NILU report 15/2026

Air Quality in Ny-Ålesund

Monitoring of Local Air Quality 2021-2024

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Classification A-Open

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www.nilu-research.se

ISBN 978-82-425-3234-3
ISSN 2464-3327

Title
Air Quality in Ny-Ålesund
Monitoring of Local Air Quality 2021-2024

Norwegian title
Luftkvalitet I Ny-Ålesund
Målinger av lokal luftkvalitet 2021-2024

Author(s)
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Short summary (English)
The concentrations of the measured components are generally low and below national limit values for the protection of human health and critical levels for the protection of vegetation. Wind from northern sectors gave the highest average concentrations of nitrogen oxides and sulfur dioxide, which indicates the power station and the harbour as possible sources. We also see single episodes of long-range transport of pollutants.

Short summary (Norwegian)
De målte konsentrasjonene var generelt lave for alle komponenter og under nasjonale grenseverdier for beskyttelse av menneskets helse og økosystemet.
Vind fra nordlige sektorer ga de høyeste gjennomsnittskonsentrasjonene av nitrogenoksider og svoveldioksid, noe som peker på kraftstasjonen og havnen som mulige kilder. Vi ser også enkelte episoder med langtransport av forurensning.

Keywords
Air quality, Long-range transport of air pollutants, Polar regions

Number of pages	**NILU project number**
32	114076
Project leader	**Quality assurer**
Ove Hermansen	Leif Marsteen
Client/Report prepared for	**Contract reference**
Kings Bay AS, 9173 Ny-Ålesund	-
Signature of the responsible person	**Date**
Aasmund Fahre Vik, deputy CEO	26/06/2026

Citation
Johnsrud, M., Hermansen, O., Tørnkvist, K. (2026). *Air Quality in Ny-Ålesund. Monitoring of Local Air Quality 2021-2024* (NILU report 15/2026). Kjeller: NILU.

Preface

The expressed mission of Ny-Ålesund Research station is to serve as an international station for scientific research and monitoring. The activities are dependent on the near pristine environment and unique qualities of the Ny-Ålesund area, in particular research related to long range transported pollution, climate change and polar ecology.

Thus, it is essential to preserve the near pristine environment of the area and to keep local human environmental impacts at the lowest possible level so as not to jeopardise scientific research and monitoring. Ny-Ålesund is expected to be a prime example of the sustainable operation and development of a research station in the Polar Regions.

Comprehensive infrastructure and logistics are required to enable the extensive research activities in and around Ny-Ålesund. This cannot be done without any impact on the environment.

The project "Monitoring of Local Air Quality in Ny-Ålesund" ran from July 2008 until 2010. The main purpose of the project was to monitor a number of air pollutants to assess the impact of the activities in Ny-Ålesund on the environment and to detect possible influences on measurements in Ny-Ålesund and the nearby Zeppelin air-monitoring observatory.

Funding from the Svalbard Environmental Protection Fund made it possible to start up the project again, with the same type of measurements in the same location, in 2014 and continuing through 2015, to gather data for looking into changes since the previous project.

In 2016, NILU financed the continuation of the measurement program.

From 2017, contribution from Kings Bay AS has made it possible to establish the measurement activities on a more permanent basis

The contribution from Kings Bay AS includes providing the facilities needed for the instrumentation. Operation of instruments and samplers were carried out by staff from the Norwegian Polar Institute at the Sverdrup station as part of the agreement between NPI and NILU. NILU was responsible for the monitoring program and contributed with the instrumentation and data quality control. The air samples were analysed at the chemical laboratory at NILU.

In November 2018, the measurement station was moved from Nordpolhotellet to Transformatorbua, both locations near the centre of Ny-Ålesund.

This report summarises the monitoring activities in the years 2021 to 2024 and presents the measurements and the results from the first comparisons with earlier measurements.

The measurement results will be freely available for scientists and others for use in further studies in the region.

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Summary

The climate and environmental research institute NILU are monitoring air quality and meteorology at a measurement station in the centre of Ny-Ålesund, Spitsbergen. The main purpose of the project is to assess the impact of the activities in Ny-Ålesund and to detect possible influences on measurements in Ny-Ålesund and the nearby Zeppelin observatory.

Continuous measurements of air quality and meteorology in Ny-Ålesund were started at measurement station Nordpolhotellet in 2014. In November 2018 the station was replaced by a new station, Transformatorbua, located about 30 m to the north.

The concentrations of the measured components are generally low and below national limit values for the protection of human health and critical levels for the protection of vegetation.

The highest average concentrations of nitrogen oxides and sulphur dioxide were measured when the wind is from the northern sector, which indicates the power station and the harbour as possible sources. We also see episodes where long range transport of air pollution probably influences the measurements in Ny-Ålesund.

1 Background

NILU have measured air quality and meteorological parameters in Ny-Ålesund continuously since June 2014. First at the measurement station Nordpolhotellet, up to November 2018 when the new measurement station Transformatorbua was established about 30 m north of the old station. A corresponding measurement program was also carried out at Nordpolhotellet in 2008-2010 (Hermansen et al., 2011). The purpose was to investigate air pollution from local sources such as cars, the power station, marine activities, etc. Measurement results can be used to look at possible environmental impact from activities in the area and to investigate any influence on scientific measurement activities in Ny-Ålesund and its surroundings. The measurement results from 2014-2015, 2016-2017, 2018 and 2019-2020 are described in previous reports (Johnsrud et al., 2016, Johnsrud et al., 2018, Johnsrud et al. 2019, Johnsrud et al. 2021).

The measurement results will be freely available to scientists and others for use in further studies in the region. This report gives an overview of the measurement program and a brief statistical summary of the results.

2 Measurement program

The measurement program 2021-2024 is summarized in Table 1. The instruments used in the measurement program at Transformatorbua are shown in Figure 1.

Table 1: Measurement program at Transformatorbua in Ny-Ålesund.

Compound	Description	Sampler	Time resolution
$NO/NO_2/NO_x$	Nitrous oxides	Continuous monitor, API	1 hour
SO_2	Sulphur dioxide	Continuous monitor, API	1 hour
Main inorganic compounds	Gaseous and particle bound inorganic compounds; HNO_3/NO_3^-, NH_4^+/NH_3, SO_2, SO_4^{2-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, HCl	Filter sampler, EK	1 week
Meteorology	Temperature, wind direction, wind speed, relative humidity, barometric pressure, precipitation intensity	Automatic weather station, Vaisala	1 hour

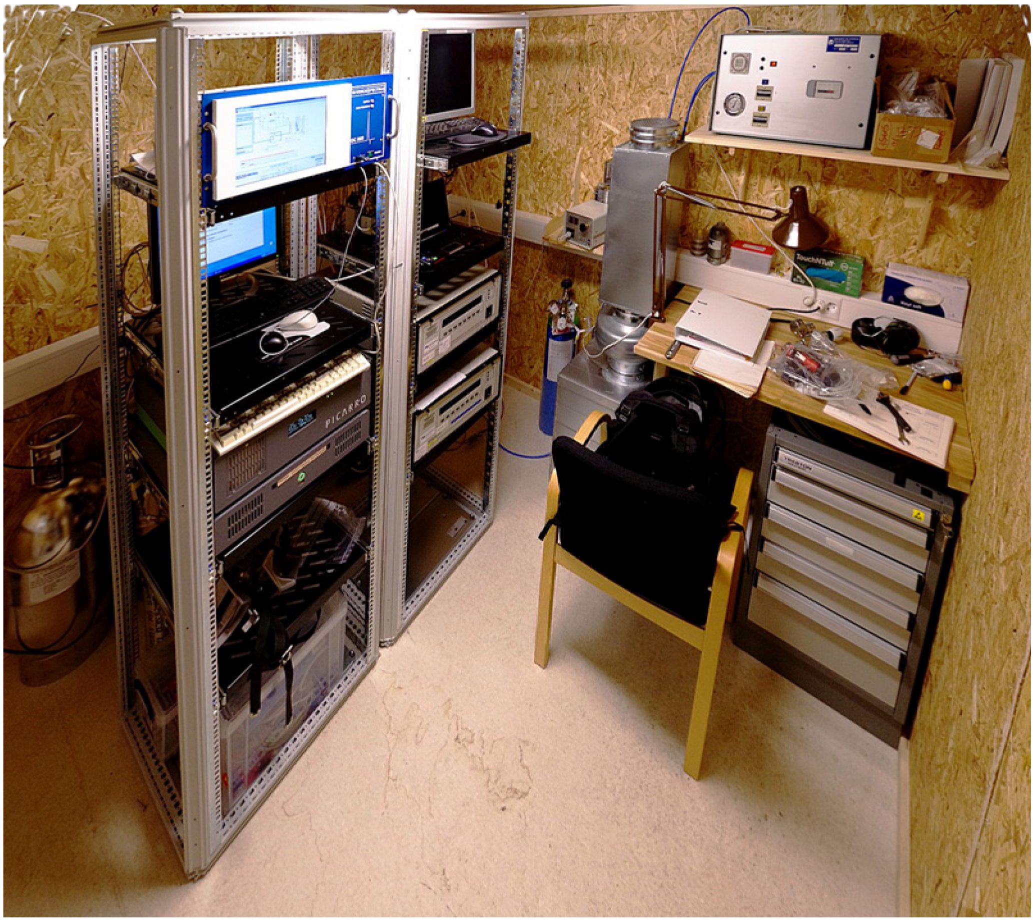


Figure 1: Interior of the measurement station Transformatorbua with instruments and other necessary equipment. (Photo: Ove Hermansen, NILU).

3 Measurement station

The measurement station, Transformatorbua, is located close to the center of Ny-Ålesund, slightly downwind, to provide representative measurements of the air quality in Ny-Ålesund. A picture of the measurement station is shown in Figure 2. Data from the Zeppelin observatory for advanced scientific measurements, south of Ny-Ålesund, is also included in some of the figures in this report. The location of both stations is shown on the map in Figure 3.

Figure 2: Measurement station Transformatorbua in Ny-Ålesund. The measurement station is the small red building to the left, by the flagpole. (Photo: Ove Hermansen, NILU).

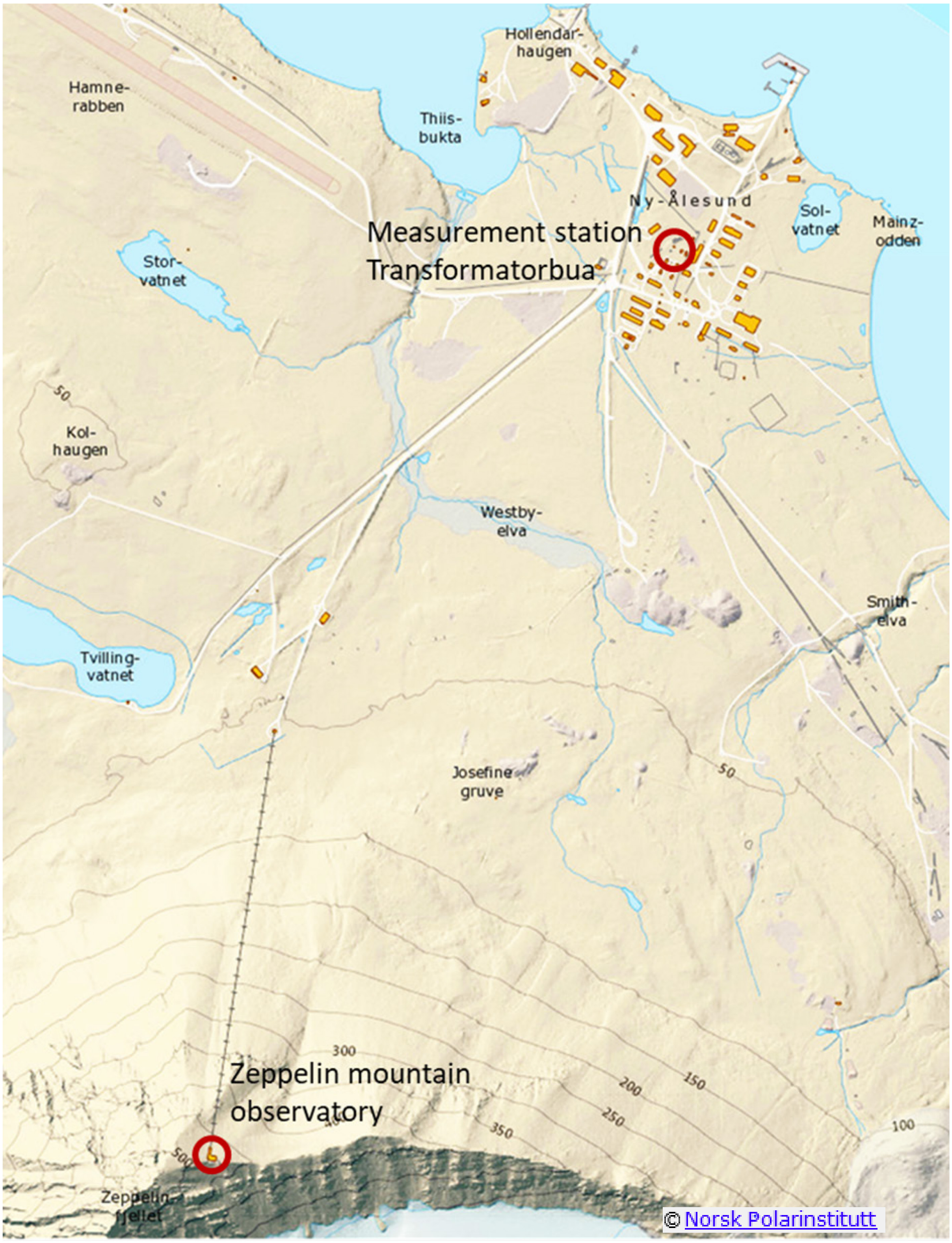


Figure 3: Location of the measurement station Transformatorbua and the Zeppelin Mountain observatory in Ny-Ålesund.

4 Results

4.1 Data capture

Periods of missing data are listed in Table 2. In general, data capture is good for most measurements. There are a few longer periods of missing data where instruments where down due to technical issues. The two gas monitors and the meteorological sensors were down from 22 March to 23 April 2024. For the nitrogen oxides monitor the stop lasted until 26 April. The nitrogen oxides monitor was also down from 5 March to 18 April 2023. The SO_2 monitor had two more periods of missing data from 8 December 2022 to 7 January 2023 and 20 May to 4 June 2024. The meteorological sensors were down from 26 June to 10 July and 26 October to 25 November 2024.

Table 2: Annual data capture and periods of missing data (24 or more consecutive hours) from Ny-Ålesund 2021-2024.

Compound/sampler	Capture 2021 (%)	Capture 2022 (%)	Capture 2023 (%)	Capture 2024 (%)	Periods of missing data
$NO/NO_2/NO_x$, monitor	99.5	98.7	87.3	88.9	05.09.2022 16:00-08.09.2022 17:00 05.03.2023 07:00-18.04.2023 18:00 22.03.2024 13:00-26.04.2024 14:00 05.05.2024 09:00-07.05.2024 15:00 03.06.2024 09:00-04.06.2024 13:00
SO_2, monitor	98.2	90.9	96.7	85.8	02.11.2021 13:00-04.11.2021 00:00 05.09.2022 16:00-07.09.2022 14:00 08.12.2022 18:00-07.01.2023 15:00 17.09.2023 10:00-18.09.2023 17:00 22.03.2024 13:00-23.04.2024 13:00 20.05.2024 10:00-04.06.2024 11:00
Main inorganic compounds, filter sampler	100	98.1	98.1	99.5	07.02.2022 07:00-14.02.2022 07:00 30.10.2023 07:00-06.11.2023 07:00 30.12.2024 07:00-06.01.2025 07:00
Meteorology: Temperature Barometric pressure Precipitation intensity Relative humidity Wind speed Wind direction	100	99	100	82	28.06.2022 07:00-30.06.2022 16:00 22.03.2024 13:00-23.04.2024 13:00 03.06.2024 09:00-04.06.2024 11:00 26.06.2024 05:00-10.07.2024 18:00 26.10.2024 00:00-26.11.2024 10:00

4.2 Meteorology

Frequency of wind from 12 30-degrees sectors (wind roses) from Transformatorbua in Ny-Ålesund, and from Zeppelin Mountain observatory for the calendar years 2021-2024 are presented in Figure 4. At Transformatorbua the prevailing wind direction is from east-southeast, and the highest wind speed is also registered from this sector. At Zeppelin Mountain the prevailing wind direction is more from south and south-southeast.

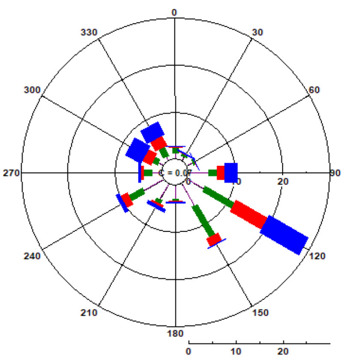
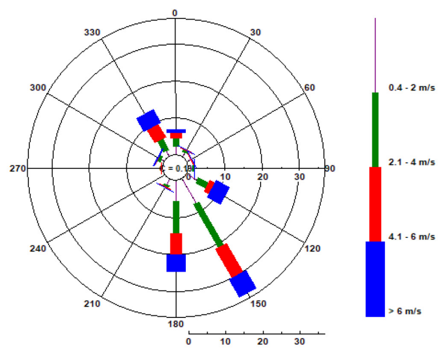
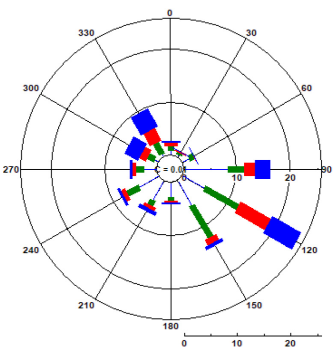
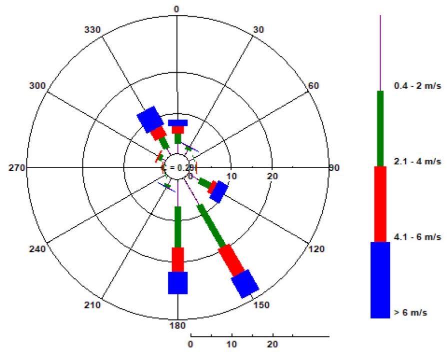
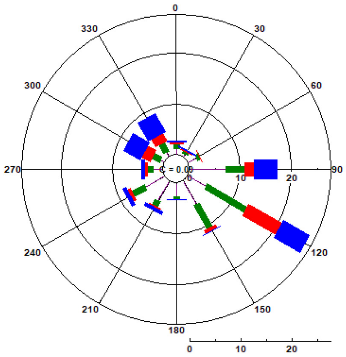
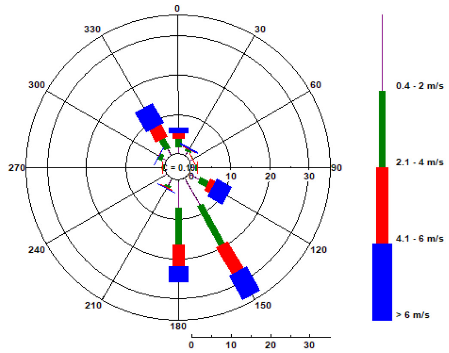
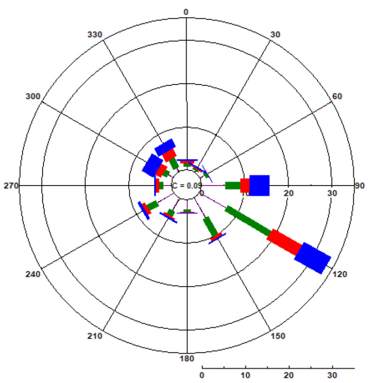
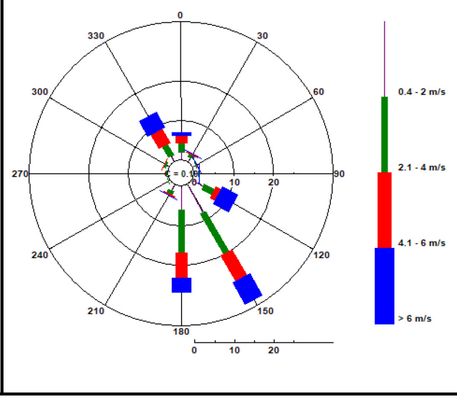
Year	Transformatorbua	Zeppelin Mountain observatory
2021		
2022		
2023		
2024		

Figure 4: Wind roses from the measurement stations at Transformatorbua and Zeppelin Mountain observatory for the calendar years 2021-2024.

Monthly average, maximum and minimum temperatures from Transformatorbua for the years 2021 to 2024 are presented in Figure 5. Monthly averages at Transformatorbua and the Zeppelin Mountain observatory, as well as the monthly normal temperatures 1991-2020 from Ny-Ålesund, given by DNMI are presented in Figure 6.

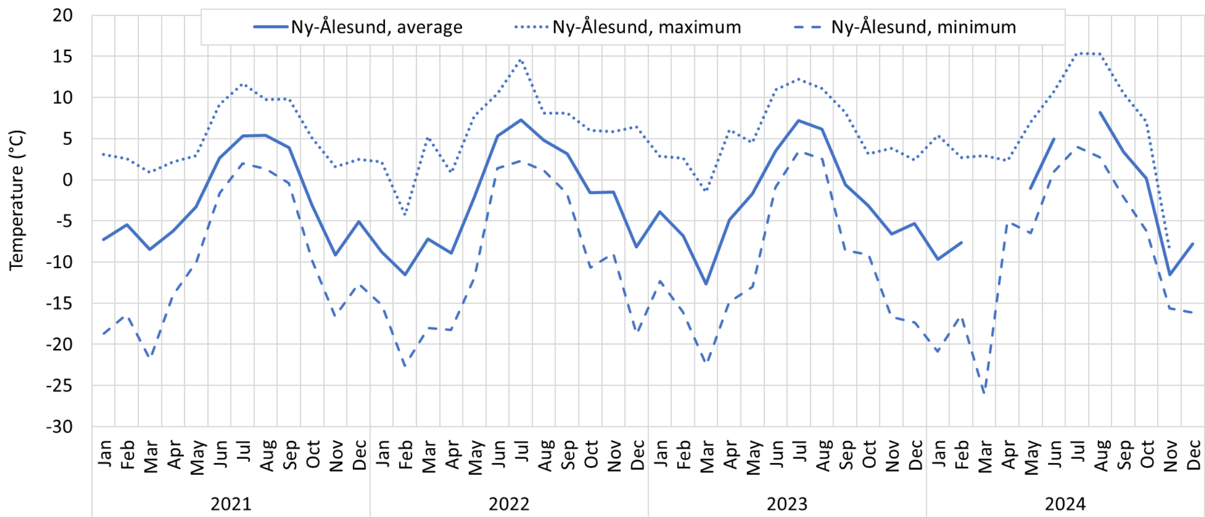


Figure 5: Monthly temperature statistics from Transformatorbua, Ny-Ålesund, from January 2021 to December 2024. No monthly value is given when data capture is less than 75%.

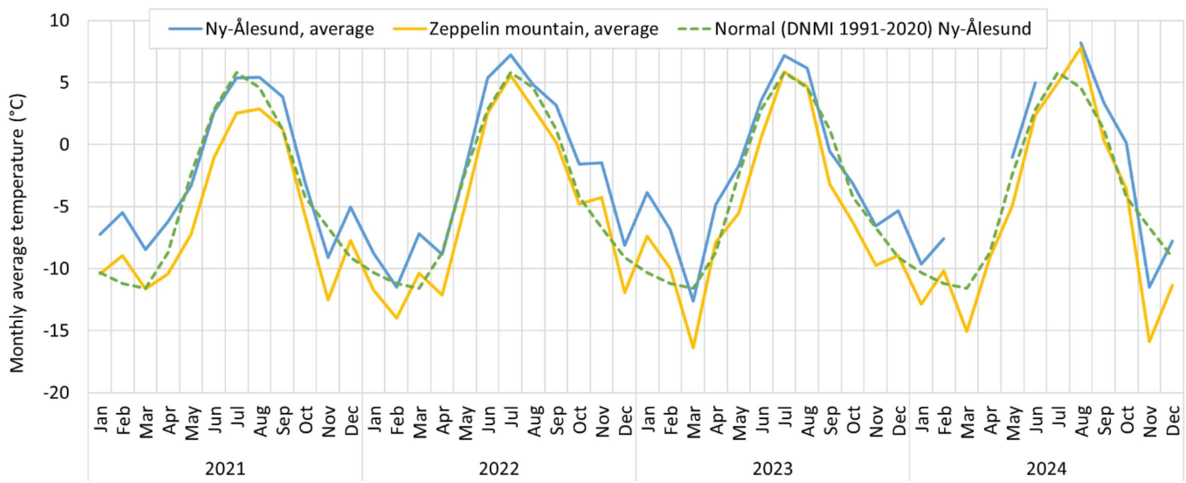


Figure 6: Monthly averages, normal temperatures from Ny-Ålesund, and measured temperatures from Transformatorbua, Ny-Ålesund, and Zeppelin Mountain observatory from January 2021 to December 2024. No monthly value is given when data capture is less than 75%.

The temperatures at Zeppelin Mountain and Transformatorbua show similar annual variation, with the monthly average temperatures at the mountain some degrees colder than down in Ny-Ålesund. At Transformatorbua during the years 2021 to 2024, each year the warmest months were July and August, with the maximum monthly average, 8,3 °C in August 2024. Each year the warmest hours were registered in July, with the maximum hourly temperature, 15,4 °C on 23 July 2024 at 10-11. Each year the coldest months were November in 2021, February in 2022, March in 2023 and January in 2024, with the coldest, -12,6 °C monthly average, in March 2023. The lowest registered hourly temperature at Transformatorbua during this period, -26,1 °C, was registered on 15 March 2024 at 00-01.

Compared to the normal temperatures for 1991-2020, given by DNMI, the monthly temperatures registered in Ny-Ålesund 2021-2024 were about the same or higher most months. The largest deviations from the normal temperature were found in February 2021, November 2022 and January 2023, with an average temperature at Transformatorbua of 5,7, 5,2 and 6,4 °C respectively above normal.

4.3 Nitrogen oxides

Hourly concentrations of nitrogen dioxide and nitrogen oxides are shown as time series plots in Appendix A. Measurements of nitrogen dioxide are summarized in Table 3 and Figure 7.

Table 3: Summary of monthly and annual averages and maximum values (µg/m^3) based on hourly measurements of NO_2 at Transformatorbua in Ny-Ålesund 2021-2024. No value is given when data capture is less than 75%.

Month	Average 2021 (µg/m^3)	Average 2022 (µg/m^3)	Average 2023 (µg/m^3)	Average 2024 (µg/m^3)	Maximum hour (µg(/m^3)	Time of maximum
January	0.4	2.5	1.0	2.2	33.0	04.01.2024 10:00
February	1.5	1.5	0.9	1.5	43.0	24.02.2024 08:00
March	1.3	1.4	-	-	48.0	03.03.2021 12:00
April	1.5	1.6	-	-	39.5	29.04.2021 21:00
May	0.8	1.8	0.8	1.5	35.2	16.05.2024 03:00
June	1.6	2.3	2.3	3.2	61.3	30.06.2023 13:00
July	3.1	1.8	4.0	2.9	73.7	20.07.2023 15:00
August	1.8	1.0	2.6	1.1	51.3	15.08.2022 13:00
September	1.6	1.2	1.7	1.9	56.0	27.09.2024 16:00
October	1.6	1.5	2.2	1.0	49.4	05.10.2023 11:00
November	1.7	0.7	0.8	1.5	39.7	24.11.2024 13:00
December	1.1	2.2	1.2	1.8	47.5	22.12.2021 20:00
Annual average	**1.5**	**1.6**	**1.8**	**1.9**		
Maximum hour	57.9	56.1	73.7	56.4		
Time of maximum hour	22.07. 19:00	19.6. 16:00	20.7. 15:00	2.7. 16:00		

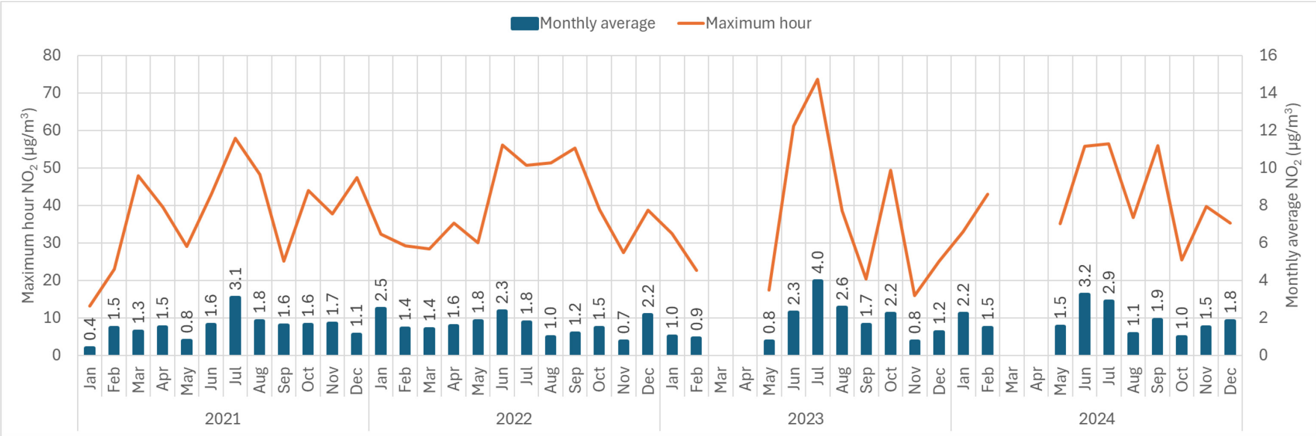


Figure 7: Monthly average and hourly maximum values (µg/m³) based on hourly measurements of NO_2 at Transformatorbua in Ny-Ålesund 2021-2024. No value is given when data capture is less than 75%.

The NO_2 concentrations are generally low compared to measurements in Norwegian cities and agglomerations. The highest registered monthly average was 4,0 µg/m³ in July 2023.

The measurements show short-term episodes where the concentrations are elevated compared to the general concentration level at the station. The highest registered hourly NO_2 average, 73,7 µg/m³, was registered on 20 July 2023 from 14:00-15:00. Observations from this episode are shown in Figure 8 with simultaneous SO_2-and wind direction-measurements. There was activity at the harbour in this period with totally 16 ships visiting. The figure shows that the maximum concentration occurred with 5 ships in the harbour and wind from north, indicating that the activity in the harbour may be an explanation for the elevated concentration this hour.

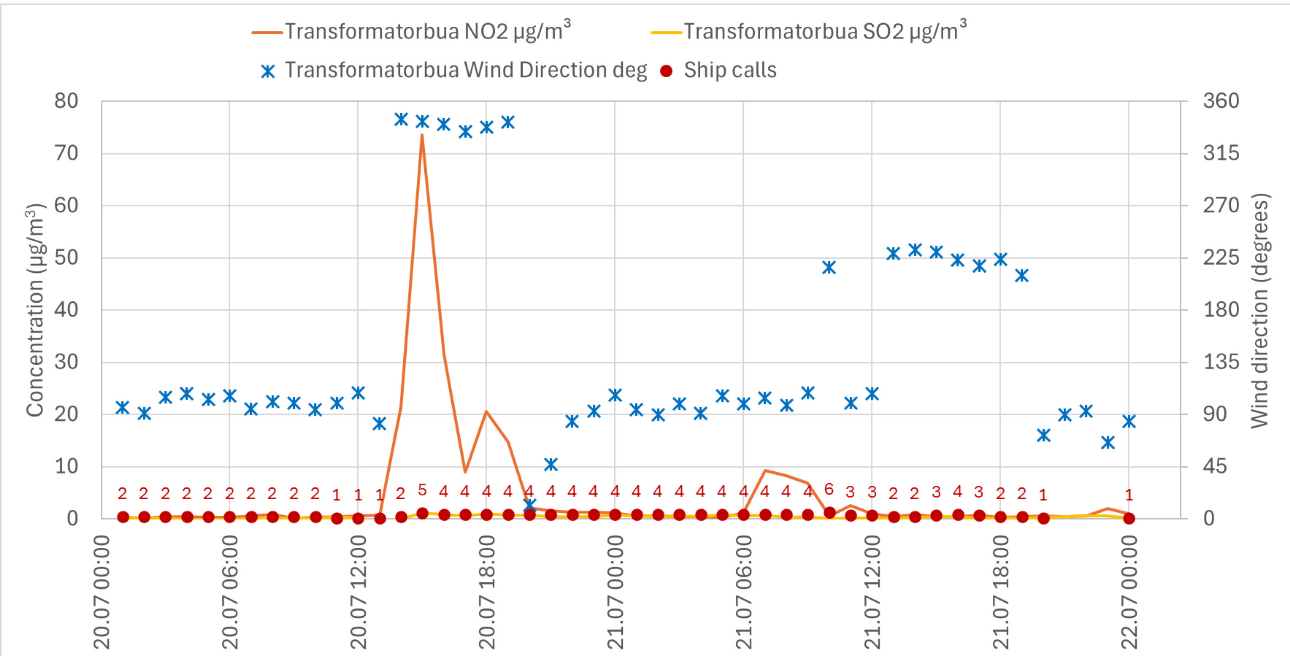


Figure 8: Hourly average concentrations of NO_2 and SO_2 and hourly registrations of wind direction at Transformatorbua, Ny-Ålesund on 20-22 July 2023. Ship activity in the harbour for the same period, based on Ny-Ålesund port calls, is also shown as red dots and numbers.

Average concentrations of NO_x and NO_2 from 12 wind direction sectors at Transformatorbua for the years 2021-2024 are shown in Figure 9. The figure illustrates that the highest average concentrations at Transformatorbua occurs with wind from north.

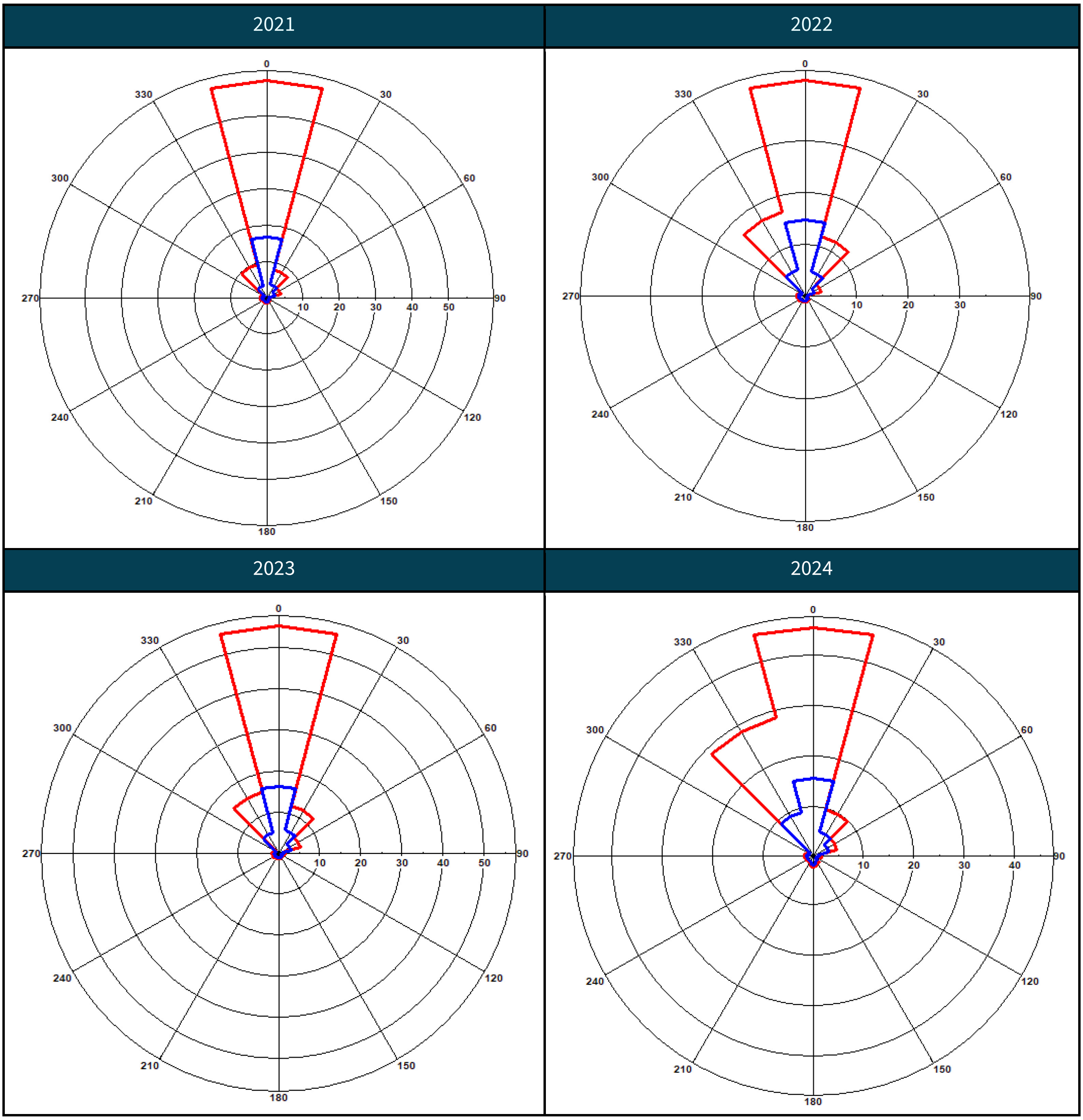


Figure 9: Average concentrations of NO_2 ($\mu g/m^3$) (in blue colour) and NO_x ($\mu g/m^3$) (in red colour) with wind from 12 30-degrees sectors at Transformatorbua, annual statistics 2021-2024. (Note the different concentration axes).

4.4 Sulphur dioxide (SO_2)

At Transformatorbua, SO_2 is measured with two different methods, a filter sampler giving weekly averages, and a continuous monitor giving hourly averages. The concentrations are generally low. The filter sampling method is more accurate than the continuous monitor at such low concentrations. The disadvantage of the filter sampling method compared to the continuous monitor is the time resolution. The method gives no information on when episodes of higher concentrations occur within the weekly sampling period.

Most of the time the values are close to, or below, the detection limit of the continuous monitor, and the uncertainty of the method is high at this low concentration level. The method is, however, good at capturing episodes of higher concentrations, which is why the instrumentation is included in the program. The higher time resolution of results, as given by the continuous monitor, is especially important when studying impact from sources that are active for short periods of time and/or close to the measurement station.

Hourly concentrations of sulphur dioxide are shown as time series plots in Appendix A. Measurements of sulphur dioxide are summarized in Table 4 and Figure 10.

Table 4: Summary of monthly and annual maximum hourly values based on monitor measurements and monthly and annual average values based on filter sampling of SO_2 at Transformatorbua 2021-2024.

Year	2021		2022		2023		2024		2021-2024	
	Max. hour (µg/m³)	Monthly average (µg/m³)	Max. hour (µg/m³)	Monthly average (µg/m³)	Max. hour (µg/m³)	Monthly average (µg/m³)	Max. hour (µg/m³)	Monthly average (µg/m³)	Max. hour (µg/m³)	Time of maximum
Month	Monitor	Filter	Monitor	Filter	Monitor	Filter	Monitor	Filter	Monitor	
January	1.9	0.07	8.6	0.06	1.2	0.11	1.4	0.14	8.6	12.01.2022 19:00
February	4.2	0.06	6.6	0.41	0.9	0.16	1.8	0.33	6.6	08.02.2022 12:00
March	5.3	0.12	9.5	0.19	6.0	0.25	-	0.50	9.5	10.03.2022 06:00
April	1.6	0.11	2.8	0.36	16.0	0.76	-	0.12	16.0	25.04.2023 02:00
May	1.4	0.08	2.4	0.26	0.7	0.19	-	0.12	2.4	02.05.2022 18:00
June	2.0	0.03	3.4	0.06	1.0	0.04	1.9	0.16	3.4	08.06.2022 10:00
July	2.0	0.03	5.2	0.02	1.4	0.08	1.8	0.02	5.2	17.07.2022 11:00
August	1.8	0.03	4.5	0.03	1.4	0.07	5.0	0.25	5.0	26.08.2024 13:00
September	1.8	0.03	5.9	0.03	1.1	0.04	3.5	0.04	5.9	13.09.2022 20:00
October	2.3	0.02	5.8	0.02	1.1	0.04	2.2	0.02	5.8	29.10.2022 07:00
November	9.1	0.15	1.8	0.03	3.9	0.29	3.1	0.02	9.1	10.11.2021 08:00
December	4.0	0.07	-	0.03	1.1	0.09	2.9	0.07	4.0	04.12.2021 10:00
Annual average		**0.07**		**0.16**		**0.17**		**0.15**		
Maximum hour	9.1		9.5		16.0		5.0		16.0	25.04.2023 02:00

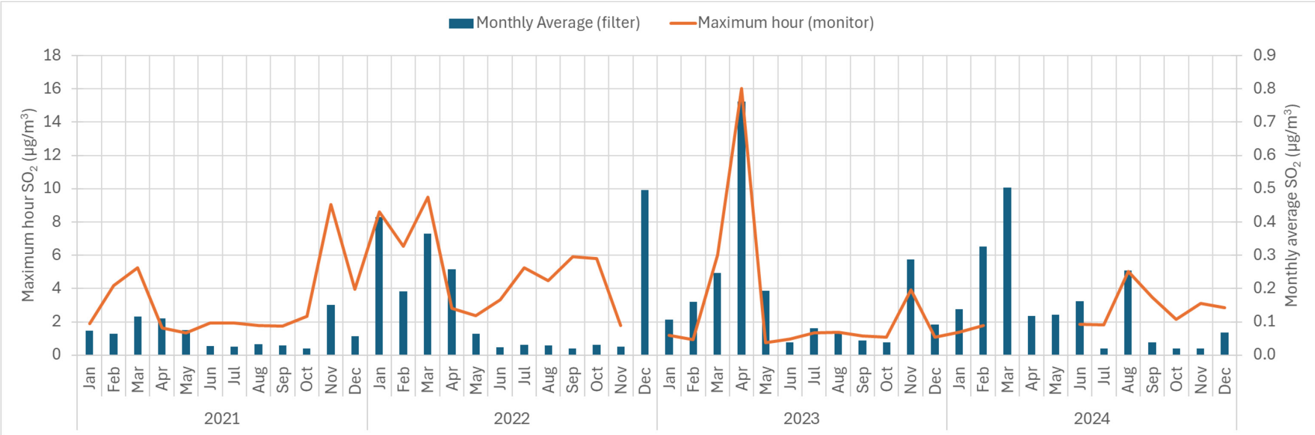


Figure 10: Monthly average and maximum hourly values (µg/m³) of SO_2 at Transformatorbua in Ny-Ålesund 2021-2024. Monthly average values from filter sampler, maximum hourly values from monitor. No value is given when data capture is less than 75%.

The highest monthly average SO_2-concentrations based on the filter sampling results were found during the winter and spring months with the maximum measured in April 2023 to 0,76 µg/m³.

The highest hourly SO_2-concentration was measured to 16 µg/m³ on 25 April 2023 from 01:00-02:00 during an episode lasting from the evening of 24 April to the morning of 26 April as shown in Figure 11. This episode of elevated SO_2 concentrations is also observed at the Zeppelin observatory, described in Aas et al., 2024, stating that FLEXPART footprints largely covered parts of the Khanty-Mansiysk, Yamalo-Nenets, and Krasnoyarsk regions in Russia, and that the major source contributing to this SO_2 episode is from the energy sector.

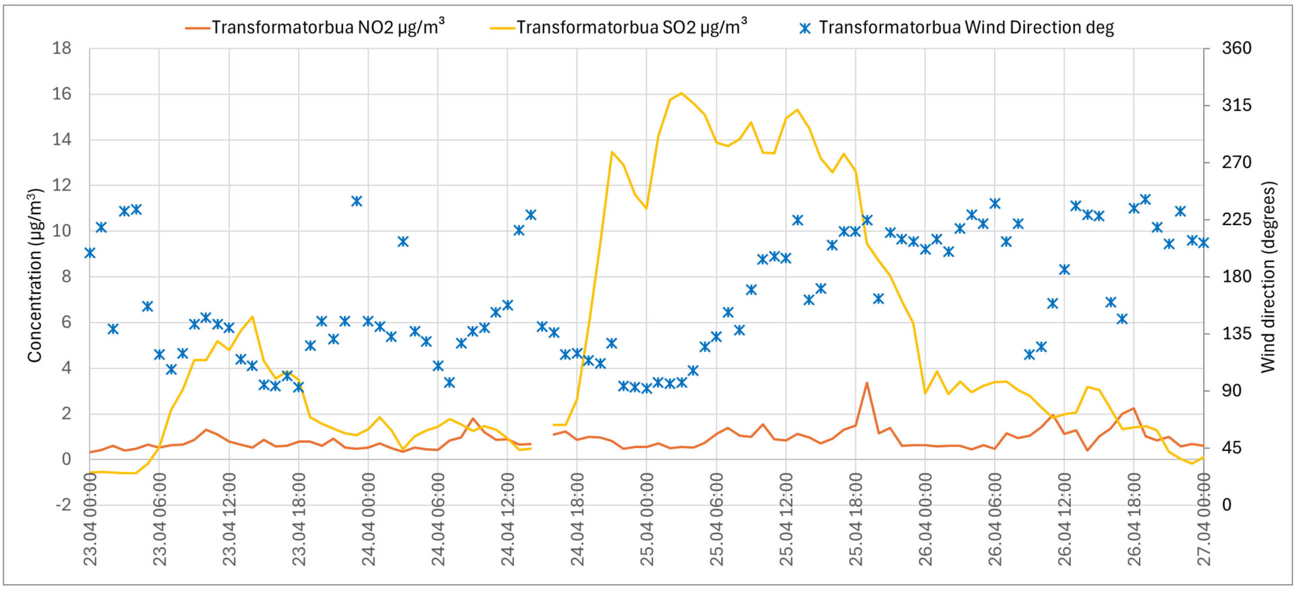


Figure 11: Hourly average concentrations of NO_2 and SO_2 and hourly registrations of wind direction at Transformatorbua, Ny-Ålesund on 23 to 27 April 2023.

Average concentrations of SO_2 from 12 wind direction sectors at Transformatorbua for the years 2021-2024, based on hourly data from the continuous monitor, are shown in Figure 12. The highest average concentrations came with wind from north.

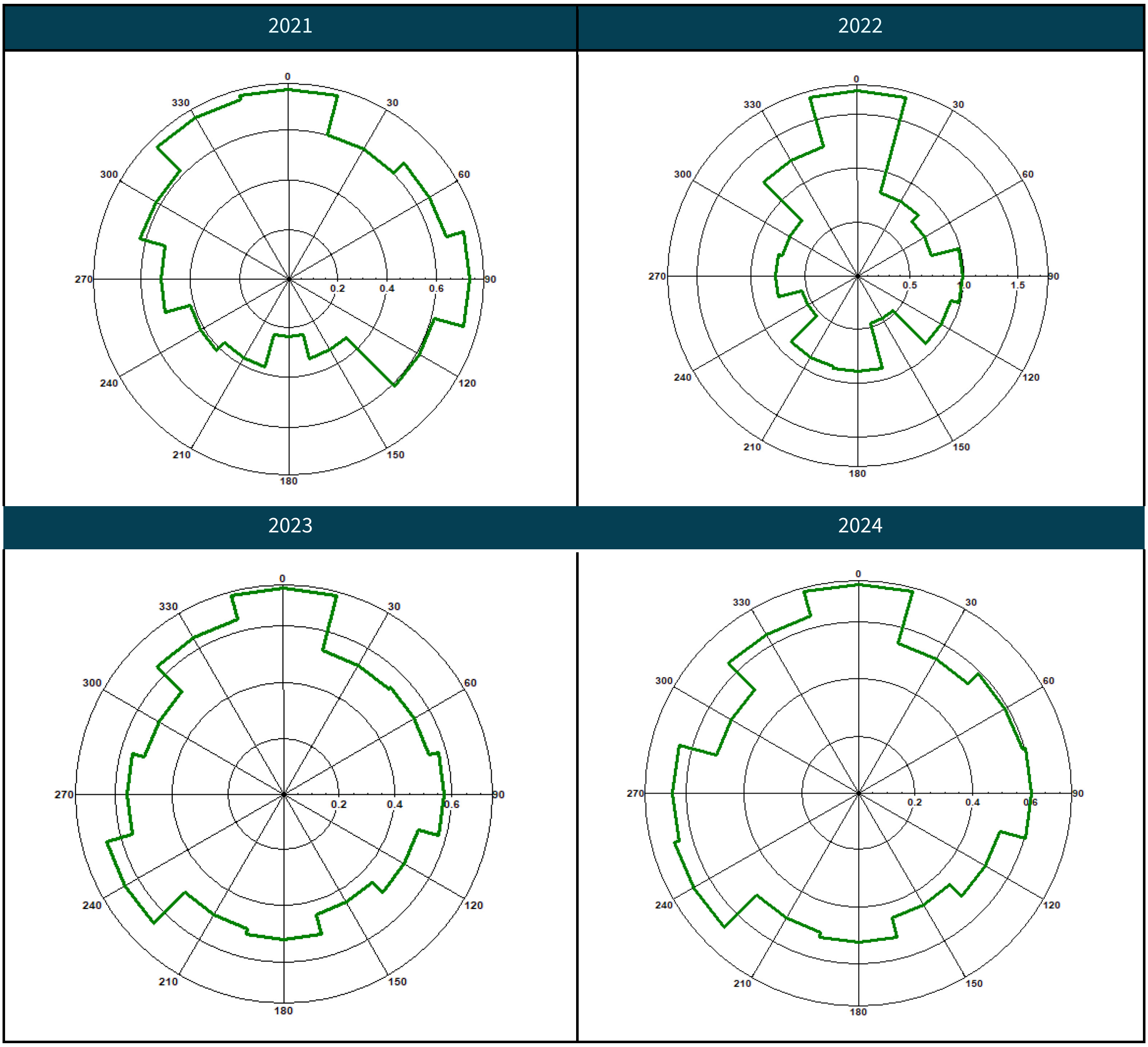


Figure 12: Average concentrations of SO_2 (µg/m³) with wind from 12 30-degrees sectors at Transformatorbua, annual statistics 2021-2024. (Note the different concentration axes).

4.5 Filter sampling of inorganic compounds

Main inorganic compounds in air are measured with a filter sampler on a weekly basis. A summary of the results is given in Table 5.

Table 5: Monthly and annual averages of main components in air measured at Transformatorbua in Ny-Ålesund in 2021-2024. Concentrations are given in µg/m³.

Month	SO_2	SO_4-S	Sum NO_3-N	Sum NH_4-N	Mg	Ca	K	Cl	Na
2021									
January	0.07	0.06	0.01	0.06	0.05	0.02	0.01	0.57	0.34
February	0.06	0.08	0.02	0.04	0.04	0.02	0.02	0.50	0.33
March	0.12	0.18	0.02	0.06	0.09	0.04	0.03	0.96	0.63
April	0.11	0.14	0.02	0.06	0.08	0.06	0.02	0.85	0.53
May	0.08	0.16	0.03	0.10	0.04	0.04	0.02	0.40	0.29
June	0.03	0.12	0.02	0.07	0.07	0.13	0.02	0.75	0.46
July	0.03	0.18	0.02	0.11	0.08	0.10	0.02	0.75	0.49
August	0.03	0.10	0.02	0.12	0.04	0.04	0.01	0.48	0.31
September	0.03	0.10	0.02	0.09	0.09	0.05	0.03	1.15	0.69
October	0.02	0.06	0.02	0.07	0.11	0.57	0.02	0.73	0.43
November	0.15	0.18	0.02	0.06	0.13	0.19	0.04	1.39	0.81
December	0.07	0.12	0.03	0.05	0.09	0.05	0.03	1.03	0.62
2022									
January	0.06	0.18	0.02	0.07	0.08	0.04	0.03	0.86	0.58
February	0.41	0.30	0.06	0.21	0.09	0.05	0.04	0.83	0.59
March	0.19	0.26	0.02	0.11	0.07	0.05	0.03	0.65	0.47
April	0.36	0.31	0.03	0.15	0.06	0.12	0.02	0.46	0.37
May	0.26	0.24	0.04	0.11	0.06	0.13	0.02	0.50	0.40
June	0.06	0.25	0.04	0.12	0.07	0.15	0.02	0.62	0.31
July	0.032	0.07	0.02	0.14	0.04	0.07	0.01	0.40	0.24
August	0.03	0.05	0.02	0.10	0.03	0.03	0.01	0.40	0.24
September	0.03	0.09	0.02	0.10	0.09	0.08	0.03	1.14	0.67
October	0.02	0.05	0.02	0.08	0.05	0.07	0.02	0.59	0.33
November	0.03	0.04	0.02	0.04	0.04	0.01	0.01	0.53	0.32
December	0.03	0.11	0.03	0.05	0.10	0.06	0.04	1.10	0.68

Table 5 continued.

Month	SO_2	SO_4-S	Sum NO_3-N	Sum NH_4-N	Mg	Ca	K	Cl	Na
2023									
January	0.11	0.13	0.02	0.08	0.10	0.05	0.04	1.30	0.79
February	0.16	0.14	0.02	0.07	0.09	0.04	0.04	1.20	0.73
March	0.25	0.19	0.03	0.09	0.06	0.04	0.03	0.54	0.37
April	0.76	0.31	0.03	0.12	0.10	0.12	0.03	0.65	0.49
May	0.19	0.28	0.03	0.10	0.09	0.17	0.03	0.91	0.56
June	0.04	0.13	0.04	0.12	0.05	0.15	0.01	0.37	0.27
July	0.08	0.07	0.02	0.14	0.04	0.08	0.01	0.23	0.16
August	0.07	0.04	0.02	0.08	0.05	0.09	0.01	0.23	0.15
September	0.04	0.03	0.02	0.09	0.02	0.04	0.01	0.31	0.19
October	0.04	0.05	0.02	0.06	0.06	0.12	0.01	0.54	0.32
November	0.29	0.11	0.02	0.06	0.08	0.04	0.03	1.08	0.64
December	0.09	0.10	0.03	0.04	0.05	0.04	0.08	0.58	0.38
2024									
January	0.14	0.14	0.02	0.05	0.10	0.44	0.03	0.97	0.59
February	0.33	0.50	0.06	0.23	0.10	0.06	0.05	0.83	0.71
March	0.50	0.15	0.03	0.09	0.07	0.07	0.03	0.55	0.35
April	0.12	0.10	0.03	0.09	0.04	0.02	0.02	0.43	0.29
May	0.12	0.22	0.02	0.09	0.08	0.12	0.02	0.63	0.43
June	0.16	0.34	0.03	0.13	0.09	0.15	0.02	0.62	0.44
July	0.02	0.10	0.03	0.16	0.04	0.05	0.01	0.35	0.25
August	0.25	0.14	0.02	0.15	0.05	0.03	0.02	0.51	0.38
September	0.04	0.05	0.02	0.08	0.05	0.08	0.01	0.45	0.28
October	0.02	0.03	0.02	0.07	0.04	0.05	0.02	0.48	0.27
November	0.02	0.06	0.02	0.05	0.06	0.06	0.02	0.70	0.41
December	0.07	0.11	0.02	0.06	0.07	0.07	0.02	0.75	0.46
Year									
2021	0.07	0.12	0.02	0.07	0.08	0.11	0.02	0.80	0.49
2022	0.16	0.16	0.03	0.10	0.06	0.07	0.02	0.67	0.43
2023	0.17	0.13	0.03	0.09	0.07	0.08	0.03	0.65	0.42

Month	SO_2	SO_4-S	Sum NO_3-N	Sum NH_4-N	Mg	Ca	K	Cl	Na
2024	0.15	0.16	0.03	0.10	0.07	0.10	0.02	0.60	0.40

In general, we find an annual variation showing higher concentrations of sulphate and sum nitrate during winter, spring and early summer months. The highest monthly average sulphate concentration, 0,5 µg S/m^3, was found in February 2024 and the highest monthly sum nitrate, 0,06 µg N/m^3, was found in February 2022 and February 2024. The sea salt components magnesium, sodium, and chloride, as well as potassium showed a pattern with higher concentrations during the winter season and lower during summer, with the minimum in July and August. Calcium and sum ammonium in general showed a pattern with the highest values respectively in spring and summer, but with the two highest monthly values of calcium in October 2021 and January 2024 and the two highest monthly values of sum ammonium in February 2022 and February 2024.

The SO2-concentrations are discussed in chapter 4.4.

5 Comparison with data from Zeppelin observatory

Main inorganic compounds in air are also measured at the nearby observatory on Zeppelin Mountain. One of the main purposes of the project is to detect possible influences of the activities in Ny-Ålesund on measurements at Zeppelin observatory. Considering the low concentration levels measured at both sites, more extensive data analysis is needed to conclude on this.

Annual averages of main components in air measured at Zeppelin observatory and at Transformatorbua down in Ny-Ålesund for the years 2021 to 2024 are presented in Figure 13.

At both locations the measured concentrations are very low and close to the detection limit of the measurement method. The station in Ny-Ålesund is closer to the sea and the concentrations of the sea-salt components are higher at this location.

Figure 13: Annual average concentrations of main inorganic components in air measured at Transformatorbua and Zeppelin observatory 2021-2024. Sulphate (SO_4) is given as µg S/m³ and sum nitrate (NO_3+HNO_3) and sum ammonium (NH_3+NH_4) are given as µg N/m³.

6 Comparison with previous years

Monthly maximum SO_2-concentrations from 2014 to 2024 are presented in Figure 14, and monthly average SO_2-concentrations from the same years are presented in Figure 15. The highest hourly concentrations occur in the period September 2014 to January 2015, which coincides with the volcanic eruption at Holuhraun, Iceland. In 2020 there were two episodes, the first in March, the second in April, when the maximum hourly concentrations were high, and up to the same level as found during the volcanic eruption in 2014-2015. Trajectories show transport of air masses over Iceland during the episode in March and over north-western Russia and the Kola peninsula during the episode in April, both indicating long-range transport of air pollution as probable explanations for the measured concentrations.

The monthly maximum hourly SO_2-concentrations found in the period 2021 to 2024 were approximately within the range of maximum monthly values measured in previous years with two exceptions. First, the monthly maximum hourly SO_2-concentrations in November 2021, which apart from the episodes described, was slightly higher than what is previously found at this time of the year. Secondly, in April 2023, there is an episode of high hourly concentrations most likely due to long range transport air pollution from northern Russia.

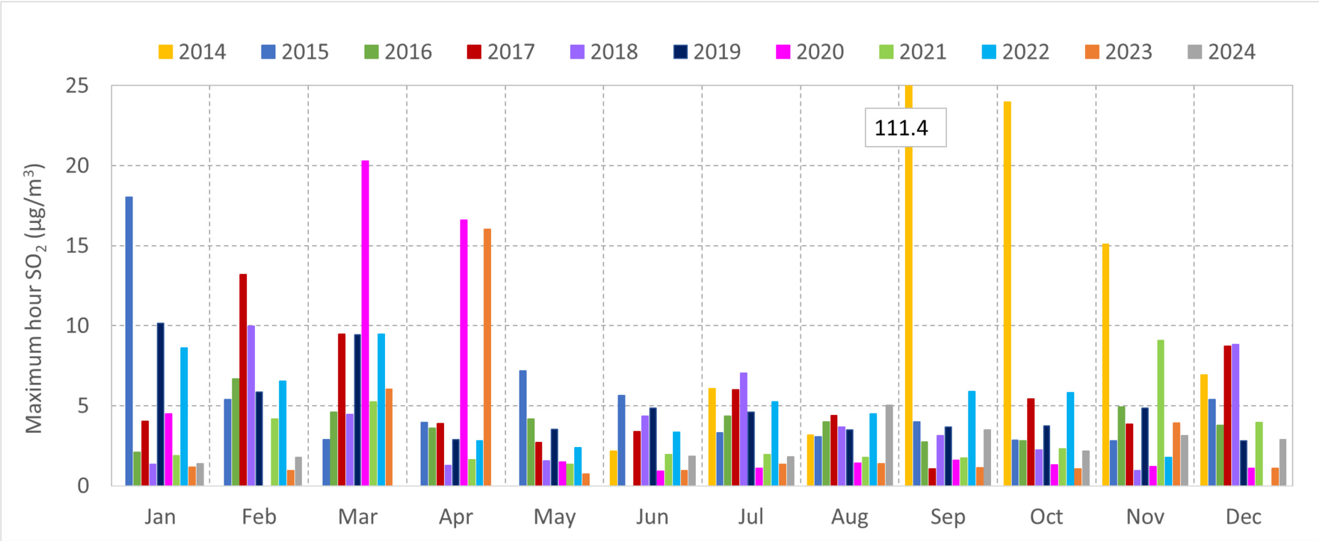


Figure 14: Monthly maximum hourly SO_2-concentrations at Nordpolhotellet for June 2014 to November 2018 and at Transformatorbua for December 2018 to December 2024. Data from continuous monitor. No value is given when data capture is less than 75%.

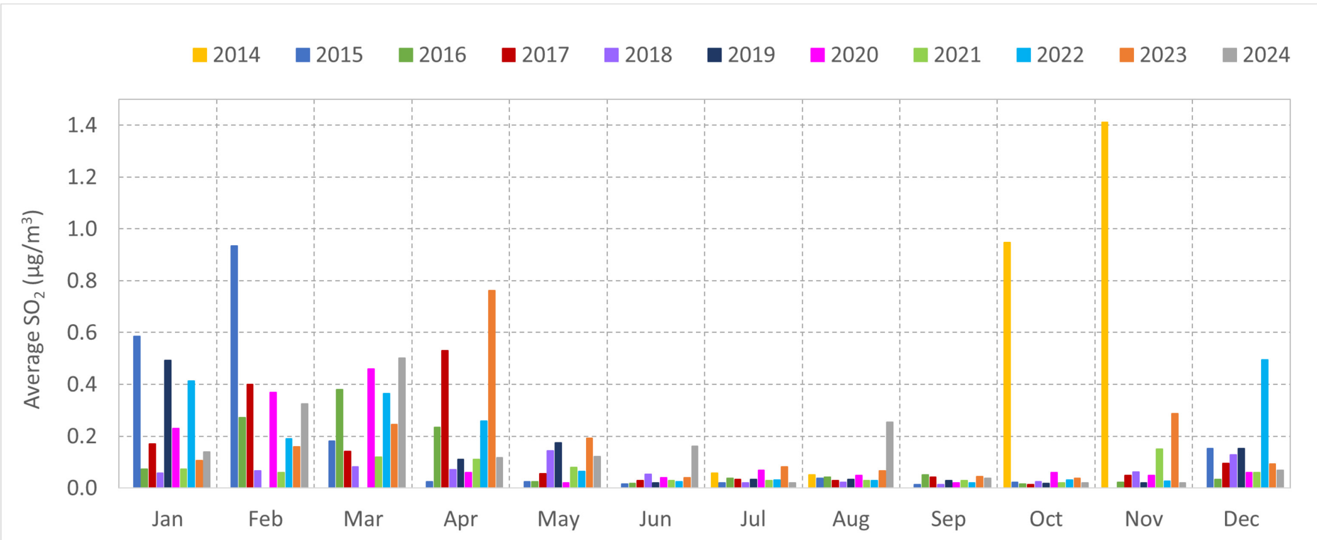


Figure 15: Monthly average SO_2-concentrations at Nordpolhotellet for July 2014 to November 2018 and at Transformatorbua for December 2018 to December 2024. Data from filter sampler. No value is given when data capture is less than 75%.

Except for the period when the measurements were influenced by the volcanic eruptions, higher monthly average SO_2-concentrations are more likely to be found during the months December to April, even in May, while the average concentrations are generally lower during the summer and autumn months June to November. In 2022, December had the highest monthly SO_2 average, clearly higher than previously measured in December. In 2023, influence most likely from long range transport of air pollution, gave the highest monthly average in April. In 2024, the average concentrations of SO_2 in June and July were still low, but slightly higher compared to the same months in previous years. Part from this, the measured monthly SO_2 concentrations in the period 2021 to 2024 were about the same level as previous years.

Monthly maximum NO_2-concentrations from 2014-2024 are presented in Figure 16. Monthly average NO_2-concentrations from the same period are presented in Figure 17.

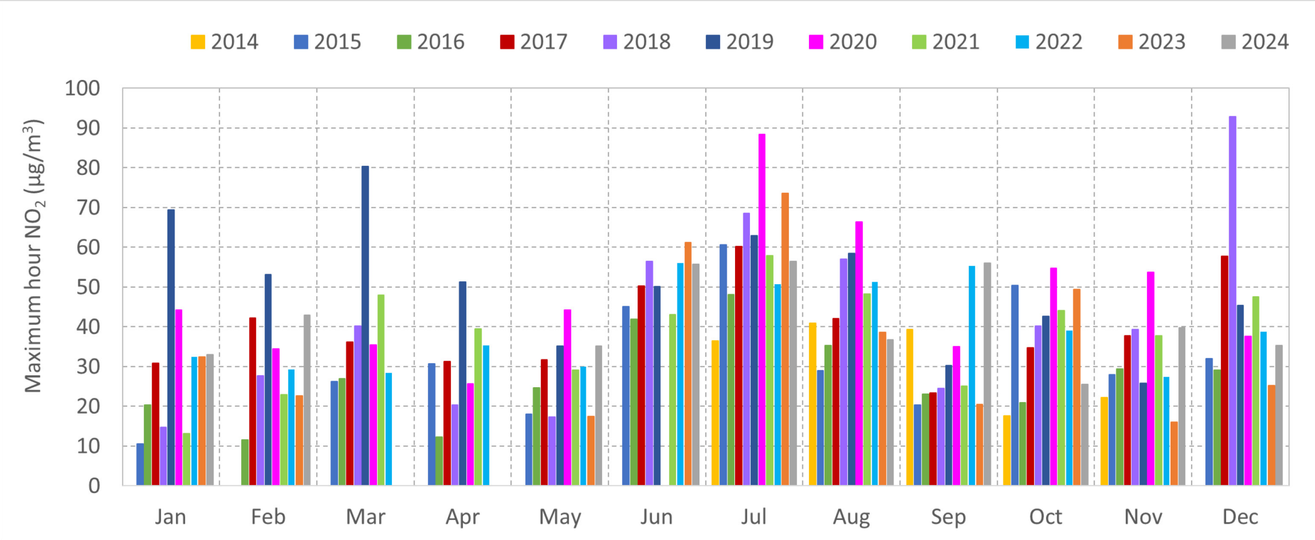


Figure 16: Monthly maximum hourly NO_2-concentrations at Nordpolhotellet for July 2014 to November 2018 and at Transformatorbua for December 2018 to December 2024. Data from continuous monitor. No value is given when data capture is less than 75%.

The first couple of years following the relocation of the measurement station from Nordpolhotellet to Transformatorbua, effective from December 2018, a general tendency of increased maximum hourly NO_2-concentrations was observed. This tendency is not seen to the same extent in the data from 2021 to 2024. For this period the highest hourly NO_2-concentrations were found in June and July. Except for September 2022 and September 2024, which had higher maximum levels than previous years, the maximum NO_2-concentrations in the period 2021 to 2024 were on the same level as previous years.

The monthly average NO_2 concentrations in Ny-Ålesund generally show an annual variation with higher averages in the summer months June to August, lower in April, May and September and often higher but more varied in the winter months October to March. Monthly average NO_2 concentrations in 2021 to 2024 showed no large deviation from yearly variation and concentration levels measured earlier.

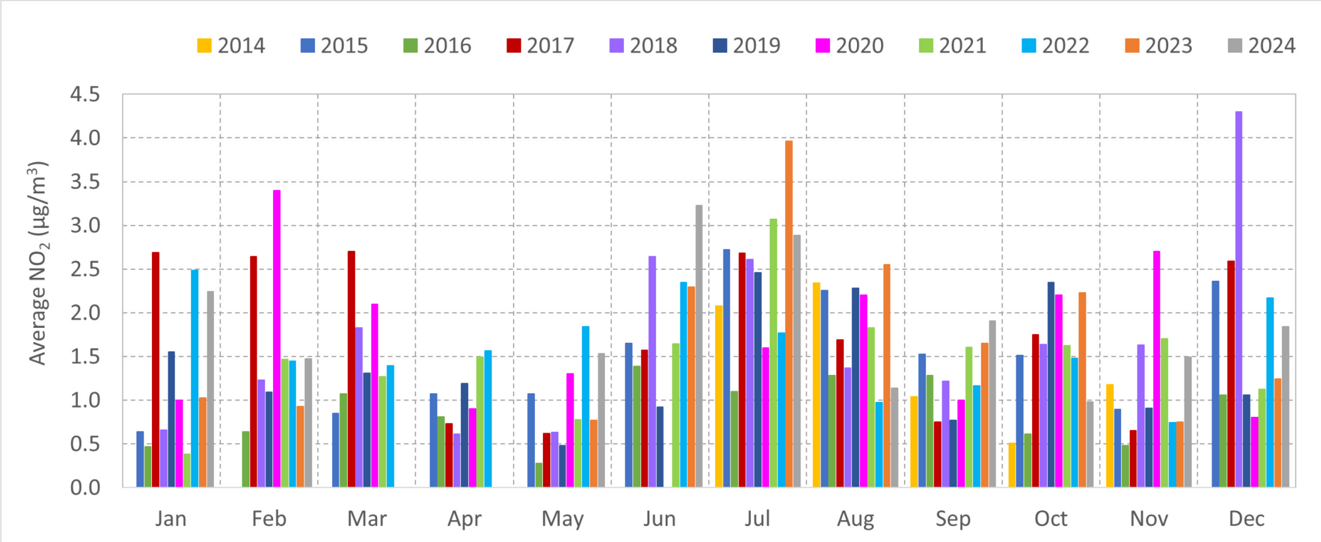


Figure 17: Monthly average NO_2-concentrations at Nordpolhotellet for July 2014 to November 2018 and at Transformatorbua for December 2018 to December 2024. Data from continuous monitor. No value is given when data capture is less than 75%.

7 References

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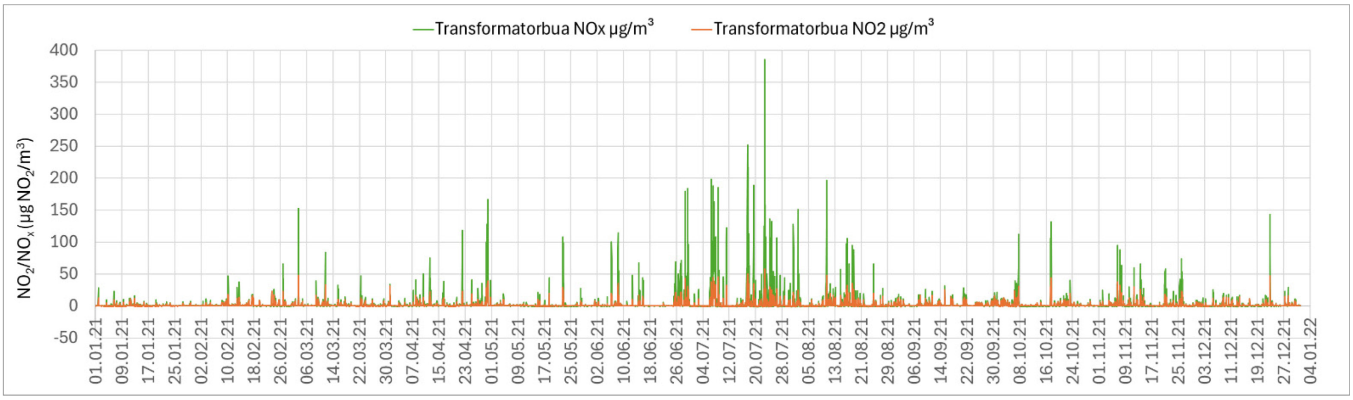
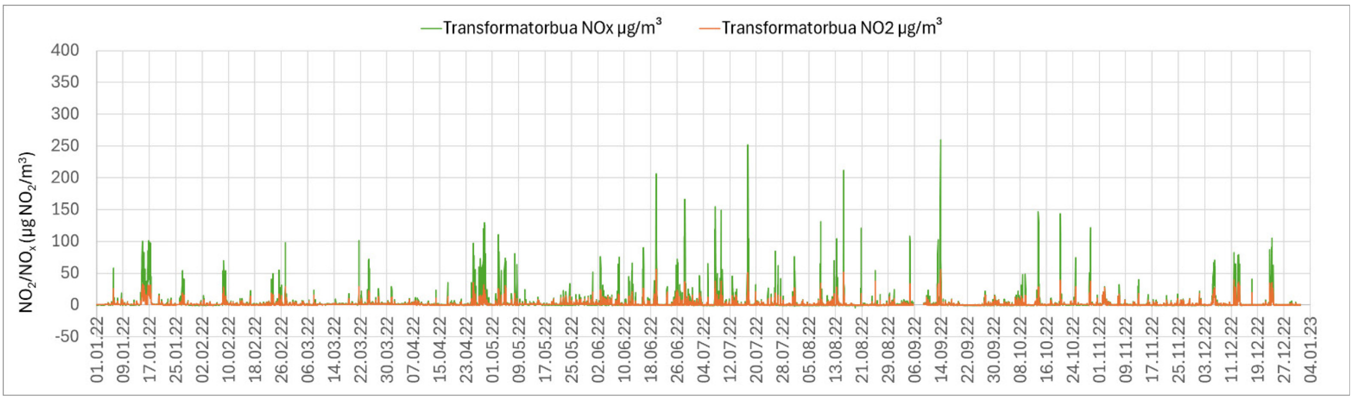
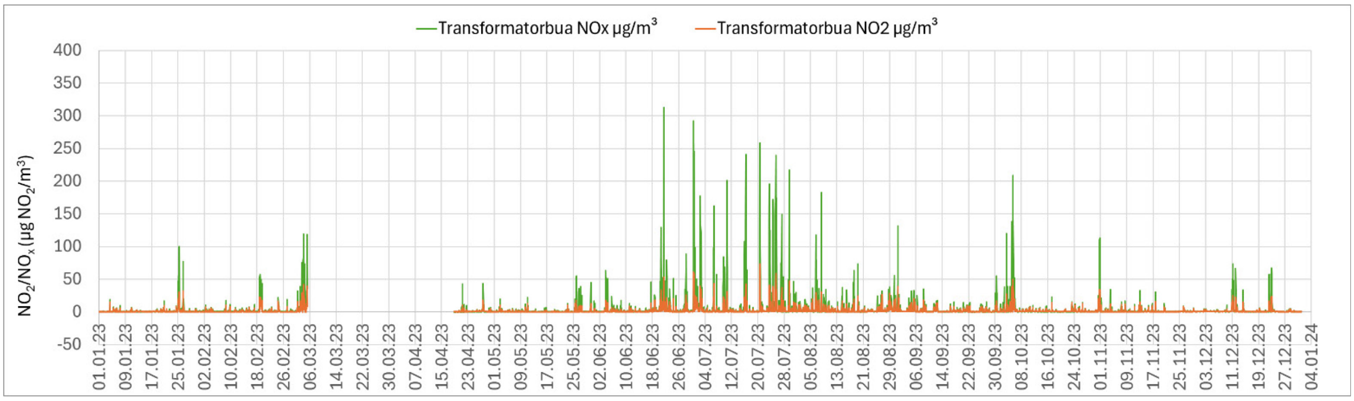
Appendix A
Measurement data

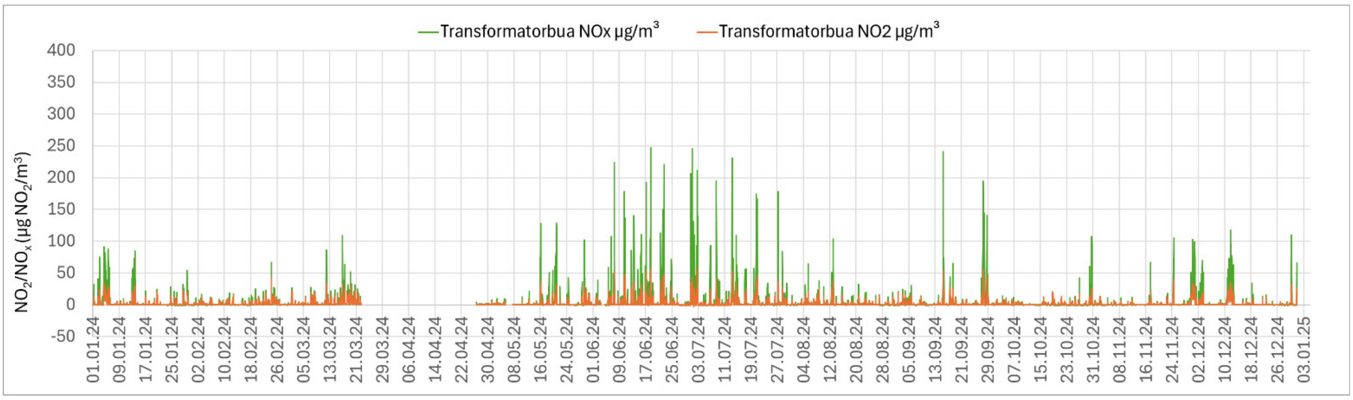
Hourly measurement data for NO_x and NO_2 at Transformatorbua, Ny-Ålesund 1.1.2021-31.12.2024.

NO_x as µg NO_2/m^3.

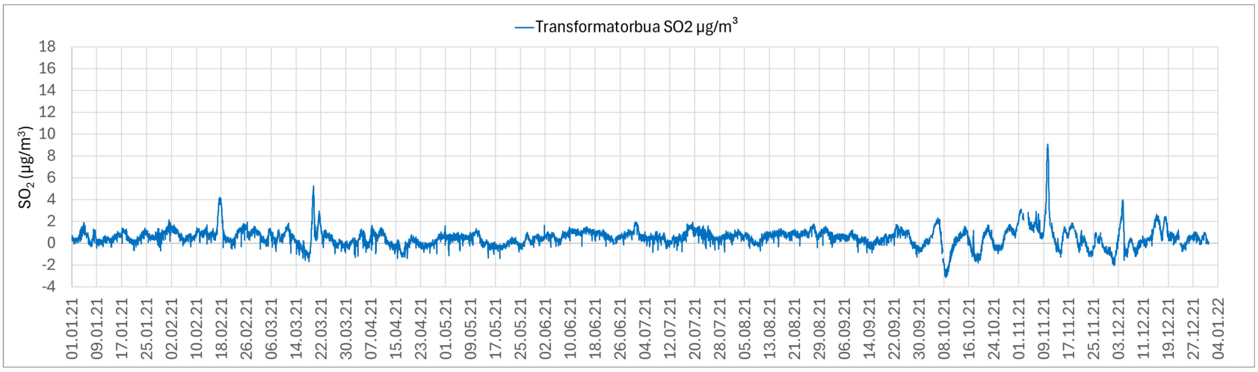


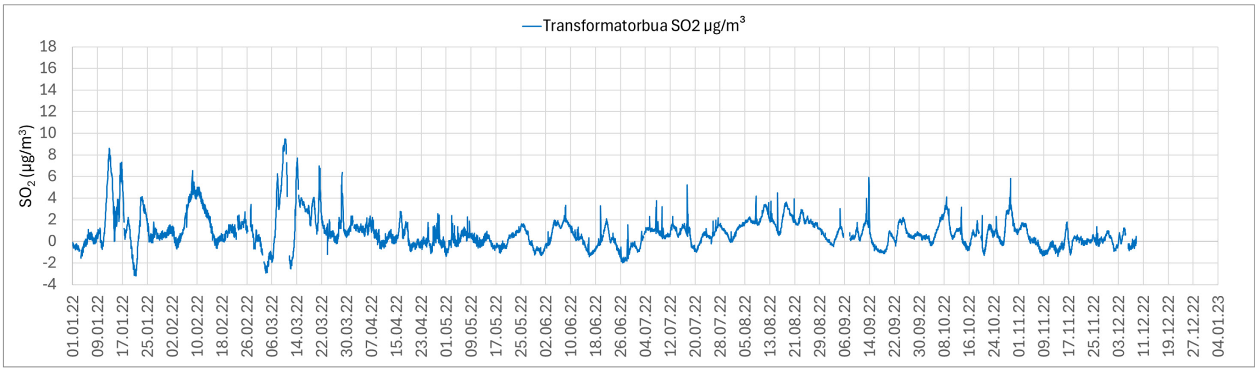


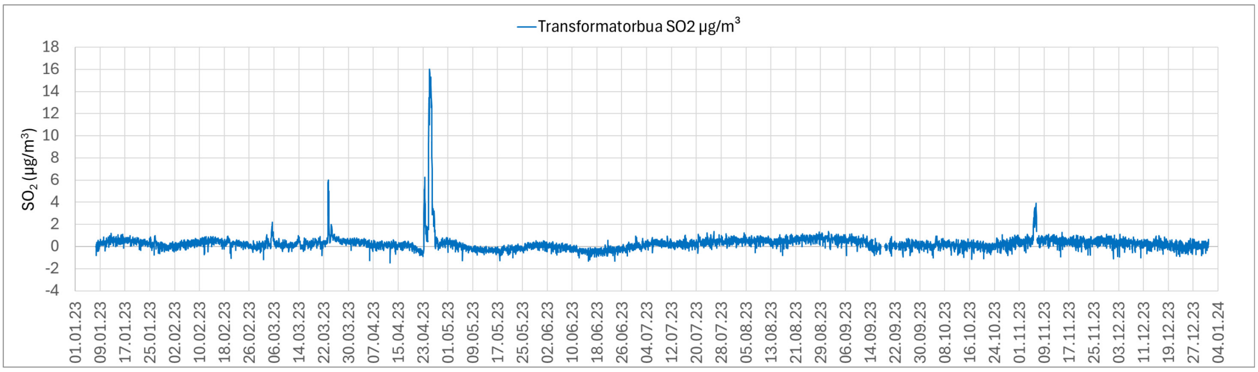


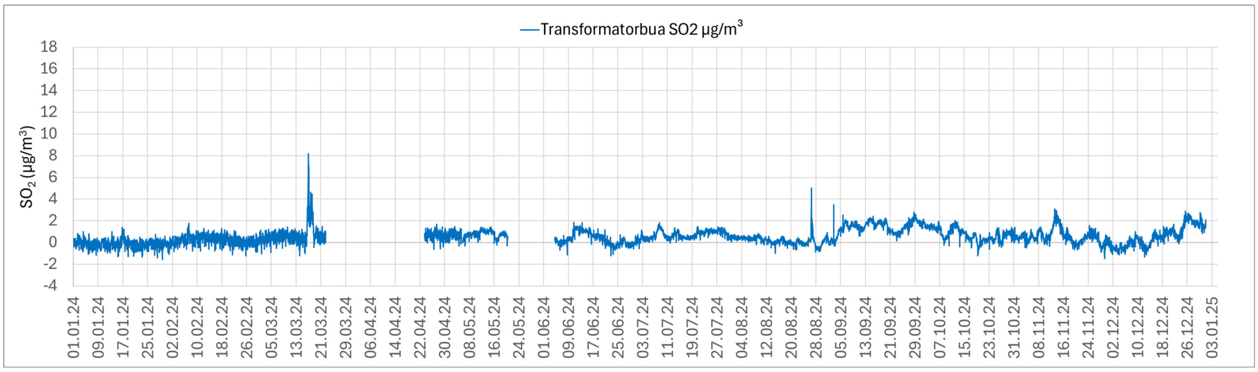


Hourly measurement data for SO_2 at Transformatorbua, Ny-Ålesund 1.1.2021 -31.12.2024.

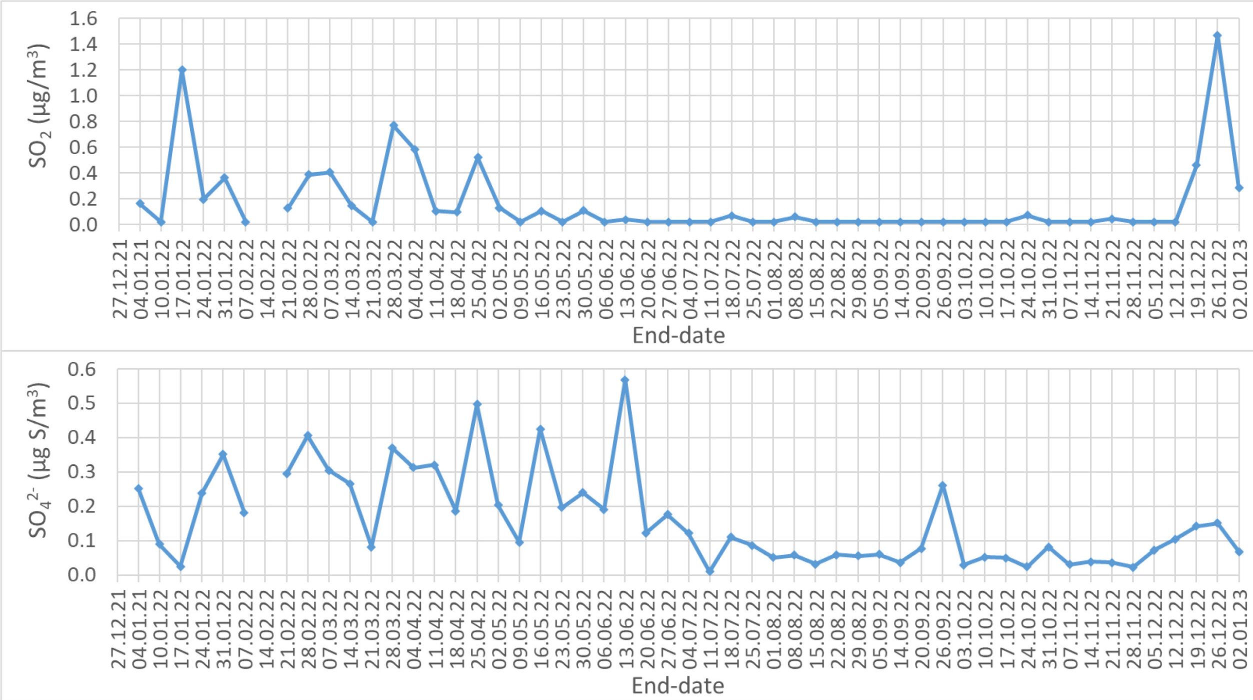


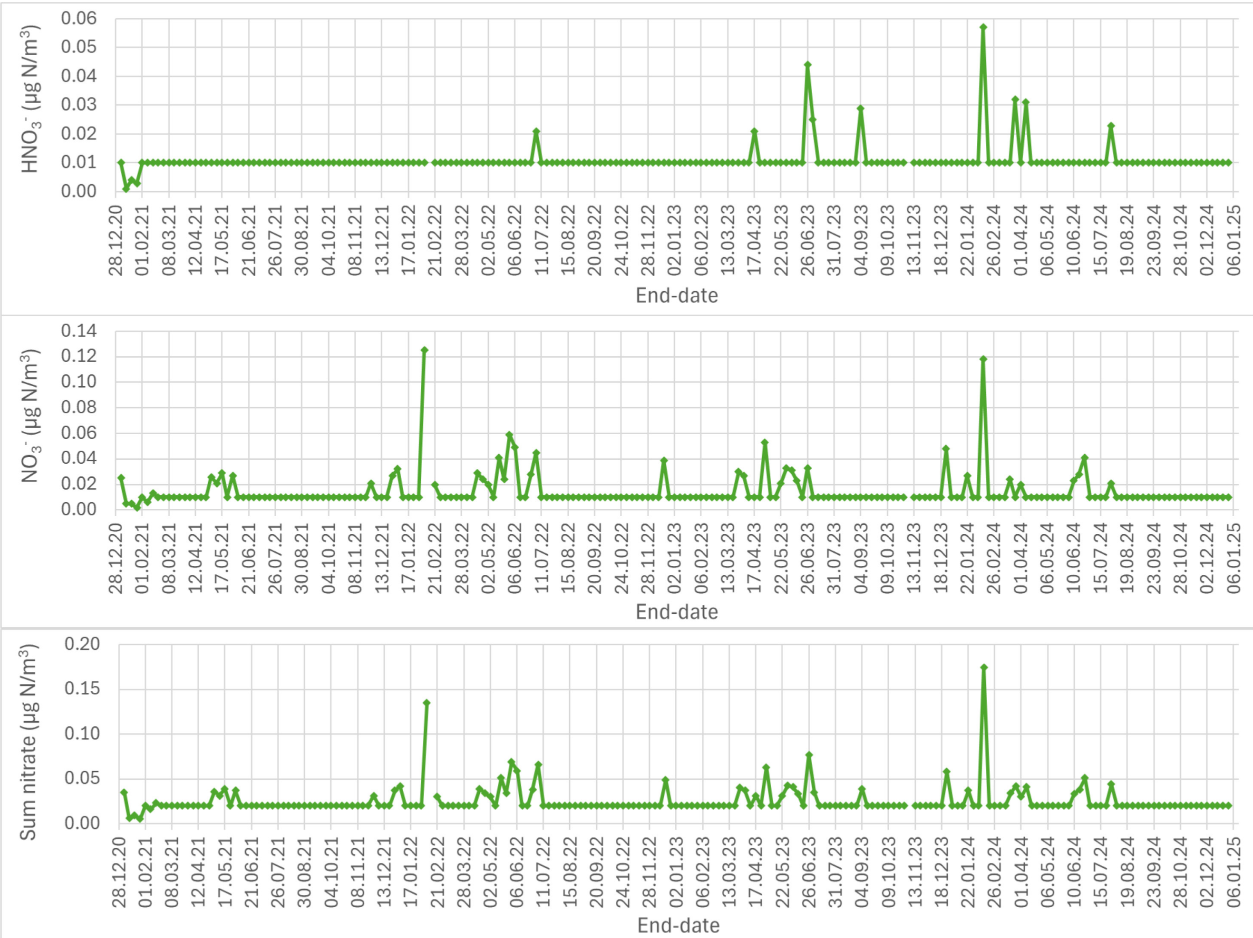




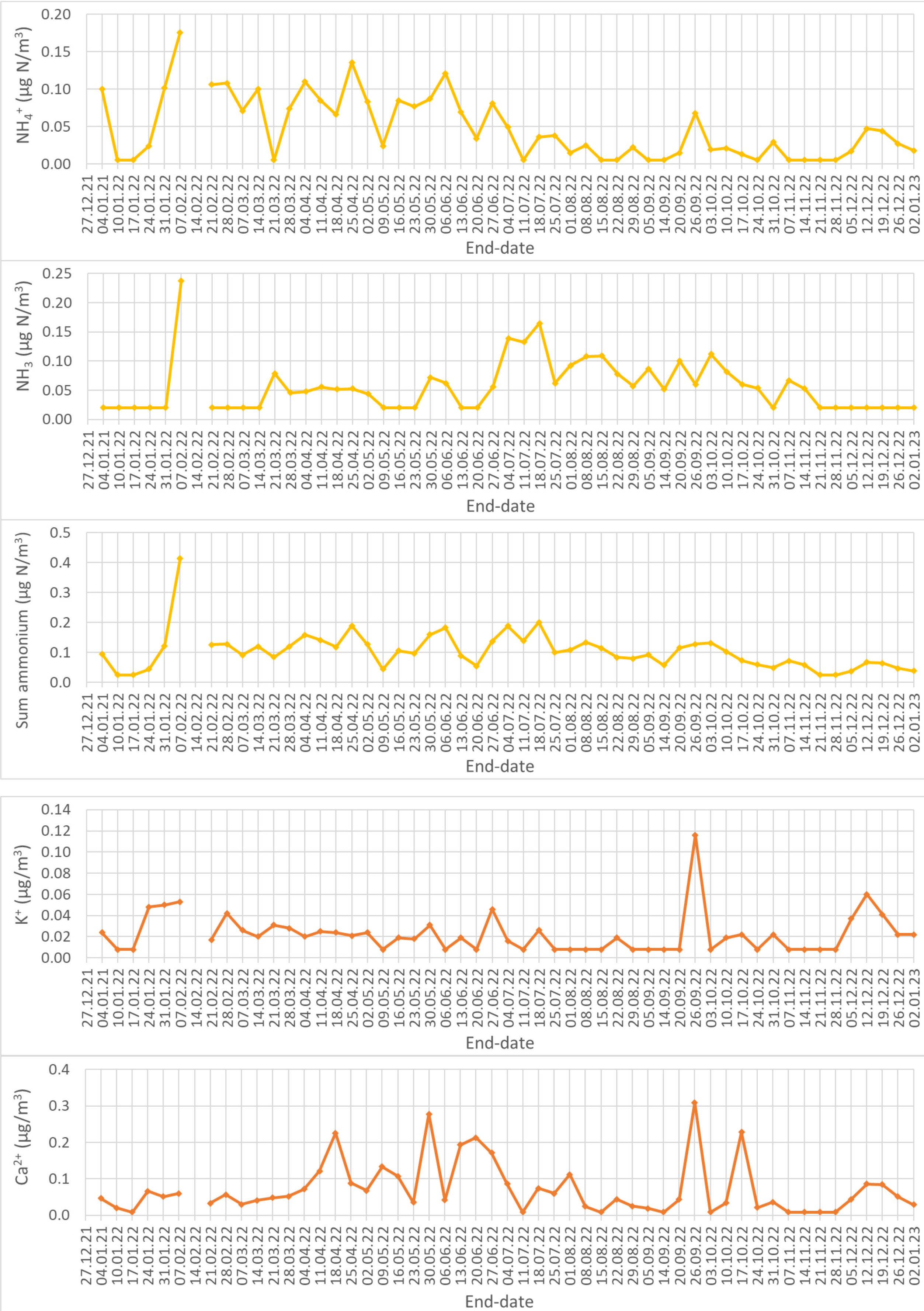


Analysis results of weekly filter sampling at Transformatorbua, Ny-Ålesund 1.1.2021-31.12.2024.





Analysis results of weekly filter sampling at Transformatorbua, Ny-Ålesund 1.1.2021-31.12.2024.



Analysis results of weekly filter sampling at Transformatorbua, Ny-Ålesund 1.1.2021-31.12.2024.