enn normalt (- 30-50%).

Til sammen viste 19 av 20 meteorologiske stasjoner som ligger i nærheten av overvåkings-elvene en statistisk signifikant økning i lufttemperatur i løpet av 1980-2021. Bare to av 20 stasjoner viste en signifikant økende trend i årlig nedbør over samme tidsrom. Dette var færre enn året før, da fem stasjoner viste en økende langtidstrend.

Vannkvalitetsstatus 2021
Orreelva, Nidelva og Altaelva hadde høyere konsentrasjoner av suspenderte partikler (SPM) og høyere turbiditet i 2021 sammenlignet med forrige femårsmiddel (2016-2020). I de to sistnevnte elvene var de høye årsmiddelverdiene forårsaket av ekstreme verdier i enkeltprøver (under vårflom i Altaelva, ukjent årsak i Nidelva). Økningen i Orreelva skyldtes forhøyede konsentrasjoner i flere prøver. De høye partikkelkonsentrasjonene påvirket også andre vannkvalitetsparametere, f.eks. fraksjoner av ulike næringsstoffer og konsentrasjoner av visse metaller.

De høyeste konsentrasjonene av total fosfor (Tot-P) og fosfat (PO_4) ble funnet i Orreelva, Alna og Glomma. En høy andel av partikulært fosfor (TPP) i forhold til løst fosfor (TDP) indikerer at Tot-P og PO_4 i mange elver er knyttet til partikler og derfor relativt lite biotilgjengelig. Konsentrasjonene av total nitrogen (Tot-N) viste små endringer i forhold til den foregående femårsperioden. Den urbane elven Alna og den jordbrukspåvirkete Orreelva har generelt mye høyere Tot-N konsentrasjoner enn de andre elvene. Middelkonsentrasjonene av silikat i elvene var generelt noe høyere i 2021 sammenlignet med forrige femårsgjennomsnitt, spesielt i Altaelva (høye verdier under vårflommen) og Tana (høye verdier i vinterhalvåret).

Orreelva viste forhøyede konsentrasjoner av arsen (As), bly (Pb), kadmium (Cd), sink (Zn) og krom (Cr) i 2021 sammenlignet med forrige femårsperiode. Det har trolig sammenheng med de høye SPM-konsentrasjonene som ble registrert dette året. Alna hadde et motsatt mønster, med reduserte konsentrasjoner av alle analyserte metaller, bortsett fra kvikksølv (Hg). Pasvikelva viste en stor reduksjon i konsentrasjoner av kobber (Cu) og nikkel (Ni), noe som kan knyttes til nedleggelsen av nikkel-smelteverket på russisk side av grensen i desember 2020. De

fleste elvene hadde noe høyere gjennomsnittlig Hg-konsentrasjon i 2021 sammenlignet med forrige femårsperiode. De største økningene ble funnet i Alna og Numedalslågen.

Prioriterte stoffer
Vannforskriftens prioriterte stoffer ble analysert i Glomma, Alna, Drammenselva, Numedalslågen og Skienselva i 2021. Ingen av elvene hadde årsmiddelkonsentrasjoner av prioriterte metaller (Cd, Hg, Ni eller Pb) som lå over grenseverdiene for årlig gjennomsnitt (AA-EQS) i Vanndirektivet. Fire elver (Glomma, Alna, Drammenselva, Numedalslågen) overskred AA-EQS for PAH[2]-forbindelsen benzo[a]pyren. Alna overskred også AA-EQS for PAH-forbindelsen fluoranten. Ingen av elvene hadde årlige konsentrasjoner av andre prioriterte stoffer som var over AA-EQS.

Langtidstrender
Glomma, Drammenselva, Numedalslågen, Orreelva viser en signifikant økning i konsentrasjon av PO_4 siden 1990, men ikke for Tot-P. På den annen side hadde tre elver signifikant nedadgående trender for Tot-P (Otra, Vefsna, Altaelva). Alle elvene viste enten ingen trender eller nedadgående trender i konsentrasjoner av uorganisk nitrogen (ammonium og nitrat). Det samme mønsteret ble sett for Tot-N, bortsett fra i Orkla som har en signifikant økende trend.

Det var ingen trend eller synkende trender for konsentrasjoner av Pb, Cd og Zn i elvene fra 2004 til 2021. De fleste elvene viser også nedadgående trender i Cu, bortsett fra Orreelva som har en signifikant oppadgående trend. Ni viser økende trender i Orreleva, Vefsna og Altaelva.

Kvaliteten på løst organisk materiale (DOM)
DOM kvantifiseres vanligvis ved å måle konsentrasjonen av løst organisk karbon (DOC) i vann, siden DOM typisk består av 60% DOC. Den molekylære strukturen er vanskelig å beskrive nøyaktig, og i stedet karakteriseres DOM basert på evnen til å absorbere lys ved forskjellige bølgelengder. To indekser er brukt i denne rapporten; sUVa (positivt korrelert med aromatisitet) og E2_E3 (negativt korrelert med aromatisitet og molekylstørrelse). Naturlig DOM som er dominert av humusstoffer er ofte preget av høy sUVa og lav E2_E3, mens DOM som stammer fra antropogene kilder eller er sterkt nedbrutt viser motsatt mønster. Den jordbruksdominerte Orreelva og den urbant påvirkete Alna bekreftet dette ved å ha lavere sUVa og høyere E2_E3 enn de andre elvene. Utover dette, var det ingen klare regionale mønstre i DOM-kvalitet på årsbasis. Dette er i samsvar tidligere funn som har dokumentert at sesongvariasjonene innad i elvene var større enn de årlige forskjellene mellom elvene.

Sensor-baserte målinger
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 fluoriserende DOM (fDOM). I Storelva var det hydrologiske mønsteret i 2021 preget av flere små flommer om vinteren og våren, men ingen utpreget snøsmeltingsflom. Det var imidlertid to større høstflommer i begynnelsen av oktober og november. I Målselva er det vanligvis svært lav vannstand om vinteren og våren, men i 2021 var det en mild periode og en liten flom allerede i slutten av januar. Som vanlig var det en stor snøsmeltingsflom i mai/juni, men ingen store flommer i løpet av høsten 2021. De sensormålte parametrene, spesielt turbiditet og fDOM, er nært knyttet til vannføringsmønsteret i begge elvene. Dette er ofte kortvarige effekter som er svært vanskelig å dokumentere i overvåkingsprogrammer som ofte er basert på månedlig manuell prøvetaking.

[2] PAH: Polysykliske Aromatiske Hydrokarboner

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 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 2021 are presented in two separate reports. The present report addresses objectives 1, 3, 4, 5 and 6. The other report include classification of biological quality elements (Kile et al. 2022) related to objective 2. Objective 7 is addressed by a separate report which is delivered to OSPAR each autumn.

2. Material and methods

2.1 Study rivers

The 20 rivers sampled within this monitoring programme discharge to the Skagerrak Sea, 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, and relevance in relation to pollution pressures and land-use (Figure 2).

The rivers Alna, Storelva, Bjerkreimselva, Orreelva, Vikdedalselva, Vosso, Nausta, Målselva and Tana were during 1973-2005 included in the Norwegian Protection Plan for River Systems, in order to prevent reduction of their conservation value through hydropower developments.

Table 1. Rivers included in the programme

River name	UTM (east)	UTM (north)	UTM zone	Catchment (km^2)	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

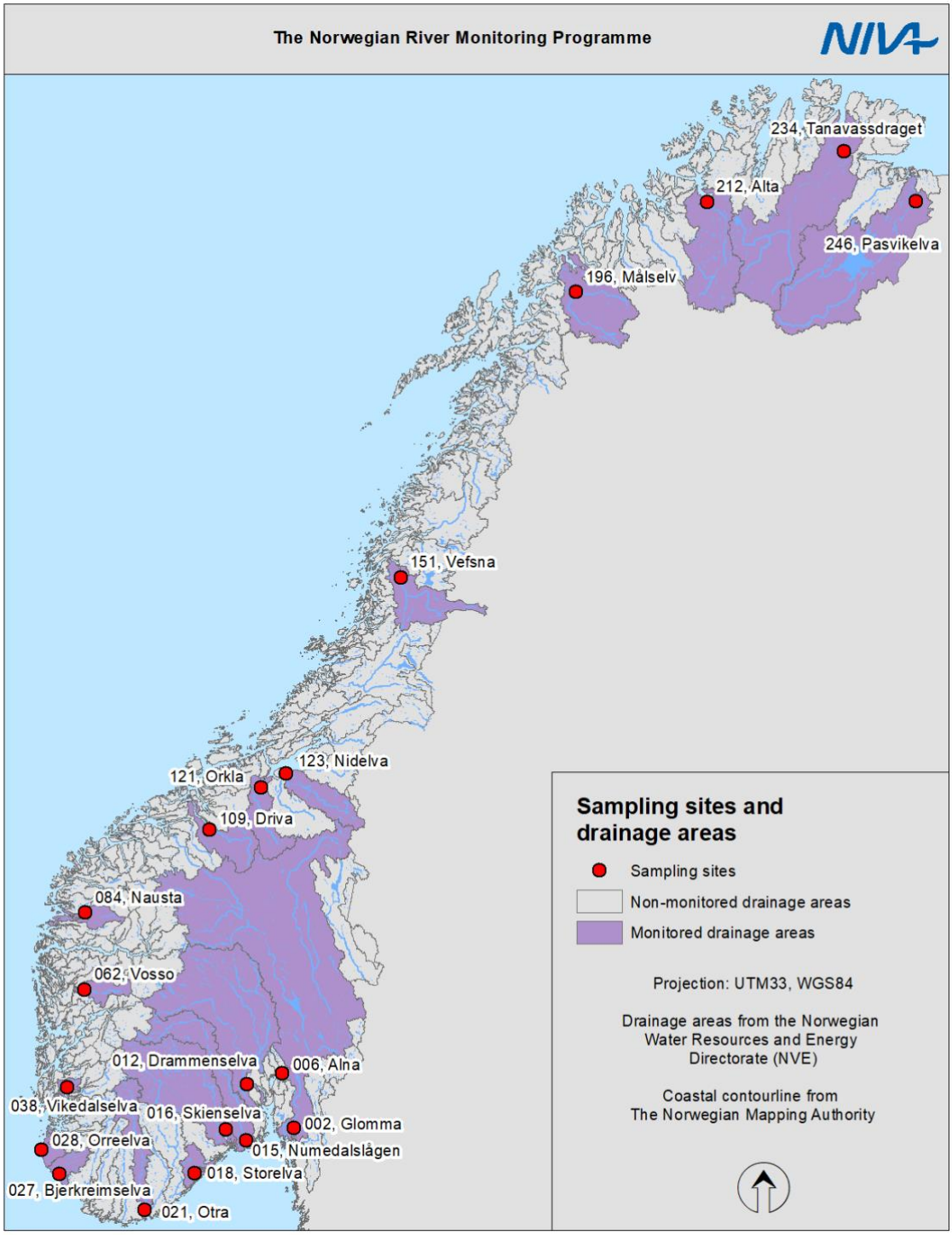

Figure 1. Map showing the location of the rivers in the Norwegian river monitoring programme, including drainage areas (purple) and the sampling sites (red dots).

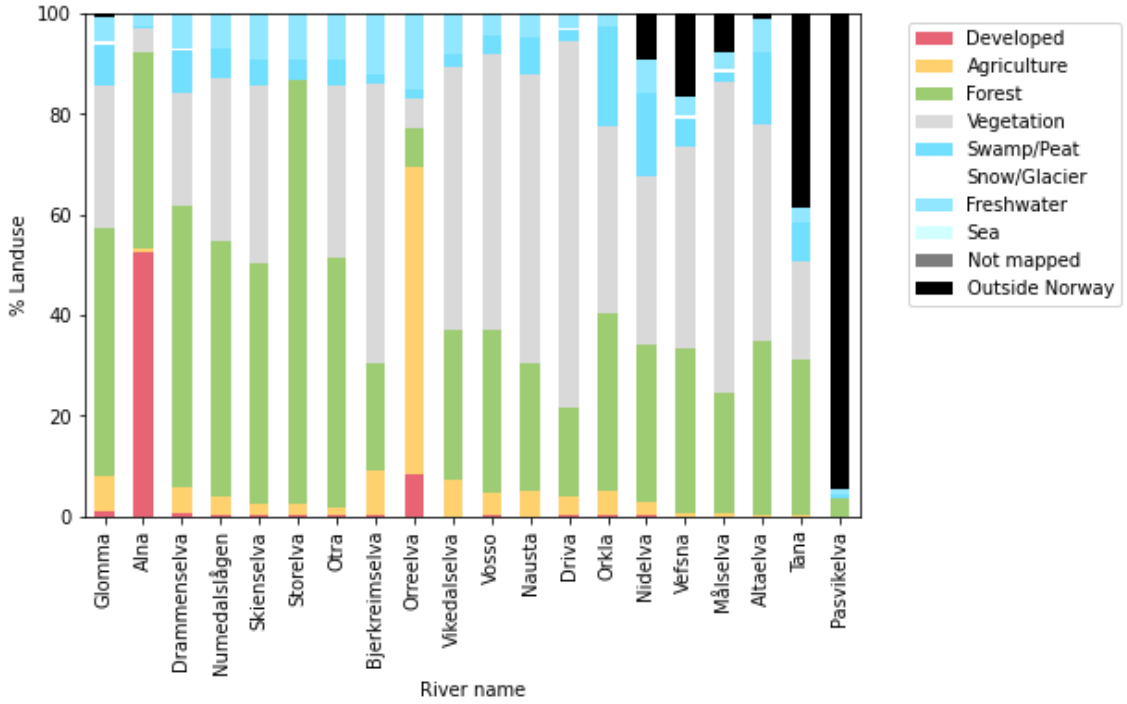

Figure 2. Land use for the 20 rivers included in the monitoring programme. Source: nevina.nve.no.

2.2 Methods

See appendix A

3. Results and discussion

3.1 Climate: status and trends

3.1.1 Air temperature and precipitation in 2021

For Norway as a whole, the weather in 2021 was close to the 1991-2020 normal (source: met.no; Grinde et al. 2022). The average temperature was equal to normal (Figure 3, left) and the precipitation was 10% lower than normal (Figure 3, right). Regionally, the average temperature was at- or slightly above the normal (+0.0-0.5°C) in southern Norway and the region furthest north, and slightly below the normal (-0.5-0.0°C) in middle Norway and most of northern Norway. Counties[3] receiving more precipitation than normal were Trøndelag and Troms and Finnmark (+20-30%), while Innlandet and Vestland counties received less precipitation than normal (-30-50%).

The **winter** season (Dec 2020 – Feb 2021) was slightly warmer (+0.7°C) and drier than normal (80% precipitation). The relatively warmest stations were in Troms and Finnmark (+1 °C above the normal) and the coldest in Innlandet (-3-5°C). Drier than normal were stations in Trøndelag, Innlandet, and Møre and Romsdal (< 25% of normal) while stations in Viken and Vestfold and Telemark were wetter than normal (300% of normal).

The **spring** average temperature was close to normal (+0.2°C) and with 10% less precipitation than normal. The relatively warmest stations were in Nordland (+1-1.5°C) while the coldest were in mountains of southern Norway (-0.5-1°C). Less than normal precipitation was measured at stations in Vestland (50-75%) and higher than normal precipitation in Troms and Finnmark and Trøndelag (+50-100%).

The **summer** season was on average 1.1°C warmer than normal and with 15% less precipitation than normal. Particularly warm were stations in Vestland (+2°C). Relatively coldest was Troms and Finnmark (0.5°C below normal). A new record was set for number of successive days with temperatures above 20°C (so-called summer days), with 88 days at Notodden airport (Vestfold and Telemark). A new county record for maximum temperature in July was set for Troms and Finnmark after measuring 34.3°C. Vestland county was driest with several stations receiving 50% of the normal. Higher than normal precipitation was measured for stations in northern Norway (+50-80%).

The **autumn** was 0.8°C warmer than normal and with 10% less precipitation than normal. Relatively warmest were stations in Innlandet and Viken (up to +2°C) while in Troms and Finnmark the relatively coldest temperatures were measured (1-1.5 °C less than normal). A new national record for maximum temperature in September was set in Drammen (Viken county) at 28.6°C. Relatively wettest were stations in Trøndelag and Møre and Romsdal (+50-100%) and relatively driest were stations in Agder and Innlandet (- 30-50%).

For more information on the 2021 weather in Norway, see Grinde et al. (2022).

[3] Location of the 11 counties in Norway are displayed in Figure 4

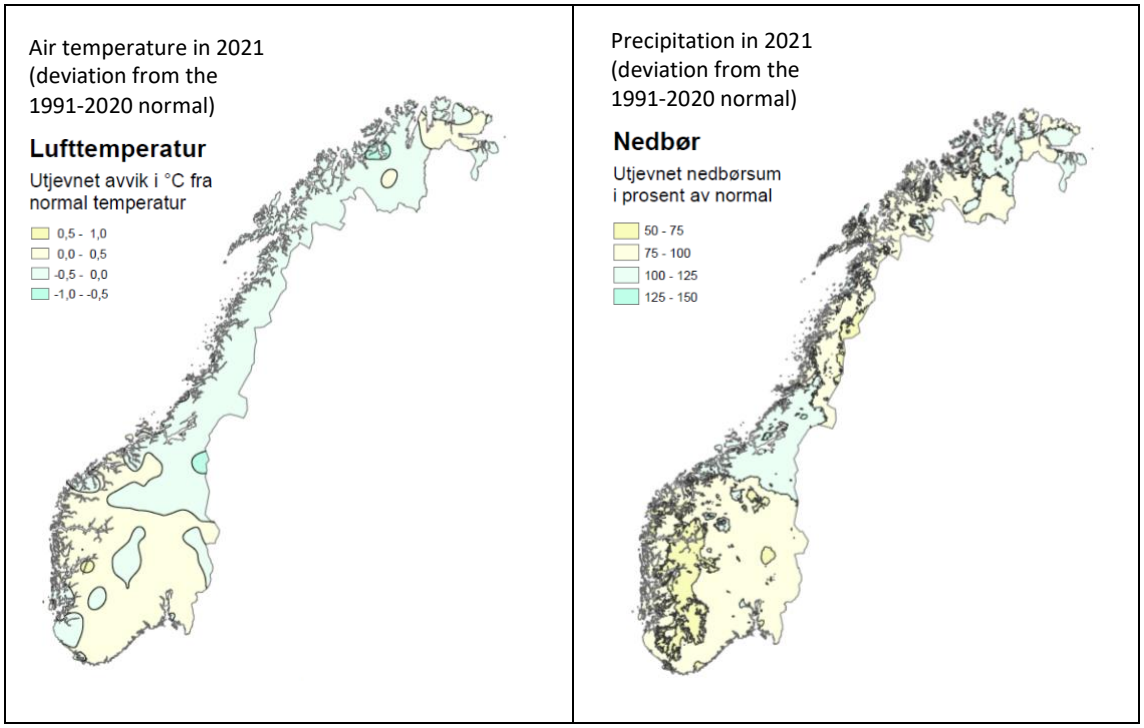

Figure 3. Air temperature (°C) and precipitation (mm) in Norway in 2021 as deviation from- or percentage of the normal values (1991-2020), respectively. Maps from Grinde et al. (2022).

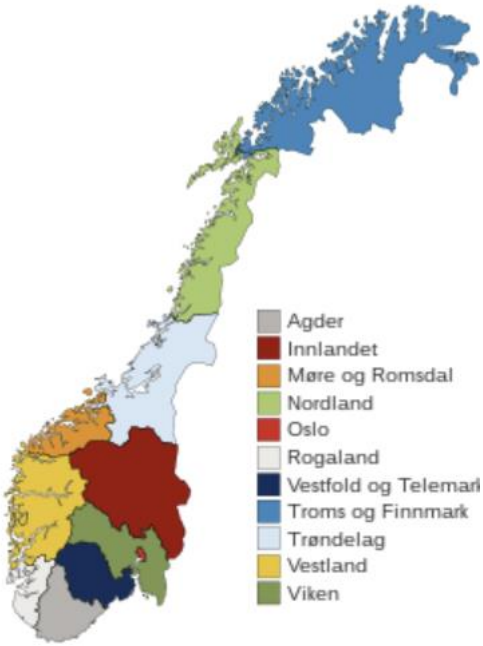

Figure 4. Map showing the location of the 11 counties in Norway. Source: no.wikipedia.org

3.1.2 Trends in air temperature and precipitation 1980-2021

Table 2 shows trends in air temperature and precipitation since 1980[4] at meteorological stations located in the near vicinity of the river monitoring sites. The results show a significant increase in air temperature at 19 of 20 stations (with the station at Målselva also close to significant with a p value of 0.06).

For precipitation, only two met stations (near Storelva and Altaelva) showed a significantly increasing trend. This was less than in 2020, when five stations showed an increasing trend (Kaste et al 2022). Large year-to-year variation in precipitation could potentially explain the lack of significant trends at more stations.

Table 2. Trends in air temperature and precipitation 1980-2021. Data from the Norwegian Meteorological Office (met.no)

	Temperature				Precipitation			
River name	**St.no**	**Years**	**Temp. trend (p-value)**	**Temp change (°C)***	**St. no**	**Years**	**Precip. trend (p-value)**	**Precip. change (mm)***
Glomma	SN700	1980-2021	0.005	+0.8	SN3780	1980-2021	0.13	+72
Alna	SN18700	1980-2021	<0.001	+1.0	SN18700	1980-2021	0.08	+81
Drammenselva	SN19710	1983-2021	0.01	+0.7	SN19710	1983-2021	0.11	+69
Numedalslågen	SN27450	1980-2021	0.005	+0.8	SN30000	1980-2021	0.99	+0
Skienselva	SN27450	1980-2021	0.005	+0.8	SN30260	1980-2015	0.15	+76
Storelva	SN36560	1980-2021	<0.001	+0.9	SN36560	1980-2021	0.025	+196
Otra	SN39040	1980-2021	0.001	+0.7	SN39040	1980-2021	0.12	+182
Bjerkreimselva	SN44560	1980-2021	<0.001	+0.8	SN43360	1980-2017	0.29	+87
Orreelva	SN44560	1980-2021	<0.001	+0.8	SN44080	1980-2020	0.47	+61
Vikedalselva	SN46910	1980-2011	<0.001	+1.0	SN46850	1980-2021	0.1	+264
Vosso	SN52290	1981-2007	0.024	+0.7	SN51250	1980-2021	0.32	+196
Nausta	SN58070	1980-2021	0.002	+0.7	SN57480	1980-2021	0.5	+83
Driva	SN64550	1980-2007	0.003	+0.9	SN63530	1980-2021	1.0	-1
Orkla	SN69100	1980-2021	0.008	+0.6	SN66210	1980-2009	0.91	+26
Nidelva	SN69100	1980-2021	0.008	+0.6	SN68270	1980-2021	0.12	+75
Vefsna	SN85380	1980-2021	<0.001	+0.8	SN78850	1980-2007	0.24	+181
Målselva	SN89350	1980-2021	0.06	+0.5	SN89350	1980-2021	0.29	+36
Altaelva	SN93140	1980-2021	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	1980-2021	<0.001	+0.9	SN99500	1980-2021	0.26	+19

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.

[4] Since 1981 for Vosso and 1983 for Drammenselva

3.2 Water quality status 2021

3.2.1 pH and calcium

There were small changes in both parameters in 2021 compared to the preceding five-year mean (Figure 5, Figure 6). The highest levels are found in the most human-influenced rivers; Alna and Orreelva, and in the middle and northern parts of Norway. The lowest pH and calcium (Ca) levels are found in southern and western Norway, although many rivers in the region are limed to counteract acidification from deposition of long-range transported air pollution (Garmo and Skancke 2021).

3.2.2 Turbidity and suspended particulate matter

Orreelva, Nidelva and Altaelva had higher concentrations of suspended particulate matter (SPM) and higher turbidity compared with the preceding five-year mean (Figure 8, Figure 8). In Nidelva and Altaelva it was mainly driven by extremely high values in February and June, respectively (cf. Appendix B). The last occasion coincided with the peak of the snowmelt flood in Altaelva, whereas the event in Nidelva happened during normal flow conditions and are harder to explain. Glomma and Alna were less turbid in 2021 compared with the preceding five years.

3.2.3 Organic carbon

The highest levels of total organic carbon (TOC) are found in the rivers draining catchments dominated by forest (e.g. Glomma, Drammenselva, Numedalslågen) or agriculture (Orreelva), whereas the lowest levels are found in areas with thin and patchy soils (e.g. Vikedalselva, Vosso, Driva) (Figure 9). The largest increase compared with the preceding five-year mean was found in Orreelva. A large fraction of the TOC in Orreelva was associated with particles (POC), most likely originating from the large agricultural areas surrounding the river (Figure 10).

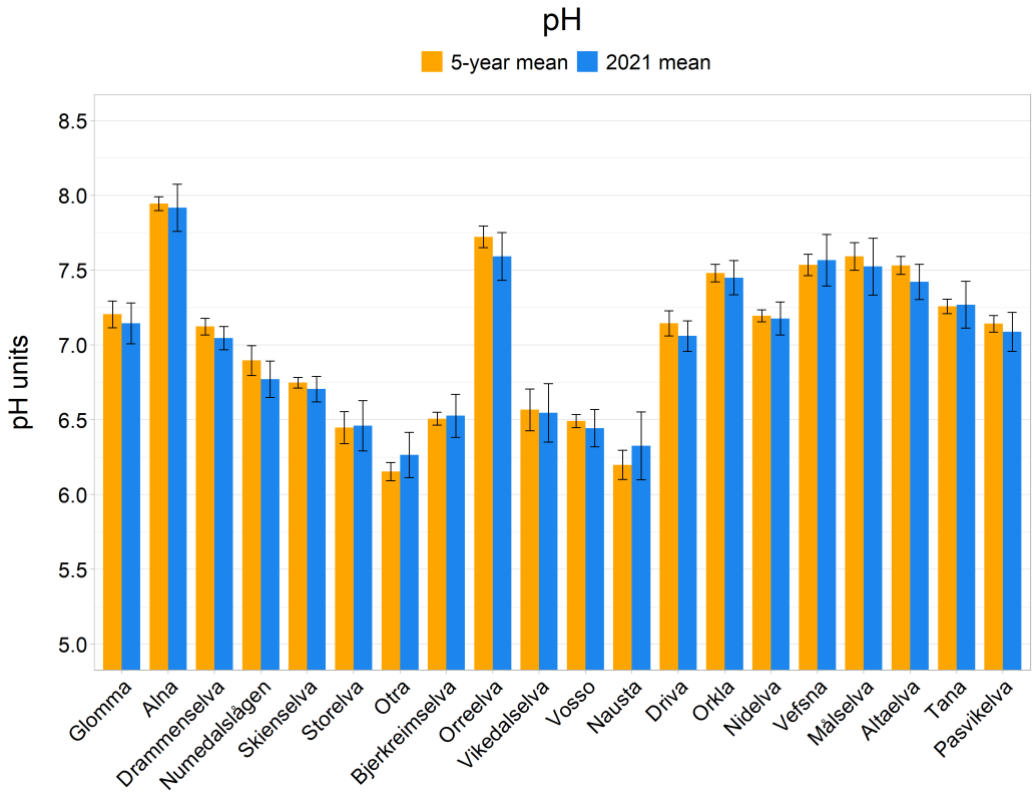

Figure 5. Average pH values in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

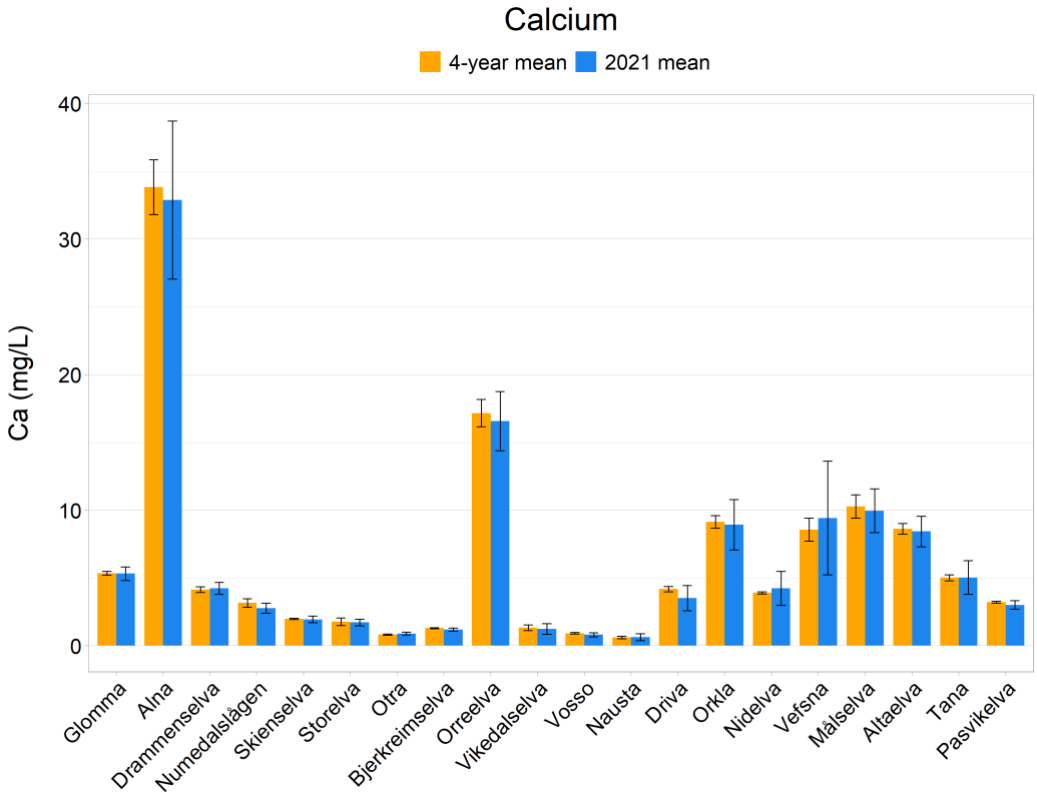

Figure 6. Average concentrations of calcium in 2021 compared with the preceding four-year mean (2017-2020). Error bars indicate one standard deviation from the mean.

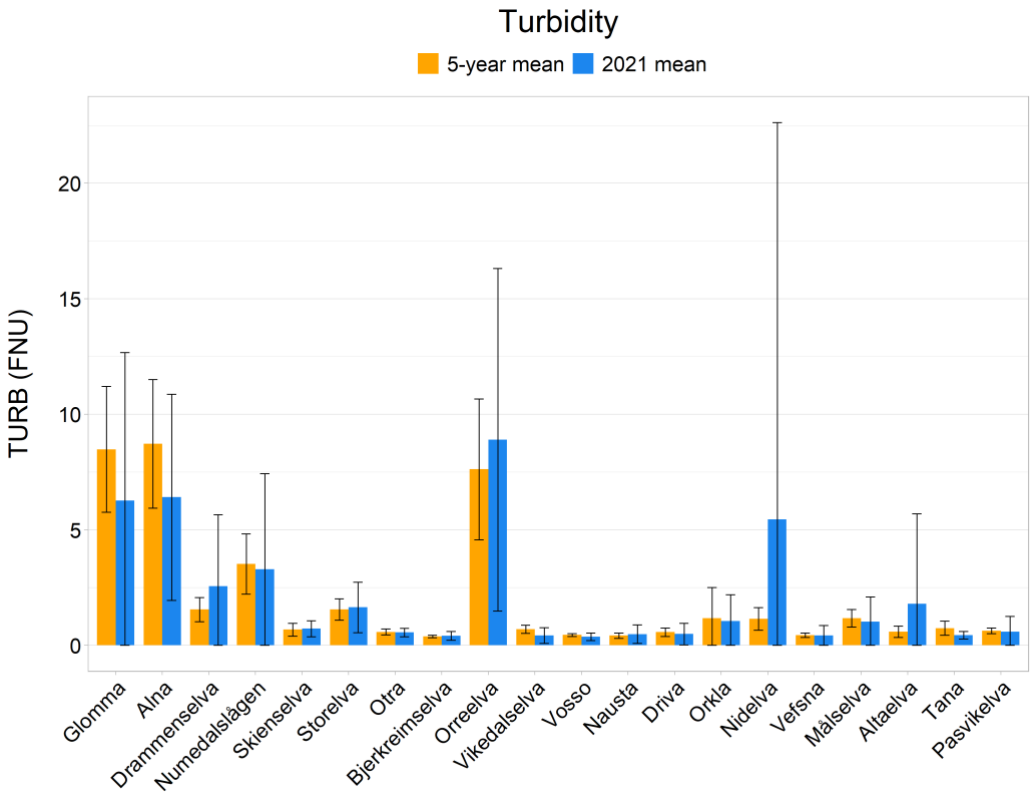

Figure 7. Average turbidity values in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

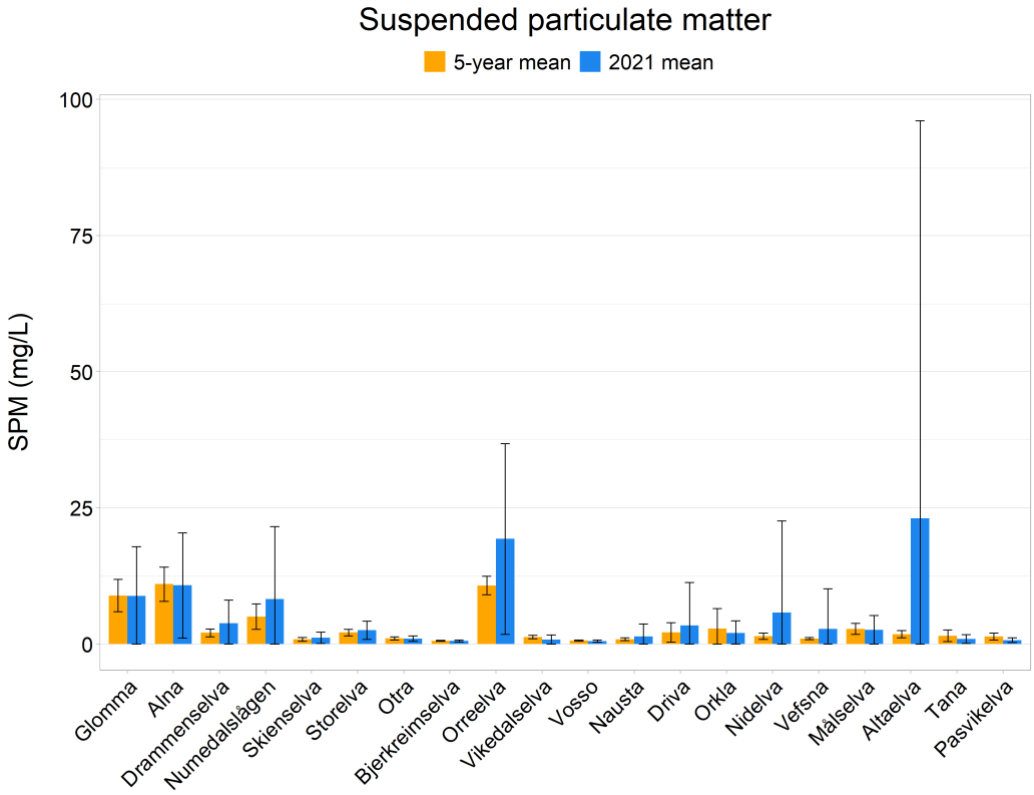

Figure 8. Average concentrations of suspended particulate matter (SPM) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

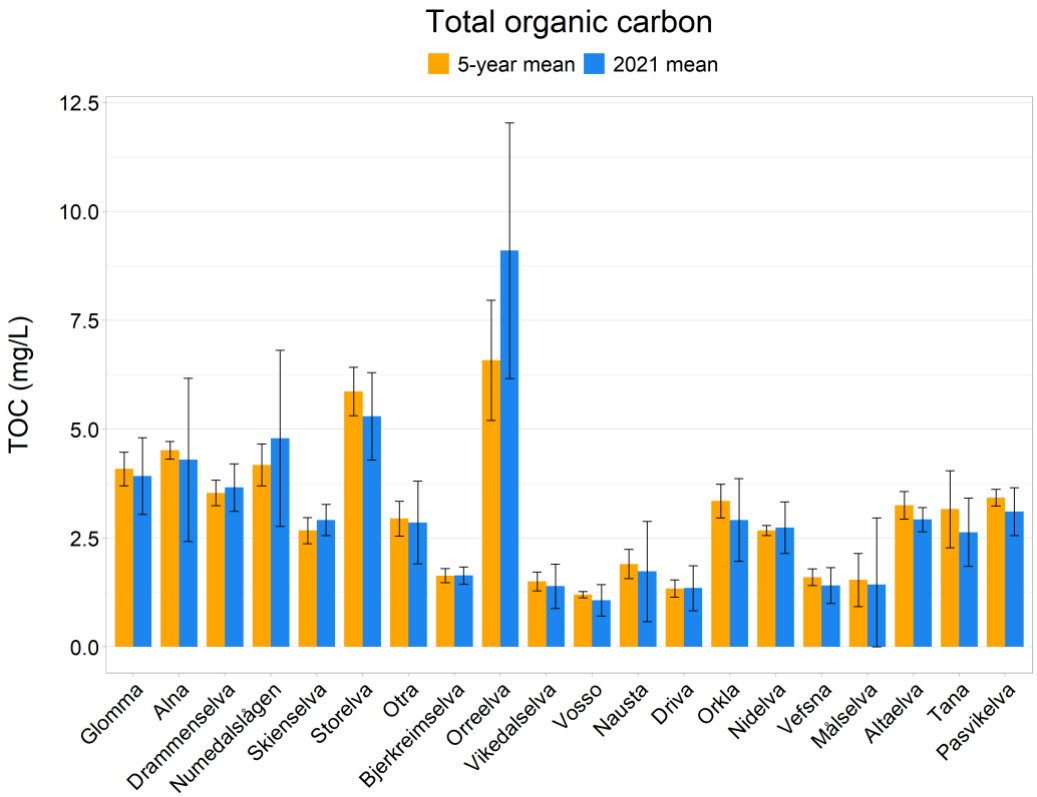

Figure 9. Average concentrations of total organic carbon (TOC) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

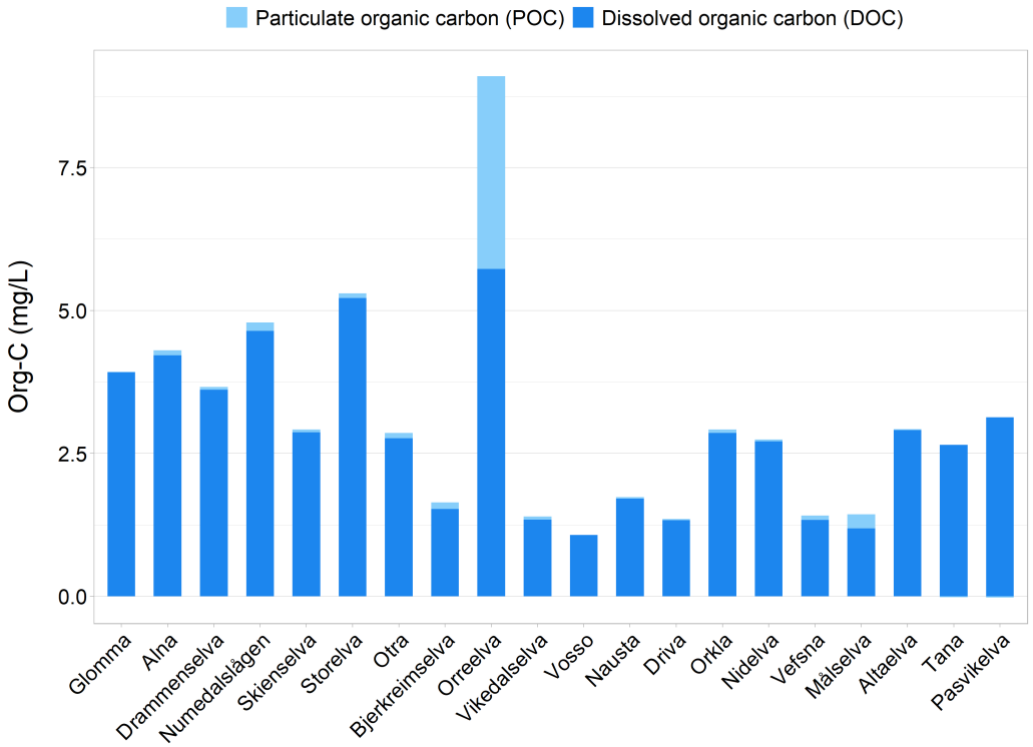

Figure 10. Average concentrations of particulate organic carbon (POC) and dissolved organic carbon (DOC) in 2021.

3.2.4 Nutrients

Phosphorus
The highest concentrations of total phosphorus (Tot-P) and phosphate (PO_4) are generally found in Orreelva, Alna and Glomma (Figure 11, Figure 12). Orreelva, Nidelva and Altaelva had a relatively large increase in Tot-P and PO_4 concentrations in 2021 compared with the preceding five-year mean. Whereas Orreelva showed high concentrations at several occasions, the high mean values in Nidelva and Altaaelva were caused by unusually high concentrations in single samples from February and June, respectively. The last occasion coincided with the peak of the snowmelt flood in Altaelva, whereas the event in Nidelva happened during normal flow conditions and are harder to explain. A high fraction of particulate (TPP) compared to dissolved phosphorus (TDP) indicate that the Tot-P and PO_4 in many rivers are associated with SPM and the bioavailability is limited (Figure 13).

Nitrogen
The total nitrogen (Tot-N) concentrations recorded in 2021 showed little deviation from the preceding five-year means (Figure 14). Alna and Orreelva generally have much higher Tot-N concentrations than the other rivers, mainly due to urban pollution and agricultural runoff, respectively. Nitrogen concentrations in Alna are mainly dominated by the inorganic N species nitrate (NO_3) and ammonium (NH_4) (Figure 15). Orreelva has a larger fraction of organic nitrogen (TON) which to a large extent is bound to particles (Figure 16) and is therefore less bioavailable than NO_3 and NH_4.

Silica
Silica (Si) concentrations in the rivers were generally a bit higher in 2021 compared with preceding five-year means, especially in Altaelva and Tana (Figure 17). In Altaelva, the Si concentrations were especially high during the snowmelt flood in June, probably associated with the high SPM concentrations that were recorded at the same time (cf. section 3.2.2).In Tana the concentrations were especially high during the winter season.

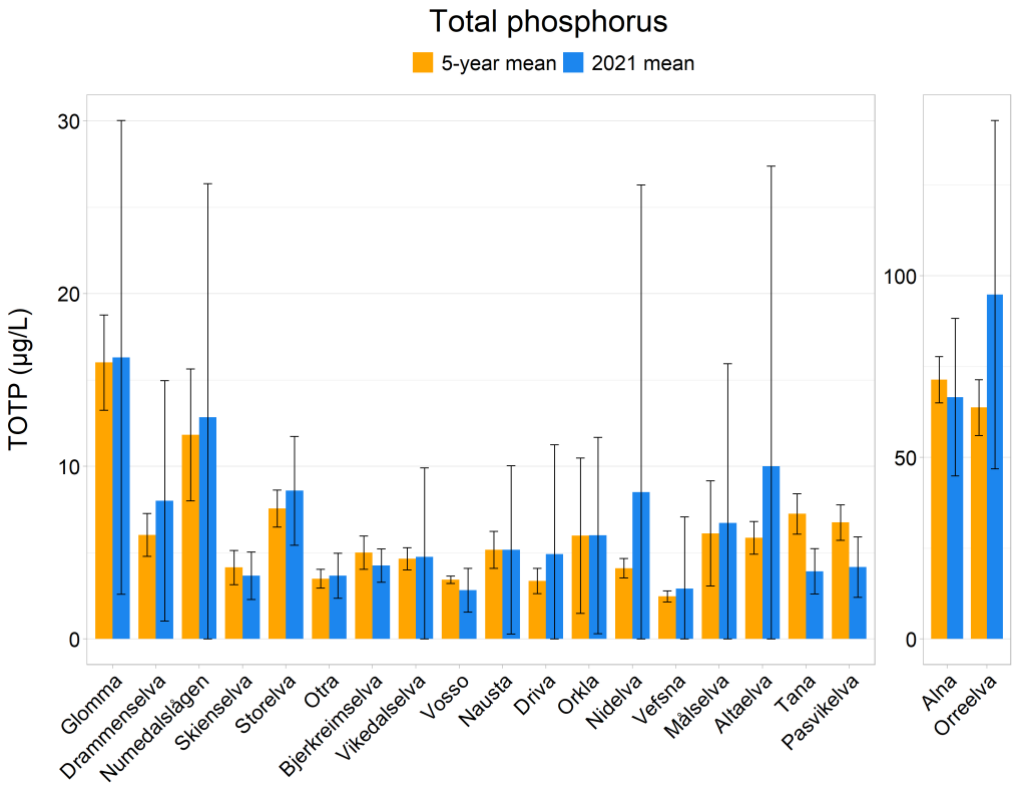

Figure 11. Average concentrations of total phosphorus (Tot-P) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean. Note different y-scale on the right panel.

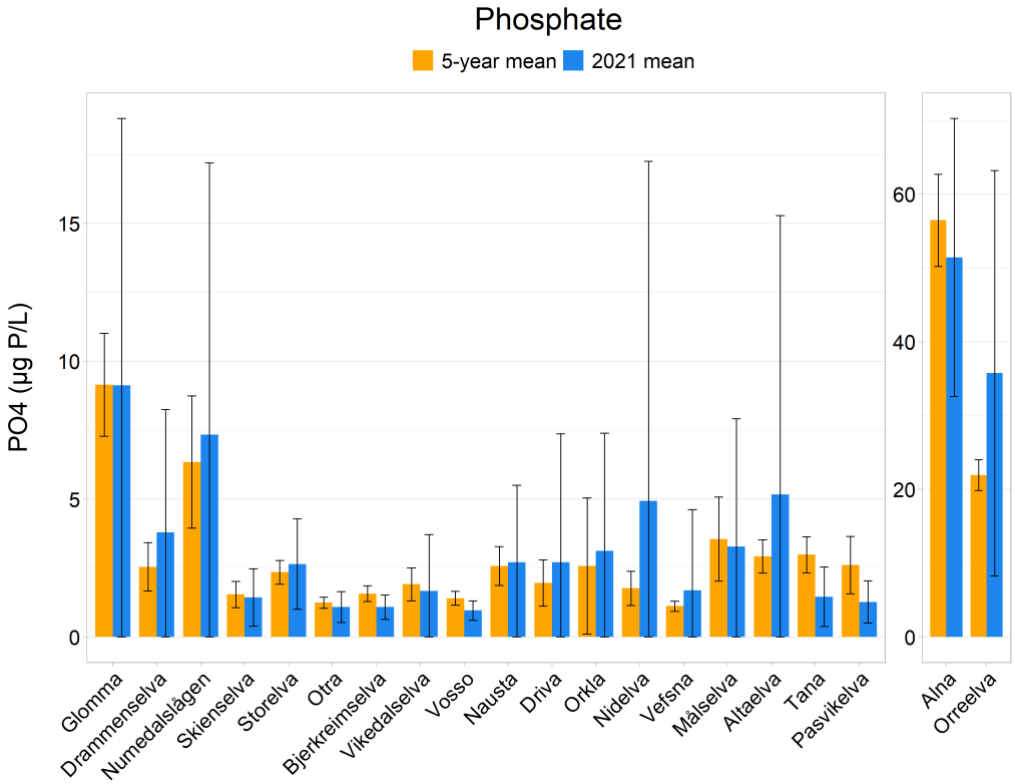

Figure 12. Average (unfiltered) concentrations of phosphate (PO_4) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean. Note different y-scale on the right panels.

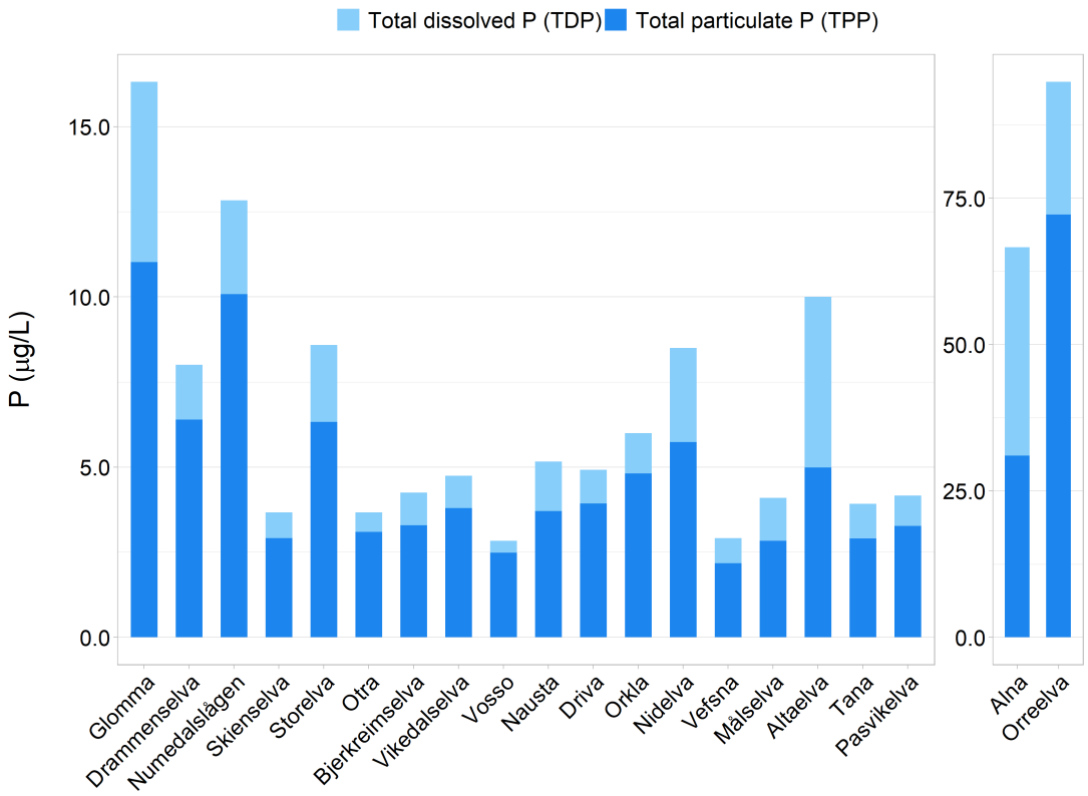

Figure 13. Average concentrations of total dissolved (TDP) and particulate (TPP) phosphorus in 2021. Note different y-scale on the right panel.

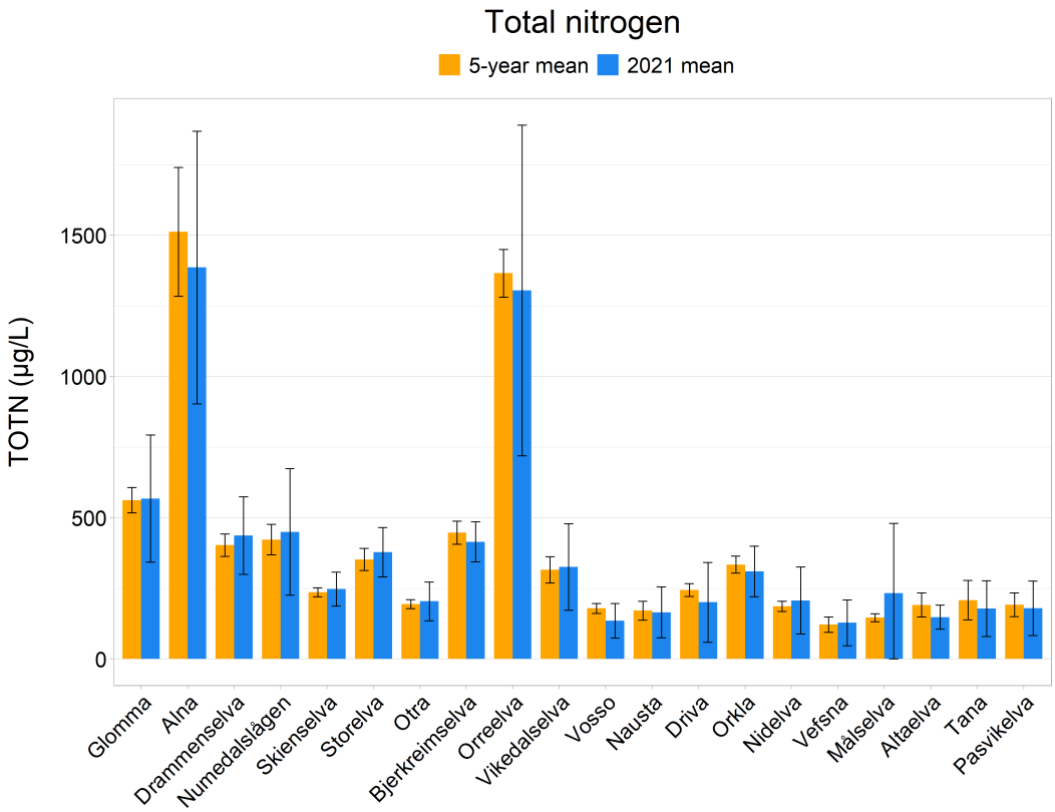

Figure 14. Average concentrations of total nitrogen (Tot-N) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

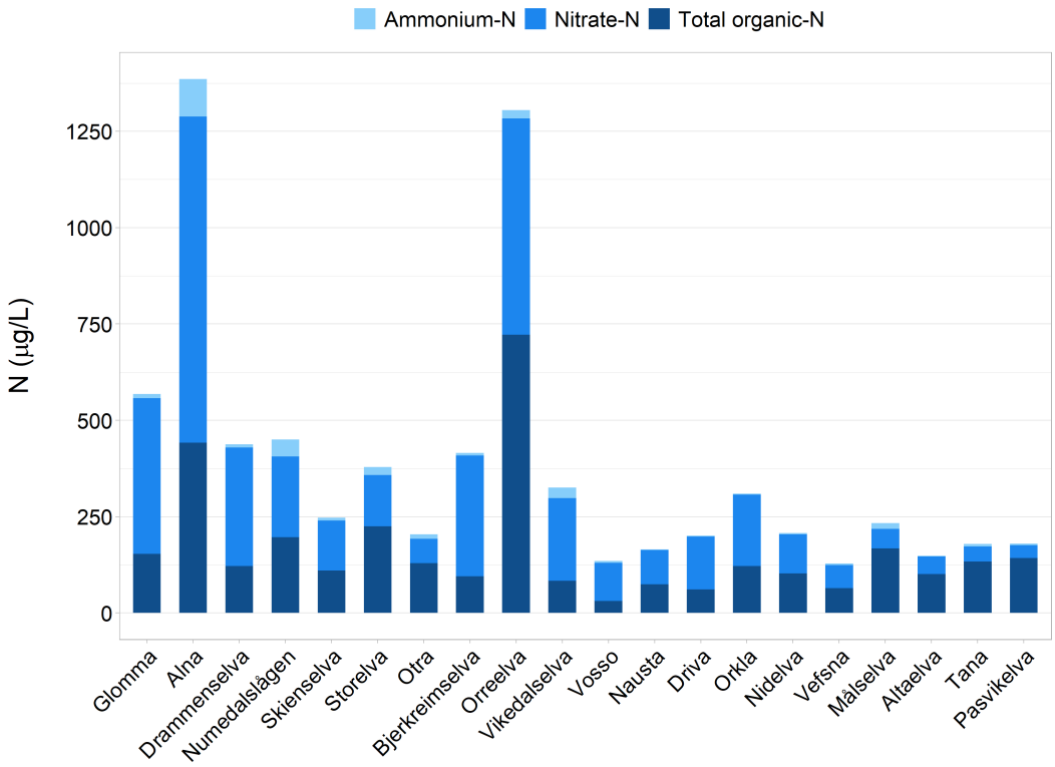

Figure 15. Average concentrations of ammonium (NH_4), nitrate (NO_3) and total organic nitrogen (TON) in 2021.

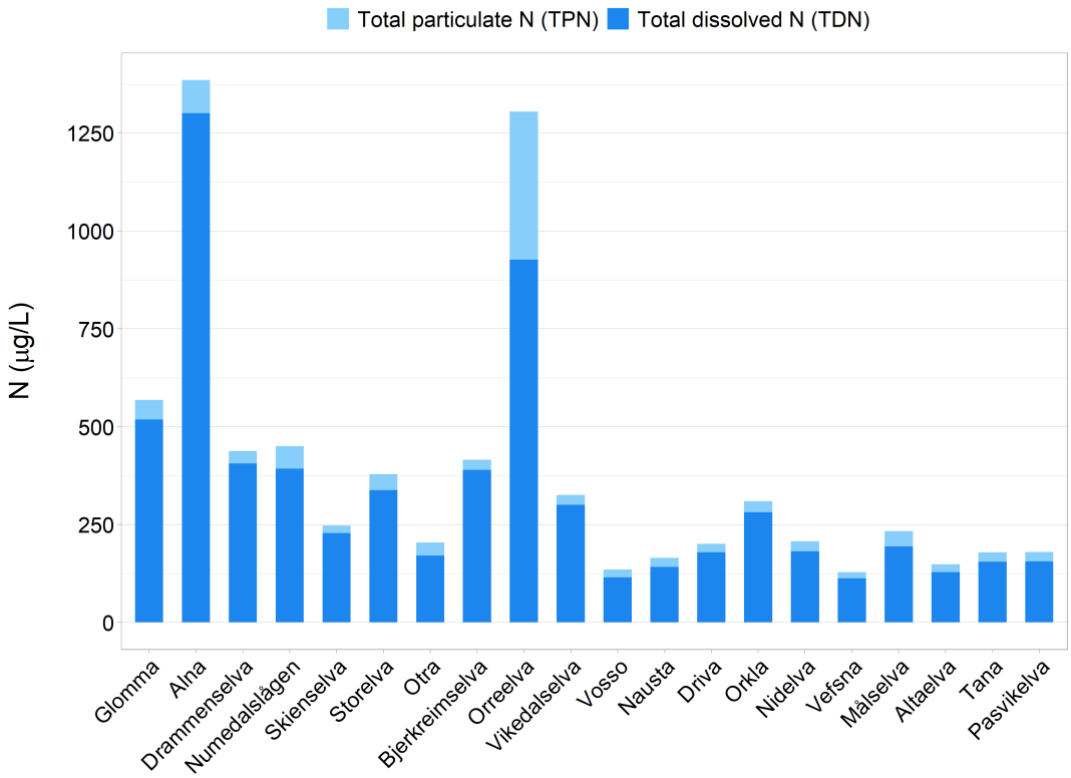

Figure 16. Average concentrations of total particulate nitrogen (TPN) and total dissolved nitrogen (TDN) in 2021. TDN is calculated as the difference between Tot-N and TPN.

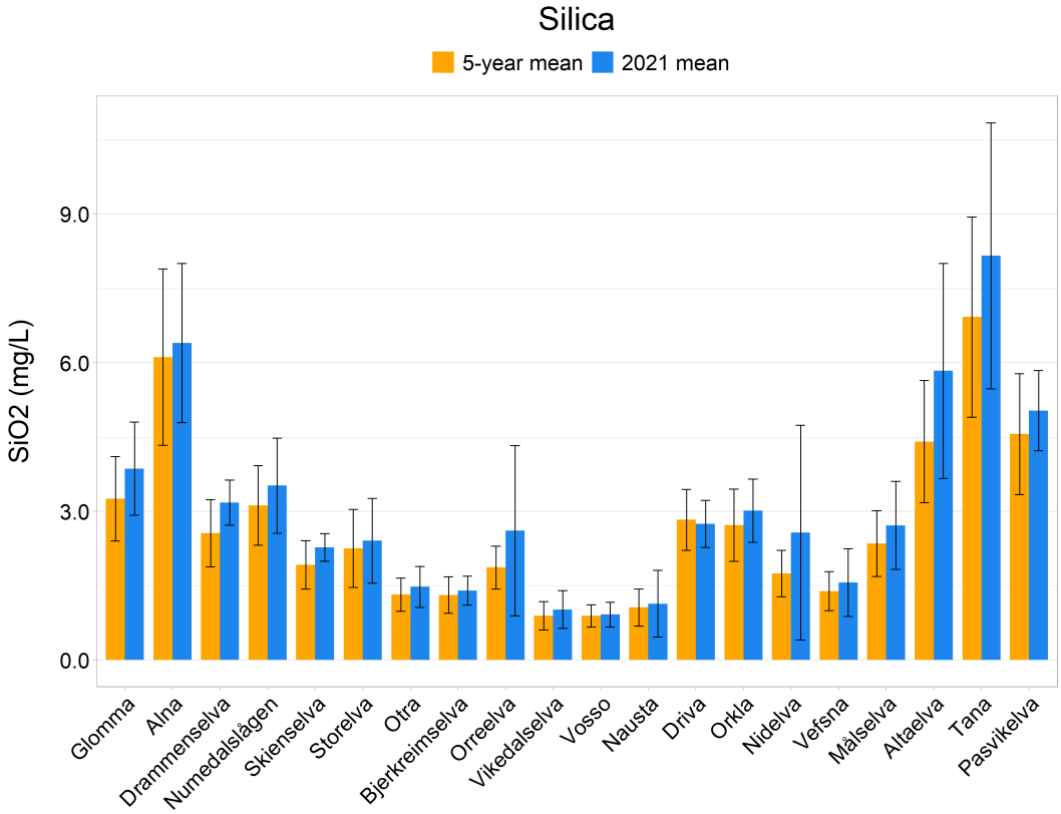

Figure 17. Average concentrations of silica (Si) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

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, other types of industries, vehicular traffic, etc. Metals are not readily soluble in water and are thus typically transported with particles (SPM). With only four samples per year (every third month) the annual mean concentrations can be affected by single samples with extraordinary high SPM levels. This introduces an uncertainty when comparing metal concentrations between years.

Arsenic (As)

The highest As concentrations in 2021 were found in Orreelva, which also experienced a large increase compared to the preceding five-year mean (Figure 18). This was mainly caused by a high value in the October sample, which was taken in the early phase of a flood event with elevated SPM and TOC concentrations in the river (se primary data in Appendix B). In contrast, Alna and especially Pasvikelva showed lower As concentrations in 2021 compared with the last five years.

Lead (Pb)

Orreelva stood out with the highest annual mean Pb concentration and had the largest increase compared to the previous five-year mean (Figure 19). Again, it was the October sample that had the biggest influence on the annual mean. Drammenselva, Numedalslågen and especially Alna showed an opposite trend with clearly lower concentrations in 2021 compared with the 2016-2020 mean.

Cadmium (Cd)

Cd to a great extent followed the same pattern as Pb, with a large increase in Orreelva and a correspondingly large decrease in Alna (Figure 20). Also, Pasvikelva had much reduced Cd concentration in 2021 compared with the last five years (-75%).

Copper (Cu)

The annual mean Cu concentration in Pasvikelva in 2021 was reduced by more than 80% compared with the previous five-year mean (Figure 21). The main reason for this is the shutdown of the smelter on the Russian side of the border in December 2020. Also, Alna and Orkla had lower Cu concentrations in 2021.

Zinc (Zn)

Zn concentrations in Orreelva were more than three times higher in 2021 compared with the previous five-year mean (Figure 22). In Målselva the relative increase was even higher (>4x), while the absolute concentration still was moderate compared with other rivers. Alna showed the largest decrease in Zn concentrations compared with the last five years.

Chromium (Cr)

Cr largely followed the same distribution pattern as Zn with reduced concentrations in Alna and increased concentrations in Orreelva and Målselva (Figure 23).

Nickel (Ni)

As with Cu, the Ni concentrations in Pasvikelva were much lower in 2021 (-70%) compared to the previous five-year mean. The reduction of both elements is related to the shutdown of the nickel smelter on the Russian side of the border in December 2020 (Figure 24). Besides that, Ni concentrations decreased somewhat in Alna and showed a corresponding increase in Glomma and Orreelva.

Mercury (Hg)

The highest Hg concentrations in 2021 were recorded in Alna and Numedalslågen (Figure 25). In the latter case, the Hg levels are probably associated with SPM which typically increases during floods. Most rivers had slightly higher mean Hg concentrations in 2021 compared to the previous five-year mean, whereas the increases were a bit more pronounced in Alna and Numedalslågen.

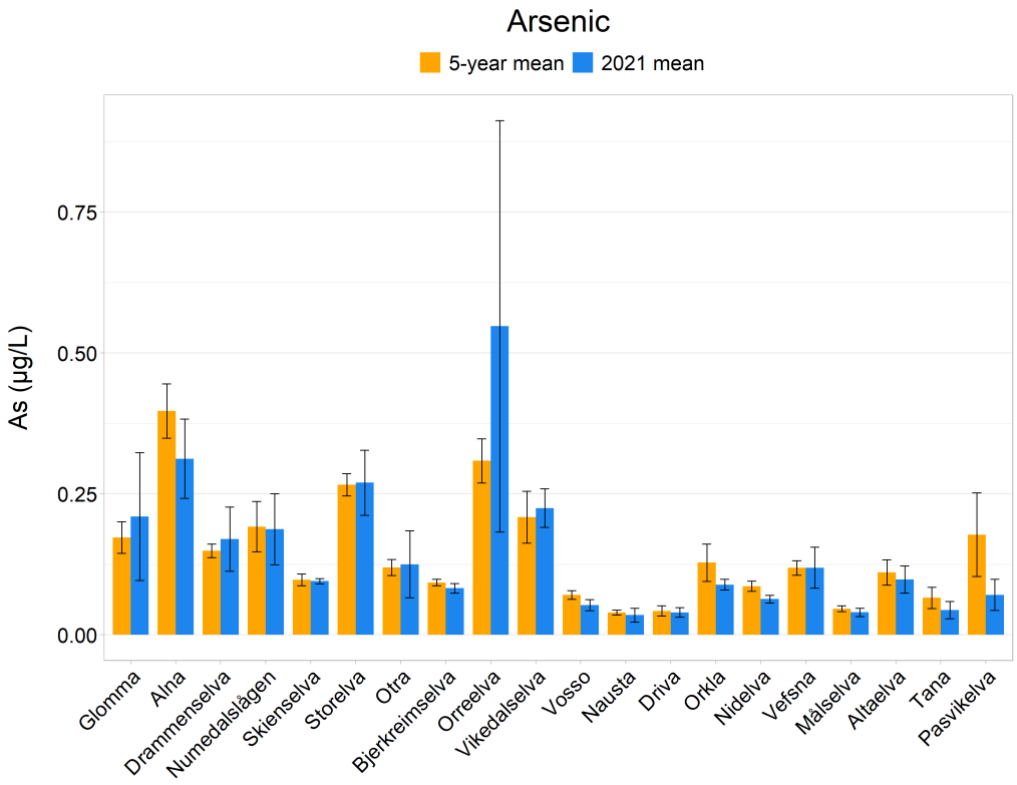

Figure 18. Average (unfiltered) concentrations of arsenic (As) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

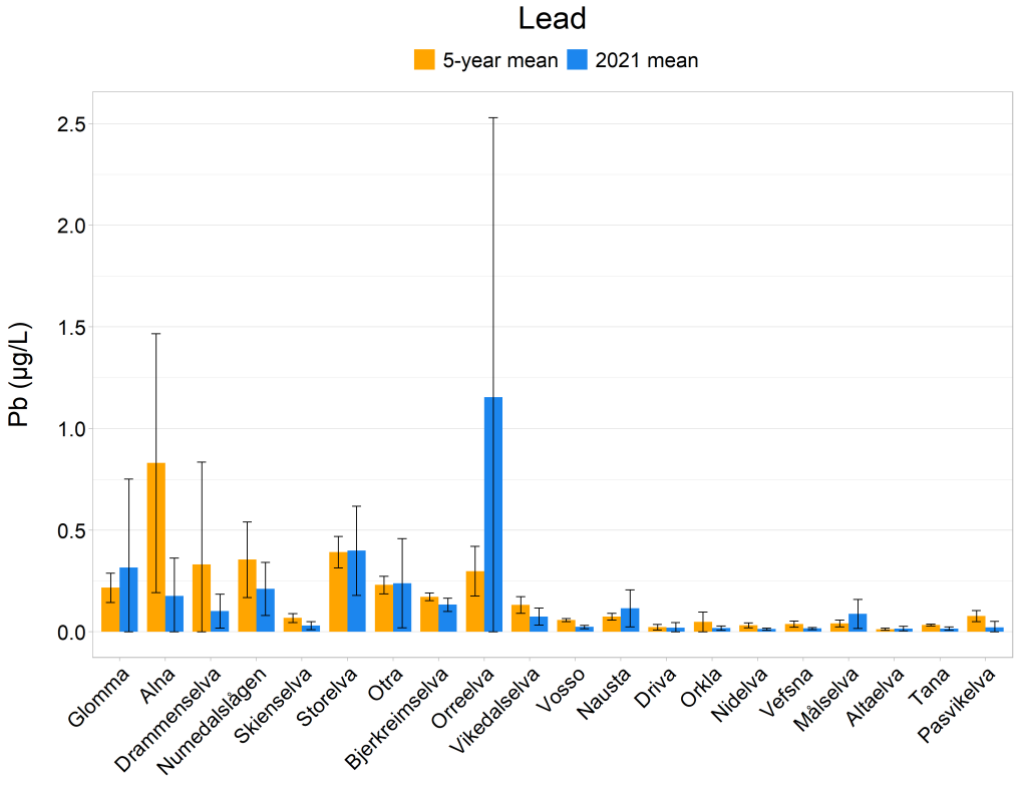

Figure 19. Average (unfiltered) concentrations of lead (Pb) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

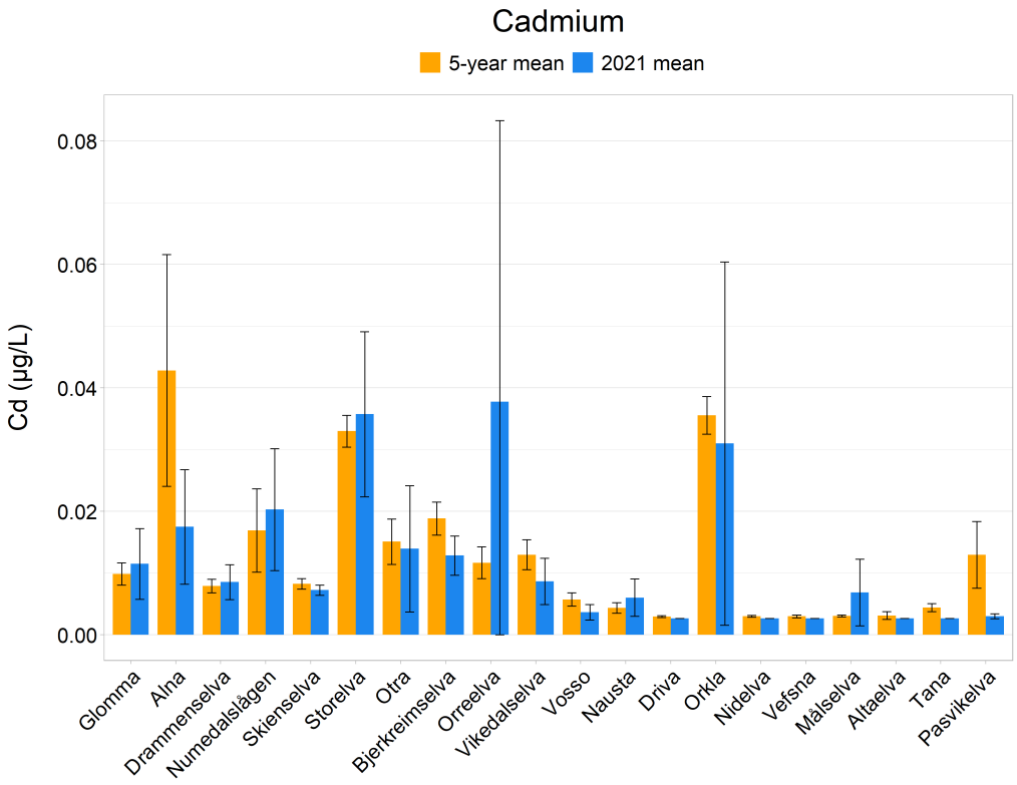

Figure 20. Average (unfiltered) concentrations of cadmium (Cd) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

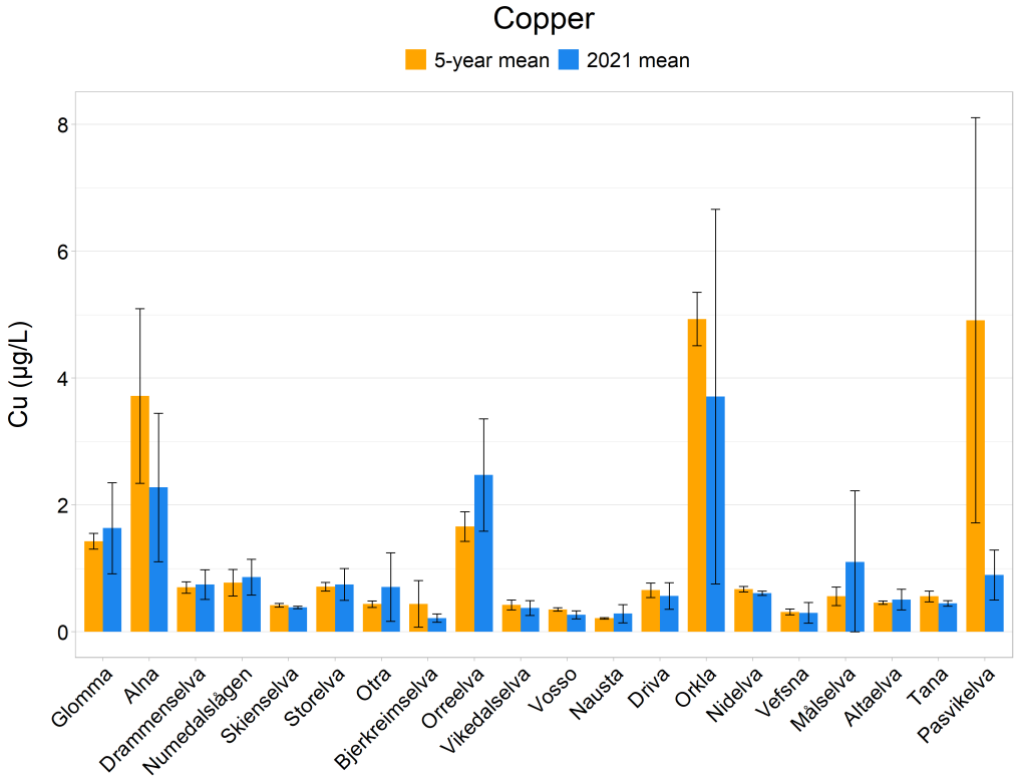

Figure 21. Average (unfiltered) concentrations of copper (Cu) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

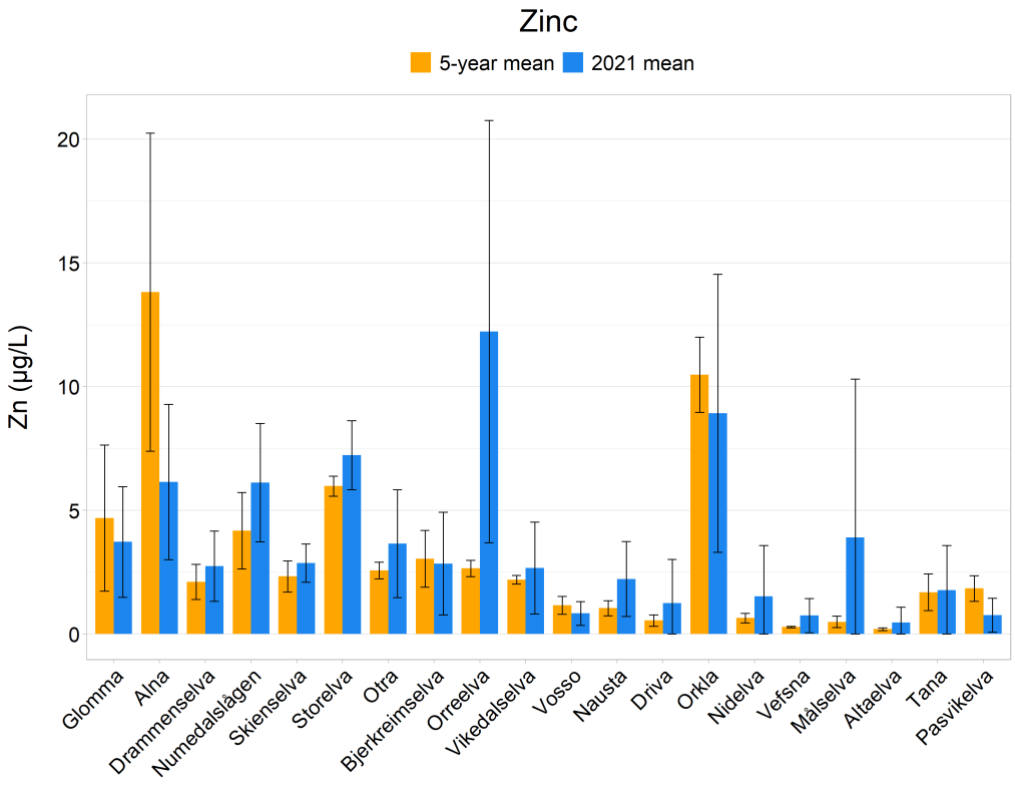

Figure 22. Average (unfiltered) concentrations of zinc (Zn) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

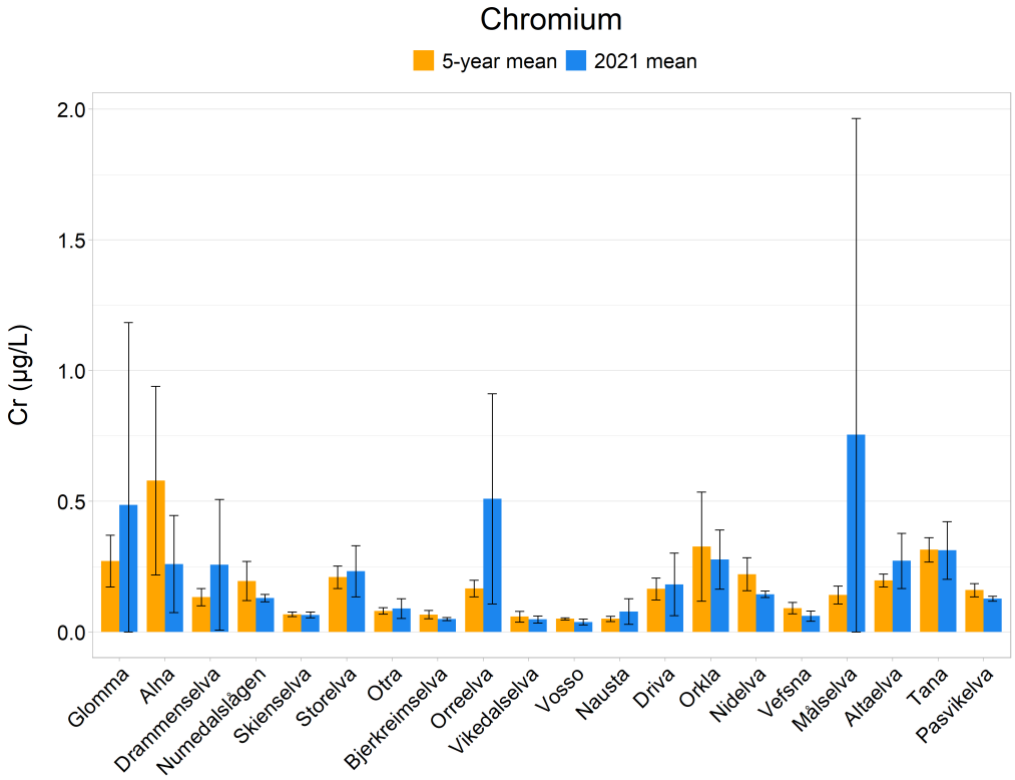

Figure 23. Average (unfiltered) concentrations of chromium (Cr) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean.

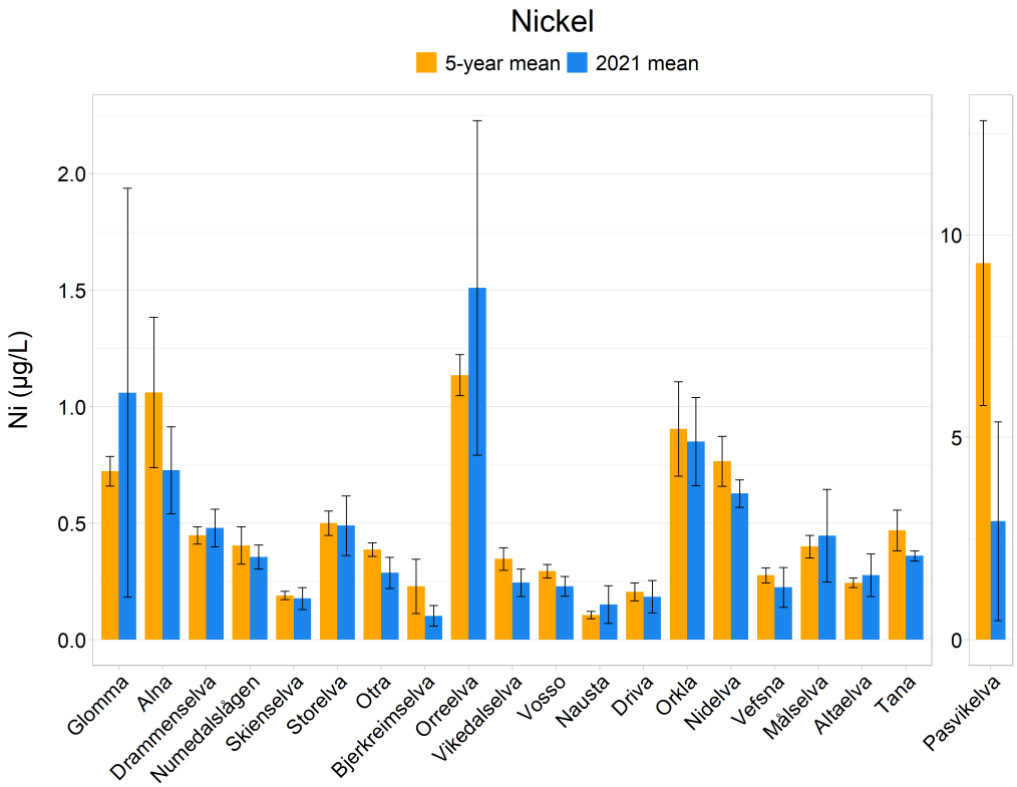

Figure 24. Average (unfiltered) concentrations of nickel (Ni) in 2021 compared with the preceding five-year mean (2016-2020). Error bars indicate one standard deviation from the mean. Note different y-scale on the right panel.

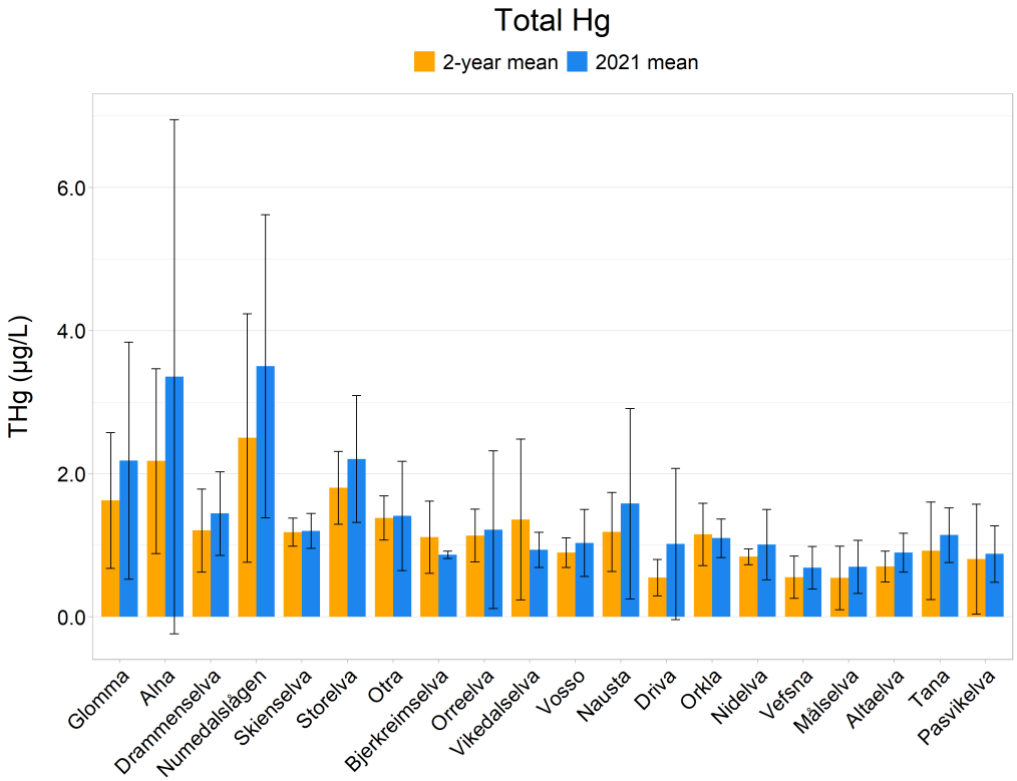

Figure 25. Average (unfiltered) concentrations of mercury (Hg) in 2021 compared with the preceding two-year mean 2019-2020. Error bars indicate one standard deviation from the mean.

3.2.6 Priority substances

In 2021, priority substances were analysed in Glomma, Alna, Drammenselva, Numedalslågen and Skienselva. Metals were analysed in filtered water samples, whereas polycyclic aromatic hydrocarbons (PAHs) and other priority substances were analysed in unfiltered ("whole water") samples. The annual averages were calculated based on four samples from each river and compared with the annual average environmental quality standards (AA-EQS) of the Water Framework Directive (Direktoratsguppen vanndirektivet 2018). Primary data for analysed priority substances are found in Appendix B (section 6.2).

Metals
None of the rivers had annual mean concentrations of priority metals (Cd, Hg, Ni or Pb) that were above the AA-EQS in 2021 (Table 3).

Polycyclic aromatic hydrocarbons (PAHs)
Four rivers (Glomma, Alna, Drammenselva, Numedalslågen) exceeded the AA-EQS for benzo[a]pyrene (BAP) (Table 4). BAP can be considered as an indicator of other PAHs. Alna also exceeded the AA-EQS for fluoranthene. The percentages of values above LOQ (% detects) are specified for each substance in the last column of Table 4.

Other priority substances
None of the rivers had annual concentrations of other priority substances that were above the AA-EQS (Table 5). The substances included organochlorinated compounds, chlorinated paraffins, alkylphenols, chlorfenvinfos, cybutryne and DEHP. The percentage of values above LOQ is specified for each substance in the last column of Table 5. There were no detects of beta-hexachlorocyclohexane (b-HCH), alkylphenols, and chlorfenvinfos in 2021.

Table 3. Annual average concentrations of priority metals in filtered water samples (N=4) from five rivers compared with WFD AA-EQS. Values below LOQ are set to half the LOQ before the mean is calculated.

		Glomma	Alna	Drammenselva	Numedalslågen	Skienselva	AA-EQS
Cadmium (Cd)	µg/l	0.007	0.013	0.007	0.017	0.006	**0.08**
Mercury (Hg)	ng/l	0.88	1.11	0.86	2.16	1.05	**47**
Nickel (Ni)	µg/l	0.67	0.65	0.42	0.35	0.18	**4**
Lead (Pb)	µg/l	0.083	0.095	0.033	0.132	0.025	**1.2**

Table 4. Annual average concentrations of PAH in unfiltered water samples (N=4) from five rivers compared with WFD AA-EQS. Values below LOQ are set to half the LOQ before the mean is calculated. Values above the AA-EQS are marked with red colour. Detection frequencies for each substance in all collected water samples are given in the far-right column (% detect).

		Glomma	Alna	Drammenselva	Numedalslågen	Skienselva	**AA-EQS**	% detect
Acenaphthene	ng/l	0.4	7.0	0.2	0.2	< LOQ	**3800**	47
Acenaphthylene	ng/l	0.3	1.2	0.2	0.1	0.1	**1280**	53
Benzo[a]anthracene	ng/l	0.1	2.2	0.1	0.1	0.1	**12**	53
Benzo[a]pyrene	ng/l	0.2	2.7	0.2	0.2	< LOQ	**0.17**	37
Benzo[b,j]fluoranthene	ng/l	0.3	3.4	0.4	0.2	0.2	-	79
Benzo[ghi]perylene	ng/l	0.2	2.3	0.2	0.1	0.1	-	53
Benzo[k]fluoranthene	ng/l	0.2	1.5	0.2	0.1	0.2	-	58
Chrysene	ng/l	0.2	2.1	0.2	0.2	0.2	**70**	74
Dibenzo[ac/ah]anthracene	ng/l	< LOQ	0.4	< LOQ	< LOQ	< LOQ	**0.6**	11
Fluoranthene	ng/l	0.7	7.2	0.6	0.5	0.5	**6.3**	100
Fluorene	ng/l	0.4	4.6	0.3	0.3	0.2	**1500**	79
Phenanthrene	ng/l	1.1	5.7	0.6	0.7	0.5	**500**	84
Anthracene	ng/l	0.1	1.7	< LOQ	< LOQ	< LOQ	**100**	21
Indeno[1,2,3-cd]pyrene	ng/l	0.2	1.7	0.2	0.1	< LOQ	-	42
Naphthalene	ng/l	2.9	9.9	1.8	1.4	1.1	**2000**	53
Pyrene	ng/l	0.5	8.0	0.4	0.3	0.3	**23**	100

Table 5. Annual average concentrations of other priority and river basin specific substances in unfiltered water samples (N=4) from five rivers compared with WFD AA-EQS. Values below LOQ are set to half the LOQ before the mean is calculated. Detection frequencies for each substance in all collected water samples are given in the far-right column (% detect).

		Glomma	Alna	Drammenselva	Numedalslågen	Skienselva	**AA-EQS**	% detect
Organochlorinated compounds								
Pentachlorobenzene (QCB)	ng/l	< LOQ	0.02	< LOQ	< LOQ	< LOQ	**7**	21
Hexachlorobenzene (HCB)	ng/l	0.008	0.063	0.010	< LOQ	0.009	**-**	53
Alpha-Hexachlorocyclohexane (a-HCH)	ng/l	0.016	0.014	0.012	0.013	0.017	**-**	89
Beta-Hexachlorocyclohexane (b-HCH)	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**-**	0
Gamma-Hexachlorocyclohexane (g-HCH)	ng/l	0.051	0.024	0.019	0.029	0.021	**20**	89
Chlorinated paraffins								
Short chain chlorinated paraffins (SCCP)	ng/l	< LOQ	113	< LOQ	< LOQ	< LOQ	**400**	5
Medium chain chlorinated paraffins (MCCP)	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**50**	0
Alkylphenols								
4-iso-nonylphenol	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**-**	0
4-n-nonylphenol	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**300**	0
4-tert-octylphenol	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**100**	0
Other substances								
Chlorfenvinfos	ng/l	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**100**	0
Cybutryne	ng/l	0.14	< LOQ	< LOQ	< LOQ	< LOQ	**2.5**	5
Di(2-ethylhexyl)phthalate (DEHP)	ng/l	64	19	63	121	11	**1300**	100

3.3 Long-term trends in riverine concentrations

3.3.1 SPM, silica and TOC (1990-2021)

Despite that many of the monitoring rivers show increasing trends in water discharge (Kaste et al. 2022) only Glomma displays an increasing trend in SPM during 1990-2021 (Table 6). On the contrary, three rivers (Otra, Orkla and Vefsna) show decreasing trends in SPM. These are, however, typically clearwater rivers with usually low SPM concentrations. TOC generally show increasing trends in southern Norway since 1990 (Hindar et al. 2020, Garmo and Skancke 2021). The increase has largely been related to increased mobilisation of TOC from soils due to decreasing acid deposition (de Wit et al. 2007, Hruška et al. 2009) but partly also to climatic factors, especially increased precipitation (de Wit et al. 2016). Among the monitoring rivers only Drammenselva and Skienselva show a significant log-term increase in TOC. Also, the other rivers in eastern and southern Norway (Glomma, Numedalslågen and Otra) show a tendency towards increased TOC concentrations, but the trends here were not significant.

Table 6. Long-term trends (1990-2021) in concentrations of suspended particulate matter (SPM), silicate (Si), total organic carbon (TOC), total phosphorus (Tot-P), phosphate (PO_4) total nitrogen (Tot-N), ammonium (NH_4) and nitrate (NO_3), in rivers. p-values are shown.

River	SPM	Si	TOC*	Tot-P	PO_4	Tot-N	NH_4	NO_3
Glomma	0.027	0.634	0.734	0.818	0.000	0.833	0.000	0.638
Drammenselva	0.178	0.095	0.050	0.516	0.049	0.795	0.000	0.088
Numedalslågen	0.112	0.095	0.255	0.122	0.018	0.094	0.253	1.000
Skienselva	0.064	0.032	0.027	0.516	0.122	0.000	0.000	0.000
Otra	0.028	0.653	0.375	0.003	0.606	0.001	0.060	0.000
Orreelva	0.083	0.205	0.979	0.113	0.014	0.570	0.017	0.034
Orkla	0.001	0.008	0.314	0.229	0.972	0.011	0.000	0.123
Vefsna	0.000	0.444	0.710	0.000	0.027	0.006	0.000	0.000
Altaelva	0.194	0.958	0.273	0.022	0.057	0.709	0.001	0.603

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

*Trend analysis in Numedalslågen, Orreelva, Alta, Vefsna and Skien started in 1999 due to limited data in the period from 1990

3.3.2 Nutrients (1990-2021)

Although four rivers show significant increases in PO_4 (Glomma, Drammenselva, Numedalslågen, Orreelva) none of these rivers have increasing trends in Tot-P. On the other hand, three rivers show decreasing trends (Otra, Vefsna, Altaelva). All rivers show either no trends or downward trends in inorganic nitrogen (NO_3, NH_4). The same applies to Tot-N, except for Orkla, which has a significantly increasing trend in Tot-N. The reason for this is not known, but the river also shows a tendency towards increasing NO_3 levels, although not significant. Skienselva and Orkla show significant increases in Si concentrations from 1990 until 2021. This might be a large-scale trend as a recent national lake survey of 1000 lakes also indicate that Si concentrations have increased regionally since the 1990s (Hindar et al. 2020). The reason for the large-scale increase is not fully understood but is has been speculated that increased temperature and precipitation due to climate change might have increased weathering rates of Si-bearing bedrock.

3.3.3 Metals (2004-2021)

For the metals Pb, Cd, Cu, Zn and Ni time series exist from 2004. The shorter time period was selected due to a shift in the sensitivity of the analytical methods (lower LOQ) over time (i.e. it has become possible to detect lower concentrations).

There are either no trend or decreasing trends for concentrations of Pb, Cd, and Zn in all rivers (Table 7). Most rivers also show downward trends in Cu, except for Orreelva that has a significant upward trend. The trend is mainly affected by relatively high concentrations in 2020 and a further steep increase in 2021. Ni show increasing trends in three rivers; Orreleva, Vefsna and Altaelva. The sources responsible for this is not known.

Table 7. Short-term trends (2004-2021) in unfiltered concentrations of lead (Pb), cadmium (Cd), copper (Cu), zinc (Zn) and nickel (Ni) in rivers monitored since 1990. P-values are shown.

River	Pb	Cd	Cu	Zn	Ni
Glomma	0.596	0.416	0.001	0.880	0.820
Drammenselva	0.044	0.006	0.000	0.001	0.058
Numedalslågen	0.596	0.788	0.112	0.185	0.703
Skienselva	0.025	0.000	0.001	0.088	0.001
Otra	0.649	0.061	0.002	0.000	0.007
Orreelva	0.225	1.000	0.025	0.850	0.009
Orkla	0.062	0.063	0.001	0.001	0.103
Vefsna	0.031	0.001	0.003	0.004	0.017
Altaelva	0.969	0.001	0.000	0.001	0.003

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

3.4 Quality of dissolved organic matter

Dissolved organic matter (DOM) plays an important role in shaping physical, chemical and biological conditions in surface waters. It is involved in processes such as transport of pollutants or nutrients, it constitutes the primary source of carbon for bacteria and other microorganisms, and it plays a role in determining the light conditions at deeper waters.

DOM is usually quantified by measuring the concentration of dissolved organic carbon (DOC), since DOM typically consists of 60% carbon (followed by oxygen, hydrogen, and nitrogen). The molecular structure of DOM is challenging to describe accurately. Instead, proxies and indices are established to describe its quality and functionality. Frequently, DOM is characterized based on its ability to absorb light at different wavelengths. Absorption of UV light is attributed to aromatic molecular structures (sUVa, Table 8) and absorption at longer wavelengths is associated with larger molecular size. With aromaticity and molecular size typically following each other, an index looking at the ratio between the two (E2_E3, Table 8) can provide more information than looking at the two separately (Peuravuori and Pihlaja 1997, Weishaar et al. 2003).

Table 8. Overview of the absorbance indices used to describe DOM quality

	Name	Definition	Characteristic
sUVa	Specific UV absorbance	(Abs 254nm / DOC) *100	Aromaticity (positive relationship)
E2_E3	(Peuravuori and Pihlaja, 1997)	Abs 250nm / Abs 365nm	Aromaticity (negative relationship) Molecular size (negative relationship)

A few of the rivers differ from the others in terms of DOM aromaticity and molecular size. Alna, Orreelva, Driva and Målselva have DOM of less aromaticity compared to the others (sUVa, Figure 26). This is especially true for the agricultural influenced river Orreelva. Less aromatic DOM is associated with more degraded OM including a higher contribution of microbially- and phytoplankton-derived source material. Less aromatic DOM in rivers draining agricultural regions is also described in the literature (Wilson and Xenopoulos 2009). It is attributed to the increased availability of nitrogen causing higher microbial activity or to structural differences in the soils resulting from agricultural practices.

The most aromatic DOM was seen in Glomma, Nausta and Nidelva, which means that the rivers have relatively large inputs of “fresh” humic material from natural sources (forest, peatlands and mountainous areas). More aromatic DOM is associated with a higher capability of transporting pollutants such as Hg (Manceau and Nagy 2019). The pattern is similar when looking at DOM aromaticity in relation to molecular size (E2_E3, Figure 27). Alna, Orreelva, Driva and Målselva show low aromaticity (negative correlation) also when molecular size is considered. Interestingly, Pasvikelva show low aromaticity when taking molecular size into account. This indicates a different relationship between aromaticity and molecular size of the DOM in this river. In 2021, the annual averages for both indices were around the levels of the four preceding years for all the rivers.

In summary, there were no clear regional patterns in the DOM aromaticity and molecular size for the annual averages of the rivers. This is in accordance with the findings from the previous years, stating that the seasonal differences within the rivers were greater than differences between the rivers on an annual basis (Braaten et al. 2020, Gundersen et al. 2019). The variability in DOM aromaticity and molecular size is mainly driven by seasonal events such as 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).

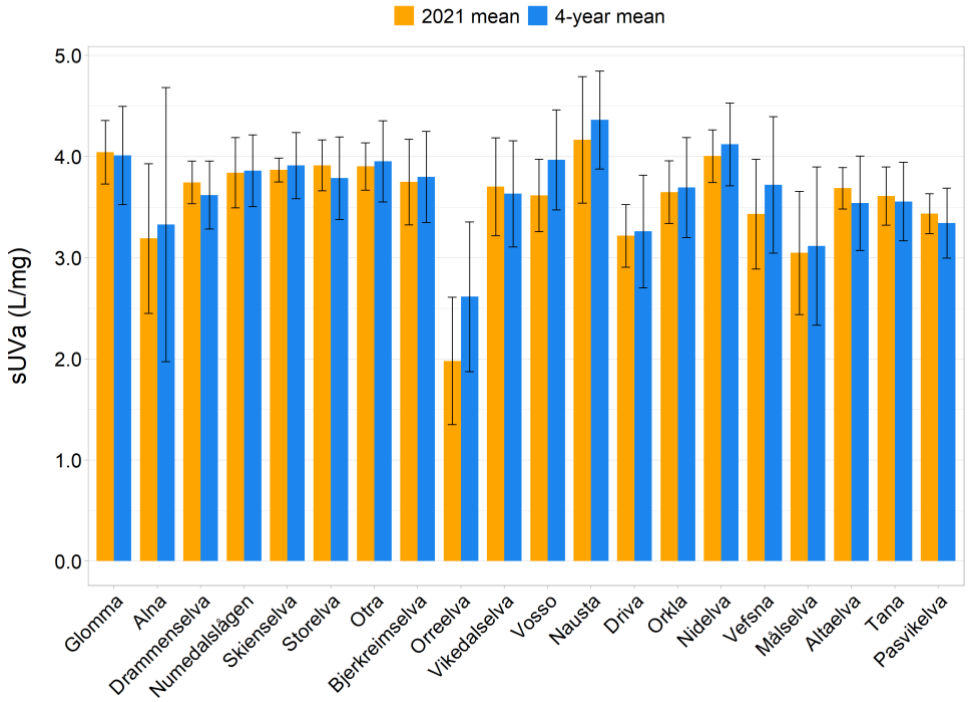

Figure 26. Average values for Specific UV absorbance (sUVa) in 2021 compared with the preceding four-year mean (2017-2020). Error bars indicate one standard deviation from the mean.

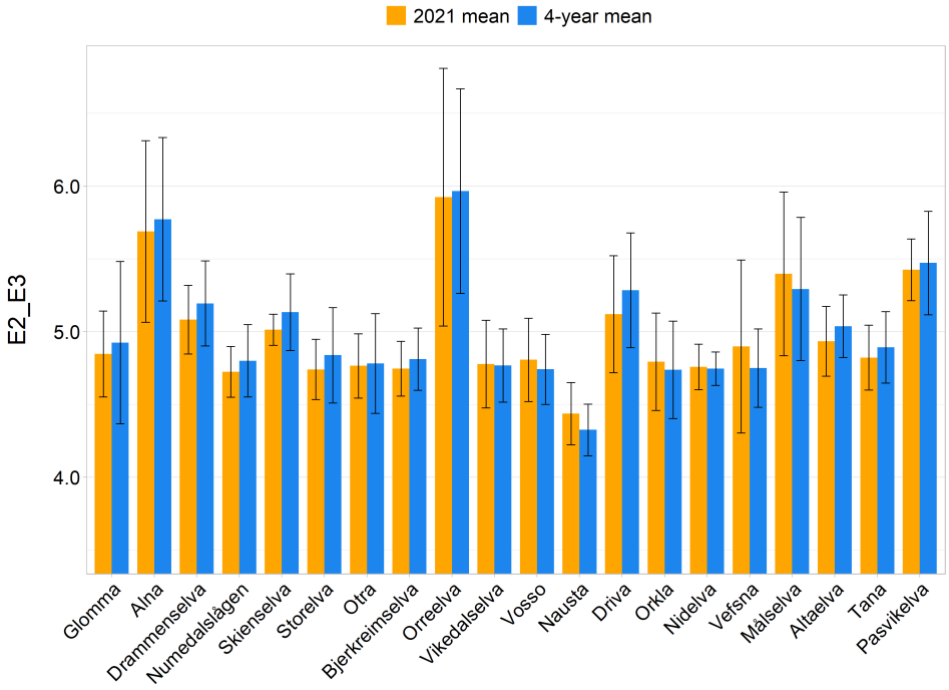

Figure 27. Average values for the E2_E3 index in 2021 compared with the preceding four-year mean (2017-2020). Error bars indicate one standard deviation from the mean.

3.5 High-frequency monitoring in Storelva and Målselva

This section includes a brief description of results from the sensor monitoring in Storelva and Målselva in 2021. A more thorough analysis of the data will be carried out in a separate project later this year. For a more detailed description of the parameters and their relation to climatic conditions, see also Poste et al. (2021) and Kaste et al. (2022).

Two new sensor stations were established in Leira and Vorma (both in the Glomma catchment) late in the autumn of 2021. The relatively short data series from the stations in 2021 will be reported together with the 2022-data in the next annual report.

The figures in the following sections display both the sensor data and lab data based on monthly samples. This serves two purposes; to show that the sensor data are in the same range as the lab data, but also to demonstrate that manual monthly sampling usually fails to capture short-term and climate-related episodes that can have a large influence on river ecology and estimates of annual riverine loads to the coast.

3.5.1 Storelva

Water flow and temperature
The water flow pattern in 2021 was characterised by several small floods during winter and spring and two larger floods in early October and November (Figure 28). There was no distinct snowmelt flood in 2021. The water temperature never reached zero during winter and was around 4-5^{o}C until April (Figure 28, upper panel). In the autumn, the temperature remained above 10^{o}C until the end of the year.

pH and conductivity
The high-frequency pH data largely followed the same pattern as the monthly samples, except during the first autumn flood when sensor-based pH values dropped to around 6.0 (Figure 28, middle panel). The conductivity (ion concentration) often peaked during flood events (Figure 28, lower panel). Exceptions were the flood events in late May and in November, when conductivity dropped as a result of ion dilution. Usually, the ion concentration increases in the early phase of a flood and decreases as the flood proceeds. The most pronounced conductivity peak occurred after a drought period in April that was followed by a small flood in early May.

Turbidity and fluorescent dissolved organic matter (fDOM)
Turbidity is related to SPM that affects the clarity of water. Turbidity usually peaks during flood events, which can be difficult to capture in the monthly manual grab samples. In 2021, there were two large, but transient peaks occurring after a flood event in late March (Figure 29, upper panel). There were also distinct flood-related turbidity peaks in May, October and November.

fDOM (the fraction of CDOM that fluoresces) can be used as proxy for DOC concentrations in water. The fDOM levels are lowest during the summer season, when DOC concentrations tend to be low. fDOM usually responds to flood events, but the amplitude can go in both directions depending on whether increased water level mobilises or dilutes DOC. The fDOM curve in Figure 29 (lower panel) illustrates that both cases occurred in Storelva in 2021.

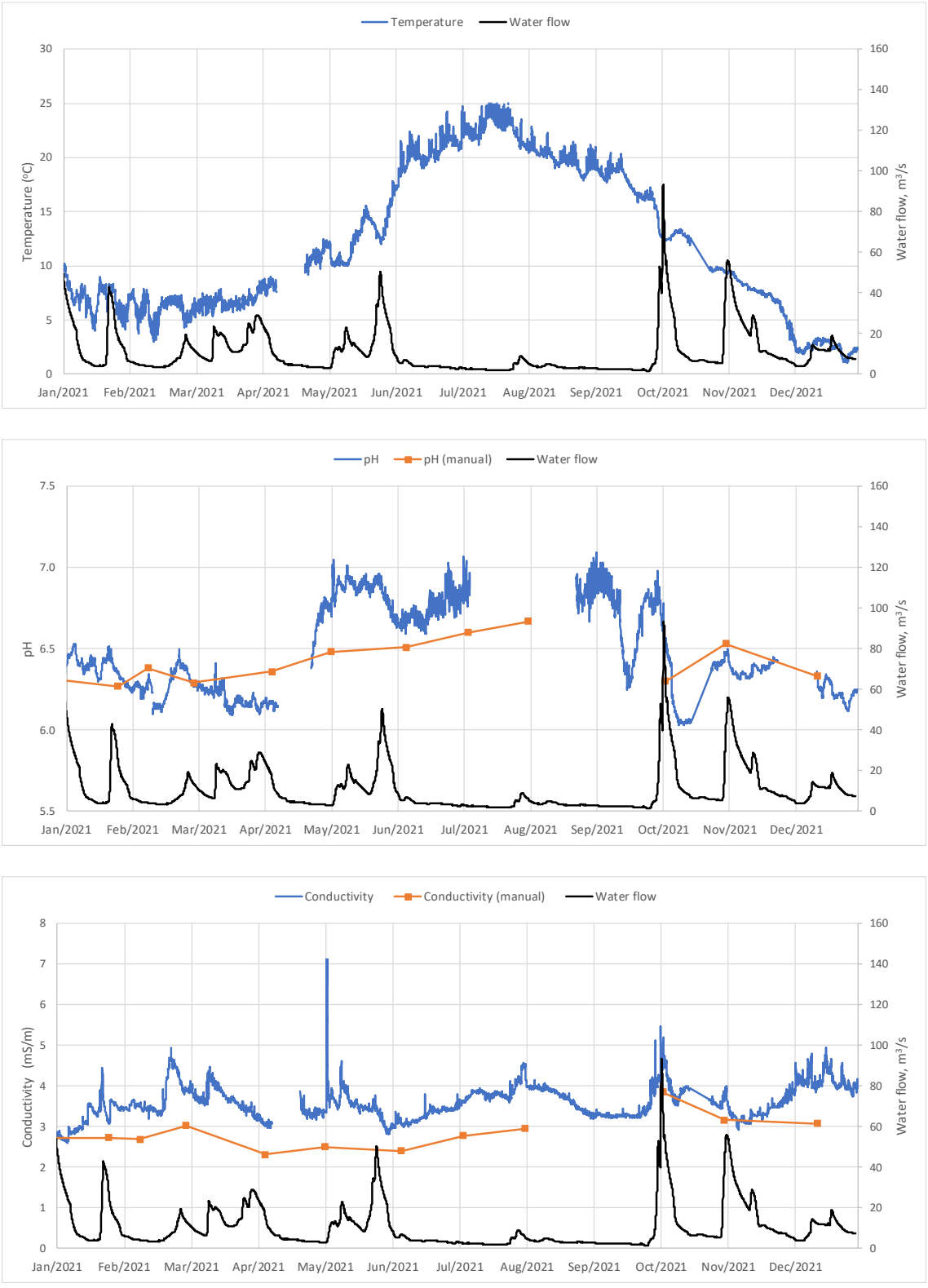

Figure 28. Water temperature (upper panel), pH (middle panel) and conductivity (lower panel) in Storelva in 2021 plotted together with water flow data from NVE's station 18.4.0 (Lundevann).

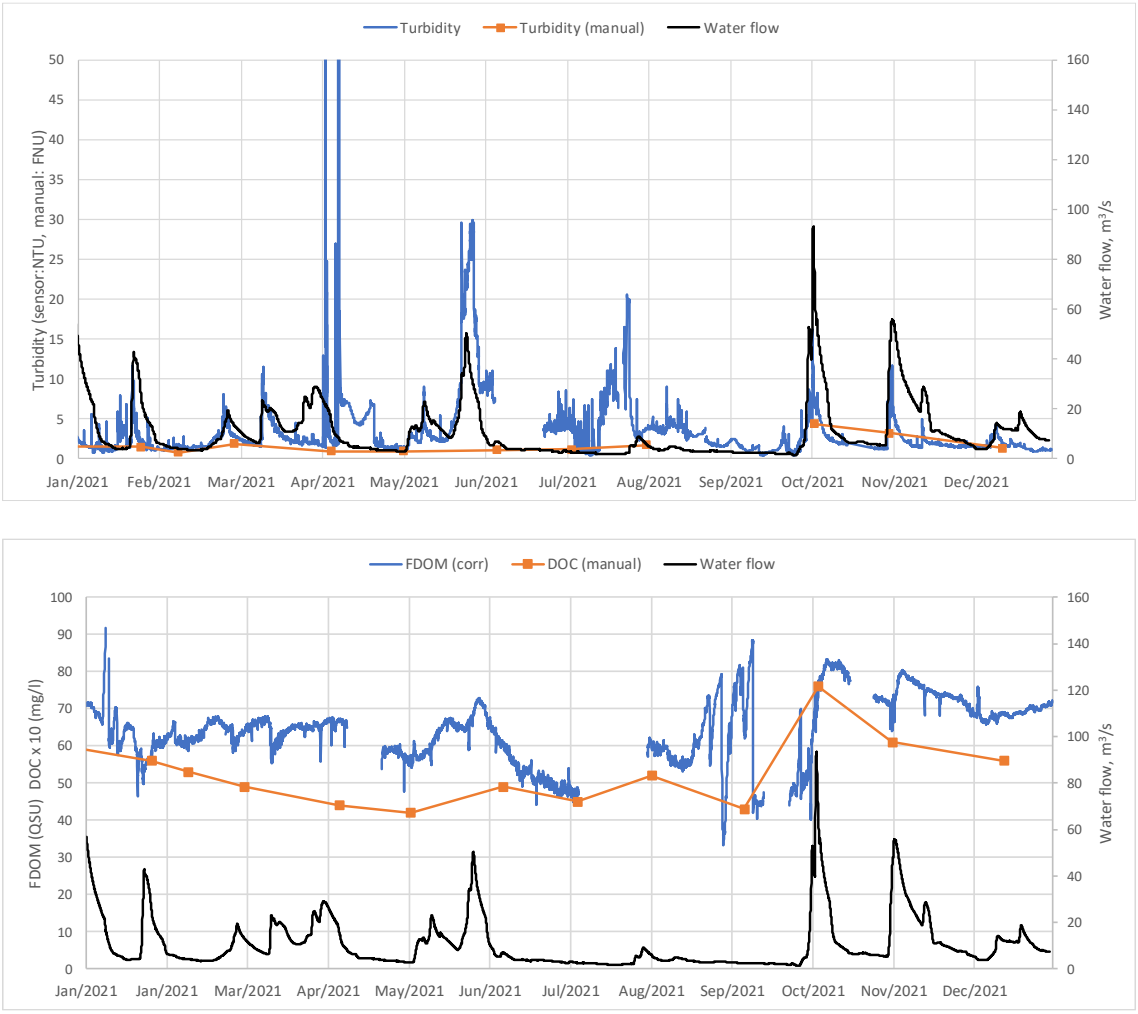

Figure 29. Turbidity (upper panel) and fluorescent dissolved organic matter (fDOM) (lower panel) in Storelva in 2021 plotted together with water flow data from NVE's station 18.4.0 (Lundevann).

3.5.2 Målselva

Water flow and temperature
The flow in Målselva is highly seasonal, with very low water levels during winter and spring until the snowmelt flood onsets in late May and usually lasts until the end of June (Figure 30). In 2021, there was a small flood in late January, in conjunction with a short period with mild weather. There were no major floods during autumn in 2021.

The water temperature was zero until the first week of May and from early November (Figure 30, upper panel). The maximum temperature approached 15^{o}C in late July.

pH and conductivity
River Målselva is well-buffered and the pH is relatively stable with pH values fluctuating around 7.5 (Figure 30, middle panel).

The conductivity data from Målselva nicely show that the ion concentration usually increases in the early phase of the flood and decreases (dilutes) as the flood proceeds. This was e.g. demonstrated during the flood peaks that occurred in mid-March and early June (Figure 30, lower panel).

Turbidity and fDOM
Since the lower parts of the river are relatively flat with several meandering bends, sediment is easily mobilised and resuspended during high-flow events. As can be seen in Figure 31 (upper panel) turbidity shows a strong relationship with water flow. The turbidity levels were especially high when the maximum flow culminated in mid-June.

The fDOM signal is also closely connected to water flow in Målselva (Figure 31, lower panel). 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. The dilution effect was especially evident during the major flood peak in the first part of June.

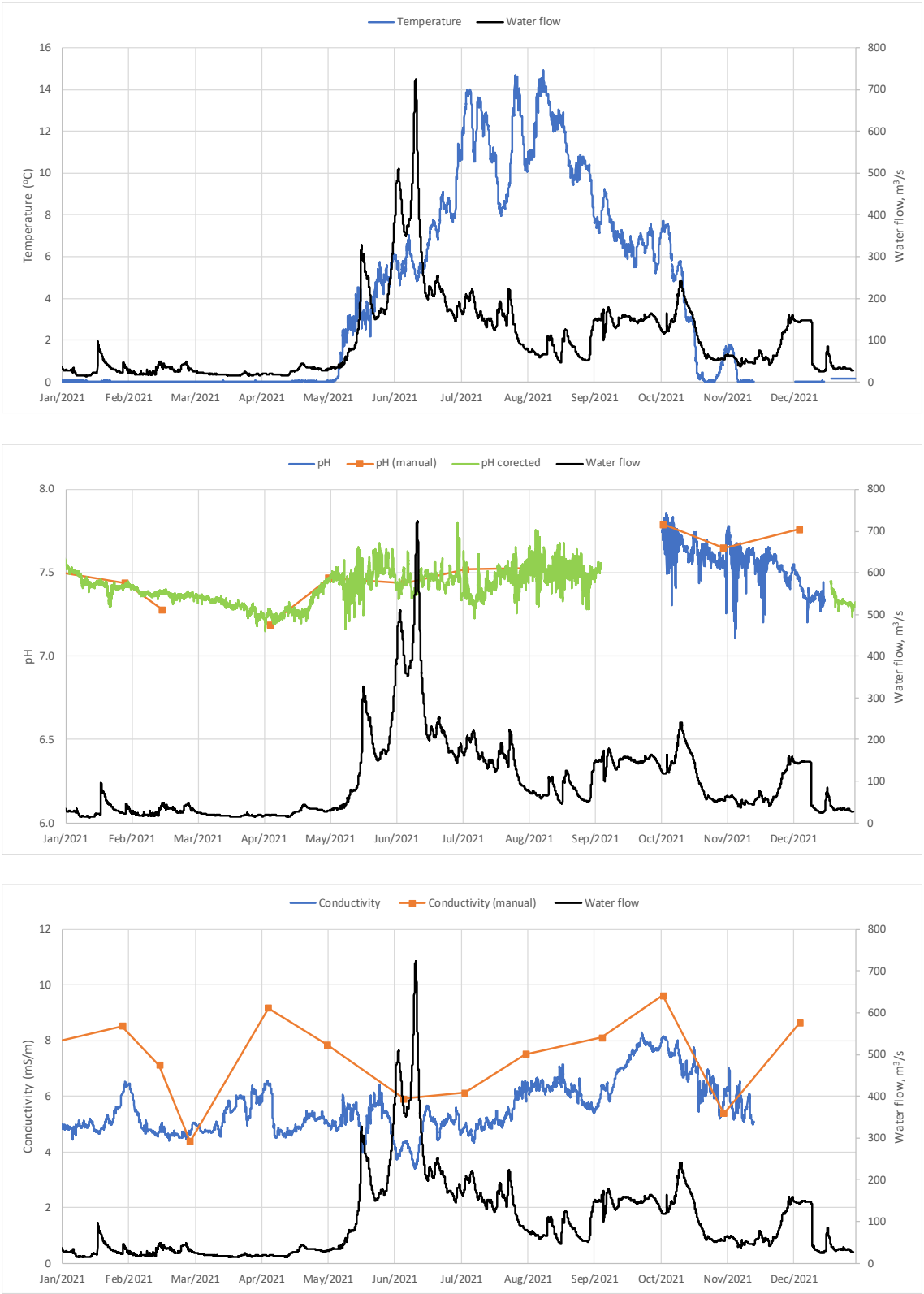

Figure 30. Water temperature (upper panel), pH (middle panel) and conductivity (lower panel) in Målselva in 2021 plotted together with water flow data from NVE's station 196.35.0 Målselvfossen.

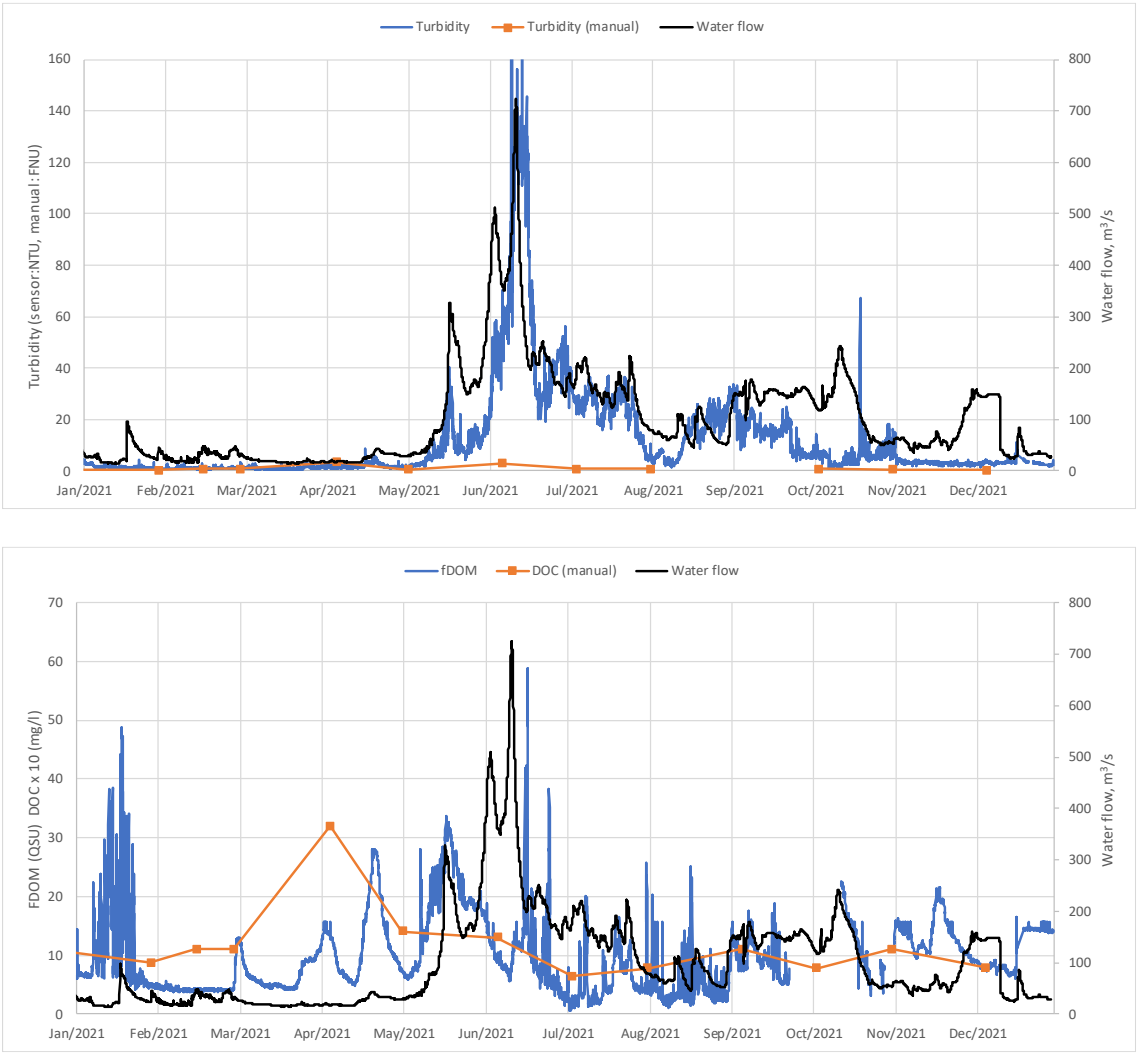

Figure 31. Turbidity (upper panel) and fluorescent dissolved organic matter (fDOM) (lower panel) in Målselva in 2021 plotted together with water flow data from NVE's station 196.35.0 Målselvfossen.

4. References

Allan I, Jenssen MTS, Bæk K, Kaste Ø. 2022. The Norwegian River Monitoring Programme Priority substances and emerging contaminants in selected Norwegian rivers. Norwegian Environment Agency, report M-2140/2021, NIVA report 7688-2022, 50 pp.

Braaten HFV, Gundersen CB, Kaste Ø, Sample JE, Hjermann DØ, Norling MD, Calidonio JLG, Allan I, Nizzetto L. 2020. The Norwegian river monitoring programme - water quality status and trends in 2019. Norwegian Environment Agency, report M-1817, NIVA report 7564, 87 pp.

de Wit HA, Mulder J, Hindar A, Hole L. 2007. Long-term increase in dissolved organic carbon in streamwaters in Norway is response to reduced acid deposition. Environmental Science & Technology 41: 7706-7713.

de Wit, HA, Valinia S, Weyhenmeyer GA, Futter MN, Kortelainen P, Austnes K, Hessen DO, Räike A, Laudon H, Vuorenmaa J. 2016. Current browning of surface waters will be further promoted by wetter climate. Environmental Science & Technology Letters 3(12): 430-435.

Direktoratsguppen vanndirektivet 2018. Klassifisering av miljøtilstand i vann - Økologisk og kjemisk klassifiseringssystem for kystvann, grunnvann, innsjøer og elver. Veileder 02-2018, 222 pp.

Garmo Ø, Skancke LB. 2021. Overvåking av langtransportert forurenset luft og nedbør. Årsrapport – Vannkjemiske effekter 2020. Norwegian Environment Agency, report M-2102, NIVA report 7661, 92 pp.

Grinde L, Heiberg H, Mamen J, Skaland RG, Tajet HTT, Tunheim K. 2022. Været i Norge. Klimatologisk oversikt. Året 2021. Norwegian Meterological Institute, Oslo, Norway.

Gundersen CB, Kaste Ø, Sample JE, Braaten HFV, Selvik JR, Hjermann DØ, Norling MD, Calidonio JLG. 2019. The Norwegian river monitoring programme - water quality status and trends in 2018. Norwegian Environment Agency, report M-1508, NIVA report 7441, 94 pp.

Hindar, A., Garmo, Ø.A., Austnes, K. and Sample, J.E. 2020. Nasjonal innsjøundersøkelse 2019. Norwegian Environment Agency, report M-1876|2020, NIVA report 7530-2020, 86 pp.

Hirsch RM, Slack JR. 1984. A nonparametric trend test for seasonal data with serial dependence. Water Resources Research 20, 727–732.

Hruška J, Krám P, McDowell WH, Oulehle F. 2009. Increased dissolved organic carbon (DOC) in Central Europe streams is driven by reduction in ionic strength rather than climate change or decreasing acidity. Environmental Science and Technology 43: 4320-4326

Kaste Ø, Gundersen CB, Poste A, Sample J, Hjermann DØ. 2022. The Norwegian river monitoring programme 2020 – water quality status and trends. Miljødirektoratet, report M-2139|2021, NIVA report 7738-2022, 72 pp.

Kaste Ø, Skarbøvik E, Greipsland I, Gundersen CB, Austnes K, Skancke LB, Calidonio JLG, Sample J. 2018. The Norwegian river monitoring programme - water quality status and trends 2017. Norwegian Environmental Agency, report M-1168. NIVA report 7313, 101 pp.

Kile MR, Ranneklev SB, Persson J, Myrvold KM, Hjermann DØ. 2022. Elveovervåkingsprogrammet 2021. Klassifisering av økologisk og kjemisk tilstand i norske elver i tråd med vannforskriften. Miljødirektoratet, rapport M-2322 I 2022.

Manceau A, Nagy KL. 2019. Thiols in natural organic matter: Molecular forms, acidity, and reactivity with mercury (II) from First-Principles calculations and high energy-resolution X-ray absorption near-edge structure spectroscopy. ACS Earth and Space Chemistry 3: 2795-2807.

Peuravuori J, Pihlaja K. 1997. Molecular size distribution and spectroscopic properties of aquatic humic substances. Analytica Chimica Acta 337, 133-149.

Poste A, Kaste Ø, Frigstad H, de Wit H, Harvey T, Valestrand L, Deininger A, Bryntesen T, Delpech LM, Christensen G. 2021. The impact of the spring 2020 snowmelt floods on physicochemical conditions in three Norwegian river-fjord-coastal systems. NIVA report 7651, 45 pp.

Ryder E, E. Jennings, De Eyto E, et al. 2012. Temperature quenching of cdom fluorescence sensors: Temporal and spatial variability in the temperature response and a recommended temperature correction equation. Limnol. Oceanogr. Methods 10: 1004-1010.

Skarbøvik E, Stålnacke PG, Kaste Ø, Selvik JR, Tjomsland T, Høgåsen T, Aakerøy PA, Beldring S. 2010. Riverine inputs and direct discharges to Norwegian coastal waters – 2009. Climate and Pollution Agency report TA-2726/2010, NIVA report 6053, 75 pp.

Stålnacke P, Haaland S, Skarbøvik E, Turtumøygard S, Nytrø TE, Selvik JR, Høgåsen T, Tjomsland T, Kaste Ø, Enerstvedt KE. 2009. Revision and assessment of Norwegian RID data 1990-2007. Norwegian Pollution Control Authority (SFT) report TA-2559/2009, Bioforsk Report Vol. 4 No. 138, 20pp.

Weishaar JL, Aiken GR, Bergamaschi BA, Fram MS, Fujii R, Mopper K. 2003. Evaluation of Specific Ultraviolet Absorbance as an Indicator of the Chemical Composition and Reactivity of Dissolved Organic Carbon. Environmental Science & Technology 37: 4702-4708.

Wilson HF, Xenopoulos MA. 2009. Effects of agricultural land use on the composition of fluvial dissolved organic matter. Nature Geoscience 2: 37-41.

5. Appendix A - Methods

5.1 General water quality – sampling and analyses

5.1.1 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.

5.1.2 Chemical parameters – detection limits and analytical methods

The parameters monitored in 2021, including information on methodology and limits of detection (LOD) and quantification (LOQ) are given in Table 9. 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 by the 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).Hg was analysed monthly in 2019-2020 and quarterly (every 3rd month) from 2021.

Table 9. Analytical methods, limits of detection (LOD) and quantification (LOQ)

Parameter	LOQ	Analytical Method
pH	3.5	NS-EN ISO 10523
Alkalinity (mmol/L)	0.03	NS-EN ISO 9963-1
Conductivity (mS/m)	0.1	NS-ISO 7888
Turbidity (FNU)	0.3	NS-EN ISO 7027
Suspended particulate matter (SPM) (mg/L), using the laboratory methods named TSM and STS.	0.1 mg/l when 1 L is filtered (TSM) 0.1 mg/L when 4 L is filtered (STS)	NS 4733 modified (Nuclepore capillary filter with nominal pore width 0.4 µm and diameter 47 mm) NS 4733 modified and NS-EN 872 modified (Whatman GF/C filters)
Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) (mg C/L)	0.1 0.5	NS-EN 1484 modified – UV peroxodisulphate NS-EN 1484 modified – catalytic combustion
Total phosphorus (Tot-P) and particulate phosphorus (PP) (µg P/L)	1 For PP: dep. on vol. filtered	NS 4725 – Peroxodisulphate oxidation method modified (automated)
Orthophosphate (PO4-P) (µg P/L)	1	NS 4724 – Automated molybdate method modified (automated)
Total nitrogen (Tot-N) (µg N/L)	10	NS 4743 and NS-EN ISO 13395 modified
Nitrate (NO_3-N) (µg N/L)	2	NS-EN ISO 10304-1
Chloride (Cl) (mg/L)	0.005	NS-EN ISO 10304-1
Sulphate (SO4) (mg/L)	0.005	NS-EN ISO 10304-1
Ammonium (NH_4-N) (µg N/L)	2	NS-EN ISO 14911
Potassium (K) (mg K/L)	0.005	NS-EN ISO 14911
Magnesium (Mg) (mg Mg/L)	0.01	NS-EN ISO 14911

Sodium (Na) (mg Na/L)	0.01	NS-EN ISO 14911
Particulate Organic Carbon (POC) (µg C/L) and particulate Nitrogen (PN) (µg N/L)	Dep. on blank & vol. filtered	Internal method, combustion at 1800°C
UV-visible absorbance spectrum	n.a.	Internal method (900 nm – 200 nm)
Colour (mg Pt/L)	2	NS-EN ISO 7887
Soluble silicates (SiO2) (µg SiO2/L)	25	NS-EN ISO 16264 modified
Calcium (Ca) (mg/L)	0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Silicone (Si) (mg Si/L)	0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Silver (Ag) (µg Ag/L)	0.0020	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Arsenic (As) (µg As/L)	0.025	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Cadmium (Cd) and total dissolved cadmium (µg Cd/L)	0.0030	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Chromium (Cr) (µg Cr/L)	0.025	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Copper (Cu) (µg Cu/L)	0.040	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Mercury (Hg) and total dissolved mercury (ng Hg/L)	0.3	USEPA 1631 (CVAFS method)
Nickel (Ni) and total dissolved nickel (µg Ni/L)	0.040	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Lead (Pb) and total dissolved lead (µg Pb/L)	0.005	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified
Zinc (Zn) (µg Zn/L)	0.15	NS-EN ISO 17294-1 and NS EN ISO 17294-2 modified

5.2 Priority substances

Water samples were collected four times in 2021 in the five rivers Glomma, Alna, Drammenselva, Numedalslågen and Skienselva.

For information about methodology for sampling and chemical analysis, see Allan et al. (2022).

5.3 Trend analyses and data comparison

Trend analysis has been conducted for air temperature, precipitation, and selected 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 trend analysis are given below. The general trend analysis methodology described is applied also for the weather data.

When monitoring data collected in 2021 is presented, results are compared with the preceding five-year mean (2016-2020). The 2021 data are presented as annual mean (based on monthly values) ± one standard deviation, while 2016-2020 data are presented as five-year mean (based on annual values) ± one standard deviation.

5.3.1 Trend analysis methodology

The Mann-Kendall test (Hirsch and Slack, 1984) has been used to test for monotonic trends (including linear trends; Sen slope) in annual riverine concentrations. Trends are regarded as statistically significant at the 95% significance level ($p < 0.05$, double-sided test).

5.3.2 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 10). The remaining two rivers included as "main rivers" in the former RID programme, Alna and Vosso, did not have enough years with monthly monitoring. 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.

5.3.3 Selection of parameters and time-periods

The water chemical parameters included in the trend analyses were suspended particulate matter (SPM), silica (Si), total organic carbon (TOC), total nitrogen (Tot-N), ammonium (NH_4), nitrate (NO_3), total phosphorus (Tot-P), phosphate (PO_4), 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 1990-2021, while the analyses for metals are only based on short-term (2004-2021) 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 10. 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. A more detailed overview of excluded data from historical records is given in Skarbøvik et al. (2010).

5.4 Sensor monitoring in Storelva and Målselva

In Storelva and Målselva, sensor stations are located at the same spot as the manual sampling sites (Table 1). In Storelva, 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). In Målselva, the sensors are mounted in a rig that is immersed in the river water. 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.

6. Appendix B – Primary data

6.1 Riverine concentrations in 2021

Glomma ved Sarpsfoss Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
21.01.2021	7.12	4.96	4.10	3.56	4.1	4.3	200.0	5	10	6.5	420	8	560	18.3	4.01									
03.02.2021	7.10	5.32	4.60	4.39	3.8	3.7	181.0	5	9	6.4	430	9	610	21.7	4.25	0.01	0.15	0.17	0.01	1.13	2.50	0.74	0.21	1.05
01.03.2021	7.05	5.34	5.60	5.03	3.4	3.5	313.0	5	12	9.3	390	48	650	19.8	4.37									
06.04.2021	6.92	5.54	19.00	17.30	3.7	3.9	453.0	14	23	8.5	570	7	660	54.2	5.15									
03.05.2021	7.15	4.87	3.90	4.47	4.6	4.6	334.0	5	12	7.1	390	19	530	41.8	4.14	0.00	0.15	0.06	0.01	1.31	2.10	0.59	0.12	1.61
18.05.2021	7.14	5.09	12.00	11.20	4.7	4.7	513.0	10	17	19.0	590	8	670	61.9	4.57									
25.05.2021	6.98	3.60	8.00	9.16	5.4	5.6	414.0	8	17	16.0	360	<2	480	48.9	3.79									
07.06.2021	6.92	4.05	2.60	5.42	3.5	3.5	337.0	5	10	9.1	220	3	410	42.1	3.11									
14.06.2021	7.22	4.43	2.70	13.10	2.9	2.9	568.0	8	14	14.0	260	6	440	62.5	3.16									
28.06.2021	7.26	4.59	1.80	5.03	2.9	2.9	364.0	4	8	8.0	260	11	440	31.1	2.94									
06.07.2021	7.20	4.47	1.70	3.74	3.6	3.4	361.0	3	9	7.0	230	10	420	41.4	2.98									
09.08.2021	7.33	4.91	2.40	8.47	3.1	3.0	417.0	11	23	8.1	290	<2	380	57.6	3.45	0.00	0.16	0.07	0.01	1.40	3.30	0.54	0.09	0.89
07.09.2021	7.40	4.23	1.90	0.63	2.7	2.7	512.0	4	8	6.6	160	17	320	40.5	2.53									
04.10.2021	7.09	5.80	23.00	38.90	5.1	4.9	1223.0	43	64	33.0	1130	<2	1300	127.0	6.09	<0.00	0.38	0.96	0.02	2.70	7.00	2.37	1.53	4.05
01.11.2021	7.17	4.81	5.40	7.99	5.4	5.3	678.0	13	18	11.0	410	2	660	73.4	4.78									
06.12.2021	7.27	4.74	1.50	2.98	3.9	3.8	225.0	3	7	6.8	350	20	560	51.6	3.94									
Lower avg.	7.15	4.80	6.26	8.84	3.9	3.9	443.3	9	16	11.0	404	10	568	49.6	3.95	0.00	0.21	0.32	0.01	1.64	3.72	1.06	0.49	1.90
Upper avg..	7.15	4.80	6.26	8.84	3.9	3.9	443.3	9	16	11.0	404	11	568	49.6	3.95	0.00	0.21	0.32	0.01	1.64	3.72	1.06	0.49	1.90
Minimum	6.92	3.60	1.50	0.63	2.7	2.7	181.0	3	7	6.4	160	2	320	18.3	2.53	0.00	0.15	0.06	0.01	1.13	2.10	0.54	0.09	0.89
Maximum	7.40	5.80	23.00	38.90	5.4	5.6	1223.0	43	64	33.0	1130	48	1300	127.0	6.09	0.01	0.38	0.96	0.02	2.70	7.00	2.37	1.53	4.05
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
n	16.00	16.00	16.00	16.00	16.0	16.0	16.0	16	16	16.0	16	16	16	16.0	16.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.14	0.57	6.41	9.07	0.9	0.9	247.5	10	14	6.9	227	12	225	26.1	0.93	0.00	0.11	0.44	0.01	0.72	2.24	0.88	0.70	1.47

Alna Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
20.01.2021	7.86	143.00	7.60	16.00	2.0	1.8	1293.0	46	58	37.0	640	160	1300	81.0	8.64									
02.02.2021	7.90	45.50	5.10	5.00	3.6	3.5	316.0	38	47	20.0	580	295	1200	29.5	8.42	0.01	0.33	0.44	0.03	2.22	8.10	0.90	0.42	1.48
04.03.2021	7.82	47.20	5.70	8.07	3.7	3.6	636.0	45	56	23.0	680	32	1000	52.6	8.40									
07.04.2021	7.85	45.00	7.90	8.93	3.4	3.2	654.0	32	43	24.0	800	19	1100	66.2	6.22									
03.05.2021	8.17	54.60	2.40	4.11	3.4	3.4	658.0	22	41	22.0	390	107	830	91.1	2.12	0.01	0.22	0.03	0.01	1.45	1.50	0.52	0.07	0.63
08.06.2021	8.00	50.60	3.20	4.81	3.6	3.4	634.0	86	110	39.0	1300	280	2200	103.0	6.29									
05.07.2021	7.57	37.70	7.60	13.50	8.6	8.7	1482.0	44	72	49.0	790	<2	1400	161.0	4.91									
02.08.2021	7.89	40.70	4.80	6.77	4.0	3.9	504.0	77	93	31.0	840	59	1200	37.1	6.28	0.01	0.31	0.06	0.01	1.49	8.00	0.62	0.13	2.01
06.09.2021	8.10	38.50	3.20	3.50	3.1	3.1	598.0	59	74	24.0	1400	<2	2500	79.3	5.79									
05.10.2021	7.86	22.40	18.00	37.90	6.7	6.5	1666.0	72	90	44.0	870	<2	1200	151.8	10.50	<0.00	0.39	0.19	0.02	3.95	7.00	0.87	0.42	7.43
02.11.2021	7.92	28.10	10.00	16.10	6.2	6.1	1515.0	49	60	37.0	890	5	1300	129.3	9.05									
06.12.2021	8.08	42.60	1.40	4.94	3.3	3.4	563.0	47	55	22.0	980	210	1400	39.2	7.40									
Lower avg.	7.92	49.66	6.41	10.80	4.3	4.2	876.6	51	67	31.0	847	97	1386	85.1	7.00	0.01	0.31	0.18	0.02	2.28	6.15	0.73	0.26	2.89
Upper avg..	7.92	49.66	6.41	10.80	4.3	4.2	876.6	51	67	31.0	847	98	1386	85.1	7.00	0.01	0.31	0.18	0.02	2.28	6.15	0.73	0.26	2.89
Minimum	7.57	22.40	1.40	3.50	2.0	1.8	316.0	22	41	20.0	390	2	830	29.5	2.12	0.00	0.22	0.03	0.01	1.45	1.50	0.52	0.07	0.63
Maximum	8.17	143.00	18.00	37.90	8.6	8.7	1666.0	86	110	49.0	1400	295	2500	161.0	10.50	0.01	0.39	0.44	0.03	3.95	8.10	0.90	0.42	7.43
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
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.16	30.73	4.46	9.66	1.9	1.9	468.4	19	22	9.9	284	112	483	44.2	2.23	0.00	0.07	0.19	0.01	1.17	3.14	0.19	0.19	3.08

Drammenselva Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
21.01.2021	7.07	3.78	0.59	0.82	3.6	3.6	113.0	1	3	2.5	270	4	380	11.5	3.25									
02.02.2021	7.09	3.97	0.78	0.96	3.4	3.2	137.0	2	5	3.3	290	<2	460	14.5	3.32	<0.00	0.14	0.06	0.01	0.59	1.80	0.45	0.17	1.08
02.03.2021	7.01	3.78	2.10	1.89	2.9	2.9	159.0	2	5	4.8	300	6	400	8.1	3.14									
06.04.2021	7.01	4.14	2.20	2.42	3.5	3.6	260.0	3	5	4.8	390	4	480	27.4	3.20									
03.05.2021	7.09	3.63	0.94	4.37	3.6	3.7	224.0	2	5	3.3	270	<2	350	21.6	2.98	<0.00	0.11	0.05	0.01	0.62	1.60	0.40	0.10	1.03
18.05.2021	6.88	3.95	3.90	6.51	4.1	4.0	413.0	5	9	8.2	470	<2	540	39.1	3.62									
25.05.2021	6.99	3.90	5.00	6.69	4.1	4.2	355.0	5	12	9.5	490	<2	560	35.3	3.60									
07.06.2021	7.05	3.56	2.10	2.48	3.7	3.6	240.0	3	5	5.1	250	21	340	25.1	3.11									
14.06.2021	7.10	3.75	1.30	1.98	3.5	3.5	304.0	3	6	4.5	260	17	390	28.9	3.08									
28.06.2021	6.97	3.67	0.86	1.49	3.3	3.2	267.0	1	5	4.0	180	8	350	21.7	2.67									
05.07.2021	7.00	4.06	0.98	1.74	3.5	3.4	415.0	<1	5	5.0	180	13	350	45.9	2.70									
02.08.2021	7.14	3.49	1.20	2.34	3.6	3.5	292.0	2	6	4.8	170	16	310	29.8	2.67	<0.00	0.19	0.07	0.01	0.69	4.70	0.48	0.13	1.38
06.09.2021	7.20	3.19	0.99	0.79	3.1	3.0	366.0	2	6	3.6	120	24	270	35.6	2.36									
04.10.2021	7.10	4.35	4.10	7.63	5.3	5.2	914.0	8	16	13.0	660	3	800	52.8	3.76	<0.00	0.24	0.23	0.01	1.09	2.90	0.59	0.63	2.29
01.11.2021	7.07	3.98	13.00	17.50	4.0	3.8	916.0	19	31	23.0	390	<2	630	94.9	4.45									
06.12.2021	6.97	3.40	0.82	1.31	3.4	3.4	156.0	2	4	2.9	230	10	390	15.8	3.29									
Lower avg.	7.05	3.79	2.55	3.81	3.7	3.6	345.7	4	8	6.4	308	8	438	31.7	3.20	0.00	0.17	0.10	0.01	0.75	2.75	0.48	0.26	1.45
Upper avg..	7.05	3.79	2.55	3.81	3.7	3.6	345.7	4	8	6.4	308	8	438	31.7	3.20	0.00	0.17	0.10	0.01	0.75	2.75	0.48	0.26	1.45
Minimum	6.88	3.19	0.59	0.79	2.9	2.9	113.0	1	3	2.5	120	2	270	8.1	2.36	0.00	0.11	0.05	0.01	0.59	1.60	0.40	0.10	1.03
Maximum	7.20	4.35	13.00	17.50	5.3	5.2	916.0	19	31	23.0	660	24	800	94.9	4.45	0.00	0.24	0.23	0.01	1.09	4.70	0.59	0.63	2.29
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	16.00	16.00	16.00	16.00	16.0	16.0	16.0	16	16	16.0	16	16	16	16.0	16.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.08	0.30	3.09	4.27	0.5	0.5	240.9	4	7	5.2	141	7	137	20.8	0.51	0.00	0.06	0.08	0.00	0.23	1.42	0.08	0.25	0.58

Numedalslågen

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
20.01.2021	6.72	2.86	1.80	3.25	3.4	3.1	389.0	4	8	6.5	210	100	440	46.5	3.57									
04.02.2021	6.80	2.89	1.40	2.15	3.0	2.9	650.0	3	6	5.1	180	97	480	82.0	3.42	0.00	0.14	0.40	0.03	1.25	7.50	0.39	0.13	1.16
01.03.2021	6.67	3.62	2.90	6.61	4.6	3.8	956.0	6	11	8.5	280	160	840	140.0	4.07									
06.04.2021	6.69	2.87	2.80	4.56	5.1	5.1	351.0	4	8	4.8	270	8	420	39.6	3.92									
03.05.2021	6.76	2.42	1.30	1.88	4.3	4.4	294.0	3	6	3.9	150	4	340	23.6	3.42	<0.00	0.13	0.14	0.01	0.57	2.60	0.28	0.12	1.54
07.06.2021	6.79	2.72	1.30	2.28	3.9	4.0	217.0	3	6	4.9	180	38	310	18.7	2.91									
05.07.2021	6.87	2.48	0.86	2.07	3.0	3.0	256.0	2	5	4.0	74	20	230	19.7	2.50									
02.08.2021	6.70	2.27	1.20	2.49	7.7	7.5	283.0	3	10	7.2	68	12	280	27.7	2.71	<0.00	0.22	0.12	0.02	0.82	7.70	0.39	0.12	3.22
06.09.2021	7.00	2.35	1.10	0.99	3.1	3.0	514.0	2	6	3.6	69	22	210	18.3	2.44									
04.10.2021	6.54	2.97	11.00	43.40	9.2	8.9	1336.0	32	43	36.0	370	<2	650	110.0	5.12	<0.00	0.26	0.19	0.02	0.81	6.70	0.36	0.15	5.75
01.11.2021	6.80	4.22	13.00	28.00	6.6	6.4	1736.0	24	40	33.0	540	23	870	142.3	5.88									
06.12.2021	6.91	2.67	0.77	1.34	3.6	3.6	190.0	2	5	3.5	120	43	330	18.4	3.87									
Lower avg.	6.77	2.86	3.29	8.25	4.8	4.6	597.7	7	13	10.1	209	44	450	57.2	3.65	0.00	0.19	0.21	0.02	0.86	6.12	0.35	0.13	2.92
Upper avg..	6.77	2.86	3.29	8.25	4.8	4.6	597.7	7	13	10.1	209	44	450	57.2	3.65	0.00	0.19	0.21	0.02	0.86	6.12	0.35	0.13	2.92
Minimum	6.54	2.27	0.77	0.99	3.0	2.9	190.0	2	5	3.5	68	2	210	18.3	2.44	0.00	0.13	0.12	0.01	0.57	2.60	0.28	0.12	1.16
Maximum	7.00	4.22	13.00	43.40	9.2	8.9	1736.0	32	43	36.0	540	160	870	142.3	5.88	0.00	0.26	0.40	0.03	1.25	7.70	0.39	0.15	5.75
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.12	0.56	4.15	13.32	2.0	2.0	495.7	10	14	11.5	140	49	224	48.5	1.03	0.00	0.06	0.13	0.01	0.28	2.39	0.05	0.01	2.09

Skienselva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
25.01.2021	6.67	2.02	0.72	0.78	3.2	3.3	76.8	1	3	2.6	150	<2	350	5.1	2.54									1.13
04.02.2021	6.64	1.93	0.66	0.82	2.9	2.8	117.0	1	3	2.8	150	<2	240	8.7	2.44	<0.00	0.10	0.06	0.01	0.39	1.80	0.21	0.08	
01.03.2021	6.63	1.90	0.72	0.80	3.0	3.0	119.0	1	3	2.5	150	<2	250	4.8	2.54									
06.04.2021	6.63	1.93	0.76	0.81	3.0	2.9	127.0	<1	3	2.4	190	<2	300	16.3	2.51									
03.05.2021	6.56	1.89	0.47	0.58	2.9	2.8	165.0	1	3	2.1	130	<2	230	16.6	2.37	<0.00	0.09	0.02	0.01	0.36	2.90	0.18	0.06	1.18
07.06.2021	6.71	1.84	0.57	0.77	2.9	2.9	203.0	1	3	2.7	110	6	230	13.6	2.29									
05.07.2021	6.74	1.72	0.31	0.71	2.6	2.6	257.0	<1	3	2.0	78	13	190	24.4	2.04									
02.08.2021	6.73	1.72	0.69	0.79	2.5	2.4	217.0	<1	4	2.5	74	17	160	23.7	1.86	<0.00	0.10	0.01	0.01	0.41	3.60	0.21	0.06	0.96
06.09.2021	6.80	1.63	0.46	1.29	2.3	2.2	402.0	2	3	2.2	71	23	170	12.9	1.87									
04.10.2021	6.69	1.89	1.40	4.33	3.1	3.0	324.0	4	6	5.3	160	3	260	31.3	2.46	<0.00	0.10	0.04	0.01	0.39	3.20	0.11	0.07	1.54
01.11.2021	6.81	2.37	1.40	1.87	3.7	3.6	460.0	3	7	5.4	160	11	340	60.8	2.61									
06.12.2021	6.85	1.87	0.51	0.58	2.9	2.9	152.0	1	3	2.5	130	11	250	9.7	2.48									
Lower avg.	6.70	1.89	0.72	1.18	2.9	2.9	218.3	1	4	2.9	129	7	248	19.0	2.33	0.00	0.10	0.03	0.01	0.39	2.88	0.18	0.07	1.20
Upper avg..	6.70	1.89	0.72	1.18	2.9	2.9	218.3	2	4	2.9	129	8	248	19.0	2.33	0.00	0.10	0.03	0.01	0.39	2.88	0.18	0.07	1.20
Minimum	6.56	1.63	0.31	0.58	2.3	2.2	76.8	1	3	2.0	71	2	160	4.8	1.86	0.00	0.09	0.01	0.01	0.36	1.80	0.11	0.06	0.96
Maximum	6.85	2.37	1.40	4.33	3.7	3.6	460.0	4	7	5.4	190	23	350	60.8	2.61	0.00	0.10	0.06	0.01	0.41	3.60	0.21	0.08	1.54
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.09	0.19	0.34	1.05	0.4	0.4	120.9	1	1	1.2	39	7	60	15.4	0.26	0.00	0.00	0.02	0.00	0.02	0.77	0.05	0.01	0.24

Storelva (Vegårdselva)

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
25.01.2021	6.27	2.73	1.50	1.92	5.6	5.6	268.0	2	7	5.6	140	34	480	23.7	2.89									
08.02.2021	6.38	2.69	0.77	1.19	5.2	5.3	277.0	<1	6	4.1	150	31	380	23.3	3.08	<0.00	0.22	0.37	0.04	0.61	7.30	0.47	0.20	2.06
01.03.2021	6.29	3.03	1.90	2.38	4.9	4.9	303.0	3	8	6.9	180	40	430	25.7	3.19									
06.04.2021	6.36	2.31	0.92	1.48	4.6	4.4	389.0	2	9	7.0	160	24	360	32.7	2.85									
03.05.2021	6.48	2.50	0.92	1.77	4.3	4.2	391.0	2	6	4.4	150	<2	300	43.8	2.35	0.01	0.22	0.22	0.03	0.48	5.30	0.37	0.14	1.72
07.06.2021	6.51	2.40	1.10	1.61	5.1	4.9	394.0	2	6	5.5	64	13	260	34.1	1.22									
05.07.2021	6.60	2.77	1.20	2.09	4.5	4.5	484.0	2	8	6.0	82	8	320	29.0	1.01									
02.08.2021	6.67	2.95	1.70	3.16	5.5	5.2	475.0	2	11	7.5	120	6	370	61.0	1.56	<0.00	0.32	0.29	0.02	0.86	7.70	0.45	0.22	1.67
06.09.2021	6.80	2.55	0.87	1.67	4.3	4.3	708.0	2	7	5.1	15	2	230	48.4	1.25									
04.10.2021	6.30	3.85	4.40	6.67	7.9	7.6	815.0	6	15	11.0	180	<2	460	64.5	3.02	<0.00	0.32	0.71	0.05	1.04	8.60	0.67	0.37	3.23
01.11.2021	6.53	3.16	3.20	5.05	6.2	6.1	718.0	6	14	8.8	140	36	470	75.5	3.20									
13.12.2021	6.33	3.07	1.30	1.70	5.5	5.6	240.0	2	6	4.0	210	51	480	24.3	3.30									
Lower avg.	6.46	2.83	1.65	2.56	5.3	5.2	455.2	3	9	6.3	133	20	378	40.5	2.41	0.00	0.27	0.40	0.04	0.75	7.22	0.49	0.23	2.17
Upper avg..	6.46	2.83	1.65	2.56	5.3	5.2	455.2	3	9	6.3	133	21	378	40.5	2.41	0.00	0.27	0.40	0.04	0.75	7.22	0.49	0.23	2.17
Minimum	6.27	2.31	0.77	1.19	4.3	4.2	240.0	1	6	4.0	15	2	230	23.3	1.01	0.00	0.22	0.22	0.02	0.48	5.30	0.37	0.14	1.67
Maximum	6.80	3.85	4.40	6.67	7.9	7.6	815.0	6	15	11.0	210	51	480	75.5	3.30	0.01	0.32	0.71	0.05	1.04	8.60	0.67	0.37	3.23
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.17	0.42	1.09	1.66	1.0	1.0	193.6	2	3	2.1	55	17	88	18.1	0.89	0.00	0.06	0.22	0.01	0.25	1.39	0.13	0.10	0.73

Otra Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
25.01.2021	6.05	1.63	0.47	0.42	3.2	3.1	202.0	<1	4	3.2	82	15	200	12.5	1.87									
08.02.2021	6.18	1.29	0.42	0.86	2.4	2.5	191.0	<1	3	3.5	71	20	160	18.0	1.82	<0.00	0.11	0.15	0.01	0.38	2.10	0.36	0.10	1.14
01.03.2021	6.06	1.62	0.51	0.87	2.7	2.7	222.0	<1	4	2.7	100	11	280	13.4	1.86									
06.04.2021	6.27	1.41	0.52	1.01	2.7	2.6	305.0	<1	3	2.8	90	6	230	29.3	1.62									
03.05.2021	6.53	1.46	0.33	0.59	2.1	2.1	233.0	<1	2	2.0	62	<2	120	19.2	1.45	<0.00	0.07	0.10	0.01	0.39	1.80	0.20	0.07	1.02
07.06.2021	6.29	1.32	0.48	0.95	2.7	2.5	290.0	1	3	3.0	51	13	150	22.9	1.33									
05.07.2021	6.38	1.11	0.44	1.00	2.4	2.3	182.0	<1	3	2.3	26	5	130	20.1	0.94									
02.08.2021	6.29	1.13	0.44	0.95	2.2	2.1	339.0	<1	3	2.7	24	5	290	26.9	0.80	0.01	0.11	0.14	0.01	1.51	6.50	0.28	0.05	0.92
06.09.2021	6.50	1.14	0.75	1.14	2.1	2.0	400.0	2	4	2.8	25	16	130	39.2	0.94									
04.10.2021	6.13	1.86	1.00	2.18	5.3	4.8	701.0	2	7	6.0	88	18	280	112.0	1.78	<0.00	0.21	0.57	0.03	0.55	4.20	0.31	0.14	2.29
01.11.2021	6.24	1.83	0.72	1.76	4.1	4.1	514.0	2	5	4.1	85	19	300	64.2	2.06									
06.12.2021	6.26	1.16	0.62	0.58	2.4	2.4	175.0	<1	3	2.0	55	14	180	24.3	1.88									
Lower avg.	6.27	1.41	0.56	1.03	2.9	2.8	312.8	1	4	3.1	63	12	204	33.5	1.53	0.00	0.13	0.24	0.01	0.71	3.65	0.29	0.09	1.34
Upper avg..	6.27	1.41	0.56	1.03	2.9	2.8	312.8	1	4	3.1	63	12	204	33.5	1.53	0.00	0.13	0.24	0.01	0.71	3.65	0.29	0.09	1.34
Minimum	6.05	1.11	0.33	0.42	2.1	2.0	175.0	1	2	2.0	24	2	120	12.5	0.80	0.00	0.07	0.10	0.01	0.38	1.80	0.20	0.05	0.92
Maximum	6.53	1.86	1.00	2.18	5.3	4.8	701.0	2	7	6.0	100	20	300	112.0	2.06	0.01	0.21	0.57	0.03	1.51	6.50	0.36	0.14	2.29
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.15	0.27	0.19	0.50	0.9	0.9	158.9	0	1	1.1	27	6	69	28.4	0.43	0.00	0.06	0.22	0.01	0.54	2.18	0.07	0.04	0.64

Bjerkreimselva

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
01.02.2021	6.30	3.27	0.33	0.45	1.5	1.5	129.0	1	4	3.4	360	<2	450	12.4	1.79									
01.03.2021	6.33	3.02	0.52	0.63	1.5	1.5	229.0	1	5	3.7	310	<2	390	14.6	1.46	<0.00	0.09	0.17	0.02	0.24	2.40	0.13	0.05	0.97
08.03.2021	6.56	3.27	0.90	<0.49	1.9	1.5	147.0	1	4	2.9	430	<2	520	21.4	1.66									
06.04.2021	6.41	3.39	0.32	0.43	1.4	1.3	164.0	<1	3	2.7	400	<2	410	19.4	1.63									
03.05.2021	6.57	3.20	<0.30	<0.50	1.6	1.5	223.0	1	3	2.3	370	<2	460	27.7	1.17	<0.00	0.08	0.10	0.01	0.18	1.50	0.10	0.05	0.84
07.06.2021	6.64	2.77	<0.30	0.51	1.4	1.4	171.0	<1	3	2.6	200	13	370	20.5	1.06									
05.07.2021	6.56	2.78	0.33	0.68	1.6	1.6	343.0	<1	4	4.0	220	9	340	27.6	1.09									
02.08.2021	6.69	2.98	0.35	0.85	1.7	1.0	297.0	<1	5	3.8	210	2	320	25.3	1.24	<0.00	0.09	0.12	0.01	0.30	5.90	0.14	0.05	0.93
06.09.2021	6.80	2.93	0.45	0.62	1.6	1.7	481.0	1	5	3.0	290	15	360	27.8	1.15									
04.10.2021	6.48	2.66	<0.30	0.51	1.9	1.8	321.0	2	5	3.5	280	17	370	38.9	1.40	<0.00	0.07	0.15	0.01	0.15	1.60	0.04	0.04	0.84
01.11.2021	6.45	3.17	0.59	1.01	2.0	2.0	422.0	2	6	4.8	280	6	440	54.6	1.62									
07.12.2021	6.53	3.30	0.44	0.54	1.6	1.5	159.0	1	4	2.8	410	7	550	14.9	1.94									
Lower avg.	6.53	3.06	0.35	0.52	1.6	1.5	257.2	1	4	3.3	313	6	415	25.4	1.43	0.00	0.08	0.13	0.01	0.22	2.85	0.10	0.05	0.90
Upper avg..	6.53	3.06	0.43	0.60	1.6	1.5	257.2	1	4	3.3	313	7	415	25.4	1.43	0.00	0.08	0.13	0.01	0.22	2.85	0.10	0.05	0.90
Minimum	6.30	2.66	0.30	0.43	1.4	1.0	129.0	1	3	2.3	200	2	320	12.4	1.06	0.00	0.07	0.10	0.01	0.15	1.50	0.04	0.04	0.84
Maximum	6.80	3.39	0.90	1.01	2.0	2.0	481.0	2	6	4.8	430	17	550	54.6	1.94	0.00	0.09	0.17	0.02	0.30	5.90	0.14	0.05	0.97
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.14	0.24	0.18	0.17	0.2	0.2	115.4	0	1	0.7	80	6	71	11.8	0.29	0.00	0.01	0.03	0.00	0.07	2.07	0.04	0.01	0.07

Orreelva Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
20.01.2021	7.36	17.50	3.30	17.70	9.7	6.4	910.0	52	110	120.0	1300	<2	2100	118.0	4.81									
08.02.2021	7.41	17.00	2.20	3.77	7.2	6.0	577.0	27	49	25.0	1160	<2	1800	80.4	4.34	<0.00	0.25	0.16	0.01	1.70	4.20	0.99	0.26	1.40
01.03.2021	7.48	17.40	4.90	6.54	6.7	5.2	1809.0	28	73	53.0	1100	34	1800	264.0	2.55									
06.04.2021	7.40	17.10	27.00	55.20	16.5	5.0	6424.0	87	170	200.0	840	<2	1600	841.0	1.52									
03.05.2021	7.54	17.70	1.60	9.85	7.2	5.2	1736.0	11	54	24.0	520	6	1200	266.0	0.21	<0.00	0.42	0.67	0.03	2.10	5.50	1.20	0.34	<0.30
07.06.2021	7.74	19.10	3.20	5.38	8.2	6.1	2347.0	12	69	47.0	12	67	650	309.0	0.56									
05.07.2021	7.66	19.90	3.80	5.52	6.0	5.7	1963.0	5	37	18.0	<2	<2	630	166.0	1.06									
02.08.2021	7.75	20.40	14.00	8.21	9.1	6.5	4491.0	12	100	79.0	<2	<2	730	589.0	2.65	<0.00	0.44	0.60	0.01	2.36	19.30	1.28	0.33	0.92
06.09.2021	7.70	19.80	11.00	15.20	6.7	5.2	1964.0	15	46	39.0	<2	110	550	257.0	4.30									
04.10.2021	7.68	20.20	11.00	31.90	11.2	5.6	3807.0	58	160	70.0	57	<2	1000	523.6	3.99	0.00	1.08	3.19	0.10	3.74	19.90	2.57	1.11	2.44
01.11.2021	7.53	19.00	15.00	23.60	9.1	6.1	4446.0	47	110	94.0	690	26	1500	573.0	3.07									
06.12.2021	7.85	19.00	9.70	49.00	11.6	5.7	4160.0	75	160	97.0	1050	13	2100	559.0	3.96									
Lower avg.	7.59	18.68	8.89	19.32	9.1	5.7	2886.2	36	95	72.2	561	21	1305	378.8	2.75	0.00	0.55	1.15	0.04	2.48	12.22	1.51	0.51	1.19
Upper avg..	7.59	18.68	8.89	19.32	9.1	5.7	2886.2	36	95	72.2	561	22	1305	378.8	2.75	0.00	0.55	1.15	0.04	2.48	12.22	1.51	0.51	1.27
Minimum	7.36	17.00	1.60	3.77	6.0	5.0	577.0	5	37	18.0	2	2	550	80.4	0.21	0.00	0.25	0.16	0.01	1.70	4.20	0.99	0.26	0.30
Maximum	7.85	20.40	27.00	55.20	16.5	6.5	6424.0	87	170	200.0	1300	110	2100	841.0	4.81	0.00	1.08	3.19	0.10	3.74	19.90	2.57	1.11	2.44
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.16	1.27	7.41	17.50	2.9	0.5	1750.6	27	48	51.7	524	34	585	232.9	1.59	0.00	0.37	1.38	0.05	0.89	8.54	0.72	0.40	0.90

Vikedalselva Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
25.01.2021	6.40	2.37	0.31	0.62	1.3	1.2	155.0	1	3	4.6	230	10	310	14.7	1.17									
15.02.2021	6.51	3.23	0.31	0.44	0.9	0.9	113.0	<1	3	2.1	400	6	440	13.2	1.95	<0.00	0.23	0.05	0.01	0.55	3.50	0.33	0.05	0.65
01.03.2021	6.28	1.94	0.41	1.00	1.1	1.1	141.0	<1	3	2.9	200	<2	250	3.3	0.96									
06.04.2021	6.45	2.31	0.40	0.62	1.2	1.1	221.0	<1	4	3.4	280	20	320	27.0	0.98									
03.05.2021	6.60	2.48	<0.30	0.43	1.1	1.0	186.0	1	3	2.1	240	<2	260	15.7	1.01	<0.00	0.19	0.05	0.01	0.29	0.99	0.21	0.03	0.90
07.06.2021	6.64	1.84	<0.30	0.36	1.0	0.9	101.0	1	2	2.0	110	6	150	13.2	0.75									
06.07.2021	6.73	2.74	1.50	3.47	2.6	2.5	727.0	8	21	16.0	230	260	740	82.0	0.89									
02.08.2021	6.60	1.86	0.35	0.69	1.4	1.3	225.0	<1	3	2.6	73	<2	250	24.9	0.61	<0.00	0.27	0.06	0.00	0.32	4.90	0.20	0.04	0.71
06.09.2021	7.00	2.90	0.36	0.53	1.1	1.1	572.0	2	4	2.1	170	6	220	16.0	0.89									
04.10.2021	6.41	1.99	0.37	0.61	2.0	1.9	457.0	2	4	3.3	170	9	280	30.5	0.83	<0.00	0.21	0.14	0.01	0.35	1.30	0.24	0.07	1.20
01.11.2021	6.34	1.85	0.37	0.81	1.9	1.9	329.0	1	4	2.7	150	6	270	54.3	0.97									
06.12.2021	6.59	2.60	<0.30	0.36	1.2	1.2	149.0	1	3	1.7	320	10	420	9.8	1.58									
Lower avg.	6.55	2.34	0.36	0.83	1.4	1.3	281.3	1	5	3.8	214	28	326	25.4	1.05	0.00	0.23	0.08	0.01	0.38	2.67	0.24	0.05	0.86
Upper avg..	6.55	2.34	0.44	0.83	1.4	1.3	281.3	2	5	3.8	214	28	326	25.4	1.05	0.00	0.23	0.08	0.01	0.38	2.67	0.24	0.05	0.86
Minimum	6.28	1.84	0.30	0.36	0.9	0.9	101.0	1	2	1.7	73	2	150	3.3	0.61	0.00	0.19	0.05	0.00	0.29	0.99	0.20	0.03	0.65
Maximum	7.00	3.23	1.50	3.47	2.6	2.5	727.0	8	21	16.0	400	260	740	82.0	1.95	0.00	0.27	0.14	0.01	0.55	4.90	0.33	0.07	1.20
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.20	0.46	0.34	0.85	0.5	0.5	201.4	2	5	3.9	91	73	153	22.1	0.37	0.00	0.03	0.04	0.00	0.12	1.86	0.06	0.01	0.25

Vosso (Bolstadelvi)

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
25.01.2021	6.28	1.25	<0.30	<0.25	0.8	0.8	100.0	<1	1	1.5	88	<2	120	8.0	0.89									
08.02.2021	6.43	1.26	<0.30	<0.49	0.6	0.7	68.3	<1	1	1.5	83	<2	97	6.5	0.76	<0.00	0.04	0.01	<0.00	0.21	0.58	0.23	0.03	0.72
01.03.2021	6.16	1.50	0.73	0.85	1.3	1.3	143.0	2	5	3.7	160	<2	210	12.8	1.17									
06.04.2021	6.34	1.56	0.59	0.74	1.3	1.4	198.0	<1	4	4.7	200	<2	160	25.5	1.18									
03.05.2021	6.53	1.61	0.31	0.45	1.2	1.1	172.0	1	3	2.4	170	<2	200	28.9	1.13	<0.00	0.05	0.03	0.01	0.36	0.87	0.29	0.05	0.97
07.06.2021	6.46	1.16	0.37	<0.50	0.9	0.9	137.0	<1	2	2.0	72	9	110	13.9	0.99									
05.07.2021	6.58	0.95	<0.30	<0.50	0.8	0.8	271.0	<1	2	2.0	40	3	75	23.2	0.72									
02.08.2021	6.49	0.95	0.38	0.57	0.8	0.7	200.0	<1	2	2.5	31	15	71	25.1	0.54	<0.00	0.06	0.02	0.00	0.26	1.50	0.20	0.03	0.60
13.09.2021	6.50	1.07	0.33	0.43	0.7	0.7	542.0	1	3	1.9	42	8	54	24.9	0.56									
05.10.2021	6.52	1.18	<0.30	0.95	1.3	1.3	238.0	1	3	2.2	80	9	95	20.1	0.91	<0.00	0.07	0.03	<0.00	0.25	0.41	0.20	0.05	1.53
01.11.2021	6.47	1.30	0.52	0.73	1.8	1.7	306.0	1	4	3.1	110	6	220	39.8	1.28									
06.12.2021	6.57	1.38	<0.30	0.41	1.4	1.5	122.0	1	4	2.3	110	6	210	13.2	1.27									
Lower avg.	6.44	1.26	0.27	0.43	1.1	1.1	208.1	1	3	2.5	99	5	135	20.2	0.95	0.00	0.05	0.02	0.00	0.27	0.84	0.23	0.04	0.96
Upper avg..	6.44	1.26	0.39	0.57	1.1	1.1	208.1	1	3	2.5	99	6	135	20.2	0.95	0.00	0.05	0.02	0.00	0.27	0.84	0.23	0.04	0.96
Minimum	6.16	0.95	0.30	0.25	0.6	0.7	68.3	1	1	1.5	31	2	54	6.5	0.54	0.00	0.04	0.01	0.00	0.21	0.41	0.20	0.03	0.60
Maximum	6.58	1.61	0.73	0.95	1.8	1.7	542.0	2	5	4.7	200	15	220	39.8	1.28	0.00	0.07	0.03	0.01	0.36	1.50	0.29	0.05	1.53
More than 70% >LOD	yes	yes	no	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.13	0.22	0.14	0.20	0.4	0.4	126.3	0	1	0.9	54	4	61	9.7	0.26	0.00	0.01	0.01	0.00	0.06	0.48	0.04	0.01	0.41

Nausta Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
20.01.2021	6.41	2.37	0.32	<0.49	1.2	1.2	83.4	2	3	1.8	230	<2	310	5.4	2.37									
22.02.2021	6.16	1.57	1.00	8.40	2.3	2.4	624.0	9	16	13.0	170	<2	280	47.8	1.83	<0.00	0.04	0.19	0.01	0.32	1.70	0.21	0.12	1.53
03.03.2021	5.98	1.22	1.50	1.19	1.9	1.9	157.0	2	4	2.8	87	<2	160	9.8	1.14									
13.04.2021	6.28	1.87	<0.30	0.30	1.6	1.5	100.0	1	2	1.7	130	<2	180	16.2	1.40									
03.05.2021	6.32	1.84	0.31	1.55	1.7	1.7	191.0	2	4	4.0	55	<2	97	32.6	1.17	<0.00	<0.03	0.05	0.00	0.17	0.90	0.10	0.05	0.97
01.06.2021	6.18	1.10	<0.30	0.41	0.8	0.8	118.0	1	2	1.8	18	<2	54	13.4	0.63									
05.07.2021	6.47	0.94	<0.30	0.68	1.0	0.9	263.0	<1	3	3.0	3	4	44	24.9	0.19									
02.08.2021	6.58	1.17	<0.30	0.35	1.1	1.1	249.0	<1	3	2.5	2	<2	79	25.2	0.13	<0.00	<0.03	0.03	<0.00	0.18	4.40	0.07	<0.03	0.67
07.09.2021	6.80	1.51	0.50	0.77	1.0	1.0	406.0	1	3	2.1	67	5	120	18.2	0.61									
04.10.2021	6.12	1.79	0.75	2.04	5.1	4.8	576.0	8	15	8.0	61	<2	270	48.0	1.58	<0.00	0.05	0.20	0.01	0.48	1.90	0.23	0.12	3.11
02.11.2021	6.18	1.12	<0.30	0.51	1.9	1.9	145.0	3	4	2.6	68	<2	170	27.7	1.17									
07.12.2021	6.43	1.72	<0.30	0.51	1.2	1.3	81.1	2	3	1.2	180	3	220	9.3	1.84									
Lower avg.	6.33	1.52	0.37	1.39	1.7	1.7	249.5	3	5	3.7	89	1	165	23.2	1.17	0.00	0.02	0.12	0.01	0.29	2.23	0.15	0.07	1.57
Upper avg..	6.33	1.52	0.52	1.43	1.7	1.7	249.5	3	5	3.7	89	2	165	23.2	1.17	0.00	0.04	0.12	0.01	0.29	2.23	0.15	0.08	1.57
Minimum	5.98	0.94	0.30	0.30	0.8	0.8	81.1	1	2	1.2	2	2	44	5.4	0.13	0.00	0.03	0.03	0.00	0.17	0.90	0.07	0.03	0.67
Maximum	6.80	2.37	1.50	8.40	5.1	4.8	624.0	9	16	13.0	230	5	310	48.0	2.37	0.00	0.05	0.20	0.01	0.48	4.40	0.23	0.12	3.11
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.23	0.42	0.38	2.26	1.2	1.1	188.3	3	5	3.4	73	1	90	14.1	0.69	0.00	0.01	0.09	0.00	0.15	1.51	0.08	0.05	1.09

Driva Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
09.02.2021	7.02	3.24	<0.30	<0.25	1.1	1.0	70.2	<1	<1	1.1	120	2	150	6.2	2.71									
22.02.2021	7.05	3.29	<0.30	0.51	1.0	1.1	38.1	<1	1	1.6	150	6	180	6.6	2.70	<0.00	0.04	<0.01	<0.00	0.42	0.22	0.15	0.13	0.32
01.03.2021	7.05	4.89	0.59	0.71	1.9	1.9	176.0	4	9	4.8	340	<2	480	15.8	3.59									
06.04.2021	7.12	5.35	0.35	0.65	2.2	2.2	138.0	<1	2	2.1	370	<2	470	18.5	3.12									
03.05.2021	7.08	4.09	<0.30	0.86	1.5	1.4	171.0	1	2	2.0	190	<2	240	17.7	2.36	<0.00	0.04	0.01	<0.00	0.57	0.31	0.21	0.14	0.42
31.05.2021	6.79	2.17	1.70	28.00	1.8	1.8	446.0	17	23	21.0	40	<2	110	38.6	2.35									
05.07.2021	6.99	2.19	<0.30	1.31	0.6	0.6	317.0	<1	3	3.0	36	<2	65	15.3	1.79									
02.08.2021	7.07	2.91	<0.30	0.50	0.7	0.7	125.0	<1	2	1.0	64	<2	80	17.7	2.41	<0.00	0.03	0.01	<0.00	0.41	3.90	0.11	0.10	0.40
06.09.2021	7.10	2.57	0.35	0.48	0.9	0.9	106.0	1	2	2.0	57	3	86	10.2	2.53									
04.10.2021	7.19	2.91	1.20	6.33	1.8	1.7	610.0	4	9	5.8	39	6	120	67.0	3.09	<0.00	0.04	0.06	<0.00	0.86	0.59	0.27	0.36	2.24
02.11.2021	7.11	2.90	<0.30	0.99	1.6	1.6	280.0	1	3	1.7	82	3	180	32.9	3.18									
06.12.2021	7.15	3.59	<0.30	<0.33	1.1	1.1	124.0	<1	2	1.1	160	6	250	10.3	3.32									
Lower avg.	7.06	3.34	0.35	3.36	1.4	1.3	216.8	2	5	3.9	137	2	201	21.4	2.76	0.00	0.04	0.02	0.00	0.56	1.25	0.18	0.18	0.85
Upper avg..	7.06	3.34	0.52	3.41	1.4	1.3	216.8	3	5	3.9	137	3	201	21.4	2.76	0.00	0.04	0.02	0.00	0.56	1.25	0.18	0.18	0.85
Minimum	6.79	2.17	0.30	0.25	0.6	0.6	38.1	1	1	1.0	36	2	65	6.2	1.79	0.00	0.03	0.01	0.00	0.41	0.22	0.11	0.10	0.32
Maximum	7.19	5.35	1.70	28.00	2.2	2.2	610.0	17	23	21.0	370	6	480	67.0	3.59	0.00	0.04	0.06	0.00	0.86	3.90	0.27	0.36	2.24
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.10	1.00	0.45	7.92	0.5	0.5	168.9	5	6	5.6	114	2	141	17.3	0.51	0.00	0.01	0.03	0.00	0.21	1.77	0.07	0.12	0.93

Orkla Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
26.01.2021	7.42	6.45	0.96	4.60	1.8	1.8	134.0	3	4	2.7	110	5	230	12.6	3.35									
09.02.2021	7.47	6.60	0.65	3.29	1.6	1.7	96.5	3	4	4.3	120	3	200	7.9	3.35	<0.00	0.08	0.02	0.02	1.54	5.40	1.00	0.41	0.53
01.03.2021	7.36	7.43	4.20	7.96	4.2	4.1	441.0	15	20	14.0	270	<2	460	42.4	4.16									
06.04.2021	7.46	8.77	1.20	1.37	4.4	4.4	232.0	1	4	3.1	280	<2	420	23.8	3.46									
03.05.2021	7.49	9.02	0.53	1.53	3.2	3.1	215.0	2	3	2.4	350	<2	420	33.5	3.24	<0.00	0.09	0.02	0.07	7.92	17.30	0.98	0.25	0.94
07.06.2021	7.19	4.01	2.20	1.03	2.5	2.3	806.0	8	16	16.0	35	3	240	62.5	1.97									
01.07.2021	7.56	6.31	<0.30	0.79	2.2	2.1	308.0	<1	3	3.0	150	4	290	36.0	2.05									
02.08.2021	7.53	6.04	1.10	1.13	2.4	2.3	240.0	1	4	3.0	150	<2	220	27.7	2.15	<0.00	0.10	0.03	0.01	1.77	6.10	0.83	0.31	0.95
06.09.2021	7.50	5.49	0.53	0.62	3.8	3.8	427.0	<1	4	2.4	110	2	230	23.3	2.61									
04.10.2021	7.64	8.45	<0.30	0.50	2.6	2.5	209.0	1	3	2.6	280	4	320	23.0	3.45	<0.00	0.09	<0.01	0.03	3.61	6.90	0.59	0.14	1.41
01.11.2021	7.36	5.34	0.42	1.34	3.9	3.9	360.0	1	4	2.2	180	<2	350	35.8	3.22									
06.12.2021	7.42	6.52	0.37	0.68	2.4	2.3	129.0	1	3	2.1	190	10	340	11.8	3.62									
Lower avg.	7.45	6.70	1.01	2.07	2.9	2.9	299.8	3	6	4.8	185	3	310	28.4	3.05	0.00	0.09	0.02	0.03	3.71	8.93	0.85	0.28	0.96
Upper avg..	7.45	6.70	1.06	2.07	2.9	2.9	299.8	3	6	4.8	185	3	310	28.4	3.05	0.00	0.09	0.02	0.03	3.71	8.93	0.85	0.28	0.96
Minimum	7.19	4.01	0.30	0.50	1.6	1.7	96.5	1	3	2.1	35	2	200	7.9	1.97	0.00	0.08	0.01	0.01	1.54	5.40	0.59	0.14	0.53
Maximum	7.64	9.02	4.20	7.96	4.4	4.4	806.0	15	20	16.0	350	10	460	62.5	4.16	0.00	0.10	0.03	0.07	7.92	17.30	1.00	0.41	1.41
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.11	1.49	1.13	2.22	1.0	1.0	194.9	4	6	4.8	92	2	89	15.1	0.69	0.00	0.01	0.01	0.03	2.96	5.62	0.19	0.11	0.36

Nidelva (Tr.heim)

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
08.02.2021	7.16	3.64	<0.30	0.93	2.4	2.4	88.0	1	4	<0.1	96	<2	240	13.9	2.01									
17.02.2021	7.07	4.00	<0.30	0.54	2.2	2.3	48.2	<1	2	1.5	100	<2	170	8.0	1.97	<0.00	0.06	0.01	<0.00	0.58	0.44	0.58	0.14	0.75
02.03.2021	7.41	8.35	60.00	59.20	4.1	3.9	1034.0	44	65	44.0	380	<2	560	98.7	12.90									
06.04.2021	7.13	4.03	1.30	1.58	3.4	3.3	138.0	2	4	2.3	130	<2	230	17.3	2.13									
03.05.2021	7.21	5.00	0.43	0.92	2.5	2.5	138.0	2	3	2.3	110	<2	180	21.1	2.03	<0.00	0.07	0.01	<0.00	0.61	0.41	0.65	0.16	0.81
07.06.2021	7.10	3.82	0.37	0.81	2.3	2.4	138.0	1	3	2.4	72	6	170	11.5	1.98									
05.07.2021	7.09	3.00	0.43	1.16	2.2	2.1	310.0	<1	3	3.0	25	7	130	34.8	1.63									
02.08.2021	7.24	3.60	0.41	0.79	2.2	2.2	238.0	<1	4	3.0	41	9	110	29.6	1.66	<0.00	0.06	0.02	<0.00	0.59	4.60	0.58	0.13	0.65
06.09.2021	7.30	3.78	0.66	1.26	2.8	2.8	390.0	2	4	3.1	63	2	160	15.9	1.90									
07.10.2021	7.14	3.16	<0.30	0.58	3.3	3.2	205.0	2	3	2.4	62	8	130	22.2	1.88	<0.00	0.07	0.02	<0.00	0.66	0.65	0.70	0.15	1.57
01.11.2021	7.25	4.21	0.45	0.72	2.8	2.8	137.0	2	4	2.7	42	3	210	23.0	2.15									
05.12.2021	7.02	3.33	0.57	1.17	2.7	2.6	148.0	1	3	2.0	91	3	200	14.6	2.24									
Lower avg.	7.18	4.16	5.38	5.81	2.7	2.7	251.0	5	8	5.7	101	3	208	25.9	2.87	0.00	0.06	0.01	0.00	0.61	1.52	0.63	0.15	0.95
Upper avg..	7.18	4.16	5.46	5.81	2.7	2.7	251.0	5	8	5.7	101	4	208	25.9	2.87	0.00	0.06	0.01	0.00	0.61	1.52	0.63	0.15	0.95
Minimum	7.02	3.00	0.30	0.54	2.2	2.1	48.2	1	2	0.1	25	2	110	8.0	1.63	0.00	0.06	0.01	0.00	0.58	0.41	0.58	0.13	0.65
Maximum	7.41	8.35	60.00	59.20	4.1	3.9	1034.0	44	65	44.0	380	9	560	98.7	12.90	0.00	0.07	0.02	0.00	0.66	4.60	0.70	0.16	1.57
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.11	1.42	17.18	16.82	0.6	0.5	264.2	12	18	12.1	93	3	118	24.1	3.16	0.00	0.01	0.01	0.00	0.04	2.05	0.06	0.01	0.42

Vefsna Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
01.02.2021	7.78	10.70	<0.30	<0.33	1.1	1.1	20.9	<1	<1	1.5	150	3	230	2.7	2.39									
17.02.2021	7.85	12.90	<0.30	0.82	2.0	1.4	85.0	1	2	1.0	230	13	280	5.9	3.55	<0.00	0.17	0.02	<0.00	0.53	1.40	0.32	0.09	<0.30
10.03.2021	7.44	6.90	0.36	0.42	1.7	1.7	57.3	<1	<1	1.2	65	<2	98	9.8	1.73									
10.04.2021	7.55	8.11	0.31	0.42	1.7	1.7	96.4	<1	2	1.3	47	<2	100	14.8	1.60									
04.05.2021	7.58	8.62	<0.30	1.47	1.8	1.8	115.0	<1	1	1.0	2	<2	110	11.7	1.24	<0.00	0.09	0.02	<0.00	0.29	<0.15	0.27	0.06	0.65
01.06.2021	7.30	3.90	0.41	1.58	1.3	1.3	118.0	1	3	2.8	18	<2	64	19.3	1.17									
05.07.2021	7.30	2.88	0.35	0.57	0.9	0.9	174.0	<1	2	2.0	9	3	51	25.8	0.70									
09.08.2021	7.50	4.59	0.43	<0.33	0.7	0.7	222.0	<1	2	1.4	23	4	68	30.2	0.83	<0.00	0.12	0.02	<0.00	0.22	1.30	0.18	0.05	0.41
01.09.2021	7.60	4.98	0.27	0.40	1.0	0.9	314.0	1	2	1.0	13	3	58	3.5	0.98									
03.10.2021	7.64	5.57	<0.30	0.38	1.3	1.2	216.0	1	1	1.0	20	3	79	26.9	1.33	<0.00	0.10	0.01	<0.00	0.16	<0.15	0.13	0.05	1.00
09.11.2021	7.53	6.25	<0.30	<0.29	1.7	1.7	92.9	<1	2	0.9	41	3	150	17.3	1.83									
07.12.2021	7.74	10.10	1.80	26.30	1.7	1.6	300.0	11	16	11.0	100	7	250	22.0	2.64									
Lower avg.	7.57	7.12	0.33	2.70	1.4	1.3	151.0	1	3	2.2	60	3	128	15.8	1.67	0.00	0.12	0.02	0.00	0.30	0.68	0.23	0.06	0.52
Upper avg..	7.57	7.12	0.45	2.78	1.4	1.3	151.0	2	3	2.2	60	4	128	15.8	1.67	0.00	0.12	0.02	0.00	0.30	0.75	0.23	0.06	0.59
Minimum	7.30	2.88	0.27	0.29	0.7	0.7	20.9	1	1	0.9	2	2	51	2.7	0.70	0.00	0.09	0.01	0.00	0.16	0.15	0.13	0.05	0.30
Maximum	7.85	12.90	1.80	26.30	2.0	1.8	314.0	11	16	11.0	230	13	280	30.2	3.55	0.00	0.17	0.02	0.00	0.53	1.40	0.32	0.09	1.00
More than 70% >LOD	yes	yes	no	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	no	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.17	3.03	0.43	7.42	0.4	0.4	94.1	3	4	2.8	69	3	81	9.3	0.84	0.00	0.04	0.01	0.00	0.16	0.69	0.09	0.02	0.31

Målselva v/gml E6-brua

Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
29.01.2021	7.44	8.53	<0.30	<0.32	0.8	0.9	27.8	<1	<1	0.6	72	14	130	3.0	3.22									
15.02.2021	7.28	7.12	0.75	1.32	1.1	1.1	484.0	<1	5	4.8	86	35	200	78.4	2.66	<0.00	0.04	0.13	0.01	2.40	11.30	0.67	2.57	0.34
06.04.2021	7.19	9.18	3.30	6.25	6.0	3.2	1672.0	16			100	67	770	195.5	2.36									
03.05.2021	7.47	7.86	0.60	1.65	1.4	1.4	158.0	4	11	2.2	72	32	430	23.5	2.50	<0.00	0.03	0.02	<0.00	0.51	0.26	0.38	0.10	0.74
07.06.2021	7.44	5.91	3.00	8.20	1.3	1.3	231.0	7	8	9.2	26	<2	85	20.6	1.97									
05.07.2021	7.52	6.13	0.73	2.71	0.7	0.6	183.0	2	3	3.0	18	<2	44	24.0	1.70									
02.08.2021	7.53	7.51	0.64	1.05	0.8	0.8	150.0	<1	2	2.2	23	<2	71	13.0	1.89	<0.00	0.05	0.17	0.01				0.20	0.31
06.09.2021	7.70	8.10	0.61	0.88	1.1	1.1	276.0	1	4	1.7	19	3	60	14.5	2.18									
04.10.2021	7.79	9.62	0.78	4.73	0.8	0.8	251.0	2	3	2.0	42	2	87	29.2	2.45	<0.00	0.04	0.04	<0.00	0.39	0.15	0.29	0.15	1.05
01.11.2021	7.65	7.65	0.40	1.52	1.0	1.1	129.0	1	3	1.6	44	4	580	21.4	2.70									
06.12.2021	7.76	8.65	<0.30	0.22	0.8	0.8	59.2	<1	1	1.0	57	5	110	6.1	3.23									
Lower avg.	7.52	7.84	0.98	2.59	1.4	1.2	329.2	3	4	2.8	51	15	233	39.0	2.44	0.00	0.04	0.09	0.01	1.10	3.90	0.45	0.76	0.61
Upper avg..	7.52	7.84	1.04	2.62	1.4	1.2	329.2	3	4	2.8	51	15	233	39.0	2.44	0.00	0.04	0.09	0.01	1.10	3.90	0.45	0.76	0.61
Minimum	7.19	5.91	0.30	0.22	0.7	0.6	27.8	1	1	0.6	18	2	44	3.0	1.70	0.00	0.03	0.02	0.00	0.39	0.15	0.29	0.10	0.31
Maximum	7.79	9.62	3.30	8.20	6.0	3.2	1672.0	16	11	9.2	100	67	770	195.5	3.23	0.00	0.05	0.17	0.01	2.40	11.30	0.67	2.57	1.05
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	11.00	11.00	11.00	11.00	11.0	11.0	11.0	11	10	10.0	11	11	11	11.0	11.00	4.00	4.00	4.00	4.00	3.00	3.00	3.00	4.00	4.00
St.dev	0.19	1.16	1.06	2.63	1.5	0.7	461.8	5	3	2.5	29	21	247	55.6	0.50	0.00	0.01	0.07	0.01	1.13	6.41	0.20	1.21	0.35

Altaelva Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
24.01.2021	7.32	7.13	0.34	1.07	3.2	3.2	76.1	1	4	1.3	53	<2	160	6.7	7.18									
08.02.2021	7.41	7.29	<0.30	2.13	2.9	2.9	75.2	2	4	2.1	58	<2	180	7.4	6.80	<0.00	0.10	0.02	<0.00	0.45	0.18	0.25	0.26	0.60
02.03.2021	7.38	7.45	0.56	1.55	3.0	2.9	82.1	2	4	1.7	59	<2	160	8.0	7.19									
07.04.2021	7.35	7.72	0.33	1.05	2.7	2.7	102.0	1	3	1.9	59	<2	130	9.7	6.31									
03.05.2021	7.57	8.94	0.37	1.05	2.7	2.6	185.0	2	4	2.5	58	<2	130	20.6	7.26	<0.00	0.07	0.01	<0.00	0.38	<0.15	0.20	0.24	0.70
07.06.2021	7.23	6.31	14.00	255.00	3.6	3.4	444.0	37	65	29.0	38	<2	220	38.1	14.10									
07.07.2021	7.29	5.49	0.68	3.33	3.1	3.1	260.0	1	6	5.0	25	<2	160	25.1	3.39									
09.08.2021	7.56	6.73	1.90	3.06	2.8	2.8	319.0	3	7	5.1	38	<2	100	47.5	4.14	<0.00	0.13	0.03	<0.00	0.75	1.40	0.41	0.42	0.79
06.09.2021	7.60	6.36	2.10	5.03	2.6	2.6	395.0	5	7	4.5	12	2	78	16.6	4.05									
11.10.2021	7.41	6.64	<0.30	1.27	3.0	3.1	162.0	2	4	2.7	41	2	110	26.0	3.94	<0.00	0.09	0.01	<0.00	0.46	<0.15	0.25	0.17	1.21
01.11.2021	7.51	6.72	<0.30	0.84	2.7	2.7	129.0	1	4	2.3	34	2	140	15.9	4.71									
05.12.2021	7.43	8.45	0.59	1.45	2.8	2.9	84.6	5	8	1.8	75	3	210	11.6	5.62									
Lower avg.	7.42	7.10	1.74	23.07	2.9	2.9	192.8	5	10	5.0	46	1	148	19.4	6.22	0.00	0.10	0.02	0.00	0.51	0.39	0.28	0.27	0.82
Upper avg..	7.42	7.10	1.81	23.07	2.9	2.9	192.8	5	10	5.0	46	2	148	19.4	6.22	0.00	0.10	0.02	0.00	0.51	0.47	0.28	0.27	0.82
Minimum	7.23	5.49	0.30	0.84	2.6	2.6	75.2	1	3	1.3	12	2	78	6.7	3.39	0.00	0.07	0.01	0.00	0.38	0.15	0.20	0.17	0.60
Maximum	7.60	8.94	14.00	255.00	3.6	3.4	444.0	37	65	29.0	75	3	220	47.5	14.10	0.00	0.13	0.03	0.00	0.75	1.40	0.41	0.42	1.21
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	no	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.12	0.95	3.89	73.05	0.3	0.3	131.1	10	17	7.7	18	0	42	12.9	2.86	0.00	0.02	0.01	0.00	0.16	0.62	0.09	0.11	0.27

Tanaelva Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
25.01.2021	7.13	6.16	<0.30	0.45	2.1	2.1	86.8	<1	2	2.2	72	33	430	11.1	12.10									
10.02.2021	7.11	6.18	<0.30	0.44	1.9	2.0	102.0	1	3	1.8	88	8	210	10.9	11.70	<0.00	0.03	0.01	<0.00	0.50	1.40	0.33	0.30	0.40
01.03.2021	7.24	6.74	0.50	0.51	1.8	1.9	228.0	<1	3	3.3	100	7	210	27.4	11.90									
07.04.2021	7.16	6.67	0.34	1.12	1.6	1.7	125.0	<1	3	2.0	91	14	290	16.3	10.90									
03.05.2021	7.42	6.14	0.31	0.81	2.4	2.4	261.0	1	4	2.9	18	<2	150	42.6	9.51	<0.00	0.03	0.02	<0.00	0.47	0.99	0.36	0.26	0.81
07.06.2021	6.98	2.71	0.66	3.45	4.0	4.1	310.0	3	6	4.5	4	<2	170	28.9	4.06									
05.07.2021	7.22	4.49	<0.30	0.51	2.3	2.2	206.0	<1	3	3.0	8	<2	100	18.8	4.92									
02.08.2021	7.38	4.82	0.48	0.86	3.6	3.6	274.0	<1	5	3.6	<2	<2	84	31.7	5.25	<0.00	0.06	0.01	<0.00	0.42	4.40	0.37	0.22	1.06
06.09.2021	7.50	4.59	0.54	0.64	2.4	2.3	336.0	2	4	2.4	8	4	110	15.2	5.91									
04.10.2021	7.39	4.85	0.73	0.84	3.0	3.0	341.0	4	6	4.2	9	3	95	42.0	7.52	<0.00	0.05	0.03	<0.00	0.41	0.30	0.38	0.47	1.56
01.11.2021	7.42	6.24	0.55	1.13	3.6	3.6	218.0	2	5	2.9	25	<2	150	29.3	9.90									
06.12.2021	7.28	5.59	0.45	0.68	2.9	2.9	88.5	<1	3	2.0	47	<2	150	12.2	10.50									
Lower avg.	7.27	5.43	0.38	0.95	2.6	2.6	214.7	1	4	2.9	39	6	179	23.9	8.68	0.00	0.04	0.02	0.00	0.45	1.77	0.36	0.31	0.96
Upper avg..	7.27	5.43	0.46	0.95	2.6	2.6	214.7	2	4	2.9	39	7	179	23.9	8.68	0.00	0.04	0.02	0.00	0.45	1.77	0.36	0.31	0.96
Minimum	6.98	2.71	0.30	0.44	1.6	1.7	86.8	1	2	1.8	2	2	84	10.9	4.06	0.00	0.03	0.01	0.00	0.41	0.30	0.33	0.22	0.40
Maximum	7.50	6.74	0.73	3.45	4.0	4.1	341.0	4	6	4.5	100	33	430	42.6	12.10	0.00	0.06	0.03	0.00	0.50	4.40	0.38	0.47	1.56
More than 70% >LOD	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.16	1.18	0.15	0.82	0.8	0.8	94.7	1	1	0.9	38	9	99	11.4	2.98	0.00	0.02	0.01	0.00	0.04	1.81	0.02	0.11	0.49

Pasvikelva Date	pH	KOND	TURB860	SPM	TOC	DOC	Part. C	PO4-P	TOTP	Tot. Part. P	NO3-N	NH4-N	TOTN	Tot. Part. N	SiO2	Ag	As	Pb	Cd	Cu	Zn	Ni	Cr	Hg
DD.MM.YYYY	[]	[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]
24.01.2021	7.00	3.25	<0.30	<0.25	3.0	3.2	81.9	<1	2	1.7	49	3	400	9.6	5.88									
14.02.2021	7.04	3.16	<0.30	<0.29	2.6	2.7	52.5	<1	2	1.6	64	<2	150	10.8	5.61	<0.00	0.05	<0.01	<0.00	0.40	0.22	0.67	0.12	0.38
02.03.2021	7.10	3.16	<0.30	<0.33	2.6	2.7	81.3	<1	2	0.3	64	<2	150	8.4	5.72									
05.04.2021	6.98	3.31	<0.30	0.68	2.1	2.2	85.7	<1	4	1.9	130	10	270	11.7	2.71									
03.05.2021	7.01	2.75	2.60	1.27	2.6	2.6	769.0	2	7	8.7	15	6	110	78.3	4.36	<0.00	0.06	0.07	0.00	1.20	1.20	1.37	0.12	0.76
06.06.2021	7.18	4.03	0.61	1.51	3.8	3.7	288.0	2	6	4.9	9	6	320	30.6	4.71									
05.07.2021	6.81	3.48	0.36	1.10	3.8	3.8	303.0	<1	4	4.0	<2	<2	120	38.7	3.38									
01.08.2021	7.17	3.36	0.60	0.65	3.3	3.3	260.0	<1	6	4.0	<2	3	140	9.8	4.27	<0.00	0.11	0.01	0.00	1.23	1.50	6.12	0.13	0.56
05.09.2021	7.30	3.37	0.73	0.82	3.6	3.6	358.0	2	6	3.7	<2	2	130	27.3	4.59									
03.10.2021	7.23	3.27	0.34	0.98	3.6	3.5	247.0	3	4	4.1	5	2	89	27.0	4.87	<0.00	0.07	<0.01	<0.00	0.76	<0.15	3.56	0.14	1.32
02.11.2021	7.11	3.67	0.63	0.69	3.2	3.2	190.0	<1	4	2.2	14	5	130	24.2	5.29									
07.12.2021	7.12	3.25	<0.30	<0.33	3.1	3.1	89.5	1	3	2.1	45	10	150	10.9	5.81									
Lower avg.	7.09	3.34	0.49	0.64	3.1	3.1	233.8	1	4	3.3	33	4	180	23.9	4.77	0.00	0.07	0.02	0.00	0.90	0.73	2.93	0.13	0.76
Upper avg..	7.09	3.34	0.61	0.74	3.1	3.1	233.8	1	4	3.3	33	4	180	23.9	4.77	0.00	0.07	0.02	0.00	0.90	0.77	2.93	0.13	0.76
Minimum	6.81	2.75	0.30	0.25	2.1	2.2	52.5	1	2	0.3	2	2	89	8.4	2.71	0.00	0.05	0.01	0.00	0.40	0.15	0.67	0.12	0.38
Maximum	7.30	4.03	2.60	1.51	3.8	3.8	769.0	3	7	8.7	130	10	400	78.3	5.88	0.00	0.11	0.07	0.00	1.23	1.50	6.12	0.14	1.32
More than 70% >LOD	yes	yes	no	no	yes	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	no	yes	no	no	yes	yes	yes	yes	yes
n	12.00	12.00	12.00	12.00	12.0	12.0	12.0	12	12	12.0	12	12	12	12.0	12.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
St.dev	0.13	0.31	0.65	0.41	0.5	0.5	198.7	1	2	2.2	39	3	96	19.9	0.99	0.00	0.03	0.03	0.00	0.40	0.68	2.46	0.01	0.41

6.2 Priority substances

Metals

StationName	SampleDate	Cd (filtered)	Hg (filtered)	Ni (filtered)	Pb (filtered)
		µg/l	ng/l	µg/l	µg/l
Glomma	03/02/2021	0.007	< 0.3	0.56	0.055
Glomma	03/05/2021	0.010	1.01	0.58	0.075
Glomma	09/08/2021	0.005	0.68	0.58	0.087
Glomma	04/10/2021	0.007	1.66	0.97	0.115
Alna	02/02/2021	0.016	< 0.3	0.64	0.106
Alna	03/05/2021	0.012	0.57	0.5	0.023
Alna	02/08/2021	0.010	0.71	0.57	0.065
Alna	05/10/2021	0.016	3	0.88	0.186
Drammenselva	02/02/2021	0.009	< 0.3	0.44	0.024
Drammenselva	03/05/2021	0.007	0.98	0.38	0.026
Drammenselva	02/08/2021	0.004		0.4	0.025
Drammenselva	04/10/2021	0.008	1.46	0.45	0.057
Numedalslågen	04/02/2021	0.017	0.65	0.31	0.142
Numedalslågen	03/05/2021	0.009	1.5	0.31	0.067
Numedalslågen	02/08/2021	0.016	3.16	0.39	0.125
Numedalslågen	04/10/2021	0.025	3.34	0.38	0.194
Skienselva	25/01/2021		0.91		
Skienselva	04/02/2021	0.007		0.19	0.021
Skienselva	03/05/2021	0.007	1.08	0.19	0.016
Skienselva	02/08/2021	0.006		0.19	0.011
Skienselva	04/10/2021	0.005	1.15	0.15	0.051

Polycyclic Aromatic Hydrocarbons (PAH)

		Acenaphthene	Acenaphthylene	Benzo[a]anthracene	Benzo[a]pyrene	Benzo[b,j]fluoranthene	Benzo[ghi]perylene	Benzo[k]fluoranthene	Chrysene	Dibenzo[ac/ah]anthracene	Fluoranthene	Fluorene	Phenanthrene	Anthracene	Indeno[1,2,3-cd]pyrene	Naphthalene	Pyrene
StationName	SampleDate	ng/L	ng/L	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/l	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Glomma	03/02/2021	0.5	0.6	< 0.1	< 0.1	0.1	< 0.1	0.2	0.3	< 0.1	0.7	0.6	1	<0.1	<0.1	6.6	0.6
Glomma	01/05/2021																
Glomma	09/08/2021	< 0.3	0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	0.4	0.3	0.9	<0.1	<0.2	<2	0.2
Glomma	04/10/2021	0.4	0.2	0.2	0.4	0.6	0.3	0.3	0.2	< 0.2	0.9	0.3	1.4	<0.1	0.3	<2	0.6
Alna	02/02/2021	13	2.5	0.9	0.5	0.8	0.7	0.7	1.6	< 0.1	4.3	9.2	5	0.9	0.4	28	5.4
Alna	03/05/2021	7.1	0.9	0.4	0.3	0.4	0.5	0.4	1.3	< 0.1	2.2	3.6	2.1	0.3	0.3	5.2	3.2
Alna	02/08/2021	5	0.7	1.4	1.8	2.6	1.7	0.8	1.2	0.3	6.2	2.8	5.8	1.7	1.1	2.5	7.5
Alna	05/10/2021	2.9	0.7	6	8.3	9.7	6.4	3.9	4.2	1	16	2.7	10	4	4.8	3.7	16
Drammenselva	02/02/2021	0.2	0.5	0.1	< 0.1	0.2	0.2	0.2	0.4	< 0.1	0.8	0.4	0.9	<0.1	0.1	4.1	0.6
Drammenselva	03/05/2021	< 0.2	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	0.2	< 0.1	0.3	0.2	0.3	<0.1	<0.1	1	0.2
Drammenselva	02/08/2021	< 0.3	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	0.4	< 0.2	< 0.3	<0.1	<0.2	<2	0.2
Drammenselva	04/10/2021	< 0.3	< 0.1	0.2	0.4	1	0.4	0.4	0.3	< 0.2	0.8	0.3	0.9	<0.1	0.5	<2	0.6
Numedalslågen	04/02/2021	0.2	0.3	< 0.1	< 0.1	0.1	< 0.1	0.1	0.3	< 0.1	0.5	0.4	0.6	<0.1	<0.1	2.2	0.4
Numedalslågen	03/05/2021	0.3	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	0.2	< 0.1	0.3	0.3	0.4	<0.1	<0.1	1.2	0.2
Numedalslågen	02/08/2021	< 0.3	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	0.4	0.3	1	<0.1	<0.2	<2	0.2
Numedalslågen	04/10/2021	< 0.3	< 0.1	0.2	0.4	0.5	0.3	< 0.2	0.2	< 0.2	0.6	< 0.2	0.6	<0.1	0.2	<2	0.5
Skienselva	04/02/2021	< 0.2	0.3	0.1	< 0.1	0.2	0.1	0.2	0.3	< 0.1	0.6	0.3	1.2	<0.1	<0.1	<0.6	0.4
Skienselva	03/05/2021	< 0.2	< 0.1	0.1	< 0.1	0.2	0.1	0.2	0.3	< 0.1	0.6	0.2	0.4	<0.1	<0.1	2.1	0.3
Skienselva	02/08/2021	< 0.3	< 0.1	< 0.1	< 0.2	< 0.2	< 0.2	< 0.2	< 0.1	< 0.2	0.3	< 0.2	< 0.3	<0.1	<0.2	<2	0.1
Skienselva	04/10/2021	< 0.3	< 0.1	< 0.1	< 0.2	0.3	< 0.2	< 0.2	< 0.1	< 0.2	0.3	< 0.2	< 0.3	<0.1	<0.2	<2	0.2

Other priority substances

		QCB	HCB	a-HCH	b-HCH	g-HCH	SCCP	MCCP	4-iso-nonylphenol	4-n-nonylphenol	4-tert-octylphenol	Chlorfenvinfos	Cybutryne	DEHP
StationName	SampleDate	ng/L	ng/l	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Glomma	03/02/2021	< 0.01	< 0.01	0.016	< 0.1	0.027	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	122
Glomma	01/05/2021						< 100	< 100	< 100	< 10	< 10			
Glomma	09/08/2021	< 0.01	< 0.01	0.016	< 0.1	0.066	< 100	< 200	< 100	< 10	< 10	< 0.2	< 0.2	1.9
Glomma	04/10/2021	< 0.01	0.015	0.016	< 0.1	0.059	< 100	< 100	< 100	< 10	< 10	< 0.2	0.39	67
Alna	02/02/2021	0.018	0.072	0.014	< 0.1	0.017	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	38
Alna	03/05/2021	0.014	0.028	0.011	< 0.1	0.012	300	< 100	< 100	< 10	< 10	< 0.2	< 0.2	30
Alna	02/08/2021	0.011	0.04	0.014	< 0.1	0.035	< 100	< 200	< 100	< 10	< 10	< 0.2	< 0.2	4.4
Alna	05/10/2021	0.031	0.11	0.016	< 0.1	0.033	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	2.8
Drammenselva	02/02/2021	< 0.01	0.011	0.016	< 0.1	0.023	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	66
Drammenselva	03/05/2021	< 0.01	< 0.01	0.012	< 0.1	0.012	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	12
Drammenselva	02/08/2021	< 0.01	< 0.01	0.013	< 0.1	0.018	< 100	< 300	< 100	< 10	< 10	< 0.2	< 0.2	58
Drammenselva	04/10/2021	< 0.01	0.018	< 0.01	< 0.1	0.024	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	114
Numedalslågen	04/02/2021	< 0.01	< 0.01	0.019	< 0.1	0.033	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	353
Numedalslågen	03/05/2021	< 0.01	< 0.01	< 0.01	< 0.1	< 0.01	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	11
Numedalslågen	02/08/2021	< 0.01	< 0.01	0.016	< 0.1	0.053	< 100	< 500	< 100	< 10	< 10	< 0.2	< 0.2	18
Numedalslågen	04/10/2021	< 0.01	< 0.01	0.013	< 0.1	0.023	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	100
Skienselva	04/02/2021	< 0.01	0.01	0.017	< 0.1	0.024	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	14
Skienselva	03/05/2021	< 0.01	0.01	0.015	< 0.1	< 0.01	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	10
Skienselva	02/08/2021	< 0.01	< 0.01	0.018	< 0.1	0.028	< 100	< 400	< 100	< 10	< 10	< 0.2	< 0.2	11
Skienselva	04/10/2021	< 0.01	0.01	0.018	< 0.1	0.026	< 100	< 100	< 100	< 10	< 10	< 0.2	< 0.2	9.1

NIVA: Norway´s leading centre of competence in aquatic environmentes

The Norwegian Institute for Water Research (NIVA) is Norway's leading institute for fundamental and applied research on marine and freshwaters. Our research comprises a wide array of environmental, climatic and resource-related fields. NIVA's world-class expertise is multidisciplinary with a broad scientific scope. We combine research, monitoring, evaluation, problem-solving and advisory services at international, national and local levels.

Norwegian Institute for Water Research

Økernveien 94 • NO-0579 Oslo, Norway
Telephone: +47 22 18 51 00
www.niva.no • post@niva.no