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Monitoring of long-range transported air pollutants in Norway

Annual Report 2025

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Main office
NILU
P.O. Box 100
2027 Kjeller
Norway

Tromsø
NILU
Framsenteret
P.O. Box 6606
Stakkevollan
9296 Tromsø
Norway

Trondheim
NILU
Kjøpmannsgata 8
7013 Trondheim
Norway

Telefon +47 63 89 80 00
nilu@nilu.no
www.nilu.no

Stiftelsen NILU
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Gothenburg
NILU Klimat- och miljöinstitutet AB
Sven Hultins plats 5
412 58 Göteborg
Sweden

Org.nr. 559442-9580
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Monitoring of long range transported air pollutants in Norway
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Norwegian title
Overvåking av langtransportert forurenset luft og nedbør
Atmosfæriske tilførsler 2025

Author(s)
Wenche Aas, Sabine Eckhardt, Nikolaos Evangeliou, Valentin Duflot, Paul Hamer, Anne-Gunn Hjellbrekke, Stephen Platt, Sverre Solberg and Karl Espen Yttri

Short summary (English)
This report presents results from the monitoring of atmospheric composition and deposition of air pollution in 2025, and focuses on main components in air and precipitation, particulate and gaseous phase of inorganic constituents, particulate carbonaceous matter, ground level ozone and particulate matter.

Short summary (Norwegian)
Denne rapporten omhandler resultater fra overvåkningsprogrammet for langtransportert forurenset luft og nedbør og atmosfæriske tilførsler i 2025. Rapporten presenterer målinger av uorganiske hovedkomponentene i luft og nedbør, partikulært karbonholdig materiale, partikkelmasse og bakkenært ozon.

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Project leader
Wenche Aas

Quality assurer
Kjetil Tørseth

Client/Report prepared for
The Norwegian Environment Agency, P.O. Box 5672 Torgarden, N-7485 Trondheim

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Contents

Summary

This report presents results from the Norwegian monitoring programme for long-range transboundary air pollutants, covering inorganic and organic compounds, particulate matter, and ground-level ozone. The main objective is to quantify pollutant levels and detect changes in atmospheric inputs, which are necessary for assessing the impacts of air pollution on ecosystems, human health, materials, and climate. The report provides an overview of pollution levels at Norwegian background stations in 2025 and compares these with long-term trends. The main findings in the report are:

- Pollutant concentrations in Norway in 2025 show clear south-to-north gradients strongly influenced by long-range transport from the European continent. Wet depositions were highest in the southwest, partly due to higher precipitation on the West Coast.
- Air quality at rural Norwegian sites remained among the cleanest in Europe, with SO_2, NO_2 (NO_x), PM_{10}, and $PM_{2.5}$ concentrations well within national, EU and WHO limit values.
- 2025 was a year without marked ozone episodes in Norway. The highest measured hourly mean concentration was 124 µg/m^3 at Birkenes in July. Although the peak levels were low and below the target value for ozone adopted by the EU and Norwegian legislation, they were above the guidelines from WHO, the Norwegian Air Quality Criteria, and the long-term objective for ozone in EU and Norway. The WHO's guideline and Norwegian Air Quality Criteria for the 6-month seasonal mean of 60 µg/m^3 was exceeded at all stations in 2025. This highlights the challenge of meeting air quality guidelines and criteria that are close to the hemispheric baseline level.
- A prolonged period of unusually high temperatures in July caused elevated PM concentrations across rural Norway. Concentrations peaked between 16 and 23 July and were dominated by fine organic aerosol particles, likely accounting for >80% of the PM mass. At Birkenes, 2-methyltetrols, tracers for biogenic secondary organic aerosol (BSOA) formed from isoprene oxidation, reached the highest levels observed in the measurement record (2017–2025), highlighting the importance of BSOA formation under warm conditions. In contrast to the July 2022 heatwave episode, which was associated with elevated ozone levels and polluted air masses from continental Europe, the July 2025 episode was dominated by air masses from forested regions in Scandinavia with low NO_x levels, favouring organic aerosol formation rather than strong ozone production.
- A clear reduction in pollutant concentrations has been observed over the past two decades, in line with emission reductions in Europe. Sulfur species in air and precipitation declined by -2.4 to -3.0% per year, while oxidised nitrogen species declined by -1.4 to -2.4% per year since 2000. PM_{10} and $PM_{2.5}$ concentrations declined by -1.0 to -2.1%/yr and -2.5 to -3.8%/yr, respectively, since 2011. These reductions were mainly driven by declines in secondary inorganic aerosol (sulfate, nitrate, ammonium) and fine organic carbon. Levoglucosan, a tracer of biomass burning, declined slightly less than elemental carbon (EC), suggesting slower abatement of biomass burning emissions compared to fossil fuels.

Sammendrag

Denne rapporten presenterer resultater fra det norske overvåkingsprogrammet for langtransportert forurensning, og omfatter målinger av uorganiske- og organiske forbindelser, partikler og bakkenært ozon. Hovedformålet er å kvantifisere forurensningsnivåer og studere endringer i atmosfærisk tilførsel, nødvendig for å vurdere virkninger av luftforurensning på økosystemer, helse, materialer og klima. Rapporten gir en oversikt over forurensningsnivåene ved norske bakgrunnsstasjoner i 2025 og sammenligner disse med langsiktige trender. Hovedfunnene i rapporten er:

- Forurensningsnivåene i Norge i 2025 viser en tydelig sør-nord-gradient, sterkt påvirket av langtransport fra det europeiske kontinentet. Våtavsetningen var høyest i sørvest, delvis som følge av høyere nedbørsmengder på Vestlandet.
- Luftkvaliteten ved rurale norske målestasjoner var blant de laveste i Europa, med SO_2, NO_2 (NOx), PM_{10} og $PM_{2.5}$ konsentrasjoner godt innenfor EUs og nasjonale grenseverdier, samt WHOs luftkvalitetskriterier.
- 2025 var et år uten markante ozonepisoder i Norge. Den høyeste målte timemiddel-konsentrasjonen var 124 µg/m^3 på Birkenes i juli. Selv om maksnivåene var lave og under målsettingsverdien for ozon fastsatt i EU og norsk lovverk, lå de over anbefalingene fra WHO, de norske luftkvalitetskriteriene samt de langsiktig mål for ozon i EU og Norge. Anbefalingene fra WHO og det norske luftkvalitetskriteriet for sesongmiddel (seks måneder) på 60 µg/m^3 ble overskredet på alle stasjoner i 2025. Dette understreker utfordringen med å oppfylle anbefalinger og kriterier som ligger nært det hemisfæriske bakgrunnsnivået.
- En lengre periode med uvanlig høye temperaturer i juli førte til forhøyede PM-konsentrasjoner. Konsentrasjonene nådde et maksimum mellom 16 og 23 juli og var dominert av fine organiske aerosolpartikler, som sannsynligvis utgjorde >80 % av PM-massen. På Birkenes nådde 2-methyltetrol-konsentrasjonene, tracere for biogene sekundære organiske aerosoler (BSOA) dannet ved oksidasjon av isopren, de høyeste nivåene observert hittil (2017–2025), hvilket understreker betydningen av BSOA-dannelse under varme forhold. I motsetning til hetebølgeepisoden i juli 2022, som var assosiert med forhøyede ozonnivåer og forurensede luftmasser fra kontinental-Europa, var episoden i juli 2025 dominert av luftmasser fra skogkledde områder i Skandinavia med lave NO_x-nivåer, hvilket favoriserer dannelse av organiske aerosoler fremfor forhøyet ozonproduksjon.
- En tydelig reduksjon i forurensningsnivåer er observert de siste to tiårene, i tråd med utslippsreduksjoner i Europa. Svovelforbindelser i luft og nedbør har avtatt med -2,4 til -3,0 % per år, mens oksiderte nitrogenforbindelser har gått ned med -1,4 til -2,4 % per år siden 2000. PM_{10} og $PM_{2.5}$ har avtatt med henholdsvis -1,0 til -2,1 %/år og -2,5 til -3,8 %/år siden 2011. Disse nedgangene skyldes hovedsakelig reduserte nivåer av sekundære uorganiske aerosoler (sulfat, nitrat, ammonium) og finpartikulært organisk karbon. Levoglucosan, en tracer for biomasseforbrenning, viste noe lavere reduksjon enn elementært karbon (EC), noe som tyder på at reduksjonen i utslipp fra vedfyring har vært langsommere enn for fossile brensler.

Table 1. Overview of different acronyms used in this report and a short description.

Acronym	Full Term	Description
AAQD	Ambient Air Quality Directive	EU directive on air quality and cleaner air for Europe.
AOT40	Accumulated Ozone over a Threshold of 40 ppb	Metric for ozone exposure impacts on vegetation.
AQG	Air Quality Guidelines	Guidelines by WHO to protect health from air pollution.
BC	Black Carbon	Commonly known as soot. BC is a tiny particle formed by the incomplete burning of fossil fuels, biofuels, and biomass.
BSOA	Biogenic Secondary Organic Aerosol	Organic particles formed in the atmosphere from oxidation of biogenic VOCs like isoprene and monoterpenes.
BVOC	Biogenic Volatile Organic Compound	Volatile organic compounds emitted by vegetation, and other biological sources, e.g., isoprene and monoterpenes.
CCN	Cloud Condensation Nuclei	Particles that can activate and form cloud droplets under supersaturated atmospheric conditions. CCN-ability depends on particle size and chemical composition.
CLTRAP	Convention on Long-range Transboundary Air Pollution	UN-ECE framework on controlling transboundary air pollution.
DOI	Digital Object Identifier	Unique identifier for digital data/publications.
eBC	Equivalent black carbon	Defined as BC determined by light absorption measurements.
EC	Elemental Carbon	Component of carbonaceous aerosols, comparable to eBC, but measured with a thermo-optical method.
EC_{BB}	Elemental Carbon from Biomass Burning	Fraction of EC attributed to wood or biomass burning.
EC_{FF}	Elemental Carbon from Fossil Fuels	Fraction of EC from fossil fuel sources.
EMEP	The co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe	Scientifically based and policy driven programme under the LRTAP Convention.
EU	European Union	
FAIR	Findable, Accessible, Interoperable, Reusable	Principles for good data management.
LRT	Long-Range Transport	Transport of air pollution over long distances.
MD	Mineral dust	Aerosol particles from crustal elements such as SiO_2, Al_2O_3, Fe_2O_3/FeO, and CaO.
MDA8	Maximum Daily running 8-hour mean	Metric for ozone exposure impacts on health.
NPF	New Particle Formation	Particles formed from gas to particle conversion by binary, ternary or ion-induced nucleation.
OC	Organic Carbon	Organic carbonaceous aerosols in PM expressed in mass of carbon (µgC/m^3).
OM	Organic Matter	Estimated mass of organic carbonaceous aerosols incl. the amount of oxygen and hydrogen i.e: OM = 1.7 x OC.
PBAP	Primary Biological Aerosol Particles	Particles like pollen and fungal spores emitted directly from biological sources.
PBL	Planetary Boundary Layer	The lowest layer of the atmosphere, where turbulent mixing driven by surface heating and friction governs dispersion of gases and particles.
PM_{10}	Particulate Matter < 10 µm	Fine and coarse particles.
$PM_{2.5}$	Particulate Matter < 2.5 µm	Fine particles.
PNC	Particle number concentration	The total number of particles per unit volume.
PNSD	Particle Number Size Distribution	Measurement of number of particles per size class, measurements used for calculating UFP.

	Accumulation mode	Particles in the size range 100 – 1000 nm.
	Aitken mode	Particles in the size range 10 – 100 nm.
SIA	Secondary Inorganic Aerosol	Includes sulfate, nitrate, and ammonium from oxidation of i.e., SO_2, NO_2 and NH_3 .
SSA	Sea Salt Aerosol	Naturally emitted aerosol particles from ocean spray.
UFP	Ultrafine Particles	Particles with diameter <100 nm. UFP represents a specific size range and usually dominating part of the overall PNC.
VOC	Volatile Organic Carbon	Organic compounds that evaporate readily into the air .
UN-ECE	United Nations Economic Commission for Europe	
WHO	World Health Organization	

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1 The monitoring programme

The main objective of the monitoring programme is to quantify the levels of regional air pollution and to document any changes. These observations are important for studies on the influence on ecosystems, human health, materials, and climate change.

The programme started in 1973 with measurements of sulfur and nitrogen compounds and was soon after extended with ozone. The first observations were conducted in Southern Norway. The measurement programme and the monitoring network was then expanded to provide improved information on atmospheric contribution of air pollution for all of Norway. Aerosol particles and carbonaceous aerosol was included in 2000/1.

This report presents results from the atmospheric monitoring programme, which currently includes observations of sulfur and nitrogen compounds in both air and precipitation, levoglucosan and other organic tracers, as well as elemental and organic carbon (EC/OC) in aerosols. Ground-level ozone, particulate matter (PM_{10} and $PM_{2.5}$, aerosol absorption coefficients, and particle number size distributions (PNSD) are also measured. These latter parameters allow for the estimation of equivalent black carbon (eBC) and ultrafine particle (UFP) concentrations. Data from a total of 16 monitoring sites located in rural background areas across Norway are included in this report.

There are no changes in the programme compared to previous years. However, in 2025 the ozone measurements were out of operation for one month at both Sandve and Tustervatn, making it difficult to assess the ozone summer levels at these sites.

Location and basic information regarding the monitoring programme at various sites are illustrated in Figure 1.1, whereas more detailed information of what is measured at each site can be found in Appendix D.

The national monitoring programme is conducted on behalf of the Norwegian Environment Agency with additional funding from the Ministry of Climate and Environment. The observations in Finnmark county are financed by the Ministry of Foreign Affairs through the Norwegian Environment Agency. The ozone measurements at Haukenes are financed by the local municipalities.

Data and results from this national monitoring programme are reported to various international programmes and all data are openly available in EBAS. The data management is defined by the FAIR principles, a set of guidelines for making data Findable, Accessible, Interoperable, and Reusable. All data used in this report are associated to Digital Object Identifiers (DOIs), and the DOIs for the 2025 data are presented in Table D.3 in Appendix D. Details regarding sampling methods and chemical analysis are described in Appendix E .

Figure 1.1: Norwegian background sites and measurement programmes 2025.

In the report we use the overlapping terms of aerosols and particles. PM_{10} and $PM_{2.5}$ are often used in a regulatory and health related context. Aerosol particles are often used in atmospheric chemistry and climate research and can be expressed in terms of mass, number, surface area, chemical composition, and optical properties.

2 The weather in Norway 2025

The variation in meteorological conditions from year to year plays a decisive role for the variation in observed concentrations of pollutants in air and precipitation in Norway. At rural sites, the level of pollutants is mostly determined by atmospheric transport from other countries. The distribution of high- and low-pressure systems controls this transport, and temperature, humidity and precipitation are determining the degree of deposition, washout and chemical transformation occurring within the air masses. Knowledge of the meteorological conditions and how it varies over time and in space from south to north is therefore important for understanding the air pollutant levels.

The weather in Norway 2025 is reported by the Norwegian Meteorological Institute (Gangstø et al., 2025). For the country as a whole, the mean temperature in 2025 was 1.5 °C above the normal and 10 % more precipitation fell than normal, making this year the warmest and the 8th wettest since the start of the monitoring in 1901.

The winter months at the beginning of 2025 were characterised by exceptionally warm conditions in the northern half of Norway. January was cooler and drier than normal in Vestland and warmer and wetter than normal in the north and east of Norway. Overall, January 2025 was just slightly warmer and wetter than normal.

February was significantly warmer and wetter than normal in Troms and Finnmark with positive temperature anomalies of 7-8°C. Southern Norway was relatively dry and close to normal temperatures. The warm weather in northern Norway during February extended into the rest of Norway during the month of March. The warmest weather in March occurred in southern Norway. The warm March weather was also accompanied by very rainy conditions with it being the 6th wettest March on record.

The April in 2025 was the 5th warmest April on record. Temperatures were particularly elevated in southern Norway, they were reasonably high in Trøndelag and Romsdal, and close to normal within northern Norway. As well as being much warmer than on average, April was also very wet and was the 10th wettest April on record. It was particularly wet in northern Norway while in southern Norway it was wet in the more northern areas, i.e., Innlandet, Vestland, and Trøndelag, while it was very dry in Agder and Rogaland.

May was 0.7°C warmer than average and was particularly warm in all areas south of Trøndelag. Overall, May had close to average precipitation but was notably very wet in Trøndelag. Isolated regions (i.e., Troms) within northern Norway experienced very dry conditions within the month of May.

Temperature and precipitation levels were both close to average in June 2025. Some regional variations did occur, with parts of northern Norway experiencing above average weather and with Rogaland and Trøndelag experiencing conditions that were much wetter than normal.

July 2025 was very warm throughout Norway and was ranked as the 3rd warmest July on record overall with a positive anomaly of 2.8°C, with Nordland experiencing the driest conditions. Despite the overall dry weather, it was much wetter than average along the Swedish border in Innlandet.

August 2025 was close to the historical average but was still slightly warmer than normal. Southern Norway had temperatures slightly below average while the northern half of Norway experienced above average temperatures. August was particularly wet compared to normal with it ranking as the 12th wettest August on record with Nordland, Nord-Trøndelag, and Vestlandet being the wettest locations.

September and October were both significantly warmer than on average ranking as the 3rd warmest and 8th warmest, respectively, for their respective months. For both months, the northern half of Norway was particularly warm compared to the historical average, with the southern half of Norway being somewhat cooler than on average. September and October were also wetter than on average. In September, the wettest regions were Sørlandet and Østlandet, November was close to average in terms of temperature. It was slightly wetter than average with the areas experiencing positive rainfall anomalies limited to coastal areas.

December was much warmer than on average with a large positive temperature anomaly of 3.0°C making it the 9th warmest December on record. December was also very wet with a positive precipitation anomaly of 25% above average making it the 11th wettest December on record.

3 Overview of different Air Quality Guidelines (AQG) and limit values

There are many target values, limit values and guideline values that set criteria levels of air pollution to protect health and environment. These are developed by several bodies, e.g. the EU, World Health Organisation (WHO), UN-ECE and by the Norwegian authorities represented by the Norwegian Institute of Public Health (FHI) and the Norwegian Environmental Agency.

In October 2024 the EU adopted the revised Directive on ambient air quality for cleaner air for Europe (AAQD) (EU, 2024). For PM_{10} and $PM_{2.5}$ The limit values defined in the earlier AAQD (EU, 2008) are included as targets to be met by 11th Dec. 2026, while the new and updated targets should be attained before 1st January 2030. The revised AAQD includes for the first time black carbon (BC), ultrafine particles (UFP), and particle number size distribution (PNSD) within its monitoring framework, specifying measurements in both urban and regional environments.

The new AAQD is not yet included in the European Economic Area (EEA) Agreement nor Norwegian law. The EU member states need to implement the Directive by 11th Dec. 2026. For ozone there are also long-term objectives to be attained by 2050. The updated targets are closer to the World Health Organisation Air Quality Guidelines (AQG) for key air pollutants that pose health risks (WHO, 2021). Limit values for some components are included in Norwegian law (Lovdata, 2022). National authorities have published air quality criteria (FHI, 2024), based on the AQG from the WHO with some adjustments. The UN-ECE has developed threshold values for ozone for the protection of vegetation (CLTRAP, 2023 and references therein).

An overview of different limit values, targets and guidelines are given for PM in Table 3.1, and for ozone in Table 3.2 (for health) and Table 3.3 (vegetation). Guidelines and limit values for NO_2 and SO_2 for health are not included since these are not very relevant for Norwegian regional air quality levels. The limit values (annual and winter mean) for protection of vegetation for NOx is 30 µg/m^3, while it is 20 µg/m^3 for SO_2 (EU, 2024; Lovdata, 2022). The regional levels are far below these limit values.

Table 3.1: EU and national limit values and Air-Quality Guidelines and Criteria for PM_{10} and $PM_{2.5}$.

	24-hours	Annual
EU limit values (EU, 2024)		
Information threshold		
PM_{10}	90 µg/m^3	
$PM_{2.5}$	50 µg/m^3	
Attained before 11 Dec. 2026:		
PM_{10}	50 µg/m^3 (≤ 35 days/ yr)	40 µg/m^3
$PM_{2.5}$		25 µg/m^3
Attained before 1 Jan. 2030:		
PM_{10}	45 µg/m^3 (≤ 18 days/ yr)	20 µg/m^3
$PM_{2.5}$	25 µg/m^3 (≤ 18 days/ yr)	10 µg/m^3
National limit values (Lovdata, 2022)		
PM_{10}	50 µg/m^3 (≤ 25 days/ yr)	20 µg/m^3
$PM_{2.5}$		10 µg/m^3
Upper and lower assessment levels:		
PM_{10}	35 and 25 µg/m^3 (≤ 25 days/ yr)	17 and 15 µg/m^3
$PM_{2.5}$		7 and 5 µg/m^3
WHO Air-Quality Guidelines (WHO, 2021)		
PM_{10}	45 µg/m^3 (≤ 4 days/ yr)	15 µg/m^3
$PM_{2.5}$	15 µg/m^3 (≤ 4 days/ yr)	5 µg/m^3
National Air-Quality Criteria (FHI, 2024)		
PM_{10}	30 µg/m^3	15 µg/m^3
$PM_{2.5}$	15 µg/m^3	5 µg/m^3

Table 3.2: Limit values and Air-Quality Guidelines and Criteria for ground-level ozone, for the protection of human health. Note that several of these metrics refer to the MDA8 as explained in the footer to the table.

Value ($\mu g/m^3$)	Averaging time (hours)	Description
EU limit values (EU, 2024)		
180	1	EU's information threshold
120	8[a)]	EU's target value (≤ 18 days/ yr averaged over 3 years)
100	8[a)]	EU's long-term objective (≤ 4 days/ yr). To be attained by 2050
National limit values (Lovdata, 2022)		
180	1	Information threshold
120	8[a)]	Target value (≤ 25 days/ yr averaged over 3 years)
120	8[a)]	Long-term objective (not to be exceeded within a calendar year).
WHO Air-Quality Guidelines (AQG) (WHO, 2021)		
100	8[a)]	Short term AQG level (≤ 4 days/ yr)
60	8[b)]	Long term AQG, 6 months mean over the peak season
National Air-Quality Criteria (FHI, 2024)		
100	1	National Air Quality Criteria
80	8[a)]	National Air Quality Criteria
60	8[b)]	National Air Quality Criteria, 6 months mean over the peak season

a) The highest 8-hour running mean value for each day calculated such that the 8-hour periods are assigned to the day on which the period ends (=MDA8).

b) Defined as the average of the daily maximum 8h running mean concentration in the 6 consecutive months with the highest 6-months running O_3 concentration.

Table 3.3: Critical levels and target values defined for the protection of vegetation from ozone exposure.

AOT40 ($\mu g/m^3$ h)	Period	Comment
UN-ECE's critical levels (CLTRAP, 2023)		
6000	3-months growing season	Critical levels for agricultural crops and semi-natural vegetation [1)]
10 000	1 April – 30 Sept	Critical level for forests [1)]
EUs and national limit values (EU, 2024; Lovdata, 2022)		
6000	1 May – 31 July	Long-term objective for vegetation[2)]
18 000	1 May – 31 July	Target value for vegetation. Should be averaged over five years [2)]

1) UN-ECE's AOT values should be based on the hours with global incoming radiation > 50 W/m^2
2) EU's AOT values should be based on the period 08-20 CET

4 Status of the observations in 2025

4.1 Annual means and spatial distribution

Norway is influenced by major anthropogenic emission regions in Europe, which are of great importance for the observed levels of air pollutants and their regional distribution. The annual and monthly mean concentration in air and precipitation in 2025 for all sites and components are given in Appendix A.

Several components have a clear South to North gradient strongly influenced by long-range transport (LRT) from the European continent. Figure 4.1 illustrates spatial gradients for selected pollutants in 2025. Sulfate concentrations were highest in south and southeast, as well as at Svanvik, which is influenced by emissions from Russia with elevated concentrations, especially of sulfate. However, concentrations have decreased considerably after the smelter in Nikel closed in December 2020 (Berglen et al., 2022). Wet depositions were highest in the southwest, partly due to higher precipitation on the West Coast. Maximum ozone concentrations showed a similar pattern as for most air components with highest levels in southern Norway (Figure 4.1).

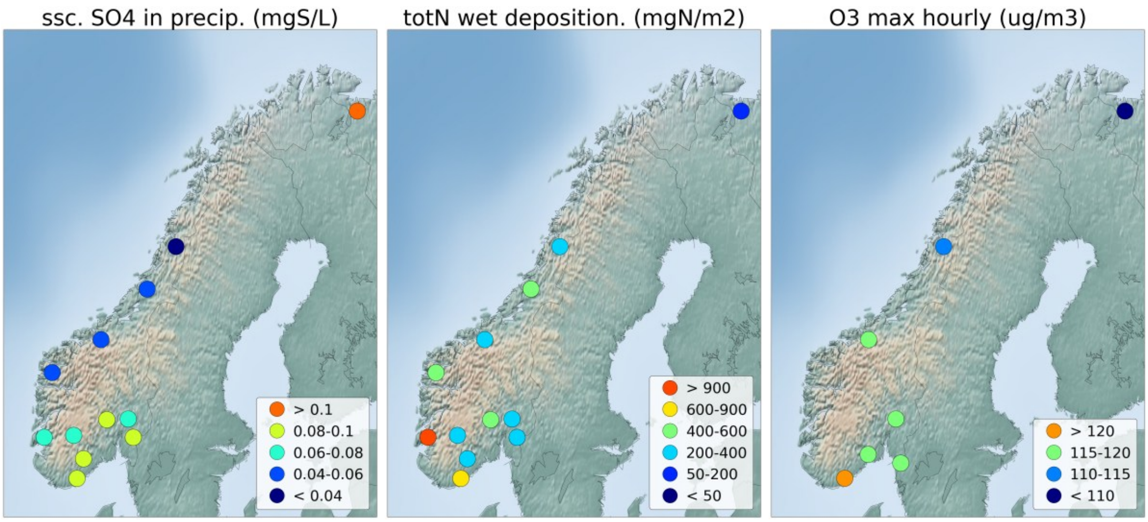

Figure 4.1: Annual volume weighted mean concentrations of sea salt corrected (ssc) sulfate (left), total wet deposition of nitrogen (middle), and the highest hourly concentration of ozone (right) observed in 2026. Note that ozone from Sandve is not included as data from June is missing .

Air pollution levels at rural sites in Norway are among the lowest in Europe (Aas et al., 2024; EMEP, 2023), with annual mean aerosol mass concentrations in 2025 ranging from 2.3 to 4.3 µg/m³ for PM_{10} and 1.3 to 2.1 µg/m³ for $PM_{2.5}$. Ozone levels in 2025 were generally low, with the highest hourly concentration seen at Birkenes (124 µg/m³, Table A.19). No sites exceeded the MDA8 limit value of 120 µg/m³, while Kårvatn and Hurdal recorded the highest number of days with MDA8 concentrations above 100 µg/m³, with 8 days each. Although peak ozone concentrations remained below the EU and Norwegian target values outlined in Table 3.1, exceedances of the WHO Air Quality

Guidelines (AQG), the Norwegian Air Quality Criteria, and the EU long-term objectives for ozone were observed. In particular, the WHO AQG and Norwegian Air Quality Criteria for the 6-month seasonal mean of 60 µg/m^3 were exceeded at all stations in 2025, illustrating the difficulty of achieving guideline levels that approach the hemispheric background concentration.

SO_2 and NO_2 concentrations were well beyond the limit values , guidelines and criteria established for both health and vegetation protection. Hourly PM_{10} measurements are only conducted at Birkenes, where the highest observed daily average was 17 µg/m^3 on 25 January.

Carbonaceous aerosol levels, including organic carbon (OC) (< 1.1 µg C/m^3) and elemental carbon (EC) (< 0.08 µg C/m^3), remained relatively low. OC (0.16 µg C/m^3) and EC (0.015 µg C/m^3) levels at the remote Arctic Zeppelin site were substantially lower compared to levels observed at the Norwegian mainland (Table A.4). Similar for the annual average eBC concentration with 0.054 and 0.013 µg/m^3, for Birkenes and Zeppelin respectively. These annual concentrations are by definition similar as for EC as these data are used when calculating eBC from the absorption coefficient. The eBC concentrations levels are higher in winter at both Birkenes and Zeppelin compared to the summer period. The temporal variation is given in Table A.20 and Figure A.2

Ultrafine particles (UFPs) are, typically defined as particles with a diameter of 100 nm or less. The annual average UFPs concentrations in 2025 were 1145 at Birkenes and 110 cm^{-3} at Zeppelin, with higher levels in summer vs. winter. The temporal variation is given in Table A.21 and Figure A.3.

4.2 High temperature period in July causing elevated air pollution

In July, large parts of Norway experienced elevated temperatures, strong solar radiation, and persistently low wind speeds, indicative of stagnant atmospheric conditions. The national mean temperature was 2.8 °C above the long-term average (Gangstø et al., 2025), making it the third warmest July on record.

PM and OC concentrations were elevated at all rural background sites for large parts of July, peaking between 16 and 23 July, and were dominated by fine aerosol particles. Secondary inorganic aerosol (SO_4^{2-}, NO_3^-, and NH_4^+), indicative of long-range atmospheric transport, and sea-salt aerosol levels were low.

The hourly PM_{10} concentration reached 18 µg/m^3 at Birkenes during this week, and on four days the PM_{10} mass concentration ranged from 9 to 10 µg/m^3. The weekly time-resolved OC concentrations corresponded to the 99th percentile for both the PM_{10} and $PM_{2.5}$ size fractions, considering the entire time series (2001/2011 – 2025). Hourly organic mass (OM) concentrations in PM_1 obtained from the ACSM instrument at Birkenes exceeded 9 µg/m^3, whereas daily means exceeded 7 µg/m^3. Further, 2-methyltetrols, oxidation products of the biogenic VOC isoprene and key contributors to biogenic secondary organic aerosol (BSOA), reached a new weekly maximum in the Birkenes time series (2017–2025), exceeding the previous record by nearly 10%. Under such high-temperature conditions, BSOA likely dominated the organic aerosol fraction and, consequently, the overall PM mass concentration, as organic aerosol (OC × 2.1) accounted for approximately 80% of the PM mass, which likely is a conservative estimate.

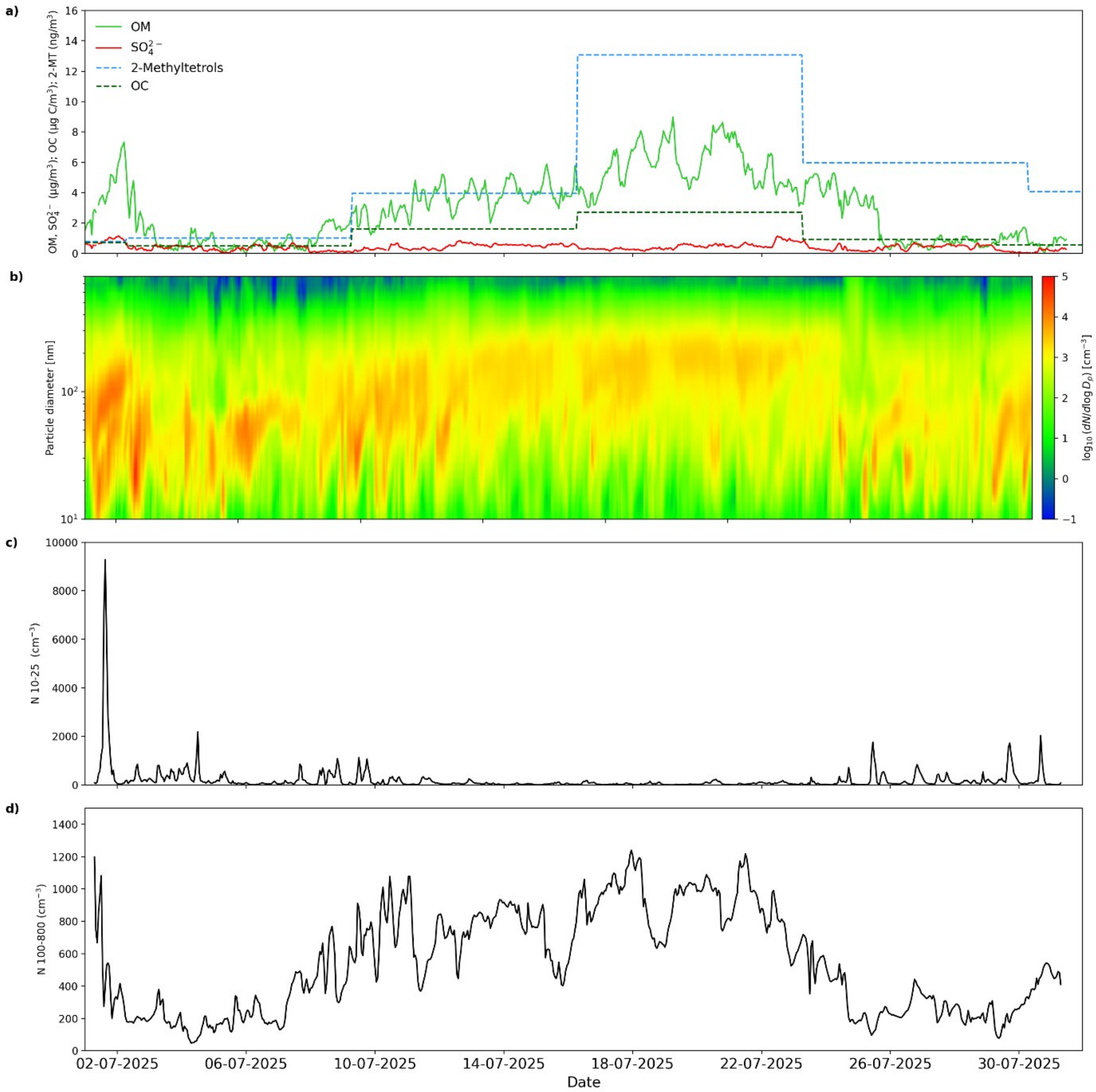

Figure 4.2: Time series at Birkenes Observatory for July 2025. Panels show, (a) weekly time resolved 2-methyltetrols and fine OC and hourly time resolved OM and fine $SO_4{}^{2-}$, (b) particle number size distribution (10–800 nm; colour = log_{10}(dN/dlogDp)), (c) particle number concentrations for 10 – 25 nm (N 10–25 nm), and (d) 100 – 800 (N 100–800 nm). The period is characterized by a pronounced accumulation mode, and elevated OM, OC, and 2-methyltetrsol concentrations, with limited new particle formation (NPF) activity, and low SO_4^{2-} concentrations.

In early July, new particle formation (NPF) was observed, with newly formed particles below the instrument detection limit (10 nm) growing towards larger diameters, visible as the characteristic banana-shaped pattern in the particle size distribution (Figure 4.2). As the warm and stagnant meteorological conditions persisted, this pattern gradually disappeared. Although NPF likely continued, the survival and continued growth of newly formed particles decreased as the condensation and coagulation sink increased due to the growing population of pre-existing particles. Particle growth was driven by condensation of low-volatility oxidation products of biogenic VOC, whereas coagulation reduced the number of small particles and shifted the size distribution towards larger particles. Consequently, particle number concentrations declined, while particle mass became increasingly dominated by accumulation-mode particles (100–1000 nm).

This shift from predominantly Aitken-mode particles (10 – 100 nm) to more long-lived, cloud condensation nuclei (CCN) active, and strongly light-scattering accumulation-mode particles, may have both climate and air-quality implications. The air-quality impact was dominated by particulate-phase processes rather than ozone-production, reflecting atmospheric conditions favouring BSOA formation, whereas high O_3 production typically requires anthropogenic NO_x influence.

The pronounced diurnal cycles observed in O_3 and OM reflect the influence of the planetary boundary layer (PBL) under stagnant high-pressure conditions. The PBL is the lowest part of the atmosphere directly influenced by the Earth's surface and typically expands during the day due to solar heating and contracts at night as the surface cools. O_3 concentrations decreased during the night because the shallow nocturnal PBL suppressed vertical mixing, limiting the downward transport of ozone-rich air from higher altitudes while dry deposition to the surface continued. During the day, O_3 concentrations increased near the surface within the PBL due to photochemical production and mixing with O_3-rich air from aloft as the PBL expanded and atmospheric mixing increased. In contrast, OM concentrations increased at night because the shallow PBL confined pollutants to a smaller volume and cooler temperatures favoured partitioning of condensable organic vapours to the particle phase. Additional formation of biogenic secondary organic aerosol (BSOA) may also have contributed. During the day, OM concentrations decreased as the expanding PBL diluted OM concentrations and evaporation of condensable outweighed continued BSOA production.

The July 2025 episode was characterized by elevated concentrations of both organic aerosol and 2-methyltetrols, but only moderate O_3 levels, persisting for about a week. In contrast, the July 2022 episode (18–25 July) (Aas et al., 2025) showed a short-lived (1–2 days) increase in O_3 (up to 157 µg/m^3, hourly) and organic aerosol (Figure 4.3, panels a and b). FLEXPART footprints (Pisso et al., 2019) for the July 2022 episode covered major O_3 precursor source regions in Germany, the Benelux countries, northern France, and the British Isles, whereas the July 2025 episode was characterized by footprints largely confined to forested regions of Scandinavia (Figure 4.3, panels c and d). In both cases, the footprints coincide with regions of the highest average mean maximum temperatures, as well as the positive temperature anomalies (Figure 4.3, panels e-h).

These two episodes highlight the importance of source regions in determining air pollution composition during heat waves. Forested areas with high BVOC emissions but low NO_x are less likely to produce similarly high O_3 levels as regions influenced by anthropogenic emissions, under comparable temperature conditions, although they promote organic aerosol formation. Figure 4.3, (panels e-h) shows that temperatures within the July 2022 footprint were slightly higher than those of the July 2025 footprint, although temperatures at Birkenes were similar during both periods. This interpretation is further supported by higher NO_2 levels during the July 2022 episode (0.83 µg/m^3) compared to the July 2025 episode (0.46 µg/m^3).

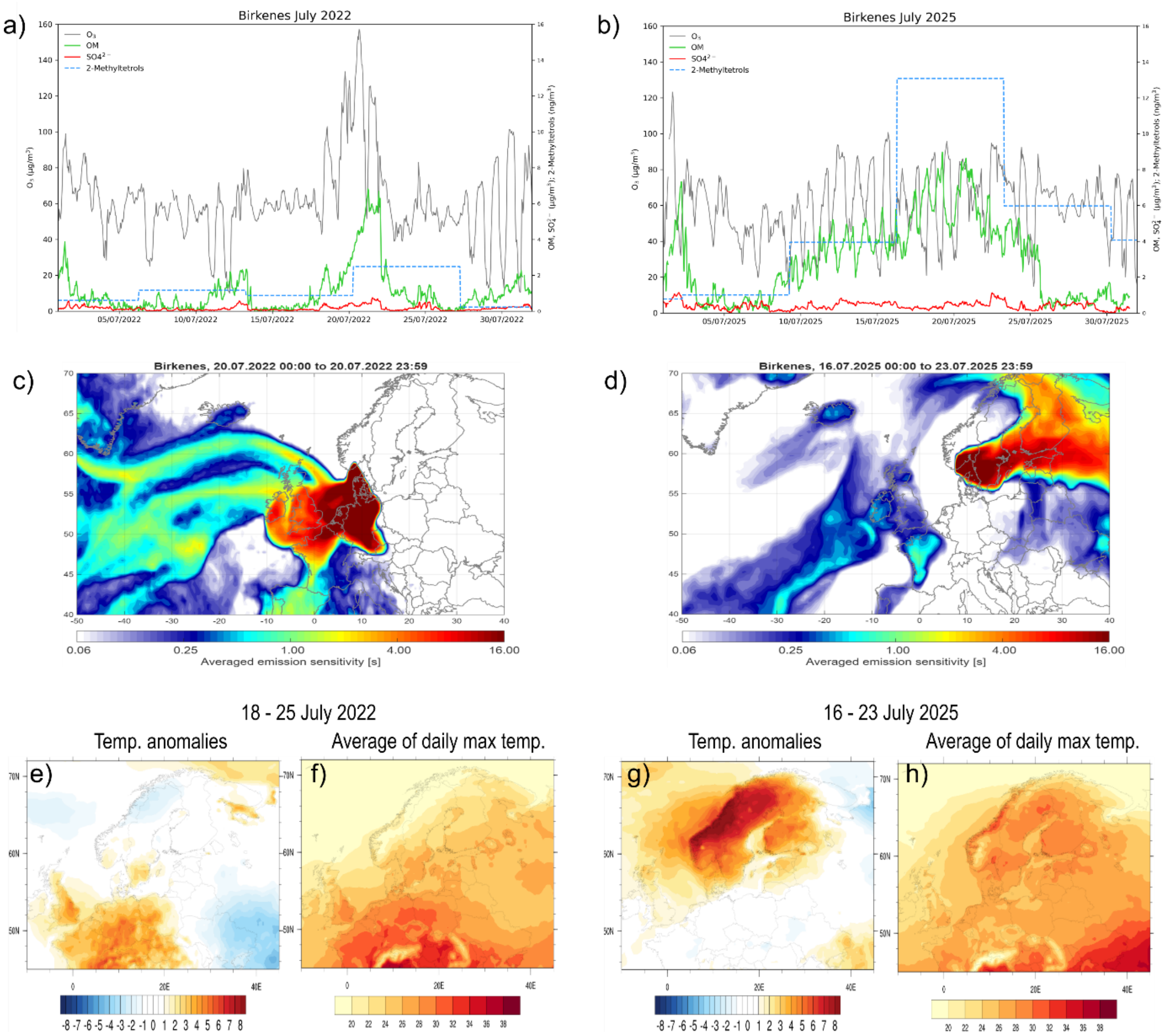

Figure 4.3: Time series of O_3, sulfate, organic matter (OM), and 2-methyltetrol concentrations measured at Birkenes during the July 2022 and July 2025 heatwave episodes (panels a–b). Panels c–d show corresponding FLEXPART emission sensitivity footprints for the July 2022 episode and the July 2025 episode. Panels e–h show temperature anomalies and average daily max temperatures for the two periods calculated from ERA5 (Hersbach et al., 2023).

5 Trends in air pollution

An important goal of the monitoring programme is to measure the effectiveness of the protocols, i.e., the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (UNECE, 2012). Since Norway is influenced by major emission sources in Continental Europe, the Norwegian rural background monitoring network can indicate changes to overall emission reductions in Europe. For the statistical analysis, the non-parametric Mann-Kendall Test was applied on annual means for detecting and estimating trends. The Sen-Theil slope estimator was used to quantify the magnitude of the trends. Tables with the calculated linear trends for 2000-2025 and 2010-2025 averaged for all sites with measurements in these respective periods are given in Appendix B. For data prior to 2000, please refer to Tables in Annex C.

5.1 Trends in inorganic compounds

Figure 5.1 shows the time series of annual mean concentrations of sulfur and nitrogen components in air and precipitation at selected sites in Norway with long time series. The average trends in sulfur are between -2.4 to -3.0% per year between 2000-2025 depending on component (Table B.1). There is also a clear reduction in oxidised nitrogen, between -1.4 to -2.4% per year (Table B.1). This is also the case for reduced nitrogen, although ammonium in aerosol shows a larger reduction (-2.6 %/yr) than in precipitation (-0.8 %/yr). These notable differences between the trends in reduced nitrogen components can be explained by the interaction of ammonia with the sulfur and oxidized nitrogen components. Ammonia readily reacts with sulfuric and nitric acids in the atmosphere to form ammonium sulfate and ammonium nitrate aerosols. The contribution of ammonia to the aerosol mass has been substantially reduced as a consequence of declining SO_x and NO_x emissions in Europe. With less acidic components available, less ammonia is needed to neutralize them, resulting in higher fraction of ammonia (i.e., non-particulate). Precipitation includes wet scavenges of both ammonia and ammonium, which may explain the smaller reduction here. (Aas et al., 2024). The observed reductions in levels of sulfur and nitrogen species agree with reported downwards trends in pollutant emissions in Europe (Aas et al., 2024; Colette et al., 2021; Lewis et al., 2023).

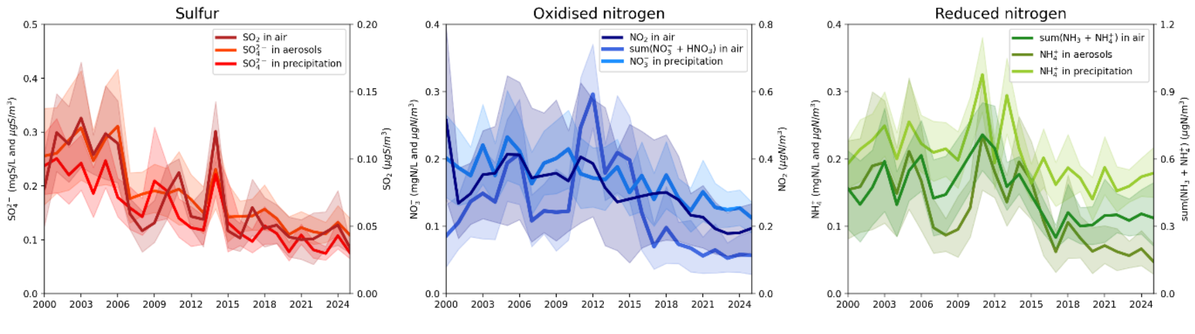

Figure 5.1: Average trends in sulfur and nitrogen components measured at Norwegian background sites (2000-2025). The solid line in the trend plots indicate the average annual mean concentrations for all the sites and the shaded area the 95% confidence interval. There are 12 sites with long term observations of sulfur and nitrogen in precipitation and 5 with measurements in air and aerosol (4 for NO_2).

5.2 Trends in surface ozone

For surface ozone, the annual mean concentration is of little interest since pollution episodes typically lead to enhanced ozone in summer and reduced levels in winter and thus the impact on the annual mean is unclear. Furthermore, the number and levels of European summer episodes vary from year to year and is closely related to the weather situation. There has, however, been a gradual decrease in the European peak levels since the early 2000s which is reflected also at Norwegian sites. The trends and significance of these are not straight-forward to quantify though since the high peaks only occur certain years and are strongly tied to the weather anomalies in the respective years.

The general pattern of the development of peak ozone levels in Norway is a very gentle decrease through the years with marked spikes in a few years. This pattern reflects the "competition" between the general ozone reduction in European air masses due to the reduction in emissions of NO_X and VOC on one side and ongoing climate change leading to more frequent and severe heat waves promoting ozone formation on the other side. As an example, 2006 was the last year when the ozone level in Norway exceeded the EU information threshold of 180 µg/m³.

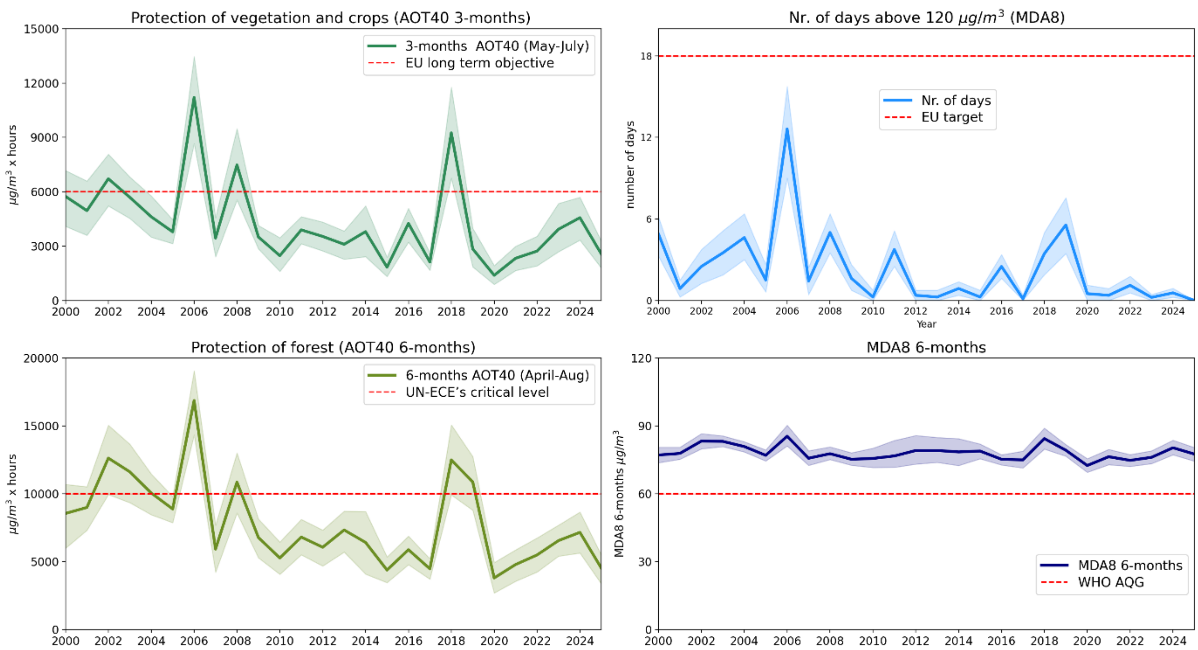

Figure 5.2 shows the development of ozone metrics linked to damage on vegetation (AOT40 = Accumulated Ozone over the Threshold of 40 ppb, Table 3.3) and human health (days with ozone exceeding certain recommendations, Table 3.2).

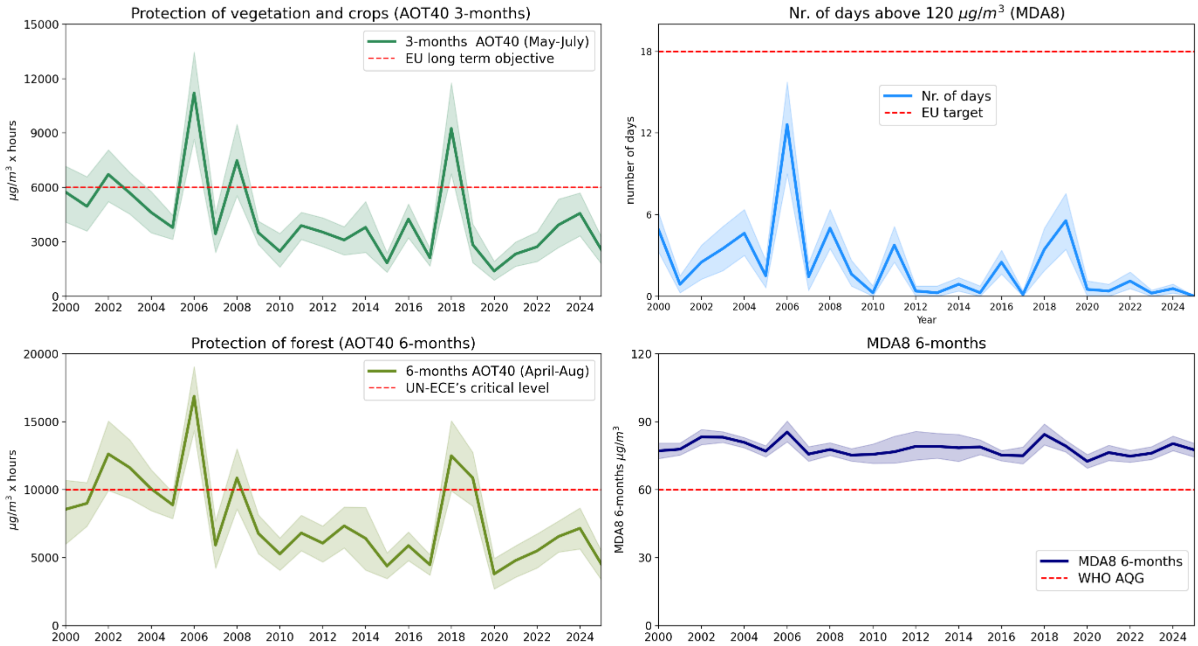

Figure 5.2: Average trends in different ozone metrics relevant for protection of vegetation (left figures,) and health (right figures) at Norwegian background sites 2000-2025. The solid lines indicate the average over all the eight sites for the various metrics and the shaded areas the 90% confidence interval of the averages. Various limit values or guidelines are indicated as red lines as outlined in Chapter 3.

Overall, these time series are characterized by a slow reduction over time while at the same time strongly variable from year to year. It is interesting, though, that the data may indicate a minimum level in the period 2012-2014 followed by slightly increasing levels, particularly marked in 2018-2019. As seen by the Figure, WHO's long term (6-months) AQG was significantly exceeded in the whole period 2000-2025.

5.3 Trends in aerosol mass and chemical composition

Trends in PM measurements at Birkenes, as depicted in Table B.3, show a statistically significant decrease in both PM_{10} (-1.6% /yr) and $PM_{2.5}$ (-2.2 % /yr) over the span of more than two decades, from 2000/1 to 2025. The decrease is less pronounced for PM_{10} due to contributions from natural sources such as sea salt aerosol (SSA), mineral dust (MD) and primary biological aerosol particles (PBAP), which dominate the coarse fraction of PM_{10}. The primary drivers behind the reduction in PM levels are the declining concentrations of secondary inorganic aerosol (SIA), such as SO_4^{2-} (-3.1% /yr), NH_4^+ (-3.0% /yr), NO_3^- (-1.7 /yr), and fine fraction organic carbon (OC) (-1.4% /yr). These trends reflect the successful efforts in reducing anthropogenic emissions of SO_2 and carbonaceous aerosol from combustion sources. The efficiency of reducing OC and EC from fossil fuel combustion appears somewhat more efficient than from biomass burning. This is evident in the lower reduction rate observed for the biomass burning tracer levoglucosan (-2.2% /yr) compared to EC (-2.9% /yr) from 2008 to 2025. Since the year 2001, there has been a consistent increase in the SSA concentration at Birkenes at a rate of 2.7% /yr.

The PM levels at Hurdal (PM_{10}: -1.0% /yr; $PM_{2.5}$: -2.6% /yr) and Kårvatn (PM_{10} -2.1% /yr; $PM_{2.5}$: -3.8% /yr) exhibit decreasing trends from 2011 to 2025. The reduction rates for PM_{10} are quite similar for Birkenes and Kårvatn, but lower for Hurdal, considering the same period, however the decreases are not statistically significant at any of the sites. Conversely, there is a statistically significant decrease in $PM_{2.5}$, at all the sites, mainly attributed to reductions SIA constituents.

In 2025, SSA constituted 28% of PM_{10} at Birkenes, slightly higher than that of SIA species (SO_4^{2-}, NO_3^-, NH_4^+) (26%), but lower than organic matter (OM) at 32%, while MD accounted for 7% (Figure 5.3). Since 2001, the SSA fraction of PM_{10} has increased notably at a rate of 7%/yr. Despite declining emissions from combustion, the OC fraction of PM_{10} increases by 1.3%/yr and for $PM_{2.5}$ by 1.9%/yr (Table B3). This underscores the importance of organic aerosols from natural sources like BSOA and PBAP. Conversely, the fractions of NH_4^+ (-2.1%/yr) and SO_4^{2-} (-2.5% /yr) to PM_{10} have shown a decreasing trend. This shift in aerosol composition at Birkenes reflects a change in the relative source composition of PM, where emissions from natural sources become more dominant compared to anthropogenic sources, typically being long-range transported pollution.

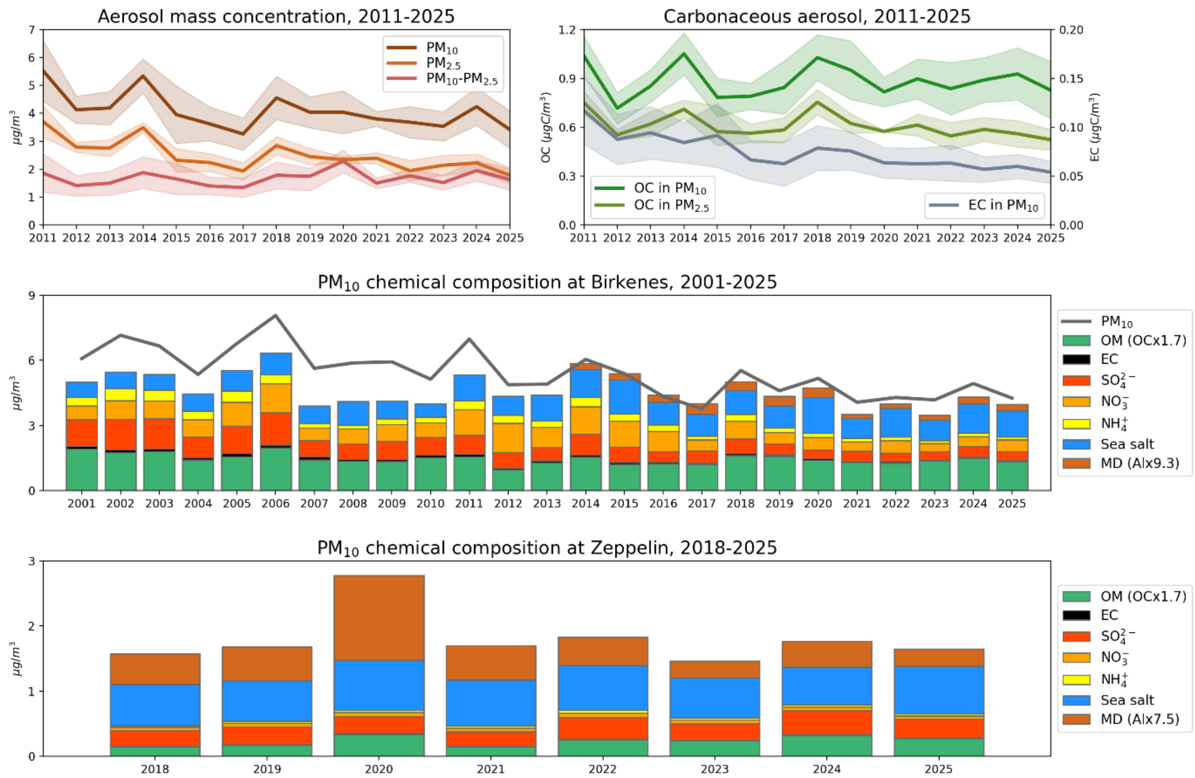

Figure 5.3: Trends for PM_{10}, $PM_{2.5}$, and $PM_{10-2.5}$ (upper left) and carbonaceous aerosol (OC and EC) (upper right) averaged for Birkenes Observatory, Hurdal, and Kårvatn (2011 – 2025). Mass closure for PM_{10} at Birkenes (middle panel) (2001 – 2025), and Zeppelin (lower panel) (2018 – 2025).

The chemical composition of PM at Hurdal and Kårvatn shows less influence from SIA and SSA compared to Birkenes, emphasizing the longer distance from important source regions of SIA precursors in continental Europe and to the coast, respectively, with OM comprising the major fraction at 44 – 51%.

The chemical composition of PM at the remote Zeppelin site shows a greater influence of SSA and MD compared to sites on the Norwegian mainland, while exhibiting lower levels of OM, and SIA intermediate between those observed at Birkenes, Hurdal and Kårvatn (Figure 5.3). This reflects the characteristics of a remote and sparsely vegetated Arctic environment, where selected natural sources (SSA and MD) play a relatively larger role than anthropogenic ones.

A statistically significant downward trend was observed for EC, ranging from 2.7% /yr to -3.9% /yr in PM_{10} and $PM_{2.5}$ at all rural background sites from 2011-2025. However, for OC in the same period, the downward trend was statistically significant only in $PM_{2.5}$ at Kårvatn (-2.0% /yr) (Table B.3).

5.4 Trends in carbonaceous aerosol sources

Equivalent black carbon exhibits pronounced seasonal variability, particularly at Zeppelin (Figures 6.2 and A2). Concentrations typically reach a minimum during the summer months, driven by a combination of reduced long-range atmospheric transport from mid-latitude source regions, enhanced wet scavenging processes (i.e., removal of aerosol particles through incorporation into cloud droplets and precipitation), and lower emissions associated with residential heating and combustion activities. In contrast, concentrations increase markedly during late winter and spring, reflecting the stronger influence of anthropogenic emissions transported into the Arctic. This period corresponds to the well-known “Arctic haze” phenomenon, characterized by the accumulation of persistent aerosol layers under stable atmospheric conditions and limited removal processes (Platt et al., 2022). These seasonal patterns highlight the interplay between atmospheric transport, removal mechanisms, and emission sources in controlling Arctic black carbon levels.

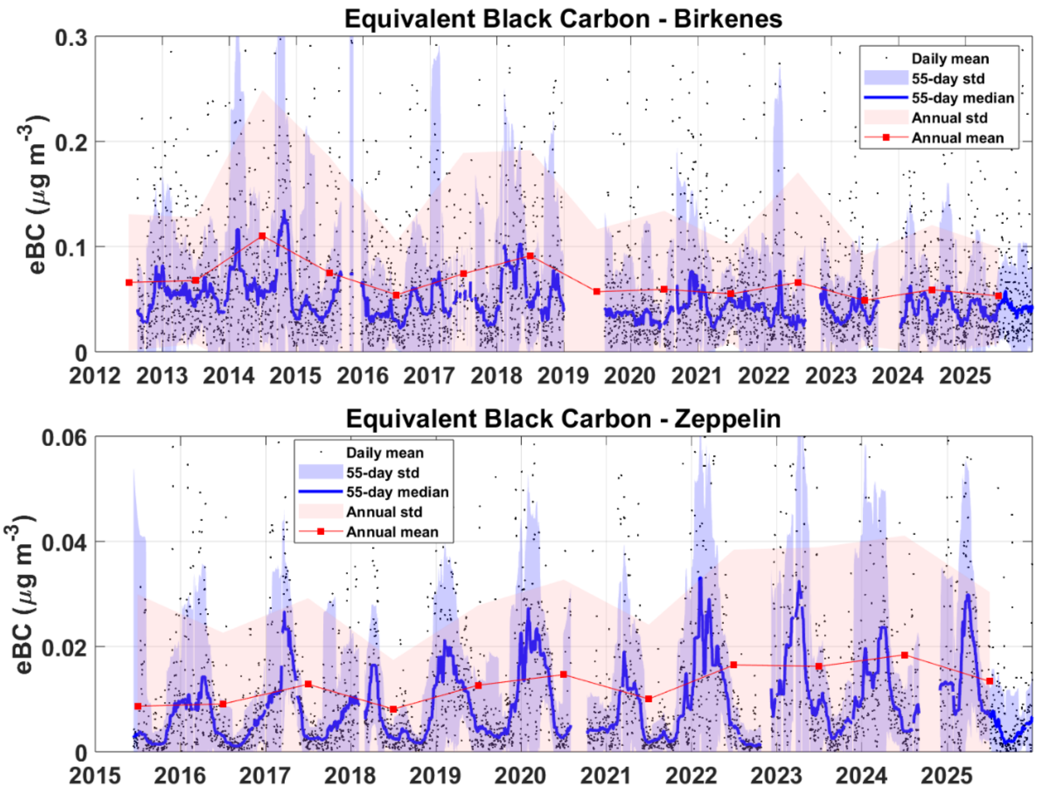

Figure 5.4: Equivalent black carbon (eBC) at Birkenes (top) and Zeppelin (bottom). Black dots show daily means, blue lines the 55-day running average, red lines the annual mean, and shaded areas the associated standard deviations.

The interannual variability of eBC concentrations at Birkenes and Zeppelin are 25% and 27%, respectively. We observe a decreasing trend at Birkenes (-2.3 ± 2.7 %/year), which, considering the uncertainties, is consistent with the trend in EC for the same period (-3.1 ± 1.8 %/year).These observed decreasing trends at Birkenes likely reflect the cumulative effect of emission mitigation policies implemented across Europe over recent decades. These measures have been largely driven by the recognition of black carbon as both a harmful air pollutant and a climate-forcing agent, with documented adverse impacts on human health, including respiratory and cardiovascular diseases (e.g. Song et al., 2022). Reductions in black carbon emissions have been achieved through a combination of regulatory and technological improvements across multiple sectors. These include increasingly stringent vehicle emission standards, the progressive adoption of cleaner fuels and combustion technologies, modernization of residential heating systems, and reductions in open biomass burning associated with agricultural practices. Additional contributions likely arise from improved industrial emission controls and a broader transition toward cleaner energy production. Together, these measures have contributed to a substantial decline in atmospheric black carbon concentrations at regional background sites such as Birkenes, highlighting the effectiveness of long-term air quality policies in northern Europe.

The spectral fingerprint of light absorption used in eBC measurements can also be used for source apportionment. This makes it possible to model the amount of eBC from high-efficiency combustion, mainly from liquid fuels and traffic, and from low-efficiency combustion, such as solid fuel burning for residential heating, as well as other sources like coal and waste burning. Figure 5.5

shows the estimated average monthly contribution from liquid and solid fuels at Birkenes and Zeppelin over the period 2023 to 2025.

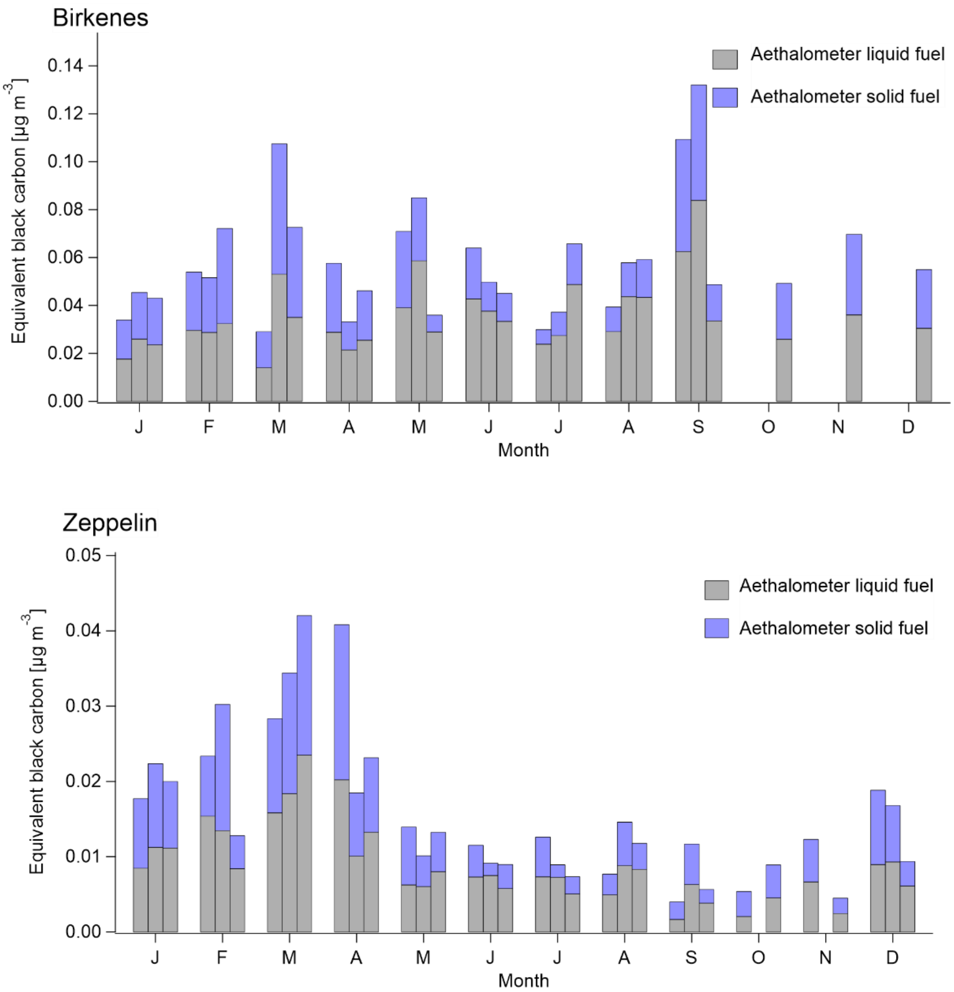

Figure 5.5 Monthly mean equivalent black carbon (eBC) concentrations at Birkenes and Zeppelin for 2023–2025, separated into liquid-fuel and solid-fuel contributions using Aethalometer source apportionment at 880 nm. Bars are grouped by month, with three bars corresponding to 2023, 2024, and 2025, respectively. Grey bars indicate liquid-fuel eBC and purple bars indicate solid-fuel eBC. Concentrations are shown in $\mu g\, m^{-3}$.

The source apportionment model indicates that around 40% of eBC at both sites is from solid fuel sources (Birkenes 39.8%, Zeppelin 40.6% in 2025), and that the solid fuel contribution is higher in winter and spring, and lower in summer. For the combined 2023 to 2025 period, the solid-fuel contribution at Birkenes increased from approximately 26% in summer to 45% during winter and spring, while at Zeppelin it increased from approximately 33% in summer to 46% during winter and spring. This likely reflects a relatively larger contribution from residential heating during cold weather, as seen in the Birkenes study by Yttri et al. (2021).

5.4.1 Levoglucosan

Levoglucosan has been routinely measured to assess biomass burning emissions at Birkenes since 2008 and at Zeppelin since 2017. The time series at Birkenes shows a consistent seasonal pattern, with elevated concentrations in winter and lower levels in summer, whereas spring and autumn are transitional periods (Figure 5.6). This pattern aligns with residential wood combustion being the primary source of levoglucosan, whereas wildfire contributions appear to be low, except for a notable episode in June 2008. Another striking feature is the year 2010, where the very cold winter across Europe (Cattiaux et al., 2010), led to a 75% increase in the annual mean compared to the long-term average.

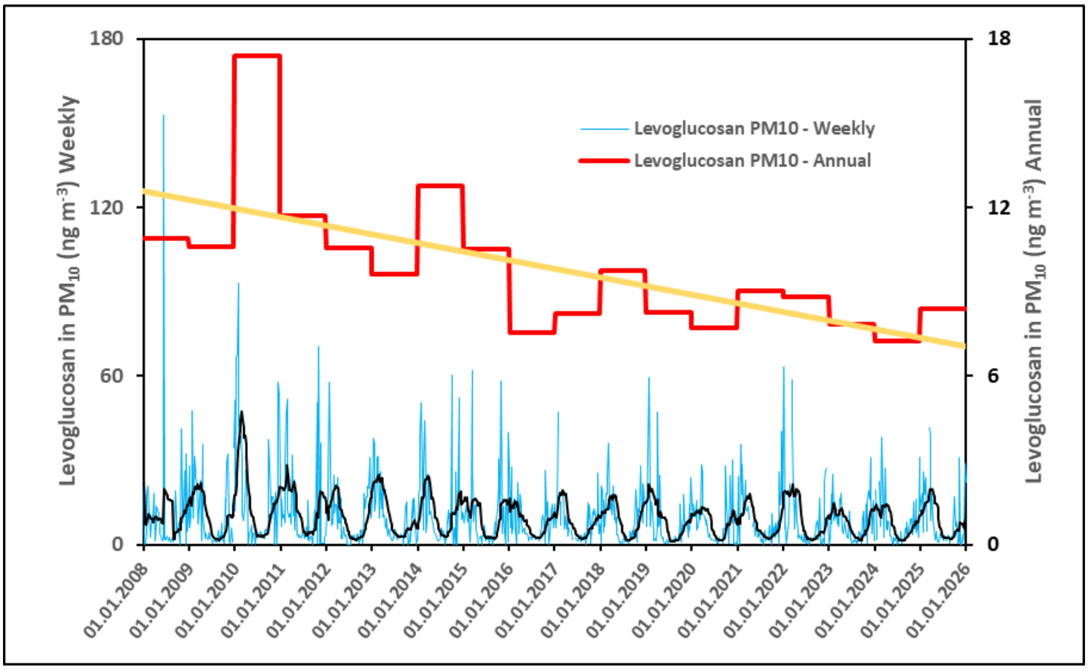

Figure 5.6: Concentrations of levoglucosan in PM_{10} at the Birkenes Observatory for the 2008 - 2025 period. Data are presented as weekly and annual mean concentrations. Trendline for the annual mean concentrations is included. The black line is the running mean.

The inter annual variability of levoglucosan (24%) matches that of elemental carbon (EC), suggesting that biomass burning is a relatively stable and consistent component of total combustion emissions over time. Based on emission ratios (Yttri et al., 2021), we estimate that biomass burning emissions contributed on average 17 – 20% to carbonaceous aerosol (on a carbon basis) and 5 – 9% to PM during the period 2008 - 2025, considering both PM_{10} and $PM_{2.5}$. In winter (December to February), when levoglucosan levels are elevated, the estimated biomass burning contribution doubles reaching 43% for carbonaceous aerosol and 12 – 19% for PM, considering both PM_{10} for $PM_{2.5}$.

The annual mean levoglucosan concentration decreased significantly (-2.2% yr^{-1}) from 2008 to 2025. This is less compared to EC (- 2.9% yr^{-1}) for the same period, indicating less effective abatement of emissions from biomass burning compared to fossil fuel combustion. As a result, the levoglucosan/EC ratio is increasing by 1.7 % yr^{-1}, which is consistent with the increasing absorption Ångström exponent (AAE) value observed at Birkenes, suggesting a growing influence of solid fuel combustion relative to liquid fuel.

5.5 Trends in Ultrafine particles

Observations at Zeppelin and Birkenes show pronounced seasonal variability in ultrafine particle concentrations and size distributions (Figures 6.7 and A3), reflecting differences in aerosol sources and atmospheric processing between Arctic and boreal environments. At Zeppelin, particle number concentrations are typically lowest during winter and early spring, despite the occurrence of Arctic haze, because the aged, transported aerosol is dominated by larger accumulation-mode particles. In contrast, summer is characterized by enhanced concentrations of ultrafine particles associated with frequent new particle formation (NPF) events linked to marine biogenic emissions from the surrounding Arctic Ocean and marginal ice zone.

Observations at Zeppelin reveal pronounced summertime increases in nucleation- and Aitken-mode particles, consistent with secondary aerosol formation processes. At Birkenes, ultrafine particle concentrations also peak during spring and summer, but with a stronger influenced from continental air masses.

Figure 5.7 shows the 2010(16)-2025 time series of UFPs concentrations in Birkenes and Zeppelin. The interannual variability of UFPs concentrations at Birkenes and Zeppelin are 10% and 23%, respectively, and no statistically significant trend are found at neither of the stations.

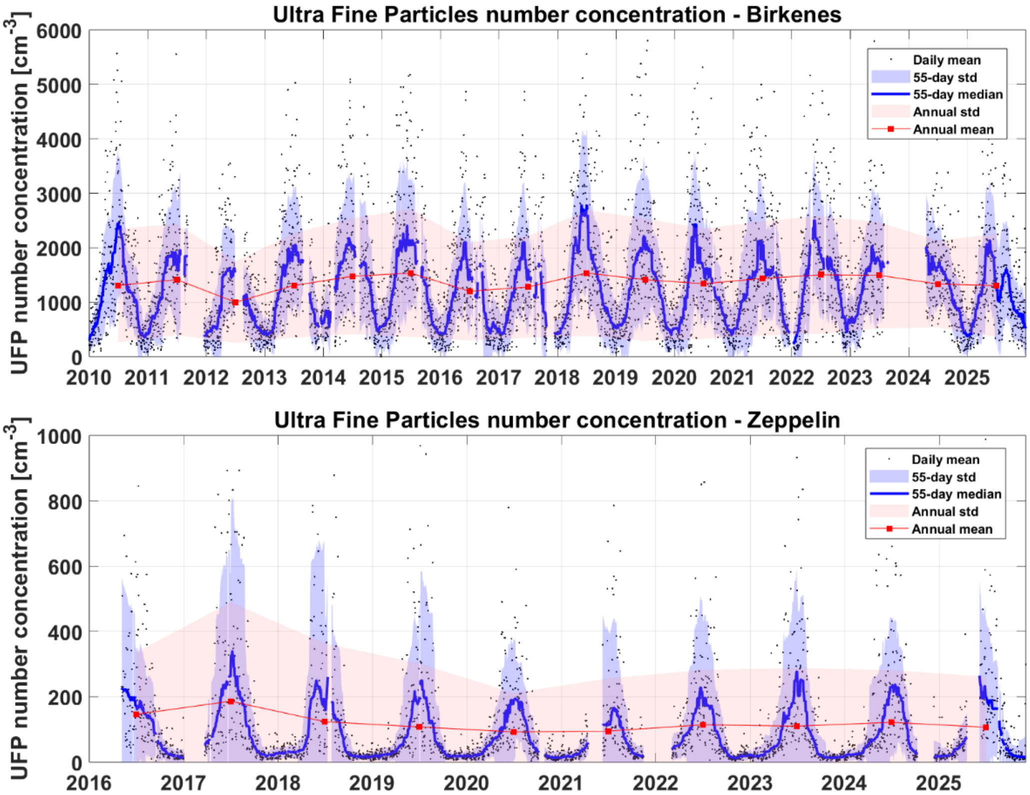

Figure 5.7 Ultrafine particles (UFPs) at Birkenes (top) and Zeppelin (bottom). Black dots show daily means, blue lines the 55-day running average, red lines the annual mean, and shaded areas the associated standard deviations.

5.6 Summary of trends

A summary of the average relative trends covered in this report is illustrated in the box plot in

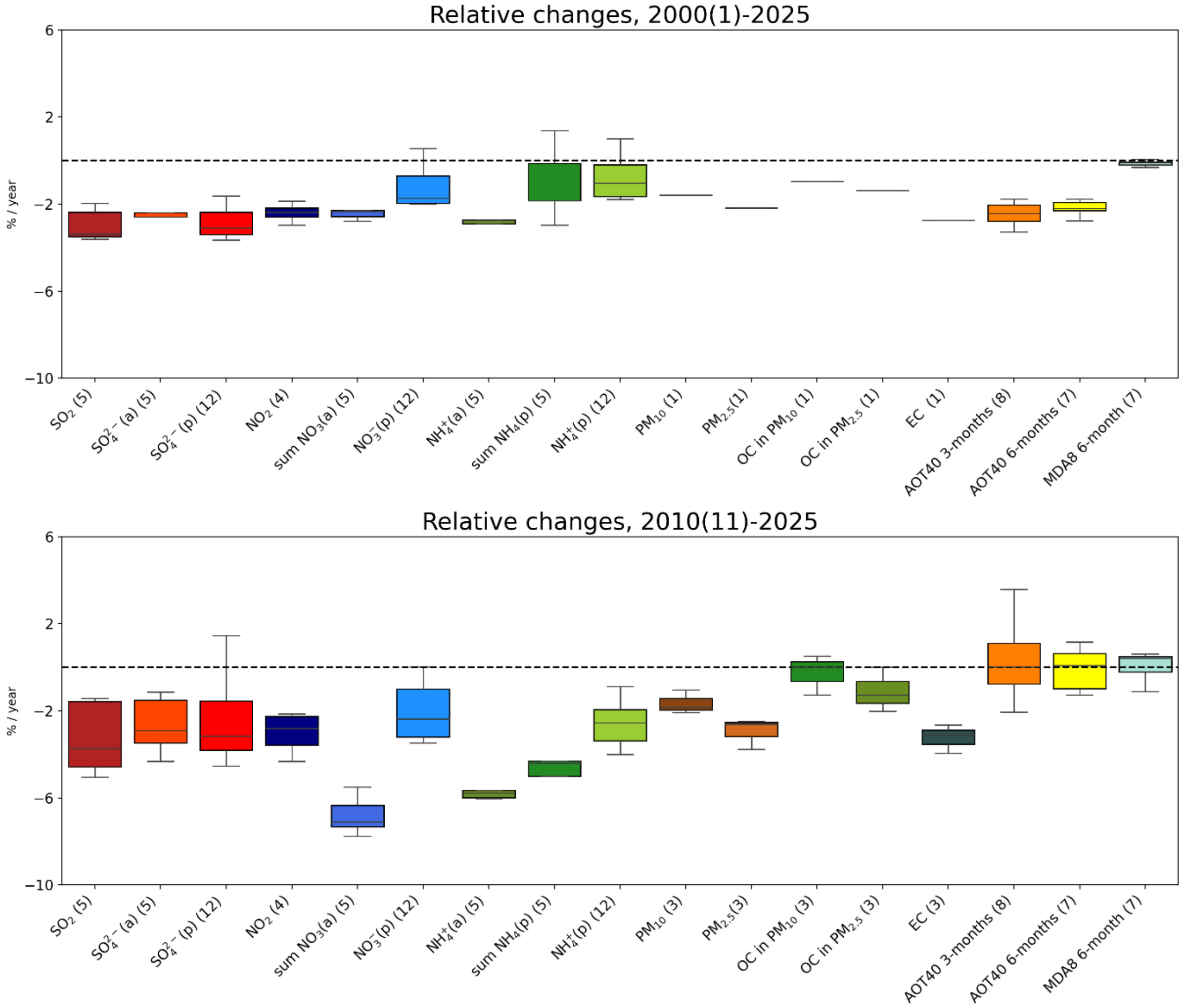

Figure 5.8.The average trends for the different sites and compounds are found in Appendix B. There are clear reductions for most of the components the last 20 years. The reductions are also seen for the shorter latter period from 2010(11), but there are larger variations between the sites, thus larger spread in the box plots, which is also reflected in less significant trend for this period (Table B1 and B.2). It should be mentioned that both the AOT metrics and the number of days above certain limits are metrics above certain levels, and thus sensitive to the prevailing levels in the years, and peaks in certain years could have strong influence on the trends. For the whole period (2000-2025) the ozone data except the peak season value indicate a significant decrease in the metrics while for the last period (2010-2025) there is no major trends.

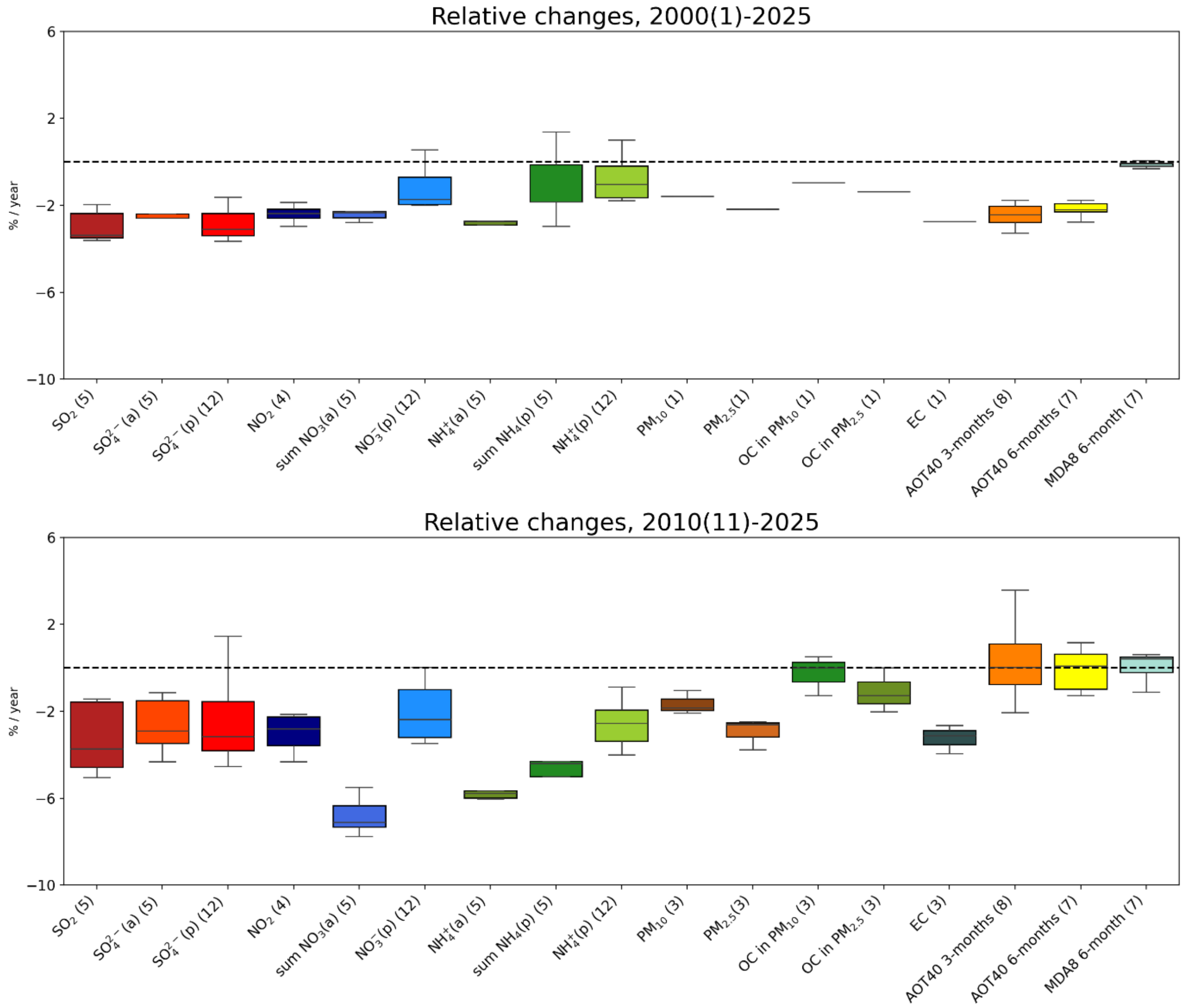

Figure 5.8: Average relative trends (Sen-Theil slope estimates) in annual levels for the period 2000(1)-2025 (top) and 2010(11)-2025 (bottom). Number of sites in the parentheses. (a) indicates in aerosols and (p) in precipitation. The box plots represent the 50th, 25th, and 75th percentiles and the whiskers lie within the 1.5 inter-quartile ranges for the trends of all the sites, including those with not significant trends.

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Appendix A

Annual and monthly mean concentrations

Table A.1: Annual volume weighted mean concentrations of inorganic ions in precipitation in 2025. (ssc= sea salt corrected, tot = total).

Site	pH	ssc SO_4 mg S/l	tot SO_4 mg S/l	NO_3 mg N/l	NH_4 mg N/l	Ca mg/l	K mg/l	Mg mg/l	Na mg/l	Cl mg/l	mm
Birkenes	5.16	0.091	0.219	0.204	0.249	0.11	0.09	0.17	1.53	2.63	1602
Grungedal	5.34	0.078	0.097	0.132	0.164	0.11	0.23	0.03	0.23	0.4	994
Treungen	5.21	0.081	0.118	0.141	0.153	0.09	0.04	0.05	0.44	0.77	1014
Løken	5.32	0.084	0.122	0.165	0.203	0.19	0.25	0.06	0.47	0.8	941
Hurdal	5.27	0.078	0.103	0.142	0.16	0.09	0.06	0.03	0.3	0.49	1043
Brekkebygda	5.17	0.097	0.118	0.129	0.335	0.13	0.11	0.02	0.26	0.42	1114
Vikedal	5.26	0.075	0.333	0.179	0.354	0.16	0.17	0.35	3.08	5.32	2794
Nausta	5.32	0.054	0.147	0.087	0.135	0.09	0.08	0.12	1.16	1.98	1958
Kårvatn	5.38	0.056	0.145	0.056	0.112	0.1	0.11	0.12	1.07	1.88	1563
Overhalla	5.56	0.049	0.24	0.063	0.186	0.21	0.11	0.27	2.28	3.99	1610
Tustervatn	5.4	0.031	0.123	0.055	0.101	0.08	0.11	0.12	1.11	1.95	1304
Svanvik	5.15	0.117	0.202	0.054	0.057	0.14	0.08	0.12	1.02	1.77	523
Ny-Ålesund	5.64	0.092	0.566	0.057	0.119	0.6	0.41	0.76	5.61	10.12	237

Table A.2: Annual wet deposition of inorganic components in 2025 (ssc= sea salt corrected, tot = total).

Site	H^+	ssc SO_4 mg S/m²	tot SO_4 mg S/m²	NO_3 mg N/m²	NH_4 mg N/m²	Ca mg /m²	K mg /m²	Mg mg /m²	Na mg /m²	Cl mg /m²	mm
Birkenes	11046	145	350	327	399	183	150	277	2451	4219	1602
Grungedal	4566	78	96	132	163	107	225	32	225	393	994
Treungen	6208	82	120	143	156	92	37	50	451	782	1014
Løken	4526	79	115	155	191	180	232	61	438	755	941
Hurdal	5640	82	108	148	167	94	64	32	318	509	1043
Brekkebygda	7579	108	131	144	374	147	124	25	287	468	1114
Vikedal	15352	210	929	501	990	458	470	986	8610	14859	2794
Nausta	9353	106	287	170	263	176	149	238	2281	3866	1958
Kårvatn	6525	87	227	87	175	162	169	181	1668	2942	1563
Overhalla	4392	79	386	101	299	338	181	433	3663	6420	1610
Tustervatn	5233	40	161	71	131	97	142	156	1445	2541	1304
Svanvik	3681	61	106	28	30	71	40	62	532	925	523
Ny-Ålesund	543	22	134	13	28	141	98	180	1331	2400	237

Table A.3: Annual mean concentrations of inorganic components in air in 2025.

Site	SO_2	SO_4^{2-}	NO_2	sum of (HNO_3 + NO_3^-)	NO_3^-	sum of (NH_3 + NH_4^+)	NH_4^+	Mg^{2+}	Ca^{2+}	K^+	Cl^-	Na^+
	µg-S/m³	µg-S/m³	µg-N/m³	µg-N/m³	µg-N/m³	µg-N/m³	µg-N/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Birkenes II	0.028	0.179	0.234	0.141	0.121	0.281	0.106	0.057	0.039	0.042	0.621	0.483
Hurdal	0.032	0.087	0.306	0.061	0.046	0.209	0.047	0.016	0.021	0.036	0.153	0.139
Kårvatn	0.03	0.077	0.152	0.032	0.021	0.705	0.029	0.023	0.027	0.021	0.274	0.191
Tustervatn	0.034	0.084	0.086	0.03	0.02	0.341	0.032	0.034	0.02	0.028	0.476	0.307
Zeppelinfjellet	0.046	0.116	-	0.022	0.011	0.152	0.024	0.031	0.022	0.021	0.413	0.273

Table A.4: Annual mean concentrations of aerosol mass and carbonaceous aerosols in 2025.

	PM_{10}					$PM_{2.5}$			
	PM_{10} mass	OC	EC	TC	Levoglucosan	$PM_{2.5}$ mass	OC	EC	TC
	µg/m³	µg C/m³	µg C/m³	µg C/m³	ng/m³	µg/m³	µg C/m³	µg C/m³	µg C/m³
Birkenes II	4.03	0.79	0.05	0.84	8.42	2.09	0.54	0.05	0.58
Hurdal	3.73	1.11	0.07	1.18		1.00	0.61	0.07	0.68
Kårvatn	2.26	0.58	0.04	0.62		1.25	0.42	0.03	0.45
Zeppelinfjellet		0.160	0.015	0.175	0.31				

Table A.5: Monthly and annual volume weighted mean pH in precipitation in 2025.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes	5.14	5.07	5.41	5.47	5.22	5.16	5.12	5.39	5.37	5.14	5.16	4.99	5.16
Grungedal	5.36	5.38	5.85	6.19	5.7	5.77	5.22	5.43	5.23	5.43	5.48	5.17	5.34
Treungen	5.11	5.34	5.38	6.22	5.15	5.11	5.05	5.44	5.35	5.18	5.26	5.02	5.21
Løken	5.02	5.7	5.77	5.97	5.51	5.23	5.24	5.25	5.49	5.28	5.46	5.33	5.32
Hurdal	5.28	5.6	5.94	5.19	5.45	5.31	5.11	5.33	5.29	5.27	5.18	5.25	5.27
Brekkebygda	5.05	5.13	5.28	6.09	5.02	5.06	5.56	4.91	5.07	5.27	5.38	5.11	5.17
Vikedal	5.48	5.26	5.83	4.72	4.69	5.45	6.18	5.21	5.27	5.3	5.38	5.4	5.26
Nausta	5.4	5.29	5.54	5.53	5.16	5.3	4.92	5.22	5.18	5.09	5.36	5.26	5.32
Kårvatn	5.17	5.36	5.54	5.44	5.34	5.4	5.25	5.27	5.32	5.4	5.53	5.54	5.38
Overhalla	5.61	5.42	5.65	5.82	5.68	5.31	5.51	5.34	6.15	5.8	5.56	5.45	5.56
Tustervatn	5.31	5.22	5.43	5.38	5.4	5.37	5.22	5.62	5.61	5.36	5.44	5.44	5.4
Svanvik	5.16	5.18	5.22	5.1	4.96	4.93	4.95	5.18	5.68	5.47	5.48	5.16	5.15
Ny-Ålesund	5.81	5.78	5.55	5.24	5.27	5.17	5.83	5.74	5.61	6.18	6.38	5.76	5.64

Table A.6: Monthly and annual volume weighted average concentrations of sulfate (sea salt corrected) in precipitation in 2025. Unit: mg S/L.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes	0.033	0.181	0.083	0.163	0.106	0.156	0.103	0.106	0.101	0.063	0.064	0.089	0.091
Grungedal	0.016	0.026	0.046	0.245	0.198	0.141	0.109	0.122	0.091	0.057	0.027	0.024	0.078
Treungen	0.024	0.084	0.136	0.22	0.114	0.121	0.101	0.122	0.111	0.034	0.03	0.038	0.081
Løken	0.044	0.105	0.163	0.205	0.119	0.095	0.107	0.087	0.096	0.064	0.049	0.074	0.084
Hurdal	0.032	0.139	0.103	0.318	0.128	0.127	0.07	0.061	0.087	0.046	0.056	0.043	0.078
Brekkebygda	0.02	0.087	0.048	0.317	0.097	0.137	0.223	0.107	0.12	0.01	0.066	0.027	0.097
Vikedal	0.01	0.065	0.086	0.279	0.176	0.212	0.195	0.163	0.078	0.031	0.02	0.013	0.075
Nausta	0.012	0.039	0.048	0.1	0.107	0.157	0.176	0.083	0.041	0.038	0.017	0.017	0.054
Kårvatn	0.028	0.018	0.03	0.062	0.13	0.117	0.159	0.06	0.034	0.013	0.023	0.02	0.056
Overhalla	0.01	0.034	0.029	0.045	0.164	0.112	0.084	0.088	0.045	0.028	0.015	0.009	0.049
Tustervatn	0.014	0.02	0.028	0.053	0.092	0.072	0.067	0.055	0.016	0.012	0.01	0.016	0.031
Svanvik	0.059	0.105	0.105	0.192	0.233	0.361	0.155	0.079	0.069	0.08	0.037	0.053	0.117
Ny-Ålesund	0.11	0.002	0.065	0.37	0.144	0.441	0.471	0.206	0.035	0.069	0.073	0.123	0.092

Table A.7: Monthly and annual volume weighted average concentrations of nitrate in precipitation in 2025. Unit: mg N/L.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes	0.139	0.5	0.296	0.34	0.198	0.242	0.098	0.196	0.172	0.124	0.173	0.25	0.204
Grungedal	0.088	0.128	0.082	0.406	0.091	0.147	0.115	0.233	0.145	0.106	0.061	0.083	0.132
Treungen	0.1	0.23	0.226	0.382	0.146	0.219	0.031	0.214	0.149	0.05	0.107	0.137	0.141
Løken	0.19	0.367	0.499	0.363	0.092	0.175	0.133	0.143	0.119	0.108	0.165	0.291	0.165
Hurdal	0.113	0.631	0.278	0.452	0.17	0.178	0.081	0.098	0.097	0.064	0.147	0.183	0.142
Brekkebygda	0.084	0.378	0.094	0.523	0.144	0.255	0.043	0.105	0.151	0.005	0.183	0.183	0.129
Vikedal	0.094	0.188	0.16	0.94	1.12	0.16	0.109	0.189	0.105	0.036	0.059	0.06	0.179
Nausta	0.032	0.112	0.093	0.184	0.078	0.124	0.151	0.047	0.075	0.072	0.057	0.076	0.087
Kårvatn	0.059	0.089	0.054	0.091	0.079	0.092	0.06	0.024	0.047	0.044	0.052	0.029	0.056
Overhalla	0.034	0.068	0.04	0.077	0.124	0.074	0.009	0.065	0.034	0.098	0.044	0.046	0.063
Tustervatn	0.038	0.106	0.05	0.064	0.082	0.069	0.076	0.104	0.057	0.036	0.022	0.045	0.055
Svanvik	0.059	0.079	0.088	0.144	0.092	0.169	0.055	0.018	0.009	0.014	0.049	0.057	0.054
Ny-Ålesund	0.034	0.078	0.152	0.089	0.095	0.329	0.128	0.159	0.034	0.025	0.027	0.059	0.057

Table A.8: Monthly and annual volume weighted average concentrations of ammonium in precipitation in 2024. Unit: mg N/L.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes	0.182	0.796	0.255	0.832	0.228	0.277	0.072	0.298	0.276	0.11	0.135	0.168	0.249
Grungedal	0.129	0.151	0.335	1.096	0.328	0.25	0.087	0.366	0.125	0.05	0.067	0.073	0.164
Treungen	0.069	0.432	0.334	1.026	0.127	0.185	0.008	0.277	0.157	0.008	0.015	0.032	0.153
Løken	0.209	0.669	0.89	0.901	0.11	0.161	0.1	0.056	0.347	0.043	0.176	0.326	0.203
Hurdal	0.062	0.699	0.402	1.133	0.289	0.229	0.034	0.134	0.135	0.044	0.088	0.104	0.16
Brekkebygda	0.022	0.497	0.037	1.23	0.113	0.225	1.665	0.059	0.126	0.008	0.075	0.053	0.335
Vikedal	0.792	0.314	0.421	1.127	0.362	0.803	1.372	0.314	0.116	0.024	0.084	0.096	0.354
Nausta	0.074	0.091	0.191	0.359	0.112	0.256	0.119	0.04	0.028	0.04	0.078	0.086	0.135
Kårvatn	0.127	0.073	0.073	0.25	0.215	0.165	0.136	0.013	0.161	0.055	0.091	0.155	0.112
Overhalla	0.232	0.152	0.22	0.443	0.41	0.116	0.045	0.117	0.197	0.141	0.093	0.087	0.186
Tustervatn	0.036	0.091	0.1	0.2	0.138	0.099	0.117	0.274	0.154	0.046	0.021	0.079	0.101
Svanvik	0.036	0.066	0.111	0.237	0.11	0.11	0.033	0.008	0.016	0.009	0.15	0.054	0.057
Ny-Ålesund	0.151	0.531	0.163	0.088	0.076	0.165	0.239	0.226	0.03	0.126	0.074	0.185	0.119

Table A.9: Monthly and annual precipitation amount at Norwegian background stations in 2024. Unit: mm.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes	199.0	111.0	24.0	44.0	62.0	59.0	68.0	97.0	269.0	242.0	180.0	247.0	1602.0
Grungedal	47.0	45.0	17.0	22.0	29.0	44.0	48.0	104.0	291.0	136.0	93.0	118.0	994.0
Treungen	108.0	60.0	24.0	34.0	35.0	43.0	71.0	88.0	227.0	137.0	64.0	123.0	1014.0
Løken	56.0	37.0	6.0	20.0	29.0	109.0	71.0	140.0	149.0	149.0	111.0	64.0	941.0
Hurdal	123.0	26.0	5.0	32.0	70.0	110.0	85.0	94.0	132.0	172.0	107.0	89.0	1043.0
Brekkebygda	75.0	38.0	7.0	27.0	60.0	75.0	151.0	66.0	227.0	216.0	88.0	86.0	1114.0
Vikedal	162.0	213.0	243.0	74.0	131.0	247.0	120.0	290.0	246.0	228.0	402.0	440.0	2794.0
Nausta	217.0	110.0	464.0	166.0	105.0	116.0	60.0	89.0	128.0	44.0	251.0	207.0	1958.0
Kårvatn	98.0	47.0	209.0	90.0	88.0	146.0	108.0	198.0	95.0	165.0	195.0	122.0	1563.0
Overhalla	161.0	67.0	207.0	122.0	81.0	135.0	42.0	177.0	75.0	248.0	155.0	141.0	1610.0
Tustervatn	194.0	45.0	171.0	94.0	43.0	106.0	42.0	108.0	92.0	196.0	118.0	96.0	1304.0
Svanvik	34.0	21.0	21.0	27.0	36.0	23.0	95.0	84.0	69.0	42.0	28.0	42.0	523.0
Ny-Ålesund	18.0	13.0	5.0	4.0	25.0	4.0	5.0	7.0	85.0	40.0	12.0	19.0	237.0

Table A.10: Monthly and annual mean concentrations of sulfur dioxide in air in 2025. Unit: µg S/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes II	0.014	0.024	0.024	0.034	0.043	0.034	0.043	0.047	0.03	0.018	0.012	0.012	0.028
Hurdal	0.018	0.017	0.027	0.048	0.069	0.055	0.051	0.036	0.025	0.014	0.01	0.01	0.032
Kårvatn	0.02	0.025	0.018	0.031	0.034	0.046	0.048	0.039	0.025	0.03	0.012	0.012	0.03
Tustervatn	0.046	0.019	0.024	0.018	0.028	0.037	0.031	0.096	0.051	0.019	0.011	0.017	0.034
Zeppelinfjellet	0.07	0.025	0.166	0.123	0.016	0.017	0.032	0.017	0.014	0.014	0.01	0.037	0.046

Table A.11: Monthly and annual mean concentrations of sulfate in aerosol in 2025. Unit: µg S/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes II	0.093	0.106	0.305	0.139	0.215	0.265	0.256	0.224	0.18	0.12	0.118	0.124	0.179
Hurdal	0.035	0.06	0.085	0.085	0.09	0.092	0.166	0.106	0.151	0.065	0.057	0.044	0.087
Kårvatn	0.025	0.021	0.051	0.085	0.141	0.091	0.162	0.08	0.079	0.089	0.016	0.032	0.077
Tustervatn	0.056	0.086	0.077	0.106	0.148	0.091	0.132	0.102	0.095	0.045	0.024	0.037	0.084
Zeppelinfjellet	0.135	0.167	0.183	0.196	0.159	0.101	0.116	0.102	0.038	0.062	0.046	0.093	0.116

Table A.12: Monthly and annual mean concentrations of nitrogen dioxide in 2025. Unit: µg N/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes II	0.213	0.376	0.196	0.165	0.196	0.158	0.135	0.175	0.344	0.195	0.386	0.286	0.234
Hurdal	0.448	0.756	0.392	0.226	0.173	0.2	0.114	0.163	0.263	0.281	0.42	0.273	0.306
Kårvatn	0.174	0.187	0.085	0.068	0.096	0.089	0.166	0.148	0.207	0.267	0.351	0.142	0.152
Tustervatn	0.083	0.081	0.057	0.069	0.079	0.068	0.054	0.095	0.131	0.12	0.115	0.068	0.086

Table A.13: Monthly and annual mean concentrations of sum of nitrate and nitric acid in air in 2025. Unit: µg N/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes II	0.08	0.16	0.29	0.12	0.15	0.17	0.09	0.18	0.14	0.07	0.14	0.09	0.14
Hurdal	0.05	0.1	0.08	0.06	0.05	0.05	0.06	0.05	0.07	0.04	0.07	0.06	0.06
Kårvatn	0.02	0.02	0.03	0.04	0.06	0.03	0.04	0.02	0.03	0.03	0.02	0.02	0.03
Tustervatn	0.02	0.03	0.02	0.04	0.04	0.04	0.03	0.03	0.04	0.02	0.02	0.03	0.03
Zeppelinfjellet	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Table A.14: Monthly and annual mean concentrations of sum of ammonium and ammonia in air in 2025. Unit: µg N/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes II	0.12	0.339	0.369	0.375	0.35	0.263	0.298	0.35	0.266	0.187	0.254	0.213	0.281
Hurdal	0.176	0.191	0.194	0.306	0.233	0.198	0.242	0.27	0.232	0.138	0.139	0.188	0.209
Kårvatn	0.742	0.954	0.483	0.579	0.566	0.782	1.043	0.619	0.783	0.645	0.4	0.599	0.705
Tustervatn	0.223	0.181	0.241	0.315	0.368	0.371	0.53	0.729	0.558	0.188	0.15	0.184	0.341
Zeppelinfjellet	0.215	0.184	0.215	0.176	0.133	0.105	0.123	0.179	0.095	0.111	0.153	0.14	0.152

Table A.15: Monthly and annual mean of aerosol mass concentrations in 2025. Unit: µg/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2025
							PM_{10}						
Birkenes II	2.8	2.73	4.27	3.6	5.67	5.24	5.46	5.35	3.88	3.26	2.93	2.98	4.03
Hurdal	2.25	2.85	4.05	3.38	3.91	4.23	6.56	4.09	6.18	3.04	2.29	1.83	3.73
Kårvatn	1.12	0.89	1.69	3.18	1.75	3.73	6.42	2.74	2.63	1.59	0.84	1.2	2.26
							$PM_{2.5}$						
Birkenes II	1.61	1.93	2.28	2.0	2.48	2.74	4.17	2.68	1.64	0.73	1.2	1.23	2.09
Hurdal	1.62	1.94	1.73	1.62	2.03	2.46	4.4	2.21	2.27	1.23	1.34	1.01	2.0
Kårvatn	0.71	0.61	0.97	1.66	1.02	2.32	3.88	1.41	1.19	0.61	0.31	0.56	1.25

Table A.16: Monthly and annual mean concentrations of organic carbon (OC) in 2025. Unit: µgC/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2025
							OC in PM_{10}						
Birkenes II	0.300	0.428	0.770	0.704	1.228	0.946	1.732	0.927	0.839	0.644	0.542	0.358	0.788
Hurdal	0.559	0.517	0.635	0.727	0.935	1.384	2.362	1.358	2.563	1.243	0.575	0.414	1.109
Kårvatn	0.215	0.239	0.306	0.471	0.611	1.051	1.637	0.945	0.965	0.414	0.236	0.273	0.580
Zeppelinfjellet	0.201	0.220	0.237	0.157	0.132	0.187	0.133	0.252	0.160	0.089	0.054	0.073	0.160
							OC in $PM_{2.5}$						
Birkenes II	0.235	0.395	0.550	0.543	0.689	0.715	1.350	0.673	0.398	0.235	0.336	0.283	0.535
Hurdal	0.530	0.449	0.481	0.443	0.545	0.815	1.455	0.687	0.712	0.410	0.389	0.332	0.608
Kårvatn	0.203	0.255	0.249	0.396	0.467	0.758	1.528	0.496	0.430	0.205	0.121	0.275	0.417

Table A.17: Monthly and annual mean concentrations of elemental carbon (EC) in 2025. Unit: µgC/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2025
	EC in PM_{10}												
Birkenes II	0.046	0.066	0.093	0.053	0.055	0.027	0.038	0.039	0.042	0.050	0.057	0.046	0.050
Hurdal	0.110	0.107	0.092	0.058	0.039	0.046	0.044	0.051	0.079	0.085	0.097	0.076	0.074
Kårvatn	0.041	0.056	0.034	0.034	0.007	0.036	0.026	0.030	0.040	0.039	0.039	0.070	0.039
Zeppelinfjellet	0.038	0.029	0.050	0.022	0.007	0.004	0.004	0.005	0.004	0.004	0.004	0.009	0.015
	EC in $PM_{2.5}$												
Birkenes II	0.050	0.065	0.070	0.044	0.033	0.032	0.039	0.037	0.041	0.046	0.060	0.044	0.047
Hurdal	0.115	0.106	0.083	0.055	0.043	0.050	0.040	0.043	0.070	0.079	0.089	0.076	0.070
Kårvatn	0.044	0.053	0.034	0.024	0.013	0.033	0.027	0.020	0.028	0.036	0.038	0.031	0.033

Table A.18: Monthly and annual mean concentrations of levoglucosan in PM_{10} in 2025. Unit: ng /m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes II	13.79	16.34	27.07	10.26	2.41	2.92	2.07	2.01	3.41	8.69	7.52	9.21	8.42
Zeppelinfjellet	0.75	0.44	0.23	0.12	0.06	0.11	0.11	0.42	0.12	0.34	0.43	0.62	0.31

Table A.19: Different metrics for ozone in 2025: The annual number of days with Max Daily 8h running average (MDA8) exceeding different health indicators and thresholds, and Accumulated exposure over the threshold of 40 ppb (AOT40), corresponding to 80 µg/m³, during the growing season for forest (6 months: 1 April – 30 Sept.), semi-natural vegetation (1 May – 31 July) and the maximum hourly concentrations. The values above the critical levels for vegetation are marked in bold.

Site	6-months MDA8, µg/m³ (AQG= 60 µg/m³)	MDA8 >80 µg/m³ nr of days	MDA8 >100 µg/m³ nr of days	MDA8 >120 µg/m³ nr of days	AOT 40 (µg/m³ hours) 3 months, vegetation	AOT 40 (µg/m³ hours) 6 months, forest	Max hourly conc. µg /m³	Max hourly conc. Date
Birkenes II	79	102	6	0	3440	5212	124	2025-07-01
Hurdal	77	104	8	0	3463	5930	120	2025-07-25
Prestebakke	77	82	4	0	2691	4487	116	2025-05-13
Haukenes	82	91	6	0	2714	4370	118	2025-04-12
Sandve[1)]	*87*	*99*	*2*	*0*	too low data capture		*108*	2025-08-14
Kårvatn	72	124	8	0	2467	5670	116	2025-04-16
Tustervatn[2)]	85	136	2	0	too low data capture		112	2025-06-14
Svanvik	70	89	4	0	1558	3320	106	2025-03-25
Zeppelin	71	96	0	0	344	1078	98	2025-02-22

1) Measurements at Sandve are missing from 6. June to 9. July.
2) Measurements at Tustervatn missing from 15 July to 18 August

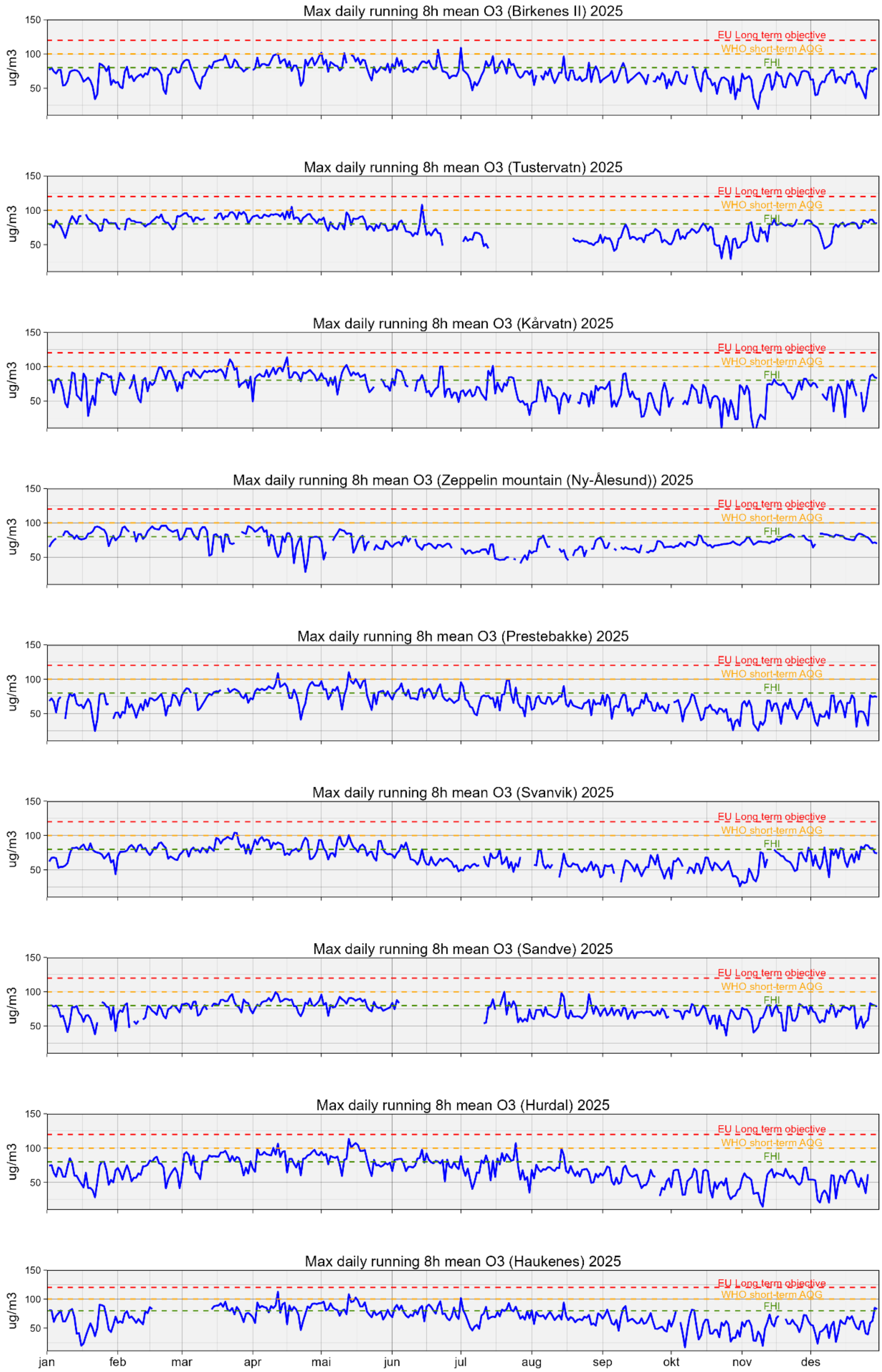


Figure A.1: Norwegian ozone sites in 2025 compared to threshold and target values set by (EU, 2024; FHI, 2024; WHO, 2021).

Table A.20: Monthly and annual mean concentrations of equivalent black carbon (eBC) for Birkenes and Zeppelin in 2025. Unit: µg/m³.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes	0.043	0.076	0.073	0.046	0.032	0.041	0.061	0.054	0.046	0.049	0.071	0.053	0.054
Zeppelin	0.020	0.009	0.042	0.024	0.013	0.009	0.006	0.008	0.003	0.007	0.004	0.007	0.013

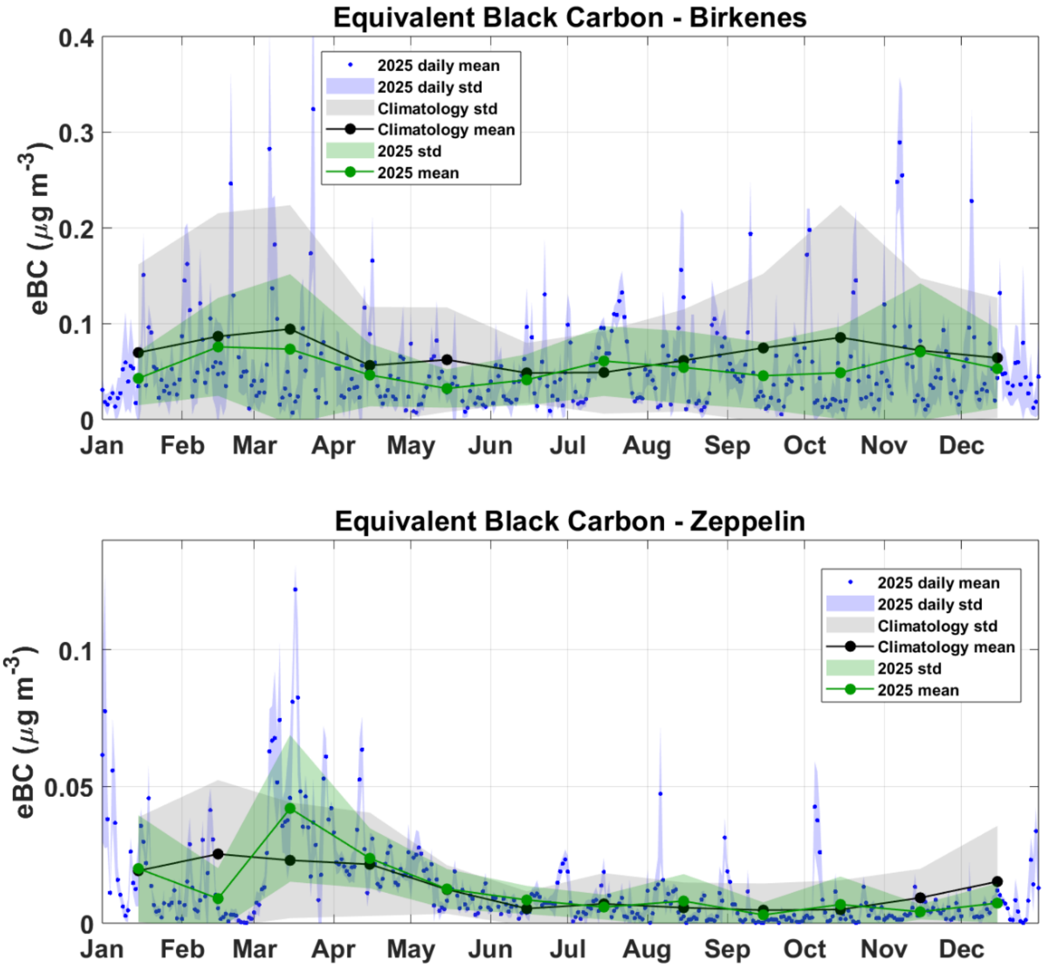


Figure A.2: Concentrations of equivalent black carbon (eBC) at Birkenes (top) and Zeppelin (bottom). Blue circle markers show 2025 daily average, blue solid lines 2025 daily standard deviation and the green line 2025 monthly mean and standard deviation. The black circles indicate the 2012(15)-2024 climatology monthly mean and the grey area the standard deviation.

Table A.21: Monthly and annual mean concentrations of ultra fine particles (UFP) for Birkenes and Zeppelin in 2025. Unit: cm^{-3}.

SITE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Birkenes	431	893	985	1551	1870	1449	950	1515	1413	952	965	762	1145
Zeppelin	26	30	59	96	-	371	212	168	74	35	29	-	110

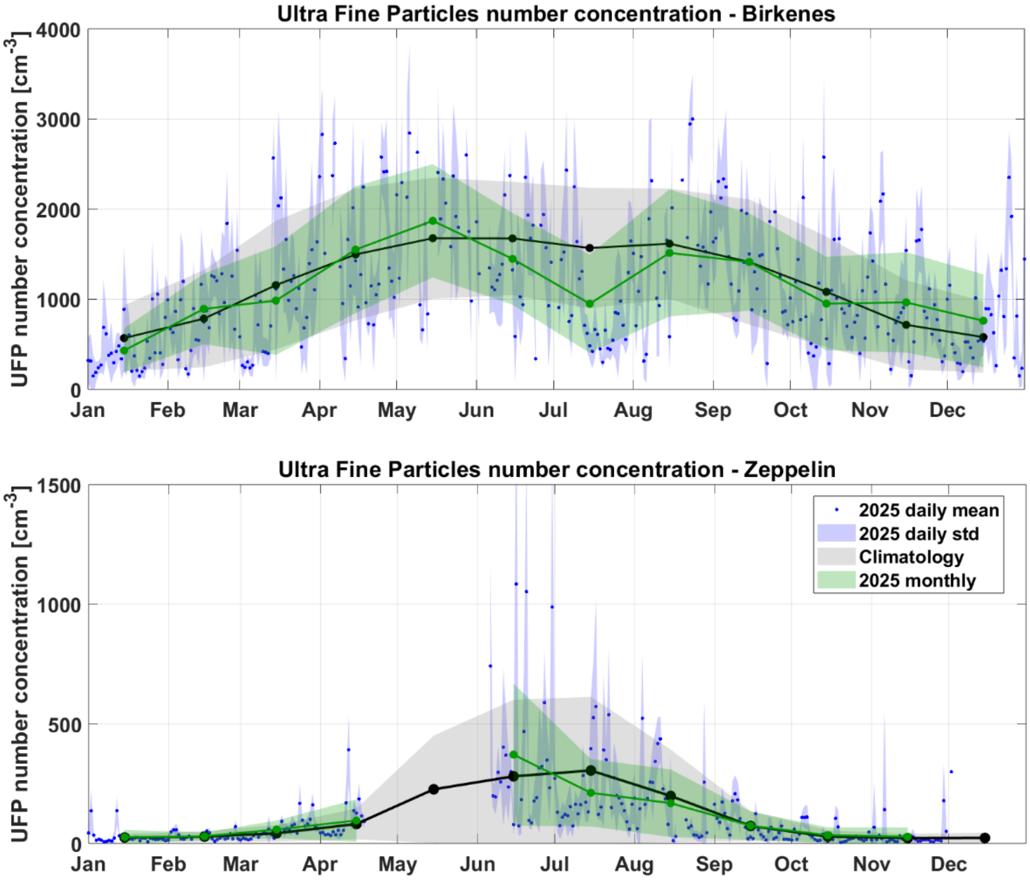


Figure A.3: The concentrations of ultrafine particles (UFPs) at Birkenes (top) and Zeppelin (bottom). Blue circle markers show 2025 daily average, blue solid lines 2025 daily standard deviation, and the green line 2025 monthly mean and standard deviation. The black line indicate the 2010(16)-2024 monthly mean and the grey area the standard deviation.

Appendix B

Trend results 2000(2010) to 2025

Table B.1: Absolute and relative change and corresponding 95% confidence intervals in annual concentrations for sulfur and nitrogen compounds in air and precipitation for 2000-2025 and 2010-2025. The number of sites with a significant outcome is provided.

		Nr of sites		Abs. change (mg/L or ug S(N)/m^3)/y		Relative change (%/y)	
component	period	tot	sign	slope	Conf. Interval.	slope	Conf. Interval.
SO_2	2000-2025	5	5	-0.003	(-0.005, -0.001)	-2.96	(-3.88, -2.04)
SO_2	2010-2025	5	2	-0.002	(-0.004, 0.0)	-3.27	(-5.36, -1.18)
SO_4^{2-} in aerosols	2000-2025	5	5	-0.007	(-0.012, -0.002)	-2.41	(-3.23, -1.59)
SO_4^{2-} in aerosols	2010-2025	5	3	-0.005	(-0.01, 0.0)	-2.67	(-4.32, -1.02)
SO_4^{2-} in precip.	2000-2025	12	11	-0.006	(-0.008, -0.004)	-2.87	(-3.31, -2.43)
SO_4^{2-} in precip.	2010-2025	12	6	-0.004	(-0.007, -0.001)	-2.64	(-3.74, -1.54)
NO_2	2000-2025	4	4	-0.012	(-0.03, 0.006)	-2.4	(-3.13, -1.67)
NO_2	2010-2025	4	3	-0.013	(-0.037, 0.011)	-3.01	(-4.62, -1.4)
NO_3^- in aerosol	2000-2025	5	5	-0.002	(-0.003, -0.001)	-2.16	(-2.64, -1.68)
NO_3^- in aerosol	2010-2025	5	5	-0.008	(-0.012, -0.004)	-7.01	(-8.74, -5.28)
sum(HNO_3 + NO_3^-)	2000-2025	5	5	-0.004	(-0.007, -0.001)	-2.35	(-2.81, -1.89)
sum(HNO_3 + NO_3^-)	2010-2025	5	5	-0.011	(-0.017, -0.005)	-6.8	(-7.91, -5.69)
NO_3^- in precip.	2000-2025	12	8	-0.004	(-0.006, -0.002)	-1.35	(-1.88, -0.82)
NO_3^- in precip.	2010-2025	12	7	-0.005	(-0.008, -0.002)	-2.07	(-2.88, -1.26)
NH_4^+ in aerosol	2000-2025	5	4	-0.005	(-0.009, -0.001)	-2.55	(-3.53, -1.57)
NH_4^+ in aerosol	2010-2025	5	4	-0.008	(-0.013, -0.003)	-5.62	(-6.3, -4.94)
sum(NH_4^+ + NH_3)	2000-2025	5	3	-0.009	(-0.024, 0.006)	-1.09	(-3.21, 1.03)
sum(NH_4^+ + NH_3)	2010-2025	5	4	-0.018	(-0.031, -0.005)	-3.84	(-6.19, -1.49)
NH_4^+ in precip.	2000-2025	12	6	-0.003	(-0.005, -0.001)	-0.81	(-1.4, -0.22)
NH_4^+ in precip.	2010-2025	12	6	-0.006	(-0.009, -0.003)	-2.32	(-3.25, -1.39)
Na^+ in aerosol	2000-2025	5	2	0	(-0.003, 0.003)	-0.03	(-1.08, 1.02)
Na^+ in precip.	2000-2025	12	0	-0.008	(-0.025, 0.009)	0.06	(-0.57, 0.69)
Ca^+ in aerosol	2000-2025	5	2	-0.001	(-0.002, -0.0)	-1.13	(-2.17, -0.09)
Ca^+ in precip.	2000-2025	12	3	-0.001	(-0.004, 0.002)	0.59	(-0.41, 1.59)
K^+ in aerosol	2000-2025	5	2	0	(-0.001, 0.001)	0.47	(-2.85, 3.79)
K^+ in precip.	2000-2025	12	3	0.001	(-0.0, 0.002)	1.18	(-0.85, 3.21)
precip amount	2000-2025	12	1	2.553	(-2.863, 7.969)	0.29	(-0.17, 0.75)

Table B.2: Absolute and relative change and corresponding 95% confidence intervals in annual concentrations for selected ozone metrics for 2000-2025 and 2010-2025. The number of sites with a significant outcome is provided.

		Nr of sites		Abs. change (µg/m^3/y or ppb h/y)		Relative change (%/y)	
component	period	tot	sign	slope	Conf. Interval.	slope	Conf. Interval.
AOT_3mon	2000-2025	8	4	-112	(-157, -67)	-2.30	(-3.03, -1.57)
AOT_3mon	2010-2025	8	0	5.7	(-42, 53)	0.31	(-1.17, 1.79)
AOT_6mon	2000-2025	7	4	-206	(-305, -108)	-1.98	(-2.66, -1.3)
AOT_6mon	2010-2025	7	0	8.8	(-71, 89)	0.23	(-1.32, 1.78)
MDA8_6mon	2000-2025	7	1	-0.115	(-0.213, -0.017)	-0.15	(-0.27, -0.03)
MDA8_6mon	2010-2025	8	2	-0.011	(-0.455, 0.477)	0.07	(-0.49, 0.63)

Table B.3: Average absolute and relative changes and corresponding 95% confidence intervals in annual concentrations for aerosol mass concentration and chemical composition for 2000(1)-2025 and 2011-2025. Individual trends for the different sites, components and fractions are also provided Trends that are not significant are given in italic.

				Absolute change		Relative change	
Site	Period	Component	p_value	µg/m^3/y	Conf. Int.	%/y	Conf. Int.
Birkenes	2000-2025	PM_{10} mass conc.	6.03E-05	-0.106	(-0.145, -0.067)	-1.58	(-2.17, -1.0)
Birkenes	2001-2025	$PM_{2.5}$ mass conc.	5.26E-06	-0.09	(-0.128, -0.066)	-2.18	(-3.1, -1.61)
Birkenes	2001-2025	PM_{10}-$PM_{2.5}$ mass	*0.27*	*-0.012*	*(-0.037, 0.008)*	*-0.49*	*(-1.57, 0.31)*
Birkenes	2001-2025	SO_4^{2-} in aerosols	2.45E-07	-0.036	(-0.049, -0.026)	-3.14	(-4.29, -2.31)
Birkenes	2001-2025	NO_3^- in aerosols	0.018	-0.017	(-0.031, -0.004)	-1.71	(-3.11, -0.37)
Birkenes	2001-2025	NH_4^+ in aerosols	4.81E-05	-0.014	(-0.018, -0.007)	-3.02	(-3.86, -1.6)
Birkenes	2001-2025	Sea salts in aerosols	0.0006	0.02	(0.011, 0.032)	2.68	(1.39, 4.28)
Birkenes	2001-2025	TC in PM_{10}	0.006	-0.013	(-0.02, -0.005)	-1.16	(-1.83, -0.44)
Birkenes	2001-2025	TC in $PM_{2.5}$	0.0004	-0.013	(-0.02, -0.005)	-1.52	(-2.44, -0.56)
Birkenes	2001-2025	OC in PM_{10}	0.022	-0.009	(-0.015, -0.001)	-0.95	(-1.62, -0.15)
Birkenes	2001-2025	OC in $PM_{2.5}$	0.004	-0.01	(-0.017, -0.002)	-1.38	(-2.45, -0.33)
Birkenes	2001-2025	OC in PM_{10}-$PM_{2.5}$	*0.37*	*0.001*	*(-0.002, 0.005)*	*0.6*	*(-0.74, 2.23)*
Birkenes	2001-2025	EC in PM_{10}	1.04E-06	-0.004	(-0.004, -0.003)	-2.74	(-3.42, -1.99)
Birkenes	2001-2025	EC in $PM_{2.5}$	6.59E-08	-0.003	(-0.004, -0.003)	-2.86	(-3.59, -2.19)
Birkenes	2008-2025	Levoglucosan in PM_{10}	0.002	-0.255	(-0.414, -0.115)	-2.15	(-3.49, -0.97)
Birkenes	2014-2025	Mineral dust in PM_{10}	*0.63*	*-0.008*	*(-0.026, 0.029)*	*-2.15*	*(-7.33, 8.11)*
Fractions:							
Birkenes	2001-2025	OC to PM_{10}	0.023	0.002	(0.0, 0.003)	1.25	(0.16, 2.15)
Birkenes	2001-2025	OC to $PM_{2.5}$	0.0035	0.003	(0.001, 0.004)	1.94	(0.89, 2.76)
Birkenes	2001-2025	EC to PM_{10}	2.37E-05	0	(-0.0, -0.0)	-1.58	(-2.14, -0.97)
Birkenes	2001-2025	SO_4 to PM_{10}	1.69E-06	-0.005	(-0.005, -0.003)	-2.45	(-2.96, -1.72)
Birkenes	2001-2025	NO_3 to PM_{10}	*0.59*	*-0.001*	*(-0.003, 0.002)*	*-0.38*	*(-2.03, 1.46)*
Birkenes	2001-2025	NH_4 to PM_{10}	0.0012	-0.001	(-0.002, -0.001)	-2.13	(-3.1, -0.88)
Birkenes	2001-2025	Sea salt to PM_{10}	2.67E-06	0.007	(0.006, 0.01)	6.97	(5.33, 9.29)
Birkenes	2014-2025	Mineral dust to PM_{10}	*0.94*	*0*	*(-0.006, 0.006)*	*-0.60*	*(-9.22, 8.91)*
Birkenes	2011-2025	PM_{10} mass conc.	*0.06*	*-0.103*	*(-0.207, 0.003)*	*-1.84*	*(-3.69, 0.05)*
Kårvatn	2011-2025	PM_{10} mass conc.	*0.092*	*-0.072*	*(-0.135, 0.014)*	*-2.09*	*(-3.95, 0.4)*
Hurdal	2011-2025	PM_{10} mass conc.	*0.067*	*-0.047*	*(-0.161, 0.005)*	*-1.04*	*(-3.6, 0.11)*
		Average PM_{10}		-0.074	(-0.144, -0.004)	-1.66	(-3.02, -0.3)
Birkenes	2011-2025	$PM_{2.5}$ mass conc.	0.004	-0.078	(-0.15, -0.039)	-2.47	(-4.77, -1.23)
Kårvatn	2011-2025	$PM_{2.5}$ mass conc.	0.014	-0.088	(-0.183, -0.029)	-3.76	(-7.8, -1.23)
Hurdal	2011-2025	$PM_{2.5}$ mass conc.	0.002	-0.084	(-0.168, -0.041)	-2.61	(-5.18, -1.26)
		Average $PM_{2.5}$		-0.083	(-0.096, -0.07)	-2.95	(-4.71, -1.19)
Birkenes	2011-2025	OC in PM_{10}	*0.59*	*0.004*	*(-0.011, 0.015)*	*0.52*	*(-1.43, 1.97)*
Kårvatn	2011-2025	OC in PM_{10}	*0.10*	*-0.01*	*(-0.023, 0.004)*	*-1.28*	*(-2.99, 0.48)*
Hurdal	2011-2025	OC in PM_{10}	*1.0*	*0*	*(-0.015, 0.025)*	*0*	*(-1.28, 2.19)*
		Average OC in PM_{10}		-0.002	(-0.02, 0.016)	-0.25	(-2.55, 2.05)
Birkenes	2011-2025	OC in $PM_{2.5}$	*0.92*	*0*	*(-0.01, 0.007)*	*0*	*(-1.75, 1.17)*
Kårvatn	2011-2025	OC in $PM_{2.5}$	0.009	-0.012	(-0.025, 0.004)	-2.02	(-4.22, -0.72)
Hurdal	2011-2025	OC in $PM_{2.5}$	*0.065*	*-0.01*	*(-0.02, 0)*	*-1.28*	*(-2.56, 0)*
		Average OC in $PM_{2.5}$		-0.007	(-0.023, 0.009)	-1.1	(-3.64, 1.44)
Birkenes	2011-2025	EC in PM_{10}	0.002	-0.003	(-0.004, -0.001)	-3.12	(-4.64, -1.56)
Kårvatn	2011-2025	EC in PM_{10}	0.015	-0.001	(-0.002, 0)	-2.65	(-4.73, -0.76)
Hurdal	2011-2025	EC in PM_{10}	0.0002	-0.006	(-0.007, -0.004)	-3.94	(-5.12, -2.51)
		Average EC in PM_{10}		-0.003	(-0.009, 0.003)	-3.24	(-4.86, -1.62)
Birkenes	2011-2025	EC in $PM_{2.5}$	0.0002	-0.003	(-0.005, -0.002)	-3.68	(-5.34, -2.32)
Kårvatn	2011-2025	EC in $PM_{2.5}$	0.003	-0.002	(-0.003, -0.001)	-3.64	(-4.76, -1.68)
Hurdal	2011-2025	EC in $PM_{2.5}$	9.07E-05	-0.005	(-0.007, -0.003)	-3.85	(-5.48, -2.69)
		Average EC in $PM_{2.5}$		-0.003	(-0.007, 0.001)	-3.72	(-4.0, -3.44)

Table B.4: Average absolute and relative changes and corresponding 95% confidence intervals in annual concentrations for equivalent black carbon at Birkenes for 2012-2025. Note that there was change in instrumentation in 2022 at Birkenes causing an uncertainty in the consistency in the trend.

				Absolute change		Relative change	
Site	Period	component	p_value	µg/m³/y	Conf. Int.	%/y	Conf. Int.
Birkenes	2012-2025	eBC	0.018	-0.002	(-0.004, -0.0)	-2.3	(-5.7, -0.4)

Table B.5: Average absolute and relative changes and corresponding 95% confidence intervals in annual mean concentrations for ultrafine particles at Birkenes and Zeppelin for 2010 (2016) – 2025. Trends that are not significant are given in italic.

				Absolute change		Relative change	
Site	Period	component	p_value	cm^{-3}/y	Conf. Int.	cm^{-3}/y	Conf. Int.
Birkenes	2010-2024	UFP	*0.50*	*3.2*	*(-12, 29)*	*0.2*	*(-0.9, 2.1)*
Zeppelin	2016-2024	UFP	*0.42*	*-3.4*	*(-9.8, 3.7)*	*-2.7*	*(-7.8, 2.9)*

Appendix C

Annual average concentrations all years

Table C.1: Volume weighted annual mean concentrations of main components in precipitation at Norwegian background stations in 1973–2025. xSO_4^{2-} is sea salt corrected SO_4^{2-}. Units are in mg/L or mgS/L and mgN/L where indicated. pH has no unit and amount in mm.

Site	Code	Year	xSO_4^{2-}-S	NO_3^--N	NH_4^+-N	K^+	Ca^{2+}	Cl^-	Mg^{2+}	Na^+	pH	amount	capture
Birkenes	NO0001R	1972	1.215						0.15		4.23	1456	100
Birkenes	NO0001R	1973	1.091		0.377		0.15		0.11		4.27	1072	100
Birkenes	NO0001R	1974	1.113	0.519	0.538		0.23		0.19		4.25	1563	100
Birkenes	NO0001R	1975	1.019	0.480	0.485		0.20		0.17		4.27	1341	100
Birkenes	NO0001R	1976	1.181	0.545	0.538		0.18		0.12		4.25	1430	100
Birkenes	NO0001R	1977	1.046				0.17	2.51	0.17	1.37	4.27	1601	100
Birkenes	NO0001R	1978	1.177	0.619	0.577		0.17	1.71	0.12	0.95	4.11	1242	100
Birkenes	NO0001R	1979	1.238	0.565	0.647		0.22	2.33	0.15	1.26	4.09	1560	100
Birkenes	NO0001R	1980	1.224	0.575	0.630	0.16	0.21	1.58	0.12	0.85	4.16	1158	100
Birkenes	NO0001R	1981	1.053	0.518	0.525	0.14	0.20	1.82	0.14	0.99	4.21	1317	100
Birkenes	NO0001R	1982	1.056	0.557	0.714	0.18	0.22	3.32	0.21	1.51	4.27	1592	100
Birkenes	NO0001R	1983	0.920	0.491	0.495	0.21	0.24	2.31	0.17	1.35	4.32	1312	100
Birkenes	NO0001R	1984	1.093	0.565	0.622	0.21	0.21	2.81	0.19	1.55	4.24	1600	100
Birkenes	NO0001R	1985	0.971	0.574	0.570	0.21	0.16	1.39	0.09	0.78	4.24	1413	100
Birkenes	NO0001R	1986	0.898	0.509	0.566	0.16	0.16	1.87	0.13	1.05	4.30	1148	87
Birkenes	NO0001R	1987	0.740	0.424	0.455	0.19	0.13	1.82	0.13	1.08	4.38	1570	100
Birkenes	NO0001R	1988	0.807	0.557	0.590	0.16	0.14	1.59	0.12	0.93	4.26	1921	98
Birkenes	NO0001R	1989	0.865	0.738	0.607	0.17	0.17	2.95	0.19	1.55	4.27	1159	93
Birkenes	NO0001R	1990	0.708	0.465	0.457	0.14	0.14	3.20	0.21	1.75	4.37	1856	99
Birkenes	NO0001R	1991	0.745	0.569	0.496	0.14	0.14	2.79	0.19	1.52	4.33	1245	100
Birkenes	NO0001R	1992	0.736	0.522	0.437	0.07	0.12	2.00	0.13	1.17	4.37	1346	100
Birkenes	NO0001R	1993	0.773	0.550	0.510	0.12	0.15	3.63	0.23	1.98	4.37	1245	100
Birkenes	NO0001R	1994	0.637	0.549	0.506	0.06	0.15	1.69	0.12	0.93	4.48	1396	100
Birkenes	NO0001R	1995	0.508	0.472	0.394	0.07	0.09	2.03	0.14	1.19	4.48	1393	99
Birkenes	NO0001R	1996	0.581	0.518	0.455	0.08	0.12	2.13	0.15	1.22	4.43	1187	99
Birkenes	NO0001R	1997	0.526	0.496	0.450	0.09	0.10	2.07	0.13	1.09	4.50	1239	100
Birkenes	NO0001R	1998	0.527	0.453	0.414	0.08	0.10	1.84	0.13	1.02	4.50	1494	97
Birkenes	NO0001R	1999	0.453	0.412	0.335	0.08	0.10	2.18	0.14	1.20	4.59	1717	96
Birkenes	NO0001R	2000	0.231	0.467	0.309	0.09	0.09	3.58	0.23	1.83	4.50	2354	98
Birkenes	NO0001R	2001	0.356	0.409	0.366	0.04	0.06	1.31	0.09	0.77	4.61	1222	79
Birkenes	NO0001R	2002	0.355	0.329	0.317	0.09	0.10	1.45	0.11	0.86	4.71	1569	100
Birkenes	NO0001R	2003	0.459	0.494	0.469	0.08	0.12	1.52	0.11	0.87	4.60	1374	100
Birkenes	NO0001R	2004	0.361	0.363	0.334	0.06	0.12	1.77	0.14	1.08	4.69	1700	100
Birkenes	NO0001R	2005	0.428	0.472	0.421	0.08	0.13	2.72	0.18	1.63	4.68	1240	100

Table C.1 (continued) - Part 2

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Birkenes	NO0001R	2006	0.318	0.424	0.341	0.08	0.10	2.11	0.15	1.18	4.70	1834	100
Birkenes	NO0001R	2007	0.304	0.326	0.277	0.06	0.11	1.61	0.12	0.96	4.75	1447	100
Birkenes	NO0001R	2008	0.257	0.348	0.286	0.08	0.13	2.59	0.20	1.59	4.77	1990	100
Birkenes	NO0001R	2009	0.328	0.439	0.365	0.07	0.10	1.98	0.15	1.22	4.72	1807	100
Birkenes	NO0001R	2010	0.376	0.459	0.361	0.06	0.10	1.35	0.08	0.75	4.69	1113	100
Birkenes	NO0001R	2011	0.258	0.385	0.422	0.10	0.12	2.65	0.19	1.50	4.86	1778	100
Birkenes	NO0001R	2012	0.225	0.380	0.326	0.09	0.16	1.87	0.13	1.07	4.86	1993	100
Birkenes	NO0001R	2013	0.212	0.350	0.366	0.10	0.17	2.30	0.16	1.34	4.97	1429	100
Birkenes	NO0001R	2014	0.313	0.348	0.350	0.10	0.16	2.46	0.18	1.44	4.77	2335	100
Birkenes	NO0001R	2015	0.178	0.292	0.283	0.10	0.15	2.27	0.16	1.29	4.91	2173	100
Birkenes	NO0001R	2016	0.173	0.346	0.294	0.12	0.15	2.27	0.16	1.32	4.91	1414	100
Birkenes	NO0001R	2017	0.196	0.311	0.292	0.10	0.17	2.02	0.14	1.17	4.95	2088	100
Birkenes	NO0001R	2018	0.200	0.431	0.436	0.09	0.14	2.62	0.18	1.50	4.95	1515	100
Birkenes	NO0001R	2019	0.147	0.262	0.238	0.08	0.12	1.27	0.09	0.74	4.98	1993	98
Birkenes	NO0001R	2020	0.159	0.290	0.283	0.09	0.16	2.43	0.17	1.41	5.03	2286	100
Birkenes	NO0001R	2021	0.167	0.328	0.304	0.10	0.20	2.21	0.15	1.29	5.02	1478	100
Birkenes	NO0001R	2022	0.104	0.240	0.225	0.08	0.14	2.23	0.14	1.30	5.04	1618	100
Birkenes	NO0001R	2023	0.097	0.213	0.237	0.08	0.09	1.74	0.10	1.06	5.07	1911	100
Birkenes	NO0001R	2024	0.121	0.236	0.270	0.08	0.14	1.31	0.09	0.77	5.12	1614	100
Birkenes	NO0001R	2025	0.091	0.204	0.249	0.09	0.11	2.63	0.17	1.53	5.16	1602	100
Vatnedalen	NO0237R	1974	0.545						0.06		4.53	880	100
Vatnedalen	NO0237R	1975	0.513	0.168	0.221				0.10		4.66	993	100
Vatnedalen	NO0237R	1976	0.497	0.184	0.357				0.10		4.77	717	100
Vatnedalen	NO0237R	1977	0.432	0.202	0.249		0.13		0.06		4.71	761	100
Vatnedalen	NO0237R	1978	0.399	0.154	0.224		0.14		0.10		4.62	862	100
Vatnedalen	NO0237R	1979	0.563	0.218	0.197		0.20		0.06		4.38	948	100
Vatnedalen	NO0237R	1980	0.451	0.157	0.101	0.09	0.14	0.96	0.06	0.57	4.55	792	100
Vatnedalen	NO0237R	1981	0.488	0.188	0.175	0.11	0.15	1.23	0.09	0.73	4.49	906	98
Vatnedalen	NO0237R	1982	0.383	0.179	0.163	0.14	0.13	1.13	0.08	0.63	4.62	966	93
Vatnedalen	NO0237R	1983	0.294	0.134	0.105		0.14	1.08	0.08		4.75	1235	96
Vatnedalen	NO0237R	1984	0.390	0.176	0.127		0.16	1.10	0.08		4.60	777	96
Vatnedalen	NO0237R	1985	0.432	0.218	0.189		0.15	0.43	0.04		4.57	794	96
Vatnedalen	NO0237R	1986	0.511	0.214	0.185	0.22	0.13	0.89	0.07	0.68	4.54	987	100
Vatnedalen	NO0237R	1987	0.413	0.167	0.146	0.17	0.12	0.53	0.04	0.39	4.60	730	100

Table C.1 (continued) - Part 3

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Vatnedalen	NO0237R	1988	0.369	0.230	0.203	0.09	0.13	0.85	0.08	0.50	4.55	898	100
Vatnedalen	NO0237R	1989	0.341	0.223	0.290	0.10	0.13	1.02	0.08	0.57	4.78	980	100
Vatnedalen	NO0237R	1990	0.267	0.140	0.116	0.10	0.14	1.50	0.11	0.76	4.71	1448	80
Vatnedalen	NO0237R	1991	0.323	0.199	0.170	0.11	0.29	1.38	0.12	0.76	4.69	865	99
Vatnedalen	NO0237R	1992	0.285	0.166	0.106	0.10	0.15	1.30	0.10	0.72	4.75	1055	97
Vatnedalen	NO0237R	1993	0.227	0.178	0.103	0.18	0.23	6.48	0.44	3.54	4.83	894	100
Vatnedalen	NO0237R	1994	0.285	0.216	0.154	0.05	0.08	1.16	0.08	0.66	4.75	1005	100
Vatnedalen	NO0237R	1995	0.259	0.181	0.132	0.09	0.11	1.41	0.10	0.89	4.82	824	100
Vatnedalen	NO0237R	1996	0.321	0.227	0.201	0.10	0.17	0.55	0.05	0.40	4.78	591	99
Vatnedalen	NO0237R	1997	0.240	0.164	0.148	0.11	0.22	1.57	0.10	0.99	4.93	806	98
Vatnedalen	NO0237R	1998	0.194	0.150	0.231	0.08	0.11	1.13	0.07	0.71	5.08	733	88
Vatnedalen	NO0237R	1999	0.239	0.166	0.244	0.12	0.12	1.24	0.08	0.72	5.05	1091	94
Vatnedalen	NO0237R	2000	0.138	0.136	0.126	0.08	0.10	1.01	0.07	0.62	5.06	1061	81
Vatnedalen	NO0237R	2001	0.163	0.091	0.103	0.10	0.12	0.69	0.04	0.50	5.27	709	96
Vatnedalen	NO0237R	2002	0.224	0.140	0.166	0.16	0.15	0.96	0.06	0.55	5.02	588	99
Vatnedalen	NO0237R	2003	0.169	0.161	0.145	0.13	0.16	0.67	0.06	0.42	4.97	803	100
Vatnedalen	NO0237R	2004	0.174	0.125	0.199	0.14	0.19	0.84	0.06	0.63	5.30	969	100
Vatnedalen	NO0237R	2005	0.187	0.150	0.138	0.07	0.16	0.68	0.05	0.46	5.17	1073	100
Vatnedalen	NO0237R	2006	0.121	0.161	0.115	0.10	0.12	0.72	0.06	0.47	5.17	1011	100
Vatnedalen	NO0237R	2007	0.102	0.105	0.131	0.12	0.17	1.06	0.10	0.73	5.31	846	100
Vatnedalen	NO0237R	2008	0.102	0.169	0.134	0.14	0.24	1.49	0.14	0.94	5.34	1020	98
Vatnedalen	NO0237R	2009	0.169	0.181	0.141	0.16	0.20	0.69	0.05	0.42	5.34	788	98
Vatnedalen	NO0237R	2010	0.185	0.154	0.197	0.21	0.16	0.50	0.04	0.36	5.38	595	95
Vatnedalen	NO0237R	2011	0.094	0.107	0.240	0.13	0.17	0.99	0.07	0.65	5.51	1225	98
Vatnedalen	NO0237R	2012	0.080	0.131	0.115	0.09	0.15	0.61	0.04	0.52	5.44	831	99
Vatnedalen	NO0237R	2013	0.093	0.135	0.347	0.15	0.14	0.78	0.05	0.60	5.50	991	98
Vatnedalen	NO0237R	2014	0.167	0.148	0.174	0.14	0.23	0.99	0.07	0.92	5.44	957	100
Vatnedalen	NO0237R	2015	0.072	0.090	0.120	0.13	0.16	1.56	0.10	1.27	5.50	1166	99
Vatnedalen	NO0237R	2016	0.086	0.078	0.114	0.17	0.14	2.72	0.17	1.83	5.30	814	100
Vatnedalen	NO0237R	2017	0.083	0.104	0.122	0.11	0.08	0.87	0.03	0.84	5.52	1272	100
Vatnedalen	NO0237R	2018	0.097	0.125	0.130	0.11	0.10	0.84	0.04	0.83	5.51	965	96
Vatnedalen	NO0237R	2019	0.102	0.107	0.132	0.13	0.08	0.80	0.03	0.90	5.72	1033	100
Vatnedalen	NO0237R	2020	0.069	0.063	0.032	0.15	0.16	1.08	0.05	0.94	5.53	1280	99
Vatnedalen	NO0237R	2021	0.112	0.113	0.120	0.19	0.15	0.73	0.05	0.69	5.50	633	100

Table C.1 (continued) - Part 4

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Vatnedalen	NO0237R	2022	0.120	0.119	0.127	0.16	0.27	1.45	0.08	1.18	5.57	773	99
Grungedal	NO0239R	2023	0.074	0.190	0.123	0.08	0.09	0.35	0.03	0.29	5.14	1150	100
Grungedal	NO0239R	2024	0.093	0.122	0.171	0.20	0.16	0.46	0.05	0.27	5.41	1275	100
Grungedal	NO0239R	2025	0.078	0.132	0.164	0.23	0.11	0.40	0.03	0.23	5.34	994	100
Treungen	NO0236R	1974	0.941				0.15		0.07		4.27	1039	100
Treungen	NO0236R	1975	0.948	0.415	0.379		0.16		0.06		4.25	891	100
Treungen	NO0236R	1976	1.044	0.522	0.422		0.10		0.06		4.20	688	94
Treungen	NO0236R	1977	0.814	0.443	0.390		0.11	0.62	0.05	0.32	4.32	1166	100
Treungen	NO0236R	1978	0.874	0.377	0.411		0.14	0.50	0.04	0.25	4.22	945	100
Treungen	NO0236R	1979	0.860	0.473	0.298		0.12	0.73	0.05	0.36	4.09		
Treungen	NO0236R	1980	0.886	0.367	0.386	0.07	0.14	0.47	0.04	0.25	4.23	758	99
Treungen	NO0236R	1981	0.867	0.392	0.464	0.09	0.12	0.60	0.05	0.34	4.29	948	93
Treungen	NO0236R	1982	0.847	0.446	0.500	0.08	0.14	0.94	0.07	0.47	4.32	1130	90
Treungen	NO0236R	1983	0.832	0.395	0.433		0.18	0.69	0.05		4.35	1089	91
Treungen	NO0236R	1984	0.765	0.363	0.266		0.15	0.66	0.05		4.27	1196	93
Treungen	NO0236R	1985	0.681	0.393	0.375		0.13	0.45	0.04		4.33	892	92
Treungen	NO0236R	1986	1.069	0.565	0.631	0.12	0.14	0.85	0.07	0.47	4.19	1030	100
Treungen	NO0236R	1987	0.678	0.374	0.369	0.10	0.13	0.90	0.07	0.49	4.39	1130	100
Treungen	NO0236R	1988	0.744	0.497	0.454	0.05	0.10	0.50	0.05	0.28	4.27	1348	100
Treungen	NO0236R	1989	0.756	0.605	0.436	0.05	0.10	0.91	0.06	0.45	4.26	754	100
Treungen	NO0236R	1990	0.631	0.425	0.366	0.05	0.06	1.02	0.07	0.51	4.37	1182	75
Treungen	NO0236R	1991	0.594	0.425	0.346	0.06	0.13	0.82	0.06	0.40	4.42	806	99
Treungen	NO0236R	1992	0.606	0.395	0.336	0.05	0.08	0.69	0.05	0.41	4.44	923	100
Treungen	NO0236R	1993	0.589	0.409	0.322	0.07	0.11	1.39	0.09	0.74	4.46	792	100
Treungen	NO0236R	1994	0.536	0.443	0.351	0.04	0.08	0.73	0.05	0.38	4.49	1015	100
Treungen	NO0236R	1995	0.506	0.444	0.399	0.07	0.10	0.99	0.08	0.57	4.47	889	98
Treungen	NO0236R	1996	0.486	0.402	0.370	0.04	0.10	0.69	0.05	0.37	4.49	822	98
Treungen	NO0236R	1997	0.407	0.371	0.319	0.04	0.11	0.64	0.06	0.33	4.56	881	99
Treungen	NO0236R	1998	0.469	0.426	0.417	0.05	0.09	0.62	0.04	0.33	4.52	818	83
Treungen	NO0236R	1999	0.353	0.310	0.296	0.04	0.06	0.80	0.05	0.41	4.67	1313	95
Treungen	NO0236R	2000	0.322	0.368	0.303	0.03	0.08	0.96	0.07	0.51	4.58	1438	87
Treungen	NO0236R	2001	0.303	0.285	0.275	0.04	0.05	0.45	0.04	0.25	4.77	1141	100
Treungen	NO0236R	2002	0.316	0.269	0.281	0.05	0.08	0.42	0.04	0.24	4.79	934	100
Treungen	NO0236R	2003	0.348	0.365	0.349	0.04	0.09	0.44	0.04	0.25	4.67	1002	100

Table C.1 (continued) - Part 5

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Treungen	NO0236R	2004	0.309	0.298	0.264	0.06	0.10	0.69	0.06	0.40	4.79	1271	100
Treungen	NO0236R	2005	0.343	0.377	0.366	0.06	0.11	0.86	0.06	0.51	4.75	898	100
Treungen	NO0236R	2006	0.234	0.284	0.204	0.05	0.09	0.62	0.05	0.37	4.79	1522	100
Treungen	NO0236R	2007	0.225	0.241	0.177	0.05	0.08	0.45	0.04	0.27	4.82	1008	100
Treungen	NO0236R	2008	0.208	0.276	0.256	0.06	0.11	0.76	0.08	0.53	4.93	1150	100
Treungen	NO0236R	2009	0.212	0.331	0.236	0.05	0.06	0.92	0.06	0.48	4.81	1198	95
Treungen	NO0236R	2010	0.285	0.340	0.319	0.03	0.07	0.42	0.03	0.23	4.79	849	100
Treungen	NO0236R	2011	0.194	0.262	0.230	0.05	0.09	0.62	0.05	0.34	4.95	1177	100
Treungen	NO0236R	2012	0.153	0.281	0.226	0.05	0.07	0.69	0.05	0.38	4.96	1093	100
Treungen	NO0236R	2013	0.165	0.265	0.303	0.08	0.09	0.71	0.06	0.42	5.12	1151	100
Treungen	NO0236R	2014	0.213	0.278	0.262	0.06	0.11	0.82	0.07	0.48	4.90	1463	100
Treungen	NO0236R	2015	0.132	0.215	0.190	0.06	0.10	0.75	0.06	0.44	4.94	1014	79
Treungen	NO0236R	2016	0.158	0.280	0.300	0.08	0.09	0.77	0.07	0.48	4.98	923	93
Treungen	NO0236R	2017	0.139	0.223	0.245	0.06	0.10	0.45	0.04	0.25	5.12	1146	92
Treungen	NO0236R	2018	0.150	0.293	0.280	0.05	0.10	0.62	0.05	0.37	5.03	862	97
Treungen	NO0236R	2019	0.118	0.187	0.198	0.07	0.10	0.35	0.03	0.20	5.15	1642	98
Treungen	NO0236R	2020	0.091	0.147	0.159	0.05	0.10	0.55	0.04	0.32	5.21	1587	100
Treungen	NO0236R	2021	0.123	0.198	0.166	0.09	0.15	0.71	0.06	0.42	5.11	1026	100
Treungen	NO0236R	2022	0.074	0.174	0.092	0.04	0.12	0.59	0.04	0.34	5.07	1028	100
Treungen	NO0236R	2023	0.091	0.174	0.180	0.05	0.08	0.41	0.03	0.25	5.04	1102	100
Treungen	NO0236R	2024	0.110	0.182	0.199	0.05	0.12	0.46	0.04	0.26	5.22	1310	100
Treungen	NO0236R	2025	0.081	0.141	0.153	0.04	0.09	0.77	0.05	0.44	5.21	1014	100
Løken	NO0218R	1972	1.117						0.09		4.35	614	84
Løken	NO0218R	1973	1.031						0.06		4.47	569	100
Løken	NO0218R	1974	0.942						0.08		4.43	828	100
Løken	NO0218R	1975	1.033	0.439	0.422				0.08		4.33	659	100
Løken	NO0218R	1976	1.184	0.496	0.496				0.09		4.34	532	100
Løken	NO0218R	1977	0.958	0.416	0.427		0.22		0.07		4.41	699	100
Løken	NO0218R	1978	1.082	0.474	0.515		0.24		0.07		4.25	597	100
Løken	NO0218R	1979	1.024	0.483	0.568		0.30		0.07		4.22	783	100
Løken	NO0218R	1980	0.976	0.384	0.497		0.25		0.08		4.33	696	100
Løken	NO0218R	1981	0.768			0.16	0.20	0.76	0.06	0.55	4.48	700	97
Løken	NO0218R	1982	1.071	0.601	0.794	0.18	0.23	1.48	0.11	0.75	4.33	858	92
Løken	NO0218R	1983	0.906	0.473	0.606		0.28	1.17	0.10		4.42	656	94

Table C.1 (continued) - Part 6

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Løken	NO0218R	1984	0.903	0.486	0.747		0.30	1.18	0.10		4.45	746	96
Løken	NO0218R	1985	0.857	0.471	0.510		0.30	0.79	0.09		4.36	896	96
Løken	NO0218R	1986	0.958	0.569		0.17	0.26	0.96	0.07	0.58	4.31	700	100
Løken	NO0218R	1987	0.789	0.403	0.449	0.14	0.17	0.69	0.06	0.44	4.40	859	100
Løken	NO0218R	1988	0.759	0.495	0.487	0.12	0.20	0.95	0.08	0.59	4.31	882	100
Løken	NO0218R	1989	0.923	0.693	0.568	0.11	0.18	1.40	0.10	0.75	4.26	421	100
Løken	NO0218R	1990	0.736	0.469	0.436	0.09	0.12	1.12	0.08	0.58	4.36	718	71
Løken	NO0218R	1991	0.649	0.497	0.444	0.12	0.18	1.29	0.09	0.67	4.41	722	100
Løken	NO0218R	1992	0.611	0.441	0.380	0.09	0.11	0.90	0.05	0.53	4.46	687	100
Løken	NO0218R	1993	0.658	0.442	0.378	0.11	0.18	0.74	0.05	0.43	4.46	714	100
Løken	NO0218R	1994	0.427	0.375	0.288	0.08	0.30	0.76	0.06	0.44	4.64	739	100
Løken	NO0218R	1995	0.517	0.430	0.355	0.12	0.24	1.15	0.09	0.68	4.56	656	100
Løken	NO0218R	1996	0.487	0.393	0.394	0.12	0.27	1.04	0.09	0.59	4.61	674	100
Løken	NO0218R	1997	0.418	0.401	0.403	0.12	0.16	0.89	0.06	0.50	4.63	547	100
Løken	NO0218R	1998	0.387	0.373	0.352	0.16	0.12	0.91	0.07	0.54	4.64	662	98
Løken	NO0218R	1999	0.387	0.359	0.353	0.11	0.10	1.10	0.07	0.61	4.71	977	93
Løken	NO0218R	2000	0.326	0.329	0.232	0.05	0.07	0.76	0.05	0.42	4.60	1049	99
Løken	NO0218R	2001	0.329	0.309	0.260	0.07	0.13	0.52	0.04	0.29	4.75	819	100
Løken	NO0218R	2002	0.264	0.284	0.251	0.08	0.12	0.49	0.04	0.28	4.84	856	100
Løken	NO0218R	2003	0.327	0.378	0.339	0.08	0.15	0.53	0.05	0.30	4.72	638	99
Løken	NO0218R	2004	0.233	0.280	0.198	0.09	0.13	0.78	0.07	0.47	4.80	953	100
Løken	NO0218R	2005	0.343	0.378	0.316	0.10	0.14	0.80	0.06	0.53	4.77	686	100
Løken	NO0218R	2006	0.210	0.336	0.251	0.07	0.09	0.80	0.06	0.46	4.79	958	100
Løken	NO0218R	2007	0.243	0.297	0.281	0.09	0.16	0.67	0.06	0.36	4.92	729	100
Løken	NO0218R	2008	0.193	0.284	0.224	0.10	0.13	1.00	0.09	0.58	4.90	997	100
Løken	NO0218R	2009	0.168	0.321	0.295	0.11	0.11	0.73	0.06	0.37	5.06	837	100
Løken	NO0218R	2010	0.226	0.291	0.238	0.10	0.12	0.33	0.04	0.15	4.95	664	98
Løken	NO0218R	2011	0.211	0.253	0.411	0.11	0.14	0.95	0.08	0.44	5.11	1101	99
Løken	NO0218R	2012	0.163	0.268	0.227	0.08	0.11	0.62	0.05	0.35	5.04	767	98
Løken	NO0218R	2013	0.173	0.274	0.485	0.11	0.14	1.17	0.09	0.69	5.22	837	98
Løken	NO0218R	2014	0.233	0.285	0.253	0.14	0.18	0.97	0.09	0.55	4.91	965	99
Løken	NO0218R	2015	0.124	0.262	0.230	0.14	0.15	0.88	0.08	0.50	5.01	851	99
Løken	NO0218R	2016	0.169	0.304	0.314	0.11	0.12	0.61	0.06	0.38	5.03	692	100
Løken	NO0218R	2017	0.120	0.246	0.212	0.17	0.18	0.68	0.06	0.40	5.12	797	100

Table C.1 (continued) - Part 7

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Løken	NO0218R	2018	0.163	0.270	0.244	0.18	0.21	0.92	0.10	0.54	5.13	619	100
Løken	NO0218R	2019	0.134	0.224	0.219	0.17	0.16	0.55	0.05	0.32	5.21	1004	100
Løken	NO0218R	2020	0.101	0.217	0.233	0.12	0.14	0.91	0.07	0.52	5.19	1000	100
Løken	NO0218R	2021	0.167	0.294	0.377	0.16	0.23	0.65	0.07	0.38	5.34	611	100
Løken	NO0218R	2022	0.117	0.272	0.293	0.25	0.20	1.09	0.10	0.65	5.27	551	100
Løken	NO0218R	2023	0.111	0.196	0.256	0.14	0.10	0.50	0.04	0.31	5.10	845	100
Løken	NO0218R	2024	0.131	0.217	0.237	0.15	0.30	0.85	0.07	0.53	5.43	811	100
Løken	NO0218R	2025	0.084	0.165	0.203	0.25	0.19	0.80	0.06	0.47	5.32	941	100
Nordmoen	NO0044R	1986	0.990	0.486		0.09	0.13	0.51	0.04	0.32	4.20	702	79
Nordmoen	NO0044R	1987	0.715	0.368		0.13	0.14	0.37	0.03	0.17	4.34	1015	100
Nordmoen	NO0044R	1988	0.778	0.447	0.382	0.06	0.12	0.43	0.04	0.24	4.26	1050	100
Nordmoen	NO0044R	1989	0.872	0.567	0.400	0.06	0.14	0.57	0.05	0.27	4.26	827	100
Nordmoen	NO0044R	1990	0.772	0.445	0.348	0.05	0.10	0.64	0.05	0.31	4.31	822	96
Nordmoen	NO0044R	1991	0.588	0.399	0.307	0.05	0.09	0.57	0.04	0.29	4.43	781	99
Nordmoen	NO0044R	1992	0.578	0.399	0.266	0.04	0.10	0.46	0.03	0.26	4.42	821	100
Nordmoen	NO0044R	1993	0.560	0.367	0.254	0.07	0.08	0.41	0.03	0.23	4.45	926	100
Nordmoen	NO0044R	1994	0.456	0.395	0.297	0.03	0.07	0.42	0.03	0.24	4.55	837	100
Nordmoen	NO0044R	1995	0.534	0.365	0.325	0.08	0.13	0.69	0.06	0.40	4.49	664	84
Nordmoen	NO0044R	1996	0.360	0.294	0.172	0.03	0.13	0.26	0.03	0.14	4.56	686	88
Hurdal	NO0056R	1997	0.326	0.314	0.267	0.04	0.06	0.25	0.02	0.14	4.62	707	77
Hurdal	NO0056R	1998	0.413	0.303	0.286	0.06	0.08	0.35	0.03	0.20	4.65	995	89
Hurdal	NO0056R	1999	0.378	0.323	0.309	0.05	0.07	0.41	0.03	0.24	4.67	1065	87
Hurdal	NO0056R	2000	0.329	0.322	0.253	0.04	0.07	0.51	0.03	0.36	4.64	1317	96
Hurdal	NO0056R	2001	0.328	0.362	0.281	0.05	0.08	0.32	0.03	0.18	4.68	946	96
Hurdal	NO0056R	2002	0.249	0.268	0.255	0.07	0.09	0.34	0.03	0.19	4.79	734	100
Hurdal	NO0056R	2003	0.316	0.348	0.322	0.05	0.09	0.35	0.04	0.22	4.66	830	100
Hurdal	NO0056R	2004	0.243	0.267	0.275	0.09	0.11	0.44	0.03	0.28	4.84	903	99
Hurdal	NO0056R	2005	0.346	0.426	0.428	0.18	0.12	0.83	0.05	0.52	4.89	738	100
Hurdal	NO0056R	2006	0.235	0.334	0.355	0.20	0.15	0.77	0.05	0.45	5.06	1043	100
Hurdal	NO0056R	2007	0.256	0.281	0.364	0.18	0.23	0.53	0.05	0.34	5.13	813	100
Hurdal	NO0056R	2008	0.205	0.316	0.313	0.16	0.19	0.73	0.06	0.43	5.10	1068	100
Hurdal	NO0056R	2009	0.204	0.274	0.244	0.12	0.14	0.59	0.03	0.35	5.08	883	99
Hurdal	NO0056R	2010	0.280	0.350	0.360	0.21	0.09	0.41	0.02	0.24	4.88	809	97
Hurdal	NO0056R	2011	0.230	0.319	0.465	0.07	0.13	0.49	0.04	0.27	5.04	1299	99

Table C.1 (continued) - Part 8

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Hurdal	NO0056R	2012	0.165	0.273	0.212	0.04	0.07	0.41	0.03	0.25	4.93	1130	100
Hurdal	NO0056R	2013	0.174	0.260	0.379	0.10	0.15	0.70	0.05	0.43	5.18	896	99
Hurdal	NO0056R	2014	0.237	0.279	0.250	0.12	0.17	0.70	0.06	0.43	4.88	1172	100
Hurdal	NO0056R	2015	0.140	0.253	0.241	0.13	0.10	0.58	0.05	0.35	4.98	1059	99
Hurdal	NO0056R	2016	0.182	0.312	0.318	0.12	0.12	0.46	0.04	0.30	5.02	854	99
Hurdal	NO0056R	2017	0.120	0.188	0.236	0.13	0.12	0.36	0.03	0.23	5.23	942	99
Hurdal	NO0056R	2018	0.174	0.303	0.310	0.10	0.14	0.81	0.06	0.49	5.03	882	98
Hurdal	NO0056R	2019	0.130	0.197	0.189	0.05	0.11	0.26	0.02	0.14	5.11	1196	96
Hurdal	NO0056R	2020	0.103	0.201	0.192	0.07	0.10	0.56	0.04	0.34	5.20	1441	100
Hurdal	NO0056R	2021	0.158	0.283	0.312	0.09	0.16	0.52	0.05	0.33	5.18	920	100
Hurdal	NO0056R	2022	0.103	0.192	0.170	0.06	0.09	0.41	0.03	0.24	5.12	930	100
Hurdal	NO0056R	2023	0.094	0.175	0.166	0.04	0.09	0.30	0.02	0.20	4.89	1329	100
Hurdal	NO0056R	2024	0.104	0.156	0.159	0.06	0.09	0.36	0.03	0.23	5.15	1171	100
Hurdal	NO0056R	2025	0.078	0.142	0.160	0.06	0.09	0.49	0.03	0.30	5.27	1043	100
Gulsvik	NO0752R	1977	0.774	0.393	0.348		0.13	0.32	0.03	0.17	4.35	683	100
Gulsvik	NO0752R	1978	0.947	0.402	0.381		0.16	0.33	0.03	0.16	4.22	693	100
Gulsvik	NO0752R	1979	1.281	0.536	0.619		0.23	0.35	0.04	0.16	4.10	790	100
Gulsvik	NO0752R	1980	0.786	0.248	0.273	0.16	0.13	0.24	0.02	0.13	4.33	667	100
Gulsvik	NO0752R	1981	0.860	0.350	0.402	0.15	0.13	0.35	0.03	0.19	4.30	628	96
Gulsvik	NO0752R	1982	0.901	0.444	0.524	0.19	0.22	0.45	0.05	0.24	4.38	778	92
Gulsvik	NO0752R	1983	0.938	0.396	0.579		0.25	0.37	0.05		4.39	664	91
Gulsvik	NO0752R	1984	0.864	0.404	0.579		0.25	0.26	0.04		4.41	946	99
Gulsvik	NO0752R	1985	0.729	0.350	0.718		0.16	0.26	0.04		4.54	686	94
Gulsvik	NO0752R	1986	0.893	0.474	0.508	0.14	0.15	0.43	0.04	0.26	4.30	804	100
Gulsvik	NO0752R	1987	0.741	0.368	0.460	0.16	0.14	0.29	0.03	0.18	4.42	915	100
Gulsvik	NO0752R	1988	0.669	0.411	0.377	0.12	0.09	0.27	0.03	0.14	4.33	1023	100
Gulsvik	NO0752R	1989	0.754	0.538	0.552	0.16	0.15	0.48	0.06	0.23	4.42	668	100
Gulsvik	NO0752R	1990	0.744	0.449	0.528	0.14	0.09	0.44	0.03	0.22	4.43	753	67
Gulsvik	NO0752R	1991	0.595	0.418	0.464	0.13	0.13	0.47	0.04	0.25	4.58	506	100
Gulsvik	NO0752R	1992	0.558	0.353	0.382	0.11	0.13	0.39	0.03	0.22	4.60	666	100
Gulsvik	NO0752R	1993	0.506	0.326	0.396	0.11	0.12	0.30	0.03	0.18	4.66	638	100
Gulsvik	NO0752R	1994	0.499	0.431	0.388	0.10	0.23	0.38	0.03	0.20	4.61	642	99
Gulsvik	NO0752R	1995	0.586	0.409	0.439	0.08	0.13	0.41	0.05	0.22	4.52	575	96
Gulsvik	NO0752R	1996	0.488	0.358	0.548	0.16	0.16	0.34	0.07	0.16	4.68	535	89

Table C.1 (continued) - Part 9

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Gulsvik	NO0752R	1997	0.361	0.332	0.328	0.11	0.11	0.32	0.04	0.20	4.75	608	92
Brekkebygda	NO1218R	1998	0.380	0.288	0.251	0.09	0.08	0.26	0.02	0.14	4.62	884	98
Brekkebygda	NO1218R	1999	0.374	0.302	0.275	0.10	0.09	0.29	0.02	0.18	4.71	844	100
Brekkebygda	NO1218R	2000	0.367	0.274	0.226	0.10	0.18	0.57	0.06	0.31	4.72	1260	100
Brekkebygda	NO1218R	2001	0.304	0.244	0.287	0.08	0.08	0.25	0.04	0.16	4.81	804	87
Brekkebygda	NO1218R	2002	0.253	0.184	0.310	0.12	0.15	0.26	0.04	0.17	5.10	825	98
Brekkebygda	NO1218R	2003	0.293	0.258	0.277	0.12	0.17	0.31	0.06	0.22	4.89	837	95
Brekkebygda	NO1218R	2004	0.256	0.187	0.211	0.10	0.22	0.33	0.07	0.21	5.03	851	100
Brekkebygda	NO1218R	2005	0.365	0.331	0.354	0.11	0.13	0.46	0.03	0.35	4.87	754	100
Brekkebygda	NO1218R	2006	0.260	0.264	0.286	0.10	0.12	0.35	0.04	0.23	4.92	935	100
Brekkebygda	NO1218R	2007	0.183	0.179	0.160	0.10	0.13	0.22	0.03	0.14	4.98	1094	100
Brekkebygda	NO1218R	2008	0.231	0.314	0.312	0.09	0.12	0.36	0.03	0.21	4.93	967	100
Brekkebygda	NO1218R	2009	0.255	0.334	0.247	0.13	0.09	0.34	0.03	0.27	4.96	924	99
Brekkebygda	NO1218R	2010		0.245	0.327	0.13	0.07	0.26	0.02	0.13	5.03	831	100
Brekkebygda	NO1218R	2011	0.229	0.280	0.454	0.08	0.09	0.30	0.03	0.18	5.04	1387	100
Brekkebygda	NO1218R	2012	0.152	0.260	0.267	0.15	0.16	0.33	0.03	0.19	5.17	1086	96
Brekkebygda	NO1218R	2013	0.172	0.223	0.253	0.14	0.13	0.41	0.04	0.26	5.21	1205	98
Brekkebygda	NO1218R	2014	0.243	0.249	0.212	0.16	0.24	0.64	0.05	0.36	4.94	1105	100
Brekkebygda	NO1218R	2015	0.105	0.178	0.188	0.14	0.14	0.47	0.04	0.29	5.13	997	99
Brekkebygda	NO1218R	2016	0.153	0.235	0.243	0.09	0.10	0.33	0.03	0.21	5.00	892	100
Brekkebygda	NO1218R	2017	0.119	0.176	0.153	0.10	0.09	0.24	0.02	0.15	4.97	1092	100
Brekkebygda	NO1218R	2018	0.150	0.248	0.196	0.08	0.14	0.64	0.05	0.39	4.95	1003	99
Brekkebygda	NO1218R	2019	0.137	0.195	0.172	0.07	0.12	0.22	0.03	0.13	5.09	1135	100
Brekkebygda	NO1218R	2020	0.093	0.148	0.121	0.10	0.10	0.32	0.03	0.20	5.22	1420	100
Brekkebygda	NO1218R	2021	0.119	0.184	0.200	0.13	0.11	0.42	0.03	0.27	5.20	817	98
Brekkebygda	NO1218R	2022	0.078	0.156	0.098	0.07	0.08	0.32	0.02	0.20	5.13	845	100
Brekkebygda	NO1218R	2023	0.091	0.133	0.136	0.06	0.05	0.21	0.01	0.14	5.00	1299	100
Brekkebygda	NO1218R	2024	0.140	0.177	0.230	0.07	0.12	0.31	0.03	0.19	5.17	1436	100
Brekkebygda	NO1218R	2025	0.097	0.129	0.335	0.11	0.13	0.42	0.02	0.26	5.17	1114	100
Vikedal	NO0572R	1982	0.671	0.279	0.341	0.14	0.16	3.92	0.26	2.06	4.46	2038	74
Vikedal	NO0572R	1983	0.401	0.167	0.166	0.16	0.20	4.23	0.29	2.39	4.65	2822	94
Vikedal	NO0572R	1984	0.519	0.240	0.265	0.15	0.24	3.69	0.25	2.04	4.57	1930	95
Vikedal	NO0572R	1985	0.639	0.304	0.332	0.16	0.21	2.77	0.20	1.55	4.45	2224	93
Vikedal	NO0572R	1986	0.558	0.249	0.298	0.14	0.15	3.66	0.26	2.11	4.53	3016	100

Table C.1 (continued) - Part 10

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Vikedal	NO0572R	1987	0.545	0.267	0.342	0.12	0.13	2.56	0.18	1.45	4.51	1935	100
Vikedal	NO0572R	1988	0.434	0.264	0.254	0.09	0.13	3.29	0.24	1.86	4.51	2694	100
Vikedal	NO0572R	1989	0.531	0.317	0.235	0.09	0.14	3.99	0.26	2.09	4.46	2998	100
Vikedal	NO0572R	1990	0.443	0.217	0.310	0.11	0.15	5.27	0.35	2.93	4.58	3336	89
Vikedal	NO0572R	1991	0.433	0.257	0.268	0.13	0.14	4.67	0.32	2.61	4.60	2924	100
Vikedal	NO0572R	1992	0.401	0.221	0.240	0.10	0.12	3.29	0.22	1.81	4.70	3214	98
Vikedal	NO0572R	1993	0.404	0.236	0.267	0.17	0.21	6.91	0.46	3.80	4.70	2075	100
Vikedal	NO0572R	1994	0.466	0.285	0.303	0.13	0.15	5.00	0.36	2.97	4.64	2741	100
Vikedal	NO0572R	1995	0.347	0.230	0.231	0.09	0.13	3.38	0.24	1.93	4.72	2639	100
Vikedal	NO0572R	1996	0.305	0.224	0.281	0.07	0.15	2.15	0.16	1.18	4.80	1819	100
Vikedal	NO0572R	1997	0.360	0.204	0.276	0.13	0.24	6.35	0.39	3.13	4.75	2469	100
Vikedal	NO0572R	1998	0.328	0.246	0.237	0.09	0.12	2.99	0.21	1.67	4.74	2612	96
Vikedal	NO0572R	1999	0.260	0.214	0.208	0.10	0.12	4.31	0.28	2.32	4.83	3074	96
Vikedal	NO0572R	2000	0.255	0.221	0.216	0.10	0.12	3.96	0.26	2.22	4.82	2917	100
Vikedal	NO0572R	2001	0.263	0.225	0.278	0.09	0.11	3.08	0.20	1.71	4.96	2347	100
Vikedal	NO0572R	2002	0.291	0.255	0.393	0.11	0.14	3.60	0.24	1.98	4.94	2265	100
Vikedal	NO0572R	2003	0.256	0.253	0.288	0.08	0.11	2.74	0.21	1.55	4.86	2802	99
Vikedal	NO0572R	2004	0.173	0.189	0.291	0.10	0.12	3.14	0.23	1.81	5.08	2815	100
Vikedal	NO0572R	2005	0.210	0.213	0.292	0.12	0.15	4.66	0.31	2.75	5.07	3041	100
Vikedal	NO0572R	2006	0.181	0.219	0.245	0.13	0.15	3.54	0.28	2.04	5.10	2771	100
Vikedal	NO0572R	2007	0.138	0.169	0.275	0.17	0.22	5.07	0.40	3.31	5.24	3150	98
Vikedal	NO0572R	2008	0.145	0.170	0.205	0.15	0.22	5.26	0.42	2.95	5.24	2986	100
Vikedal	NO0572R	2009	0.169	0.196	0.264	0.09	0.10	2.92	0.20	1.74	5.33	2545	98
Vikedal	NO0572R	2010	0.284	0.276	0.310	0.17	0.28	1.84	0.12	1.01	5.26	1835	99
Vikedal	NO0572R	2011	0.108	0.184	0.369	0.14	0.16	5.11	0.34	2.78	5.33	3319	98
Vikedal	NO0572R	2012	0.105	0.167	0.283	0.10	0.12	2.96	0.21	1.65	5.34	2562	100
Vikedal	NO0572R	2013	0.119	0.183	0.411	0.13	0.21	4.17	0.29	2.42	5.48	2566	100
Vikedal	NO0572R	2014	0.166	0.178	0.273	0.13	0.22	3.75	0.27	2.15	5.21	2891	100
Vikedal	NO0572R	2015	0.055	0.149	0.222	0.18	0.21	6.91	0.47	3.91	5.24	3283	97
Vikedal	NO0572R	2016	0.104	0.176	0.247	0.18	0.15	4.66	0.33	2.69	5.14	2487	100
Vikedal	NO0572R	2017	0.064	0.118	0.158	0.11	0.14	4.07	0.26	2.32	5.25	3570	100
Vikedal	NO0572R	2018	0.089	0.158	0.219	0.11	0.17	3.84	0.26	2.16	5.39	2792	98
Vikedal	NO0572R	2019	0.086	0.109	0.136	0.20	0.16	3.08	0.22	1.80	5.38	2937	100
Vikedal	NO0572R	2020	0.063	0.111	0.192	0.19	0.21	4.69	0.31	2.72	5.44	3560	93

Table C.1 (continued) - Part 11

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Vikedal	NO0572R	2021	0.095	0.170	0.236	0.15	0.21	2.74	0.19	1.57	5.38	2266	100
Vikedal	NO0572R	2022	0.070	0.133	0.183	0.15	0.21	4.07	0.29	2.31	5.45	2756	100
Vikedal	NO0572R	2023	0.062	0.115	0.160	0.11	0.15	3.31	0.20	1.92	5.21	2710	100
Vikedal	NO0572R	2024	0.082	0.113	0.197	0.11	0.16	3.66	0.27	2.10	5.34	3086	100
Vikedal	NO0572R	2025	0.075	0.179	0.354	0.17	0.16	5.32	0.35	3.08	5.26	2794	100
Nausta	NO0655R	1985	0.293	0.127	0.089	0.08	0.09	1.75	0.12	0.95	4.70	1942	99
Nausta	NO0655R	1986	0.271	0.098	0.076	0.08	0.09	2.28	0.16	1.26	4.74	2315	100
Nausta	NO0655R	1987	0.267	0.120	0.108	0.09	0.09	1.62	0.11	0.92	4.72	1965	100
Nausta	NO0655R	1988	0.209	0.134	0.086	0.08	0.14	3.30	0.23	1.86	4.68	2244	100
Nausta	NO0655R	1989	0.214	0.122	0.068	0.07	0.10	3.39	0.23	1.87	4.80	3336	100
Nausta	NO0655R	1990	0.228	0.107	0.072	0.07	0.09	3.42	0.23	1.90	4.78	3551	96
Nausta	NO0655R	1991	0.189	0.121	0.091	0.11	0.11	4.15	0.29	2.35	4.83	2405	100
Nausta	NO0655R	1992	0.213	0.126	0.069	0.06	0.09	2.33	0.16	1.26	4.80	2967	100
Nausta	NO0655R	1993	0.235	0.125	0.096	0.18	0.17	6.05	0.39	3.21	4.87	2215	100
Nausta	NO0655R	1994	0.206	0.123	0.151	0.06	0.10	2.59	0.19	1.45	4.96	2743	100
Nausta	NO0655R	1995	0.181	0.113	0.128	0.07	0.08	2.46	0.17	1.38	4.91	2514	100
Nausta	NO0655R	1996	0.198	0.153	0.143	0.05	0.07	1.26	0.10	0.69	4.87	1577	100
Nausta	NO0655R	1997	0.155	0.120	0.130	0.08	0.11	3.85	0.23	1.93	5.01	2426	100
Nausta	NO0655R	1998	0.130	0.112	0.122	0.06	0.07	2.19	0.15	1.17	5.01	2541	98
Nausta	NO0655R	1999	0.139	0.104	0.079	0.05	0.07	2.56	0.16	1.37	4.99	2881	100
Nausta	NO0655R	2000	0.141	0.105	0.080	0.09	0.11	4.24	0.27	2.27	4.98	2273	100
Nausta	NO0655R	2001	0.132	0.106	0.091	0.06	0.06	2.26	0.14	1.23	5.01	2153	100
Nausta	NO0655R	2002	0.154	0.132	0.131	0.11	0.08	2.25	0.16	1.29	5.00	1882	100
Nausta	NO0655R	2003	0.123	0.122	0.136	0.08	0.11	2.99	0.21	1.56	5.01	2615	100
Nausta	NO0655R	2004	0.100	0.102	0.083	0.07	0.07	1.69	0.13	0.99	5.12	2803	100
Nausta	NO0655R	2005	0.187	0.115	0.136	0.05	0.07	2.23	0.15	1.33	5.10	3200	99
Nausta	NO0655R	2006	0.113	0.132	0.111	0.06	0.07	2.20	0.16	1.22	5.09	2340	100
Nausta	NO0655R	2007	0.069	0.078	0.102	0.07	0.10	2.53	0.20	1.38	5.26	3089	100
Nausta	NO0655R	2008	0.057	0.100	0.133	0.13	0.18	5.60	0.45	3.00	5.24	2464	100
Nausta	NO0655R	2009	0.088	0.087	0.100	0.05	0.06	1.79	0.13	1.06	5.27	2074	100
Nausta	NO0655R	2010	0.096	0.135	0.160	0.06	0.03	1.01	0.05	0.50	5.23	1588	96
Nausta	NO0655R	2011	0.069	0.090	0.208	0.08	0.10	2.55	0.17	1.39	5.41	2818	98
Nausta	NO0655R	2012	0.038	0.080	0.167	0.08	0.10	2.36	0.17	1.33	5.50	2182	97
Nausta	NO0655R	2013	0.067	0.091	0.291	0.06	0.08	2.19	0.14	1.22	5.55	2292	100

Table C.1 (continued) - Part 12

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Nausta	NO0655R	2014	0.103	0.098	0.189	0.09	0.15	2.51	0.18	1.41	5.24	1725	99
Nausta	NO0655R	2015	0.049	0.078	0.129	0.10	0.15	3.05	0.21	1.72	5.27	2533	80
Nausta	NO0655R	2016	0.070	0.092	0.154	0.16	0.13	4.15	0.29	2.39	5.13	1477	91
Nausta	NO0655R	2017	0.068	0.091	0.114	0.13	0.10	2.62	0.17	1.43	5.18	1111	86
Nausta	NO0655R	2018	0.045	0.087	0.127	0.07	0.08	1.89	0.13	1.10	5.41	2031	96
Nausta	NO0655R	2019	0.059	0.098	0.166	0.11	0.12	2.56	0.18	1.44	5.45	1866	99
Nausta	NO0655R	2020	0.040	0.069	0.116	0.11	0.11	3.04	0.20	1.74	5.48	3047	100
Nausta	NO0655R	2021	0.051	0.069	0.120	0.09	0.12	2.24	0.15	1.25	5.40	2013	100
Nausta	NO0655R	2022	0.047	0.074	0.110	0.09	0.13	2.58	0.17	1.46	5.43	2502	100
Nausta	NO0655R	2023	0.030	0.043	0.084	0.09	0.07	2.32	0.13	1.34	5.29	1983	98
Nausta	NO0655R	2024	0.051	0.067	0.095	0.09	0.10	2.69	0.18	1.51	5.26	2460	98
Nausta	NO0655R	2025	0.054	0.087	0.135	0.08	0.09	1.97	0.12	1.16	5.32	1958	100
Kårvatn	NO0039R	1978	0.158	0.051	0.090		0.11	1.84	0.13	1.00	4.98	1317	100
Kårvatn	NO0039R	1979	0.232	0.080	0.084		0.11	1.49	0.11	0.91	4.65	1197	100
Kårvatn	NO0039R	1980	0.207	0.073	0.076	0.07	0.11	1.89	0.13	1.07	4.88	1224	100
Kårvatn	NO0039R	1981	0.220	0.080	0.123	0.12	0.17	3.65	0.25	1.91	4.96	1102	100
Kårvatn	NO0039R	1982	0.259	0.078	0.109	0.10	0.15	2.31	0.16	1.30	4.87	994	100
Kårvatn	NO0039R	1983	0.138	0.052	0.055		0.18	2.84	0.20		5.08	1911	100
Kårvatn	NO0039R	1984	0.234	0.099	0.181		0.22	2.47	0.18		5.04	920	100
Kårvatn	NO0039R	1985	0.202	0.068	0.100		0.15	1.57	0.11		5.00	1462	100
Kårvatn	NO0039R	1986	0.206	0.070	0.127	0.11	0.10	1.61	0.11	0.89	4.95	1267	99
Kårvatn	NO0039R	1987	0.244	0.088	0.120	0.12	0.15	2.54	0.17	1.36	4.87	1465	100
Kårvatn	NO0039R	1988	0.106	0.060	0.091	0.10	0.12	2.63	0.19	1.55	5.08	1480	99
Kårvatn	NO0039R	1989	0.108	0.062	0.061	0.13	0.13	4.02	0.26	2.13	5.11	1524	97
Kårvatn	NO0039R	1990	0.102	0.043	0.066	0.08	0.07	2.03	0.14	1.11	5.07	1512	99
Kårvatn	NO0039R	1991	0.110	0.063	0.105	0.13	0.12	3.11	0.23	1.82	5.14	1617	100
Kårvatn	NO0039R	1992	0.098	0.070	0.058	0.12	0.11	2.92	0.19	1.68	5.17	1622	100
Kårvatn	NO0039R	1993	0.102	0.061	0.119	0.10	0.12	2.49	0.18	1.43	5.16	1422	100
Kårvatn	NO0039R	1994	0.116	0.068	0.081	0.09	0.12	2.03	0.15	1.14	5.12	1473	100
Kårvatn	NO0039R	1995	0.082	0.048	0.064	0.08	0.10	2.03	0.15	1.16	5.17	1663	100
Kårvatn	NO0039R	1996	0.074	0.067	0.092	0.09	0.10	1.66	0.13	0.96	5.16	1153	99
Kårvatn	NO0039R	1997	0.093	0.057	0.110	0.12	0.12	3.56	0.23	1.81	5.22	1822	99
Kårvatn	NO0039R	1998	0.080	0.056	0.110	0.08	0.09	2.80	0.19	1.50	5.22	1417	99
Kårvatn	NO0039R	1999	0.085	0.068	0.071	0.06	0.06	1.98	0.13	1.10	5.21	1242	97

Table C.1 (continued) - Part 13

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Kårvatn	NO0039R	2000	0.088	0.049	0.083	0.09	0.10	3.50	0.22	2.05	5.26	1204	98
Kårvatn	NO0039R	2001	0.067	0.047	0.074	0.08	0.07	3.18	0.21	1.84	5.31	1513	100
Kårvatn	NO0039R	2002	0.104	0.067	0.101	0.09	0.08	1.62	0.11	0.90	5.26	1304	100
Kårvatn	NO0039R	2003	0.092	0.077	0.115	0.09	0.12	3.30	0.23	1.82	5.19	1668	99
Kårvatn	NO0039R	2004	0.054	0.038	0.065	0.08	0.11	2.14	0.16	1.22	5.40	1986	99
Kårvatn	NO0039R	2005	0.093	0.054	0.080	0.10	0.11	2.74	0.19	1.64	5.33	1733	100
Kårvatn	NO0039R	2006	0.079	0.076	0.138	0.08	0.09	1.68	0.13	0.94	5.29	1218	100
Kårvatn	NO0039R	2007	0.049	0.038	0.114	0.09	0.11	2.85	0.22	1.52	5.40	1930	100
Kårvatn	NO0039R	2008	0.052	0.074	0.081	0.10	0.13	2.60	0.22	1.49	5.37	1422	99
Kårvatn	NO0039R	2009	0.052	0.052	0.077	0.08	0.06	1.40	0.09	0.79	5.46	1315	100
Kårvatn	NO0039R	2010	0.074	0.051	0.120	0.06	0.03	1.07	0.06	0.61	5.36	1465	96
Kårvatn	NO0039R	2011	0.054	0.046	0.172	0.09	0.10	3.03	0.20	1.60	5.48	1500	100
Kårvatn	NO0039R	2012	0.056	0.060	0.118	0.09	0.12	2.83	0.21	1.60	5.42	1526	99
Kårvatn	NO0039R	2013	0.040	0.056	0.127	0.15	0.14	3.54	0.22	1.96	5.45	1432	99
Kårvatn	NO0039R	2014	0.175	0.113	0.099	0.16	0.21	2.16	0.16	1.24	5.03	1099	100
Kårvatn	NO0039R	2015	0.059	0.083	0.088	0.14	0.15	2.57	0.18	1.49	5.20	1343	99
Kårvatn	NO0039R	2016	0.068	0.101	0.102	0.11	0.10	2.29	0.16	1.30	5.19	1540	99
Kårvatn	NO0039R	2017	0.050	0.042	0.063	0.08	0.09	1.77	0.12	1.00	5.26	1724	96
Kårvatn	NO0039R	2018	0.051	0.073	0.084	0.10	0.10	2.34	0.16	1.33	5.35	1134	97
Kårvatn	NO0039R	2019	0.049	0.068	0.088	0.11	0.12	2.73	0.19	1.58	5.30	1491	95
Kårvatn	NO0039R	2020	0.038	0.042	0.094	0.11	0.11	2.97	0.20	1.67	5.49	1773	100
Kårvatn	NO0039R	2021	0.064	0.062	0.073	0.10	0.14	2.62	0.18	1.46	5.34	1893	100
Kårvatn	NO0039R	2022	0.038	0.061	0.102	0.13	0.15	3.47	0.23	1.97	5.52	1552	84
Kårvatn	NO0039R	2023	0.050	0.069	0.090	0.08	0.10	2.35	0.13	1.35	5.13	1610	100
Kårvatn	NO0039R	2024	0.052	0.059	0.077	0.09	0.12	2.42	0.17	1.39	5.28	1274	99
Kårvatn	NO0039R	2025	0.056	0.056	0.112	0.11	0.10	1.88	0.12	1.07	5.38	1563	99
Høylandet	NO0478R	1987	0.338	0.155	0.363	0.15	0.14	2.49	0.18	1.39	4.97	802	86
Høylandet	NO0478R	1988	0.217	0.113	0.171	0.13	0.16	2.79	0.20	1.59	5.00	1307	100
Høylandet	NO0478R	1989	0.176	0.102	0.138	0.18	0.20	7.46	0.45	3.71	5.11	1594	100
Høylandet	NO0478R	1990	0.204	0.101	0.133	0.10	0.14	3.94	0.26	2.21	4.92	1606	100
Høylandet	NO0478R	1991	0.229	0.112	0.195	0.12	0.21	3.96	0.31	2.24	5.10	1309	100
Høylandet	NO0478R	1992	0.156	0.086	0.152	0.14	0.16	5.23	0.36	2.95	5.16	1418	100
Høylandet	NO0478R	1993	0.203	0.121	0.204	0.14	0.17	5.04	0.35	2.77	5.10	1145	100
Høylandet	NO0478R	1994	0.149	0.092	0.224	0.11	0.12	3.25	0.24	1.79	5.23	1182	100

Table C.1 (continued) - Part 14

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Høylandet	NO0478R	1995	0.183	0.104	0.226	0.13	0.18	3.79	0.28	2.13	5.19	1383	96
Høylandet	NO0478R	1996	0.161	0.102	0.204	0.11	0.16	3.86	0.26	2.04	5.11	816	100
Høylandet	NO0478R	1997	0.141	0.101	0.217	0.14	0.17	5.18	0.32	2.61	5.25	1418	100
Høylandet	NO0478R	1998	0.108	0.079	0.216	0.10	0.14	2.77	0.19	1.51	5.46	1456	100
Høylandet	NO0478R	1999	0.142	0.100	0.267	0.10	0.12	2.81	0.19	1.53	5.41	1173	98
Høylandet	NO0478R	2000	0.126	0.070	0.206	0.15	0.18	5.60	0.35	3.03	5.37	1183	100
Høylandet	NO0478R	2001	0.135	0.083	0.246	0.17	0.17	6.25	0.38	3.42	5.37	1280	100
Høylandet	NO0478R	2002	0.142	0.116	0.283	0.13	0.16	3.63	0.25	2.02	5.40	971	100
Høylandet	NO0478R	2003	0.111	0.101	0.234	0.16	0.22	4.63	0.37	2.74	5.25	1536	100
Høylandet	NO0478R	2004	0.063	0.076	0.215	0.16	0.22	4.70	0.35	2.77	5.57	1391	100
Høylandet	NO0478R	2005	0.147	0.101	0.263	0.14	0.16	4.42	0.29	2.51	5.44	1790	100
Høylandet	NO0478R	2006	0.111	0.135	0.322	0.15	0.17	4.55	0.33	2.50	5.47	1182	100
Høylandet	NO0478R	2007	0.080	0.118	0.381	0.17	0.25	6.55	0.49	3.58	5.88	1071	100
Høylandet	NO0478R	2008	0.113	0.106	0.328	0.21	0.32	6.44	0.51	3.44	5.78	1030	98
Høylandet	NO0478R	2009	0.074	0.106	0.274	0.10	0.11	2.80	0.18	1.62	5.68	1153	100
Høylandet	NO0478R	2010	0.112	0.090	0.307	0.12	0.07	2.36	0.10	1.10	5.68	927	99
Høylandet	NO0478R	2011	0.055	0.068	0.488	0.18	0.19	5.38	0.35	2.87	5.86	1633	100
Høylandet	NO0478R	2012	0.045	0.114	0.323	0.18	0.21	4.75	0.33	2.59	5.82	1361	91
Høylandet	NO0478R	2013	0.060	0.077	0.341	0.15	0.17	3.65	0.24	2.08	5.67	1551	98
Høylandet	NO0478R	2014	0.197	0.109	0.338	0.19	0.29	3.58	0.25	1.97	5.28	999	99
Høylandet	NO0478R	2015	0.027	0.055	0.142	0.12	0.13	3.06	0.21	1.68	5.46	1148	71
Høylandet	NO0478R	2016	0.052	0.054	0.166	0.13	0.14	3.90	0.27	2.24	5.47	1283	100
Høylandet	NO0478R	2017	0.043	0.043	0.184	0.14	0.14	3.82	0.25	2.13	5.47	1502	100
Høylandet	NO0478R	2018	0.047	0.049	0.176	0.14	0.15	4.43	0.30	2.43	5.60	853	94
Høylandet	NO0478R	2019	0.062	0.075	0.206	0.15	0.16	5.02	0.34	2.76	5.51	1197	97
Høylandet	NO0478R	2020	0.017	0.044	0.172	0.14	0.16	5.08	0.33	3.05	5.61	1207	98
Høylandet	NO0478R	2021	0.042	0.035	0.212	0.15	0.16	3.43	0.24	1.92	5.67	951	100
Høylandet	NO0478R	2022	0.042	0.046	0.307	0.14	0.31	3.78	0.28	2.16	5.77	960	100
Overhalla	NO0240R	2023	0.046	0.069	0.182	0.15	0.17	4.51	0.27	2.62	5.25	1120	96
Overhalla	NO0240R	2024	0.056	0.085	0.237	0.18	0.28	5.54	0.40	3.17	5.51	1390	100
Overhalla	NO0240R	2025	0.049	0.063	0.186	0.11	0.21	3.99	0.27	2.28	5.56	1610	100
Tustervatn	NO0015R	1972	0.325						0.15		4.74	1070	100
Tustervatn	NO0015R	1973	0.261						0.17		4.91	1340	100
Tustervatn	NO0015R	1974	0.284						0.09		4.86	693	100

Table C.1 (continued) - Part 15

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Tustervatn	NO0015R	1975	0.254						0.23		4.89	1260	100
Tustervatn	NO0015R	1976	0.281						0.17		4.96	819	100
Tustervatn	NO0015R	1977	0.292				0.17		0.15		4.91	1111	100
Tustervatn	NO0015R	1978	0.221	0.076	0.101		0.16		0.16		4.84	1128	100
Tustervatn	NO0015R	1979	0.277	0.084	0.127		0.15		0.11		4.73	1168	100
Tustervatn	NO0015R	1980	0.266	0.083	0.144	0.16	0.47	2.25	0.16	1.20	4.98	858	100
Tustervatn	NO0015R	1981	0.189	0.068	0.096	0.12	0.22	2.17	0.15	1.15	5.00	1099	100
Tustervatn	NO0015R	1982	0.168	0.079	0.085	0.21	0.21	7.23	0.47	3.77	4.98	1385	100
Tustervatn	NO0015R	1983	0.197	0.059	0.083		0.16	3.30	0.22		4.82	1677	100
Tustervatn	NO0015R	1984	0.233	0.089	0.083		0.12	1.44	0.10		4.85	1060	100
Tustervatn	NO0015R	1985	0.220	0.080	0.098		0.12	2.11	0.15		4.93	1344	100
Tustervatn	NO0015R	1986	0.258	0.086	0.116	0.15	0.11	2.11	0.15	1.12	4.89	1033	99
Tustervatn	NO0015R	1987	0.218	0.084	0.114	0.13	0.12	1.80	0.12	1.01	4.89	1162	100
Tustervatn	NO0015R	1988	0.125	0.072	0.091	0.11	0.13	2.00	0.15	1.16	5.04	1155	100
Tustervatn	NO0015R	1989	0.188	0.074	0.095	0.17	0.18	6.10	0.40	2.98	5.00	1790	94
Tustervatn	NO0015R	1990	0.164	0.088	0.141	0.12	0.11	3.31	0.21	1.84	4.99	1500	99
Tustervatn	NO0015R	1991	0.172	0.098	0.141	0.15	0.14	3.12	0.21	1.69	5.04	1399	100
Tustervatn	NO0015R	1992	0.148	0.083	0.146	0.19	0.19	5.47	0.37	3.03	5.12	1507	100
Tustervatn	NO0015R	1993	0.132	0.083	0.156	0.23	0.24	7.55	0.50	4.09	5.19	1339	100
Tustervatn	NO0015R	1994	0.101	0.077	0.128	0.13	0.12	2.13	0.15	1.19	5.24	1119	100
Tustervatn	NO0015R	1995	0.094	0.063	0.122	0.13	0.13	3.05	0.21	1.70	5.22	1515	100
Tustervatn	NO0015R	1996	0.110	0.082	0.153	0.13	0.15	2.32	0.18	1.27	5.15	1073	100
Tustervatn	NO0015R	1997	0.088	0.065	0.177	0.17	0.17	4.54	0.29	2.28	5.34	1516	99
Tustervatn	NO0015R	1998	0.071	0.063	0.164	0.12	0.11	2.77	0.19	1.50	5.39	1395	99
Tustervatn	NO0015R	1999	0.090	0.077	0.163	0.09	0.07	1.33	0.08	0.70	5.38	1121	99
Tustervatn	NO0015R	2000	0.095	0.060	0.142	0.14	0.11	3.17	0.21	1.76	5.33	1303	99
Tustervatn	NO0015R	2001	0.074	0.065	0.152	0.12	0.10	3.04	0.19	1.72	5.36	1440	99
Tustervatn	NO0015R	2002	0.089	0.071	0.136	0.11	0.11	2.59	0.17	1.42	5.38	1158	100
Tustervatn	NO0015R	2003	0.073	0.074	0.179	0.16	0.16	3.55	0.26	2.02	5.32	1516	100
Tustervatn	NO0015R	2004	0.044	0.068	0.170	0.15	0.20	3.05	0.23	1.81	5.50	1427	100
Tustervatn	NO0015R	2005	0.124	0.083	0.184	0.16	0.15	2.84	0.20	1.74	5.39	1308	100
Tustervatn	NO0015R	2006	0.080	0.098	0.127	0.11	0.12	2.74	0.20	1.60	5.30	1207	100
Tustervatn	NO0015R	2007	0.071	0.082	0.134	0.10	0.13	3.65	0.26	1.98	5.28	1298	100
Tustervatn	NO0015R	2008	0.069	0.080	0.087	0.07	0.16	2.79	0.22	1.51	5.33	1162	100

Table C.1 (continued) - Part 16

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Tustervatn	NO0015R	2009	0.054	0.062	0.109	0.05	0.06	1.60	0.10	0.80	5.40	1158	100
Tustervatn	NO0015R	2010	0.107	0.082	0.154	0.09	0.06	1.21	0.08	0.77	5.35	913	99
Tustervatn	NO0015R	2011	0.107	0.063	0.146	0.09	0.12	3.02	0.20	1.66	5.35	1430	93
Tustervatn	NO0015R	2012	0.025	0.073	0.135	0.10	0.12	3.50	0.24	1.89	5.41	775	98
Tustervatn	NO0015R	2013	0.043	0.052	0.142	0.06	0.09	1.56	0.10	0.86	5.39	1152	94
Tustervatn	NO0015R	2014	0.143	0.083	0.105	0.14	0.19	3.55	0.25	2.01	5.06	893	100
Tustervatn	NO0015R	2015	0.045	0.073	0.093	0.15	0.17	3.51	0.24	1.96	5.26	1444	97
Tustervatn	NO0015R	2016	0.053	0.070	0.090	0.11	0.09	1.88	0.13	1.06	5.24	1029	100
Tustervatn	NO0015R	2017	0.037	0.054	0.095	0.11	0.10	2.51	0.16	1.44	5.34	1317	99
Tustervatn	NO0015R	2018	0.045	0.066	0.087	0.09	0.09	1.49	0.10	0.87	5.36	1183	99
Tustervatn	NO0015R	2019	0.121	0.069	0.124	0.13	0.15	3.87	0.26	2.24	5.19	1130	99
Tustervatn	NO0015R	2020	0.032	0.046	0.105	0.10	0.12	2.98	0.20	1.72	5.49	1360	99
Tustervatn	NO0015R	2021	0.055	0.079	0.085	0.09	0.12	1.68	0.12	0.94	5.34	1119	100
Tustervatn	NO0015R	2022	0.035	0.055	0.094	0.07	0.10	1.84	0.12	1.03	5.47	1305	100
Tustervatn	NO0015R	2023	0.040	0.053	0.101	0.10	0.09	2.57	0.16	1.46	5.23	1002	100
Tustervatn	NO0015R	2024	0.061	0.091	0.149	0.15	0.15	3.42	0.24	2.00	5.33	1374	100
Tustervatn	NO0015R	2025	0.031	0.055	0.101	0.11	0.07	1.95	0.12	1.11	5.40	1304	98
Svanvik	NO0047R	1986	0.629	0.141	0.187	0.14	0.14	1.98	0.14	1.01	4.61		
Svanvik	NO0047R	1987	0.677	0.115	0.209	0.13	0.13	1.23	0.10	0.70	4.49	365	100
Svanvik	NO0047R	1988	0.565	0.134	0.129	0.05	0.18	1.53	0.13	0.92	4.49	390	100
Svanvik	NO0047R	1989	0.723	0.118	0.100	0.05	0.19	1.19	0.12	0.64	4.47	424	100
Svanvik	NO0047R	1990	0.478	0.135	0.082	0.06	0.11	1.70	0.13	0.89	4.50	266	100
Svanvik	NO0047R	1991	0.560	0.143	0.158	0.07	0.08	1.11	0.09	0.61	4.55	389	100
Svanvik	NO0047R	1992	0.510	0.123	0.215	0.06	0.11	1.35	0.10	0.78	4.71	432	99
Svanvik	NO0047R	1993	0.622	0.158	0.234	0.08	0.16	1.65	0.14	0.93	4.66	331	100
Svanvik	NO0047R	1994	0.579	0.176	0.349	0.13	0.12	1.07	0.12	0.61	4.63	342	100
Svanvik	NO0047R	1995	0.592	0.114	0.187	0.10	0.13	1.29	0.13	0.73	4.68	273	78
Svanvik	NO0047R	1996	0.437	0.162	0.216	0.08	0.22	1.60	0.17	0.86	4.64	211	81
Svanvik	NO0047R	1997	0.481	0.140	0.294	0.09	0.20	1.70	0.14	0.91	4.79	278	100
Svanvik	NO0047R	1998	0.499	0.129	0.267	0.10	0.13	1.89	0.15	1.02	4.69	326	93
Svanvik	NO0047R	1999	0.358	0.129	0.179	0.07	0.08	0.72	0.07	0.38	4.85	448	99
Svanvik	NO0047R	2000	0.512	0.141	0.238	0.08	0.10	1.18	0.10	0.68	4.69	431	98
Svanvik	NO0047R	2001	0.655	0.131	0.305	0.11	0.16	1.71	0.15	0.95	4.90	355	98
Svanvik	NO0047R	2002	0.447	0.105	0.303	0.16	0.20	3.28	0.24	1.87	4.96	427	100

Table C.1 (continued) - Part 17

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Svanvik	NO0047R	2003	0.327	0.126	0.268	0.12	0.17	1.85	0.16	1.10	4.97	371	100
Svanvik	NO0047R	2009	0.821	0.139	0.161	0.08	0.13	0.86	0.09	0.58	4.40	313	92
Svanvik	NO0047R	2012	0.324	0.090	0.081	0.07	0.10	0.87	0.08	0.51	4.86	522	100
Svanvik	NO0047R	2015	0.622	0.124	0.117	0.14	0.15		0.11	0.75	4.63	319	84
Svanvik	NO0047R	2018	0.331	0.119	0.079	0.17	0.12	0.84	0.12	0.46	4.87	356	82
Svanvik	NO0047R	2020	0.098	0.158	0.042	0.04	0.14	1.31	0.10	0.74	5.10		
Svanvik	NO0047R	2021	0.144	0.076	0.166	0.11	0.21	1.28	0.10	0.73	5.27	459	81
Svanvik	NO0047R	2022	0.158	0.082	0.063	0.06	0.12	1.18	0.08	0.65	5.00	398	93
Svanvik	NO0047R	2023	0.122	0.106	0.150	0.10	0.15	1.70	0.10	0.98	5.07	344	98
Svanvik	NO0047R	2024	0.117	0.054	0.042	0.05	0.11	0.93	0.07	0.52	5.06	383	100
Svanvik	NO0047R	2025	0.117	0.054	0.057	0.08	0.14	1.77	0.12	1.02	5.15	523	100
Ny-Ålesund	NO0057R	1983	0.520	0.044	0.020		0.39	4.62	0.56		5.11	220	82
Ny-Ålesund	NO0057R	1984	0.652	0.171			0.71	12.98	0.93		4.60	365	100
Ny-Ålesund	NO0057R	1985	0.606	0.138			0.71	18.95	1.28		4.72	237	100
Ny-Ålesund	NO0057R	1986	0.397	0.065			0.55	6.97	0.58		4.98	306	99
Ny-Ålesund	NO0057R	1987	0.700	0.118			0.64	12.11	0.91		4.63	390	97
Ny-Ålesund	NO0057R	1988	0.275	0.068	0.209		0.54	6.85	0.58	3.85	5.18	307	100
Ny-Ålesund	NO0057R	1989	0.087	0.052	0.063		0.87	20.50	1.47	9.82	5.55	295	100
Ny-Ålesund	NO0057R	1990	0.328	0.073	0.064		0.52	11.22	0.79	6.10	4.92	410	100
Ny-Ålesund	NO0057R	1991	0.336	0.110	0.103	0.43	0.80	14.33	1.13	8.09	4.96	424	100
Ny-Ålesund	NO0057R	1992	0.413	0.100	0.108	0.36	0.79	13.40	1.02	7.64	5.10	271	95
Ny-Ålesund	NO0057R	1993	0.162	0.096	0.085	0.32	0.52	13.13	0.92	6.85	5.03	491	100
Ny-Ålesund	NO0057R	1994	0.297	0.078	0.286	0.27	0.59	8.40	0.63	4.57	5.34	280	100
Ny-Ålesund	NO0057R	1995	0.270	0.108	0.165	0.35	0.75	10.61	0.77	5.70	5.16	181	87
Ny-Ålesund	NO0057R	1996	0.328	0.113	0.319	0.28	0.51	10.21	0.75	5.73	4.98	429	94
Ny-Ålesund	NO0057R	1997	0.367	0.106	0.566	0.58	1.70	13.21	1.20	7.18	5.77	233	90
Ny-Ålesund	NO0057R	1998	0.191	0.133	0.186	0.41	0.73	13.90	1.06	7.56	5.22	174	93
Ny-Ålesund	NO0057R	1999	0.435	0.220	0.220	0.35	0.87	9.67	0.78	5.21	4.95	188	85
Ny-Ålesund	NO0057R	2000	0.157	0.076	0.098	0.18	0.47	6.25	0.49	3.42	5.37	422	98
Ny-Ålesund	NO0057R	2001	0.154	0.078	0.069	0.26	0.52	11.75	0.82	6.63	5.34	340	94
Ny-Ålesund	NO0057R	2002	-0.021	0.062	0.042	0.59	1.14	23.64	1.93	12.68	5.63	321	87
Ny-Ålesund	NO0057R	2003	0.258	0.111	0.120	0.59	1.67	26.50	2.22	13.95	5.50	205	89
Ny-Ålesund	NO0057R	2004	0.226	0.116	0.098	0.28	0.93	12.27	1.01	7.28	5.14	253	96
Ny-Ålesund	NO0057R	2005	0.189	0.092	0.087	0.25	1.29	10.45	0.89	5.91	5.45	212	96

Table C.1 (continued) - Part 18

Site	Code	Year	xSO4-S	NO3-N	NH4-N	K	Ca	Cl	Mg	Na	pH	mm	Capture
Ny-Ålesund	NO0057R	2006	0.205	0.081	0.179	0.38	1.21	15.59	1.19	8.18	5.43	341	97
Ny-Ålesund	NO0057R	2007	0.193	0.047	0.121	0.43	0.79	15.00	1.11	8.18	5.89	304	93
Ny-Ålesund	NO0057R	2008	0.083	0.090	0.224	0.33	0.94	10.78	0.81	5.42	5.69	346	100
Ny-Ålesund	NO0057R	2009	0.127	0.091	0.066	0.15	0.36	6.63	0.44	3.37	5.45	221	98
Ny-Ålesund	NO0057R	2010	0.080	0.106	0.198	0.37	0.51	35.48	1.21	10.10	5.23	211	88
Ny-Ålesund	NO0057R	2011	0.074	0.081	0.301	0.32	0.56	14.28	1.00	7.53	5.51	294	100
Ny-Ålesund	NO0057R	2012	0.061	0.058	0.046	0.14	0.30	6.10	0.46	3.50	5.51	373	99
Ny-Ålesund	NO0057R	2013	0.100	0.068	0.090	0.20	0.47	7.72	0.63	4.57	5.38	268	98
Ny-Ålesund	NO0057R	2014	0.467	0.093	0.082	0.22	0.44	7.46	0.60	4.37	4.78	311	100
Ny-Ålesund	NO0057R	2015	0.113	0.102	0.086	0.28	0.55	11.01	0.79	6.25	5.12	356	100
Ny-Ålesund	NO0057R	2016	0.074	0.056	0.078	0.17	0.30	6.53	0.48	3.66	5.49	490	100
Ny-Ålesund	NO0057R	2017	0.128	0.086	0.072	0.18	0.35	7.25	0.52	3.98	5.19	309	98
Ny-Ålesund	NO0057R	2018	0.101	0.068	0.064	0.13	0.29	6.46	0.46	3.63	5.39	484	100
Ny-Ålesund	NO0057R	2019	0.197	0.114	0.193	0.21	0.56	8.83	0.73	5.16	5.61	162	100
Ny-Ålesund	NO0057R	2020	0.109	0.069	0.085	0.23	0.88	10.18	0.83	5.92	5.75	228	100
Ny-Ålesund	NO0057R	2021	0.121	0.076	0.067	0.25	0.58	10.46	0.80	6.06	5.43	227	100
Ny-Ålesund	NO0057R	2022	0.074	0.065	0.121	0.18	0.50	7.45	0.56	4.25	5.43	340	100
Ny-Ålesund	NO0057R	2023	0.065	0.086	0.211	0.33	0.48	12.07	0.85	6.95	5.32	350	100
Ny-Ålesund	NO0057R	2024	0.283	0.098	0.195	0.29	0.90	9.93	0.83	5.56	5.13	181	100
Ny-Ålesund	NO0057R	2025	0.092	0.057	0.119	0.41	0.60	10.12	0.76	5.61	5.64	237	98

Table C.2: Annual mean concentrations of main components in air and aerosols at Norwegian background stations in 1973–2025. xSO_4^{2-} is sea salt corrected SO_4^{2-}, sNO_3^- is sum of NO_3^- and HNO_3 while sNH_4 is the sum of NH_4^+ and NH_3. Units in μg/m³ or μgS/m³ and in μgN/m³.

Site	Code	Year	SO_2-S	SO_4^{2-}-S	xSO_4^{2-}-S	NO_2-N	NO_3^--N	sNO_3-N	NH_4^+-N	sNH_4-N	K^+	Ca^{2+}
Birkenes	NO0001R	1972	2.377	1.101								
Birkenes	NO0001R	1973	2.746	0.807								
Birkenes	NO0001R	1974	2.988	1.105								
Birkenes	NO0001R	1975	2.566	1.074								
Birkenes	NO0001R	1976	4.447									
Birkenes	NO0001R	1978	1.738	1.089								
Birkenes	NO0001R	1979	1.115	1.329								
Birkenes	NO0001R	1980	1.419	1.415								
Birkenes	NO0001R	1981	0.754	0.967								
Birkenes	NO0001R	1982	0.977	1.146		1.171						
Birkenes	NO0001R	1983	0.535	0.946								
Birkenes	NO0001R	1984	0.648	1.271		1.123						
Birkenes	NO0001R	1985	0.695	0.875		0.830						
Birkenes	NO0001R	1986	0.695	0.828		1.070		0.359		0.663		
Birkenes	NO0001R	1987	0.719	0.778		1.120		0.295		0.650		
Birkenes	NO0001R	1988	0.628	0.753		1.267		0.284		0.632		
Birkenes	NO0001R	1989	0.481	0.671		1.109		0.259		0.627		
Birkenes	NO0001R	1990	0.495	0.761		1.008		0.275		0.777		
Birkenes	NO0001R	1991	0.536	0.905		0.931		0.264		0.764		
Birkenes	NO0001R	1992	0.397	0.649		0.688		0.241		0.530		
Birkenes	NO0001R	1993	0.397	0.596		0.589	0.139	0.233	0.428	0.548	0.052	0.053
Birkenes	NO0001R	1994	0.399	0.647		0.660	0.158	0.283	0.457	0.631	0.046	0.056
Birkenes	NO0001R	1995	0.313	0.576		0.662	0.165	0.296	0.438	0.539	0.045	0.048
Birkenes	NO0001R	1996	0.400	0.664		0.680	0.156	0.286	0.473	0.575	0.043	0.054
Birkenes	NO0001R	1997	0.225	0.531	0.496	0.690	0.144	0.236	0.370	0.535	0.049	0.045
Birkenes	NO0001R	1998	0.157	0.458	0.429	0.618	0.131	0.189	0.310	0.413	0.040	0.033
Birkenes	NO0001R	1999	0.136	0.490	0.459	0.525	0.143	0.201	0.330	0.512	0.043	0.037
Birkenes	NO0001R	2000	0.121	0.443	0.408	0.570	0.167	0.204	0.305	0.433	0.048	0.038
Birkenes	NO0001R	2001	0.162	0.435	0.410	0.466	0.141	0.209	0.307	0.454	0.048	0.028
Birkenes	NO0001R	2002	0.151	0.497	0.469	0.455	0.193	0.265	0.432	0.527	0.058	0.055
Birkenes	NO0001R	2003	0.150	0.498	0.468	0.575	0.185	0.260	0.378	0.499	0.051	0.042
Birkenes	NO0001R	2004	0.127	0.349	0.319	0.462	0.181	0.259	0.298	0.397	0.045	0.052
Birkenes	NO0001R	2005	0.194	0.458	0.423	0.458	0.245	0.334	0.404	0.604	0.054	0.060
Birkenes	NO0001R	2006	0.179	0.531	0.495	0.477	0.302	0.397	0.324	0.621	0.049	0.127

Table C.2 (continued)- Part 2

Site	Code	Year	SO2-S	SO4-S	xSO4-S	NO2-N	NO3-N	sNO3-N	NH4-N	sNH4-N	K	Ca	Cl	Mg	Na
Birkenes	NO0001R	2007	0.064	0.277	0.249	0.320	0.127	0.170	0.171	0.286	0.036	0.052	0.37	0.05	0.36
Birkenes	NO0001R	2008	0.067	0.279	0.240	0.343	0.153	0.194	0.138	0.345	0.040	0.084	0.50	0.07	0.48
Birkenes	NO0001R	2009	0.055	0.304	0.275	0.443	0.177	0.255	0.203		0.038	0.037	0.36	0.04	0.38
Birkenes II	NO0002R	2010	0.122	0.295	0.274	0.311	0.150	0.228	0.204		0.037	0.025	0.26	0.03	0.30
Birkenes II	NO0002R	2011	0.108	0.333	0.291	0.435	0.268	0.371	0.321	0.628	0.079	0.043	0.53	0.08	0.53
Birkenes II	NO0002R	2012	0.073	0.272	0.237	0.391	0.306	0.460	0.280	0.609	0.070	0.046	0.35	0.06	0.43
Birkenes II	NO0002R	2013	0.087	0.248	0.206	0.280	0.209	0.285	0.231	0.465	0.064	0.060	0.57	0.06	0.51
Birkenes II	NO0002R	2014	0.167	0.373	0.325	0.306	0.283	0.378	0.343	0.619	0.075	0.066	0.64	0.07	0.52
Birkenes II	NO0002R	2015	0.070	0.286	0.235	0.297	0.265	0.319	0.266	0.439	0.061	0.066	0.81	0.08	0.61
Birkenes II	NO0002R	2016	0.055	0.204	0.169	0.300	0.208	0.250	0.231	0.399	0.060	0.041	0.53	0.05	0.42
Birkenes II	NO0002R	2017	0.059	0.222	0.189	0.275	0.115	0.147	0.131	0.274	0.045	0.032	0.51	0.05	0.40
Birkenes II	NO0002R	2018	0.096	0.261	0.223	0.320	0.186	0.238	0.253	0.466	0.056	0.054	0.54	0.06	0.45
Birkenes II	NO0002R	2019	0.070	0.205	0.170	0.317	0.117	0.149	0.157	0.320	0.063	0.049	0.50	0.06	0.42
Birkenes II	NO0002R	2020	0.060	0.190	0.135	0.298	0.130	0.165	0.146	0.397	0.069	0.063	0.87	0.08	0.66
Birkenes II	NO0002R	2021	0.070	0.187	0.156	0.248	0.094	0.120	0.134	0.274	0.040	0.042	0.46	0.05	0.37
Birkenes II	NO0002R	2022	0.056	0.175	0.132	0.245	0.129	0.153	0.140	0.311	0.043	0.048	0.68	0.06	0.52
Birkenes II	NO0002R	2023	0.050	0.159	0.129	0.233	0.085	0.104	0.104	0.282	0.033	0.034	0.49	0.04	0.39
Birkenes II	NO0002R	2024	0.039	0.201	0.158	0.230	0.105	0.126	0.129	0.311	0.044	0.062	0.69	0.07	0.53
Birkenes II	NO0002R	2025	0.028	0.179	0.140	0.234	0.121	0.141	0.106	0.281	0.042	0.039	0.62	0.06	0.48
Nordmoen	NO0044R	1986	0.472	0.876		2.014				0.592					
Nordmoen	NO0044R	1987	0.617	0.816		3.261				0.730					
Nordmoen	NO0044R	1988	0.701	0.851		3.007				0.605					
Nordmoen	NO0044R	1989	0.399	0.748		2.635				0.695					
Nordmoen	NO0044R	1990	0.365	0.717						0.666					
Nordmoen	NO0044R	1991	0.298	0.770		2.579				0.608					
Nordmoen	NO0044R	1992	0.212	0.562		2.426				0.524					
Nordmoen	NO0044R	1993	0.253	0.593		2.092			0.424	0.544					
Nordmoen	NO0044R	1994	0.227	0.583		2.568			0.451	0.616					
Nordmoen	NO0044R	1995	0.191	0.540		2.142			0.443	0.542					
Nordmoen	NO0044R	1996	0.158	0.576		2.479			0.480	0.599					
Hurdal	NO0056R	1997	0.183	0.408		1.098			0.292	0.532		0.060		0.03	0.19
Hurdal	NO0056R	1998	0.138	0.332		1.118			0.211	0.418		0.039		0.02	0.14
Hurdal	NO0056R	1999	0.095	0.391		1.040			0.267	0.392		0.035		0.02	0.16
Hurdal	NO0056R	2000	0.076	0.346		1.002			0.246	0.365		0.035		0.02	0.19

Table C.2 (continued)- Part 3

Site	Code	Year	SO2-S	SO4-S	xSO4-S	NO2-N	NO3-N	sNO3-N	NH4-N	sNH4-N	K	Ca	Cl	Mg	Na
Hurdal	NO0056R	2001	0.095	0.328					0.213	0.246		0.031		0.02	0.15
Hurdal	NO0056R	2002	0.084	0.380	0.369		0.048	0.179	0.253	0.289		0.036	0.04	0.02	0.14
Hurdal	NO0056R	2003	0.113	0.428	0.407		0.097	0.235	0.273	0.383	0.055	0.042	0.15	0.03	0.27
Hurdal	NO0056R	2004	0.108	0.306	0.295	0.592	0.104	0.184	0.182	0.363	0.041	0.050	0.08	0.02	0.15
Hurdal	NO0056R	2005	0.121	0.397	0.384	0.835	0.142	0.245	0.288	0.512	0.058	0.046	0.09	0.02	0.20
Hurdal	NO0056R	2006	0.127	0.428	0.413	0.779	0.173	0.258	0.242	0.506	0.056	0.102	0.11	0.04	0.19
Hurdal	NO0056R	2007	0.056	0.221	0.210	0.777	0.095	0.165	0.152	0.303	0.038	0.045	0.07	0.02	0.13
Hurdal	NO0056R	2008	0.039	0.210	0.197	0.727	0.111	0.164	0.111	0.289	0.032	0.088	0.12	0.03	0.17
Hurdal	NO0056R	2009	0.043	0.207	0.197	0.709	0.092	0.171	0.120		0.035	0.033	0.07	0.02	0.14
Hurdal	NO0056R	2010	0.068	0.210	0.205	0.657	0.107	0.157	0.179		0.038	0.021	0.07	0.01	0.11
Hurdal	NO0056R	2011	0.097	0.261	0.247	0.790	0.247	0.344	0.405	0.710	0.077	0.035	0.10	0.03	0.19
Hurdal	NO0056R	2012	0.063	0.219	0.206	0.764	0.183	0.301	0.194	0.491	0.069	0.038	0.10	0.03	0.16
Hurdal	NO0056R	2013	0.042	0.170	0.157	0.694	0.117	0.176	0.153	0.371	0.060	0.051	0.14	0.02	0.17
Hurdal	NO0056R	2014	0.089	0.286	0.274	0.547	0.146	0.218	0.254	0.495	0.059	0.047	0.13	0.02	0.16
Hurdal	NO0056R	2015	0.050	0.142	0.129	0.645	0.240	0.269	0.244	0.417	0.050	0.048	0.14	0.02	0.16
Hurdal	NO0056R	2016	0.030	0.172	0.160	0.608	0.125	0.163	0.152	0.303	0.056	0.029	0.14	0.02	0.16
Hurdal	NO0056R	2017	0.041	0.145	0.137	0.639	0.070	0.093	0.088	0.198	0.049	0.021	0.10	0.01	0.11
Hurdal	NO0056R	2018	0.042	0.180	0.168	0.594	0.093	0.126	0.134	0.287	0.045	0.037	0.14	0.02	0.16
Hurdal	NO0056R	2019	0.036	0.141	0.130	0.499	0.065	0.086	0.096	0.238	0.036	0.035	0.14	0.02	0.14
Hurdal	NO0056R	2020	0.027	0.102	0.088	0.348	0.062	0.080	0.079	0.179	0.050	0.037	0.20	0.02	0.17
Hurdal	NO0056R	2021	0.022	0.121	0.112	0.395	0.059	0.074	0.092	0.216	0.029	0.026	0.11	0.02	0.12
Hurdal	NO0056R	2022	0.022	0.102	0.090	0.319	0.067	0.082	0.072	0.251	0.026	0.030	0.15	0.02	0.15
Hurdal	NO0056R	2023	0.032	0.103	0.096	0.264	0.052	0.068	0.062	0.240	0.019	0.019	0.11	0.01	0.12
Hurdal	NO0056R	2024	0.035	0.127	0.116	0.302	0.058	0.074	0.085	0.305	0.046	0.033	0.16	0.02	0.15
Hurdal	NO0056R	2025	0.032	0.087	0.076	0.306	0.046	0.061	0.047	0.209	0.036	0.021	0.15	0.02	0.14
Kårvatn	NO0039R	1978	0.215	0.433											
Kårvatn	NO0039R	1979	0.478	0.479											
Kårvatn	NO0039R	1980	0.541	0.546											
Kårvatn	NO0039R	1981	0.509	0.470											
Kårvatn	NO0039R	1982	0.292	0.402											
Kårvatn	NO0039R	1983	0.188	0.384											
Kårvatn	NO0039R	1984	0.427	0.536											
Kårvatn	NO0039R	1985	0.436	0.453											
Kårvatn	NO0039R	1986	0.393	0.433											

Table C.2 (continued)- Part 4

Site	Code	Year	SO2-S	SO4-S	xSO4-S	NO2-N	NO3-N	sNO3-N	NH4-N	sNH4-N	K	Ca	Cl	Mg	Na
Kårvatn	NO0039R	1987	0.316	0.384											
Kårvatn	NO0039R	1988	0.338	0.397		0.562		0.069		0.436					
Kårvatn	NO0039R	1989	0.171	0.302		0.336		0.081		0.423					
Kårvatn	NO0039R	1990	0.122	0.319		0.393		0.063		0.353					
Kårvatn	NO0039R	1991	0.141	0.310		0.263		0.063		0.356					
Kårvatn	NO0039R	1992	0.123	0.298		0.191		0.062		0.373					
Kårvatn	NO0039R	1993	0.151	0.296		0.161	0.029	0.066	0.171	0.380			0.30		
Kårvatn	NO0039R	1994	0.124	0.301		0.219	0.038	0.101	0.182	0.478			0.26		
Kårvatn	NO0039R	1995	0.158	0.221		0.261	0.029	0.095	0.127	0.365			0.24		
Kårvatn	NO0039R	1996	0.080	0.273		0.242	0.035	0.084	0.176	0.464			0.16		
Kårvatn	NO0039R	1997	0.054	0.219	0.208	0.253	0.036	0.072	0.135	0.500	0.021	0.026	0.33	0.03	0.22
Kårvatn	NO0039R	1998	0.045	0.152	0.141	0.266	0.025	0.047	0.078	0.330	0.015	0.016	0.19	0.02	0.14
Kårvatn	NO0039R	1999	0.031	0.200	0.191	0.231	0.028	0.049	0.115	0.450	0.017	0.019	0.14	0.01	0.12
Kårvatn	NO0039R	2000	0.033	0.167		0.320	0.036	0.052	0.093	0.561	0.021	0.018	0.27	0.02	0.19
Kårvatn	NO0039R	2001	0.060	0.163	0.151	0.187	0.054	0.077	0.112	0.372	0.022	0.017	0.19	0.02	0.16
Kårvatn	NO0039R	2002	0.071	0.205	0.192	0.255	0.059	0.091	0.129	0.690	0.026	0.031	0.18	0.02	0.16
Kårvatn	NO0039R	2003	0.069	0.218	0.200	0.303	0.064	0.092	0.131	0.854	0.028	0.036	0.27	0.03	0.22
Kårvatn	NO0039R	2004	0.070	0.203	0.186	0.213	0.043	0.075	0.103	0.337	0.024	0.048	0.21	0.03	0.21
Kårvatn	NO0039R	2005	0.069	0.185	0.171	0.224	0.089	0.143	0.146	0.504	0.025	0.030	0.18	0.02	0.18
Kårvatn	NO0039R	2006	0.056	0.245	0.232	0.244	0.107	0.145	0.125	0.731	0.056	0.080	0.16	0.04	0.16
Kårvatn	NO0039R	2007	0.032	0.127	0.114	0.168	0.044	0.064	0.057	0.614	0.020	0.044	0.20	0.03	0.16
Kårvatn	NO0039R	2008	0.029	0.139	0.125	0.196	0.045	0.070	0.057	0.550	0.019	0.083	0.26	0.03	0.18
Kårvatn	NO0039R	2009	0.025	0.136	0.125	0.174	0.029	0.058	0.057		0.028	0.025	0.15	0.02	0.15
Kårvatn	NO0039R	2010	0.031	0.139	0.131	0.251	0.054	0.077	0.098		0.024	0.015	0.13	0.01	0.13
Kårvatn	NO0039R	2011	0.068	0.131	0.115	0.264	0.121	0.166	0.152	0.875	0.046	0.027	0.24	0.03	0.21
Kårvatn	NO0039R	2012	0.041	0.141	0.125	0.217	0.155	0.256	0.164	0.715	0.054	0.033	0.25	0.03	0.19
Kårvatn	NO0039R	2013	0.022	0.094	0.082	0.156	0.085	0.128	0.093	0.573	0.038	0.043	0.16	0.02	0.15
Kårvatn	NO0039R	2014	0.124	0.196	0.183	0.138	0.106	0.175	0.170	0.629	0.032	0.052	0.17	0.02	0.17
Kårvatn	NO0039R	2015	0.031	0.088	0.076	0.107	0.124	0.144	0.128	0.507	0.031	0.031	0.21	0.02	0.16
Kårvatn	NO0039R	2016	0.026	0.109	0.097	0.146	0.044	0.066	0.063	0.437	0.027	0.019	0.17	0.02	0.15
Kårvatn	NO0039R	2017	0.060	0.093	0.083	0.166	0.021	0.035	0.031	0.355	0.018	0.016	0.19	0.02	0.14
Kårvatn	NO0039R	2018	0.030	0.119	0.108	0.184	0.036	0.055	0.060	0.602	0.031	0.037	0.18	0.02	0.15
Kårvatn	NO0039R	2019	0.027	0.104	0.092	0.163	0.023	0.042	0.055	0.456	0.034	0.031	0.18	0.02	0.14
Kårvatn	NO0039R	2020	0.027	0.073	0.060	0.146	0.022	0.035	0.035	0.460	0.030	0.028	0.21	0.02	0.18

Table C.2 (continued)- Part 5

Site	Code	Year	SO2-S	SO4-S	xSO4-S	NO2-N	NO3-N	sNO3-N	NH4-N	sNH4-N	K	Ca	Cl	Mg	Na
Kårvatn	NO0039R	2021	0.028	0.104	0.091	0.139	0.022	0.034	0.054	0.688	0.021	0.026	0.20	0.02	0.15
Kårvatn	NO0039R	2022	0.022	0.087	0.070	0.133	0.023	0.035	0.029	0.550	0.025	0.035	0.30	0.03	0.22
Kårvatn	NO0039R	2023	0.032	0.084	0.072	0.115	0.022	0.034	0.038	0.529	0.016	0.025	0.20	0.02	0.15
Kårvatn	NO0039R	2024	0.034	0.088	0.072	0.124	0.022	0.034	0.041	0.602	0.025	0.035	0.29	0.03	0.20
Kårvatn	NO0039R	2025	0.030	0.077	0.062	0.152	0.021	0.032	0.029	0.705	0.021	0.027	0.27	0.02	0.19
Tustervatn	NO0015R	1978		0.337											
Tustervatn	NO0015R	1979	0.875	0.676											
Tustervatn	NO0015R	1980	0.630	0.702											
Tustervatn	NO0015R	1981	0.668	0.522											
Tustervatn	NO0015R	1982	0.441	0.517											
Tustervatn	NO0015R	1983	0.256	0.475											
Tustervatn	NO0015R	1984	0.706	0.728											
Tustervatn	NO0015R	1985	0.597	0.585											
Tustervatn	NO0015R	1986	0.477	0.426											
Tustervatn	NO0015R	1987	0.724	0.594											
Tustervatn	NO0015R	1988	0.668	0.538		0.490		0.045		0.559					
Tustervatn	NO0015R	1989	0.156	0.231		0.288		0.076		0.523					
Tustervatn	NO0015R	1990	0.288	0.356		0.366		0.079		0.528					
Tustervatn	NO0015R	1991	0.255	0.384		0.320		0.075		0.681					
Tustervatn	NO0015R	1992	0.149	0.277		0.255		0.061		0.542					
Tustervatn	NO0015R	1993	0.178	0.310		0.192	0.035	0.072	0.155	0.661			0.57		
Tustervatn	NO0015R	1994	0.161	0.287		0.193	0.036	0.085	0.144	0.714			0.42		
Tustervatn	NO0015R	1995	0.156	0.280		0.159	0.032	0.090	0.150	0.618			0.44		
Tustervatn	NO0015R	1996	0.120	0.286		0.108	0.041	0.105	0.168	0.720			0.36		
Tustervatn	NO0015R	1997	0.087	0.269	0.241	0.176	0.035	0.072	0.147	1.146	0.026	0.050	0.52	0.05	0.36
Tustervatn	NO0015R	1998	0.098	0.205	0.187	0.176	0.030	0.060	0.105	1.034	0.019	0.024	0.35	0.03	0.23
Tustervatn	NO0015R	1999	0.084	0.231	0.215	0.144	0.033	0.052	0.122	0.991	0.017	0.020	0.31	0.02	0.21
Tustervatn	NO0015R	2000	0.041	0.181		0.167	0.044	0.060	0.100	0.879	0.021	0.023	0.35	0.03	0.27
Tustervatn	NO0015R	2001	0.137	0.201	0.181	0.153	0.057	0.082	0.121	0.836	0.025	0.022	0.38	0.03	0.26
Tustervatn	NO0015R	2002	0.091	0.208	0.185	0.182	0.068	0.103	0.114	0.728	0.026	0.036	0.36	0.03	0.28
Tustervatn	NO0015R	2003	0.094	0.222	0.190	0.183	0.093	0.121	0.153	1.045	0.026	0.044	0.56	0.05	0.39
Tustervatn	NO0015R	2004	0.093	0.212	0.188	0.165	0.055	0.086	0.122	0.783	0.024	0.039	0.37	0.04	0.30
Tustervatn	NO0015R	2005	0.077	0.215	0.194	0.140	0.064	0.098	0.116	0.849	0.024	0.035	0.36	0.03	0.28
Tustervatn	NO0015R	2006	0.092	0.225	0.205	0.149	0.102	0.133	0.113	0.947	0.023	0.070	0.33	0.04	0.25

Table C.2 (continued)- Part 6

Site	Code	Year	SO2-S	SO4-S	xSO4-S	NO2-N	NO3-N	sNO3-N	NH4-N	sNH4-N	K	Ca	Cl	Mg	Na
Tustervatn	NO0015R	2007	0.059	0.145	0.120	0.112	0.056	0.091	0.076	0.793	0.025	0.050	0.42	0.04	0.29
Tustervatn	NO0015R	2008	0.029	0.152	0.128	0.139	0.066	0.088	0.069	0.838	0.021	0.102	0.40	0.05	0.29
Tustervatn	NO0015R	2009	0.049	0.155	0.139	0.106	0.049	0.074	0.060		0.019	0.036	0.26	0.03	0.21
Tustervatn	NO0015R	2010	0.080	0.153	0.147	0.121	0.071	0.096	0.108		0.019	0.013		0.01	0.15
Tustervatn	NO0015R	2011	0.078	0.131	0.111	0.136	0.194	0.246	0.225	0.940	0.048	0.029	0.32	0.03	0.25
Tustervatn	NO0015R	2012	0.046	0.123	0.109	0.175	0.168	0.249	0.156	1.067	0.056	0.026	0.23	0.03	0.18
Tustervatn	NO0015R	2013	0.034	0.082	0.066	0.130	0.094	0.129	0.091	0.691	0.034	0.038	0.25	0.02	0.20
Tustervatn	NO0015R	2014	0.084	0.098	0.087	0.099	0.087	0.119	0.098	0.590	0.022	0.031	0.16	0.02	0.14
Tustervatn	NO0015R	2015	0.025	0.083	0.063	0.077	0.119	0.140	0.111	0.611	0.042	0.033	0.37	0.03	0.25
Tustervatn	NO0015R	2016	0.036	0.127	0.107	0.106	0.052	0.074	0.068	0.427	0.033	0.019	0.34	0.03	0.25
Tustervatn	NO0015R	2017	0.038	0.121	0.101	0.111	0.025	0.039	0.035	0.270	0.022	0.021	0.39	0.03	0.26
Tustervatn	NO0015R	2018	0.039	0.128		0.106	0.028	0.044	0.063	0.348	0.037	0.021	0.37	0.03	0.25
Tustervatn	NO0015R	2019	0.045	0.137	0.116	0.137	0.045	0.064	0.080	0.370	0.029	0.029	0.38	0.03	0.26
Tustervatn	NO0015R	2020	0.028	0.076	0.053	0.141	0.019	0.034	0.032	0.331	0.023	0.022	0.42	0.03	0.28
Tustervatn	NO0015R	2021	0.027	0.108	0.093	0.128	0.019	0.030	0.049	0.397	0.018	0.022	0.26	0.02	0.18
Tustervatn	NO0015R	2022	0.021	0.081	0.062	0.076	0.019	0.030	0.035	0.410	0.015	0.019	0.35	0.03	0.23
Tustervatn	NO0015R	2023	0.035	0.108	0.086	0.104	0.024	0.035	0.053	0.336	0.017	0.021	0.41	0.03	0.29
Tustervatn	NO0015R	2024	0.042	0.109	0.087	0.069	0.022	0.033	0.051	0.358	0.024	0.028	0.41	0.03	0.27
Tustervatn	NO0015R	2025	0.034	0.084	0.059	0.086	0.020	0.030	0.032	0.341	0.028	0.020	0.48	0.03	0.31
Gruvebadet	NO0618R	1980	0.323		0.307										
Gruvebadet	NO0618R	1981	0.358		0.231										
Gruvebadet	NO0618R	1982	0.289		0.277										
Gruvebadet	NO0618R	1983	0.423		0.409										
Gruvebadet	NO0618R	1984	0.245		0.343										
Gruvebadet	NO0618R	1985	0.361		0.390										
Gruvebadet	NO0618R	1986	0.273		0.289										
Gruvebadet	NO0618R	1987	0.532		0.402										
Gruvebadet	NO0618R	1988	0.321		0.315										
Gruvebadet	NO0618R	1989	0.213		0.237										
Zeppelin	NO0042G	1990	0.213	0.224				0.040		0.089					
Zeppelin	NO0042G	1991	0.236	0.193		0.014		0.045		0.093					
Zeppelin	NO0042G	1992	0.194	0.189		0.024		0.036		0.080					
Zeppelin	NO0042G	1993	0.172	0.199	0.181	0.026	0.017	0.056	0.054	0.092	0.024	0.044	0.27	0.03	0.22
Zeppelin	NO0042G	1994	0.164	0.154	0.140	0.046	0.016	0.057	0.036	0.092	0.013	0.026	0.22	0.02	0.17

Table C.2 (continued)- Part 7

Site	Code	Year	SO2-S	SO4-S	xSO4-S	NO2-N	NO3-N	sNO3-N	NH4-N	sNH4-N	K	Ca	Cl	Mg	Na
Zeppelin	NO0042G	1995	0.149	0.167	0.148		0.021	0.083	0.047	0.099	0.017	0.050	0.30	0.04	0.22
Zeppelin	NO0042G	1996	0.104	0.151	0.135		0.021	0.083	0.051	0.109	0.012	0.043	0.25	0.03	0.19
Zeppelin	NO0042G	1997	0.131	0.189	0.170		0.020	0.070	0.063	0.131	0.023	0.035	0.31	0.04	0.23
Zeppelin	NO0042G	1998	0.207	0.174	0.158		0.016	0.042	0.046	0.129	0.013	0.027	0.26	0.03	0.19
Zeppelin	NO0042G	1999	0.129	0.186	0.164		0.016	0.032	0.075	0.189	0.015	0.033	0.46	0.05	0.32
Zeppelin	NO0042G	2000	0.120	0.142	0.125		0.014	0.028	0.029	0.107	0.013	0.024	0.31	0.03	0.21
Zeppelin	NO0042G	2001	0.144	0.177	0.155		0.033	0.055	0.041	0.082	0.021	0.019	0.42	0.03	0.30
Zeppelin	NO0042G	2002	0.158	0.136	0.114		0.021	0.047	0.021	0.135	0.029	0.039	0.34	0.04	0.28
Zeppelin	NO0042G	2003	0.226	0.175	0.156		0.019	0.037	0.040	0.168	0.016	0.049	0.28	0.04	0.23
Zeppelin	NO0042G	2004	0.118	0.164	0.148		0.052	0.078	0.040	0.105	0.013	0.035	0.21	0.04	0.20
Zeppelin	NO0042G	2005	0.133	0.184	0.164		0.094	0.151	0.103	0.272	0.018	0.055	0.29	0.04	0.27
Zeppelin	NO0042G	2006	0.104	0.126	0.104		0.073	0.107	0.034	0.275	0.017	0.074	0.34	0.05	0.25
Zeppelin	NO0042G	2007	0.085	0.113	0.092		0.030	0.052	0.035	0.132	0.014	0.051	0.30	0.04	0.23
Zeppelin	NO0042G	2008	0.070	0.145	0.125		0.076	0.099	0.060	0.188	0.016	0.054	0.28	0.05	0.25
Zeppelin	NO0042G	2009	0.091	0.153	0.138		0.030	0.048	0.038		0.017	0.031	0.23	0.03	0.19
Zeppelin	NO0042G	2010	0.072	0.132	0.119		0.037	0.055	0.048		0.019	0.024	0.25	0.02	0.19
Zeppelin	NO0042G	2011	0.099	0.115	0.094		0.075	0.108	0.072	0.390	0.040	0.037	0.35	0.04	0.26
Zeppelin	NO0042G	2012	0.064	0.120	0.101		0.148	0.216	0.111	0.359	0.045	0.034	0.26	0.04	0.23
Zeppelin	NO0042G	2013	0.091	0.156	0.135		0.128	0.179	0.113	0.284	0.035	0.037	0.32	0.04	0.25
Zeppelin	NO0042G	2014	0.139	0.201	0.179		0.121	0.158	0.114	0.330	0.027	0.045	0.32	0.04	0.27
Zeppelin	NO0042G	2015	0.058	0.114	0.091		0.095	0.121	0.091	0.217	0.032	0.041	0.39	0.04	0.26
Zeppelin	NO0042G	2016	0.060	0.106	0.087		0.029	0.048	0.025	0.171	0.050	0.025	0.33	0.04	0.23
Zeppelin	NO0042G	2017	0.122	0.141	0.120		0.021	0.036	0.027	0.156	0.045	0.046	0.38	0.04	0.26
Zeppelin	NO0042G	2018	0.036	0.097	0.079		0.012	0.028	0.020	0.107	0.030	0.023	0.35	0.03	0.23
Zeppelin	NO0042G	2019	0.077	0.111	0.091		0.012	0.027	0.026	0.125	0.045	0.029	0.32	0.04	0.24
Zeppelin	NO0042G	2020	0.069	0.109	0.086		0.014	0.025	0.023	0.164	0.050	0.053	0.42	0.05	0.28
Zeppelin	NO0042G	2021	0.054	0.094	0.073		0.013	0.024	0.029	0.166	0.029	0.026	0.39	0.04	0.25
Zeppelin	NO0042G	2022	0.083	0.130	0.109		0.015	0.025	0.037	0.235	0.036	0.025	0.37	0.03	0.26
Zeppelin	NO0042G	2023	0.080	0.102	0.084		0.013	0.024	0.026	0.245	0.020	0.020	0.34	0.03	0.22
Zeppelin	NO0042G	2024	0.105	0.138	0.120		0.013	0.024	0.028	0.204	0.017	0.029	0.31	0.03	0.22
Zeppelin	NO0042G	2025	0.046	0.116	0.095		0.011	0.022	0.024	0.152	0.021	0.022	0.41	0.03	0.27

Table C.3: Annual mean concentrations of PM aerosols at Norwegian background stations in 1973–2025. Units for PM are in µg/m³, while OC, EC and TC are in µgC/m³ and levoglucosan in ng /m³.

Site	Code	Year	PM_{10}	$PM_{2.5}$	PM_{10}-$PM_{2.5}$	OC in PM_{10}	OC in $PM_{2.5}$	OC in PM_{10}-$PM_{2.5}$	EC in PM_{10}	EC in $PM_{2.5}$	TC in PM_{10}	TC in $PM_{2.5}$	Levoglucosan
Birkenes	NO0001R	2000	6.76										
Birkenes	NO0001R	2001	6.08	4.04	2.02	1.13	1.00	0.08	0.130	0.156	1.26	1.15	
Birkenes	NO0001R	2002	7.15	4.78	2.27	1.03	0.92	0.19	0.140	0.123	1.17	1.04	
Birkenes	NO0001R	2003	6.66	4.40	2.22	1.06	0.86	0.24	0.110	0.118	1.17	0.98	
Birkenes	NO0001R	2004	5.35	3.28	2.06	0.84	0.59	0.27	0.095	0.085	0.94	0.68	
Birkenes	NO0001R	2005	6.77	4.06	2.67	0.92	0.63	0.28	0.153	0.117	1.08	0.75	
Birkenes	NO0001R	2006	8.06	4.95	3.36	1.16	0.87	0.33	0.132	0.128	1.29	1.00	
Birkenes	NO0001R	2007	5.63	3.33	2.50	0.84	0.63	0.21	0.141	0.121	0.98	0.75	
Birkenes	NO0001R	2008	5.88	3.00	2.68	0.80	0.57	0.24	0.087	0.080	0.89	0.65	10.94
Birkenes	NO0001R	2009	5.93	3.53	2.30	0.79	0.58	0.23	0.101	0.087	0.89	0.67	10.60
Birkenes II	NO0002R	2010	5.13	3.40	2.24	0.90	0.67	0.24	0.106	0.101	1.00	0.77	17.35
Birkenes II	NO0002R	2011	6.98	4.11	3.09	0.92	0.68	0.26	0.112	0.113	0.98	0.79	11.66
Birkenes II	NO0002R	2012	4.88	3.06	2.03	0.57	0.50	0.10	0.080	0.083	0.64	0.58	10.54
Birkenes II	NO0002R	2013	4.90	2.92	2.18	0.76	0.57	0.21	0.086	0.080	0.84	0.65	9.58
Birkenes II	NO0002R	2014	6.04	3.44	2.69	0.91	0.65	0.29	0.087	0.083	1.00	0.73	12.80
Birkenes II	NO0002R	2015	5.39	2.70	2.56	0.72	0.52	0.19	0.091	0.080	0.81	0.60	10.45
Birkenes II	NO0002R	2016	4.34	2.46	1.88	0.73	0.54	0.21	0.064	0.062	0.80	0.60	7.52
Birkenes II	NO0002R	2017	3.77	1.99	1.74	0.72	0.52	0.25	0.054	0.052	0.78	0.58	8.24
Birkenes II	NO0002R	2018	5.53	3.04	2.49	0.96	0.73	0.26	0.075	0.071	1.03	0.80	9.79
Birkenes II	NO0002R	2019	4.60	2.79	2.09	0.93	0.63	0.30	0.079	0.078	1.01	0.71	10.73
Birkenes II	NO0002R	2020	5.17	2.45	2.69	0.82	0.57	0.27	0.078	0.064	0.90	0.63	7.65
Birkenes II	NO0002R	2021	4.07	2.30	1.72	0.77	0.58	0.19	0.056	0.051	0.83	0.64	8.82
Birkenes II	NO0002R	2022	4.29	2.23	2.09	0.75	0.55	0.20	0.063	0.056	0.81	0.61	8.70
Birkenes II	NO0002R	2023	4.18	2.60	1.92	0.80	0.56	0.23	0.054	0.050	0.85	0.61	7.74
Birkenes II	NO0002R	2024	4.93	2.53	2.43	0.88	0.58	0.30	0.057	0.055	0.94	0.64	7.26
Birkenes II	NO0002R	2025	4.26	2.09	2.17	0.79	0.54	0.26	0.050	0.046	0.84	0.58	8.42
Hurdal	NO0056R	2011	5.87	4.35	1.46	1.28	0.89		0.171	0.165	1.46	1.05	
Hurdal	NO0056R	2012	4.08	2.77	1.29	0.86	0.60		0.130	0.126	0.99	0.73	
Hurdal	NO0056R	2013	4.55	3.12	1.44	1.05	0.76		0.139	0.138	1.19	0.90	
Hurdal	NO0056R	2014	5.73	3.79	1.94	1.30	0.82		0.114	0.112	1.42	0.93	
Hurdal	NO0056R	2015	4.15	2.75	1.50	0.99	0.73		0.141	0.134	1.14	0.86	
Hurdal	NO0056R	2016	4.00	2.61	1.37	0.94	0.66	0.30	0.098	0.097	1.04	0.76	
Hurdal	NO0056R	2017	3.87	2.36	1.56	1.15	0.73	0.50	0.101	0.093	1.25	0.83	
Hurdal	NO0056R	2018	4.92	3.23	1.81	1.27	0.88	0.41	0.115	0.108	1.39	0.99	

Table C.3 (continued)- Part 2

Site	Code	Year	PM_{10}	$PM_{2.5}$	PM_{10}-$PM_{2.5}$	OC in PM_{10}	OC in $PM_{2.5}$	OC in PM_{10}-$PM_{2.5}$	EC in PM_{10}	EC in $PM_{2.5}$	TC in PM_{10}	TC in $PM_{2.5}$	Levoglucosan
Hurdal	NO0056R	2019	4.58	2.65	1.92	1.23	0.71	0.52	0.103	0.095	1.34	0.81	
Hurdal	NO0056R	2020	4.07	2.23	1.88	0.95	0.58	0.38	0.080	0.070	1.03	0.65	
Hurdal	NO0056R	2021	4.04	2.74	1.65	1.14	0.73	0.41	0.090	0.084	1.23	0.81	
Hurdal	NO0056R	2022	4.15	2.36	1.82	1.12	0.67	0.44	0.091	0.082	1.22	0.75	
Hurdal	NO0056R	2023	3.80	2.28	1.52	1.14	0.71	0.44	0.078	0.077	1.21	0.79	
Hurdal	NO0056R	2024	4.86	2.55	2.09	1.19	0.67	0.57	0.080	0.083	1.27	0.76	
Hurdal	NO0056R	2025	3.73	2.00	1.70	1.11	0.61	0.51	0.073	0.070	1.18	0.68	
Kårvatn	NO0039R	2011	3.72	2.65	1.03	0.91	0.68		0.068	0.068	0.98	0.75	
Kårvatn	NO0039R	2012	3.42	2.52	0.92	0.72	0.56		0.053	0.053	0.78	0.62	
Kårvatn	NO0039R	2013	3.11	2.22	0.88	0.75	0.53		0.058	0.061	0.81	0.59	
Kårvatn	NO0039R	2014	4.23	3.23	1.00	0.94	0.66		0.052	0.055	1.00	0.71	
Kårvatn	NO0039R	2015	2.31	1.51	0.89	0.64	0.47		0.043	0.046	0.68	0.52	
Kårvatn	NO0039R	2016	2.52	1.64	0.95	0.70	0.49	0.23	0.038	0.038	0.74	0.53	
Kårvatn	NO0039R	2017	2.14	1.45	0.73	0.66	0.50	0.21	0.033	0.036	0.69	0.53	
Kårvatn	NO0039R	2018	3.20	2.26	1.05	0.85	0.65	0.22	0.046	0.050	0.89	0.69	
Kårvatn	NO0039R	2019	2.93	1.91	1.23	0.69	0.53	0.18	0.045	0.048	0.74	0.57	
Kårvatn	NO0039R	2020	2.87			0.68			0.033		0.71		
Kårvatn	NO0039R	2021	3.28	2.14	1.14	0.78	0.53	0.27	0.042	0.045	0.82	0.57	
Kårvatn	NO0039R	2022	2.60	1.25	1.39	0.64	0.42	0.23	0.036	0.036	0.68	0.45	
Kårvatn	NO0039R	2023	2.62	1.54	1.12	0.73	0.49	0.24	0.039	0.040	0.77	0.53	
Kårvatn	NO0039R	2024	2.92	1.59	1.33	0.71	0.43	0.30	0.043	0.041	0.75	0.47	
Kårvatn	NO0039R	2025	2.25	1.25	1.02	0.58	0.42	0.21	0.039	0.033	0.62	0.45	
Zeppelin	NO0042G	2017				0.12			0.012		0.13		0.47
Zeppelin	NO0042G	2018				0.09			0.006		0.10		0.33
Zeppelin	NO0042G	2019				0.10			0.013		0.11		0.55
Zeppelin	NO0042G	2020				0.20			0.016		0.21		0.92
Zeppelin	NO0042G	2021				0.09			0.007		0.09		0.32
Zeppelin	NO0042G	2022				0.15			0.015		0.17		0.42
Zeppelin	NO0042G	2023				0.14			0.012		0.15		0.49
Zeppelin	NO0042G	2024				0.19			0.017		0.21		0.65
Zeppelin	NO0042G	2025				0.16			0.015		0.17		0.31

Table C.4: Concentrations for equivalent black carbon at Birkenes and Zeppelin for 2012 (2015) – 2025. MAC values given in italics are derived from absorption measurements performed at 520 nm, while other MAC values are derived from absorption measurements performed at 880 nm. Please also note that for Zeppelin, as no elemental carbon measurements were performed prior to 2017, the 2017 MAC value was used for the year 2015 and 2016. Please refer to Appendix E for further information on the link between absorption, elemental carbon and MAC.

Site	Code	Year	Equivalent Black Carbon, Unit : µg/m^3	MAC value used
Birkenes	NO0001R	2012	0.069	*20.83*
Birkenes	NO0001R	2013	0.078	*18.75*
Birkenes	NO0001R	2014	0.106	*22.71*
Birkenes	NO0001R	2015	0.078	*21.07*
Birkenes	NO0001R	2016	0.057	*20.60*
Birkenes	NO0001R	2017	0.075	*21.56*
Birkenes	NO0001R	2018	0.089	*22.35*
Birkenes	NO0001R	2019	0.055	*22.34*
Birkenes	NO0001R	2020	0.060	*21.63*
Birkenes	NO0001R	2021	0.055	*21.66*
Birkenes	NO0001R	2022	0.066	*21.71*
Birkenes	NO0001R	2023	0.055	8.83
Birkenes	NO0001R	2024	0.060	9.79
Birkenes	NO0001R	2025	0.053	9.99
Zeppelin	NO0042G	2015	0.008	15.15
Zeppelin	NO0042G	2016	0.008	15.15
Zeppelin	NO0042G	2017	0.011	15.15
Zeppelin	NO0042G	2018	0.007	15.81
Zeppelin	NO0042G	2019	0.012	15.29
Zeppelin	NO0042G	2020	0.015	13.83
Zeppelin	NO0042G	2021	0.010	14.16
Zeppelin	NO0042G	2022	0.017	13.66
Zeppelin	NO0042G	2023	0.012	13.05
Zeppelin	NO0042G	2024	0.017	11.79
Zeppelin	NO0042G	2025	0.013	10.86

Table C.5: Number concentrations for ultrafine particles at Birkenes and Zeppelin for 2010 (2016) – 2025.

Site	Code	Year	Ultrafine particles (Dp < 0.1µm), Unit : cm^{-3}
Birkenes	NO0001R	2010	1309
Birkenes	NO0001R	2011	1414
Birkenes	NO0001R	2012	1001
Birkenes	NO0001R	2013	1315
Birkenes	NO0001R	2014	1495
Birkenes	NO0001R	2015	1573
Birkenes	NO0001R	2016	1245
Birkenes	NO0001R	2017	1321
Birkenes	NO0001R	2018	1537
Birkenes	NO0001R	2019	1412
Birkenes	NO0001R	2020	1340
Birkenes	NO0001R	2021	1436
Birkenes	NO0001R	2022	1503
Birkenes	NO0001R	2023	1494
Birkenes	NO0001R	2024	1351
Birkenes	NO0001R	2025	1145
Zeppelin	NO0042G	2016	146
Zeppelin	NO0042G	2017	148
Zeppelin	NO0042G	2018	127
Zeppelin	NO0042G	2019	109
Zeppelin	NO0042G	2020	88
Zeppelin	NO0042G	2021	92
Zeppelin	NO0042G	2022	99
Zeppelin	NO0042G	2023	110
Zeppelin	NO0042G	2024	112
Zeppelin	NO0042G	2025	110

Appendix D Appendix

The monitoring programme and the datasets

Table D.1: Site locations and station keepers for the background sites in 2025.

Stasjon	Fylke	m.o.h.	Bredde N	Lengde E	Start dato	Stasjonsholder	Adresse
Birkenes	Aust-Agder	190	58° 23'	8° 15'	nov-71	Olav Lien	4760 Birkeland
Birkenes II		219					
Grungedal	Vestfold og Telemark	800	59° 42'	7° 45'	nov-22	Sondre Hustveit	3895 Edland
Treungen		270	59° 01'	8° 32'	sep-74	Per Ø. Stokstad	4860 Treungen
Haukenes		20	59° 12'	9° 31'	apr-79		
Prestebakke	Østfold	160	59° 00'	11° 32'	nov-85	NILU	2027 Kjeller
Løken	Akershus	135	59° 48'	11° 27'	mar-72	Anne Mørch	1960 Løken
Hurdal		300	60° 22'	11° 04'	jan-97	Arild Sørlien	2090 Hurdal
Brekkebygda	Buskerud	390	60° 18'	9° 44'	des-97	Kjersti Brekka	3534 Sokna
Vikedal II	Rogaland	60	59° 32'	5° 58'	jan-84	Siri Leifsen	4210 Vikedal
Sandve		40	59° 12'	5° 12'	jun-96	Jan M. Jensen	4272 Sandve
Naustal	Vestland	230	61° 34'	5° 53'	des.84	Bente Helen og Hanna Ullaland	6043 Naustdal
Kårvatn	Møre og Romsdal	210	62° 47'	8° 53'	feb-78	Gudmund Kårvatn	6645 Todalen
Overhalla	Trøndelag	60	64° 28'	11° 52'	dec-2022	Andreas Fiskum	7864 Overhalla
Tustervatn	Nordland	439	65° 50'	13° 55'	des-71	Dagfinn Tustervatn	8647 Bleikvassli
Svanvik	Finnmark	30	69°27'	30°02'	aug-86	NIBIO	9900 Kirkenes
Ny-Ålesund	Svalbard	8	78° 55'	11° 55'	1974	NP forskningsst.	9173 Ny-Ålesund
Zeppelin		474	78° 54'	11° 53'	sep-89	NP forskningsst.	9173 Ny-Ålesund

Table D.2: Measurement programme at Norwegian background stations in 2025

	Air						Precipitation	
	Hourly		Daily			Weekly	Daily	Weekly
Stasjon	Metr.	Ozone	eBC, UFP	main	NO2	$PM_{2,5}$, PM_{10} + EC/OC	main	main
Birkenes	X	X	X	X	X	X	X	
Grungedal								X
Treungen								X
Haukenes		X						
Prestebakke		X						
Løken								X
Hurdal	X	X		X	X	X	X	
Brekkebygda								X
Vikedal								X
Sandve		X						
Nausta								X
Kårvatn		X		X	X	X	X	
Overhalla								X
Tustervatn		X		X	X		X	
Svanvik		X						X
Zeppelin, Ny-Ålesund	X	X	X	X		EC/OC		X
Total number	3	8+1		5	4	3+1	4	9

Metr. = meteorology

main.precip. = amount (mm), pH, conductivity, SO_4, NO_3, Cl, NH_4, Ca, K, Mg, Na

main air = SO_2, SO_4, $HNO_3 + NO_3$; $NH_4 + NH_3$, Ca, K, Mg, Na, Cl

Table D.3: The 2025 datasets used in this report and their associated DOI's

Site	Name	Instruments	Components	
NO0001R	Birkenes	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/ZQ7U-3W8F
NO0002R	Birkenes II	3-stage filterpack	Inorganics in air/aerosol	https://doi.org/10.48597/NMMW-2ZM3
NO0002R	Birkenes II	Vaisala	Meteorology	https://doi.org/10.48597/X5UJ-33E4
NO0002R	Birkenes II	Glass sinters	NO_2	https://doi.org/10.48597/9T8D-KGYP
NO0002R	Birkenes II	UV absorption	Ozone	https://doi.org/10.48597/TNHU-B4DD
NO0002R	Birkenes II	TEOM	PM_{10} (monitor)	https://doi.org/10.48597/B823-4429
NO0002R	Birkenes II	Low Vol Sampler PM_{10}	PM_{10} (gravimetric)	https://doi.org/10.48597/AR55-BT3F
NO0002R	Birkenes II	Low Vol Sampler PM_{10}	OC and EC in PM_{10}	https://doi.org/10.48597/BRDP-VG52
NO0002R	Birkenes II	Low Vol Sampler PM_{10}	Organic tracers	https://doi.org/10.48597/EHY3-297R
NO0002R	Birkenes II	Low Vol Sampler $PM_{2.5}$	$PM_{2.5}$ (gravimetric)	https://doi.org/10.48597/AR55-BT3F
NO0002R	Birkenes II	Low Vol Sampler $PM_{2.5}$	OC and EC in $PM_{2.5}$	https://doi.org/10.48597/VBYW-FTMM
NO0002R	Birkenes II	Magee AE33	Aerosol absorption coefficient (eBC)	https://doi.org/10.48597/Q7P8-PRRW
NO0002R	Birkenes II	DMPS	PNSD (UFP)	https://doi.org/10.48597/FWYN-RBT7
NO0056R	Hurdal	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/Z3J2-BXF2
NO0056R	Hurdal	3-stage filterpack	Inorganics in air/aerosol	https://doi.org/10.48597/F9R6-MXTA
NO0056R	Hurdal	Glass sinters	NO_2	https://doi.org/10.48597/WG6J-3PGC
NO0056R	Hurdal	Low Vol Sampler PM_{10}	PM_{10} (gravimetric)	https://doi.org/10.48597/VQ7V-43UJ
NO0056R	Hurdal	Low Vol Sampler PM_{10}	OC and EC in PM_{10}	https://doi.org/10.48597/B3FX-EBNE
NO0056R	Hurdal	Low Vol Sampler $PM_{2.5}$	$PM_{2.5}$ (gravimetric)	https://doi.org/10.48597/NFNS-SNGS
NO0056R	Hurdal	Low Vol Sampler $PM_{2.5}$	OC and EC in $PM_{2.5}$	https://doi.org/10.48597/T3UA-V32E
NO0056R	Hurdal	UV absorption	Ozone	https://doi.org/10.48597/KUXT-TH2F
NO0039R	Kårvatn	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/G5CG-BHTY
NO0039R	Kårvatn	3-stage filterpack	Inorganics in air/aerosol	https://doi.org/10.48597/ECQT-D6HM
NO0039R	Kårvatn	Glass sinters	NO2	https://doi.org/10.48597/X5JZ-KWF8
NO0039R	Kårvatn	UV absorption	Ozone	https://doi.org/10.48597/9GUM-X4QX
NO0039R	Kårvatn	Low Vol Sampler PM_{10}	PM_{10} (gravimetric)	https://doi.org/10.48597/N3V4-C86T
NO0039R	Kårvatn	Low Vol Sampler PM_{10}	OC and EC in PM_{10}	https://doi.org/10.48597/RRYK-YXDF
NO0039R	Kårvatn	Low Vol Sampler $PM_{2.5}$	$PM_{2.5}$ (gravimetric)	https://doi.org/10.48597/N3V4-C86T
NO0039R	Kårvatn	Low Vol Sampler $PM_{2.5}$	OC and EC in $PM_{2.5}$	https://doi.org/10.48597/8MRY-W7XR
NO0015R	Tustervatn	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/WD3P-8J5S
NO0015R	Tustervatn	3-stage filterpack	Inorganics in air/aerosol	https://doi.org/10.48597/MJHW-A3QA
NO0015R	Tustervatn	Glass sinters	NO_2	https://doi.org/10.48597/2SWC-737H
NO0015R	Tustervatn	UV absorption	Ozone	https://doi.org/10.48597/4TYP-G98M
NO0057R	Ny-Ålesund	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/J4UU-CZEK
NO0042G	Zeppelin	3-stage filterpack	Inorganics in air/aerosol	https://doi.org/10.48597/QTUQ-VFKH
NO0042G	Zeppelin	Vaisala	Meteorology	https://doi.org/10.48597/3RB9-ZCQS
NO0042G	Zeppelin	Low Vol Sampler PM_{10}	OC and EC in PM_{10}	https://doi.org/10.48597/JYT6-QNSS
NO0042G	Zeppelin	Low Vol Sampler PM_{10}	Organic tracers	https://doi.nilu.no/doi/UTJW-J3A6
NO0042G	Zeppelin	Magee AE33	Aerosol absorption coefficient (eBC)	https://doi.org/10.48597/U9N3-WR28
NO0042G	Zeppelin	DMPS	PNSD (UFP)	https://doi.org/10.48597/KT7D-M2K9
NO0042G	Zeppelin	UV absorption	Ozone	https://doi.org/10.48597/8NB6-PQET
NO0047R	Svanvik	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/T6RP-TA8K
NO0047R	Svanvik	UV absorption	Ozone	https://doi.org/10.48597/RUM9-N7VC
NO0218R	Løken	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/HNN6-655V
NO0236R	Treungen	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/63HT-SPNC
NO0239R	Grungedal	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/AMV8-JBUN
NO0240R	Overhalla	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/P32M-PX94
NO0572R	Vikedal	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/D6MM-YPKH
NO0655R	Nausta	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/9DRZ-9RW6
NO1218R	Brekkebygda	Bulk collector	Inorganics in precipitation	https://doi.org/10.48597/ZQ7F-5UEC
NO0043R	Prestebakke	UV absorption	Ozone	https://doi.org/10.48597/UVZU-2UHN
NO0052R	Sandve	UV absorption	Ozone	https://doi.org/10.48597/2B95-SF2E
NO0489R	Haukenes	UV absorption	Ozone	https://doi.org/10.48597/F9C3-BVX9

Appendix E

Sampling and chemical analysis (incl. background information on aerosols)

Main components in precipitation

For precipitation sampling, a NILU Precipitation Collector (funnel + bucket type) is used (P.no. 9713,RS1). The bucket has a size of 2.5 litre, and the diameter of the collecting surface is 200 mm. The collector is placed 2 meters above ground. In winter, during snow conditions, the bulk + funnel collector is exchanged with a so-called Particulate Fallout Collector (P.no. 9711, SF1), see figure on the right of the two bulk collector types. The material used for the collectors is high density polyethylene.

The precipitation sampler is emptied and cleaned with distilled water between each sampling period (daily or weekly), also in periods when there has been no precipitation. The precipitation amount is measured by volume at the site, and an aliquot of the sample is sent to NILU for chemical analysis.

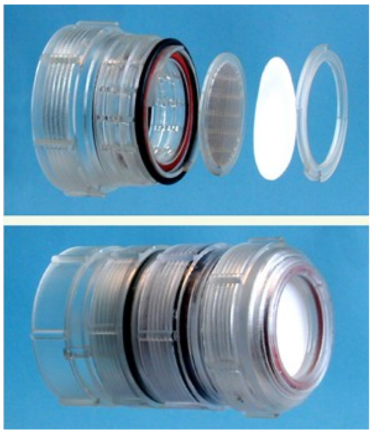
pH is measured with potentiometric method and conductivity with a conductivity meter. Anions and cations are measured with an ion chromatograph. The detection limit for the different ions are given in the table below:

Parameter	Detection limit (unit)
SO_4^{2-}	0.01 (mg S/l)
NO_3^-	0.01 (mg N/l)
NH_4^+	0.01 (mg N/l)
Na^+	0.01 (mg Na/l)
Cl^-	0.01 (mg Cl/l)
K^+	0.01 (mg K/l)
Ca^{2+}	0.01 (mg Ca/l)
Mg^{2+}	0.01 (mg Mg/l)

Main components in air

The main ions in air is sampled with a three stage filterpack using the NILU filter holder system designed for sampling of particles and gaseous compounds, see figure below. The first filter in the air stream is an aerosol filter (Zeflour 2 µm) for collecting the airborne particles containing SO_4^{2-}, NH_4^+, NO_3^-, Ca^{2+}, K^+, Cl^-, Na^+. This is followed by an alkaline (KOH) impregnated filter (Whatman 40), which will collect HNO_3, SO_2, HNO_2, HCl, and other volatile acidic substances. Nitric acid and sulfur dioxide will react with potassium hydroxide on this impregnated filter to give potassium nitrate and potassium sulphite. Oxidizing species in air e.g. ozone are believed to convert most of the sulphite to sulfate during the sampling. The third filter (Whatman 40) is acid-impregnated (oxalic acid) for absorbing alkaline air component such as NH_3. The filter pack method is biased in separating gaseous nitrogen compounds from aerosols and therefore the sum is reported. In other words, the concentration of nitrates in air equals the sum of the nitrate found on the aerosol filter and nitrate found on the alkaline impregnated filter. The same for ammonium, where the sum of ammonium concentration equals the sum of ammonium collected on the aerosol front filter and ammonia collected on the acid impregnated filter.

The filterpack samplers does not have a pre-impactor, but the air intake has a cylindrical vertical plastic section covering the filter holder – about 15 cm wide and 25 cm high. This air intake reduces the sampling efficiency for large particles such as soil dust particles, large sea spray droplets, large pollen, and fog droplet, thus the size cut off is approximately PM_{10} except for strong sea salt episodes when larger particles are collected.



After exposure, the filter holders are sent to NILU for chemical analysis. The filters are put into a test tubes with additions of extraction solution. Hydrogen peroxide solution is used for the alkaline filter in order to oxidize any remaining sulphite to sulfate. An HNO_3 is added to the acid impregnated filter. The aerosol Teflon© filters are given an ultrasonic treatment before analysis in order to obtain a complete extraction. The ions are analysed using an ion chromatograph, and the detection limits are given below:

Parameter	Detection limit (unit)
SO_2	0.01 (µg S/m^3)
SO_4^{2-}	0.01 (µg S/m^3)
Sum (NO_3^-+HNO_3)	0.01 (µg N/m^3)
Sum (NH_4^++NH_3)	0.05-0.1 (µg N/m^3)
Na^+	0.02 (µg Na/m^3)
Cl^-	0.02 (µg Cl/m^3)
K^+	0.02 (µg K/m^3)
Ca^{2+}	0.02 (µg Ca/m^3)
Mg^{2+}	0.02 (µg Mg/m^3)

Nitrogen dioxide

NO_2 is determined with the manual NaI glass sinter method. Ambient air with a flow rate of about 0.5 l/min is drawn through an air intake (inverted funnel) and a glass filter impregnated with sodium iodide (NaI) and sodium hydroxide (NaOH). Nitrogen dioxide is absorbed in the filter, and the iodide reduces NO_2 to nitrite. The nitrite formed on the glass filter is extracted with deionized water. After extraction the nitrite concentration can be determined spectrophotometrically at 540 nm after a reaction with sulphanilamide and N-(1-naphthyl)-ethylenediamine (NEDA). The detection limit for this method is 0.03 µg N/m^3.

Ozone

Ozone (O_3) is determined with the UV-absorption method (UV light at 254 nm) using a monitor with continuous measurements. The results are given in hourly resolution.

Particles (Mass, EC/OC, UFP, eBC and levoglucosan)

Background

Size is the most fundamental parameter describing aerosol particles, being decisive for transport and removal, and essential for understanding the effects of ambient aerosol particles. Aerosol particles are most commonly defined by their equivalent aerodynamic diameter, defined as, that of a spherical particle of unit density (1 g cm^{-3}), having a settling velocity equal to that of the particle in question. The size distribution of the tropospheric aerosol particle is commonly divided into three major modes (Whitby, 1978); the nuclei mode, the accumulation mode, and the coarse mode, all having different formation processes, leading to different characteristics of the aerosol particle. Tropospheric aerosol particles are either emitted directly (primary) or formed in the troposphere by oxidation of precursor gases (secondary) (Seinfeld and Pandis, 1998). The sources of tropospheric aerosol particles are both natural (e.g. windborne dust, sea spray, volcanic activity, wild fires) and anthropogenic (fuel combustion, industrial processes, non-industrial fugitive sources and transportation sources), and hence its chemical composition is highly diverse, including amongst others: sulfate (SO_4^{2-}), nitrate (NO_3^-), ammonium (NH_4^+), organic carbon (OC), which is a bulk fraction of numerous organic molecules, light absorbing/refractory carbon (BC/EC), aluminium and silicon (major constituents of mineral dust), inorganic cations (e.g., K^+, Na^+, Ca^{2+} Mg^{2+}) and anions (e.g., Cl^-).

The adverse health effects of ambient aerosol particles are well established, with numerous studies linking particulate matter (PM) exposure to a range of cardiopulmonary diseases, including chronic obstructive pulmonary disease, ischemic heart disease, lung cancer, and pneumonia (Dockery et al., 1993; Schwartz et al., 1996). While the statistical associations between PM concentrations, such as PM_{10} and $PM_{2.5}$, and health outcomes are robust, uncertainties remain regarding the underlying causal mechanisms. This has led to increasing focus on other aerosol properties, including particle number size distribution, surface area, and chemical composition, which may be more directly linked to toxicity.

There is strong evidence that fine particles pose greater health risks than coarse ones (Schwartz et al., 1996; Schwartz & Neas, 2000), although coarse particles are also associated with adverse effects (Castillejos et al., 2000; Ostro et al., 2000). Ultrafine particles (UFPs), defined as particles with diameters below 100 nm, have received particular attention due to their ability to penetrate deep into the lungs and even translocate into the bloodstream, potentially contributing to diseases beyond the respiratory system (Donaldson et al., 2001). UFPs have a high specific surface area, allowing them to carry substantial amounts of toxic substances such as transition metals and organic compounds, which can trigger oxidative stress and inflammation. Reflecting these concerns, UFPs have been included in the revised Ambient Air Quality Directive in (EU, 2024). The World Health Organization has also emphasized the importance of combustion-derived particles, noting their high surface area and toxic chemical load.

More details on health effects are found in Norwegian at the Norwegian Institute for Public Health: https://www.fhi.no/kl/luftforurensninger/luftkvalitet/temakapitler/svevestov/.

The tropospheric aerosol has an influence on the radiation budget both directly, by scattering and absorption of sunlight and terrestrial radiation, and indirectly, by influencing cloud reflectivity and lifetime. Both effects lead to a mostly cooling effect for the Earth's surface. The particle size distribution is essential for quantifying the magnitude of both direct and indirect aerosol climate effect, whereas particle chemical composition influences aerosol absorption and the lower size limit of particles acting as cloud condensation nuclei.

The tropospheric aerosol also plays an important role when it comes to acidification and eutrophication of water bodies. This is attributed to the content of secondary inorganic species such as SO_4^{2-}, NO_3^- and NH_4^+, which typically are associated with accumulation mode particles, enabling long-range transport and deposition in regions far from where the precursors where emitted.

Elemental (EC) and organic (OC) carbon are important fractions of the ambient aerosol particle, contributing to the aerosol particle influence on the radiation budget both directly, by scattering and absorption of sunlight, and indirectly, by cloud formation. Likewise does the carbonaceous fraction contribute to the adverse health effects observed, i.e., respiratory and cardiovascular diseases. EC enters the atmosphere exclusively as a primary (i.e., direct particulate) emission, whereas OC includes both primary aerosol particles and secondary aerosol particles, of which the latter is formed from gaseous precursors oxidized in the atmosphere. The carbonaceous fraction can be of both anthropogenic and natural origin. E.g., EC and OC from incomplete combustion of fossil fuel (e.g., vehicular tailpipe emissions) and biomass (residential wood burning and wildfires), OC from oxidation of gaseous emissions from coniferous and deciduous trees, and OC associated with primary biological aerosol particles (PBAP), such as pollen and fungal spores. EC and OC are typically associated with the fine aerosol particle, although OC can appear in the coarse fraction as well, e.g., the PBAPs or due to condensation of OC on coarse aerosol particles. Despite the importance of the carbonaceous aerosol, detailed apportionment and quantification of its sources is still difficult due to the large number of sources, the complexity of atmospheric formation, and the vast number of organic compounds associated with the aerosol.

EC and OC are simply operational definitions, and do not provide information about the source *pr. se*, thus additional measurements to EC and OC are required to provide information about the carbonaceous aerosol sources and their relative share. Source apportionment studies (Yttri et al., 2011a, b; Yttri et al.., 2021) including both ^{14}C and organic tracers show that natural sources dominate OC in PM_{10} at Norwegian rural background sites in summer, of which OC associated with the biogenic secondary organic aerosol (BSOA) is the major source followed by OC associated with PBAP. In winter, anthropogenic sources dominates OC in PM_{10}, i.e., emissions from fossil fuel combustion and residential wood burning. The picture is rather similar for OC in PM_1, except that OC associated with PBAP is of much less importance in summer than seen for PM_{10}. Combustion of fossil fuel appears to be the major source of EC regardless of season and size fraction, but EC from residential wood burning increases substantially in winter.

Levoglucosan is a thermal degradation product of cellulose with a low vapor pressure and a high emission factor from combustion of biomass (Locker, 1988; Simoneit et al., 1999; Oja and Suuberg, 1999), and thus well suited to trace biomass-burning aerosol in the ambient atmosphere. Aqueous-phase reaction with OH radical in deliquescent particles appears to be the most efficient pathway causing depletion of levoglucosan in the atmosphere. The ½ values (the time until half of the levoglucosan has been degraded) for levoglucosan in the atmosphere is debated and likely to vary with photochemical activity and OH concentrations, being a function of temperature and season (Hennigan et al., 2010; Yttri et al., 2014).

Levoglucosan is considered the most robust and reliable tracer of biomass burning, and is commonly used to trace biomass burning aerosol, not only qualitatively, but also quantitatively by combining ambient concentrations with emission ratios, or as input along with other species to e.g. positive matrix factorization (PMF). For studies using levoglucosan as biomass burning tracer in Norway, see Yttri et al., 2005, 2007a, b, 2009, 2011a, b, 2014, 2021, 2024. Although levoglucosan appears to be best suited to trace biomass burning emissions in winter and on a local to regional scale, conservative estimates of the biomass burning aerosol concentration can still be provided for the remote environment. Emission ratios used to convert observed ambient concentrations of levoglucosan to OC and EC from biomass burning, are associated with great uncertainty. An OC/levoglucosan ratio of 12.7 for PM_{10} and 11.1 for $PM_{2.5}$ and an EC/levoglucosan ratio of 2 are derived from positive matrix factorization (PMF) analysis of PM and PM species at Birkenes (Yttri et al., 2021), which are consistent with results presented in the scientific literature e.g., by Zotter et al. (2017). A factor of 2 can be used to convert biomass burning OC to OM, and a factor of 1.1 for biomass burning EC.

Sampling and chemical analysis

PM_{10} and $PM_{2.5}$ are obtained using Kleinfiltergerät samplers (one sampler pr. size faction), collecting filter samples on a weekly basis. The ambient aerosol particles are collected on prefired (850 °C; 3 h) quartz fibre filters (Whatman QM-A, 47 mm). The quartz fibre filters are conditioned (20 °C; 50% RH; 48 h) prior to and after being exposed. The mass concentration of the quartz fibre filters is determined gravimetrically. The uncertainty of the PM mass concentrations obtained for PM_{10} and $PM_{2.5}$ is estimated to be around 0.1 – 0.15 µg/m^3 for a sampling volume of 386 m^3.

Number concentration measurements at Birkenes dates back to 2010. The number concentration of ultrafine particles (D_p <0.1 µm) are obtained by measurements of a Differential Mobility Particle Spectrometer (DMPS)

In May 2017, a continuous, direct aerosol mass instrument was installed at Birkenes, a so-called tapered element oscillating microbalance (TEOM) instrument with a size cut off to measure PM_{10} mass. The TEOM Monitor draws (then heats) ambient air through a filter at constant flow rate, continuously weighing the filter and calculating near real-time mass concentrations of particulate matter. The mass is corrected with a factor 1.1 and -2.8 µg m^{-3} based on intercomparison with gravimetric measurements, which is the reference method.

Thermal-Optical Analysis of EC, OC, and TC in PM_{10} and $PM_{2.5}$ are performed on the same filter samples as the mass concentration of PM_{10} and $PM_{2.5}$ are obtained from at the three rural background sites. For the remote site Zeppelin, analysis is performed on prefired (850 °C; 3 hrs) quartz fibre filters (PALLFLEX Tissuequartz 2500QAT-UP; 150 mm in diameter) obtained from a Digitel high-volume sampler with a PM_{10} inlet, operating at a flowrate of 40 m^3 h^{-1}, collecting aerosol filter samples on a weekly basis. The T-O analysis is performed according to the EUSAAR-2 protocol (Cavalli *et al.*, 2010). The analytical detection limit of the TOA instruments is 0.2 µg C/cm^2. This corresponds to a methodological detection limit of 0.007 µg C m^{-3} for a sampling volume of 386 m^3 and an exposed filter area of 13.4 cm^2 for the rural background sites and, and a methodological detection limit of 0.005 µg C m^{-3} for a sampling volume of 6720 m^3 and an exposed filter area of 153.9 cm^2 for the remote site.

Concentrations of the biomass burning tracers levoglucosan, mannosan and galactosan are determined from the same PM_{10} filter samples as the mass concentration, OC, EC, and TC at the rural background sites and from the same PM_{10} filter samples as OC, EC, and TC at the remote site. Analysis is performed using ultra-performance liquid chromatography (UPLC) (Vanquish UHPLC, Thermo Fisher Scientific) in combination with Q Exactive™ Plus Orbitrap (Thermo Fisher Scientific) operated in the negative electrospray ionization (ESI) mode (Yttri et al. 2024). The methodological detection limit is approximately 1-20 pg m^{-3} for the rural background sites and 1-4 pg m^{-3} for the remote site.

Equivalent black carbon (eBC)

eBC is defined as black carbon measured by optical techniques. We use measurements from a seven wavelength, λ= {370, 470, 520, 590, 660, 880, and 950 nm} Aethalometer (AE33, Magee) at Birkenes and Zeppelin since 2023. In earlier years, we used slightly different instruments at Birkenes and Zeppelin, but the principle is the same: air is drawn through a filter to collect particles and the instrument measures how much light passes through the filter spot. As the particles build up less light passes through the filter spot, i.e. the light is said to be attenuated. The attenuation is converted to the absorption coefficient (BAbs). The instrument uses 'dual-spot technology' to correct for the loading effect, wherein increased attenuation due to accumulating particles can lead to underestimation of absorption. Data quality assurance followed ACTRIS-recommended protocols, including the removal of anomalous data points and correction for scattering artefacts. Dual spot technology and a full overview of the instrument is given in Drinovec et al. 2015.

We convert BAbs at 520 nm into equivalent black carbon (eBC) by using the mass absorption cross section (MAC):

$$eBC = B_{Abs}/MAC$$

We determine MAC by comparing our measurements to the co-located EC measurements. Thus, our eBC measurements are analogous to EC, but with much higher time resolution. Note that small differences in averaged eBC vs EC levels may arise due to non-overlapping measurements in either time series. The MAC value is determined as the ratio between the summed aggregated aerosol light absorption (B_{abs}) and the summed EC concentrations over the overlapping averaging periods for the entire measurement period. Therefore, the time series is updated annually using the most recent MAC value derived for the measurement period, resulting in small deviations compared to previously reported values. Recalculation to earlier values is possible using the ratio between MAC values (Table C3), e.g.

$$eBC_{new} = eBC_{old} \times \frac{MAC_{new}}{MAC_{old}}$$

The Aethalometer also allows source apportionment by measuring how the absorption changes across different wavelengths, the so-called the Ångström exponent (AAE). In general, particles from controlled combustion (e.g., engines using liquid fuels) have a simple carbon structure and show little change in absorption with wavelength (AAE close to 1). In contrast, less controlled combustion (e.g., residential wood burning, wildfires, or waste burning) produces additional light-absorbing compounds that affect shorter wavelengths, resulting in a higher AAE (above 1). By analysing the AAE, we can divide the measured black carbon into two main categories: liquid fuel combustion (likely mainly traffic), and solid fuel combustion (likely mainly from wood stoves or wildfires). While some sources, such as coal burning or gas flaring, are more uncertain, this method gives a useful approximation of where the black carbon in the atmosphere comes from.

We use the optimised 'aethalometer model' described in Savadkoohi et al., 2025. Assuming the total Babs is the sum of liquid (BAbs, L) and solid fuel sources (BAbs, S), then:

$$B_{Abs\ (s)}(\lambda_2) = \frac{B_{Abs}(\lambda_1) - B_{Abs}(\lambda_2) \times \left(\frac{\lambda_1}{\lambda_2}\right)^{-AAE_{(l)}}}{\left(\frac{\lambda_1}{\lambda_2}\right)^{-AAE_{(s)}} - \left(\frac{\lambda_1}{\lambda_2}\right)^{-AAE_{(l)}}},$$

and,

$$B_{Abs\ (l)}(\lambda_2) = \frac{B_{Abs}(\lambda_1) - B_{Abs}(\lambda_2) \times \left(\frac{\lambda_1}{\lambda_2}\right)^{-AAE_{(s)}}}{\left(\frac{\lambda_1}{\lambda_2}\right)^{-AAE_{(l)}} - \left(\frac{\lambda_1}{\lambda_2}\right)^{-AAE_{(s)}}},$$

where (λ_2) and (λ_1) are a pair of higher and lower wavelengths at which measurements are done, respectively, and $AAE_{(l)}$ and $AAE_{(s)}$ are the a priori AAEs for the liquid and solid fuel contributions to BAbs. Instead of assuming fixed AAE values for all situations, the optimised model finds the most suitable AAE values for each dataset individually by using the distribution of AAE in the observed total BAbs data ("bulk" BAbs values). We find percentile ranges that likely represent periods dominated by traffic or liquid fuel burning (low AAE, 1st percentile of the bulk data) or by solid fuel burning (high AAE, 99th percentile of the bulk data). Based on these percentile ranges, we select priori values for the liquid and solid fuel AAEs that best match the observed absorption patterns.

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