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Norsk institutt for luftforskning
Norwegian Institute for Air Research

Air Quality Ny-Ålesund

Monitoring of Local Air Quality 2008-2010
Measurement Results

Ove Hermansen, Jan Wasseng, Are Bäcklund[1]
Johan Ström, Birgitta Noon, Tabea Hennig[2]
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Scientific report

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[2] Department of Applied Environmental Science, Stockholm University
[3] Norwegian Polar Institute

Preface

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

To achieve this, 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.

A comprehensive infrastructure and logistics is required to enable the extensive research activities in and around Ny-Ålesund. This can not be done without any impact on the environment.

The project Local Air Quality Monitoring in Ny-Ålesund was started in July 2008. The main purpose of the project is 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 station.

Contents

Summary

A selected number of air pollutants has been monitored in Ny-Ålesund to map the local emissions of air pollutants and to map the air quality of the area.

National health limits has not been exceeded during the measurement period for any of the compounds monitored.

As expected, the power station is a major source of nitrogen oxides in Ny-Ålesund. Measurements during the period do however indicate that boat traffic (cruise ships and larger transport vessels) might contribute even more to the levels of nitrogen oxides.

Nitrification of soil in the surroundings of Ny-Ålesund from local emissions is low, but may have an impact on biology in this pristine arctic environment.

Sulphur dioxide-levels are generally low. Some episodes of elevated levels occur during visits of larger vessels. The major source of SO_2 is long range transport of polluted air. Acidification from sulphuric compounds are low.

The measured levels of aromatic hydrocarbons (BTX) are generally low. Some peak values occur during the snowmobile season.

Parallel soot and particle measurements in Ny-Ålesund and at the Zeppelin monitoring station indicate very little influence from emissions in Ny-Ålesund, thanks to topography and local meteorology. Emissions from larger vessels further east into the Kongsfjord however has on several occasions been detected at the Zeppelin monitoring station.

Air Quality in Ny-Ålesund
Monitoring of Local Air Quality 2008-2010

1 Background

The purpose of this project is to investigate air pollution from local sources such as car traffic, the power station, boat traffic etc. Measurement results are used to look at possible environmental impact from all activities in the area and to investigate any influence on scientific measurement activities in Ny-Ålesund and its surroundings.

2 Measurement programme

A number of compounds were selected to be monitored over a longer period. Emphasis is put on monitoring of compounds related to fuel consumption such as CO, NO_x and BTX (benzene, toluene, xylene). SO_2 has also been monitored as an indicator of pollution originating from larger marine vessels.

A combination of in situ measurements using continuous monitors with high sampling frequency (1-15 mins) and samplers with longer sampling periods (1-2 weeks) and lower detection limits.

Compound	**Description**	**Sampler**	**Sampling time**
CO	Carbon monoxide	Monitor	1-5 min
NO_x	Nitrous oxides	Monitor	1-5 min
SO_2	Sulphur dioxide	Monitor	1-5 min
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	1 week
BTX	Aromatic compounds	Monitor Passive samples	15 mins 2 weeks
Black Carbon	Particles and soot	Monitor	Cont.
Meteorology	Temperature, wind direction, wind speed, rel. humidity	Automatic weatherstation	1 min

The local air quality measurement programme

The filter sampler for gaseous and particle bound inorganic compounds was operated for one year.

3 The station

The measurement station is located close to the centre of Ny-Ålesund, slightly downwind, to provide representative measurements of the air quality in Ny-Ålesund.

Kings Bay got a permission from the Directorate for Cultural Heritage in Norway to install a mobile monitoring station at the given location in the summer of 2008. The permission was granted for a maximum period of two years.

Figure 1: The monitoring station is a mobile hut located in "Hyttebyen" in the centre of Ny-Ålesund.

The measurements were stopped mid August 2010 when the permission expired. There are plans to establish a permanent measurement station at the same location, but at the moment there is no funding available.

3.1 Nitrogen oxides NOx

The power station in Ny-Ålesund is a major source of nitrogen oxides. It is located north of the monitoring station and the measured levels are closely related to the wind direction.

High levels were measured during the winter when the power consumption is higher due to heating of buildings in Ny-Ålesund. The highest levels were however measured during late summer, indicating that boat traffic (cruise ships and larger vessels) might be the largest source of nitrogen oxides.

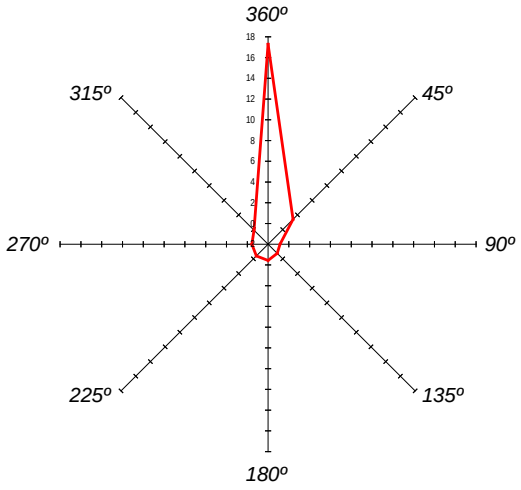


Figure 2: NOx-levels vs. wind direction

The overall levels of nitrogen oxides are well below the limits stated by national health standards which were never exceeded during the monitoring period.

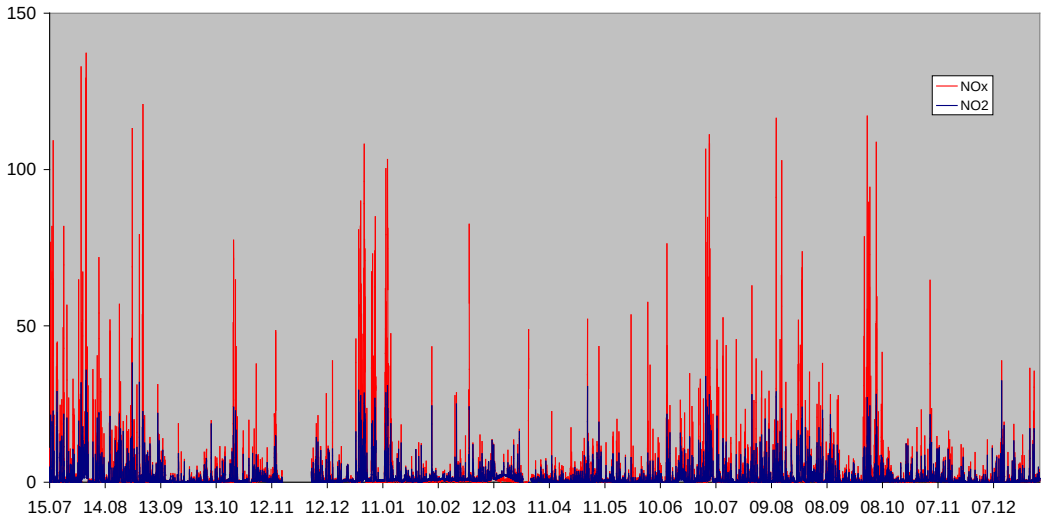


Figure 3: Hourly averages of NO2/NOx

Nitrification of soil in the surroundings of Ny-Ålesund from local emissions are low due to slow reaction rates of NOx. However, since nitrogen is a limiting factor for plants and microbes in the arctic, small changes may have an impact on plant community composition and production.

3.2 Sulphur dioxide SO_2

There should be no major source of SO2 in Ny-Ålesund due to strict regulations of sulphur content in fuel for motorised vehicles and for the power station.

Measured levels in Ny-Ålesund are low with some slightly elevated levels during wintertime due to long range transport of polluted air. Measurements in Ny-Ålesund are mostly comparable to measurements at the Zeppelin station.

During summer and fall there are some episodes of elevated levels coinciding with visits of larger vessels. These episodes have not been detected at Zeppelin.

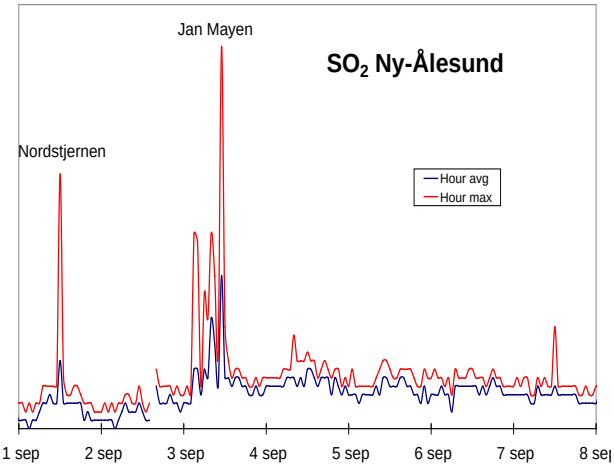


Figure 4: Increased SO2-levels during vessel calls

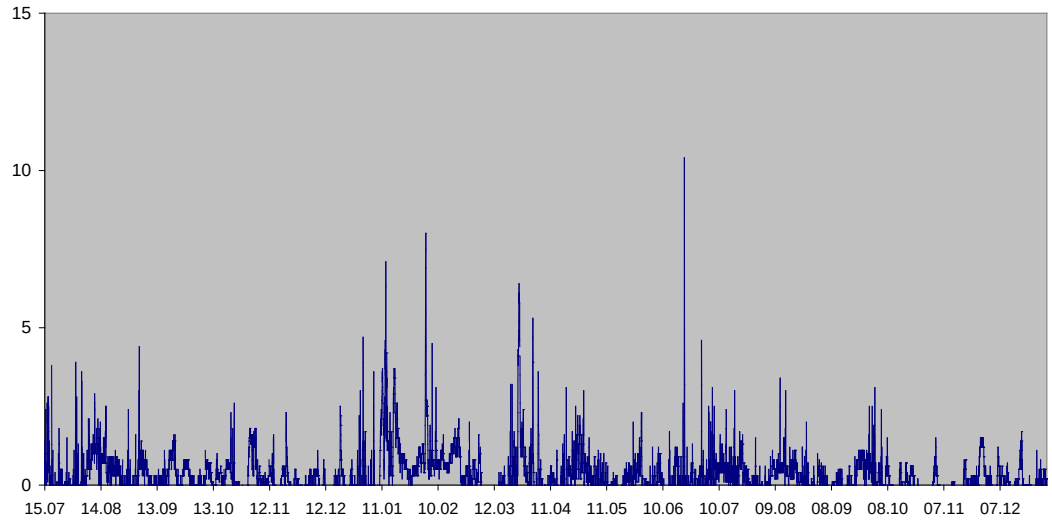


Figure 5: Hourly averages of SO_2

3.3 Other inorganic compounds

A filter sampler for gaseous and particle bound inorganic compounds were in operation at the measurement station for one year.

All compounds were measured at low levels with sea salt as the dominating ionic compound. Some elevated levels were detected for some compounds during summer due to mineral dust from road work.

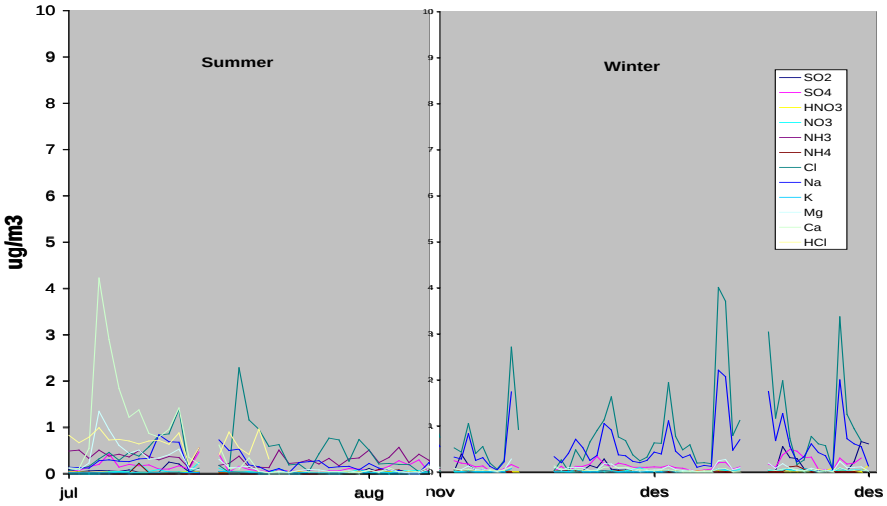


Figure 6: Typical summer and winter levels of main inorganic compounds.

3.4 Aromatic hydrocarbons BTX

The main source of BTX is gasoline and diesel released from combustion engines. A recent study from Longyearbyen shows that snowmobiles with two stroke engines can be a major pollution source, due to incomplete combustion. The total number of such vehicles in Ny-Ålesund is low and the local topography helps dispersing the pollutants, giving overall low concentrations of such compounds in the air.

3.5 Soot and particles

Black carbon measurements have been monitored in parallel at the measurement hut in Ny-Ålesund and at the Zeppelin station. Interesting features in the data are the very clear diurnal pattern in the emissions and that concentrations remain high many times when one would expect more similar values (e.g. middle of the night). On average there is about a factor of 10 difference between the two sites.

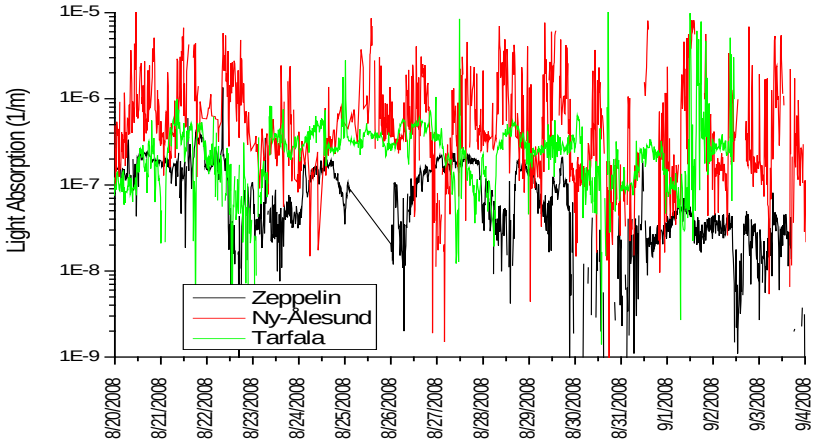


Figure 7: Comparison of black carbon data from the Zeppelin station, measurement hut in Downtown Ny-Ålesund, and from the Tarfala research station in northern Sweden.

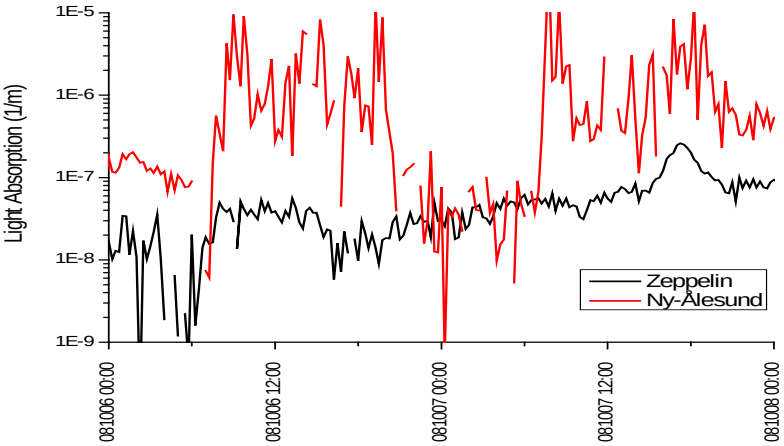


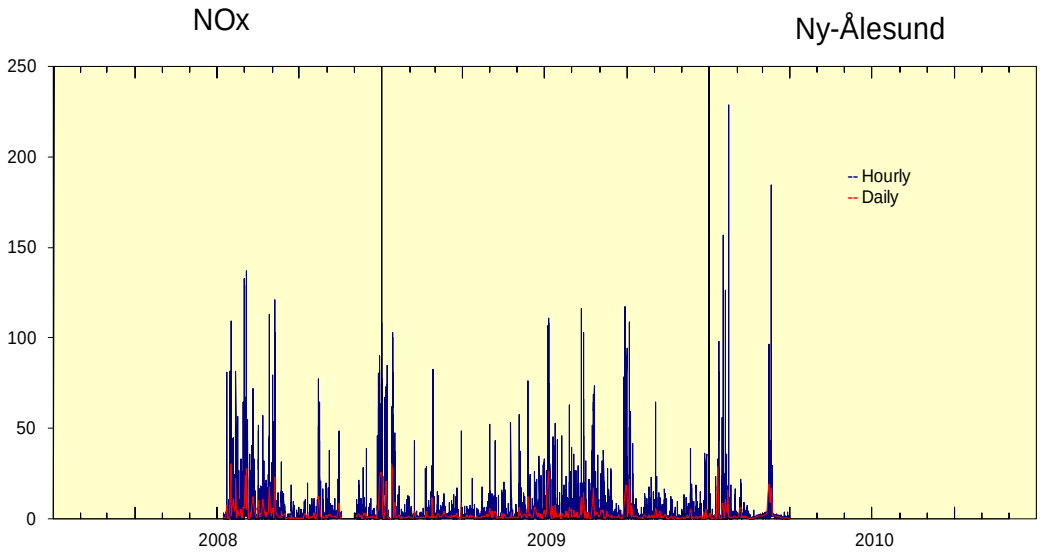
Figure 8: Two days of data showing how the concentrations at Zeppelin and Downtown merge during the night time

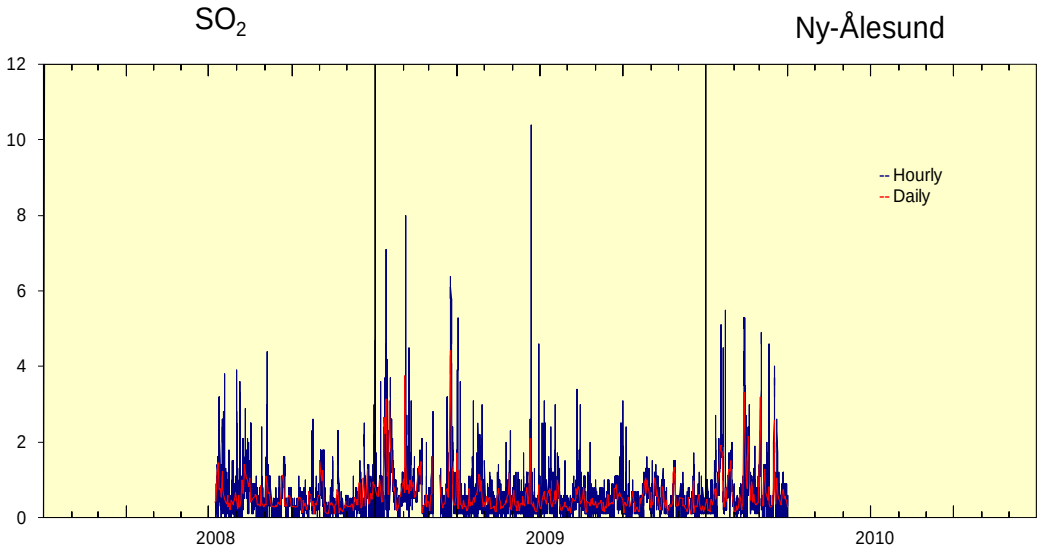
Over all the measurements at the Zeppelin station seems to be little influenced by activities in Ny-Ålesund and by vessels arriving by sea. Some elevated levels of BC have been detected at Zeppelin during traffic of larger boats further east into the Kongsfjord.

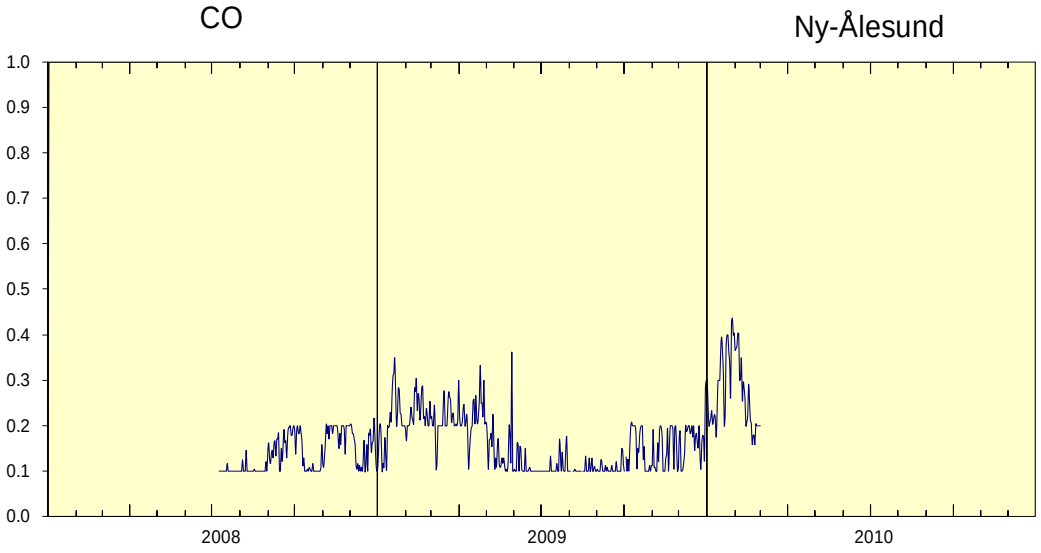
Appendix A

Measurement data

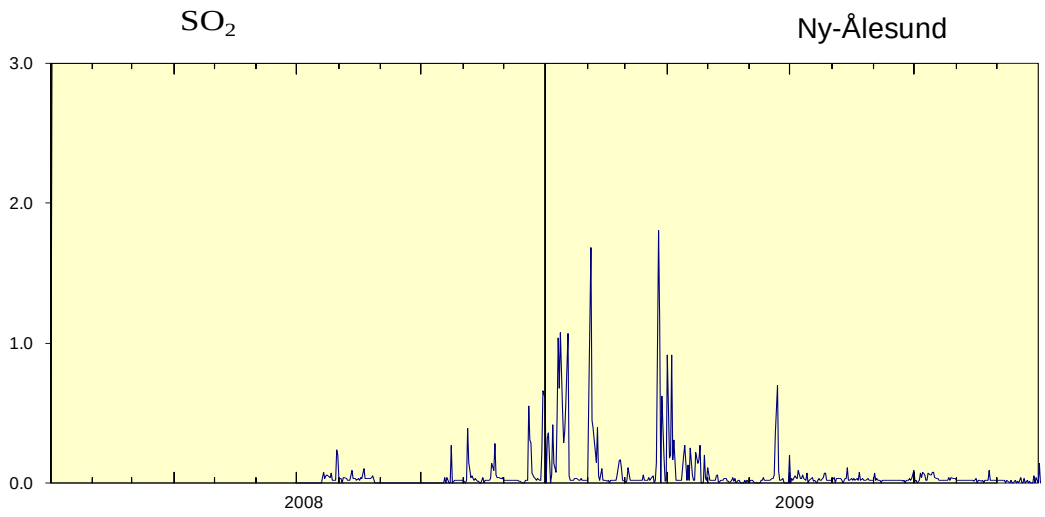
Monitor measurements Ny-Ålesund

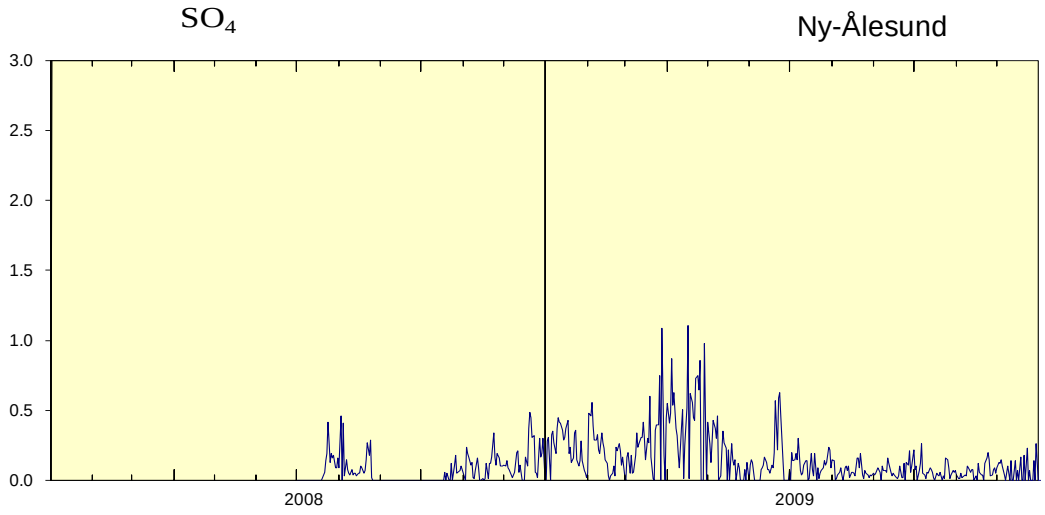


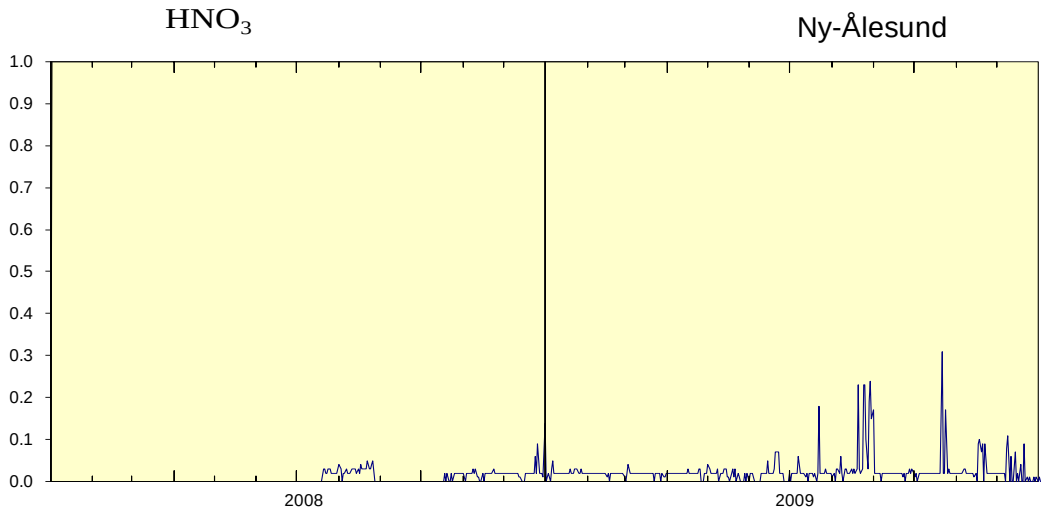


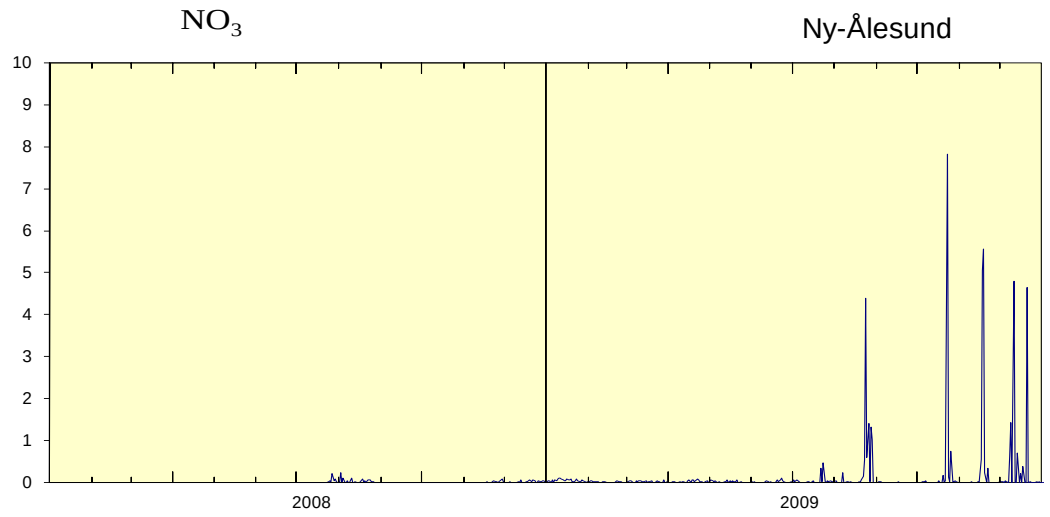


Filter sampling Ny-Ålesund





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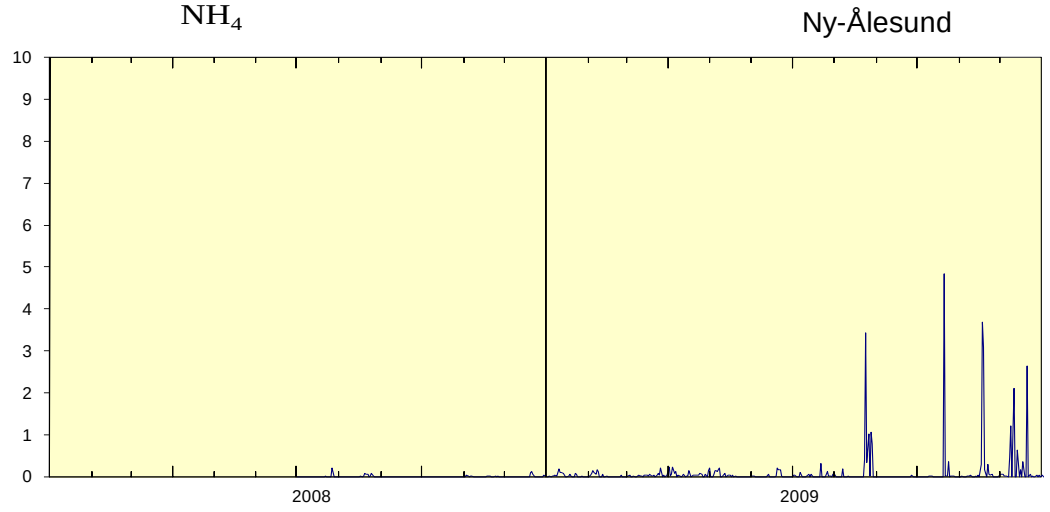
Ny-Ålesund
10
9
8
7
6
5
4
3
2
1
0
2008
2009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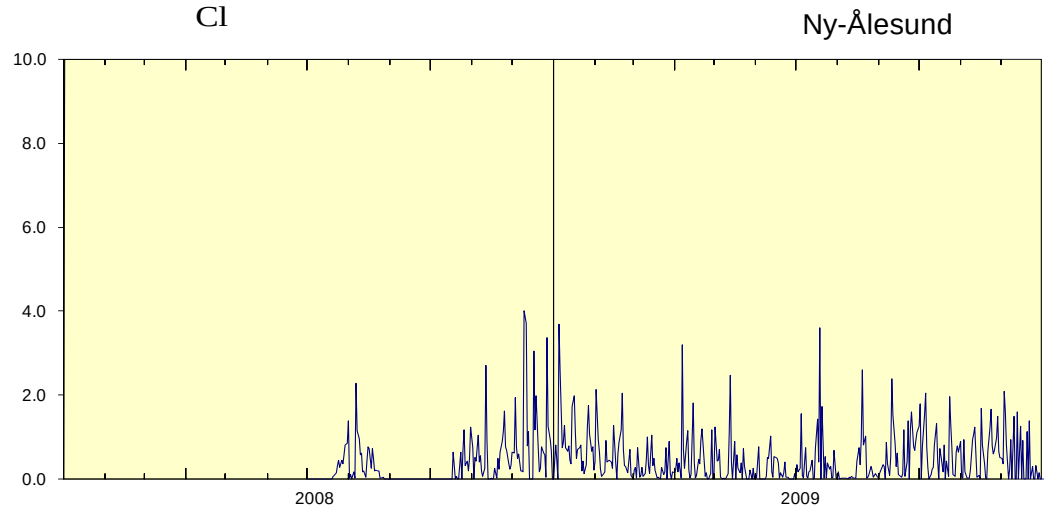
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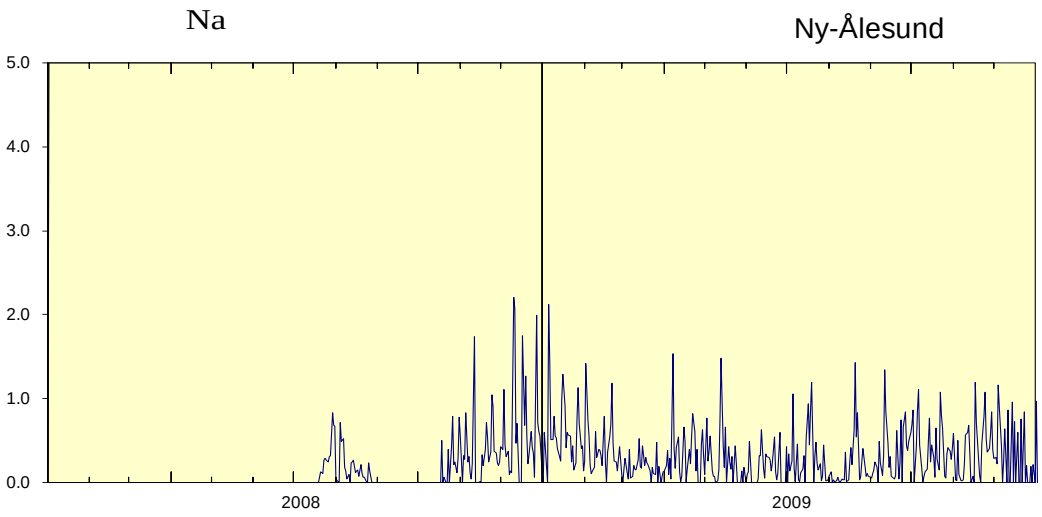
2008
2009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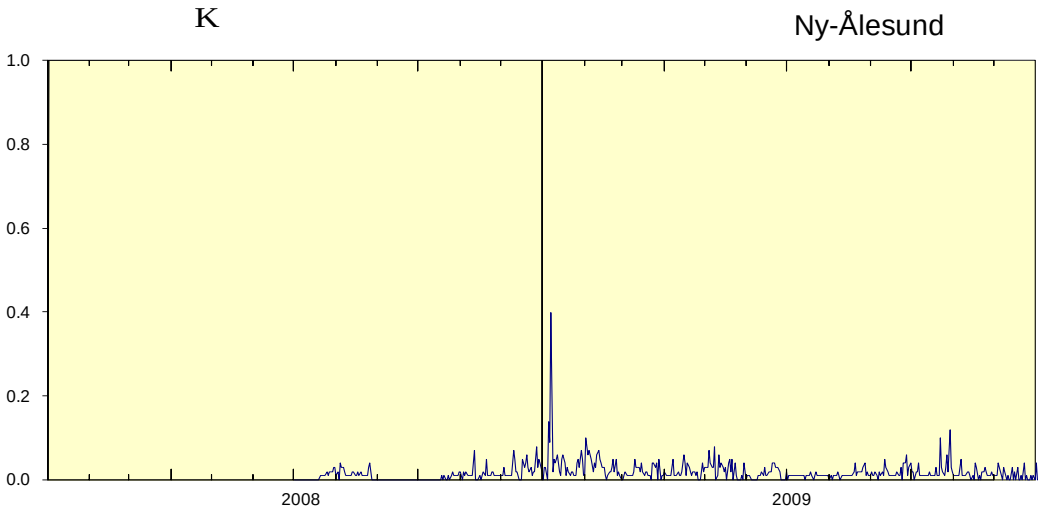
2008
2009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0.0
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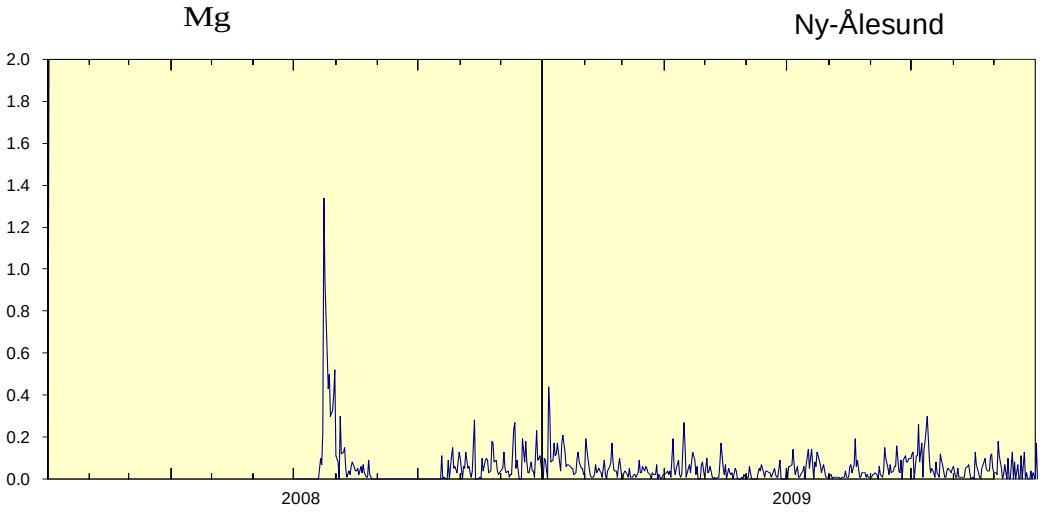
2009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1.4
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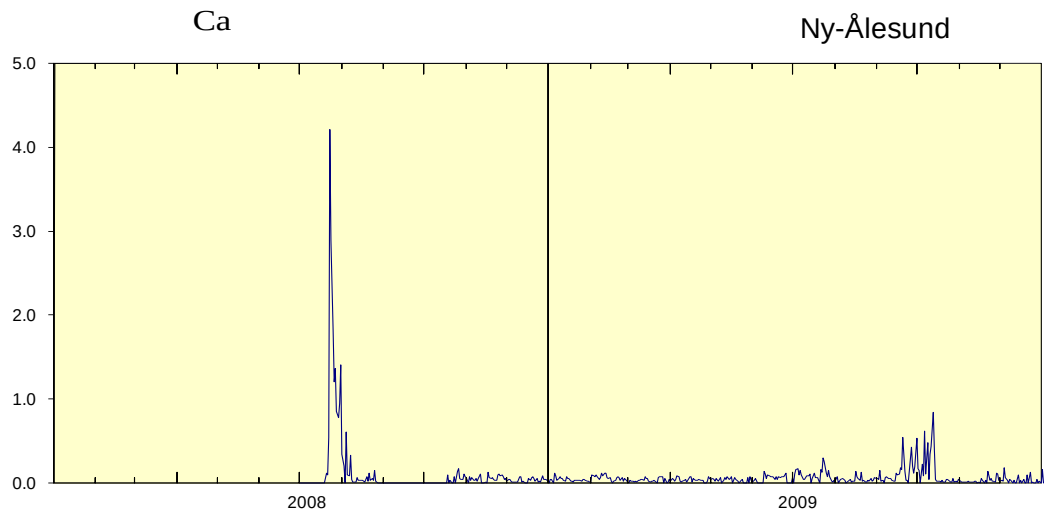
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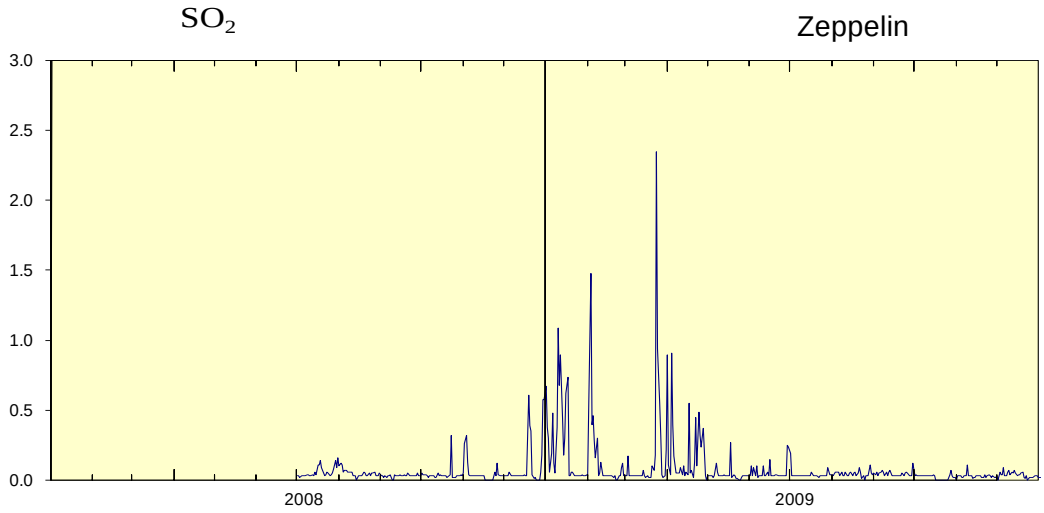
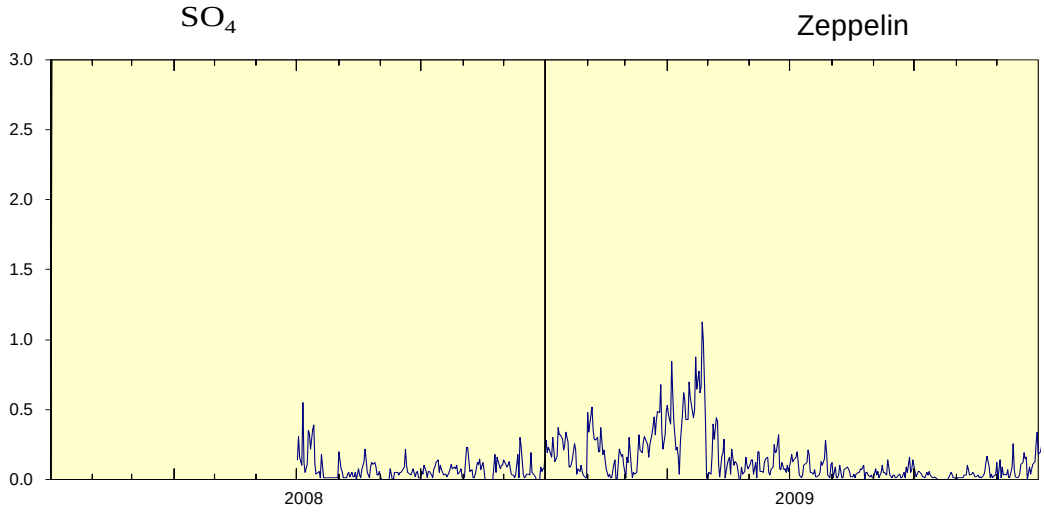
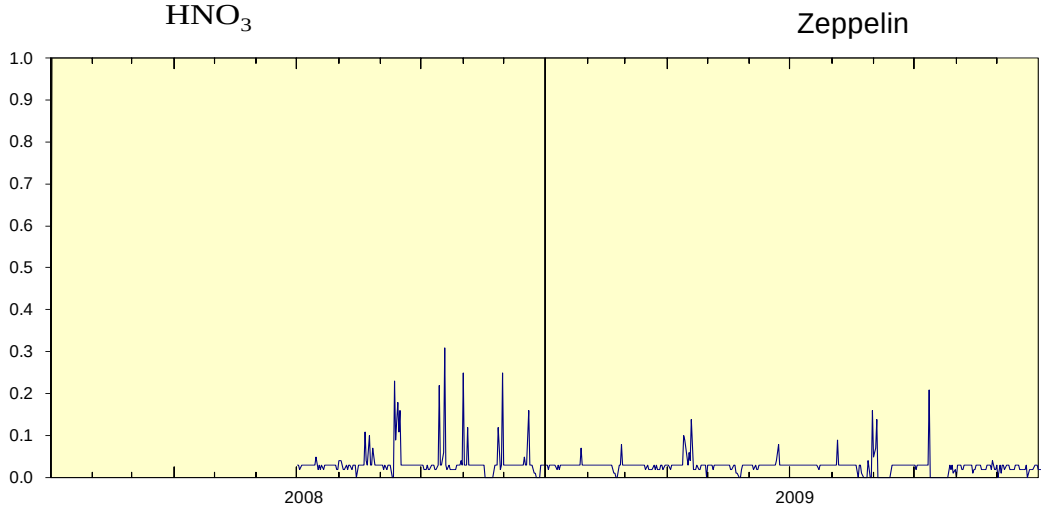
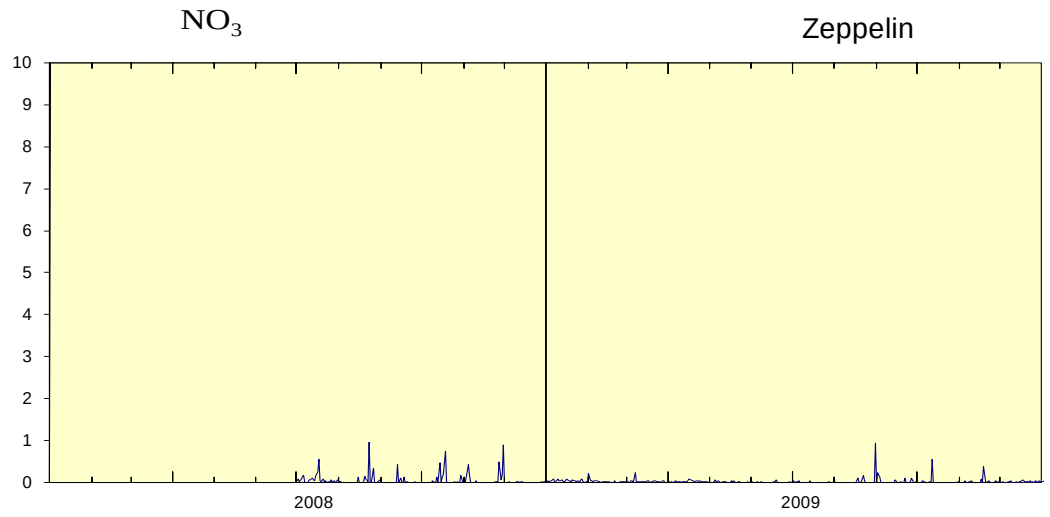
2008
2009

Filter sampling Mt Zeppelin





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Zeppelin
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9
8
7
6
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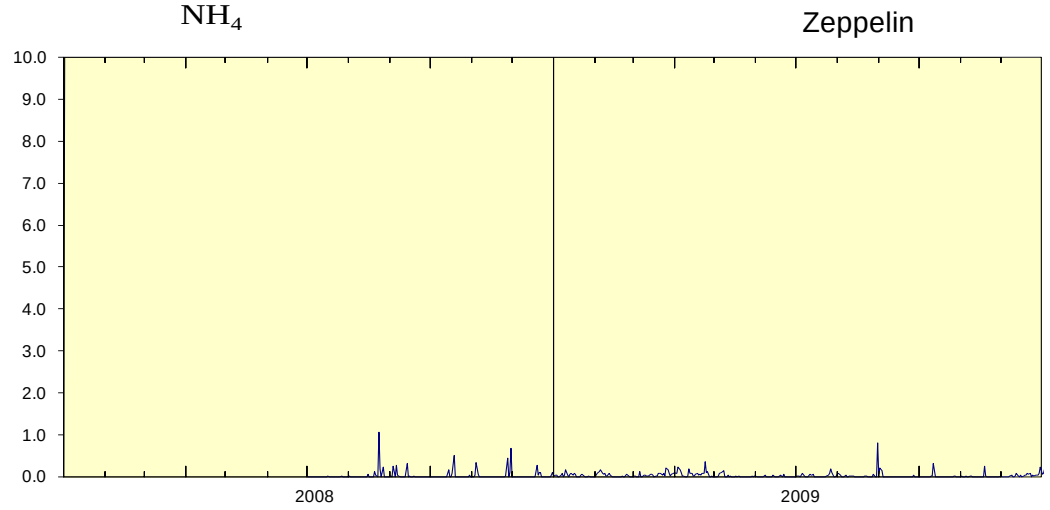
3
2
1
0
2008
2009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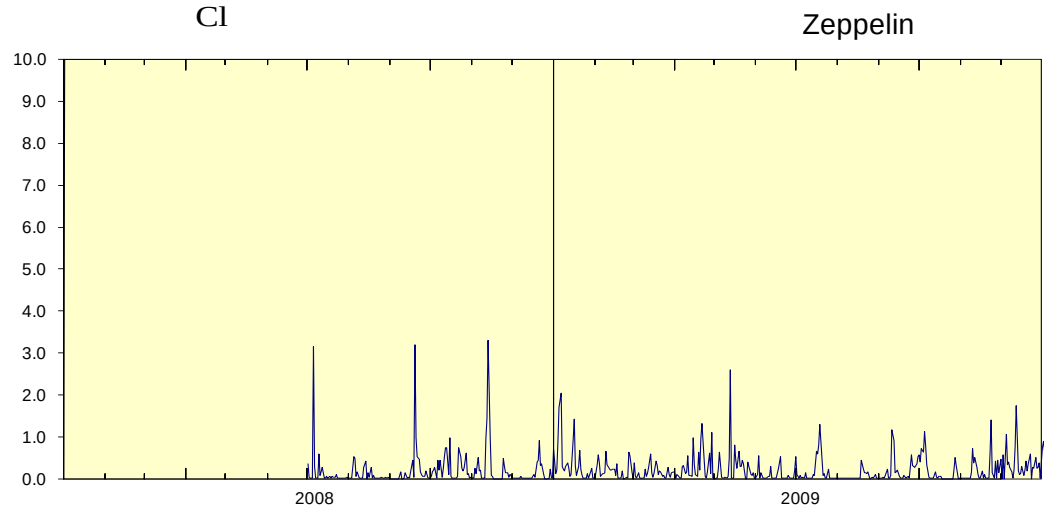
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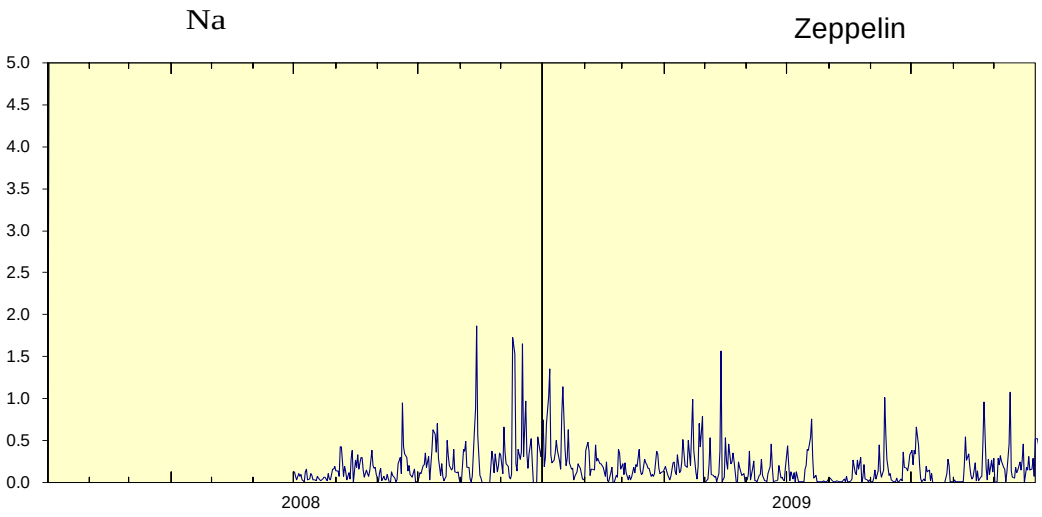
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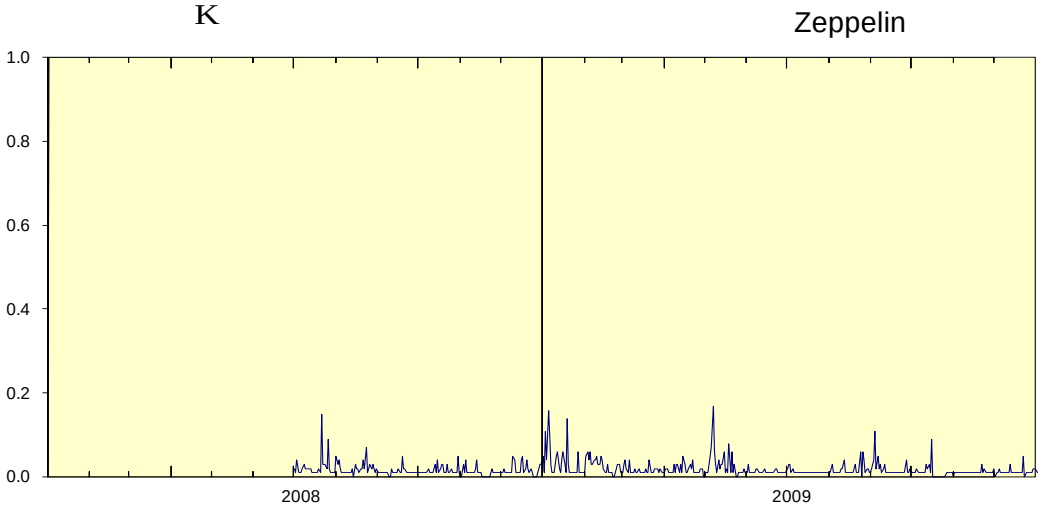
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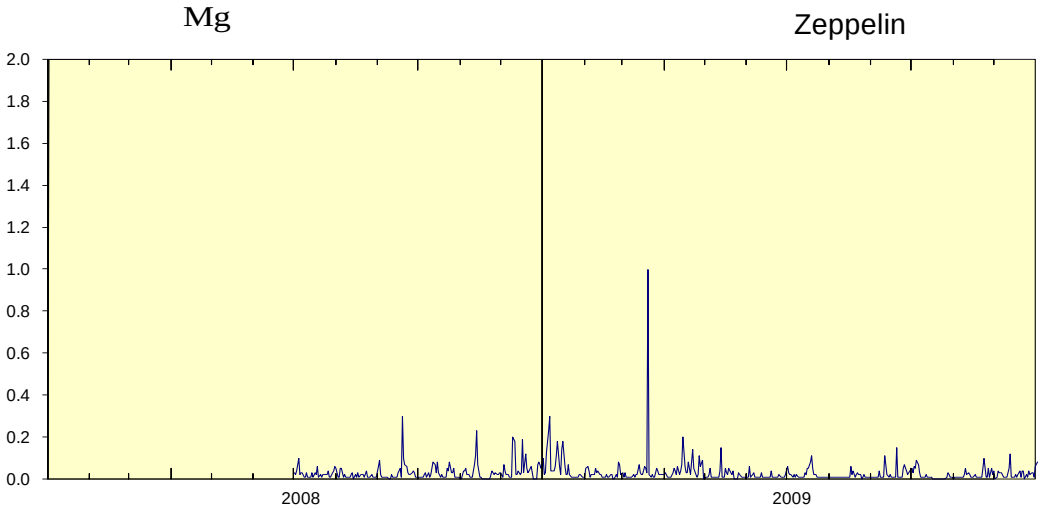
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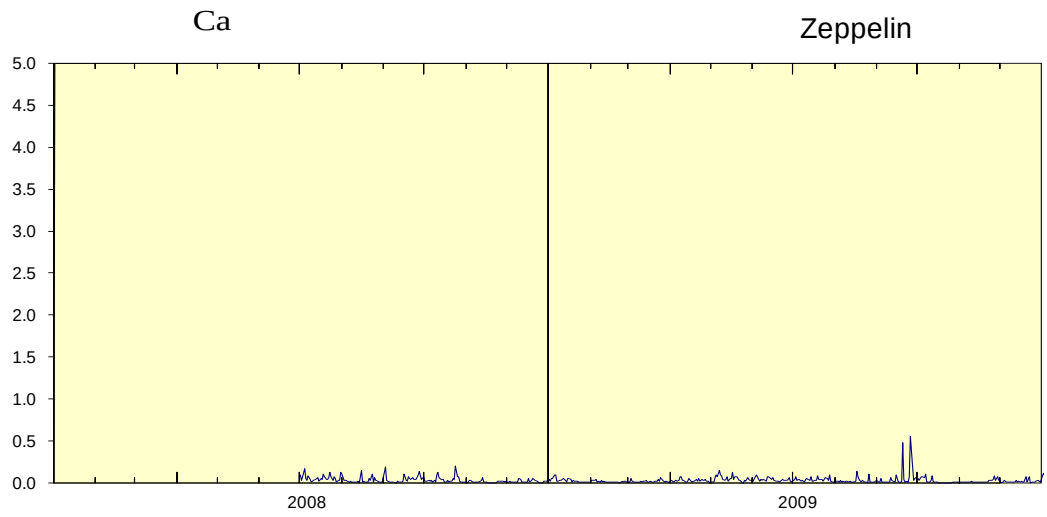
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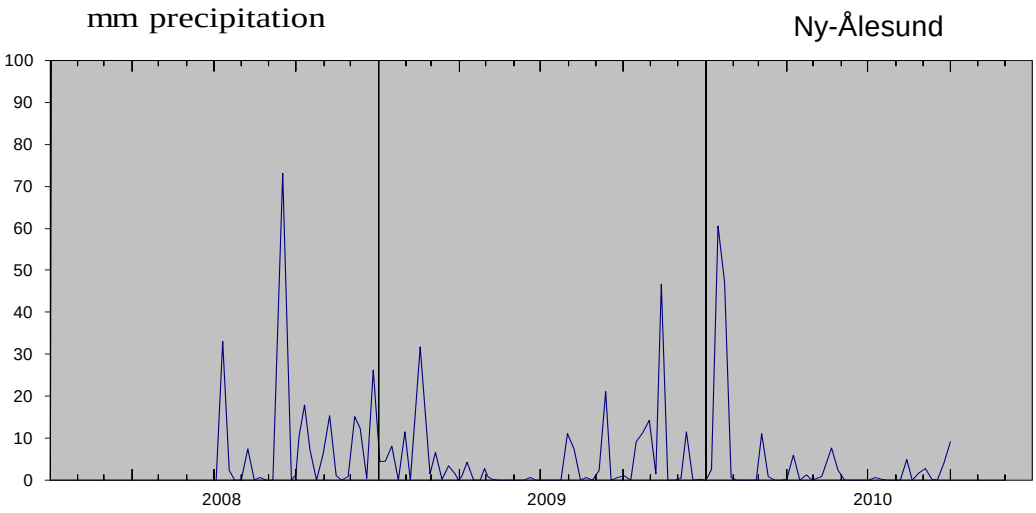
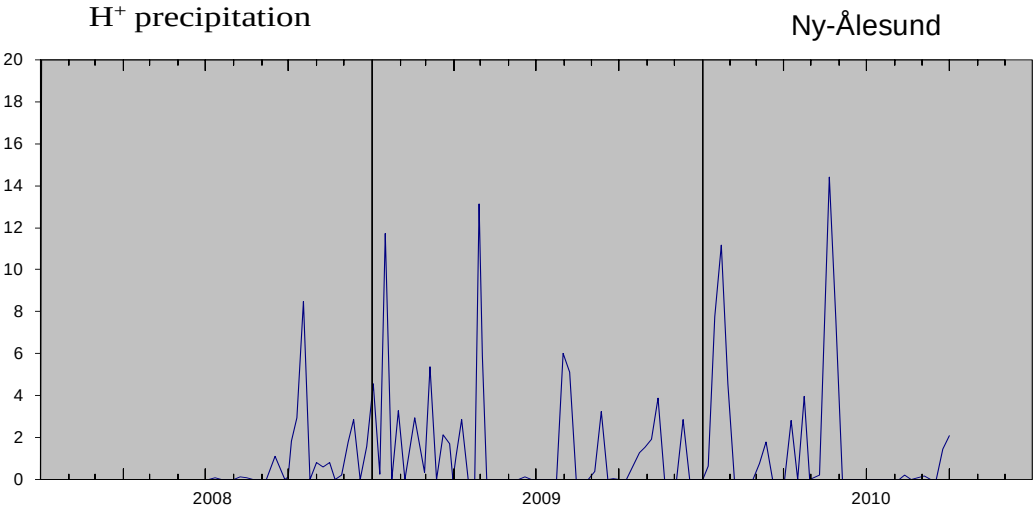
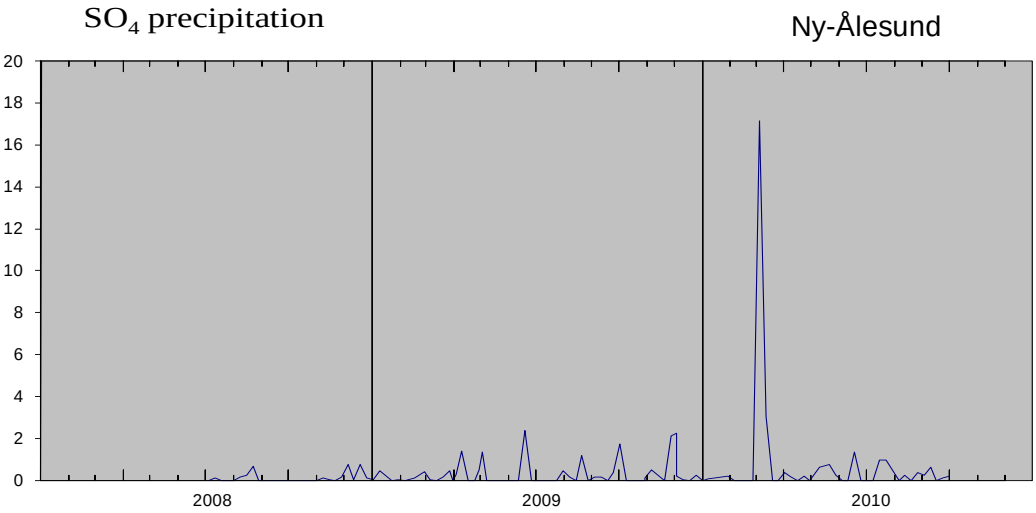
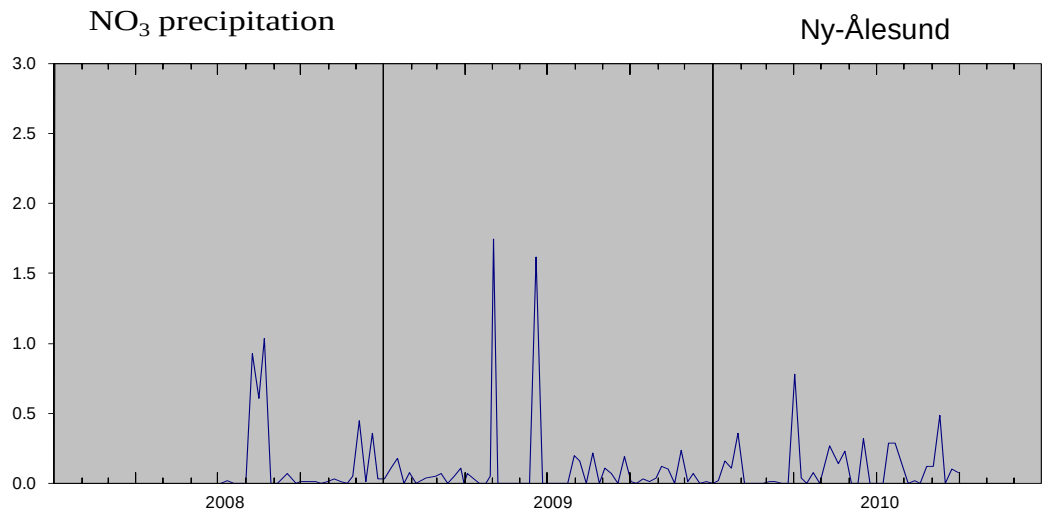
2008
2009

Precipitation sampling Ny-Ålesund





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2009
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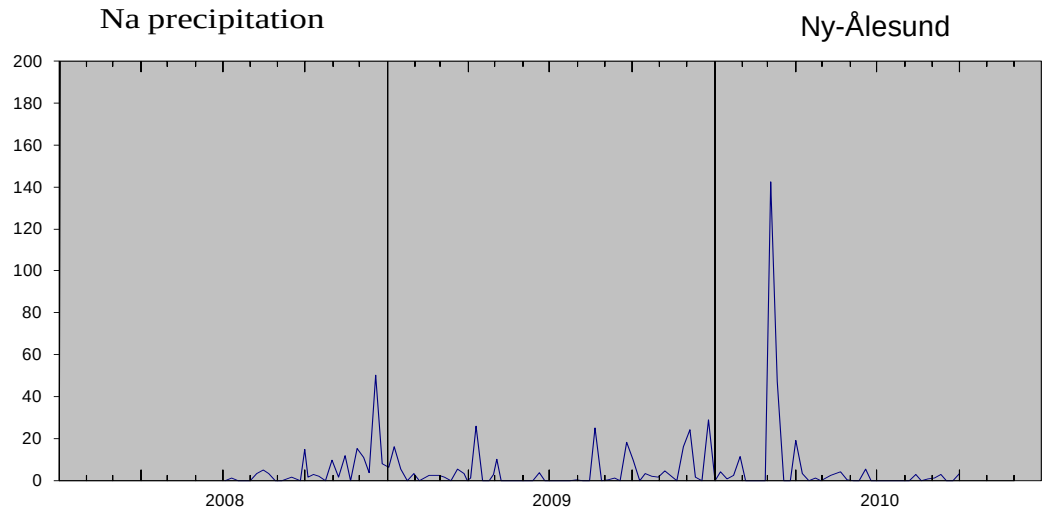
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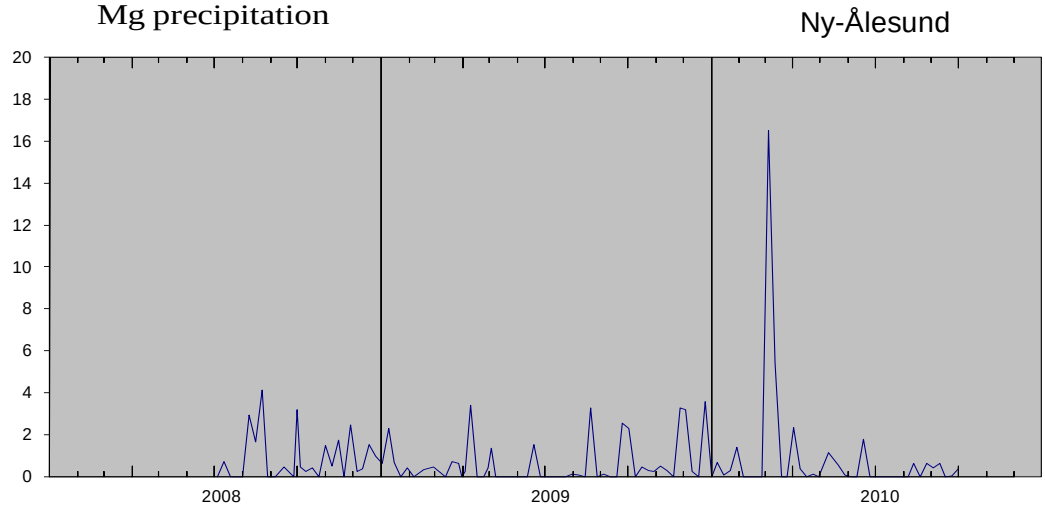
2008
2009
2010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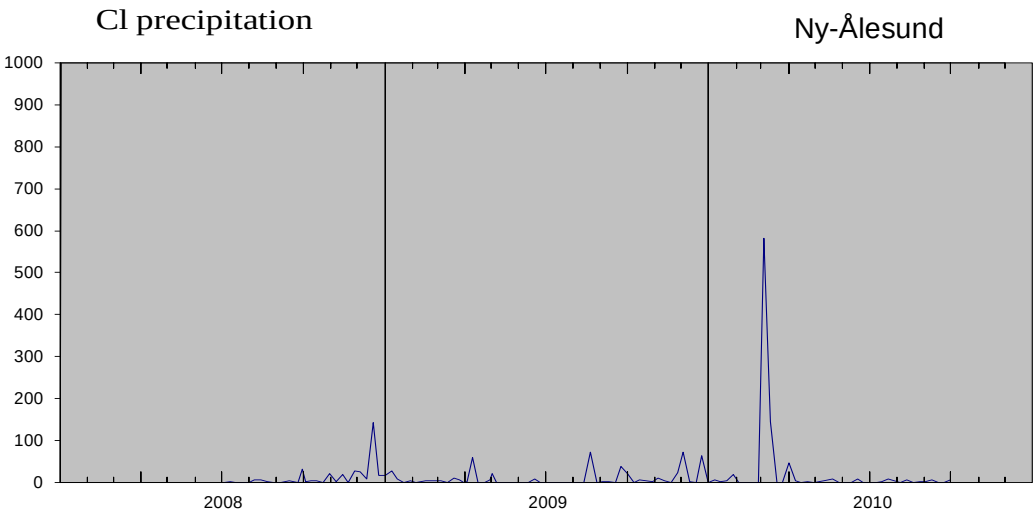
Cl precipitation
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700
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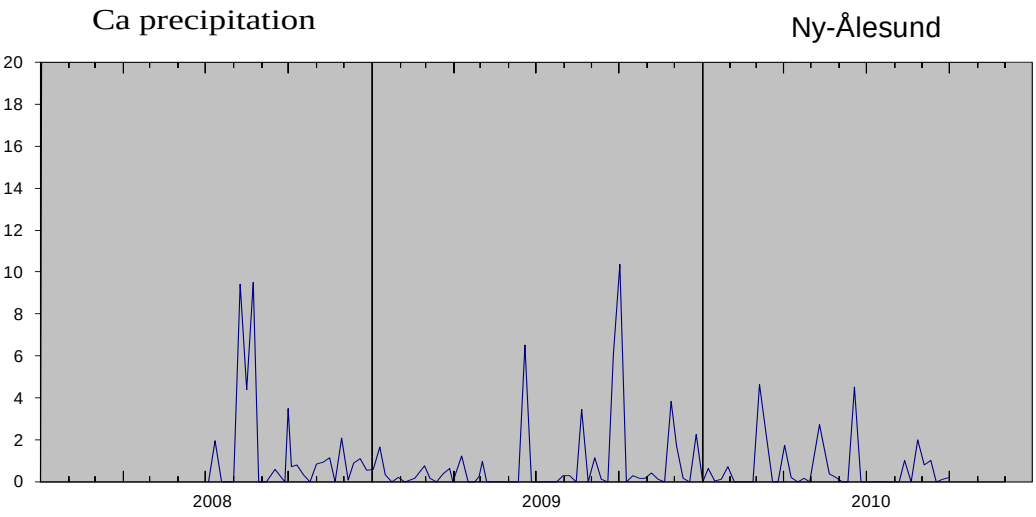
2009
2010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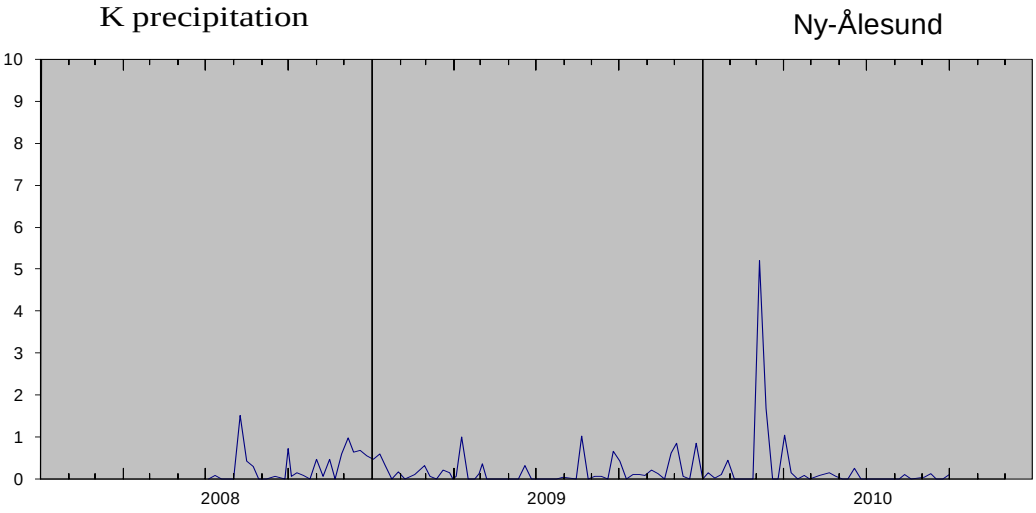
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AUTHOR(S) Ove Hermansen, Jan Wasseng, Are Bäcklund, Johan Ström, Birgitta Noon, Tabea Henning, Dorothea Schultze, Vigdis Lonar Barth	CLASSIFICATION * A CONTRACT REF. -

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ABSTRACT

A selected number of air pollutants has been monitored in Ny-Ålesund to map the local emissions of air pollutants and to map the air quality of the area.

NORWEGIAN TITLE

KEYWORDS		
Air quality	Environmental monitoring	Polar regions

ABSTRACT (in Norwegian)

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