

UKEAP 2025 annual report

Prepared for the Environment Agency, the Department of Environment Food and Rural Affairs and the Devolved Administrations



Title UKEAP 2025 annual report

Client Environment Agency on behalf of the Department of Environment Food and Rural Affairs and the Devolved Administrations

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Executive summary

This annual report for 2025 was prepared by UK Centre for Ecology & Hydrology and WSP for the Environment Agency, the Department of Environment and Rural Affairs, the Department of Environment Northern Ireland, the Welsh Government and the Scottish Government.

The **UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP)** comprises the following measurement network:

- **UK Environmental Monitoring and Evaluation Program (EMEP) monitoring supersites** (Chilbolton Observatory and Auchencorth Moss)
- **National Ammonia Monitoring Network (NAMN)** – 113 sites)
- **Acid Gases and Aerosol Network (AGANet)** – 28 sites)
- **Precipitation chemistry Network (Precip-Net)** – 48 sites)
- **Rural nitrogen dioxide (NO₂) diffusion tube network (NO₂-Net)** – 25 sites)

The report provides information on:

- Updates on network operations during 2025.
- Annual concentrations.
- Interpretation of data and discussion of trends across the network.
- A brief summary of the scientific research, publications and other activities related to the network.

Key network changes for 2025:

- 1 NAMN site was closed and 1 site was relocated.
 - No Precip-Net or NO₂-net sites were relocated.
-

1. Introduction

The UK Eutrophying and Acidifying Atmospheric Pollutants (UKEAP) network is commissioned by Defra, the Environment Agency, and the Devolved Administration and is operated by WSP and the UK Centre for Ecology and Hydrology (UKCEH). UKEAP measurements are undertaken to allow improvements in understanding of the chemical composition, deposition and removal processes of inorganic air pollutants and to allow validation of atmospheric transport models. This report summarises operation and monitoring data under the UKEAP contracts for 2025. UKEAP is comprised of the following measurement networks:

- UK EMEP Supersites (Chilbolton Observatory and Auchencorth Moss)
- National Ammonia Monitoring Network (NAMN)
- Acid Gases and Aerosol Network (AGANet)
- Precipitation chemistry Network (Precip-Net)
- Rural NO₂ diffusion tube network (NO₂-Net)

Embedded within the NAMN and Precip-Net networks are the air quality measurements of Natural England's Long Term Monitoring Network (LTMN) and a network in Northern Ireland as part of NAMN and AGANet. The data from the UKEAP measurements underpins UK rural air quality modelling and mapping which feeds into policy. In addition, data from the networks within UKEAP are used both within the UK and internationally. Figure 1 highlights the most significant data applications both in the UK and internationally.

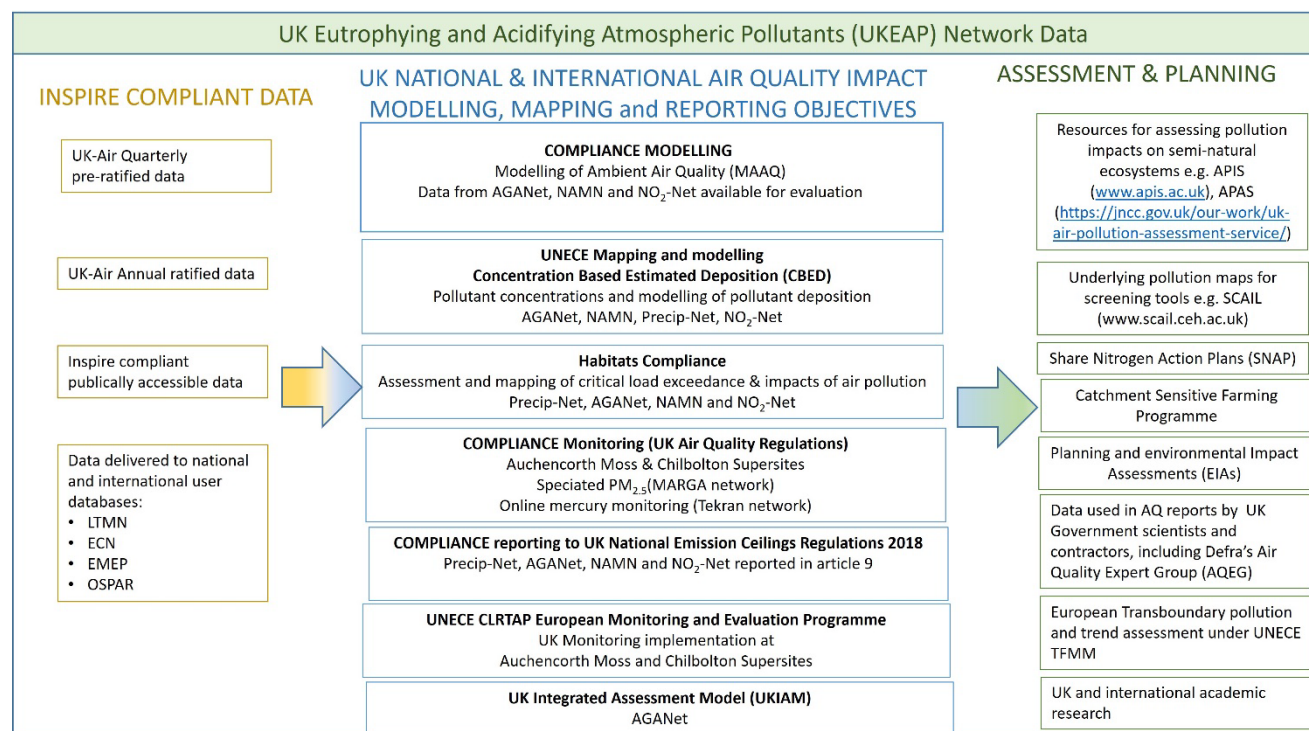


Figure 1 Summary of the data applications of the UKEAP datasets.

1.1 Background

The UKEAP measurements are in place to support compliance on estimates of secondary aerosol for $PM_{2.5}$, assess exceedances of critical loads and the risks to ecosystem, as well as to inform policy development on measures to reduce concentrations and deposition of atmospheric pollutants. UKEAP has been in place since 2012, however the 5 individual monitoring networks have been in operation much longer under separate contracts. The following section provides a brief background summary of the measurements and objectives of each network.

1.1.1 NAMN

The National Ammonia Monitoring Network (NAMN) has been in operation since 1996, and reports ammonia (NH_3) gas and ammonium (NH_4^+) aerosol. Ammonia is an air pollutant which is a precursor to secondary inorganic aerosol found in particulate matter of $< 2.5 \mu m$ in diameter ($PM_{2.5}$), which is known to be detrimental to human health. In addition, deposition of NH_3 can cause damage to sensitive ecosystems directly through the eutrophication and indirectly through acidification. The objective of this network is to understand the long term spatial and temporal trends in concentrations across the UK, as well as providing information on the gas/aerosol partitioning of NH_3 to NH_4^+ . The data is used to examine the changes in agricultural practices and allow assessment of the compliance to legislation, as well as to support deposition modelling. Examples of the data use can be found in Figure 1.

1.1.2 AGANet

The Acid Gases and Aerosol Network (AGANet) has been in operation since 1999 and provides information on the spatial concentrations of acid gases; nitric acid (HNO_3), sulphur dioxide (SO_2) and aerosols including chloride (Cl^-), nitrate (NO_3^-), sulphate (SO_4^{2-}), sodium (Na^+), calcium (Ca^{2+}) and magnesium (Mg^{2+}). Nitric acid is a secondary pollutant produced from the photochemical reaction of nitrogen dioxide (NO_2) and is the precursor of NO_3^- aerosol. Sulphur dioxide is a primary pollutant, with the main anthropogenic source being the combustion of fossil fuels and major biogenic source being volcanic emissions. It is also the precursor to some SO_4^{2-} found in $PM_{2.5}$ and PM_{10} , which can also be found in sea salt. Sodium is predominantly from sea salt, whereas Ca^{2+} and Mg^{2+} also found in sea salt can be from other crustal sources such as soil resuspension and Saharan Sand. Aerosol potassium is associated with crustal sources and is also a marker for biomass burning. The objective of this network is to provide information on the long-term rural trends of pollutants that contribute to the acidification and eutrophication of ecosystems within the UK (refer to Figure 1).

1.1.3 Precip-Net

The Precipitation Network (Precip-Net) started monitoring in 1986. It provides information on the chemical composition of the precipitation across the UK. Specifically, the network reports the following parameters in precipitation: Ca^{2+} , Cl^- , Mg^{2+} , K^+ , phosphate (PO_4^{3-}), NH_4^+ , NO_3^- , SO_4^{2-} and Cl^- , as well as pH, conductivity and rainfall amount. The objective of this network is to provide information on the long-term trends of wet deposition of pollutants that are responsible for eutrophication and acidification of ecosystems. Further details of the use of the data can be found in Figure 1.

1.1.4 NO_2 - Net

The nitrogen dioxide network (NO_2 -Net) started monitoring in 1993. Measurements from the Rural NO_2 network are made available to Defra and its modelling contractors to ensure that the national compliance modelling results are grounded in reality (in accordance with the Government's [AQuA book guidance](#) on Analytical Quality Assurance). Further details of the use of the data can be found in Figure 1. EMEP supersites

EMEP is the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe operates under the [UNECE Convention on Long Range Transboundary Air Pollutants](#)).

There are two UK EMEP supersites, Auchencorth Moss has operated as an atmospheric observatory for long term measurements since 1995 and became EMEP Supersite in 2006, whereas Chilbolton Observatory completed its first year of measurements in 2016, following a relocation from Harwell (2006-2015) due to decommissioning of the site. Measurements made at the supersites in 2025 are summarised in Table 1.

The sites in addition provide the required coverage, of at least one station every 100,000 km², to determine the composition of PM_{2.5} at rural background locations which were required under [Annex IV](#) of Directive 2008/50/EC on Ambient Air Quality and Cleaner Air For Europe, which is now implemented under the Air Quality Standards Regulations¹ (Refer to section 1.2 further details). The chemical composition of PM_{2.5} is determined for the following species:

Elemental carbon (EC) and organic carbon (OC), from the UK Particle Concentrations and Numbers Monitoring Network.

Inorganic species (K⁺, Na⁺, NH₄⁺, Ca²⁺, Mg²⁺, Cl⁻, NO₃⁻, SO₄²⁻), from the MARGA instrument.

The UK Particle Concentrations and Numbers Monitoring Network provide the OC and EC, whereas UKEAP provides the inorganic species required. The high-resolution data is sufficient to allow comparison with atmospheric models and back-trajectory source apportionment.

EMEP supersite measurements funded under the UKEAP contract are specifically:

Trace gas (HCl, HONO, HNO₃, NH₃, SO₂) and PM₁₀ and PM_{2.5} aerosol concentrations (K⁺, Na⁺, NH₄⁺, Ca²⁺, Mg²⁺, Cl⁻, NO₃⁻, SO₄²⁻), Chilbolton Observatory and Auchencorth Moss.

Online mercury measurements (Chilbolton Observatory: total gaseous mercury; Auchencorth Moss: elemental and speciated mercury).

Meteorological observations (barometric pressure, dewpoint, wind speed & direction, relative humidity, temperature, (total) rainfall) for Chilbolton Observatory and are reported to EMEP. Auchencorth Moss meteorological measurements are instead funded by NERC National Capability for UK Challenges project. Data are from Auchencorth Moss are available on request and archived on STFC Centre for Environmental Data Analysis (CEDA, <https://www.ceda.ac.uk/>)

Table 1. Pollutants measured at the UK EMEP Supersites during 2025 (Highlighted in bold are those reported under the UKEAP contract)

Pollutant	CHO ¹	AUC ¹	EMEP Level	Averaging period	Monitoring network (CHO/AUC)
SO₂, HCl, HNO₃, HONO, NH₃ (MARGA)	X	X	II	Hourly	UKEAP
PM_{2.5} K⁺, Na⁺, NH₄⁺, Ca²⁺, Mg²⁺, Cl⁻, NO₃⁻, SO₄²⁻ (MARGA)	X	X	II	Hourly	UKEAP
PM₁₀ K⁺, Na⁺, NH₄⁺, Ca²⁺, Mg²⁺, Cl⁻, NO₃⁻, SO₄²⁻ (MARGA)	X	X	II	Hourly	UKEAP
Elemental mercury (GEM)		X	III	Hourly	UKEAP
Particulate mercury (PBM)		X	III	Hourly	UKEAP
Reactive mercury (GOM)		X	III	Hourly	UKEAP
Total gaseous mercury (TGM) in air	X		II	Hourly	UKEAP
Meteorological parameters (WS, WD, T, RH, rainfall)	X	X ²	I	Hourly	UKEAP/UKCEH
Precipitation chemistry	X	X	I	Daily	UKEAP
NO and NO ₂ (thermal converter)	X	X ²	I	Hourly	AURN/UKCEH
Sulphur dioxide	X		I	Hourly	AURN
Ozone	X	X	I	Hourly	AURN/UKCEH
Particulate matter PM _{2.5} , PM ₁₀	X	X	I	Hourly	AURN
VOCs in air	X	X	II	Hourly	Automated HC Network
PAH in PM ₁₀ , air and rain	X	X	I	Monthly	PAH
Black carbon	X	X	II	Hourly	Particle numbers
Particle counts (>7 nm)	X		II	Hourly	Particle numbers/UKCEH
Particle size distribution	X		II	Hourly	Particle numbers
PM ₁₀ carbon-content (elemental carbon, EC, organic carbon, OC, total carbon, TC)	X	X	II	Weekly	Particle numbers
DELTA sampler (particulate-phase ions: Ca²⁺, Mg²⁺, Na⁺, Cl⁻, NH₄²⁺, NO₃⁻, SO₄²⁻)	X	X	I	Monthly	UKEAP
Trace gases (HCl, HNO₃, NH₃, and SO₂)	X	X	I	Monthly	UKEAP
Heavy metals in precipitation	X	X	I	Monthly	Heavy Metals
Mercury in precipitation	X	X		Monthly	Heavy Metals
Heavy metals in PM ₁₀	X	X	II	Weekly	Heavy Metals
Persistent Organic Pollutants (POPs) in air	X	X	I	Monthly	TOMPS
CO ₂ measurements		X	III	Hourly	ICOS
NO and NO ₂ (photolytic)		X	I	Hourly	NERC NC ²

¹CHO: Chilbolton Observatory; AUC: Auchencorth Moss; ²NERC UKCEH National capability funded

1.2 UK Air Quality Legislation

The Ambient Air Quality Directive (2008/50/EC) and Fourth Daughter Directive (2004/107/EC) set standards such as statutory limit values and target values for the concentration of pollutants in ambient air. They also define monitoring and reporting obligations. In the UK, responsibility for meeting air quality targets and limit values is the Secretary of State in England but also devolved to the administrations in Scotland, Wales and Northern Ireland. These Directives were transposed by respective Air Quality Standard Regulations (as detailed below):

- The Air Quality Standards Regulations 2010 in England (UK Government, 2010), and their December 2016 and January 2019 amendments (UK Government, 2016 and 2019)
- The Air Quality Standards (Scotland) Regulations 2010 in Scotland (Scottish Government, 2010), and their December 2016 amendment (Scottish Government, 2016)
- The Air Quality Standards (Wales) Regulations 2010 in Wales (Welsh Government, 2010) and their February 2019 amendment (Welsh Government, 2019).
- The Air Quality Standards Regulations (Northern Ireland) 2010 (DAERA, 2010), and their December 2016, December 2018 and November 2020 amendments (DAERA, 2017, 2018 and 2020)

The Secretary of State for Environment, Food and Rural Affairs has responsibility for meeting the limit values and target values as defined through the Air Quality Standards Regulations 2010 for England and the Department for Environment, Food and Rural Affairs (Defra) co-ordinates assessment for the UK as a whole.

International relations are reserved to the UK Government; therefore, Defra retains overall policy responsibility for the formulation of international air quality policy. Defra continues to represent the UK internationally, which reflects that while new domestic legislation is a devolved responsibility the overall compliance with international agreements will remain the responsibility of the UK Government.

The UK Environment Act (2021) (UK Government, 2021) established a duty for the UK Government to set a legally mandatory target in England to reduce PM_{2.5}, alongside at least one further long-term target on air quality. Within this framework, the Environmental Targets (Fine Particulate Matter) (England) Regulations (2023) (UK Government, 2023) came into force in January 2023. The Environmental Targets (fine particulate matter) (England) Regulations 2023 set two PM_{2.5} targets to be met by 2040, these provide

- A legal target to reduce population exposure to PM_{2.5} by 35% in 2040 compared to 2018 levels
- A legal target to require a maximum annual mean concentration of 10 micrograms of PM_{2.5} per cubic metre (µg/m³) by 2040.

Since then the [Environmental Improvement Plan \(EIP\) 2025](#) has set new two interim targets for PM_{2.5}:

- a. An annual mean concentration target of 10 micrograms per cubic metre to be achieved by December 2030.
- b. A population exposure reduction target of 30% compared to 2018 to be achieved by December 2030

1.3 Scope of the report

The following annual report for 2025 contains:

- A summary of network operations including Quality Assurance (QA)/ Quality Checks (QC) results, notable events and changes to the networks during 2025.
- Measured annual concentrations from all monitoring sites for each network.
- Interpretation of data and discussion of trends across the network.
- A brief summary of the scientific research and publications.
- A brief summary other activities using data from the network.

2. Methodologies

The following section outlines the methodologies used in each network and outlines information on site activities, calibrations or testing that is of note in 2025 to each network.

2.1 Precipitation Network (Precip-Net)

Bulk precipitation samples are collected using a bulk deposition collector. The bulk sampler consists of a funnel that collects the rain into a 3-litre sampling bottle. The sample bottle is protected by a stainless heat shield. An example bulk collector is shown in Figure 2.



Figure 2. An example of a bulk rain collector (Moorhouse).

Samples are collected at fortnightly intervals by the local site operators (LSOs) at each of the 48 sites in the network (refer to Figure 3).

The network also incorporates fifteen sites (Ainsdale Dunes and Sands, Bure Marshes, Fenns, Whixall and Bettisfield Mosses, Ingleborough, Lullington Heath, Monks Wood, Stiperstones and Thursley Common 2, Branton Burrows, Finglandrigg Woods, Lindisfarne, Saltfleetby-Theddlethorpe Dunes, Malham Tarn, Roudsea Wood & Mosses and Dersingham Bog) which form part of the Natural England's Long Term Monitoring Network (LTMN). The latter seven sites started operating in 2023.

There were no changes to the network in 2025. All major ions in the rainwater samples are analysed including pH, S in sulphate ($\text{SO}_4^{2-}\text{-S}$), N in nitrate ($\text{NO}_3\text{-N}$), N in ammonium ($\text{NH}_4^+\text{-N}$), Na^+ , Cl^- , Ca^{2+} , Mg^{2+} , K^+ ,

conductivity and PO_4^{3-} . Samples are deemed to be contaminated by bird strike if phosphate concentration is greater than 0.10 mg l^{-1} . Rainwater water volume is also measured. Derived parameters include sulphate derived from non-sea salt (anthropogenic) sources, hydrogen ion and rainfall height.

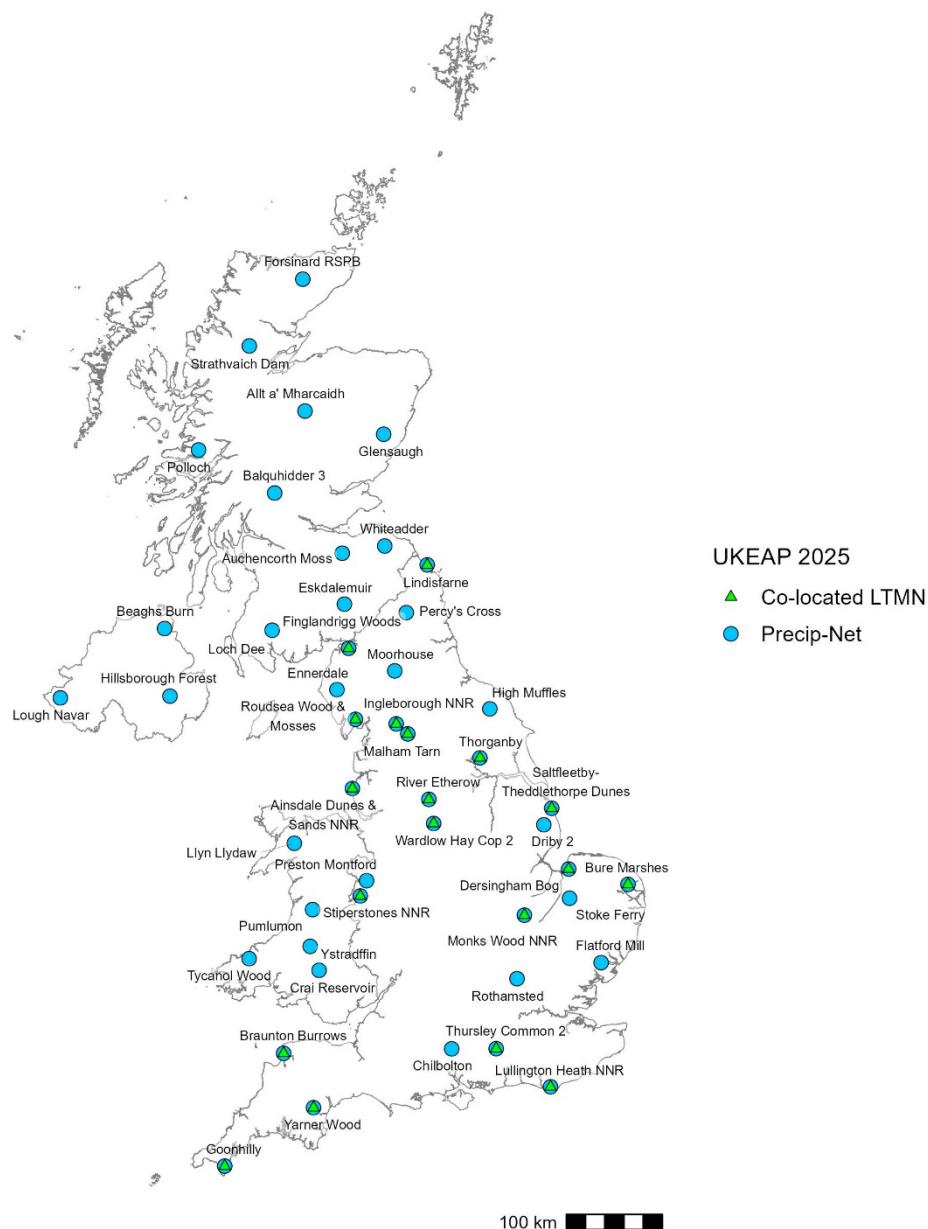


Figure 3 UK Precipitation chemistry Network (Precip-Net) in 2025

2.1.1 Overview of activities (site changes/services/audits/data ratification)

Local Sites Operators (LSOs) are used to undertake the site operation including replacing rain collection bottles, cleaning funnels, replacing debris filters and making observations at the site. LSOs also ensure the return of the collected rain samples. Quality assurance and laboratory intercomparison results from 2025 are summarised in the Appendix 2.

All sites are inspected and serviced during the summer months.

Maintenance and servicing of equipment at UKEAP network sites is undertaken across the UK with responsibility shared between WSP and UKCEH. The site maintenance and service visits are an opportunity to discuss with the LSO what local changes have occurred and provide training to LSOs where necessary. Vegetation surrounding the samplers is trimmed back during these visits.

All analysed samples undergo an ion balance check which involves comparing the total concentration of positive ions (cations) with the total concentration of negative ions (anions) in a sample. Samples are submitted for reanalysis if the difference in ion balance is greater than 15%, 30% or 60% depending on the ion strength of the sample. Samples are also submitted for reanalysis if the difference between the measured and theoretical conductivity is greater than 30%. Typically, 10-20% of samples are submitted for reanalysis.

2.1.2 Certification, testing and calibration

The analytical laboratory used within the Precipitation Network (Precip-net) is Socotec's Advanced Chemistry and Research laboratory. Historically analytical methods used to measure the concentrations of anions and cations, pH and conductivity in the rainwater samples from Precip-net were UKAS ISO/IEC 17025:2017 accredited. The current accreditation covers ammonium, sodium, chloride, fluoride and nitrate. Details of the analytical laboratory's current accreditation can be found at <https://www.ukas.com/download-schedule/1252/Testing/>. The analytical laboratory is currently in the process of updating methods for calcium, magnesium, potassium and sulphate. Methods for pH and conductivity have been prepared for UKAS approval.

Each year the analytical laboratory participates in a laboratory intercomparison exercise managed by the Norwegian Institute for Air Research (NILU) <https://emep-ccc.nilu.no/intercomparison>. This involves the analysis of four synthetic rainwater samples typical of concentrations currently measured in Europe. A discussion of the performance for the 42nd intercomparison is presented in Appendix 2.

2.2 NO₂-Net Network

The diffusion tubes are deployed in triplicate at 25 monitoring locations (see Figure 4) and are exposed for 4-week exposure periods. These tubes, provided by Gradko, are like those used in the [UK Urban NO₂ Network \(UUNN\)](#). The wind protection caps help maintain the diffusion path length and hence reduces the positive sampling bias. As for the UUNN, the absorbent is a solution of 20% triethanolamine in water.

Monitoring of nitrogen dioxide by diffusion tube began at Auchencorth Moss at the end of 2023 alongside two automatic NO₂ analysers: a cavity ring down instrument and a blue light instrument which have been operating since 2019 and aimed to assess how the diffusion tubes with wind protection caps compared in performance with each automatic analyser. This intercomparison will be discussed in further detail in Section 3.2.1.

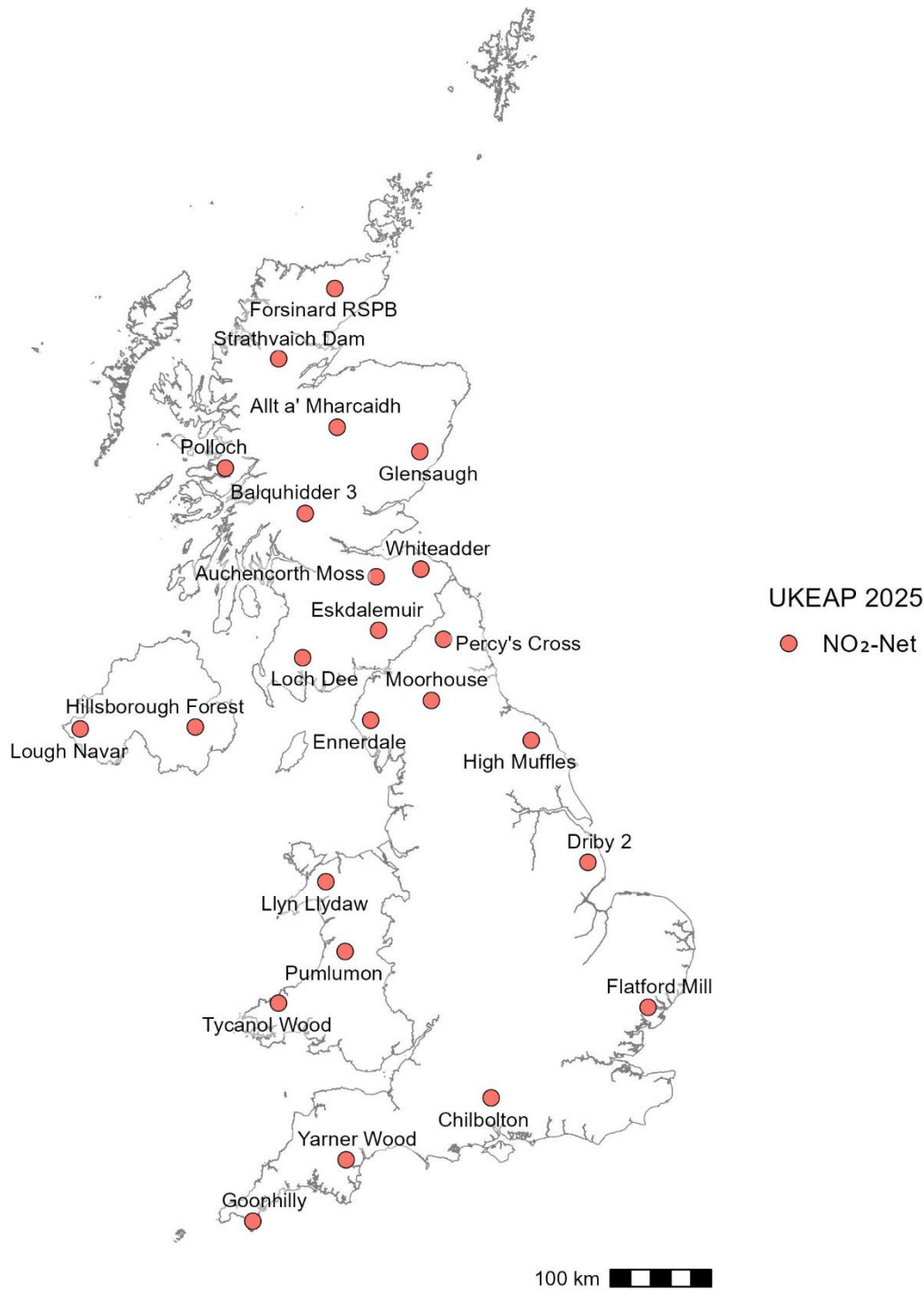


Figure 4 UK NO₂ diffusion tube (NO₂-Net) Network in 2025.

2.2.1 Overview of activities (site changes/ services/ audits, data ratification)

All sites are inspected during the summer months with responsibility shared between WSP and UKCEH. The site maintenance and service visits are an opportunity to discuss with the LSO local changes that have occurred and provide training to LSOs where necessary. Vegetation around samplers is maintained during these visits.

2.2.2 Accreditation, analytical proficiency testing (PT) and intercomparisons

The analytical methods used by Gradko to measure the concentrations of NO₂ using diffusion tubes are UKAS accredited. Details of the laboratory's accreditation can be found at [Gradko UKAS](#). The analytical laboratory also participates in the [AIR-PT analysis scheme](#). This is an independent analytical proficiency-testing scheme, operated by LGC Standards and supported by the Health and Safety Laboratory (HSL). Defra and the Devolved Administrations advise that diffusion tubes used for Local Air Quality management (LAQM) should be obtained from laboratories that have demonstrated satisfactory performance in the AIR NO₂ PT scheme. The performance of Gradko International in 2025 is provided in Table 2.

Table 2 Performance of Gradko International in the AIR-PT scheme in 2025

AIR PT Round	AIR PT AR068	AIR PT AR069	AIR PT AR071	AIR PT AR072
Period	January – February 2025	April – June 2025	July – September 2025	October – December 2025
Gradko International Ltd	50%	75%	100%	100%

The results from AIR PT AR0068 are lower than maybe expected, as Gradko have consistently obtained Z scores of 100 % over recent years. There is no indication that the ambient results had been impacted, For example, coefficient of variation for the triplicate tubes are low (range from 4 % at Chilbolton and 5 % at Auchencorth Moss).

2.2.3 Bias adjustment

Based on an intercomparison of nitrogen dioxide concentrations measured using diffusion tubes with and without wind protection caps with NO₂ concentrations measured by chemiluminescence analysers at three AURN sites: Chilbolton, High Muffles and Yarnier Wood, the use of diffusion tubes with no wind protection caps was discontinued from the end of 2023 and only diffusion tubes with wind protection caps have been deployed since. The intercomparison was reported in the [UKEAP 2023 annual data report](#) (Appendix 3).

In addition, due to the overestimation of NO₂ by the chemiluminescence analysers- attributed to the oxidation of total reactive nitrogen, NO_y (where NO_y is an umbrella term that includes NO_x, nitrous oxide, nitric acid, organic acid and peroxyacetyl nitrate) at rural locations. The results for the diffusion tubes with wind protection caps are reported without any bias adjustment using a chemiluminescence analyser.

2.3 National Ammonia Monitoring Network (NAMN)

NAMN measurements continue to be made with a mixture of active DELTA® (NH₃ and NH₄⁺) systems and passive ALPHA® samplers (NH₃ only)². Details for the two methods are described below.

ALPHA®

The ALPHA® (**A**dapted **L**ow-cost **H**igh **A**bsorption) sampler (Figure 5) is a badge type diffusive sampler designed by the UK Centre for Ecology & Hydrology³ for the long-term sampling of NH₃ concentrations. The samplers are deployed in triplicate at each monitoring location, with uptake rates calculated annually by collocating samplers with DELTAs at 9 sites around the UK. The sampling protocol used is based on the EN17346:2020 standard⁴ with samplers changed on a monthly basis by local site operators (LSOs).

From January 2024, the NAMN ALPHA samplers operated using a new membrane, as membranes used previously had been discontinued. A year of collocation of ALPHAs using both types of membranes were undertaken at the 9 calibration sites (DELTA) across the UK (using triplicate ALPHAs for each membrane variant) during 2023. The new membrane showed a 14.11% higher uptake rate (UR) with a very high correlation between the two membranes ($R^2 = 0.9913$). The change in UR is attributed to a change in membrane thickness (for further details please refer [UKEAP Annual Report 2024](#)).



Figure 5. ALPHA® Site Example (Carlisle)

DELTA®

The DELTA® (**DE**nuder for **L**ong-**T**erm **A**tmospheric sampling, Figure 6)⁵ is a low-volume denuder filter pack method designed for time integrated monitoring of trace gases (NH₃, HNO₃, SO₂) and aerosols (NH₄⁺, NO₃⁻, SO₄²⁻, Cl⁻, Na⁺, Ca₂⁺ and Mg²⁺)⁸. Samplers are changed on a monthly basis as per the UKEAP protocols.



Figure 6. DELTA® site example (Forsinard).

2.3.1 Overview of activities

During 2025 the number of NAMN sites providing monthly measurements of atmospheric NH₃ remained at 113 until November 2025, when the Brown Moss 2 site ceased operations. The final number of sites for the NAMN network at the end of 2025 is summarised in Table 3.

Table 3. Summary of National Ammonia Monitoring Network (NAMN) monitoring site types in December 2025

Site Type	Number
UKCEH DELTA® sites sampling	28
UKCEH ALPHA® sites sampling	93 ^[1]
Total number of sites	112 ^[2]

^[1]There were 94 sites operating until November 2025; ^[2]9 sites were co-located ALPHA and DELTA sites for calibration.

Ratarnet Rd station was relocated in April 2025 as the site leasing agreement was terminated and the monitoring site was relocated to Derryraine Rd (UKA01106) at the end of May 2025. Changes are summarised in Table 4. Data from the NAMN network have been submitted according to the agreed project deadlines: unratified data was submitted to UK-AIR quarterly and ratified data for the entire year was submitted to UKAIR at the end of April 2026.

Table 4 Changes in the NAMN during the 2025 monitoring period.

<i>Changes to NAMN monitoring sites due to local site operator availability</i>				
UKAIR code	NAMN site name	Closed	Opened	Latitude/ Longitude
UKA00369	Brown Moss 2	03/11/2025	-	52.946771, - 2.652058
<i>Changes to NAMN monitoring sites in 2025</i>				
UKAIR code	NAMN site name	Closed	Opened	Latitude/ Longitude
UKA00949	Ratarnet Rd.	07/04/2025	-	54.33, -6.55
UKA01106	Derryraine Rd.	-	27/05/2025	54.33, -6.6

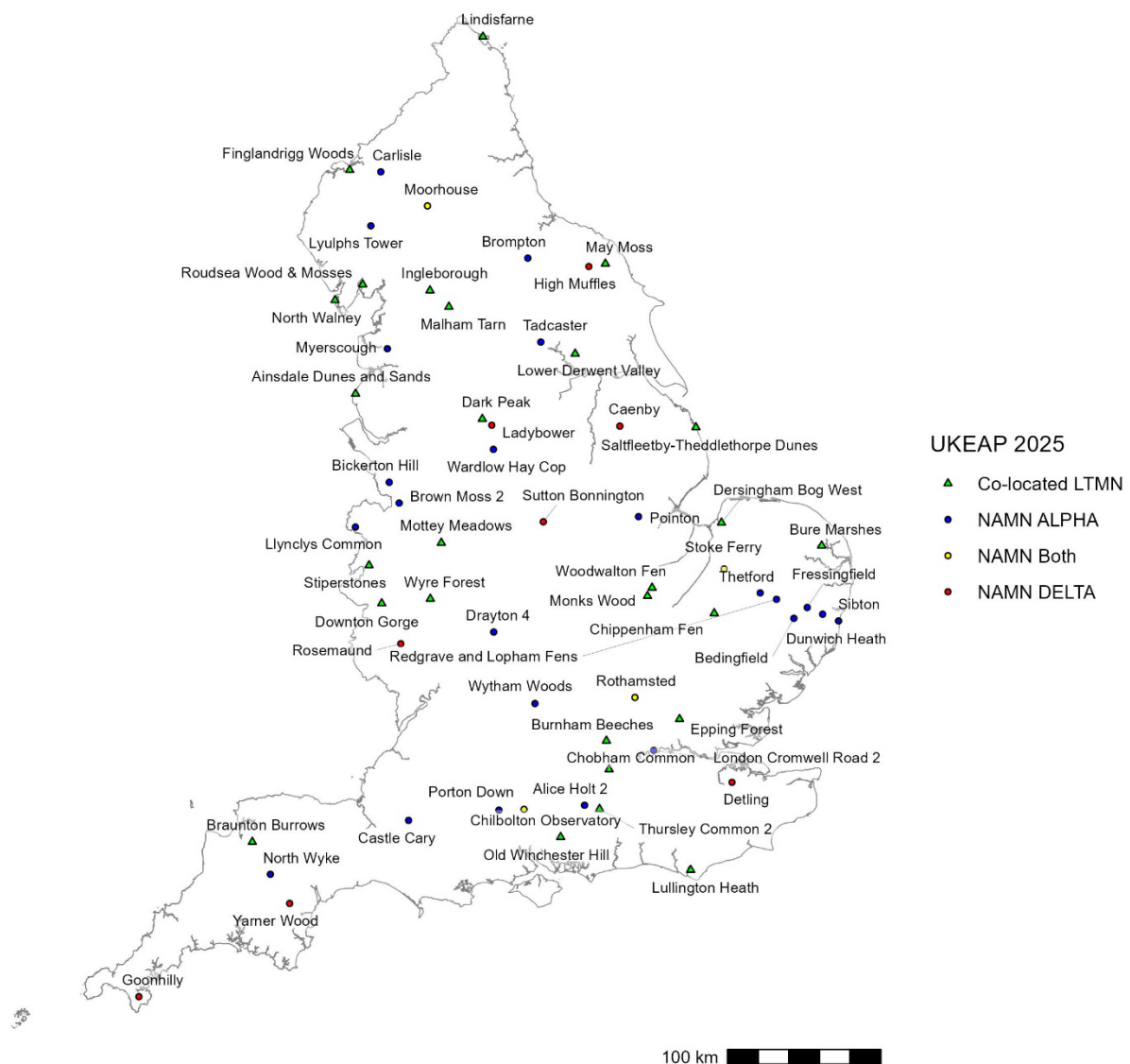


Figure 7. UK National Ammonia Monitoring Network (NAMN) and co-located LTMN sites in England. NAMN both – sites which have co-located ALPHA® and DELTA® samplers.



Figure 8. UK National Ammonia Monitoring Network (NAMN) in Northern Ireland. NAMN both – sites which are co-located ALPHA® and DELTA® samplers.

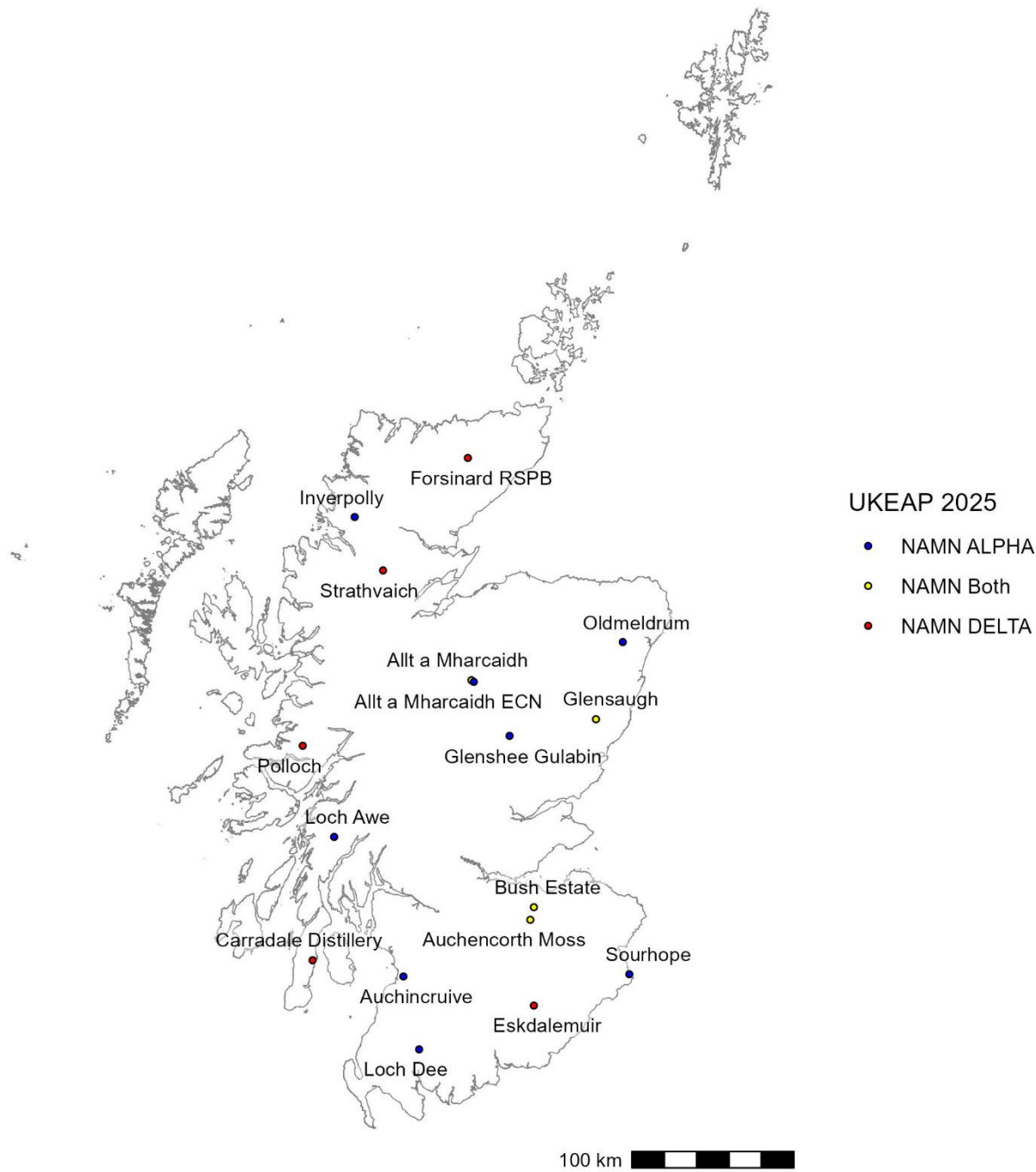


Figure 9. UK National Ammonia Monitoring Network (NAMN) in Scotland. NAMN both – sites which have co-located ALPHA® and DELTA® samplers.

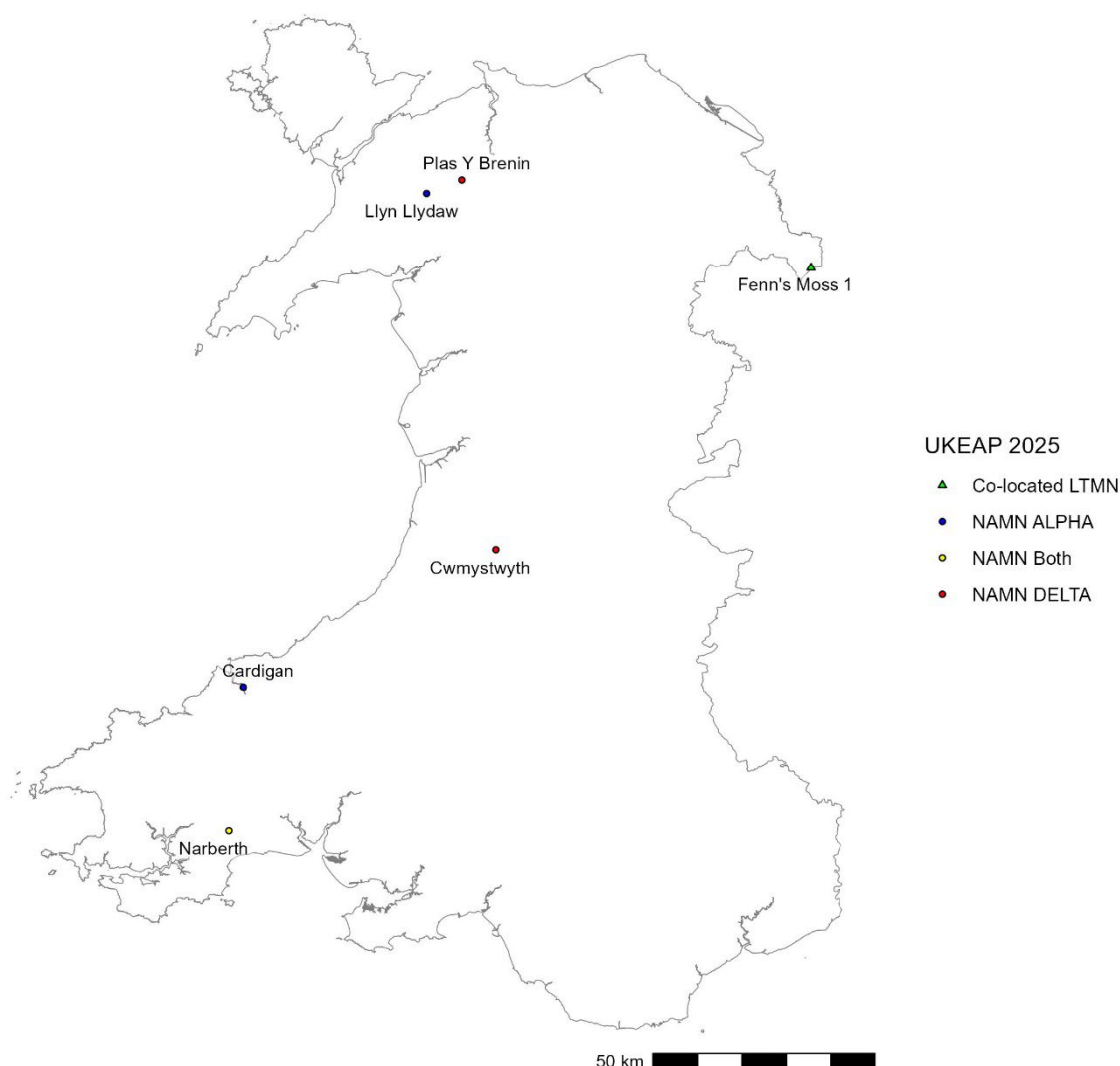


Figure 10. UK National Ammonia Monitoring Network (NAMN) in Wales. NAMN both – sites which have co-located ALPHA® and DELTA® samplers.

Figure 7 to Figure 10 summarises the current locations of the NAMN network. The maps also shows where the NAMN sites are embedded in the Natural England Long Term Monitoring Network (Figure 7, LTMN, 31 sites) and the sites from the Northern Ireland Network (NI Network, 25 sites added in 2022, Figure 8).

2.3.2 Certification, testing and calibration

At 9 NAMN sites around the UK, parallel measurements are made with both the UKCEH DELTA® systems and passive UKCEH ALPHA® samplers to 1) determine the annual uptake (UR) rate of the ALPHA® as per the EN17346:2020 standard⁶ and 2) to ensure that no bias is introduced into the sampling and to maintain the validity of long-term trends

After the investigation on the change in the UR for the years 2022 and 2023 (for further details please refer [UKEAP Annual Report 2024](#)), it was concluded that the ALPHA® performance was comparable to previous years, while the comparison against the DELTA® method was less reliable due to increasing uncertainties caused by

their low data capture in 2022 and 2023. The DELTA[®] samplers age (>10 years in harsh outdoor conditions) was deemed the main cause of their poor performance in the years 2022-2024, and an installation of 28 new DELTA units was carried out during 2025 to improve data capture and overall performance of the DELTA[®].

The 2025 calibration shows a good correlation between ALPHAs and DELTAs ($R^2 = 0.98$). Based on the comparison with DELTAs as the reference, the calibrated uptake rate was $0.0038714 \text{ m}^3 \text{ hr}^{-1}$, falling within the acceptable predicted range determined in the 2024 UR calculation process (Refer to Appendix 4 of the [UKEAP Annual Report 2024](#)). However, only 50% of the total available data was considered valid, and therefore the data capture was determined not sufficiently representative of the 2025 sampling conditions. The calculated uptake rate of **$0.003546 \text{ m}^3 \text{ hr}^{-1}$** was therefore applied to 2025 data.

Laboratory Quality Assurance

Preparation and analysis of both the UKCEH ALPHA[®] and UKCEH DELTA[®] sampler was conducted by UKCEH Lancaster Laboratories. These laboratories operate and are certified to ISO 17025:2017 for the analysis relating to the UKCEH ALPHA[®] and DELTA[®] systems. Details of the laboratory accreditation can be found at [UKAS](#). Replicate UKCEH ALPHA[®] samplers were used for each measurement (triplicate samplers) and were only accepted when they were within 15% (Coefficient of Variance, CV).

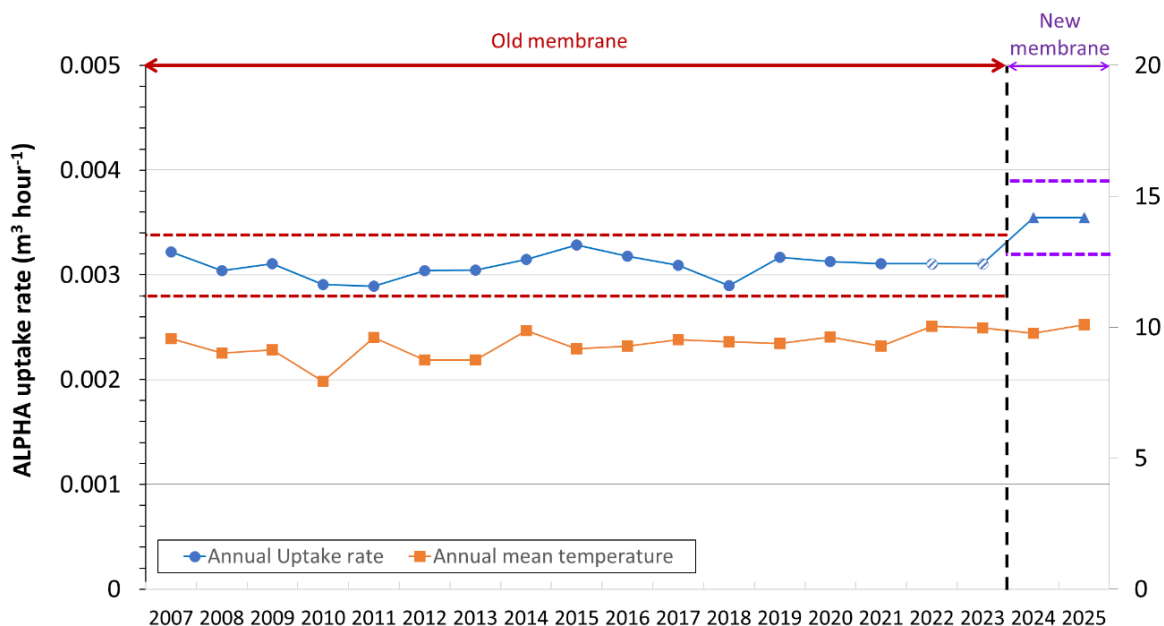


Figure 11: UKEAP uptake rate for ALPHA samplers and UK annual average temperature (source: <https://www.metoffice.gov.uk/research/climate/maps-and-data/summaries/index>). 2022 and 2023 UR (dashed circles marker) were reissued using the average UR from 2016-2021 (Refer to 2024 UKEAP report for further details). The circle markers correspond to old membranes used in the ALPHA sampler; the triangle marker corresponds to the new membrane introduced into the network for 2024. The dashed lines above and below the annual UR values correspond to the accepted UR deviation for the old and new membrane as outlined in Appendix 4 of the [UKEAP Annual Report 2024](#).

2.4 Acid Gas and Aerosol Network (AGANet)

The UK Acid Gas and Aerosol Network (AGANet) provides monthly speciated measurements of atmospheric reactive gases (HNO_3 , SO_2) and aerosols (NO_3^- , SO_4^{2-} , Cl^- , NH_4^+ , Na^+ , Ca^{2+} , Mg^{2+}) at 28 sites across the UK (Table 5). Measurements are carried out using the DELTA® sampler as described in Section 2.3.

Table 5 Summary of the number of sites within AGANet in December 2025.

Site Type	Number
AGANET UKCEH DELTA® sites	28
Total number of sites	28

2.4.1 Overview of activities

All AGANet sites had LSO and annual site visits conducted according to project protocols. There are currently no outstanding actions from the 2025 service round. Data from the AGANet was submitted according to the agreed project deadlines. Unratified data was submitted to UKAIR quarterly and annual ratified data for the 2025 calendar year was submitted to UKAIR in April 2026. During 2025, the DELTA units at 27 sites in the network were replaced as they > 10 years old.

2.4.2 Certification, testing and calibration

Laboratory Quality Assurance

Preparation and analysis of both the UKCEH ALPHA® and UKCEH DELTA® sampler was conducted by UKCEH Lancaster Laboratories. These laboratories operate and are certified to ISO 17025:2017 for the analysis relating to the UKCEH ALPHA® and DELTA® systems. Details of the laboratory accreditation can be found at <https://www.ukas.com>. In July 2024, the inductively coupled plasma optical emission spectrometer (ICP-OES) that is used for reporting aerosol cation species, Na^+ , Ca^{2+} and Mg^{2+} failed beyond repair. An alternative analytical method inductively coupled plasma mass spectrometer (ICP-MS), was used to report concentrations from July 2024 until June 2025. The network then returned to being analysed by ICP-OES following testing for UKAS accreditation (refer here for UKCEH [UKAS accreditation certificate](#)) Details on the equivalence method testing can be found in the Appendix 3 of the [UKEAP Annual Report 2024](#).

2.5 UK EMEP supersites

The instrumentation used under UKEAP as part of the reporting to EMEP is summarised below.

Monitor for Aerosols and Gases in Ambient air (MARGA)

Measurements of water soluble inorganic cations and anions in PM_{10} and $\text{PM}_{2.5}$: sulphate (SO_4^{2-}), nitrate (NO_3^-), sodium ion (Na^+), potassium ion (K^+), ammonium ion (NH_4^+), chloride ion (Cl^-), calcium ion (Ca^{2+}), and magnesium ion (Mg^{2+}) were measured by the Monitor for AeRosols and Gases in ambient Air monitor (MARGA 2S, Metrohm, NL, Figure 12). In addition, the MARGA measure ammonia (NH_3), nitric acid (HNO_3), nitrous acid (HONO), hydrochloric acid (HCl) and sulphur dioxide (SO_2).



Figure 12. Photo of the MARGA 2S in operation at Auchencorth Moss

The MARGA 2S operates by sampling the ambient air through a PM₁₀ size-selective inlet head at a nominal flow rate of 2 m³ hr⁻¹. The air stream is then split as there are two sample boxes, which both contain a wet rotating annular denuder (WRD) and a steam jet aerosol collector (SJAC). One sample box reports PM₁₀ and the trace gases, whereas the second sample box reports the PM_{2.5}. The PM_{2.5} fraction is separated from the sampled PM₁₀ by means of a cyclone separator fitted at the inlet to the PM_{2.5} sample box. On entering the sample box, the WRD removes water-soluble gases from the sampled air stream. Particles (PM) pass through the denuder unsampled and undergo rapid growth in a steam chamber (at ~120°C) into droplets in the SJAC and are mechanically removed via a cyclone. The solutions of dissolved gases and PM species are then analysed on-line, and in near real-time, by ion chromatography. IC systems are used for the detection of the cation and anion species. The system is continually calibrated using an internal standard of lithium bromide (LiBr). Further details of the method can be found in Twigg et al. (2015)⁶.

Tekran

Both sites use a Tekran 2537X (Figure 13, Tekran Instruments, USA) to measure the mercury in ambient air. The analyser uses an automated dual channel amalgamation technique and Cold Vapour Atomic Fluorescence Spectroscopy (CVAFS, 253.7nm) to detect gaseous elemental mercury (GEM). The Tekran 2537X reports everything as GEM however different sampling set-ups can change the mercury species reported.

At the Auchencorth Moss site there are extra instruments (Tekran 1130 and 1135, Teledyne, USA) running alongside the Tekran 2537X. The units separate the sample prior to analysis resulting in speciated mercury measurements. The sampled air (10 l min⁻¹) first passes through a PM_{2.5} impactor and through onto a coated denuder which captures the gaseous oxidised mercury (GOM) species. The air then flows through a filter to capture any particle bound mercury (PBM). The remaining air goes straight to the Tekran 2537X, where any mercury is reported as gaseous elemental mercury (GEM). The system operates on a 3-hour cycle. For the first 2 hours it collects the GOM and PBM, while the GEM is measured every 5 minutes. In the third hour, zero air is flowed through the sample train and the denuder and filter are heated in sequence giving results for the GOM and PBM, from the 2-hour sampling period.

At the Chilbolton Observatory site there is only the Tekran 2537X. This has a 0.2 μm filter on a heated inlet line sampling a 1 l min⁻¹. Due to its difference in set-up, it reports total gaseous mercury (TGM), as the particulate is removed by the filter leaving the sample made up of GEM and GOM.

Both Tekran 2537X instruments perform a calibration from a permeation source every 25 hours. Annually as part of the maintenance service a manual multipoint perm source verification is carried out. Full details of the Chilbolton Observatory set-up can be found in Kentisbeer et al. (2015)⁷, whereas the Auchencorth Moss set-up is described in Kentisbeer et al. (2014)⁸.



Figure 13. Photo of the Tekran set-up at Auchencorth Moss.

2.5.1 Overview of activities

The Chilbolton Observatory EMEP Supersite is operated by WSP summarised on UK-AIR. There were no modifications to the site infrastructure in 2025. WSP act as Local Site Operator for the Chilbolton Observatory (CHO) EMEP Supersite measurements except those conducted by the National Physical Laboratory (NPL) and the Environment Agency (EA). The Auchencorth Moss (AUC) EMEP Supersite is operated by UKCEH, summarised on UK-AIR. UKCEH is LSO for all measurements at Auchencorth Moss. There were no operational changes at the site during 2025.

2.5.2 Certification, testing and calibration

The MARGA's detection system was continuously calibrated using an internal standard, containing ions not normally present in ambient air. At Auchencorth Moss the solutions are: stock solution: Li^+ 28 mg/L and Br^- 325 mg/L, working solution: Li^+ 70 ppb Br^- 800 ppb. The Chilbolton Observatory instrument's working solution was made-up periodically by diluting a high concentration stock solution of LiBr. The nominal concentration of Li^+ in the stock and work solutions were 320000 ppb and 320 ppb, respectively, and 3680 mg L^{-1} and 3.68 mg L^{-1} ($1 \text{ mg L}^{-1} = 1 \text{ ppm}$) of Br^- .

Sub-samples of the internal standard used at both sites were analysed by UKCEH to ensure that both the stock and working solutions contained the correct concentrations (with Li^+ and Br^- within $\pm 20\%$ of the nominal concentrations). Spot samples of the stock and working solution were sent once a quarter via mail-out and analysed retrospectively. The Li^+ and Br^- concentrations were determined by inductively coupled plasma mass spectrometry (ICP-MS) and ion chromatography (IC), respectively. As part of the data ratification process, MARGA measurements were rejected if the measured concentrations of Li^+ and Br^- , in the internal standard, deviated by more than $\pm 20\%$ of the nominal concentration.

A regular maintenance scheme is in place on the MARGA instrument includes monthly calibration of the 2 mass flow controllers in the instrument, to ensure the correct flow rate through a steam jet aerosol collector (SJAC), which has been designed to operate at $1 \text{ m}^3/\text{hr}$. The frequency of calibration is increased if the positions of annular denuders in the system are altered. As part of the MARGAs ongoing QC a monthly blank. As well as being used to identify any potential contamination in the system, it was used in the calculation of a detection limit for certain species which is used in the ratifying process.

2.5.3 Data quality objectives

The UK has a legal obligation to report speciated $\text{PM}_{2.5}$ concentrations, currently this is provided by the MARGA at Auchencorth Moss and Chilbolton Observatory. In 2025 the $\text{PM}_{2.5}$ time coverage by MARGA instruments met the minimum time coverage requirement of 14% which is required under compliance of the Air Quality Standard Regulations.

3. Results and discussion

3.1 Precipitation Network (Precip-Net)

The data capture measured as an average of all measured components for each site is presented in Table 6. Data capture has been defined as the percentage of samples with valid data. Reasons why samples might become invalid include contamination, usually by bird strike, extended sampling times or loss or damage of samples during transit. The data capture for Loch Dee is significantly improved this year (87%) compared to last year (52 %) and can be likely attributed to the increase in bird deterrents added to the funnel frame

The spatial patterns of the annual mean precipitation-weighted concentration of non-sea salt sulphate (nss- SO_4^{2-}), NO_3^- , NH_4^+ and H^+ are presented in Figure 14 and Figure 15 for 2025. These are prepared using kriging. The maps show that: the non-sea salt sulphate and nitrate concentrations tend to be highest on the eastern seaboard where the rainwater volume is smallest. Ammonium concentrations are highest in the areas of the UK where intensive livestock activity is highest. There is no clear pattern in the hydrogen ion concentration.

Figure 16 summarises the National Emissions Inventory (NAEI) estimated annual emission of precursor gases since the inception of the Precip-Net network in 1986. All the emission estimates have decreased though the rate of decrease for sulphur dioxide was greater than that for oxides of nitrogen and ammonium. Sulphur dioxide emissions have decreased by about 98 %, oxides of nitrogen emissions have decreased by about 82% and ammonia emissions have decreased by about 18 %. Figure 16 also presents projected emissions for 2025, 2030, 2040 ([National Atmospheric Emissions Inventory](#), accessed 6th July 2026).

Table 6 Data capture with the Precip-Net network in 2025.

Site	UKAIR ID	Average, %	Site	UKAIR ID	Average, %
Ainsdale Dunes and Sands	UKA00635	63.6	Loch Dee	UKA00107	87.1
Allt a'Mharcaidh	UKA00086	87.1	Lough Navar	UKA00166	91.5
Auchencorth Moss	UKA00451	86.8	Lullington Heath	UKA00152	79.1
Balquhiddier 3	UKA01087	93.4	Malham Tarn	UKA00974	86.8
Beaghs Burn	UKA00383	98.0	Monks Wood	UKA00639	82.3
Braunton Burrows	UKA00969	62.6	Moorhouse	UKA00357	83.8
Bure Marshes	UKA00641	82.0	Percy's Cross	UKA00504	86.8
Chilbolton Observatory	UKA00614	81.9	Polloch	UKA00180	96.2
Crai Reservoir 2	UKA00657	94.5	Preston Montford	UKA00110	83.8
Dersingham Bog	UKA00970	77.9	Pumlumon	UKA00173	65.2
Driby 2	UKA00550	90.7	River Etherow	UKA00391	86.0
Ennerdale	UKA01086	67.4	Rothamsted	UKA00275	87.1
Eskdalemuir	UKA00130	96.7	Roudsea Wood & Mosses	UKA00975	85.4
Fenn's, Whixall and Bettisfield Mosses	UKA00642	81.4	Saltfleetby-Theddlethorpe Dunes	UKA00973	81.4
Finglandrigg Woods	UKA00971	83.3	Stiperstones	UKA00640	90.1
Flatford Mill	UKA00103	74.5	Stoke Ferry	UKA00317	80.3
Forsinard RSPB	UKA00607	67.4	Strathvaich	UKA00162	99.3
Glensaugh	UKA00348	80.3	Thorganby	UKA00112	84.5
Goonhilly	UKA00056	99.2	Thursley Common 2	UKA00588	86.6
High Muffles	UKA00169	84.7	Tycanol Wood	UKA00113	74.7
Hillsborough Forest	UKA00293	58.1	Wardlow Hay Cop	UKA00119	80.5
Ingleborough	UKA00637	83.0	Whiteadder	UKA00123	79.8
Lindisfarne	UKA00972	80.7	Yarner Wood	UKA00168	93.2
Llyn Llydaw	UKA00268	91.0	Ystradffyn	UKA00505	91.1
Network average					83.5

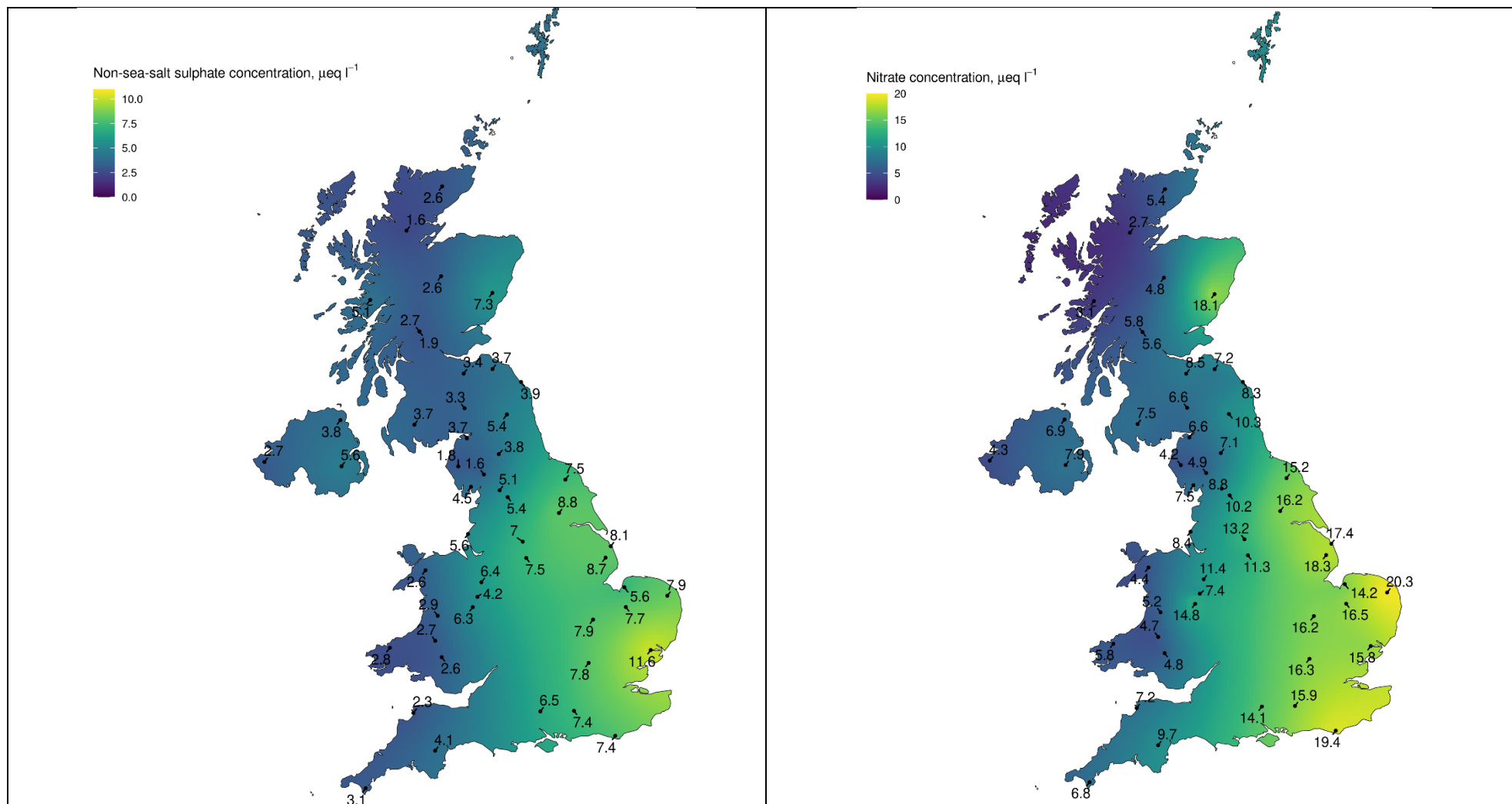


Figure 14. Interpolated concentration maps for nss-SO₄²⁻ and NO₃⁻ ($\mu\text{eq l}^{-1}$).

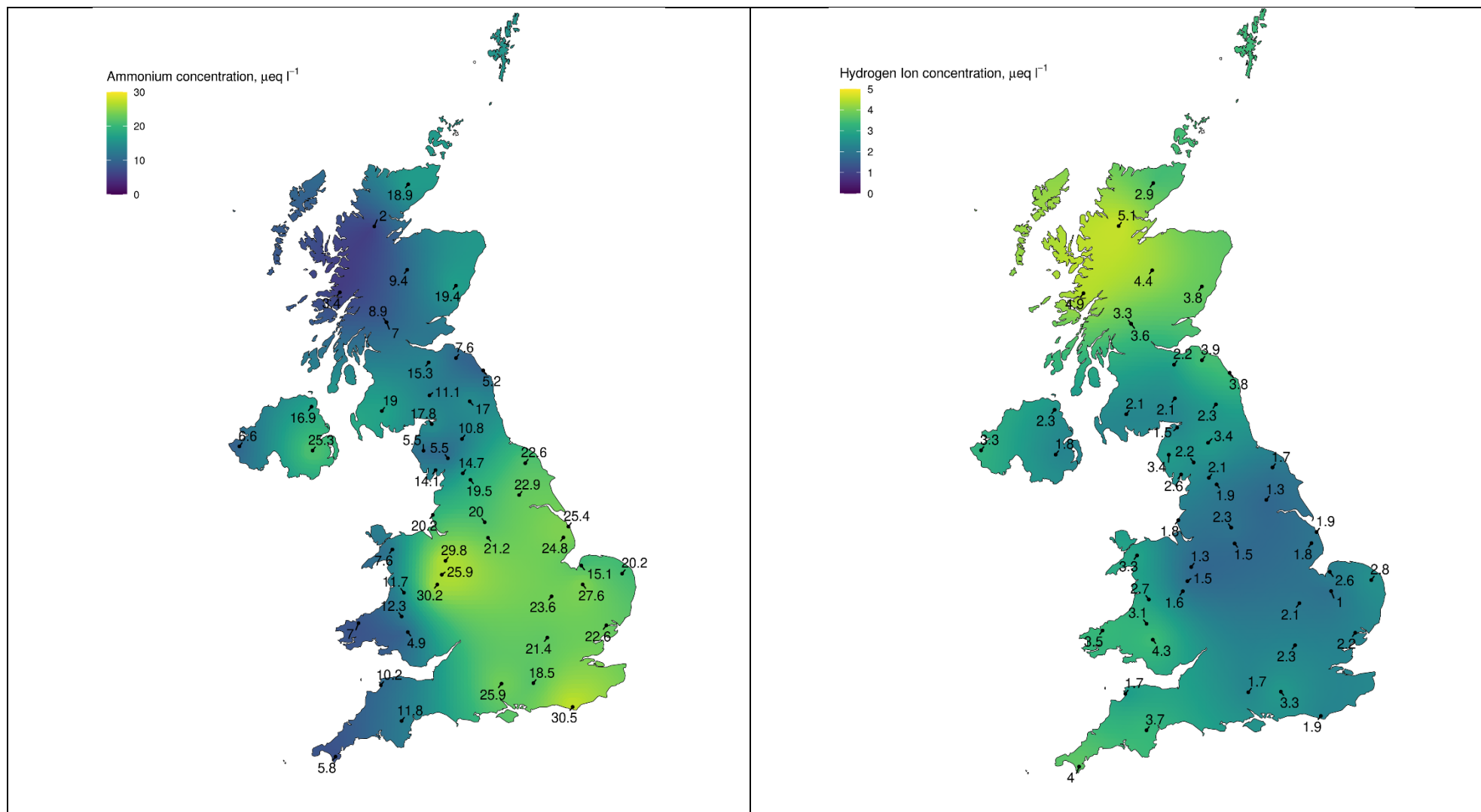


Figure 15. Interpolated concentration maps for NH_4^+ and H^+ ion ($\mu\text{eq l}^{-1}$)

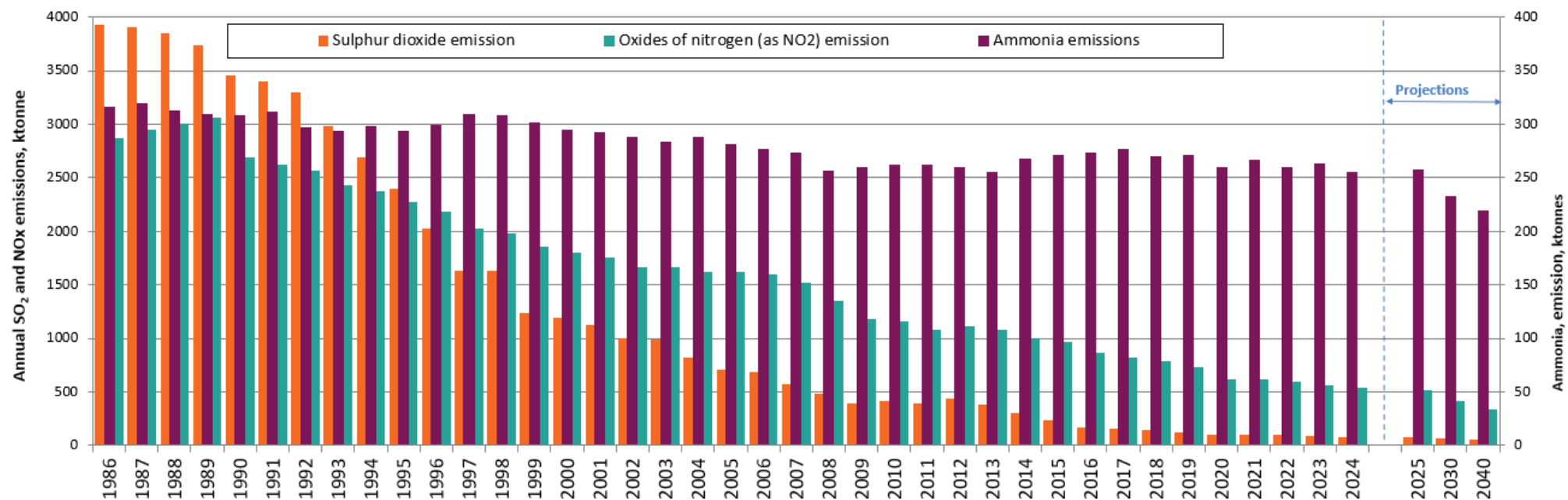


Figure 16. Sulphur dioxide, oxides of nitrogen and ammonia NAEI emissions since 1986.

Figure 17, Figure 18 and Figure 19 compare the total sulphur dioxide, oxides of nitrogen and ammonium emissions for the UK with the Precip-Net national average concentrations for nss-SO_4^{2-} , NO_3^- and NH_4^+ , respectively. At this highly aggregated scale the rate of decrease in NO_3^- and NH_4^+ concentrations is smaller than that for SO_4^{2-} .

Network average nss-SO_4^{2-} concentrations decreased from 0.083 mg l^{-1} ($5.2 \text{ } \mu\text{eq l}^{-1}$) in 2024 to 0.082 mg l^{-1} ($5.1 \text{ } \mu\text{eq l}^{-1}$) in 2025. The total sulphur dioxide emissions were projected to decrease by about 9 % (83.7 kt to 76.3 kt)

Network average NO_3^- concentrations decreased slightly from 0.15 mg l^{-1} ($10.6 \text{ } \mu\text{eq l}^{-1}$) in 2024 to 0.14 mg l^{-1} ($10.1 \text{ } \mu\text{eq l}^{-1}$) in 2025. At the national scale, total NO_x emissions are projected to decrease by about 3 % from 2024 to 2025 (535.0 kt to 516.6 kt).

There was a decrease in the network NH_4^+ average from 0.25 mg l^{-1} ($17.6 \text{ } \mu\text{eq l}^{-1}$) in 2024 to 0.23 mg l^{-1} ($16.4 \text{ } \mu\text{eq l}^{-1}$) in 2025. The national NH_3 emissions are projected to increase by 1 % 2024 to 2025 (255.7 kt to 258.2 kt).

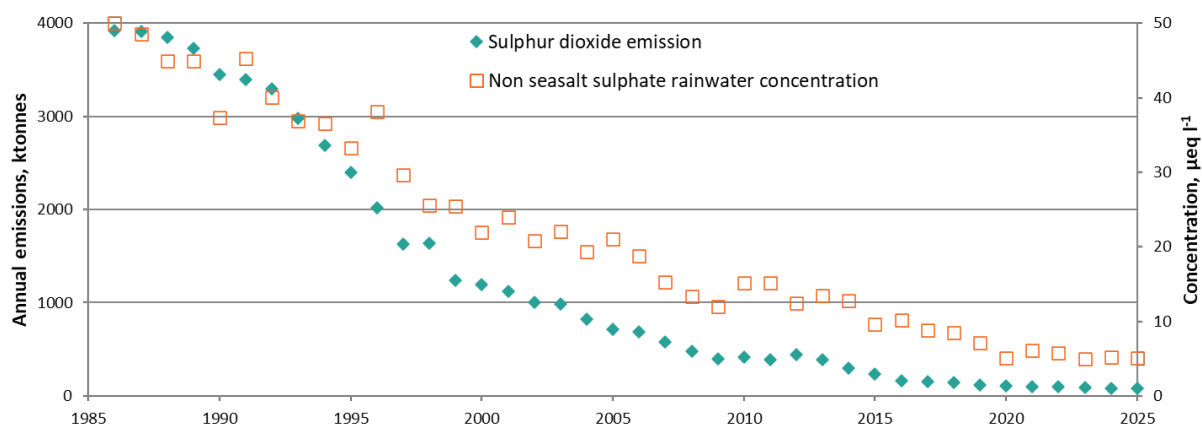


Figure 17. UK sulphur dioxide emissions and network average sulphate concentrations in rainwater.

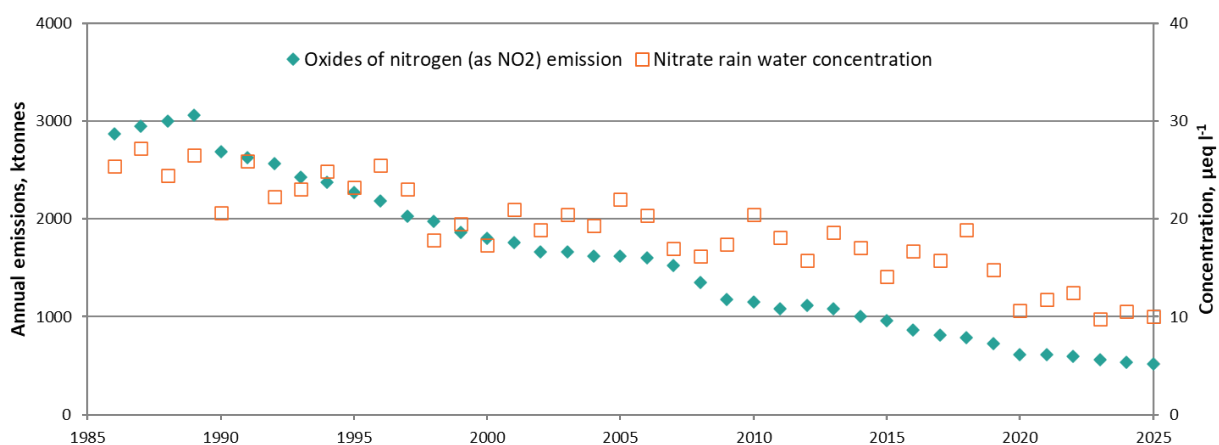


Figure 18. UK oxides of nitrogen emissions and network average nitrate concentrations in rainwater.

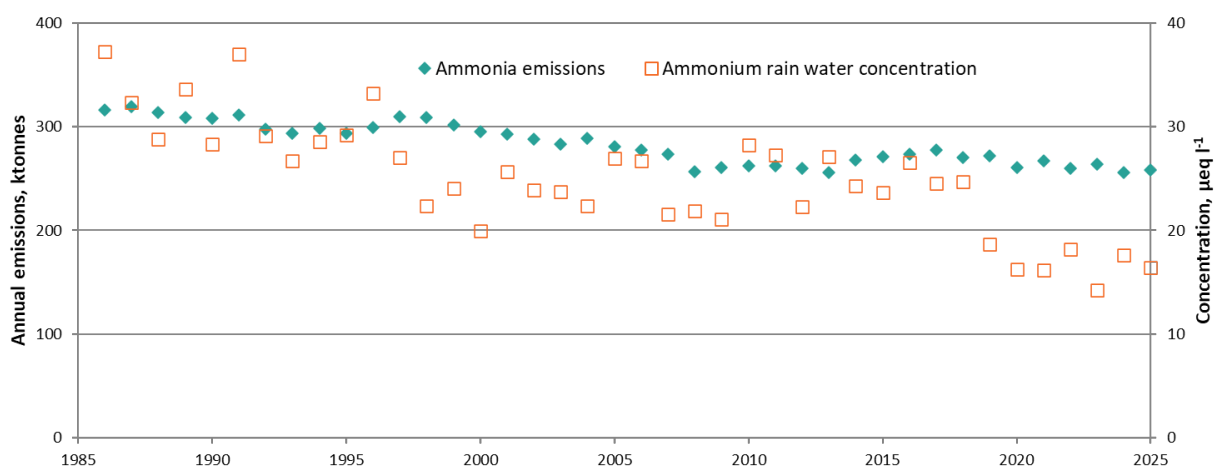


Figure 19. UK ammonia emissions and network average ammonium concentrations in rainwater.

3.2 NO₂-Net Network

Table 7 presents the annual mean NO₂ concentrations for 2025. There is a southeast to northwest gradient in concentrations with the highest concentrations in the southeast of England. On an individual site basis, the highest concentration was measured at Flatford Mill (5.6 µg m⁻³) and the lowest in northern Scotland at Strathvaich (0.49 µg m⁻³). The mean data capture was 92% with 20 of the 25 sites achieving > 90% and 13 sites achieving 100%. The lowest data capture was observed at Ennerdale, Goonhilly and Hillsborough Forest these were all attributed to local site operation issues causing the lower data captures of 57.7 %, 62.8 % and 63.8 %, respectively.

Figure 20 shows the trend in emissions of NO_x and NO₂ concentrations measured by the diffusion tubes in the network as a network average, very rural site (Strathvaich) and less rural site (Flatford Mill). The estimated emissions of NO_x in the UK as a whole show a reduction over the period shown and there is also a reduction in the average concentrations of all the active NO₂-Net site over the same period. More information relating to emissions in the UK can be found on the National Atmospheric Emissions Inventory (NAEI) [website](#).

Table 7 2025 NO₂ concentration from the Diffusion Tubes in the NO₂-Net

Site Name	UK-AIR_ID	NO ₂ concentration, µg m ⁻³	Data capture, %
Allt a'Mharcaidh	UKA00086	0.53	100.0
Auchencorth Moss	UKA00451	1.74	99.8
Balquhiddier 3	UKA01087	1.15	97.7
Chilbolton Observatory	UKA00614	5.05	100.0
Driby 2	UKA00550	4.40	99.3
Ennerdale	UKA01086	1.65	57.7
Eskdalemuir	UKA00130	1.23	100.0
Flatford Mill	UKA00103	5.64	91.4
Forsinard RSPB	UKA00607	0.77	100.0
Glensaugh	UKA00348	1.26	100.0
Goonhilly	UKA00056	3.55	62.8
High Muffles	UKA00169	2.77	99.3
Hillsborough Forest	UKA00293	3.63	63.8
Llyn Llydaw	UKA00268	1.55	100.0
Loch Dee	UKA00107	1.20	83.6
Lough Navar	UKA00166	1.44	100.0
Lullington Heath	UKA00152	4.84	100.0
Moorhouse	UKA00357	1.33	100.0
Percy's Cross	UKA00504	1.85	100.0
Polloch	UKA00180	0.59	92.2
Pumlumon	UKA00173	1.38	100.0
Strathvaich	UKA00162	0.49	93.6
Tycanol Wood	UKA00113	1.55	100.0
Whiteadder	UKA00123	1.73	92.2
Yarner Wood	UKA00168	2.55	84.2
Network Average			93

NO₂ emissions are associated with transport or industrial processes involving combustion, therefore there are smaller influences in concentrations at rural locations. There is an observable difference in trends in concentrations at the Flatford Mill when compared to the more remote rural locations such as Strathvaich. The difference is attributed for rural sites like Flatford Mill which have an urban influence, in this case being ~ 50 miles from London located between Colchester and Ipswich compared to the more remote rural locations Strathvaich site located in the north of Scotland can also be seen in the Figures 20 and 21. The trend in concentrations at the Strathvaich site does not appear to show a pronounced reduction in NO₂ concentration whereas the Flatford Mill sites shows a similar rate of reduction to that of the NAEI estimated.

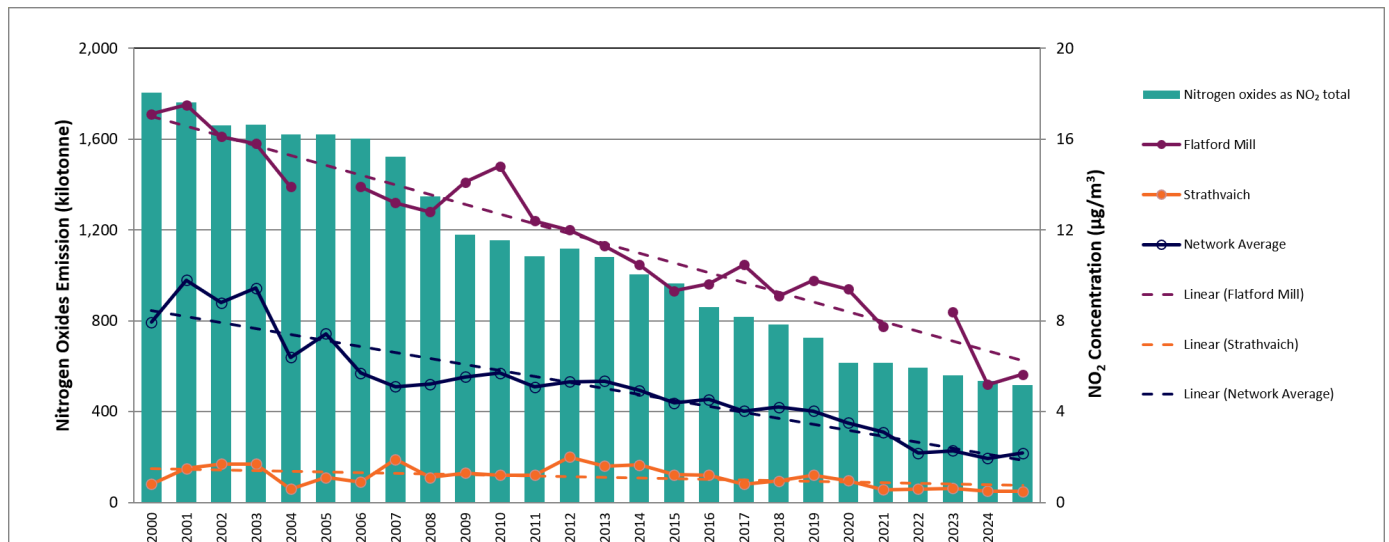


Figure 20. Long term trends where NAEI estimated emissions are plotted against selected sites in the network.

The annual average NO₂ concentrations from 2000-2025 indicates the differing NO₂ concentrations at rural locations across the UK. Most sites show some reduction between 2010 and 2021, with the largest decreases observed at sites closer to sources of NO_x.

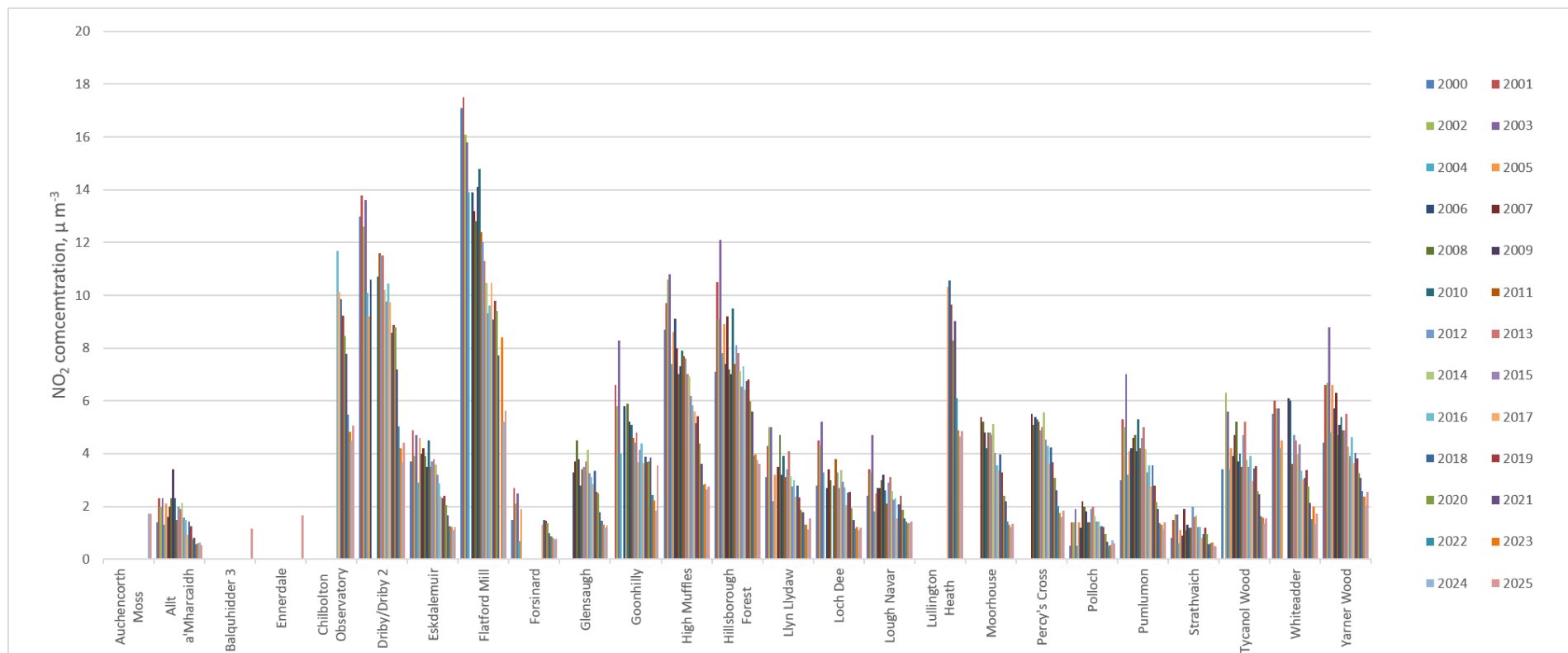


Figure 21 Annual mean NO₂ concentration (µg m⁻³) at the NO₂-Net sites 2000-2025

3.2.1 Intercomparison of diffusion tube and automatic analysers at Auchencorth Moss

Following on from the intercomparison reported in the [UKEAP 2023 annual data report](#) which showed that the chemiluminescence analysers measured more NO₂ at rural locations compared to the diffusion tubes with wind protection caps. A two-year study was instigated at Auchencorth Moss to compare the nitrogen dioxide concentrations measured by the diffusion tubes with wind protection caps with the two NO₂ molecule specific analysers at Auchencorth Moss. These analysers have been in operation since 2019 and include the following:

- Teledyne CAPS T200U; UV Absorption Spectroscopy (cavity attenuated phase shift spectroscopy, CAPS);
- Teledyne T200P; Chemiluminescent: Photolytic Conversion (Blue Light).

In total, 28 sets of triplicate tubes were exposed over the period 27th December 2023 to 25th February 2026. In order to compare the NO₂ the hourly concentrations were aggregated up to the same sampling times as the diffusion tubes Results are compared on a line chart in Figure 22 and as scatter plots in Figure 23.

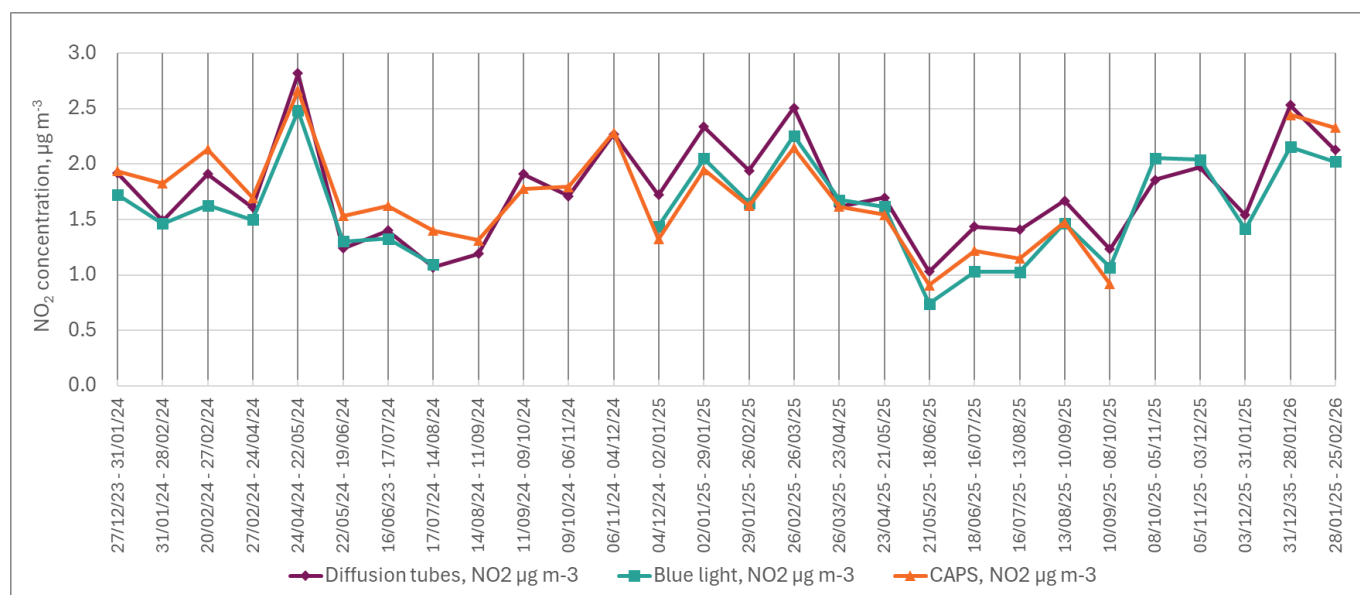


Figure 22 Line plot showing nitrogen dioxide concentrations measured at Auchencorth Moss by diffusion tubes with wind protection caps, by a Teledyne T200 blue light and a Teledyne T200U CAPS

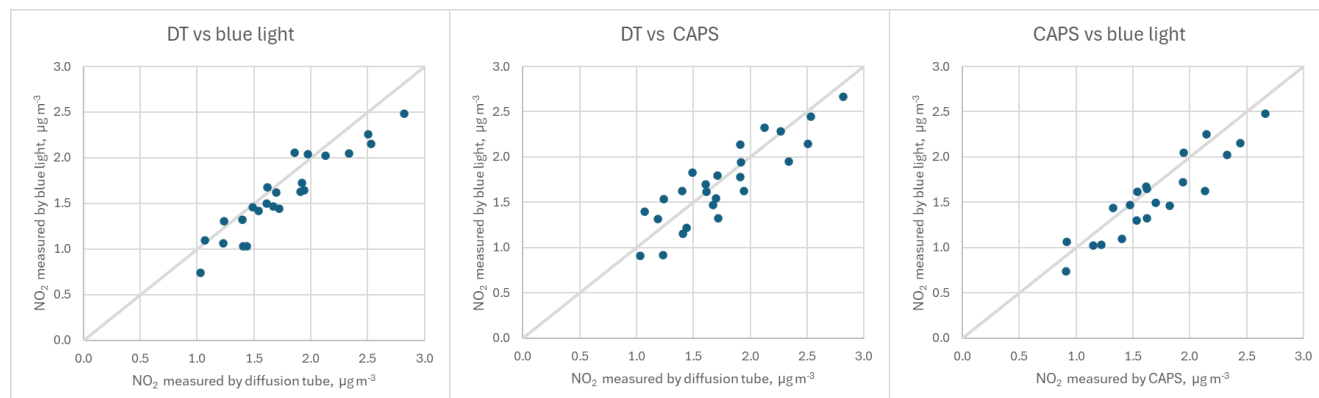


Figure 23 Scatter plots between each pair of measurement methods: diffusion tube vs blue light, diffusion tube vs CAPS, CAPS vs blue light.

In summary the following conclusions can be drawn:

- Over the extended two-year period both the diffusion tubes ($1.76 \mu\text{g m}^{-3}$) and CAPS ($1.71 \mu\text{g m}^{-3}$) reported slightly higher concentrations than the blue light ($1.59 \mu\text{g m}^{-3}$).
- The diffusion tubes are representing well the NO_2 trends as measured by the automatic instruments.
- Diffusion tubes are a reliable cost method for measuring NO_2 concentrations in rural locations.

3.3 National Ammonia Monitoring Network (NAMN)

NAMN Performance and Data capture

Figure 24 contains the average percentage data capture across all sites reported in the National Ammonia Monitoring Network (NAMN). Average data capture was 73% (ALPHA® and DELTA® measurements) for NAMN.

UKCEH ALPHA® Sampler

Data capture at ALPHA® sites was 94% in 2025. Data capture losses were primarily due to:

- Measurements failing the Quality Assurance and Quality Control (QA/QC) data process.
- Sampler losses either due to animal causes, poor weather conditions, lost in transit or inaccessible site.

The ALPHA data capture increased by 6% compared to 2024.

UKCEH DELTA® Sampler

DELTA systems data capture in 2025 are 63%. This an increase in 20% compared to the data capture of 2024. The causes of the main data losses are outlined in Table 8.

Table 8: Summary of main causes to DELTA data loss during 2025

Cause	Data Capture loss (%)	Comments
Sample washout	14.1	Analysis results showed on the blank levels, either through confirmed water ingress (6.4%) or sampler unidentified issues (7.7%). These samples fail the QA/QC processes.
Equipment Failure	8	Issues with the air flow in the samplers (for example: too far out of the recommended operational range and malfunctions of the pump box.) These samples fail the QA/QC process
Ion Balance issues	3.8	Ion balance deviations caused by various issues (for example: breakthrough of NH ₃ from denuders to filter pack and/or samplers with water ingress.) These samples fail the QA/QC process
Site issues	3.57	Site power loss and/or inaccessibility due to adverse weather conditions.
Other	2.6	Issues such as local contaminations (0.6%), samplers not returning to the laboratory (0.6%), issues in the analytical chain (0.4%), and damages to the sampler in the mail chain (1%).

The upgrade of DELTA systems reporting to both NAMN and AGANet was carried out between April 2025 and December 2025. Improvements in data capture have already been observed during 2025; however, the full benefit of the network upgrade is not expected to be realised until 2026, when a complete year of sampling data is available. Additional reviews and updates to the Standard Operating Procedures (SOPs) for Local Site Operators for both ALPHA and DELTA sites were Implemented February 2025. The laboratory sampler preparation procedures were subsequently reviewed and updated in November 2025.

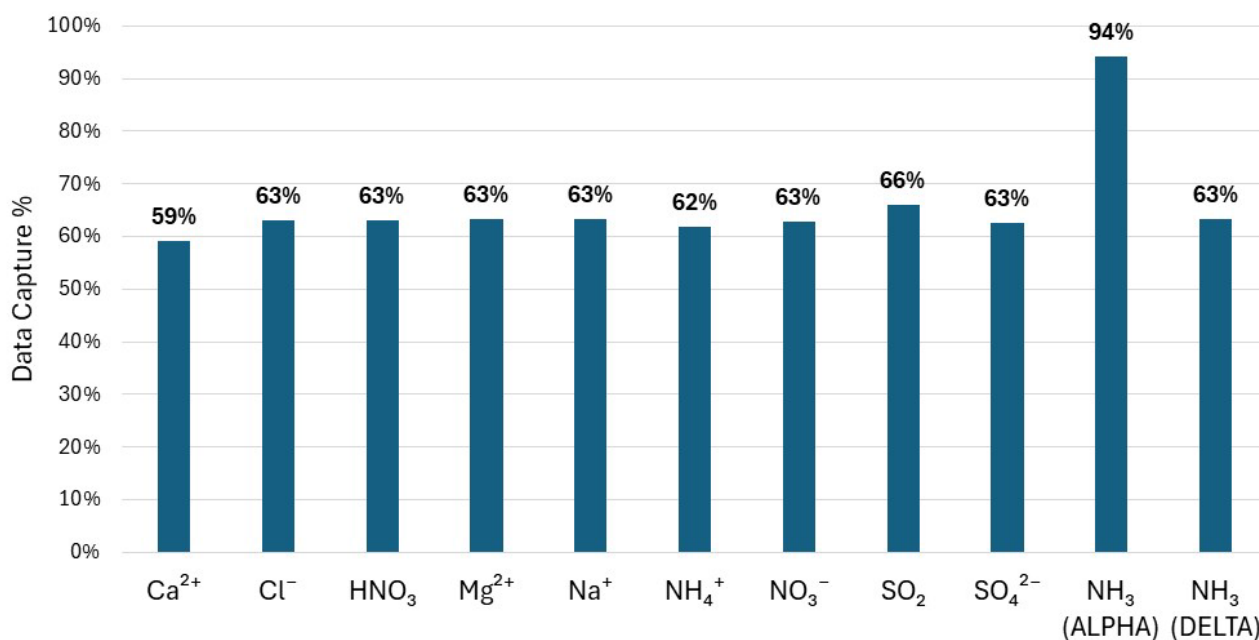


Figure 24 NAMN (NH₃ and NH₄⁺) and AGANet (HNO₃, SO₂, Cl⁻, NO₃⁻, SO₄²⁻, Na⁺, Ca²⁺, Mg²⁺) percentage data capture by chemical component in 2025.

NAMN Network Trends

The 2025 annual average NH₃ concentrations observed at each site in NAMN is presented in Figure 25 with the bars showing the monthly maximum and minimum concentration reported at each site. A high spatial variability was observed in NH₃ concentrations across the UK, with seasonal variability across each site. The sites in the north of Scotland, which are typically remote rural sites, reported the lowest annual concentrations (Allt A Mharcaidh, Inverpolly, Loch Awe, Strathvaich, Eskdalemuir). The highest reported concentrations were generally reported from Northern Ireland (Caddy Rd, Drumclaph 2, Derryraine Rd., Turmennan Rd.) and the centre-eastern side of England (Brompton, Fressingfield)

Although the NAMN reports both NH₃ and NH₄⁺, in this report the NH₄⁺ results will be presented alongside the rest of the particulate phase components in the AGANet section for coherence purposes.

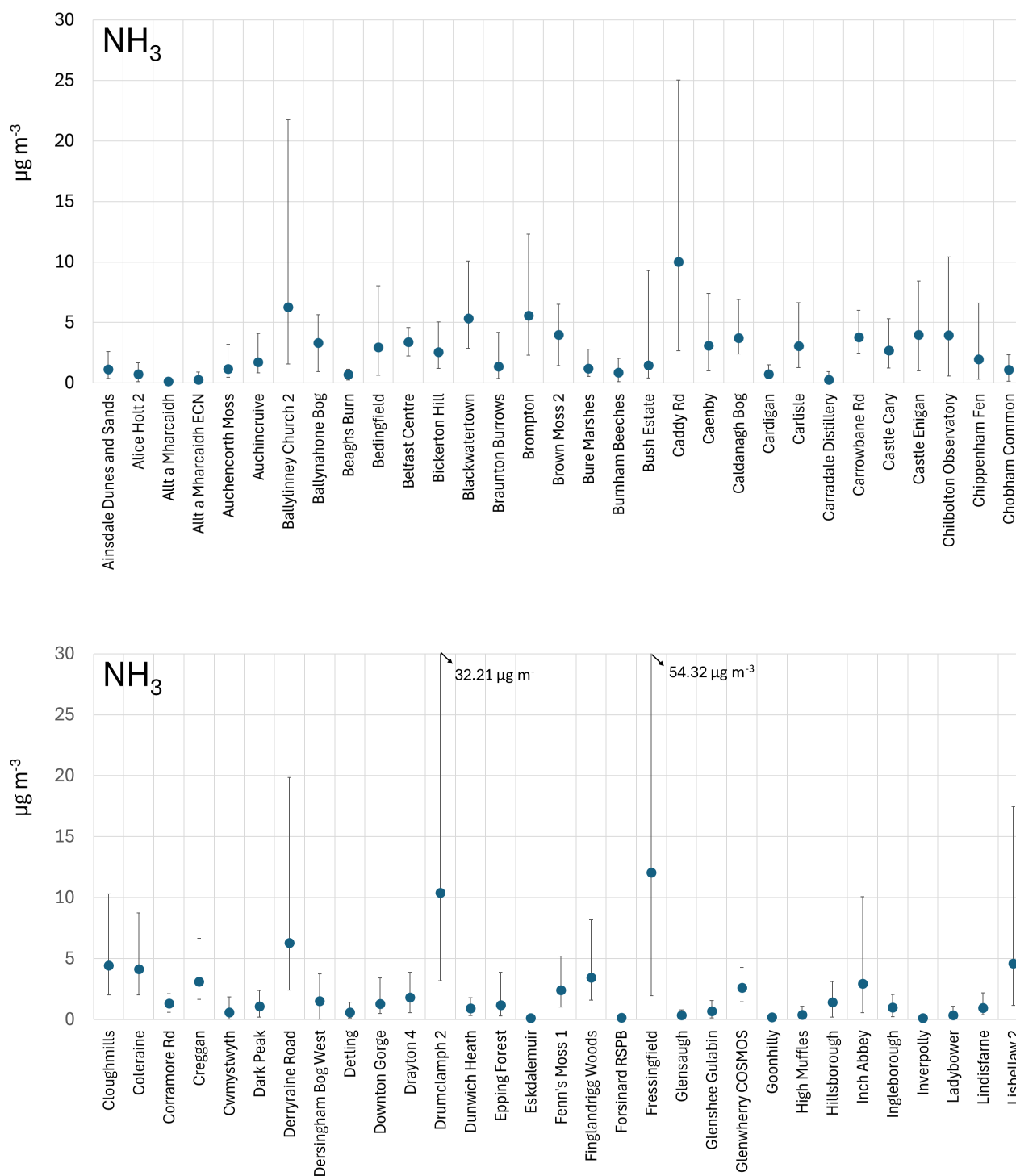


Figure 25 Annual mean concentrations of gaseous NH_3 in the NAMN. Each data point represents the averaged concentrations of monthly measurements made at each site in 2025, whilst the bars show the minimum and maximum concentrations observed.

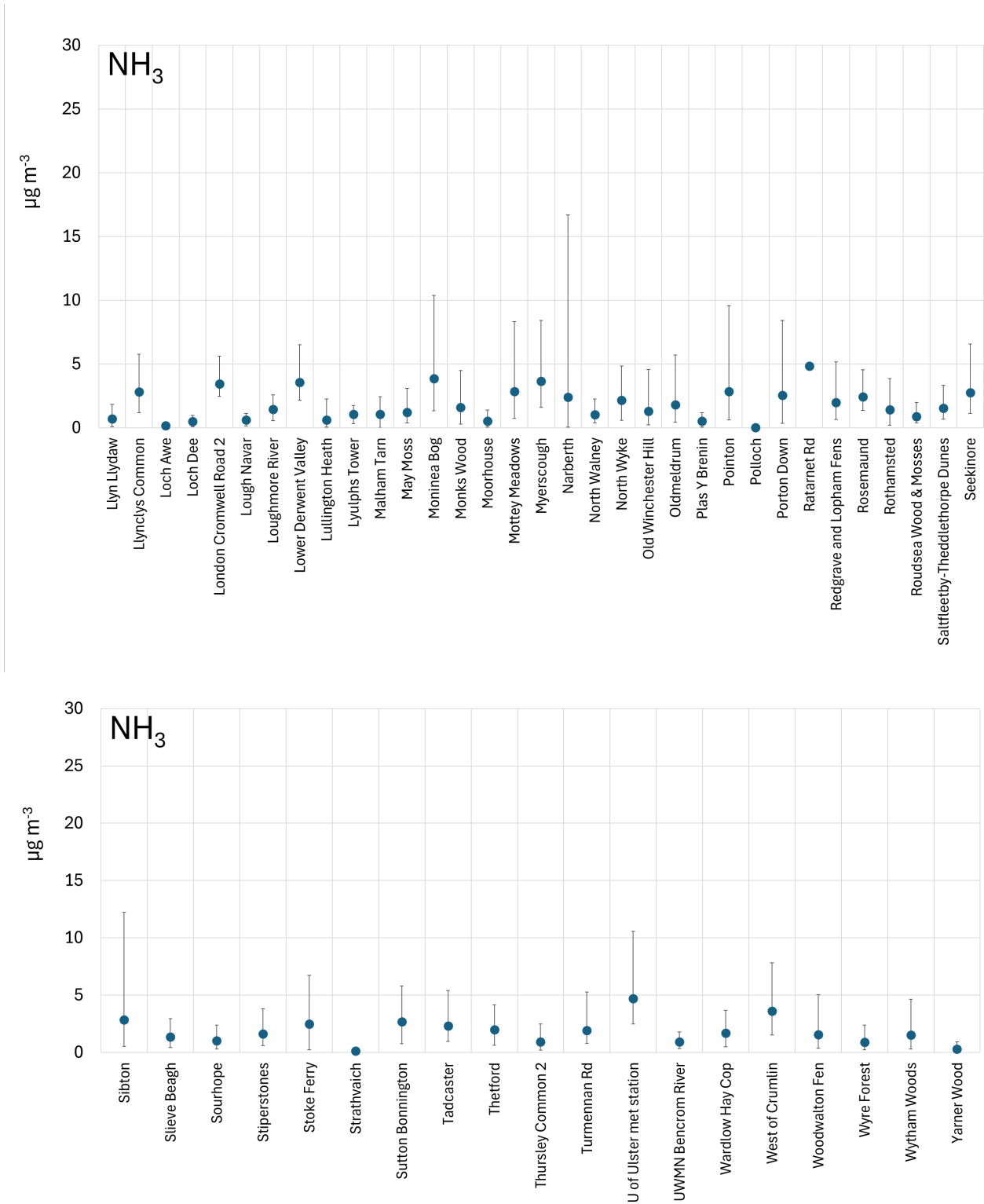


Figure 25 (continued). Annual mean concentrations of gaseous NH_3 in the NAMN. Each data point represents the averaged concentrations of monthly measurements made at each site in 2025, whilst the bars show the minimum and maximum concentrations observed.

Historical changes in the annual average NH_3 concentrations can be seen in Figure 26. The annual average across the network is similar to the range previously reported across the measurement period. The step change in the maximum concentrations in 2022 was caused by the addition of the NI network (25 sites) into the NAMN, with some sites reporting $> 30 \mu\text{g NH}_3 \text{ m}^{-3}$. The year 2025 recorded the highest annual mean ($2.2 \mu\text{g m}^{-3}$) and maximum NH_3 concentrations ($54.3 \mu\text{g m}^{-3}$) since the inception of the network.

Average UK NH_3 Concentrations

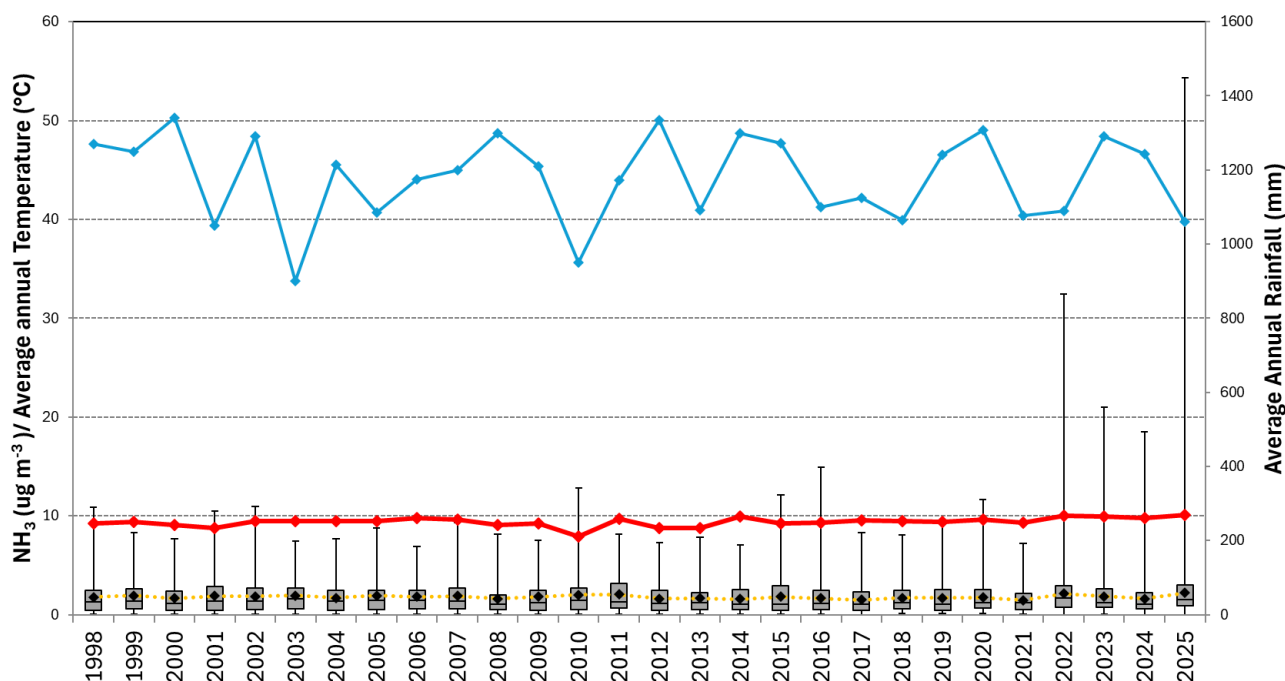


Figure 26 Changes in atmospheric NH_3 averaged over all sites in NAMN operational between 1998 and 2025 summarised in a box plot. The whiskers show the absolute max and min and the diamond is the mean annual concentration accounting for ALPHA® and DELTA® NH_3 measurements. Meteorological data is also displayed for comparison. The red line is the average annual temperature and the blue line the annual average rainfall (data source: <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-and-regional-series>).

The spatial variability of the annual concentration of NH_3 is presented in Figure 27. For NH_3 , lower concentrations are primarily located in the North of Scotland, with some locations close to the south coast of England. High NH_3 concentrations are observed in Northern Ireland and some locations in eastern England.

NAMN 2025

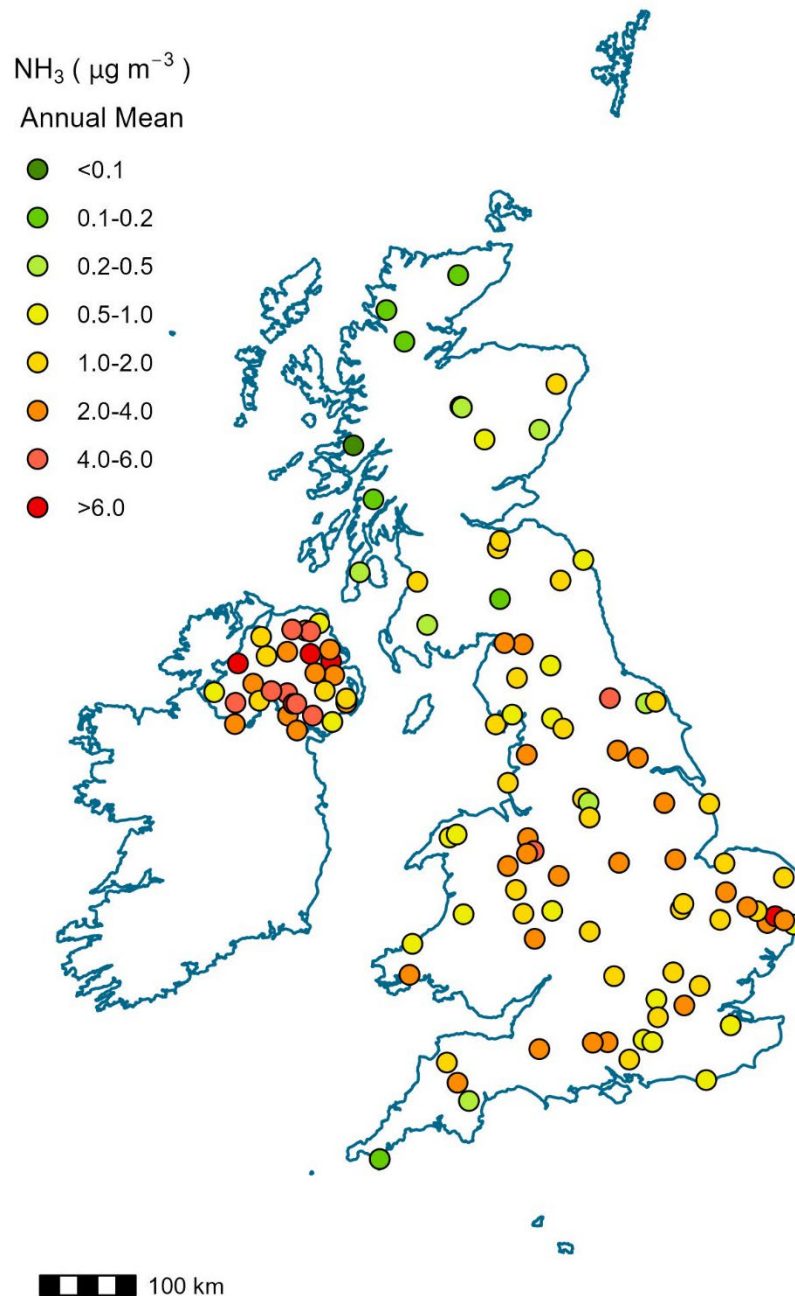


Figure 27 Spatial patterns of annual NH_3 concentrations from monthly NAMN measurements in 2025.

3.4 Acid Gas and Aerosol Network(AGANet)

AGANet Performance and Data capture

Figure 24 summarises the data capture of each species in the Acid Gases and Aerosol Network (AGANet). The data capture from the DELTA systems improved compared to 2024, reaching 63% data capture on average for the reported species. The data capture however still remains lower compared to years prior to 2024. Details of the main factors contributing to the data losses are described in Section 3.3.

AGANet Network Trends

Figure 28 presents the annual average concentrations of SO_2 and HNO_3 at each site, alongside the minimum and maximum concentrations reported. In 2025 annual concentrations remained at low, with concentrations below $0.3 \mu\text{g SO}_2 \text{ m}^{-3}$. Figure 29 shows the spatial distribution is homogenous for SO_2 during 2025, with the exception of central and southern England where the concentrations are slightly higher but still relatively low compared to historic records.

For HNO_3 , no site in the network surpassed annual average concentrations of $0.3 \mu\text{g HNO}_3 \text{ m}^{-3}$ in 2025. Nitric acid annual average spatial distribution can be found in Figure 29. The lowest concentrations are observed in the north of Scotland, where annual average concentrations are below $0.1 \mu\text{g HNO}_3 \text{ m}^{-3}$, compared to south-east England where the highest HNO_3 concentrations are generally observed.

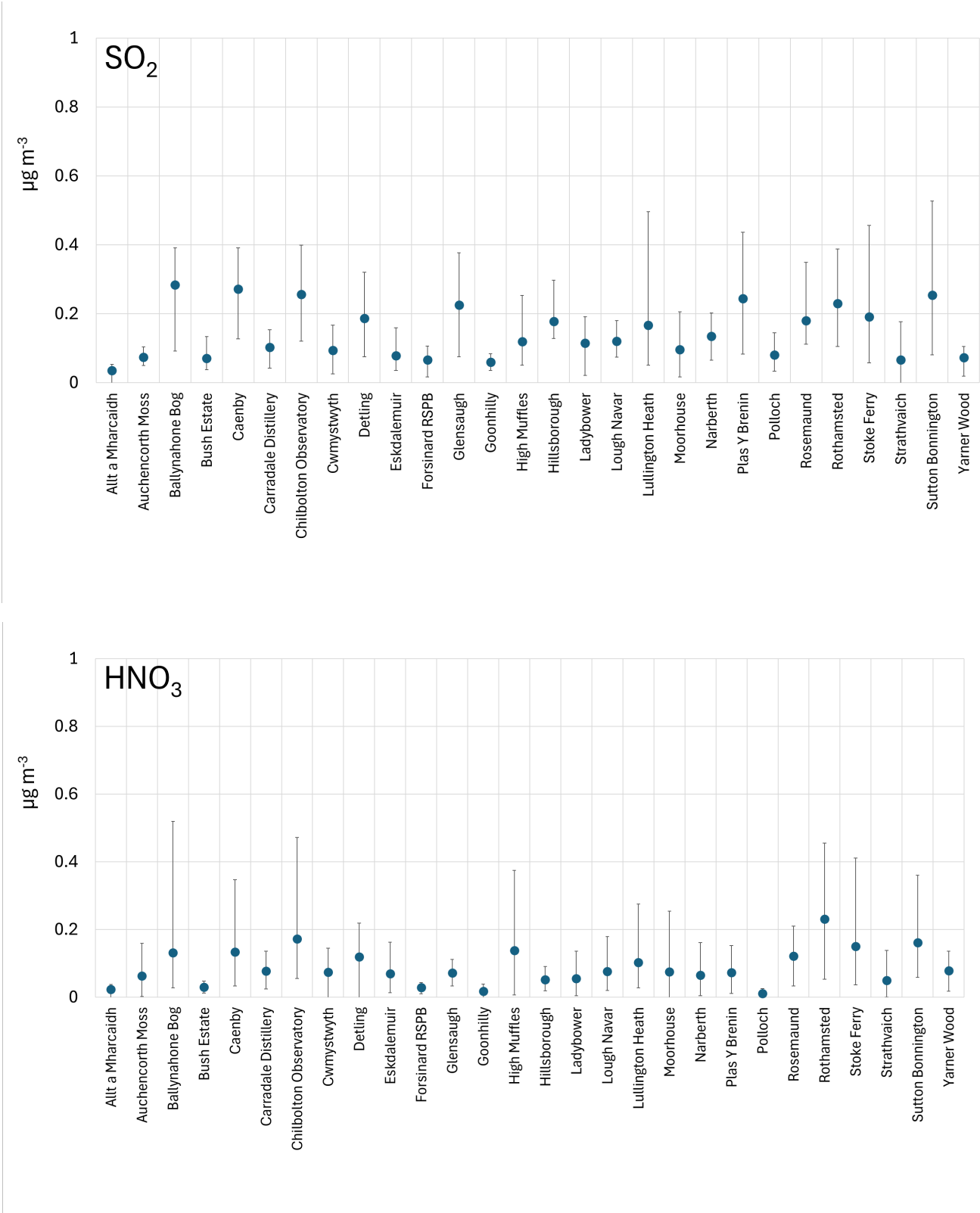
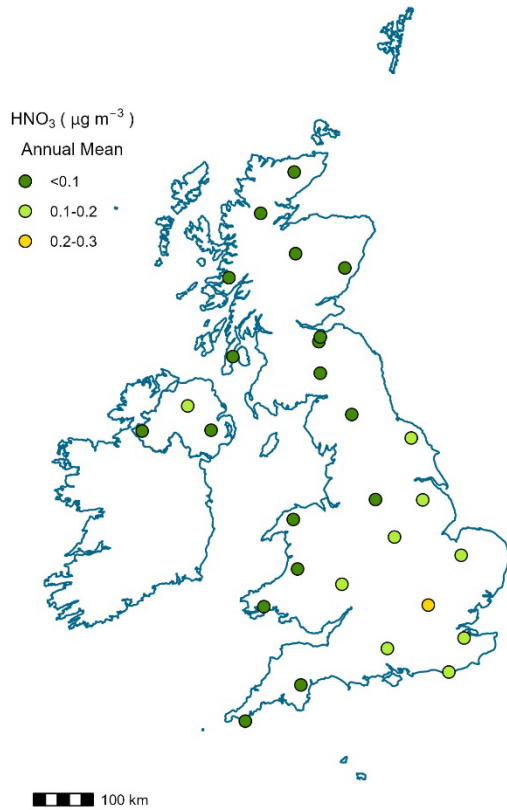


Figure 28 Annual average concentration of HNO_3 and SO_2 at individual sites in AGANET. Each data point represents annual averaged concentrations of monthly measurements made at each site in 2025, whilst the bars show the minimum and maximum monthly concentration observed.

AGANET 2025



AGANET 2025

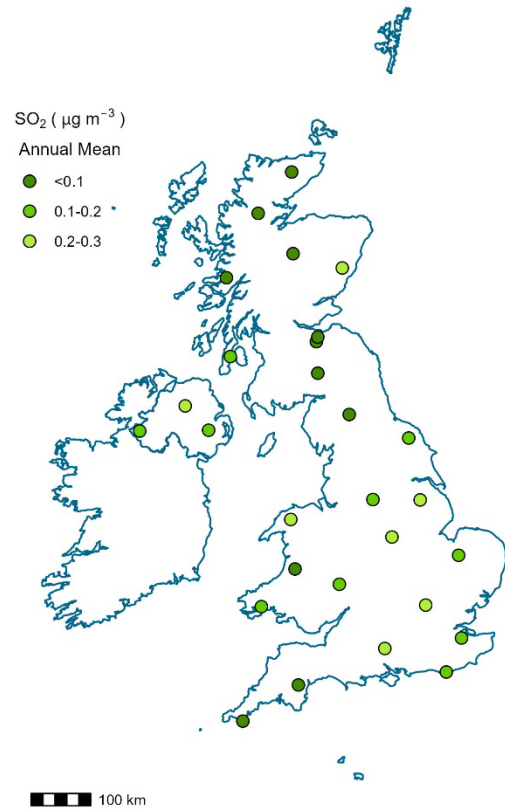


Figure 29 Annual average concentration of HNO_3 and SO_2 across the UK measured by AGANet in 2025.

Figure 30 shows the annual average, maximum and minimum of NO_3^- , SO_4^{2-} , NH_4^+ and Cl^- from each site during 2025 reported by AGANet. The lowest reported concentrations for the main secondary inorganic aerosol (SIA) components NO_3^- , SO_4^{2-} and NH_4^+ are from sites in the North of Scotland (Figure 31), while higher concentrations are found in southeastern England for all SIA components and for NH_4^+ and SO_4^{2-} in Northern Ireland.

For Cl^- (Figure 30 and Figure 31) and Na^+ (Figure 32 and Figure 33) there is a more distinct variability in the observed concentrations, with the southwest coast of the UK observing the higher concentrations primarily attributed to sea salt. A similar spatial pattern is found for Mg^{2+} (Figure 32 and Figure 33) as it is also found in sea salt, whereas Ca^{2+} concentrations were highest in southeast England and Northern Ireland.

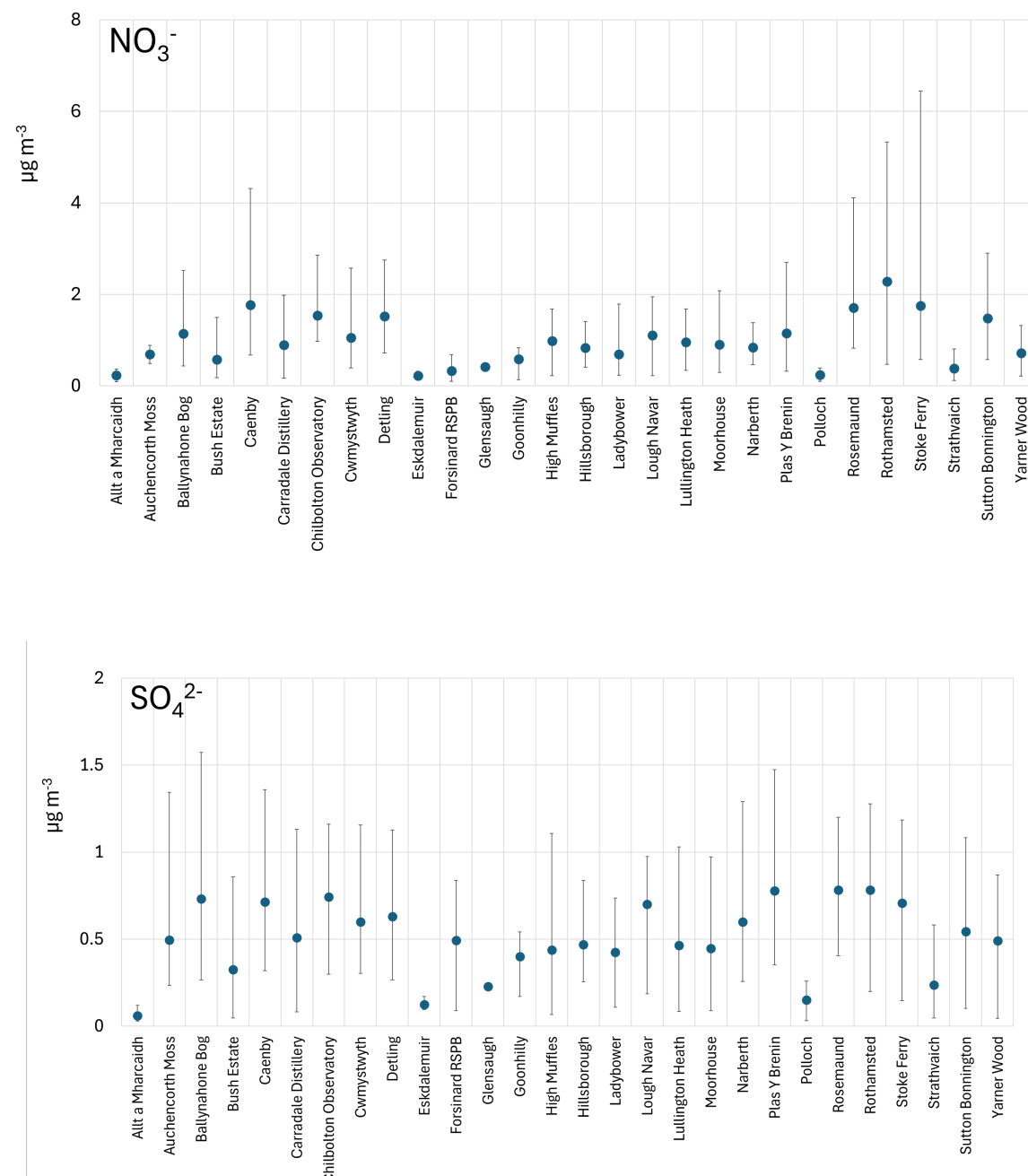


Figure 30 Mean monitored annual concentrations of particulate NO₃⁻, SO₄²⁻, Cl⁻ and NH₄⁺ at individual sites in AGANET. Each data point represents the averaged concentrations of monthly measurements made at each site in 2025, whilst the bars show the minimum and maximum concentrations observed.

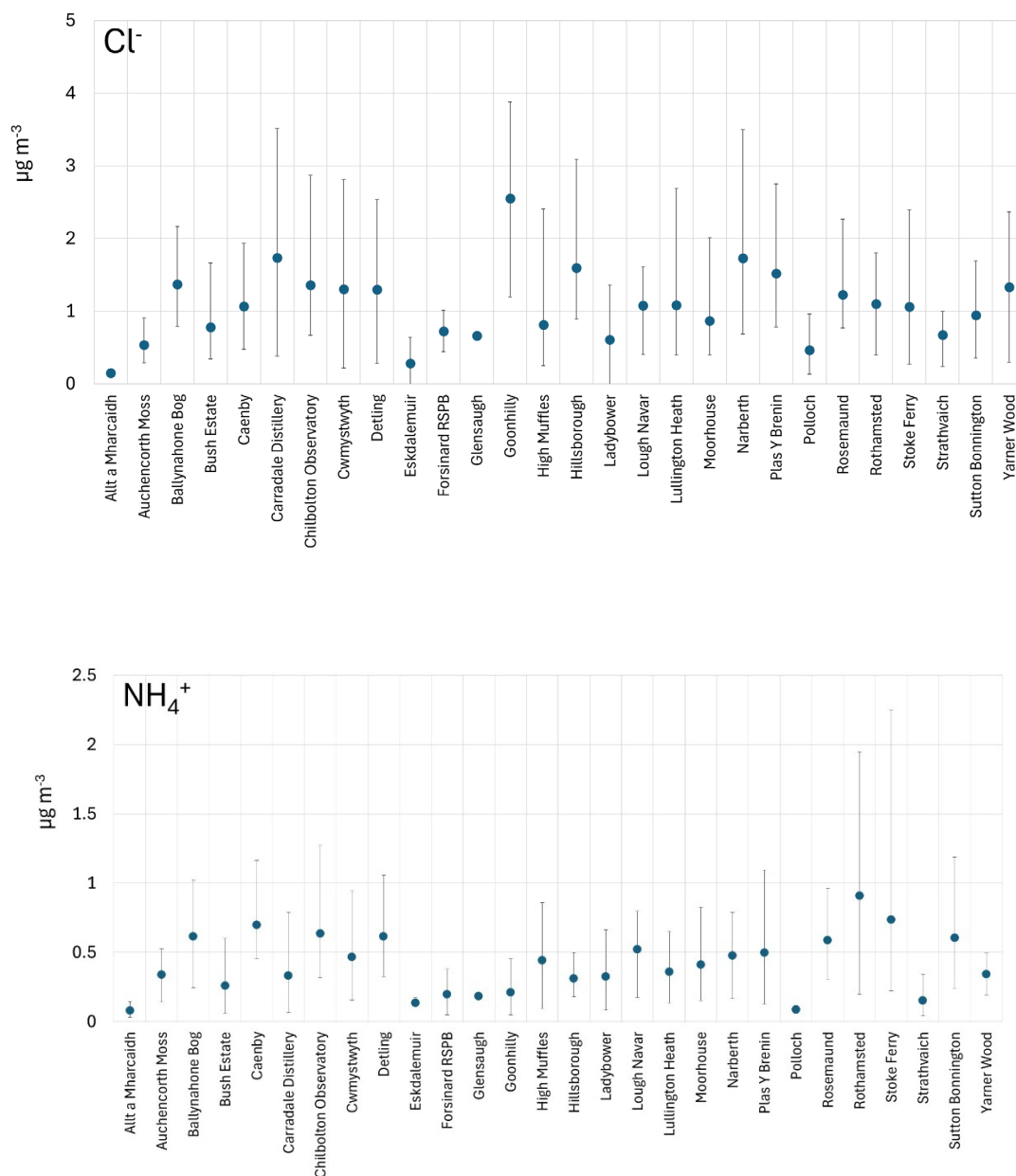
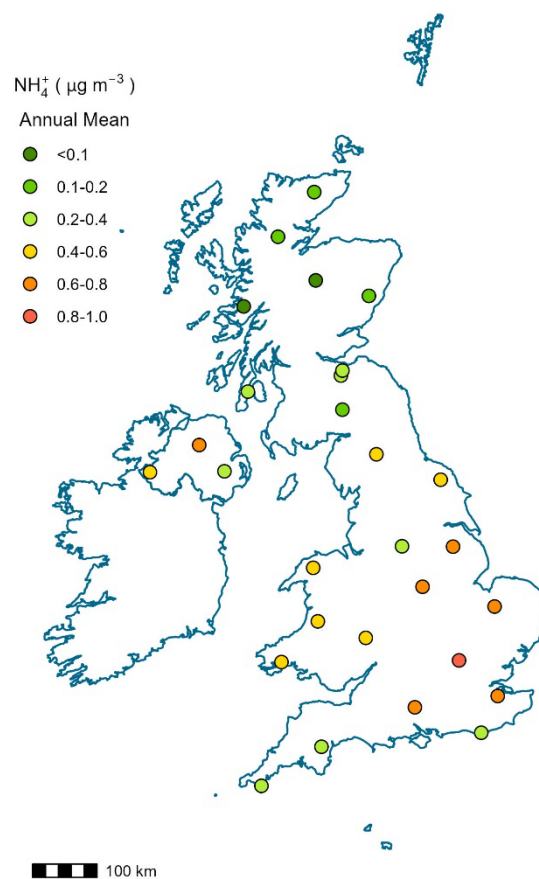


Figure 30 (continued). Mean monitored annual concentrations of particulate NO₃⁻, SO₄²⁻, Cl⁻ and NH₄⁺ at individual sites in AGANET. Each data point represents the averaged concentrations of monthly measurements made at each site in 2025, whilst the bars show the minimum and maximum concentrations observed.

NAMN 2025



AGANET 2025

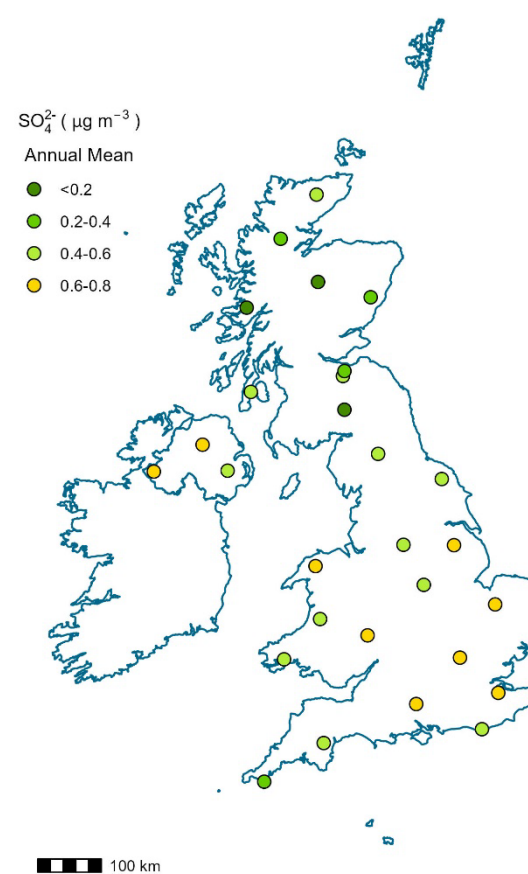
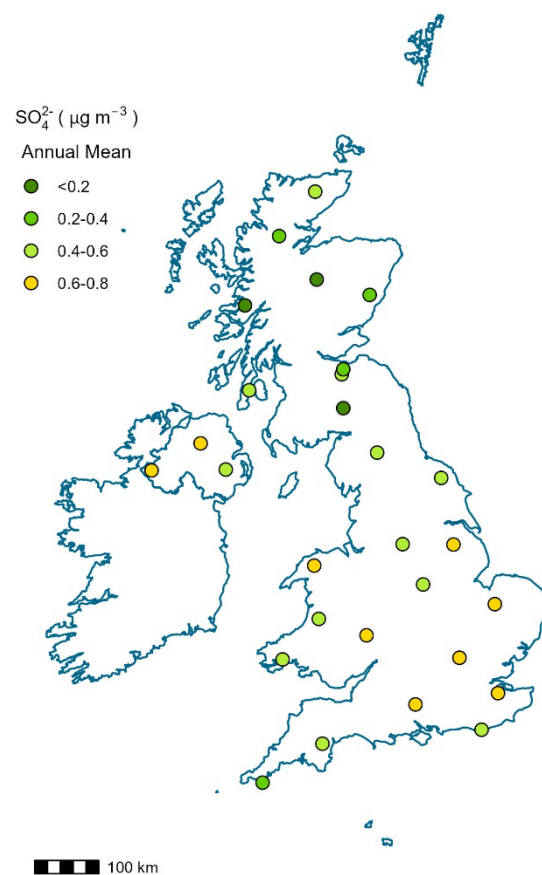


Figure 31 Spatial distribution of annual average concentrations of NH_4^+ and SO_4^{2-} during 2025.

AGANET 2025



AGANET 2025

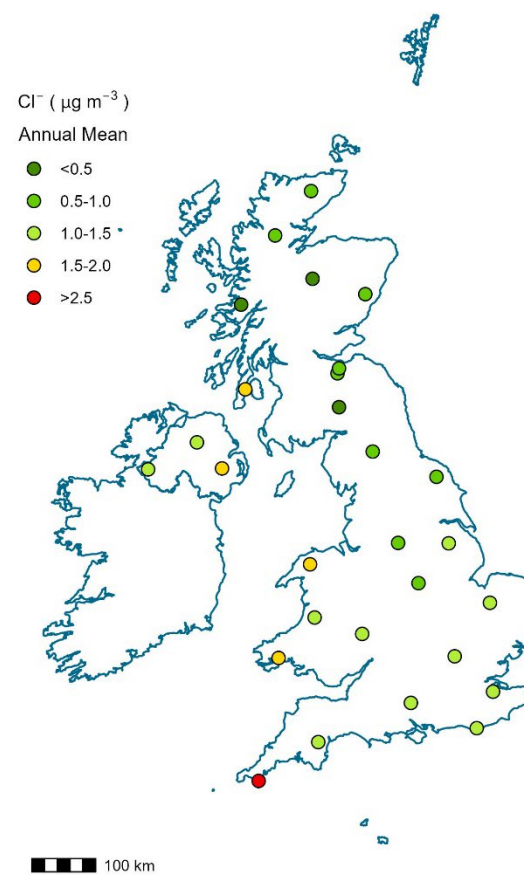


Figure 31 (continued) Spatial distribution of annual average concentrations of NO_3^- and Cl^- from AGANet during 2025.

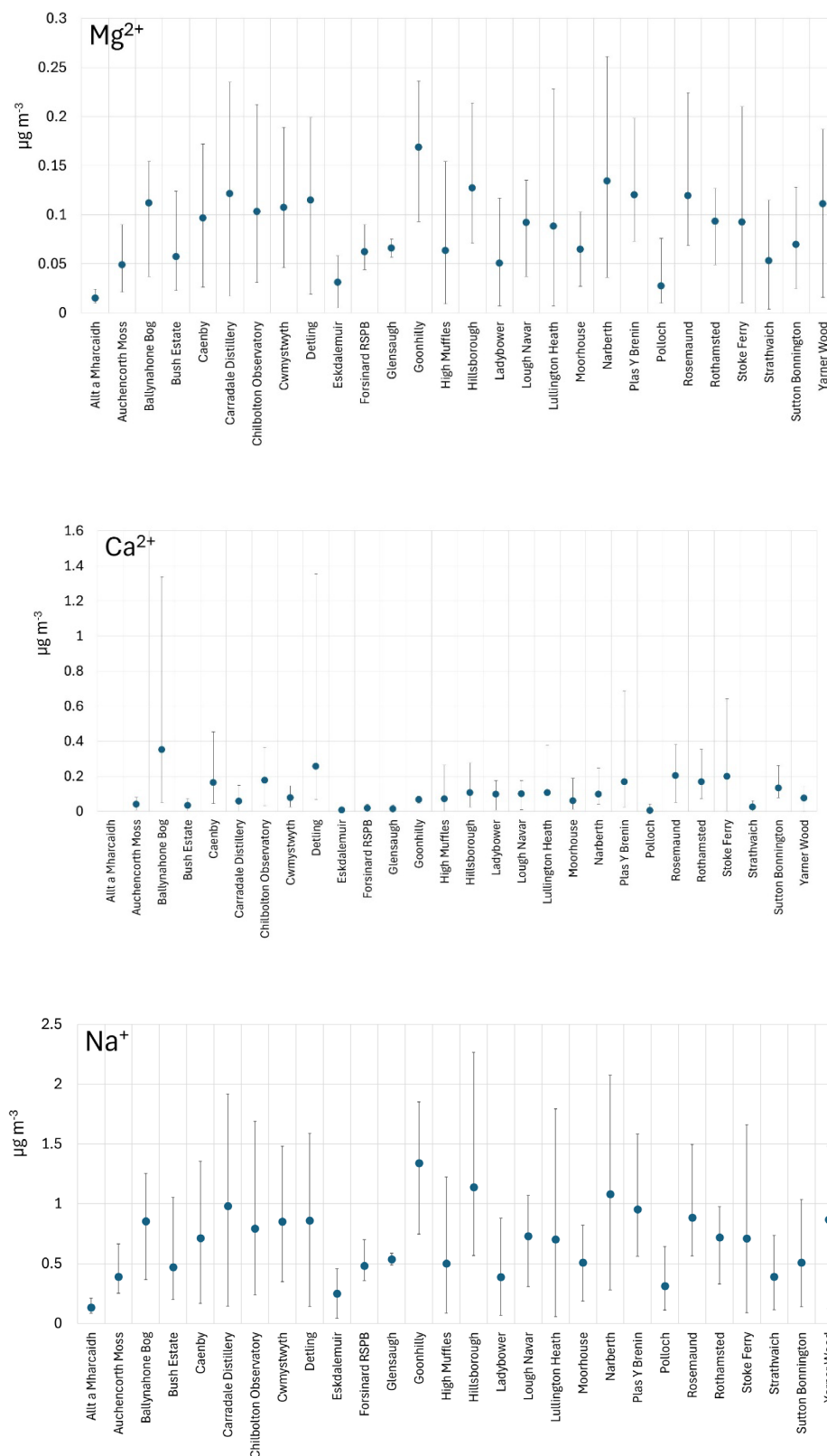
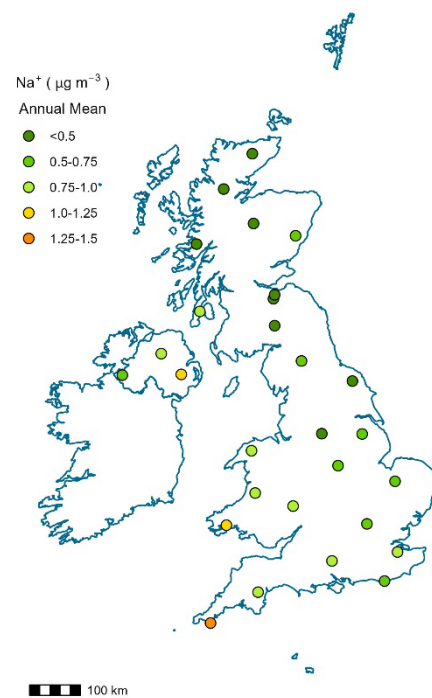
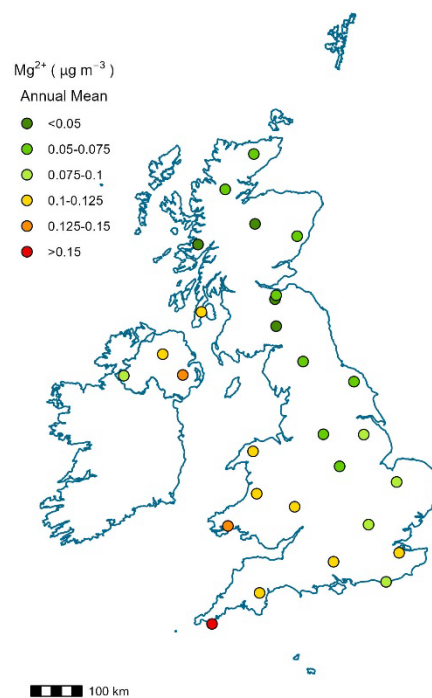


Figure 32 Annual average concentrations of particulate Mg^{2+} , Ca^{2+} and Na^{+} at individual sites in AGANET. Each data point represents the averaged concentrations of monthly measurements made at each site in 2025, whilst the bars show the minimum and maximum monthly concentration

AGANET 2025



AGANET 2025



AGANET 2025

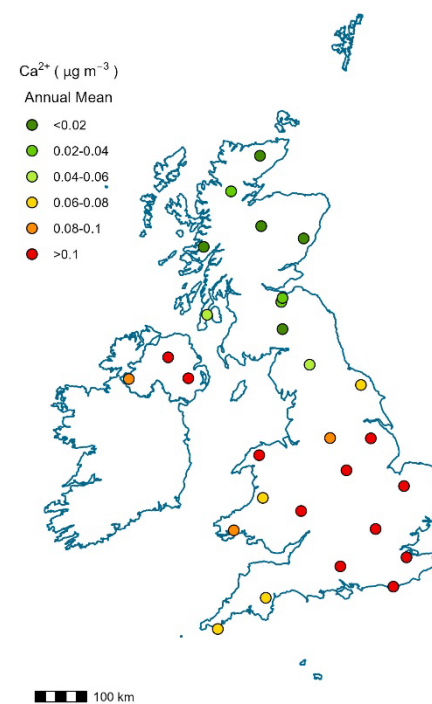


Figure 33 Spatial distribution of annual average concentrations of base cations (Na^+ , Mg^{2+} and Ca^{2+}) across the UK from the average monthly measurements made in 2025.

The long-term averages for AGANet are shown in Figures 34 to Figure 38. Caution however is advised in over interpretation of 2024 data due to the low data capture during that year.

Both HNO_3 and particulate NO_3^- annual 2025 concentration levels return to those observed in 2023 albeit slightly lower, seemingly following the pattern of longer-term trend of decreasing concentration (Figure 34). Particulate NO_3^- and Ca^{2+} has an observable step change in 2016 with an increase in concentration that is attributed to the method change, resulting in the increased capture of the aerosol components (refer to [UKEAP annual report 2016](#) for further details). Since this method change, an inter-annual variability is observed with concentrations relatively stable within $\pm 0.5 \mu\text{g m}^{-3}$ between 2016 and 2020 for all components. In 2021, there was a decrease in NO_3^- concentration, with a further slight decrease in 2024. It is noted that observed decrease in NO_3^- concentrations are concurrent with an observed decrease in HNO_3 , as well as NO_2 (Figure 20) and NO_3^- in precipitation (Figure 19).

In Figure 35, NH_3 annual average concentrations have been calculated as the annual average mean concentration for ALPHAs, DELTAs as well as diffusion tubes previously used in the network from the period 2000-2006. The NH_3 annual averages showed a decreasing trend following the peak observed in 2022 which coincided the addition of 25 sites in Northern Ireland to the network. However, concentrations in 2025 increased to levels comparable to those reported in 2022, complicating the interpretation of a clear long-term clear trend. In contrast, NH_4^+ concentrations remained relatively stable in 2025 and exhibited a similar temporal pattern similar to NO_3^- .

The SO_2 annual average concentration has remained stable around $0.2 \mu\text{g m}^{-3}$ since 2016 except for 2024, when a volcanic plume event in May increased the annual average back to 2014 levels. During 2025 there was volcanic plume reported over the UK but there is no evidence that this impacted the annual average concentrations of SO_2 (Figure 36). Particulate sulphate (SO_4^{2-}) follows a slight decreasing trend after the increase observed from the period 2020 to 2023.

Figure 39 compares the annual seasonal cycle (monthly averages) in 2025 compared to previous years for selected species in NAMN (only DELTAs) and AGANet:

- Ammonia (NH_3) in 2025 follows the temporal profile from 2000-2024 average, with high concentrations during March and April but with a second peak also August. The NH_3 concentrations tended to fall outside of the historic range (average $\pm$ standard deviation) for a number of months (January, February, June, July, and then from September onwards). Ammonium (NH_4^+) levels are comparable to historic data from 2000-2024 with a peak in concentration observed in spring, matching the peaks observed for NO_3^- and SO_4^{2-} . For NAMN Ammonia (NH_3) in 2024 follows a similar temporal profile to the 2000-2023 average, except for a small dip in April (DELTA only measurements). Lower mean monthly concentrations were reported for all months, lying outside the historic range (average $\pm$ standard deviation). Ammonium (NH_4^+) shows lower concentrations compared to historic data from 2000-2023, especially in the first four months of the year; after April concentrations return to the historic range. Peaks are observed during May and on a minor scale, September, matching the peaks observed for both NO_3^- and SO_4^{2-} .
- The monthly SO_2 concentrations in 2025 are within the minimum of the historic profile ($\approx 0.2 \mu\text{g m}^{-3}$), reflecting the lack of significant emission events within the network. The SO_4^{2-} monthly concentrations in 2025 are within the historical profile with a maximum during July. The increase in July is attributed to an aged volcanic plume crossing the UK that had undergone oxidation of SO_2 to SO_4^{2-} (Twigg et al., 2015⁹).
- Nitric acid (HNO_3) concentrations are low ($< 0.2 \mu\text{g m}^{-3}$) all year. Concentrations increased during spring and summer months, then dropped below $0.1 \mu\text{g HNO}_3 \text{ m}^{-3}$ from September onwards. Particulate NO_3^- concentrations are within the range for the 2000-2024 period. The temporal pattern shows higher concentrations in February, March and October months, coinciding with the spring and autumn agricultural high activity periods.

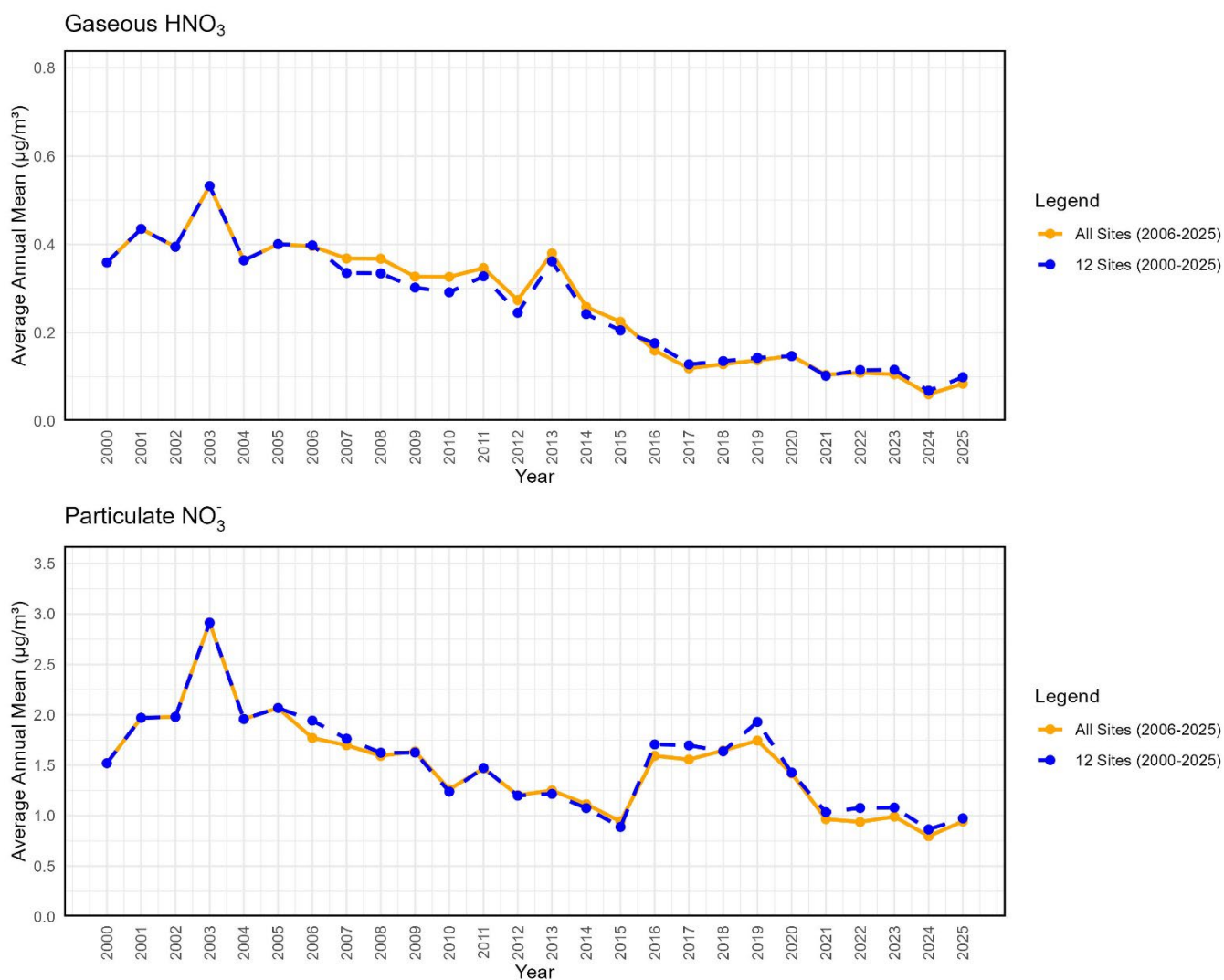


Figure 34 Long-term trend in annual mean concentrations of HNO_3 and NO_3^- monitored in AGANET. Each data point represents the time-weighted average annual mean from all sites (2006 – 2016 = 30 sites; from 2017 = 27 sites, from April 2022 = 28 sites) and also the original 12 DELTA monitoring sites in the network (12 sites until 2016, then 11 sites following closure of Barcombe Mills).

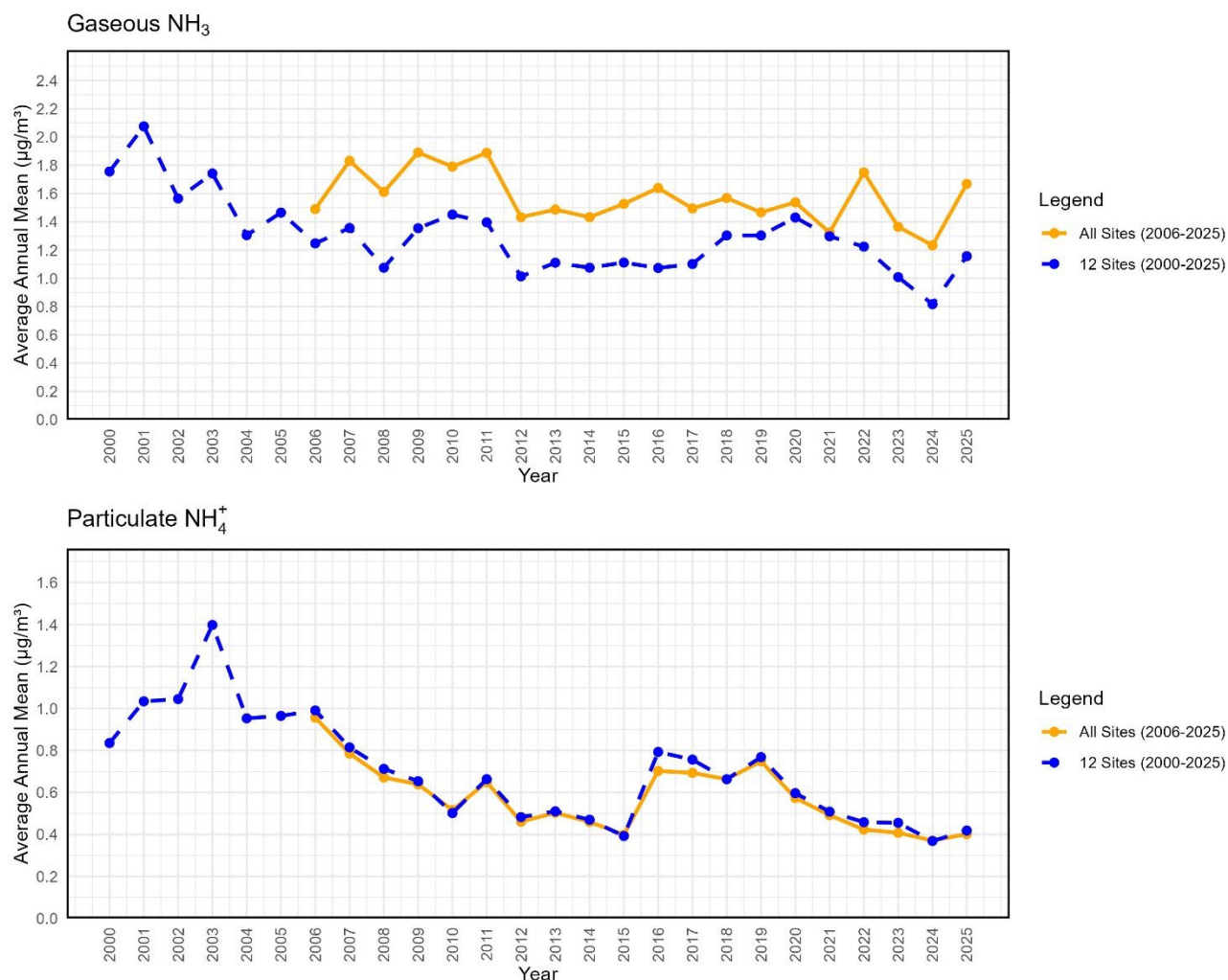


Figure 35 Long-term trend in annual mean concentrations of NH₃ (as the total annual average using network data from ALPHA and DELTA (from 2000 – 2025) as well as diffusion tubes (from 2000 to 2006) and NH₄⁺ monitored in the NAMN. Each data point represents the time-weighted average annual mean from all sites (2006 – 2016 = 30 sites; from 2017 = 27 sites, from April 2022 =28 sites) and also the original 12 DELTA monitoring sites in the network (12 sites until 2016, then 11 sites following closure of Barcombe Mills).

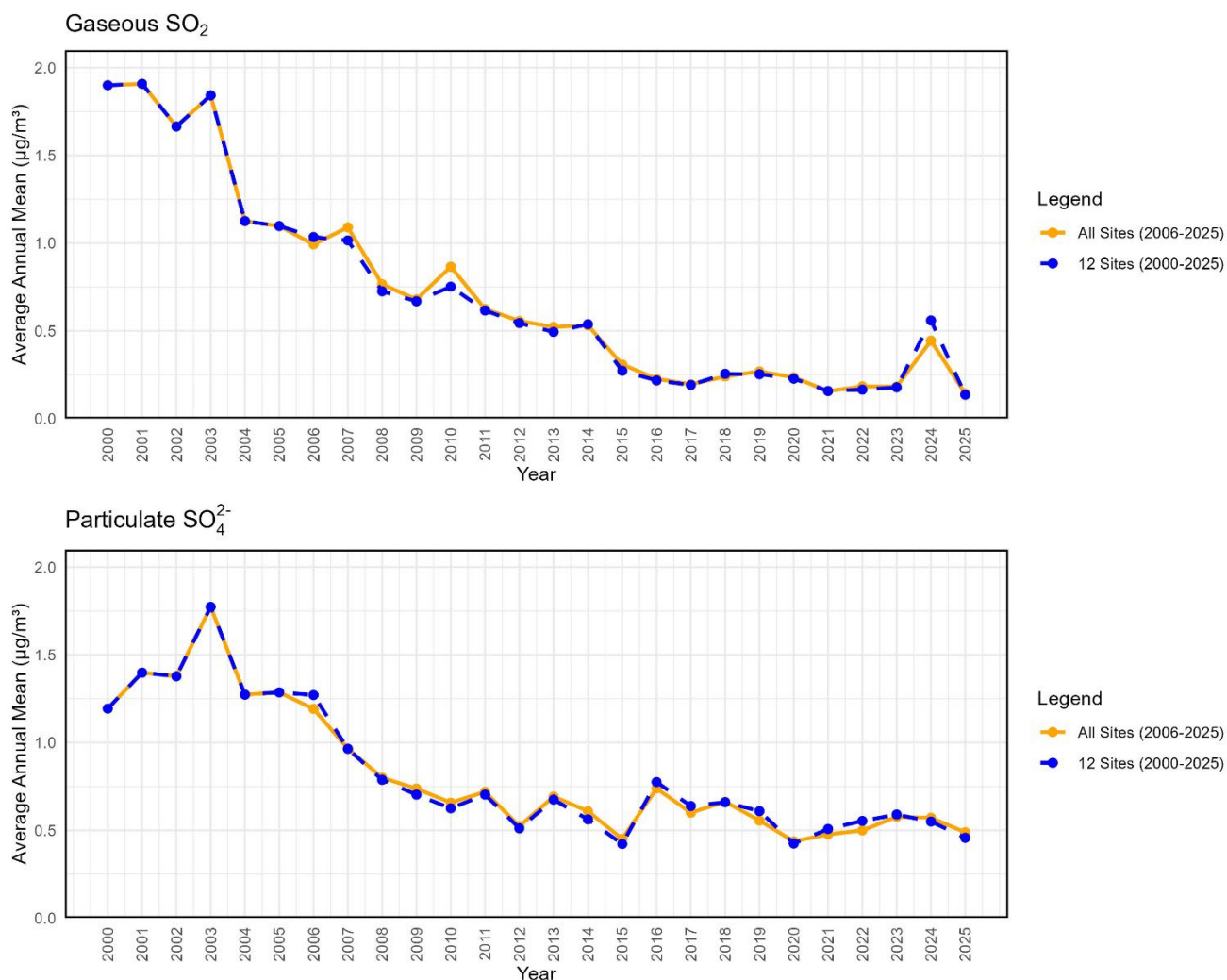


Figure 36 Long-term trend in annual mean concentrations of SO₂ and SO₄²⁻ monitored in AGANET. Each data point represents the time-weighted average annual mean from all sites (blue line; 2006 – 2016 = 30 sites; from 2017 = 27 sites, from April 2022 =28 sites) and also the original 12 DELTA monitoring sites in the network (12 sites until 2016, then 11 sites following closure of Barcombe Mills).

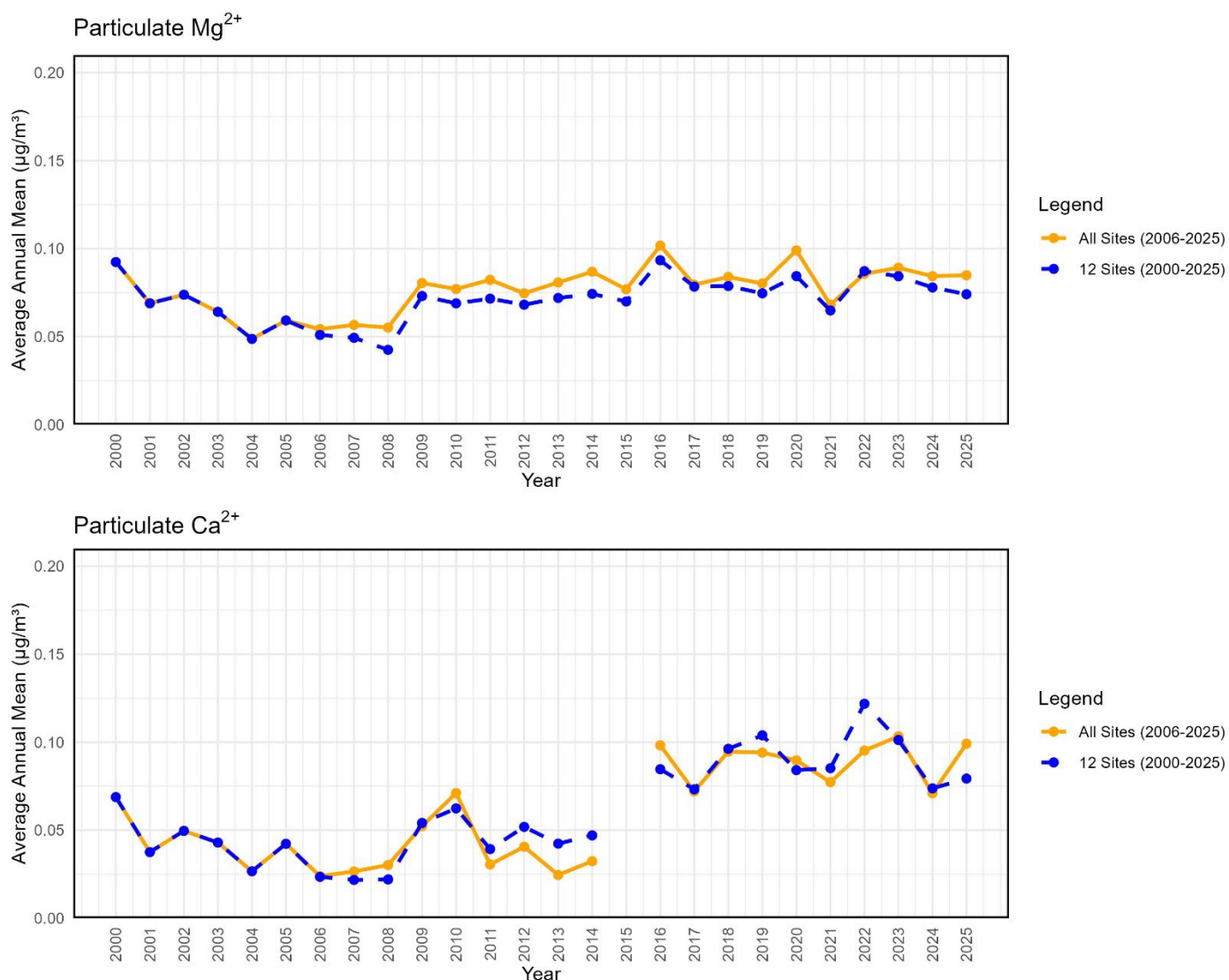


Figure 37 Long-term trend in annual mean concentrations of Ca²⁺ and Mg²⁺ monitored in AGANET. Each data point represents the time-weighted average annual mean from all sites (blue line; 2006 – 2016 = 30 sites; from 2017 = 27 sites, from April 2022 =28 sites) and also the original 12 DELTA monitoring sites in the network (12 sites until 2016, then 11 sites following closure of Barcombe Mills).

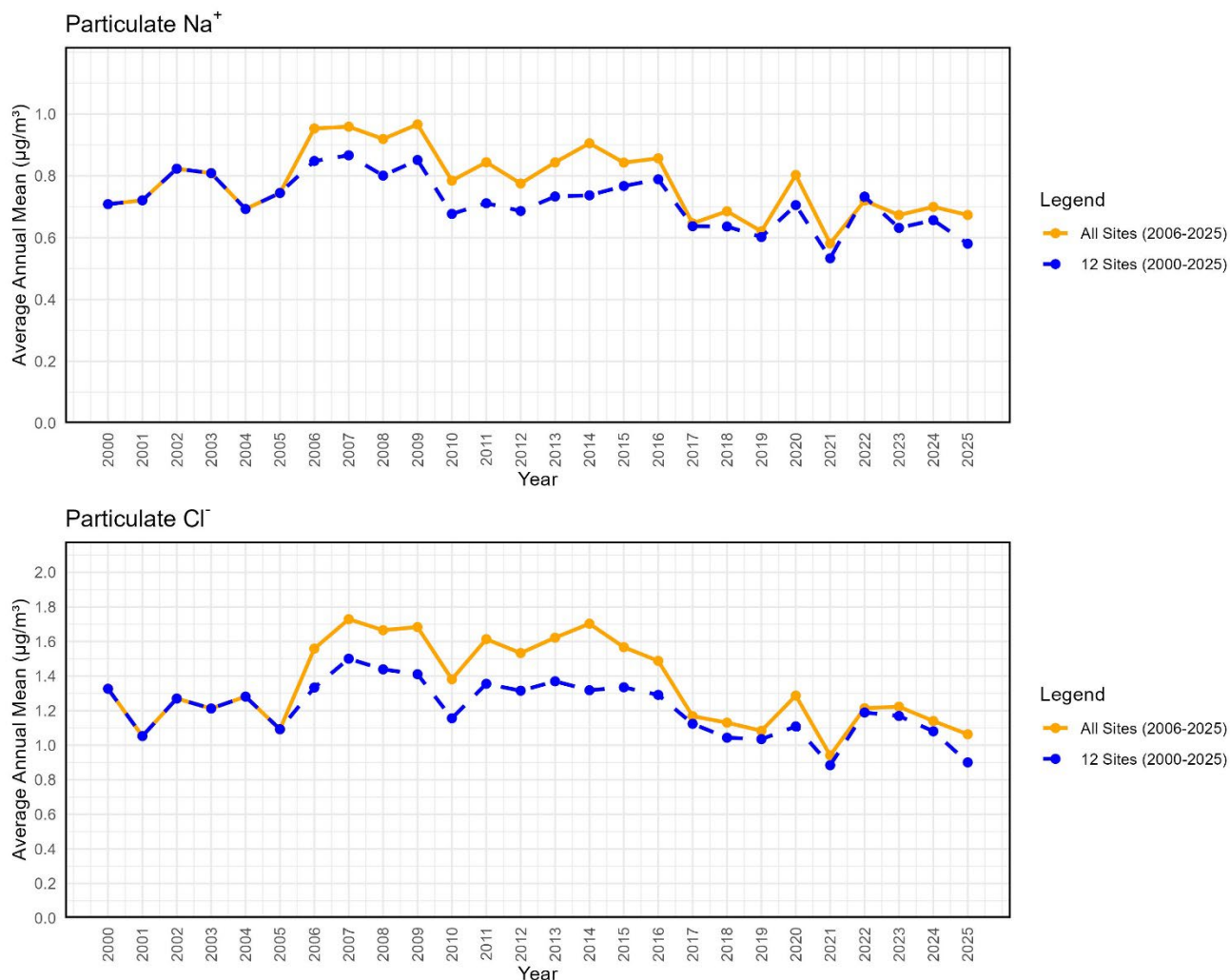


Figure 38 Long-term trend in annual mean concentrations of Na⁺ and Cl⁻ monitored in AGANET. Each data point represents the time-weighted average annual mean from all sites (blue line; 2006 – 2016 = 30 sites; from 2017 = 27 sites, from April 2022 =28 sites) and also the original the original 12 DELTA monitoring sites in the network (12 sites until 2016, then 11 sites following closure of Barcombe Mills).

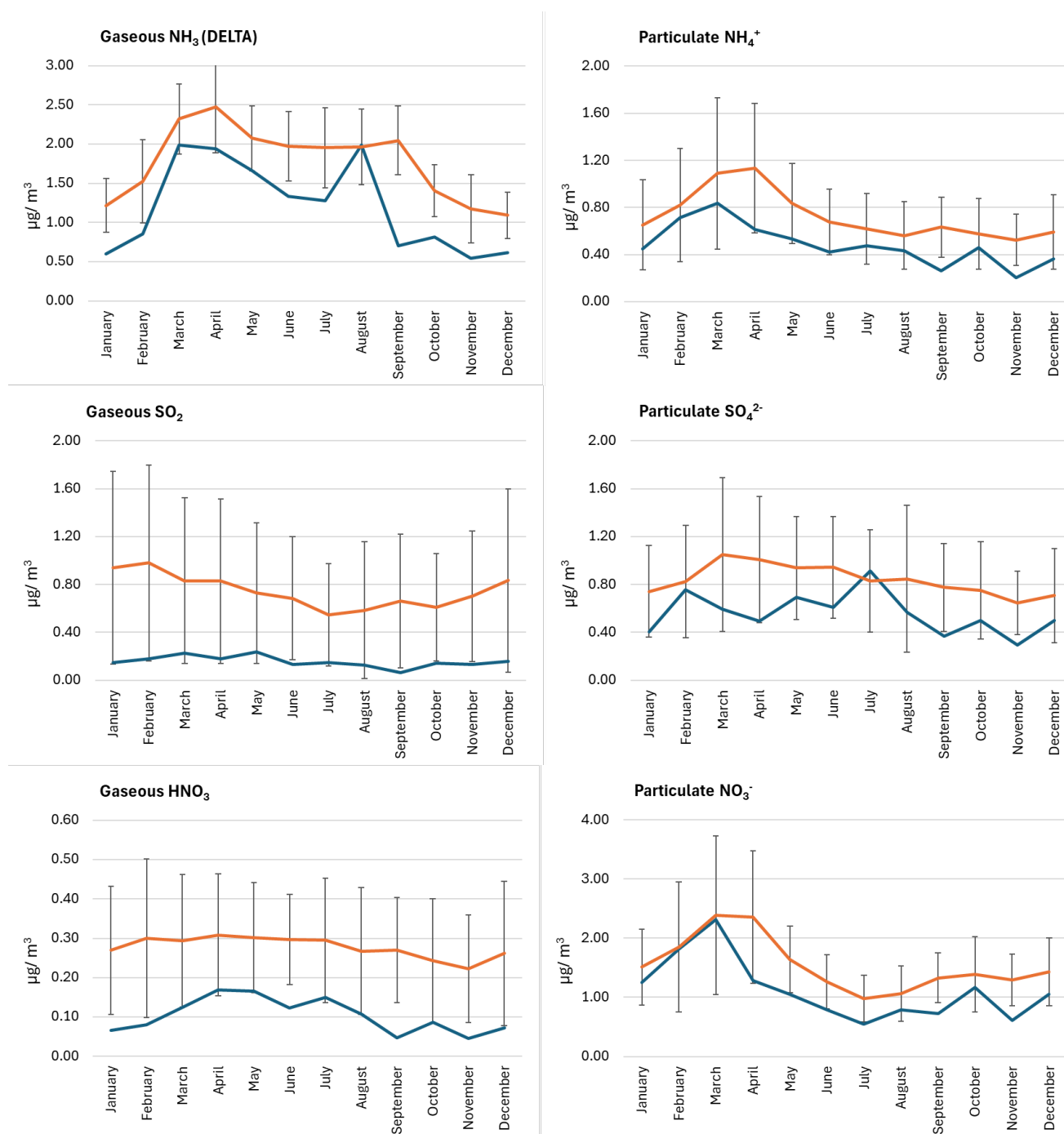


Figure 39 Monthly average profiles for the inorganic precursor gases and main secondary aerosol species from the NAMN and AGANet sites across the UK in 2025 (blue line), compared to the mean seasonal profile for year 2000-2024 (orange line). Error bars are +/- standard deviation across the AGANet sites for all available sites.

3.5 UK EMEP supersites

3.5.1 MARGA

During the year 2025, both sites met the minimum data capture of 14% required under the UK regulations for speciated $PM_{2.5}$ (refer to Table 9 for data capture). At Auchencorth Moss the 2025 data capture was lower at the end of December due to a failure of the motor to the SJAC supply. The system was down from the 22/12/2025 until 07/01/2026 until a replacement pump was sourced. At Chilbolton the 2025 data capture was affected by operational issues. From end of March to the 10th of April unstable anion pressure impacted data capture, but the problem was resolved by the in house MARGA operatives. From mid-June till mid-July the internal standard concentrations were out of acceptance. MARGA operatives check the concentration of internal standard with independent laboratory and calibrate MARGA detectors. This gives us confidence in data.

Figure 40 to Figure 45 present the time series of the PM_{10} (NH_4^+ , Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Cl^- , NO_3^- and SO_4^{2-}), $PM_{2.5}$ (NH_4^+ , Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Cl^- , NO_3^- and SO_4^{2-}) and trace gases (NH_3 , HCl , HNO_3 , $HONO$, SO_2) reported by the MARGA at Chilbolton Observatory and Auchencorth Moss for 2025. Annual average concentrations from the MARGA at Auchencorth Moss continued to report lower concentrations to that of Chilbolton Observatory (Table 9). Between the 22nd July to 25th July a large SO_4^{2-} plume was observed at both sites, which was attributed to a volcanic plume.

Table 9 Summary of the ratified speciated PM_{10} and $PM_{2.5}$ and trace gases of annual mean concentrations and data capture for Auchencorth Moss and Chilbolton Observatory.

	Chilbolton Observatory		Auchencorth Moss	
Ion (PM_{10})	Annual mean ($\mu g m^{-3}$)	Data capture (%)	Annual mean ($\mu g m^{-3}$)	Data capture (%)
NH_4^+	1.026	85.87	0.469	89.84
Na^+	0.720	89.06	0.501	90.13
K^+	0.088	87.42	0.043	88.43
Ca^{2+}	0.437	79.18	0.049	89.95
Mg^{2+}	0.214	87.97	0.063	90.19
Cl^-	1.394	71.70	0.820	83.58
NO_3^-	2.755	75.64	1.038	85.25
SO_4^{2-}	1.160	72.83	0.692	85.26
Ion ($PM_{2.5}$)	Annual mean ($\mu g m^{-3}$)	Data capture (%)	Annual mean ($\mu g m^{-3}$)	Data capture (%)
NH_4^+	0.957	86.26	0.433	89.96
Na^+	0.512	88.16	0.271	88.31
K^+	0.069	87.10	0.021	88.40
Ca^{2+}	0.259	80.24	0.018	89.90
Mg^{2+}	0.166	87.23	0.033	90.13
Cl^-	0.964	72.11	0.462	85.15
NO_3^-	2.455	75.91	0.855	85.19
SO_4^{2-}	1.087	72.68	0.606	85.19
Trace Gases	Annual mean ($\mu g m^{-3}$)	Data capture (%)	Annual mean ($\mu g m^{-3}$)	Data capture (%)
NH_3	3.752	77.42	1.572	90.54
HCl	0.099	56.32	0.084	86.08
HNO_3	0.146	96.98	0.067	86.05
$HONO$	0.310	71.38	0.065	86.08
SO_2	0.081	67.32	0.040	86.05

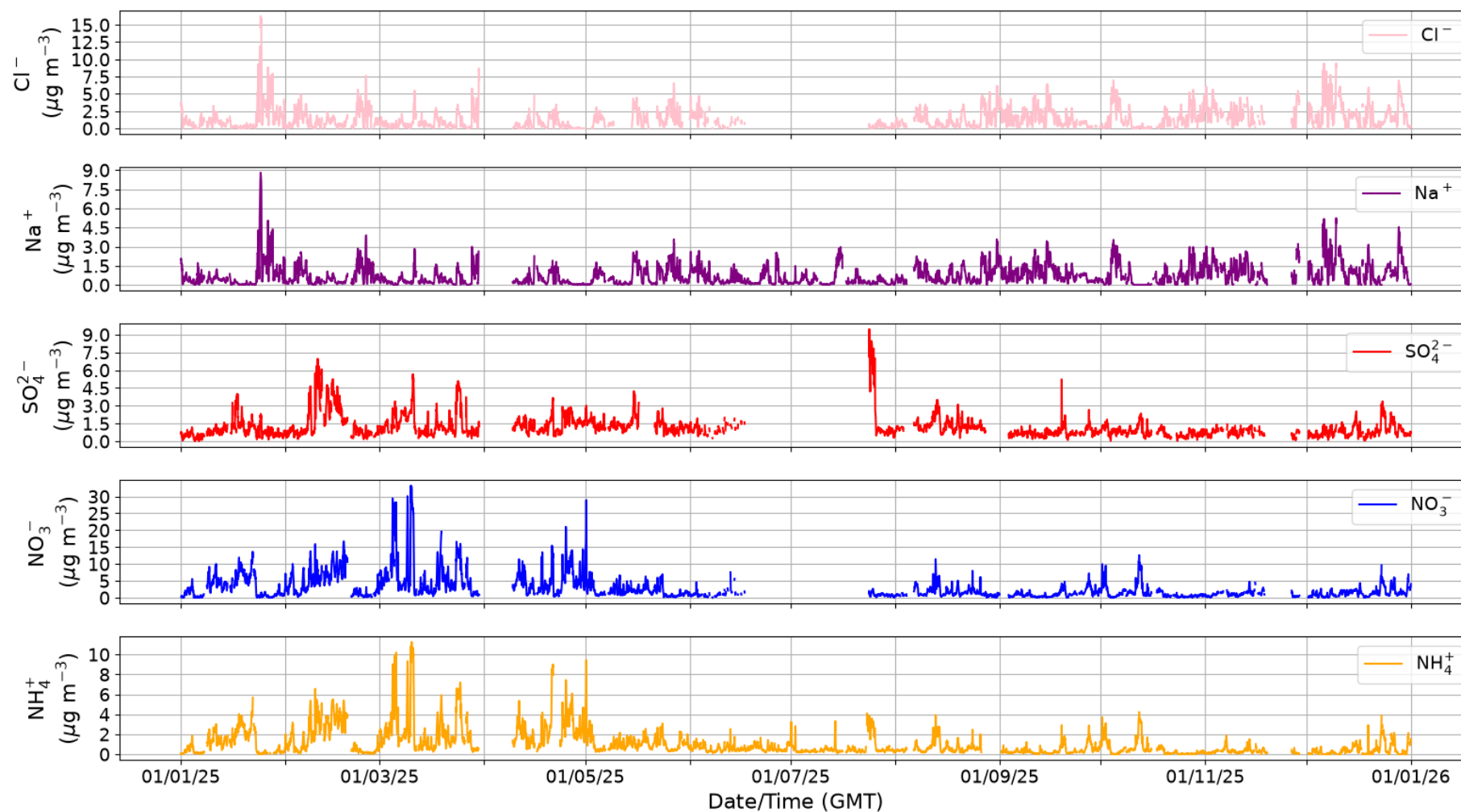


Figure 40 Ratified PM_{10} speciated measurements by the MARGA at the Chilbolton Observatory supersite for 2025

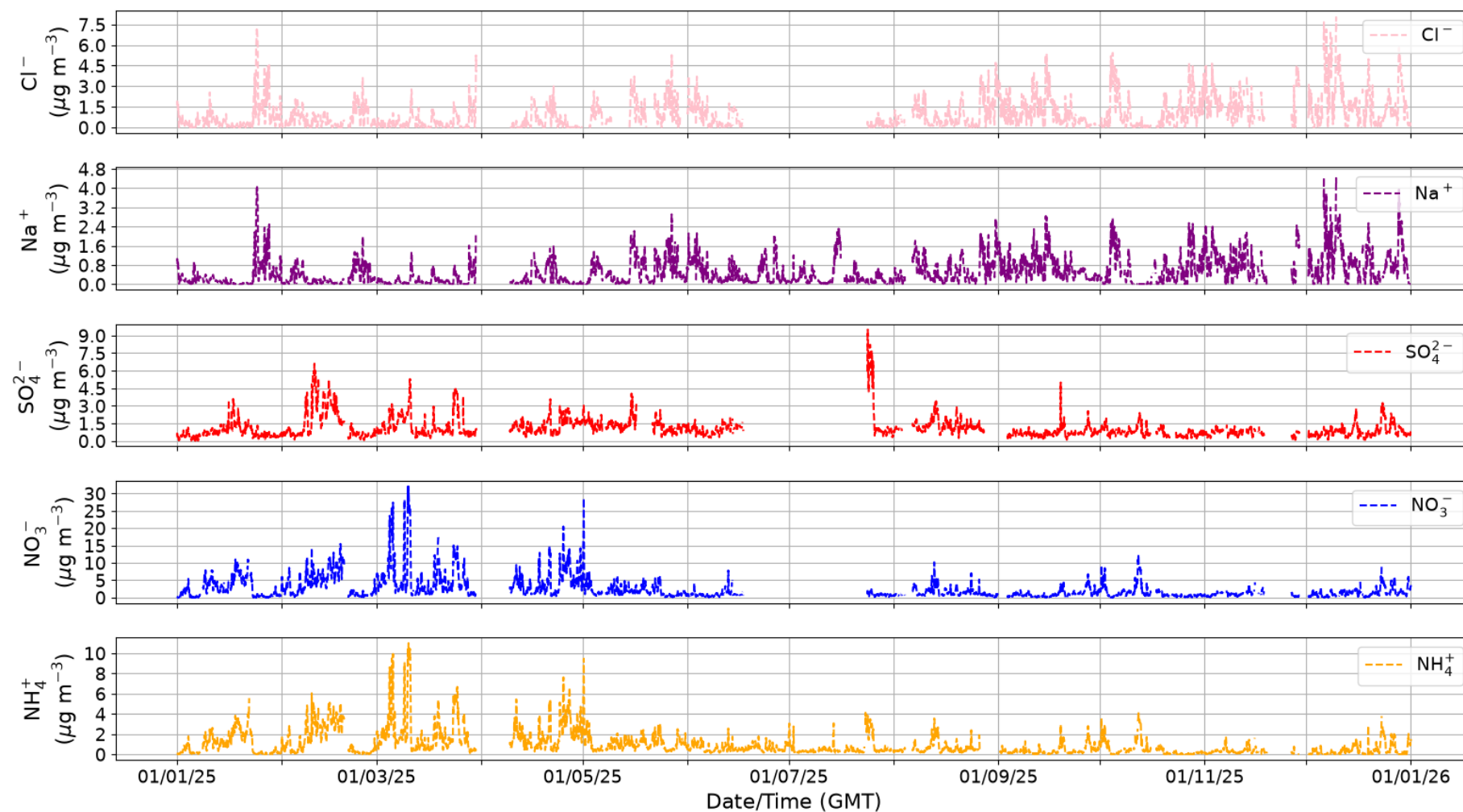


Figure 41 Ratified PM_{2.5} speciated measurements by the MARGA at the Chilbolton Observatory supersite for 2025

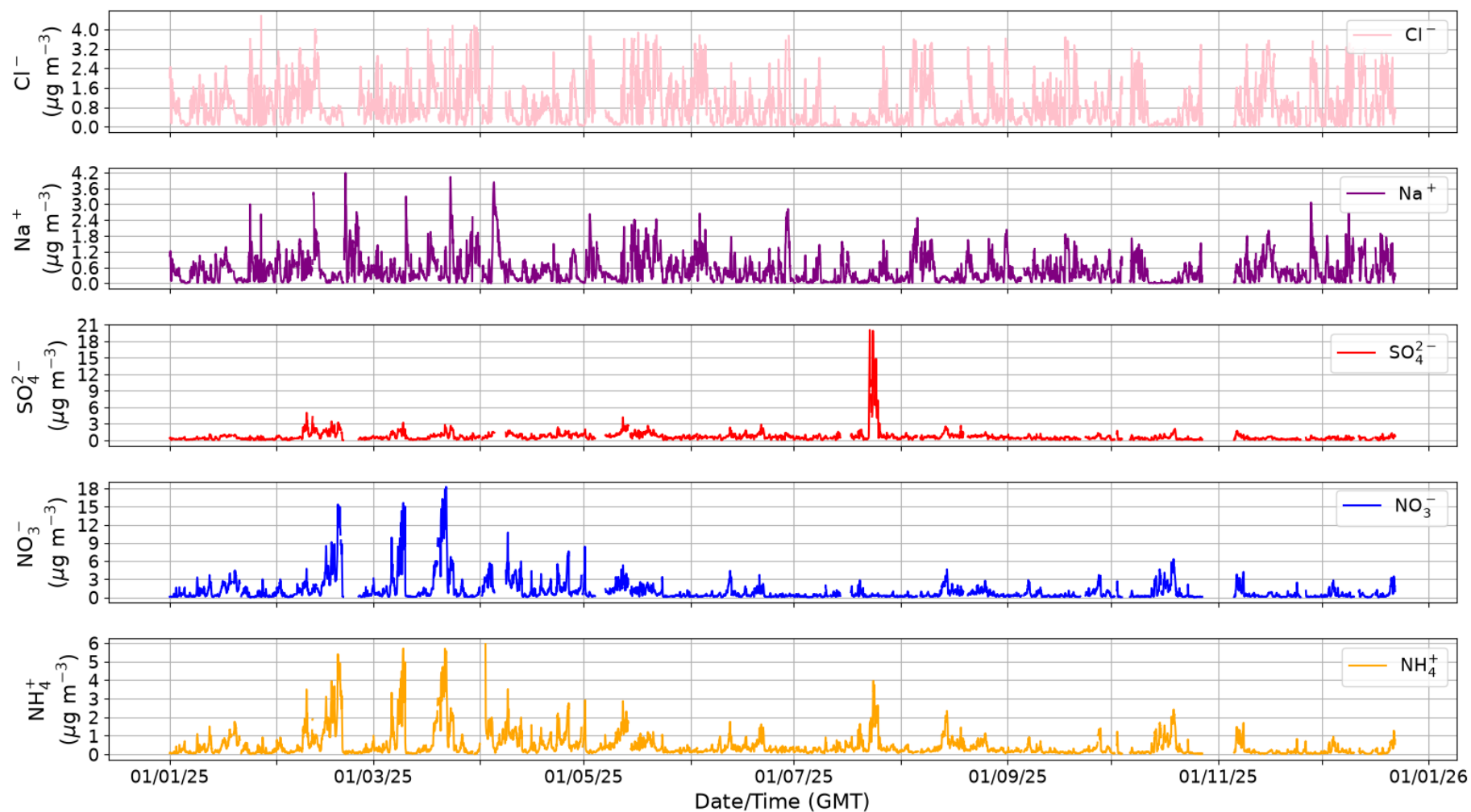


Figure 42 Ratified PM₁₀ speciated measurements by the MARGA at the Auchencorth Moss supersite for 2025

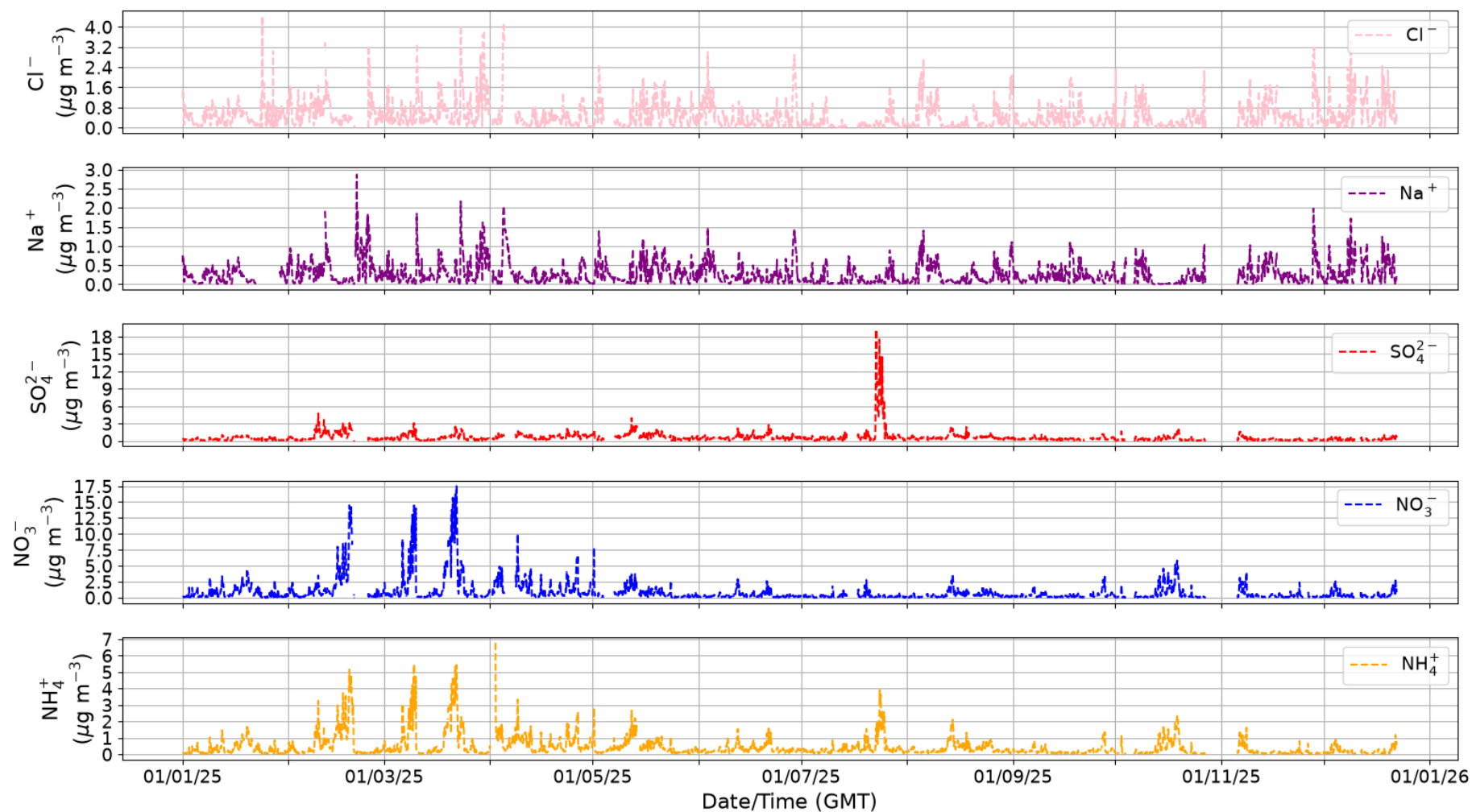


Figure 43 Ratified PM_{2.5} speciated measurements by the MARGA at the Auchencorth Moss supersite for 2025

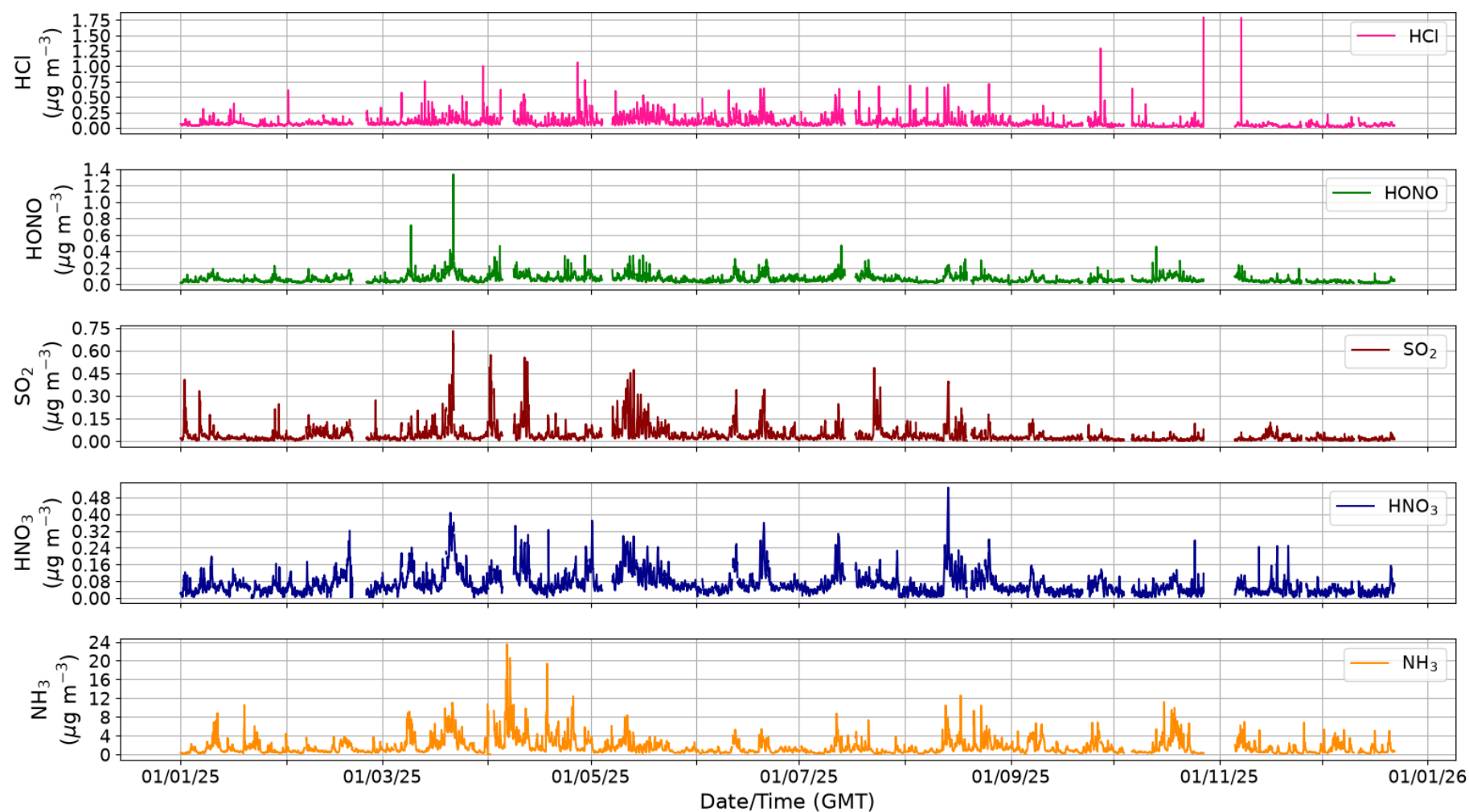


Figure 44 Ratified trace gas measurements by the MARGA at the Auchencorth Moss supersite for 2025.

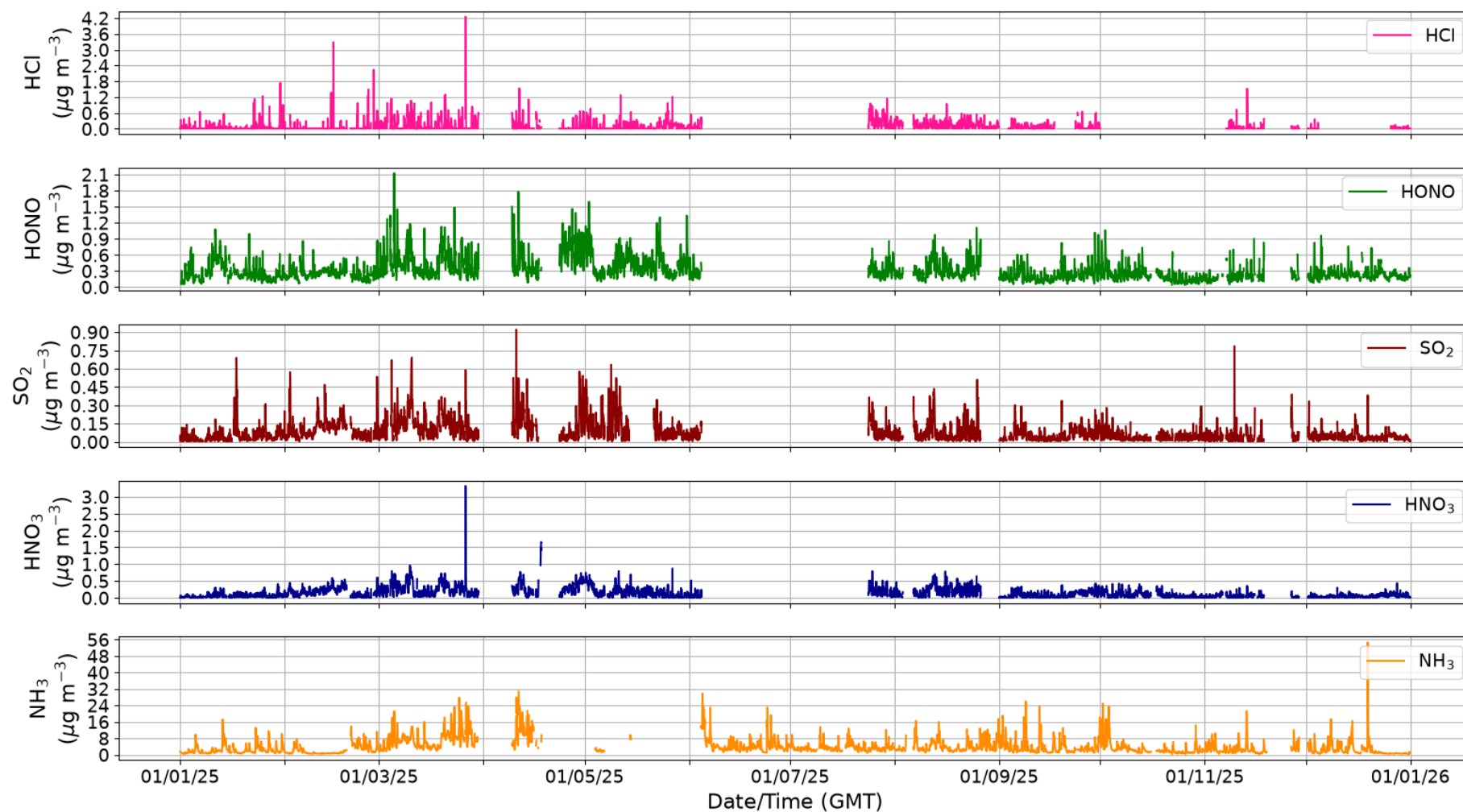


Figure 45. Ratified trace gas measurements by the MARGA at the Chilbolton Observatory supersite for 2025

3.5.2 Tekran

The annual means and data capture for the 2025 ratified mercury measurements are shown below in Table 10.

The time series of the Auchencorth Moss measurements are shown in Figure 46. The system had reduced data capture due to the following reasons:

- January – March 2025 contamination in speciated samples, resulting in non-zero blanks. Data was invalidated as result as part of QA/QC protocols.
- Mid July – Mid December 2025: failure of fan in Tekran 1135, which is the PBM measurement module. System was reconfigured during this period to report only GOM and GEM, whilst PBM was sent back to manufacturer for repair.
- Mid-October – Mid Dec 2025 – temperature controller failed in Tekran 1130 (GOM measurement module). Oven running too hot during sampling to capture GOM and resulted in contamination of sampling train. Data invalidated as part of QA/QC protocols.

The 2025 data from the Chilbolton Observatory site is shown in Figure 47. The gap from August to September was when the analyzer was removed from site for its annual service.

Table 10. Ratified mercury measurements at the Auchencorth Moss and Chilbolton Observatory field sites.

	Annual Mean	Data Capture (%)
Auchencorth Moss		
Gaseous Elemental Hg (GEM) ng m ⁻³	1.316	66.03
Gaseous Oxidised Hg (GOM) pg m ⁻³	0.613	44.25
Particulate bound Hg (PM _{2.5}) pg m ⁻³	2.465	21.44
Chilbolton Observatory		
Total Gaseous Hg (TGM) ng m ⁻³	1.486	93.21

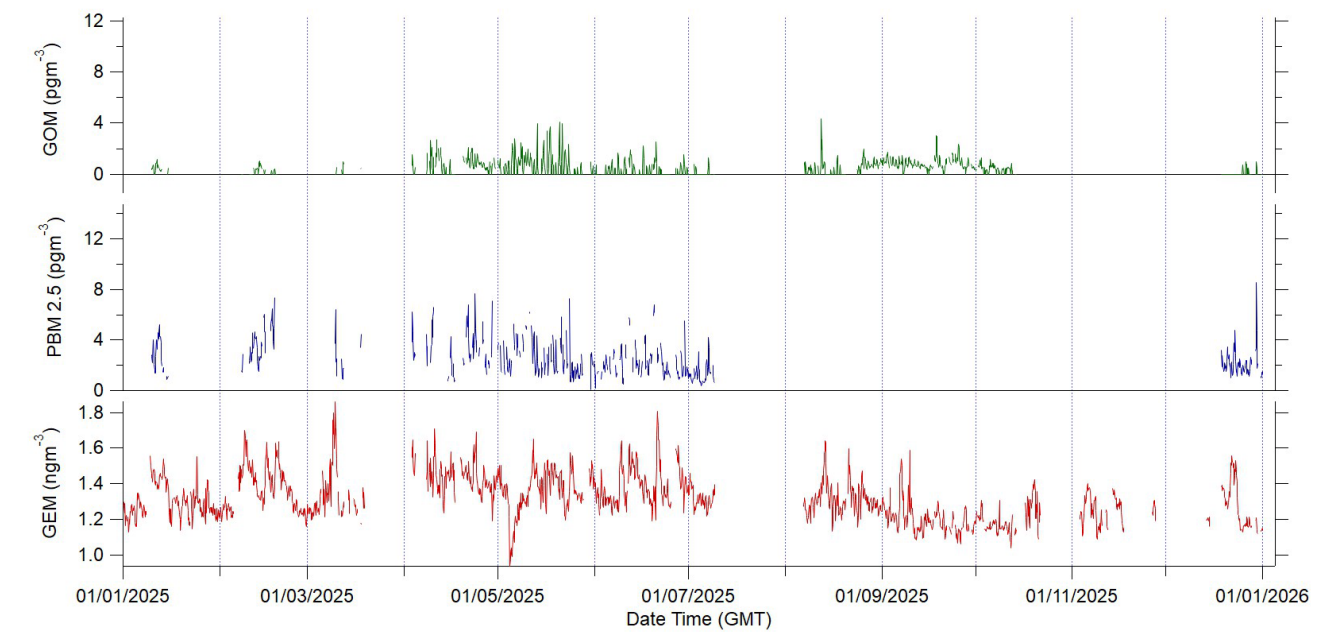


Figure 46 Ratified mercury measurements by the at the Auchencorth Moss supersite

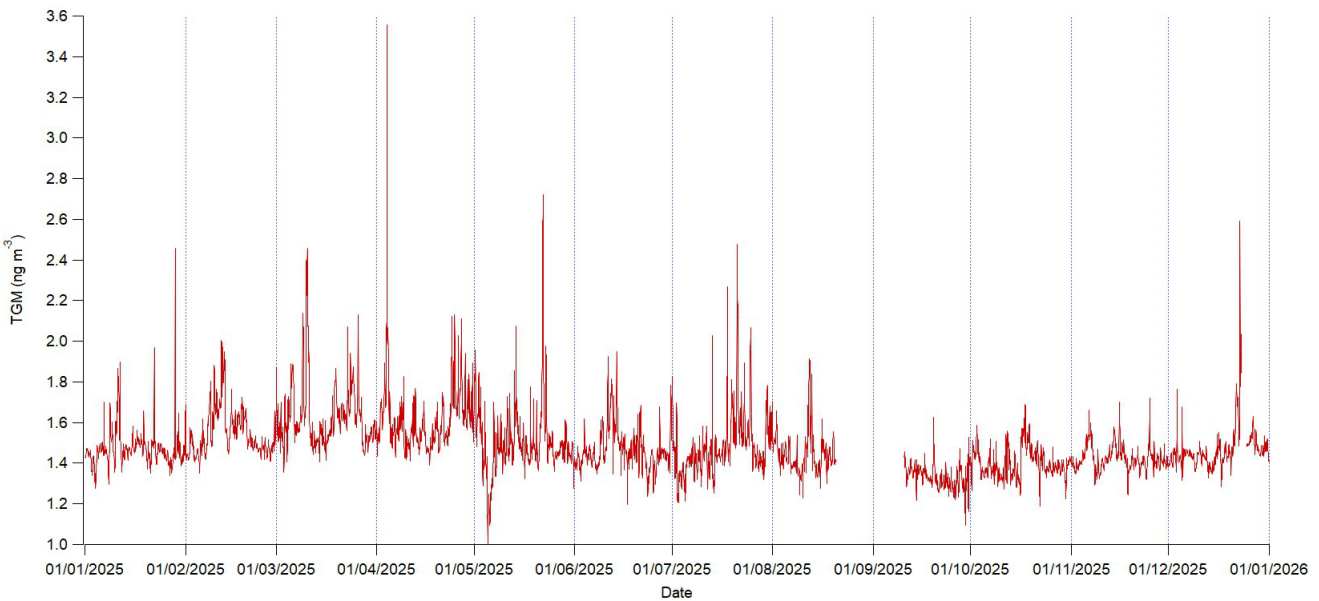


Figure 47 Ratified mercury measurements by the Tekran at the Chilbolton observatory

4. Publications and related activities

The UKEAP data is used to allow improvements in understanding of the chemical composition, deposition and removal processes of inorganic air pollutants and to allow validation of atmospheric transport models. It is however also used by a number of different organisations beyond the reporting required for Defra and the devolved administrations.

Below is a summary of the publications identified to have been published since 2025 that have used the UKEAP network data:

Aas, ., Salameh, T., Wegener, R., Hellén, H., Jaffrezo, J.-L., Roldin, P., Alonso-Blanco, E., Alastuey, A., Amelynck, C., Arduini, J., Bergmans, B., Bertrand, M., Borbon, A., Bourtsoukidis, E., Bouvier, L., Butterfield, D., Buxbaum, I., Ceburnis, D., Claude, A., Colomb, A., Darfeuil, S., Dernie, J., Desservettaz, M., Díaz-Ramiro, E., Dufresne, M., Dubus, R., Duval, M., Dury, M., Font, A., Fossum, K., Freney, E., Gangoiti, G., Ge, Y., Gomez, M. C., Gómez-Moreno, F. J., Gohy, M., Gros, V., Hamer, P., Hellack, B., Herrmann, H., Holla, R., Holubová, A., Jensen, N., Jokinen, T., Jones, M., Käfer, U., Kesper, L., Klemp, D., Kubistin, D., Marinoni, A., Mazzini, M., Thuy Dinh, V. N., Ovadnevaite, J., Petäjä, T., Portillo-Estrada, M., Přívězníková, J., Putaud, J.-P., Reimann, S., Renzi, L., Riffault, V., Ritchie, S., Robins, C., Rodríguez de Torres, B. A., Poulain, L., Rüdiger, J., Sanocka, A., Saez de Camara Oleaga, E., Schoon, N., Seco, R., Simmons, I., Simon, L., Simpson, D., Tison, E., Thomasson, A., Tsyro, S., Twigg, M., Tykkä, T., Verreyken, B., Yáñez-Serrano, A. M., Solberg, S., Yeung, K., Ylivinkka, I., Yttri, K. E., Watne, Å., and Williams, K.: Spatial variability of VOCs, ozone, and carbonaceous aerosols during the 2022 European summer heatwave, EGU sphere [preprint], <https://doi.org/10.5194/egusphere-2025-6166>, 2025

Beaudor, M., Hauglustaine, D., Lathière, J., Van Damme, M., Clarisse, L., and Vuichard, N.: Evaluating present-day and future impacts of agricultural ammonia emissions on atmospheric chemistry and climate, *Atmos. Chem. Phys.*, 25, 2017–2046, <https://doi.org/10.5194/acp-25-2017-2025>, 2025.

Evans, C.R., Hatton, D.A. and Swindles, G.T., 2025. Testate amoebae are informative bioindicators of critically high ammonia deposition on peatlands. *European Journal of Protistology*, 99, p.126147.

Hjellbrekke, A.G. and Hjellbrekke, A.G., 2025. Data Report 2023. Particulate matter, carbonaceous and inorganic compounds (EMEP/CCC-Report 1/2025). Kjeller: NILU. (https://emep-ccc.nilu.no/static/reports/EMEP_CCC-Report%201_2025%20Data%20Report%202023%20FINAL%2016-09-2025.pdf)

Kirby, K.J. Fisher, N. Hector, M. J. Leimu-Brown, N. Macdonald, D.W. Malhi, Y. Sheldon, B.C. Watkinson, S.C. 2025 Wytham Woods: How a landscape works, Oxford University Press.

Tan, D.Y., Heal, M.R., Stevenson, D.S., Reis, S., Vieno, M. and Nemitz, E., 2026. Long-range impacts of biomass burning on PM_{2.5}: a case study of the UK with a globally nested model. *Atmospheric Chemistry and Physics*, 26(6), pp.3973-3993.

Written Evidence (AIR0105) on Ammonia Reduction and Agricultural Mitigation Technologies (2026). Published: March 2026 by UK Parliament Committees and Natural England.

5. Legislation and standardisation

There were to the authors' knowledge no changes to legislation or standardisation to UKEAP network in 2025.

6. Where to find out more

All datasets are submitted to UK-AIR. To access the data, use the UK-AIR tool found at: <https://uk-air.defra.gov.uk/data/>. Provisional data is available on a quarterly basis and ratified data is made available on an annual basis.

Information on the sites within the UKEAP network can be found using the interactive map on UK-AIR here: <https://uk-air.defra.gov.uk/interactive-map>

Data are also submitted to the [OSPAR](#) and [EMEP](#) databases. UKEAP Team members at WSP and UKCEH are available to give information on the measurements when requested (please refer to Appendix 1).

7. Acknowledgements

The measurements in the UKEAP network would not be possible without the dedicated support of Local Site Operators across the UK throughout the year.

8. References

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3. Tang, Y. S., Cape, J. N. & Sutton, M. A. Development and types of passive samplers for monitoring atmospheric NO₂ and NH₃ concentrations. *ScientificWorldJournal* 1, 513–529 (2001).
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6. Twigg, M. M. et al. soluble aerosols and gases at a UK background site – Part 1: Controls of PM_{2.5} and PM₁₀ aerosol composition. *Atmos. Chem. Phys.* 15, 8131–8145 (2015).
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8. Kentisbeer, J. et al. Patterns and source analysis for atmospheric mercury at Auchencorth Moss, Scotland. *Environ. Sci. Process. Impacts* 16, 1112–1123 (2014).

9.

Twigg, M.M., Ilyinskaya, E., Beccaceci, S., Green, D.C., Jones, M.R., Langford, B., Leeson, S.R., Lingard, J.J., Pereira, G.M., Carter, H. and Poskitt, J., 2016. Impacts of the 2014–2015 Holuhraun eruption on the UK atmosphere. *Atmospheric Chemistry and Physics*, 16(17), pp.11415–11431.

Appendix 1: Guide to UKEAP data and Data usage

Please contact UK Centre for Ecology and Hydrology or WSP for guidance or discussion regarding authorship of multi-year datasets.

Chilbolton Observatory EMEP Supersite

Trace gas and aerosols (MARGA) Contact: Mr Chris Conolly, WSP

Sanocka, A., Ritchie, S., Conolly, C. UK Eutrophying and Acidifying Atmospheric Pollutant Project's Monitoring instrument for AeRosols and reactive Gases (MARGA), Harwell Supersite (Data funded by Defra and the Devolved Administrations and published under the Open Government Licence v3.0, UK EMEP Supersite, <http://uk-air.defra.gov.uk/networks/network-?view=uheap>, Data downloaded/received (Data user insert date of data receipt)

Mercury measurements: Contact: Ms Sarah Leeson, UK Centre for Ecology and Hydrology

Leeson, S.R., Ritchie, S. UK Eutrophying and Acidifying Atmospheric Pollutant project's mercury instrument, Auchencorth Supersite (Data funded by Defra and the Devolved Administrations and published under the Open Government Licence v3.0, UK EMEP Supersite, <http://uk-air.defra.gov.uk/networks/network-?view=uheap>, Data downloaded/received (Data user insert date of data receipt)

Meteorological Data: Contact Mr Chris Conolly WSP

Auchencorth Moss EMEP Supersite

MARGA: Contact: Dr Marsailidh Twigg, UK Centre for Ecology and Hydrology

Twigg, M.M., Leeson, S.R., Simmons, I., Harvey, D., Yeung, K. Jones, M.R., A. Iwanicka, Duarte, F., UK Eutrophying and Acidifying Atmospheric Pollutant project's Monitoring instrument for AeRosols and reactive Gases (MARGA), Auchencorth Supersite (Data funded by Defra and the Devolved Administrations and published under the Open Government Licence v3.0, UK EMEP Supersite, <http://uk-air.defra.gov.uk/networks/network-?view=uheap>, Data downloaded/received (Data user insert date of data receipt)

Mercury: Contact: Ms Sarah Leeson, UK Centre for Ecology and Hydrology

Leeson, S.R. J., Harvey, D. Yeung, K. UK Eutrophying and Acidifying Atmospheric Pollutant project's Tekran instrument, Auchencorth Supersite (Data funded by Defra and the Devolved Administrations and published under the Open Government Licence v3.0, UK EMEP

Supersite, <http://uk-air.defra.gov.uk/networks/network-?view=uheap>, Data downloaded/received (Data user insert date of data receipt)

Acid Gas and Aerosol Network (AGANet)

Contact: Dr Marsailidh Twigg, Dr Angelica Orsi and Dr Pablo Espina Martin, UK Centre for Ecology and Hydrology

ACM Stephens, A. Orsi, P. Espina Martin, A. Iwanicka, F. Duarte, D. Leaver, C. Andrews, CF Braban, S. Thacker, PO Keenan, M.G. Pereira, H. Guyatt, A. Hunt, E. Salisbury, N. Chetiu, F. Cook, A. Warwick, D. Rylett, S. Teagle, W. Lord, G. Bannister & MM Twigg. UK Eutrophying and Acidifying Atmospheric Pollutants. (Data funded by Defra and the Devolved Administrations and published under the Open Government Licence v3.0, UK AGANet, <http://uk-air.defra.gov.uk/networks/network-?view=uheap>, Data downloaded/received (Data user insert date of data receipt)

National Ammonia Monitoring Network (NAMN)

Contact: Dr Marsailidh Twigg, Dr Angelica Orsi and Dr Pablo Espina Martin, UK Centre for Ecology and Hydrology

ACM Stephens, A. Orsi, P. Espina Martin, A. Iwanicka, F. Duarte, D. Leaver, C. Andrews, CF Braban, S. Thacker, PO Keenan, M.G. Pereira, H. Guyatt, A. Hunt, E. Salisbury, N. Chetiu, F. Cook, A. Warwick, D. Rylett, S. Teagle, W. Lord, G. Bannister & MM Twigg. UK Eutrophying and Acidifying Atmospheric Pollutants. (Data funded by Defra and the Devolved Administrations and published under the Open Government Licence v3.0, UK AGANet, <http://uk-air.defra.gov.uk/networks/network-?view=uheap>, Data downloaded/received (Data user insert date of data receipt)

Precipitation Network (Precip-Net)

Contact: Mr Christopher Conolly and Dr Keith Vincent, WSP

Conolly, C., Collings, A., Knight, D., Vincent, K., Donovan, B., UK Eutrophying and Acidifying Atmospheric Pollutant Project's Precipitation Network (Data funded by Defra and the Devolved Administrations and published under the Open Government Licence v3.0, Precip-Net, <http://uk-air.defra.gov.uk/networks/network-info?view=uheap>, Date received: *(insert date of data receipt)*)

NO₂-Network

Contact: Mr Christopher Conolly and Dr Keith Vincent, WSP

Conolly, C., Collings, A., Knight, D., Vincent, K., Donovan, B., UK Eutrophying and Acidifying Atmospheric Pollutant project's rural NO₂-Network (Data funded by Defra and the Devolved Administrations and published under the Open Government Licence v3.0, NO₂-Net, <http://uk-air.defra.gov.uk/networks/network-info?view=uheap>, Date received: *(insert date of data receipt)*)

Appendix 2: Precip-Net: EMEP Intercomparison

EMEP and WMO Inter-comparisons

An important data quality assessment is organised annually by the EMEP Chemical Co-ordinating Centre (CCC) at the Norwegian Institute for Air Research (NILU). Each year, samples are sent to nearly fifty analytical laboratories in Europe, and to other internationally recognised analytical laboratories. The intercomparison exercise is required as part of the EMEP monitoring programme – such a fundamental check on analytical performance is essential if response to emission reductions can be observed consistently throughout Europe.

Until September 2025 the University of Illinois had coordinated the Laboratory Intercomparison Study coordination role for the World Meteorological Organization's Quality Assurance/Science Activity Centre-Americas (QA/SAC-Americas). Unfortunately, due to US funding cuts this activity has stopped, so there was no participation in the intercomparison this year.

The analytical laboratory used within the Precipitation Network (Precip-net) is Socotec's Advanced Chemistry and Research laboratory. Historically analytical methods used to measure the concentrations of anions and cations, pH and conductivity in the rainwater samples from Precip-net were UKAS ISO/IEC 17025:2017 accredited. The current accreditation covers ammonium, sodium, chloride, fluoride and nitrate. Details of the analytical laboratory's current accreditation can be found at <https://www.ukas.com/download-schedule/1252/Testing/>. The analytical laboratory is currently in the process of updating methods for calcium, magnesium, potassium and sulphate. Methods for pH and conductivity have been prepared for UKAS approval.

Results of the 43rd EMEP Inter-comparison

The inter-comparison in 2025 was the 43rd time such an inter-comparison took place.

Synthetic Rainwater Samples

The results of the intercomparison for the synthetic rainwater samples are shown in Appendix 2 Table 1.

Satisfactory results were obtained for all four samples for nitrate, sulphate, sodium, chloride, calcium, pH and conductivity. However, three of the four ammonium measurements, two magnesium and one potassium were considered questionable, one ammonium measurement and two potassium were considered unsatisfactory.

These results were considered inconsistent with on-going method development work undertaken by Socotec which aimed to improve analytical performance. As part of the method development the samples were also analysed. This additional analysis resulted in all measurements passing as satisfactory, except for two samples for potassium which remained unsatisfactory. It was suspected that there was contamination in the initial sample. NILU were asked to provide replacement samples, and all results were within the satisfactory norm values using the new method.

Appendix 2 Table 1. 43rd EMEP Intercomparison.

Species	Sample code	Reported value concentration mg l ⁻¹	Expected concentration mg l ⁻¹	Difference (%)	EMEP Quality Norm
SO ₄ ²⁻	G1	0.291	0.32	9	S
	G2	0.305	0.337	9	S
	G3	0.313	0.343	9	S
	G4	0.276	0.305	10	S
NH ₄ ⁺	G1	0.072	0.086	16	Q
	G2	0.057	0.086	34	U
	G3	0.085	0.112	24	Q
	G4	0.123	0.147	16	Q
NO ₃ ⁻	G1	0.174	0.194	10	S
	G2	0.282	0.313	10	S
	G3	0.231	0.255	9	S
	G4	0.303	0.334	9	S
Na ⁺	G1	0.819	0.891	8	S
	G2	0.91	0.966	6	S
	G3	1.31	1.4	6	S
	G4	1.29	1.37	6	S
Mg ²⁺	G1	0.092	0.108	15	Q
	G2	0.097	0.113	14	S
	G3	0.086	0.1	14	S
	G4	0.077	0.091	15	Q
Cl ⁻	G1	1.26	1.2	5	S
	G2	1.14	1.12	2	S
	G3	1.85	1.93	4	S
	G4	1.75	1.81	3	S
Ca ²⁺	G1	0.13	0.134	3	S
	G2	0.138	0.139	1	S
	G3	0.124	0.124	0	S
	G4	0.111	0.112	1	S
K ⁺	G1	0.243	0.109	123	U
	G2	0.319	0.227	41	U
	G3	0.166	0.143	16	Q
	G4	0.209	0.187	12	S
pH*	G1	5.28	5.36	0.08	S
	G2	5.26	5.32	0.06	S
	G3	5.13	5.15	0.02	S
	G4	5.17	5.23	0.06	S
Cond**	G1	10.58	10.13	4	S
	G2	11.59	11.24	3	S
	G3	14.39	14.32	0	S
	G4	14.28	14.04	2	S

* pH as pH units, **Cond, conductivity, units: µS/cm

¹ EMEP quality norm given as Satisfactory (S), Questionable (Q) or Unsatisfactory (U)

