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Christina A. Pedersen (ed.)

Report from the Ny-Ålesund Seminar

Tromsø, Norway, 23-25 September 2015

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Summary

Eighty-three participants from twelve countries attended the three-day Ny-Ålesund seminar 23-25 September 2015 at the Fram Centre in Tromsø. The seminar focused on research and monitoring in Ny-Ålesund in particular, and Svalbard in general.

The Ny-Ålesund seminar is a biannual meeting for scientists whose research and monitoring activities take them to Ny-Ålesund and Svalbard. The seminar serves the dual purpose of providing a meeting place to exchange scientific results, advances, and ideas and fostering coordination and collaboration among researchers in Ny-Ålesund.

The 2015 seminar focused on research and monitoring within the four programme areas established for Ny-Ålesund: the Atmosphere Flagship, the Kongsfjorden System Flagship, the Terrestrial Ecology Flagship, and the Glaciology Flagship. In addition, there was a special session on how to connect the research and monitoring done in Ny-Ålesund with activities in the rest of Svalbard and beyond. This session included keynote presentations on ongoing activities in Hornsund, Barentsburg and Longyearbyen.

The seminar had sixty presentations in total, which spanned from space weather to number size distribution of aerosols, from tundra ecosystem monitoring to microbiota, from migration of the arctic skua to the bathymetry of Kongsfjord, from snow and ice archives to calibration-validation for glacier mass balance.

The last day of the seminar had four parallel sessions, one for each flagship. The Atmosphere Flagship arranged its own Atmosphere Symposium, with scientific presentations and discussion, while the three other flagships had workgroup discussions dealing with future prioritised tasks for the flagships, and flagship organisation. All four flagships now have updated lists of prioritised topics and/or projects, and have developed a flagship structure with a scientific chair, co-chair and scientific committee.

A major outcome of the discussion from the Atmosphere flagship programme was the determination of the further progress for the programme. In particular, the participants agreed that the atmosphere flagship, in order to facilitate and encourage the cooperation within the flagship, should form smaller work groups focusing on specific scientific questions of common interest. The formation of such work groups should be transparent and participation should be open to any of the Ny-Ålesund research groups. Also new groups could be formed when suggested. The working groups should each have a clear focus and goals. The following working groups have so far been identified:

- Clouds and local – regional short term processes
- Long-term observations and trends in temperature, precipitation, clouds, and radiation
- Boundary layer meteorology

- Aerosols (black carbon) and snow
- Atmospheric aerosols
- Variability in surface UV irradiance and ozone column

It was further agreed to submit another proposal to Svalbard Strategic Grant to support the Atmosphere Flagship Programme in the next two years 2016-17. The proposal was submitted asking for support of the flagship programme and the above mentioned six work groups in particular.

The Terrestrial Ecosystem Flagship group discussion outlined the four scientific topics that capture the current and future directions of the flagship; High-Arctic model ecosystem, terrestrial food webs, external drivers (abiotic and biotic), and adaptations to changing conditions in the Arctic. This flagship also intends to organize their work into three operational work-packages. The work-packages overlap thematically to some degree, and may be viewed as three integrated components of the revitalised terrestrial flagship programme:

- Ecosystem
- Ecosystem-based adaptive monitoring COAT
- Adaptations of organisms to Arctic environments and its seasonality

In addition, infrastructure and funding needs were identified. The next action points decided upon for the flagship are a common research proposal, integrative papers, and establishment of common long-term monitoring sites at landscape level.

The Kongsfjorden System Flagship group discussion started by reviewing the research priorities from 2008, when the flagship programme was established, to assess where there had been good progress and where there had not. The flagship further agreed on five points which summarised the research priorities:

- Modelling of the Kongsfjord ecosystem
- Land-Fjord interactions
- Seasonality and seasonal drivers of Kongsfjord ecosystem functioning (including the role of sea ice cover and dynamics)
- Biodiversity changes and adaptations in Kongsfjorden
- Kongsfjorden in a pan-Arctic perspective

Participants in the flagship agreed that in order to work together in a concerted effort on research projects, the ground must first be laid in joint workshops, preferably including participants from other flagships as well. Four prioritised workshops were agreed on, and a proposal for a workshop on “Adaptation to environmental changes in the Arctic” was submitted to the Svalbard Strategic Grant programme in November.

A review of knowledge gaps, and updating the status on the flagship topics was the starting point for the Glaciology Flagship group discussion. The important topics are listed as mass balance, dynamics, hydrology, snow, ice cores, and biochemistry. The group suggested improving integration through use of data repositories, and increasing the communication between the

national groups, as means to increase the coordination. The results can be summarised by the following six items:

- Improve cooperation between groups, with some direct suggestions on how to do that
- Investigate future funding possibilities
- Comparison of mass balance data (planned workshop and Symposium)
- The need for a hydrology station
- Common airborne photographic campaigns
- Required flagship webpage updates

Last autumn NySMAC updated their webpages, and the four flagships now have individual flagship webpages, all available from http://nysmac.npolar.no/research/flagships/. The complete workgroup reports, updates, and common e-mail lists will be available from the webpages.

The Ny-Ålesund seminar as a whole was seen as a particularly successful event. It both fostered new discussion among international participants, continued the discussions within the flagships, and laid the fundament for future common scientific publications, field work and cooperations.

The Ny-Ålesund seminar including the special session Atmosphere Symposium received financial support from the Research Council of Norway through the MILUTV-ARENAER and Svalbard Strategic Grant calls, respectively. Additional support was received from the Norwegian Polar Institute.

Seminar participants in Tromsø. Photo: Ann Kristin Balto, Norwegian Polar Institute

Report from the Kongsfjorden System Flagship Group discussion

Participants: Geir W. Gabrielsen (Chair), Sebastien Descamps (referent), Sebastian Gerland, Kai Bishop, Francisco Ardini, Maria Granberg, Verena Mohaupt

Joined later: Pedro Duarte, Marzena Kaczmarska, Caixin Wang, Vittorio Pasquali

This list of participants is referred as "*the group*" hereafter in this document.

Organisation of the flagship

NySMAC suggests to have a leader and a co-leader, a scientific committee and some working groups.

Kai Bishop has accepted to be the leader of the Kongsfjorden System Flagship. Geir Gabrielsen has accepted to be the co-leader of the flagship. The group emphasised the value of having not only biologists in the flagship leading group and committee. All fields within marine science should be represented in the group.

The scientific committee should have 4 to 5 members. Haakon Hop has accepted to be a member of the committee. Participants from countries other than Norway or Germany should be part of this committee as well. Olivier Chastel (CNRS, France) has been contacted and asked to become a member of the committee. The importance of marine biology for several countries is uncertain. Kim Holmén will provide one name for a possible member of the committee.

Then, some working groups or at least a mailing list should be set up so that everyone can stay aware of what is going on with research in the Kongsfjorden system. The need to include all research fields and groups working with the marine environment was stressed. For example, we should not forget people working with biochemistry which is a new topic within the Kongsfjorden System Flagship. The objective is now to make this mailing list. Svalbard Science Forum (RiS database) will be contacted to help in making the marine science list.

Note: it has been suggested that new projects and new published papers could appear on the NySMAC webpage. However, this will require a coordinator and a large amount of work. In a first step, a mailing list putting everyone in touch might be enough. The NySMAC webpage can stay as simple as it is now but at least, reports provided online should be updated.

Prioritised tasks

First, the group reviewed the research priorities and research programmes listed in 2008 at the establishment of the flagship programme to assess which ones have made good progress (green color below) or no progress (red colour).

The flagship stated the following future research priorities

- A combination of atmospheric measurements of long-range pollutants with measurements of contaminant levels in the biota

Overall, this work is going on (NILU) but there is a need to improve the accessibility to the data (time-series). The group also mentioned that particle (e.g. black carbon) transport should be monitored. The question is how realistic is this?

- Studies of feedback mechanisms from the biosphere to the atmosphere

It is unclear what has been achieved in this field?

The group still considers this field as a research priority. More specifically the interactions between marine and land/terrestrial systems must be studied more intensely (e.g., energy transfer, importance of glacier run offs, …). This will imply collaborative work between flagships).

- Investigation of interactive effects of rising temperatures and enhanced UV- radiation

The effect of rising temperatures on seabirds and seaweeds has been to some extent addressed. UV-radiation is likely a more important parameter for terrestrial systems. Overall, lots of work is going on in this field and it might be a good timing to integrate our knowledge and data into a more integrative approach (potentially through modelling).

- Studies of changes in the pelagic fish community of Kongsfjorden

Even if some data may exist and some work (e.g. changes in kittiwake diets) has been done, there is clearly a lack of knowledge regarding the changes in the pelagic fish community in Kongsfjorden. This needs to be developed.

- Studies of organic carbon mineralisation

There is a clear lack of studies and knowledge here and this should be developed (and the carbon should not be the only focus).

- Studies of water exchange processes in the fjord and small scale turbulences

There might be very good knowledge for larger-scale phenomenon in the inner part of the fjord. However, how can we access those data?

When it comes to small scale turbulences (e.g. run off at glacier fronts, turbulences in kelp forests), there is clearly a need for more studies as nothing is done in that field.

- The use of clams as environmental indicators

It is likely that nothing has been done here. The group questions the relevance of having such a narrow topic as a research priority for the flagship.

- A monitoring programme for phytoplankton

It seems that some work has been done (e.g. work from the Dutch group, work based on fluorescence, sampling done by AWIPEV for Polish group, NPI Kongsfjorden MOSJ cruise led by P. Assmy in July). But it is unclear which data exist, and the length of the time series (if any).

There is a need for long-term monitoring that investigates not only the inter-annual changes but also the seasonal changes in phytoplankton.

- Monitoring and modelling of the underwater light climate (with FS Atmosphere)

There is no regular programme here but some work has been done. This needs to be checked in more detail.

In this context, this is important to be able to link sea ice in the fjord with different processes, biological or not, and the light will be an important factor to consider here.

- Land – Fjord interactions (impact of terrestrial run-off and freshwater discharge; with FS Cryosphere & Terrestrial Ecology)

One project led by Jack Kohler (NPI TIGRIF) is related to this, but otherwise there is virtually nothing done in this field. This is however an important topic that needs to be addressed more thoroughly (e.g. importance of glacier run offs, sedimentation, pollutant transport).

- Studies on seasonal drivers of Kongsfjord ecosystem functioning, including overwintering strategies in benthic and pelagic communities (with FS Terrestrial Ecology)

UNIS / J. Bergen group have done some work here (Polar Night project) but the focus was on the pelagic community. Kai Bishop et al. will start a project on benthos from 2016 onwards.

Note: the need to study what is going on outside the fjord and basically how much is coming from the outside (boundary effects) must be taken into account if some modelling of the Kongsfjorden system is to be developed.

Proposed projects in 2008 to fill the documented knowledge gaps (see Flagship System Report, 2009):

Project 3-1: partly ongoing

Project 3-2: partly ongoing

Project 3-3: not ongoing

Project 3-4: ongoing

Project 3-5: ongoing

Project 3-6: ongoing / to be confirmed

Project 3-7: not ongoing

Project 3-8: ongoing

Project 3-9: ongoing

Then, the group discussed potential new research priorities that should be addressed within this Kongsforden System Flagship. Several ideas have been proposed that could be summed up in five points:

- Modelling of the Kongsfjord ecosystem
- Land – fjord interactions
- Seasonality and seasonal drivers of Kongsfjord ecosystem functioning (incl. role of sea ice cover and dynamics)
- Biodiversity changes and adaptations in Kongsfjorden
- Kongsfjorden in a pan-Arctic perspective

To move forward, the group discussed potential actions. Everyone agreed that it is too early to come up with specific research projects now but there are needs for workshops. These workshops should include participants from other flagships. Four workshops have been proposed:

- Workshop focusing on "Seasonality". It should bring people from atmospherics science and glaciology
- Workshop on "land – fjord interactions"
- Workshop on "Adaptation to environmental changes in the Arctic"
- Workshop "New methods and technologies for research and monitoring in the Arctic"

The group defined the workshop on *Adaptation* as the first priority. The objective is to send an application to Svalbard Strategic Grant for application, and, if successful, organise this workshop in early 2016.

How to interact with NySMAC

The group stressed that there should be some agreement here among all flagships in the way to communicate and interact with NySMAC.

One weakness emphasised by the group is the poor access to or knowledge of end-products. Publications related to RiS projects are rarely visible on SSF/RiS website, and it is also difficult to really know what is going on in the fjord. What data are collected and where exactly?

The RiS database provides some answers but clearly not complete. An updated map showing the research locations within Kongsfjorden with associated metadata would be extremely useful. How to develop such a tool requires a specific workshop.

How to use/take advantage of the new NySMAC webpage

The NySMAC website does not need to be developed. It can stay as simple as it is now. However, the content should be updated and the reports about flagships revised. Research priorities have changed since 2008. The list of participants within each flagship should also appear on the webpage.

Report from the Terrestrial Ecology Flagship Group discussion

Participants: Bernt Johansen, Vittorio Pasquali, Åshild Ønvik Pedersen, Edda-Marie Rainer, Mette M. Svenning and Alexander Tveit

Åshild Ønvik Pedersen drafted the report 28 September 2015; updated ÅØP 19 October 2015 based on comments from Alexander, Edda-Marie and Vittorio; updated 01 November based on comments from Mette Svenning and Bernt Johansen; Final version based on comments from Maarten Loonen, Eva Fuglei and Virve Ravolainen 08.12.15.

Introduction

NySMAC asked the working groups to discuss the following topics during working group meeting.

1. Flagship tasks list
   - Scientific topics
   - Activities (SSF funding possibilities!)
2. Organisation of flagship
3. Flagship website content
4. Flagship – NYSMAC interaction

In addition to reporting on these topics, we also emphasise the infrastructural and funding needs for the Terrestrial Flagship at the end of the report.

The participants agreed on that there was a strong need for revitalising the content of the original Terrestrial Flagship document and make some suggestions for concrete actions, however, we still acknowledge the content and validity of the former document (Coulson et al. 2009)

The working group also agreed on that the Terrestrial flagship should focus on the ecosystem food webs above and below ground as illustrated by the figure below (Figure 1).

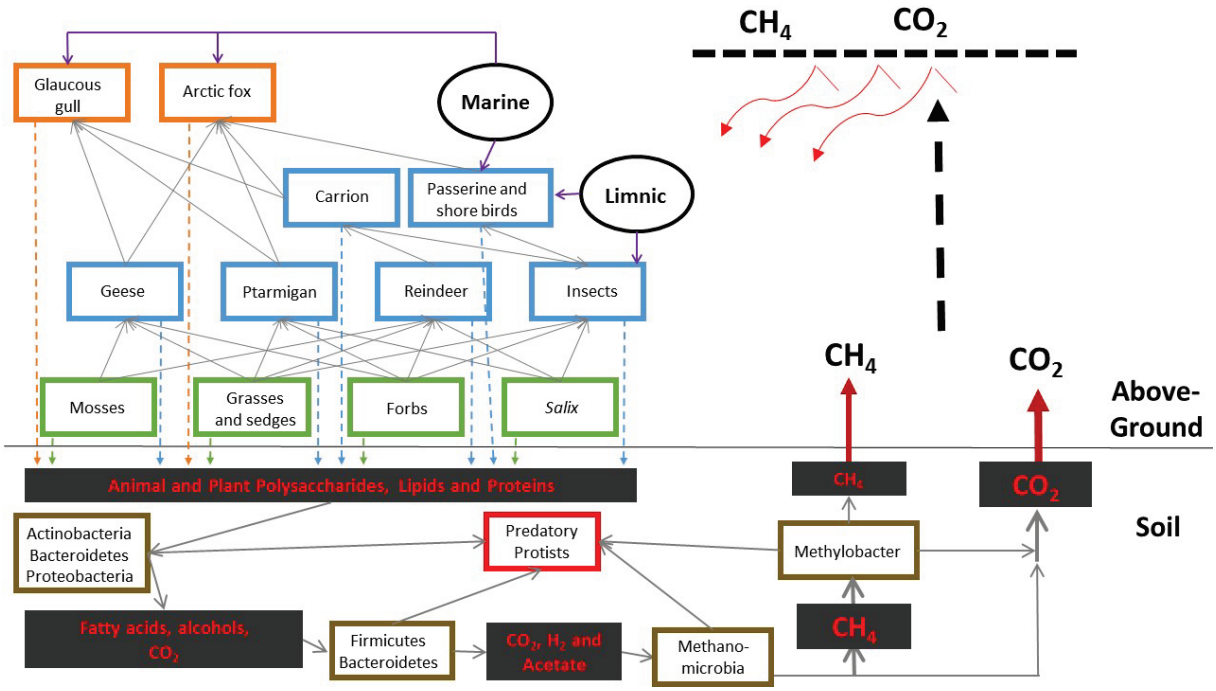

Figure 1. The above ground plant-based food web, with input from marine and limnic ecosystems, and the below-ground soil system, for high-Arctic tundra in Svalbard. The soil microbiota are indicated by key taxonomic units involved in degradation of soil organic carbon to greenhouse gases. The terrestrial food web figure is modified from Ims et al. (2013).

Flagship tasks list

Scientific topics

In this section of the report, we outline four scientific topics that capture the current and future direction of the Terrestrial Flagship. We outline them by keywords below.

I. High-Arctic model ecosystem

- Focus research on all trophic levels – from soils microbes to top vertebrate predators.
- Model system to detect changes from external drivers (e.g. climate change).
- Long-term monitoring data time series are present for parts of the system.
- The linkages between marine and freshwater systems are evident.
- Change detection analysis based on photographs (historical) and multi-scale satellite data.

II. Terrestrial food webs

- Trophic interactions within the terrestrial food web and between food webs (terrestrial and marine and freshwater).
- Focus on both below and above ground interactions that may impact processes and functions in the tundra ecosystem.

- Focus on tundra processes and functions from local (high-resolution level) to landscape/regional levels that may be affected by trophic interactions within and between the ecosystems.
- Investigate how the links between terrestrial food-webs and soil biogeochemistry affect the carbon cycle and greenhouse gas balance.

III. External drivers (abiotic and biotic)

- Drivers affecting species/communities/populations and their interactions e.g. temperature above/below ground, precipitation (winter rain and snow), snow-pack properties, basal ground ice and permafrost.
- Sea-ice spatial and temporal distribution.
- Contaminants.

IV. Adaptations to changing conditions in the Arctic

- Physiological adaptations of arctic life.
- Behavioural ecology.
- Resilience and resistance of organisms.
- Seasonality, phenology and morphology.
- Mechanisms for coping with extreme events and weather variability.

The group suggests organising the work into three operational work-packages (WP) with not yet assigned leader structure or working groups. The three work-packages are to some degree overlapping thematically and may be viewed as three integrated components of the revitalised Terrestrial Flagship Programme.

WP 1: Ecosystem

The main goal of this work package is to establish replicated long-term monitoring sites in targeted habitat types (e.g. wetlands/moss tundra with high productivity) on the entire Brøgger Peninsula. In each site we will measure a set of state variables describing e.g. species/communities, ecosystem functions and processes. An important strength of the Ny-Ålesund scientific base is the opportunity to combine observational and experimental studies on different temporal and spatial scales to obtain a mechanistic understanding of long-term stressors and their impacts on the ecosystem. Establishment of replicated sites in the Brøgger Peninsula will enable to understand how small-scale local process applies to the landscape level. Such establishment requires coverage of a sufficient range of biotic and abiotic components of the ecosystem, coordinated monitoring of producers, consumers and predators, as well as weather parameters at the same locations. Some examples of state variables can be: Snow-pack properties, basal ground ice, herbivore exclosures at site to assess impacts from grazing and climate warming, plant biomass, gas fluxes (methane, CO_2), precipitation and hydrology (linked directly to events like methane emissions etc.).

WP 2: Ecosystem-based adaptive monitoring COAT

The Brøgger Peninsula is designated as a COAT-site *(Climate-Ecological Observatory for Arctic Tundra)*. COAT is a system for long-term adaptive ecosystem monitoring based on food-web theory, and aims to become the world's most comprehensive and management relevant long-term

research enterprise for arctic terrestrial ecosystems (Ims et al. 2013). In this regards reference sites will be designated for monitoring natural changes and will be intensively instrumented to record relevant parameters (cf. WP 1 Ecosystem).

The COAT science plan includes:

- A comprehensive review of the functioning of the terrestrial food webs in the Arctic with specific references to science-based knowledge about climate impacts.
- A formulation of climate impact prediction models that define climate sensitive and management relevant monitoring targets, state variables, sampling designs, and mathematical/statistical modelling approaches.
- Protocols for updating prediction models, monitoring design, and methods in response to new knowledge, technologies, and societal priorities according to the paradigm of adaptive monitoring.

We have already established inter-institutional cooperation (NPI, NTNU, University of Groningen), that has originated from Ny-Ålesund meetings (e.g. NySMAC). Currently we are planning to combine the long-term monitoring data time-series in integrative studies where we focus on how climate variability (winter rain and summer temperature [e.g. influencing plant biomass]) shape population dynamics across the herbivore (barnacle goose, reindeer) and predator (Arctic fox) community in Brøgger Peninsula. COAT-Infrastructure is currently fully funded from 2016 to 2020.

Both WP 1 and 2 may be linked to the ongoing research from other stations (e.g. NL, NERC, Italian and Chinese stations), not participating in this workshop, that are working on interactions between vegetation, soil, permafrost and climate.

WP 3: Adaptations of organisms to Arctic environments and its seasonality

The Ny-Ålesund scientific base and the Brøgger Peninsula provide unique opportunities for in-depth studies of Arctic biota, from unicellular organisms to plants and animals. Living in the high-Arctic demands evolutionary understanding of single species/species groups and ecosystem adaptations to e.g. low temperatures, photoperiod and extreme climate shifts. Moreover, organisms in nature encounter seasonal climatic variation and cope with that variation through physiological, morphological and behavioural adjustments at the behavioural (for the animals), hormonal, cellular, and biochemical levels. Biota responds directly to increasing temperatures e.g. warmer winters, earlier springs, later autumns, longer growing seasons, rising sea levels or melting glaciers. Changes both within and between seasons may cause long-term effects on biological activity, processes and life history of terrestrial organisms.

The biotic world has already responded to recent rapid climate change by expanding ranges poleward and by altering the timing of important events in seasonal life histories, orchestrated principally by light and temperature.

In this work-package, we will focus on:

- Behavioural adaptations of focal species/species groups in the ecosystem.
- Evolutionary low-temperature adaptations.
- Microbial system adaptations to changing hydrology, temperature and substrate availability.
- Temperature/photoperiodic (light) interactions.
- Comparative adaptations between species/species groups.
- Aline species and ecosystem impacts.

Organisation of the flagship

We agreed to organise the flagship with a leader (Maarten Loonen, University of Groningen) and a co-leader (Åshild Ønvik Pedersen, Norwegian Polar Institute). The flagship is defined by three work-packages.

Website content

We suggest that the webpage contains a contact database. Here we suggest to list information about e.g. name, e-mail, research topic and home-institution's web-page etc. The database may be organized under topics e.g. freshwater, microbiology, plants, vertebrates etc. The contact database will enable both new and established researchers to get a quick overview of researchers/institutions that do terrestrial research in Ny-Ålesund and be a natural first point of contact. We suggest the same simple set-up for the other flagships to ease flow and exchange of information between people.

We also suggest that when new articles based on research from Ny-Ålesund are published a small feature, similarly to the ones that home institutions often make on web-pages, may be posted. Here we suggest to link to the web-pages of the home institutions to reduce the amount of overlapping information.

Flagship – NySMAC interaction

The workgroup briefly discussed *NySMAC Project Information and Discussion forum* and agreed to the importance of using such a fora to address issues regarding project organisation and management. It was also mentioned that the web-forum could be used to post questions and information. The group did, however, not see themselves as frequent users of such forum.

Infrastructure needs

A. **In situ stations for long-term monitoring of biotic and abiotic state variables** related to tundra species, communities, populations, processes and functions (see WP 1 Ecosystem).
B. **Small-scale terrestrial laboratory** (e.g. a designated room in the marine laboratory or in the «Vaskeri-building») with standardized lab equipment. Such equipment could be: Oven to dry samples (up to 300 ° C), temperature regulated incubators, centrifuges, analytical scale, autoclave, distilled or mili-Q water, vortex etc.

C. **Mobile lab unit** should be further discussed if feasible and realistic given funding.
D. **Organized storage** of field and lab-equipment. Currently several visiting scientist lack a warm space to store equipment. A warm storage would enable scientist to store equipment and reduce transporting of goods from one to another field season.

Funding needs

We briefly addressed the issue of funding and made some specific suggestions for how funding from SSF can meet the needs of the flagship. We agreed that there is a need for making the flagship more active in funding of common projects, but so far we experience the effect of the flagship on funding to be relatively low.

We need funding to workshops that:

1. Generate within and across-flagship scientific publications where long-term existing monitoring data series are utilised (*«paper-writing workshops*»).
2. Generate research proposals within and across flagships to be submitted to national/international funding agencies (*«research proposal writing workshops»*).

We also need funds that give support to:

1. Developing (complementing and sustaining) programmes that are sustained over time – given quality assurance through publications and/or scientific review of programme or application.

   «Sustaining good robust science is the way to novel contributions from time-series data».

2. Common in-situ monitoring infrastructure for automated field stations/sites at landscape level (coordinated with COAT and under the umbrella of SIOS) where data can be available for flagship members and collaborators.

Flagship actions

We suggest the following actions:

A. Common research proposal

Theme: Linking below and above ground trophic interactions that may affect processes and functions in the tundra ecosystem.

Investigate / follow funding resources: National Research councils and International funding programmes e.g. EU-funding (Horizon 2020). All members need to follow instruments and calls relevant for Arctic research in their own countries.

Workshop funding to develop a proposal may be sought from SSF in 2017.

B. Integrative papers

We will actively search for funds that can contribute to «paper-writing workshops» that focus on 1) trophic interactions within the terrestrial food web (vertebrate community, plants and abiotic drivers such as snow/ice; WP 2) and 2) linking below/above ground systems (WP 1, 2 and 3) and quantifying the greenhouse gas balance.

C. Establishment of common long-term monitoring sites at landscape level

We will actively work towards establishing common long-term in situ monitoring sites coordinated with COAT and the development of SIOS. Such sites will combine observational and experimental studies to obtain a mechanistic understanding, as well as investigate the generality of patterns in long-term impacts on the ecosystem in the landscape (all WPS), and secure long term monitoring of important state variables related to climate change in the Arctic.

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Report from the Glaciology Flagship Group Discussion

Chair: Jack Kohler

Co-chair: Songtao Ai

Participants: Jack Kohler, Ward van Pelt, Florian Tolle, Micał Pętlicki, Dimitry Divine, Thomas Vikhamar Schuler, Jon Ove Hagen, Elisabeth Isaksson, Songtao Ai, Ankit Pramanik, Vikram Goel, Katrin Lindbäck, Geir Moholdt, Jean-Charles Gallet

Glaciology in Ny-Ålesund

Ny-Ålesund is an ideal site for glaciological research; despite its remote location, it provides an excellent logistical base for fieldwork programmes. Apart from large ice caps, the area around Ny-Ålesund most types of glaciers found in Svalbard and even the high Arctic: fast-flowing, surge type, polythermal, and calving glaciers. Two Ny-Ålesund glaciers, Midtre Lovénbreen and Austre Bøggerbreen, have among the longest Arctic mass balance time-series, and in addition there are many other relevant long-term measurements available.

Knowledge gaps

In terms of the overall science, many processes crucial for future glacier behaviour are still relatively poorly understood. In particular, such important processes as calving, surging, sliding, and glacial drainage are still important open research topics. Ny-Ålesund glaciers provide a useful laboratory for studying these processes.

In terms of our local knowledge, a handful of glaciers have been studied extensively in the Ny-Ålesund area, mostly with respect to mass balance and hydrology. However, there are still gaps in our knowledge. We know little about spatial and temporal distribution of snow at the landscape and regional scale. While there are a number of mass balance programmes established in and around Ny-Ålesund, little is still known about ice and meltwater fluxes from glaciers outside of this immediate area. And basic information, such as bed topography, is still missing for most glaciers in Svalbard, including most around Ny-Ålesund.

General topics to be addressed

The first workshop identified a number of important topics to be focused on, based on knowledge gaps, existing long-term series and advantages of the location Ny-Ålesund:

Mass balance

Glacier mass balance is the amount of snow and ice lost or gained on a particular glacier during a certain time period. It is usually reported as a single number which reflects the loss or gain for the

glacier as a whole. Mass balance is a lumped climate signal influenced primarily by winter precipitation and summer temperature.

Roughly 60% of Svalbard is covered by glaciers, and these glaciers have been retreating from their last maximal front positions since about 1920. An important motivation for measuring mass balance is to determine the contribution of Svalbard glacier loss to sea level rise. Roughly half of the current observed sea level increase is attributed to "small" glacier melting, that is, all glaciers besides Greenland and Antarctica, but there are still relatively large error bars on these estimates. It is therefore important to determine the contributions to sea level from the different glaciated areas around the world. Svalbard is not an insignificant contributor, since it constitutes about 10% of the total Arctic glacier area (again, excluding Greenland). Furthermore, ice melt rates on Svalbard are relatively high due to its location in a relatively warm part of the Arctic.

Two of the longest Artic mass balance time-series are from Ny-Ålesund; together with the available ancillary meteorological data, these data provide a useful foundation for conducting retrospective studies of mass balance. Furthermore, with its easy logistical access, the glaciers around Ny-Ålesund provide an ideal ground-truthing platform for mass balance models, from simple degree-day type models to full energy balance models, as well as downscaling and upscaling experiments using large scale climate model output.

Dynamics

One of the most significant current problems in glaciology with regards to understanding better future cryosphere behavior concerns the dynamical component, chiefly through the process of glacier calving. Physical calving laws are needed to improve our ability to model future ice volume changes and the resultant effect on sea-level rise.

Glacier calving model are currently being developed and tested on the fast-flowing tidewater glacier Kronebreen, at the mouth of Kongsfjord. Kronebreen is an ideal platform for calving studies, again because of the logistical ease of conducting research there, but also because of the wealth of available data such as basal topography, velocity distribution and surface mass balance. Kronebreen has been thinning in recent years, and it is predicted that the glacier will undergo acceleration and rapid retreat through a basal overdeepening once the ice margin thins to a critical threshold thickness.

A related issue in glacier dynamics concerns surging. Surge-type glaciers alternate long periods of relative dynamic quiescence and short duration surges lasting 1-3 years, in which the glacier speeds increase dramatically and the glacier front advances, often by hundreds of meters, and up to several kilometers.

Estimates for the number of surging glaciers in Svalbard vary, ranging from 13 to 90%, however, only a limited number of glaciers in the Ny-Ålesund area have been observed to have surged. These include: Kongsvegen (ca. 1948), Blomstrandbreen (ca. 1966, ca. 2009), and

Comfortlessbreen (ca. 2008). Surge frequency in Svalbard is observed for a few glaciers to vary from decades to a century or more.

The exact cause of surging remains an unsolved problem in glaciology, but is thought to be related to developments in the subglacial drainage system (see below).

Hydrology

Glacier hydrology exerts the dominant control on glacier sliding in temperate glaciers, primarily through flow of surface meltwater down to the bed and through the subglacial drainage system. Svalbard glaciers are polythermal, that is they consist of both cold and temperate ice. Glaciers that are entirely cold (in Svalbard, glaciers that are relatively thin, less than ca. 70 m thick on average) do not have subglacial drainage, and so their dynamics are relatively static throughout the year. Larger, and therefore thicker, Svalbard glaciers have temperate bases and are thus affected by summer melt. Glacier hydrology is also thought to be a key factor in glacier surging (see above).

Beyond its effect on dynamics, glacier hydrology is important for fluxes of sediment, chemistry, and nutrients. Glaciers which flow all the way down into fjords typically drain relatively large accumulation areas; combined summer melt and rain can lead to high concentrated discharge amounts at the glacier front. This has a significant impact on the freshwater budget for fjord circulation, on sedimentation processes, and as a result on the ecosystem.

Accordingly studies of glacier hydrology are of importance both for glaciologists as well as other disciplines. This includes melt studies, through energy balance modeling and deployment of automatic weather stations, through studies of the development of the summer drainage system, e.g. tracing studies, and through monitoring of sediment, chemistry and water fluxes at proglacial site. At present there is one permanent hydrology station in Ny-Ålesund, on Bayelva near the aiport. A temporary station is located at Austre Lovenbreen, closer to the glacier front.

Snow

Snow is the dominant component in the winter land water cycle; it provides insulation for plants and soils, it is a source of soil moisture in the growing season, and it gives shelter for animals and protection from predators. Snow changes the albedo of land surface, and alters the energy balance of the land surface significantly. Arctic climate is changing, but what the effect will be on snow cover, and what the cascading effects of changes to patterns of snowfall in the hydrological cycle and in arctic ecology remains an important research topic.

Despite the importance of snow, regular measurements of one of the most basic snow parameters, snow depth, or the related quantity snow water equivalent (SWE), are largely lacking in Ny-Ålesund. Regular measurements of snow depth have only started recently as part of the routine synoptic observations conducted by the Norwegian Meteorological Institute. There are no longer-term records at daily, weekly, or even monthly time-scales. Annual data have been available on the mass balance glaciers, with records of average spring SWE made on the four NPI mass

balance glaciers. SWE amounts are available digitally since 1999, with map coordinates and elevations, collected on a roughly regular grid. However, a broader set of measurements are desirable.

Over the past decade, an ad hoc set of springtime snow measurements was initiated by NPI around the Brøgger peninsula, with data for most years since 2000. Snow depths were measured at ca. 200-500 m intervals along a series of more or less coincident profiles, useful long-term data, although they only represent a single picture of the snowpack in each year.

Besides the issue of spatial and temporal aspects of snow cover evolution, chemistry, impact on ecology, physical characteristics as density, crystal evolution and albedo.

A key goal will be to conduct systematic snow transects on Brøggerhalvøya, and to make these measurements available to the larger research community.

Ice cores

Our knowledge of climate variability over time scales of 100 years or greater is still incomplete. The relative shortness and sparsity of historical and contemporary instrumental records necessitates the use of various proxy-based sources of climate information. Studies of ice cores from glaciers and ice caps have developed into a powerful and successful paleoclimatic tool.

Since the 1970s a number of ice cores have been drilled on glaciers and ice caps in Svalbard. While most of these ice core records either cover short time periods or have time gaps created by negative balances at the drill sites during past warm periods, Svalbard ice core research has improved knowledge about climate variation in this part of the Arctic during the last 800 years. New ice cores will not only be important for furthering our knowledge of past climate, but it will also be valuable in increasing the spatial distribution of high resolution ice-cores around Svalbard for climate reconstruction.

Ice cores provide archives of not only climate proxies but also of wide range of chemical species, including black carbon, organic contaminants and heavy metals. Furthermore, new techniques make it possible to improve some of the previous work, making it of interest to obtain new cores from previous drill sites.

Using data from deep ice cores, shallow cores and snow pits it is possible to investigate links between atmospheric circulation, transport and deposition in snow/ice investigate the aerosol-temperature link through the ice cores proxies. For example, the atmospheric transport of black carbon to Svalbard was studied by connecting atmospheric soot measurements to back-trajectory calculations. Linking the observed atmospheric equivalent black carbon BC concentration at the Zeppelin Observqatory with air mass trajectories, shows that generally higher concentrations are observed when the air comes from the east than from west. Ice cores can then be linked to concurrent measurements at Zeppelin, and used to extend our understanding of long-term variability in atmospheric circulation and transport.

Biochemistry

Glacier ice and snow melt affects the timing, magnitude and release of nutrients to aquatic and terrestrial ecosystems. Important research topics center on improving our understanding of: the way glacial, snow, and permafrost melting influence the downstream transfer of nutrients and organic matter to aquatic ecosystems; how the carbon economy of glacier forefields and permafrost change as climate change continues to influence winter and summer thermal conditions.

Integrated glaciological activity

Currently research groups in Ny-Ålesund are not well integrated across national boundaries, and research activities at the different glaciers are often not coordinated.

Following the last flagship meeting, it was decided to better coordinate these activities to facilitate integration, reduce costs and minimise the environmental footprint of glaciological research. Ultimately with better integration and coordination, larger projects will be possible, increasing the scientific value of the work performed in Ny-Ålesund. Ideally more could be accomplished through teamwork than through the uncoordinated efforts of individual scientists or small research groups.

In the future we seek to facilitate sharing of data (including for example satellite data), to avoid research duplication, to develop new methodology. Integration could be achieved within glaciological systems (e.g. regional catchment studies) or with other systems, such as marine and terrestrial systems.

Improve integration

One means for better integration between groups and activities would be for groups to make more efficient use of data repositories (such as are planned in SIOS), as well as the RiS database. In addition links should be established between external data providers such as eKlima or NVE and localities outside of the immediate area of Ny-Ålesund (e.g. Kaffiøyra, Austfonna, Barentsburg, Hornsund, etc).

Communication between the groups

At the last flagship meeting, two measures were proposed to enhance collaboration and coordination: 1) conduct regular workshop meetings; and 2) establish an email group. While the latter has not had significant activity, this flagship meeting represents the second meeting of Ny-Ålesund glaciologists.

Results of latest flagship meeting

Cooperation between groups

In this latest flagship meeting, we reiterated in general terms the need to improve cooperation between glaciology groups, and to identify areas of future collaboration.

There is continued interest from other nations in establishing activities in Ny-Ålesund, with the potential for even more glaciological activity, underscoring the need again for more coordinated collaboration within Ny-Ålesund.

An interesting aspect of multiple national activities is that national funding agencies are not so bothered about duplication. Furthermore, duplication is not necessarily problematic; it can be used to advantage to test methods and uncertainties.

We discussed more specifically the need to reduce mass balance measurement duplication, in particular at Austre Lovenbreen (French/Chinese teams), and at Brøggerbreen (Norwegian/Indian teams). NPI proposes to collaborate with Indian colleagues to measure mass balance on the north side of Kongsfjorden. Boat transport is needed to go there, and lack of sea ice is a problem. NPI will take the initiative for this collaboration.

Future funding

We discussed the possibility for future funding sources. Only two nations have confirmed longer-term funding (10+ years) prospects: the Chinese and Norwegian programmes. This may be the case for the Indian programme as well, but no representative from India was in attendance. All other programmes are contingent on short-term research projects.

Future sources for collaborative funding might include EU, although the "Horizon2020" programme seems to have little interest in glaciology, as it focuses more on Arctic interdisciplinary work and on infrastructure. Nor is there any role in EU in Europe – Asian collaboration.

Mass balance

We discussed the need to compare available mass balance data. This is needed to understand the distribution of mass balance variables in space and time. In addition, the mass balance programme can be starting point for more data collection of other variables. We discussed the possibility of arranging annual meetings in April in Ny-Ålesund, in connection with spring fieldwork. However, time is always limited, and the field parties do not always overlap. More formal meetings are required.

In Autumn 2016, we will hold an SSF-funded workshop meeting concerning glacier mass balance: "NÅGLAMB – Ny-Ålesund GLAcier Mass Balance workshop." The primary aim of this workshop will be to bring together researchers from the five international groups studying glacier mass balance in the Ny-Ålesund area. Secondary aims are: 1) to promote better

collaboration and cooperation between these groups, and 2) to integrate the field studies with modelling efforts, through inclusion of selected members of the Svalbard modelling community.

Finally, NPI will seek funding to organise a Svalbard Mass Balance Symposium in 2017. This year is the 100th anniversary of the birth of Olav Liestøl, the NPI glaciologist who initiated mass balance measurements in Svalbard in the 1950s, and the two long-term programmes at Austre Brøggerbreen and Midtre Lovénbreen in Ny-Ålesund in 1966 and 1967, respectively. In 2017, the record from Austre Brøggerbreen will be 50 years long, thus providing the occasion for this symposium.

Hydrology station

We proposed again setting up a hydrological station at Austre Lovenbreen. This would be a French initiative. Observations are needed only during the summer melt season. Cooperation will be required with engineers at AWIPEV, with one person needed one week per year for data checking. Data should be freely accessible.

Airborne photographic campaigns

Airborne photographic campaigns can be used for generating DEMs. NPI has developed a helicopter-borne system that allows rapid data acquisition for relatively modest costs compared to traditional fixed-wing photogrammetry. Helicopter costs still need to be covered, but with multiple nations sharing usage there could be saving.

Other issues

- Study linkage between glacier hydrology and calving (e.g. the CRIOS project). CRIOS has finished, but there will be legacy data, and new calving studies (UiO, NPI) are in the process of being started at Kronebreen.
- Integrate glaciological and marine studies. There are projects (NPI) currently in progress and underway looking at the linkage between the calving face, fjord circulation, and the fjord ecosystem.
- Integrate glaciological and terrestrial studies (e.g. snow).
- Cameras can be used to monitor snow distribution, e.g. from Zeppelin Observatory. Cameras might also be used to analyse calving, as well as ocean modelling.
- Snow research around Ny-Ålesund:
  - Setup more general operational system for snow modeling. Available models: Crocus (high-detail), Liston snow redistribution model (lack of ground ice).
  - Collaborate on snow monitoring (e.g. CC tower).
  - Implement camera at Zeppelin Observatory for snow distribution monitoring.
- We should seek to improve integration with Hornsund research station.

Data and web

- At the Glaciology Flagship webpage, links should be added to:
  - The World Glaciological Monitoring Service database

    - Mass balance data at the NPI data site (data.npolar.no)
    - Austfonna page (still needs to be developed)
    - Hornsund page
    - MOSJ pages (monitoring mass balance Svalbard/Jan Mayen)
- We should add Austfonna/Nordenskiöldbreen mass balance data to WGMS.
- Webpages should be developed at individual institutes with regards to mass balance or other glaciological observations.
- Mass balance data from other nations could also be made available through the NPI data portal.
- It was proposed that a list of Ny-Ålesund glaciology publications be put together. However, it was decided that it is better to use ISI or Google Scholar rather than making and maintaining our own list, a rather significant undertaking.

Report from the Ny-Ålesund Atmosphere Flagship Group discussion

Background

The Ny-Ålesund Atmosphere Flagship programme comprises the atmosphere research activities at those stations, which have ongoing atmosphere science topics. They cover the whole atmosphere, from the surface including atmosphere – ice / snow – permafrost exchange processes, the free troposphere and its constituents (trace gases, aerosols, clouds), the middle and the upper atmosphere (ozone layer and ionosphere). The goal of the flagship programme is to foster cooperation and collaboration in order to achieve research goals beyond the capabilities of the individual stations or research groups.

After NySMAC had initiated the flagship programmes, SSF had supported the first and second atmosphere flagship meetings (in 2008 and 2014), as well as the symposium in 2015. The attendance and topics of the 2015 symposium reflects how the flagship has developed over the years. In addition to the research work performed in Ny-Ålesund, the flagship includes also joint work with researchers based in Barentsburg and Hornsund.

The symposium

The first Atmosphere Flagship Symposium took place during the Ny-Ålesund week at the Fram Centre in Tromsø, Norway, on 25 September 2015. The symposium had 50 participants supported by SSF with respect to accommodation and meal costs. Symposium contributions were given as lectures or during poster sessions on 23 and 24 September. The list of attendees, talks and posters are given as appendices.

I addition to the symposium, there was a meeting of the flagship steering committee, as well as a side meeting for the boundary layer working group.

The symposium covered the following main science topics:

- Tropospheric aerosols
- Black carbon and atmospheric transport processes
- Trace gases, pollutants, and water vapour isotopes
- Results from long term observations of meteorological parameters
- The Atmospheric boundary layer
- Atmosphere – snow interaction processes
- Methane in the Arctic atmosphere
- Clouds above Ny-Ålesund

- Ionospheric research

A key part of the symposium was the discussion with all attendees about the further development of the atmosphere flagship programme.

Outcome

The symposium was particularly successful. It fostered many discussion among international participants, who often so far had not met on site before, although they have been working from the same location, namely Ny-Ålesund. Several papers presenting scientific results were initiated or developed during the symposium.

A major outcome of the discussion about the flagship programme was the determination of the further progress the programme shall achieve. In particular, the participants agreed that the atmosphere flagship, in order to facilitate and encourage the cooperation within the flagship, should form smaller working groups focusing on specific scientific questions of common interest. However it was also stated that the formation of such working groups should be transparent and participation should be open to any of the Ny-Ålesund research groups. The working groups should each have a clear focus and goals. New groups could be formed when so suggested by any group of Ny-Ålesund scientists. The overarching goal is to enhance the possibility to study as well detailed scientific questions as getting better and deeper insight in broader more general scientific questions. So far the following working groups have been identified:

- Clouds and local – regional short term processes
- Long-term observations and trends in temperature, precipitation, clouds, and radiation
- Boundary layer meteorology
- Aerosols (black carbon) and snow
- Atmospheric aerosols
- Variability in surface UV irradiance and ozone column

Following the positive development during the symposium, it was agreed to submit again a proposal to SSF to support the Atmosphere Flagship Programme through the Strategic Grants scheme. A corresponding proposal was submitted in time, asking for support of the flagship programme and the above mentioned six work groups in particular. The lively contributions to formulating the proposal show the high activity of this flagship programme and that it appears to be on a constructive development path.

Appendix 1: Seminar Programme

Tuesday 22 September 2015

19:00 *Ice Breaker*
Polaria Visitors Centre, next to Fram Centre

Wednesday 23 September 2015

08:30-09:00 *Registration*

09.00-09.15 **Welcome**
Research Director Nalân Koç, NPI

09:15-09:30 **Practical information**
Christina A. Pedersen, NPI

Terrestrial Ecology Flagship Session
Chair: Mette Svenning, UiT

09:30-10:00 **Keynote talk about status and activities within the Terrestrial Ecology Flagship**
Maarten Loonen, UoG

10:00-10:15 **Decades of tundra ecosystem monitoring suggest ecosystem-based monitoring as the future paradigm**
Åshild Pedersen, Eva Fuglei, Virve Ravolainen

10.15-10:30 **Vegetation mapping of Brøgger Peninsula and the Ny-Ålesund town area utilizing very-high resolution WorldView2 satellite data**
Bernt Johansen, Hans Tømmervik

10:30-11:00 *Coffee break*

11:00-11:15 **Metabolic and trophic interactions modulate methane production by Arctic peat microbiota in response to warming**
Alexander Tveit, Tim Urichb, Peter Frenzeld, Mette Marianne Svenning

11:15-11:30 **Automatic detection of snow avalanches on Svalbard using satellite-borne radar remote sensing**
Dieuwertje Wesselink, Eirik Malnes, Roderik Lindenbergh

Kongsfjorden System Flagship Session
Chair: Maria Granberg, NPI

11:30-12:00 **Keynote talk about status and activities within the Kongsfjorden System Flagship**
Haakon Hop, NPI

12:00-12:15 **Arctic Skua migration: linking individual consistency, migratory connectivity and contaminant loads**

Sveinn Are Hanssen, Rob van Bemmelen, Olivier Chastel, Dorte Herzke, Jan Ove Bustnes, Elise Skottene, Anette Fenstad, Amalie Ask, Geir Wing Gabrielsen, Richard A Philips, Børge Moe

12:15-12:30 **DNA damage in arctic avian predators: baseline, sensitivity to stress and association to contaminant exposure**
Ane Haarr, Ketil Hylland, Dorte Herzke, Jan Ove Bustnes, Geir Wing Gabrielsen, Katrine Borgå

12:30-13:30 *Lunch break (lunch served in the Arktika cantina)*

Chair: Caixin Wang, NPI

13:30-13:45 **Environmental impact of polycyclic aromatic hydrocarbons in Svalbard – a refined perspective**
Maria E. Granberg, Geir Wing Gabrielsen, Kjetil Sagerup, Sveinn Are Hanssen, Åse Krøkjed, Jasmine Nahrgang, Jan Christensen, Marina Vazquez

13:45-14:00 **Future bathymetry of Kongsfjord**
Jack Kohler

14:00-14:15 **Pelagic long-term surveys in Kongsfjorden, Svalbard**
Haakon Hop, Philipp Assmy, Slawek Kwasniewski, Anette Wold

14:15-14:30 **Seaweed Biology in a changing Arctic: The long-term program on Arctic benthic algae**
Kai Bischop, Martin Paar, Benoit Lebreton, Katharina Zacher, Markus Molis, Christian Buschbaum, Harald Asmus, Ragnhild Asmus & Inka Bartsch

14:30-14:45 **Observed summer biomass variability and associated biophysical coupling in Kongsfjorden – Cancelled**
Divya David, Archana Singh, Nazira Begum, Rupesh Kumar Sinha, K. P. Krishnan

14:45-15:00 **Winter vertical migration: using Kongsfjorden as an insight into pan Arctic behaviours**,
Finlo Cottier, Laura Hobbs , Jørgen Berge, Kim Last

15:00-15:30 *Coffee break*

Chair: Kai Bischof, University of Bremen

15:30- 15:45 **Life and light in the dead of night: unexpected levels of biological activity during the polar night offer a new perspective on Arctic ecosystems**
Jørgen Berge

15:45-16:00 **Identification and Quantification of Bisphenol S in the sediments of Kongsfjorden Using High Resolution Mass Spectrometry – Cancelled**
K. Nejumal, Mahesh Mohan, K.P. Krishnan, D. Dineep, U.K. Aravind, C.T. Aravindakumar.

16:00-16.15 **Update on Sea Ice Monitoring in Kongsfjorden, Svalbard**
Sebastian Gerland, Olga Pavlova

16:15-16:30 **Trace elements in Kongsfjorden: occurrence, sources and bioavailability – Postponed to Thursdag 15:45**
Francisco Ardini, Marco Grotti, Andrea Bazzano, Francesco Soggia, Paola Rivaro

16:30-16:45 **Sedimentation rate in Kongsfjorden using 210Pb/210Po based dating technique – Cancelled**
M. Mohan, Sreelakshmi U., Gopikrishna V.G., G.G. Pandit, S.K. Sahu, M. Tiwari, P.Y. Ajmal

17:00-18:30 **Poster Session (with refreshments)**

Thursday 24 September 2015

Glaciology Flagship Session
Chair: Dmitry Divine, NPI

09:00-09:30 **Keynote talk about status and activities within the Glaciology Flagship**
Jack Kohler, NPI

09:30-09:45 **From east to west – satellite cal-val for glacier mass balance in Svalbard**
Geir Moholdt, Kirsty Langley, Thomas V. Schuler, Thorben Dunse

09:45-10:00 **Austfonna mass balance in a Pan-Svalbard perspective**
Thomas V. Schuler, K. Aas, T. Dunse, K. Langley, T. Østby, J. O. Hagen, J. Kohler, G. Moholdt

10:00-10:15 **Reconstruction of the mass balance of Ariebreen (Hornsund, Svalbard) in years 1983-2008**
Michal Petlicki

10:15-10:30 **Estimation of sub-ice melting during winter time in Pedersenbreen, Svalbard**
Songtao Ai, Zemin Wang, Ming Yan

10:30-11:00 *Coffee break*

Chair: Ankit Pramanik, NPI

11:00-11:15 **Cryosphere monitoring in the Austre Lovénbreen basin**
Florian Tolle, Eric Bernard, Jean-Michel Friedt, Alexander Prokop, Sophie Schiavone, Christelle Marlin, Songtao Ai, Madeleine Griselin

11:15-11:30 **Svalbard ice and snow as archives for climate and pollution**
Elisabeth Isaksson, Dmitry Divine, Tõnu Martma, Carmen Vega, Mark Hermansson, Isabel Wendl, Anja Eichler, Margit Schwikowsk

Pan-Svalbard Session
Chair: Boris Ivanov, AARI

11:30-12:00 **Keynote talk about Longyearbyen research**
Ole-Arve Misund, UNIS, given by Karoline Bælum, SSF.

12:00-12:30 **Keynote talk about Hornsund research**
Michal Petlicki, IG, PAS

12:30-13:30 *Lunch break (lunch served in the Arktika cantina)*

Chair: Karoline Bælum, SSF

13:30-14:00 **Keynote talk about Barentsburg research**
Sergey Priamikov, AARI

14:00-14:15 **Space weather and scintillations at high latitudes**
Yngvild L. Andalsvik, Knut Stanley Jacobsen

14:15-14:30 **Meteorology network, long term data sets**

Marion Maturilli

14:30-14:45 **Comparing model output and observations on a regional scale**
Markus Kayser, Marion Maturilli, Annette Rinke, Robert Graham, Stephen Hudson, Mats Granskog, Torbjørn Taskjelle

14:45-15:00 **Tromsø Geophysical Observatory activities in Ny-Ålesund and Arctic – past, current and future activities**
Magnar G. Johnsen, Chris Hall

15:00-15:30 *Coffee Break*

Chair: Grzegorz Karasiński, IOPAS

15:30-15:45 **Seabird monitoring in Kongsfjorden in a regional, national and international perspective**
Sébastien Descamps

15:45-16:00 **Environmental pollution impact on radiation properties of snow cover (Barentsburg area) – Cancelled**
P. Sviashchennikov, B. Ivanov, A. Yrazgildeeva, Y. Kurochkin, K. Chistyakov, D. Divine, S. Hudson

16:00-16:15 **Metrology for the Arctic**
Chiara Musacchio, A. Merlone, R. Atkinson, G. Coppa, V. Ebert, R. Emardson, C. Garcia Izquierdo, L. Gianfrani, J. Gröbner, L.G. Lanza, M. Maturilli, M. K. Rasmussen, H. Sairanen, F. Sanna, F. Sparasci, A. Viola, V. Vitale

16:15-16:30 **The trend analysis of the UV measurements at Polish Polar Station, Hornsund, 77° 00' N, 15° 33' E) for the period 1996-2014 – Postponed to Friday 11:15**
Piotr Sobolewski, Janusz W. Krzyścin

16:30-16:50 **Research in Svalbard: Orientations from SSF and the Research Council of Norway**
Karoline Bælum

16:50-17:10 **How to further develop the Ny-Ålesund Flagships – Preparations for Fridays break-out groups**
Roland Neuber and Christina A. Pedersen

17:10-18:00 **Poster Session**

19:00 *Seminar/Symposium Dinner*
Scandic Ishavshotel

Friday 25 September 2015

Break-out groups

09:00-12:30 **Parallel sessions/working groups to discuss the further development of the Ny-Ålesund Flagships. These sessions are run in parallel with the Atmospheric Symposium. For participants with interests in the Atmospheric Flagship there will be allocated time during the symposium to discuss the further development of the Atmosphere flagship.**
-Participants with research interests within the Terrestrial Ecology Flagship meet in Tre Kroner (5 floor at NPI). Working group chair Åshild Pedersen, NPI
-Participants with research interests within the Kongsfjorden System Flagship meet in Ny-Ålesund meeting room (2 floor). Working group chair Geir W. Gabrielsen, NPI
-Participants with research interests within the Glaciology Flagship meet in Barentsburg meeting room (2 floor). Working group chair Jack Kohler, NPI

Coffee break at the 2 floor at 10:30-11:00

Atmospheric Symposium

09:00-09:15 **Welcome**
Roland Neuber and Christina A. Pedersen

Chair: Jean-Charles Gallet, NPI

09:15-09:30 **Connecting Aerosol Size Distributions at Three Arctic Stations**
Eyal Freud, Radovan Krejci, Peter Tunved, Leonard Barrie

09:30-09:45 **Number size distributions and concentration during multiannual measurements campaign at Ny Alesund**
Angelo Lupi, M. Busetto, M. Mazzola, C. Lanconelli, F. Giardi, S. Becagli, R. Udisti, V. Vitale, A. Viola and H.C. Hansson

09:45-10:00 **Aerosol properties from the 2014 haze season derived by lidar**
Christoph Ritter

10:00-10:15 **Insights from size distribution and chemical composition of aerosol collected at Ny Alesund during the 2010-2014 spring–summer campaigns**
Roberto Udisti, Italian Aerosol Research Group

10:15-10:30 **Aerosol physical and chemical properties measured during the 2014 iAREA campaign on Spitsbergen**
Tymon Zielinski, J. Lisok, C. Ritter, R. Neuber,K.M. Markowicz, I.S. Stachlewska, M. Chilinski, P. Makuch , P. Pakszys, P. Markuszewski, A. Rozwadowska, T. Petelski, T. Zielinski, S. Becagli, R. Traversi, R. Udisti, J. Struzewska, J. W. Kaminski, M. Jefimow, M. Gausa

10:30-11:00 Coffee Break

Chair: Christoph Ritter, AWI

11:00-11:15 **How does European aerosol emissions affect the Arctic climate?**

Acosta Navarro, H. C. Hansson, J. C., Varma, V., Riipinen, I., Seland, Ø., Kirkevåg, A., Struthers, H., Iversen, T., Ekman, A. M. L.

11:15-11:30 **Measurements of BC mass concentration, microphysical characteristics of near-ground aerosol and its chemical composition in Barentsburg (Svalbard) in 2011-2014**
Valerii Kozlov, D.G. Chernov, M.V. Panchenko, V.F. Radionov, L.P. Golobokova, O.I. Khuriganova

11:30-11:45 **Increase in elemental carbon values between 1970 and 2004 observed in a 300-year ice core from Holtedahlfonna (Svalbard)**
Meri Ruppel, E. Isaksson , J. Ström , E. Beaudon, J. Svensson, C. A. Pedersen , A. Korhola

11:45-12:00 **Quantifying influence of regional air pollution on atmospheric measurements in Ny-Ålesund**
Alena Dekhtyareva, K. Edvardsen, K. Holmén, O. Hermansen, H.-C. Hansson

12:00-12:15 **Understanding of the atmospheric methane evolution and change over the last decades with focus on the Arctic region**
Cathrine Lund Myhre, S. Dalsøren, O. Hermansen, G. Myhre, and I. Isaksen

12:15-12:30 **Long-term observations of air surface exchange of elemental mercury in the Norwegian Arctic**
Katrine A. Pfaffhuber, L. R. Hole, T. Berg, A. Ryjkov, A. Dastoor

12:30-13:30 *Lunch break (lunch served in the Arktika cantina)*

Chair: Alena Dekhtyareva, UiT

13:30-14:00 **Discussions within the Flagship Programme**

14:00-14:15 **Water vapor in Hornsund – comparison of lidar, sun photometer and satellite sensors data**
Magdalena Bloch, Grzegorz Karasiński, Piotr S. Sobolewski

14:15-14:30 **36 years of meteorological measurements in Polish Polar Station at Hornsund**
Grzegorz Karasiński, Tomasz Wawrzyniak, Bartłomiej Luks, Magdalena Bloch

14:30-14:45 **Arctic Warming, Moisture Increase and Circulation Changes Observed in the Ny-Ålesund Homogenized Radiosonde Record**
Marion Maturilli, Markus Kayser

14:45-15:00 **Precipitation in Arctic and associated synoptic atmospheric condition – Cancelled**
Sourav Chatterjee, Nuncio Murukesh, K Satheesan

15:00-15:30 *Coffee Break*

Chair: Angelo Viola, CNR

15:30-15:45 **Ny-Ålesund atmospheric boundary layer**
Alexander Schulz

15:45-16:00 **The next step for snow research in Ny-Ålesund: towards a coupled snow–atmosphere long term sampling site**
Jean-Charles Gallet, C. A. Pedersen, S. Gerland, E. Isaksson

16:00-16:15 **Interactions between snow and atmosphere in the Arctic**
Hans-Werner Jacobi

16:15-16:30 **Lidar Observations of Tropospheric Aerosols and Clouds over Ny-Aalesund**
Takashi Shibata, Koichi Shiraishi, Iwasaki, Masataka Shiobara and Toshiaki Takano

16:30-16:45 **A case study on microphysical characteristics of Arctic clouds based on simultaneous measurements with a polarized Micro-Pulse Lidar and a 95-GHz Cloud Radar at Ny-Ålesund, Svalbard**
Masataka Shiobara, T. Takano, H. Okamoto, Masanori, Yabuki, C. Ritter

16:45-17:00 **The interannual change of cloud and the radiative contribution at Ny-Ålesund**
Kyohei Yamada, T. Hayasak, M. Shiobara, M. Kuji, M. Yabuki, M. Maturilli

Poster Sessions

All posters should be up at both sessions (Wednesday 17:00-18:30, and Thursday 17:10-18:00) if possible.

Atmosphere Flagship Posters

Ship Traffic Particulate Matter Emissions – First Results
Are Backlund, Matthias Karl, Ove Hermansen, Caroline Leck

Long-term monitoring of persistent organic pollutants (POPs) in air at Zeppelin station – Cancelled
Pernilla Bohlin-Nizzetto, Ove Hermansson, Athanasios Katsoyiannis, Lisa Melymuk, Petra Pribylova, Jana Klanova

Event-based observations of stable water isotopes in precipitation in Ny-Ålesund to support interpretation of Svalbard ice core data
Dmitry Divine, Elisabeth Isaksson, Tonu Martma

Vertical mixing of Aerosol in the Planetary Boundary Layer at Ny-Ålesund, Svalbard (Spitzbergen)
Oxana Drofa, C. Lanconelli, A. Lupi, M. Mazzola, F. Tampieri, A. P. Viola, V.Vitale, S. Becagli, F. Giardi, R. Udisti, M.Maturilli, A.Schultz

Halogenated and organophosphorus flame retardants on particles in the Arctic atmosphere
Mark Hermanson, Amina Salamova, Ronald A. Hites

An introduction to the Norwegian Mapping Authority's ionospheric research at high latitudes
Knut Stanley Jacobsen, Yngvild Linnea Andalsvik

Intrinsic chemical transformation in ice and its environmental effects – The fate of pollutants trapped in ice media
Kitae Kim

Direct observations of Arctic cloud particle content using a Counterflow Virtual Impactor
Radovan Krejci, Paul Zieger, Johan Ström, H-C Hansson, Peter Tunved

Annual variation of the cloud fraction and base height at Ny-Ålesund with ground-based observations
Makoto Kuji, Mayu Miyagawa, Masanori Yabuki, Masataka Shiobara

Troposphere halogens in Ny-Ålesund by DOAS measurements – Cancelled
Yuhan Luo

AGAP: an Atmospheric Gondola for Aerosol Profiling
Mauro Mazzola, D. Cappelletti , M. Busetto , C. Lanconelli, A.P. Viola, L. Ferrero, E. Bolzacchini, A. Lupi, V. Vitale

The roughness length evaluation at Ny-Alesund: a preliminary results
A. Pelliccioni, F.Tampieri , A.Viola, M.Mazzola

Variability in solar UV irradiance and atmospheric ozone column observed at Ny-Ålesund: current results of the U-VIVA RiS project

Boyan Petkov, Vito Vitale, Mauro Mazzola, Angelo Lupi, Christian Lanconelli, Angelo Viola, Kerstin Stebel, Georg H. Hansen

Sub-sea emissions of methane and light hydrocarbons from Arctic Ocean to atmosphere
Stephen Platt, Ove Hermansen, Norbert Schmidbauer, Anna Silyakova, Benedicte Ferré, Jürgen Mienert, Cathrine Lund Myhre

Seasonal variation of aerosol water uptake and its impact on the direct radiative effect at Ny-Ålesund, Svalbard
Narges Rastak, Sanna Silvergren, Paul Zieger , Ulla Wideqvist, Johan Ström, Birgitta Svenningsson, Marion Maturilli, Matthias Tesche, Annica Ekman, Peter Tunved, Ilona Riipinen

Monitoring of aerosol optical depth and water vapor content of the atmosphere in Barentsburg with the help of SPM and SP-9 sun photometers
S. M. Sakerin, Kozlov V., Kabanov D.M., Radionov V.F.

Ny-Ålesund atmospheric boundary layer
Alexander Schulz

Hygroscopicity and cloud forming properties of Arctic aerosol during one year
Sanna Silvergren, Ulla Wideqvist, Johan Ström, Staffan Sjögren, and Birgitta Svenningsson

Reconciling aerosol light extinction measurements from spaceborne lidar observations and in situ measurements in the Arctic
Mattias Tesche, Paul Zieger, Narges Rastak, Robert J. Charlson, Paul Glantz, Peter Tunved, and H-C. Hansson

Springtime atmospheric chemistry of Ny Ålesund, Svalbard – Cancelled
Roseline C. Thakur, Meloth Thamban

Organophosphate flame retardants and plasticizers in air and snow of the Arctic
Zhiyong Xie

Size resolved CCN concentration measurements in the Arctic – two case studies during summertime 2008
Julia Zabori, Narges Rastak, Young-Jun Yoon, Ilona Riipinen and Johan Ström

Terrestrial Ecology Flagship Posters

«Rain-On-Snow» events and its Influence on the Environment: the example of the Svalbard reindeer Jean-Charles Gallet, Åshild Ønvik Pedersen, Virve Ravolainen, Jack Kohler

Ammonia oxidation potentials and ammonia oxidizers of topsoil under moss–polar willow vegetation in Ny-Ålesund
Kentaro Hayashi, Yumi Shimomura, Sho Morimoto, Masaki Uchida, Takayuki Nakatsubo, Masahito Hayatsu

Vegetation mapping of Brøgger Peninsula and the Ny-Ålesund town area utilizing very-high resolution WorldView2 satellite data
Bernt Johansen, Hans Tømmervik

Geomorphological features of Kongsfjorden area (Ny-Ålesund, Blomstrandøya and Ossian Sarsfjellet) – Cancelled
Enrico Miccadei, Tommaso Piacentini, Claudio Berti, Ruggiero Casacchia, Oliver Grant, Anne Hormes, Henriette Linge, Roberto Sparapani

Chronobiology of polar organisms: Melatonin and polar lighting effects on an arctic "living fossil"
Vittorio Pasquali, Cristiano Bertolucci & David Hazlerigg

Methylobacter tundripaludum SV96; a methane filter in the Arctic environment and a model organism for Arctic adaptation
Mette M. Svenning, Anne Grethe Hestnes, Edda Marie Rainer, Alexander Tøsdal Tveit

Kongsfjorden System Flagship Posters

Monitoring past and recent ecosystem changes in Kongsfjorden using benthic foraminifera
Katrine Husum, Patrycja Jernas, Arto Miettinen

Forthcoming reconstructions for the past ocean conditions in Kongsfjorden over the last millennium based on improved paleo proxy methods
Arto Miettinen, Katrine Husum, Rahul Mohan

Mercury Fractionation in the Sediments of Kongsfjorden
Mahesh Mohan, Chandini P.K., Gopikrishna V.G, Kannan V.M

Continuous reflectance characterization of snowed surfaces in Ny-Ålesund
Roberto Salzano, Salvatori Rosamaria, Lanconelli Chrisitan, Esposito Giulio, Giusto Marco, Montagnoli Mauro, Di Nino Roberto, Mazzola Mauro, Viola Angelo

Modelling snow ice and superimposed ice on landfast sea ice in Kongsfjorden, Svalbard
Caixin Wang, Bin Cheng, Keguang Wang, Sebastian Gerland, and Olga Pavlova

Seasonal diversity in bacterial sequences retrieved from water samples of Kongsfjorden, Svalbard, Norway
Rupesh Sinha, K.P. Krishnan, Savita Kerkar

Glaciology Flagship Poster

Structure from motion: a low cost, very high resolution method for surveying glaciers using GoPros and opportunistic helicopter flights
Luc Girod, Olivia Gautrais, Christopher Nuth, Jack Kohler

High resolution glacier dynamics and calving from GNSS and passive seismology
Christopher Nuth, Jack Kohler, Kenneth Bahr , Andreas Köhler, Giuseppa Buscaino

Analyzing snowfall on the glaciers Holtedahlfonna and Kongsvegen, in the Kongsfjorden area
Ankit Pramanik, Ward Van Pelt, Jack Kohler

Modelling the long-term mass balance and firn evolution of glaciers around Kongsfjorden, Svalbard

Ward van Pelt, J. Kohler

Other Posters

Biological rhythms, sleep and cognitive performance of high arctic residents during summer and winter
Fabio Ferlazzo, Francesca Patacchioli and Vittorio Pasquali

Appendix 2: Seminar Participants

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Title	Space weather and scintillations at high latitudes

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	PS

Presentation preference (O=oral, P=poster)	O

Space weather can affect Global Navigation Satellite Systems (GNSS) quite severely, particularly in equatorial areas and at high latitudes. Two main effects are present, a delay of the signal, that can be mitigated with dual frequency receivers, and fluctuations in phase and amplitude of the signal, a phenomenon called scintillation. These space weather effects are linked in their origin, but are not necessarily coinciding.

Norwegian Mapping Authority (NMA) has established a network of 10 scintillation receivers monitoring these effects in real-time. With, among others, receivers in Ny-Ålesund, on Bjørnøya and on Hopen these data will provide invaluable information on some the most affected areas of space weather. The data is calculated in real-time for monitoring purposes and also stored in an archive to provide statistics for future investigations.

This presentation will look at some of the main challenges for GNSS systems related to space weather in the arctic and case studies of events and their effects. We will also show that for high latitudes events too small to be characterized as a geomagnetic storm by the NOAA scale still can have significant impact. We will present examples from a solar storm from January 2013, where NMAs near real-time kinematic positioning network showed an increase in position noise and bias during the event.

Title	**Trace elements in Kongsfjorden: occurrence, sources and bioavailability**

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Presentation preference (O=oral, P=poster)	O

The main goal of this research project is to obtain a better knowledge of the occurrence, bioavailability, sources and transport pathways of trace elements in the marine environment of Kongsfjorden. This task has been obtaining by oceanographic activities in the fjord and extensive analytical work to measure hydrological (temperature, salinity), biological (nutrients, phytoplankton pigments) and chemical (major and trace elements associated to suspended particulate matter) parameters for the sea surface and water column. The sources of trace elements are evaluated by measuring lead isotope ratios ($^{208}Pb/^{207}Pb$ and $^{206}Pb/^{207}Pb$) and comparing them with the isotopic signature of the atmospheric particulate and marine sediments collected in the same area.

In the 2012 surveys, it was found that natural input from the glaciers is the major source for Al, Co, Fe, K, Ti and V, whereas Ba, Cr, Cu, Mn, Mo, Ni, Pb and Zn of anthropogenic origin are mainly introduced into the fjord through the intrusion of Atlantic waters. The influence of the glacial runoff decreased with the distance from the front and it was higher at the end of the summer season than in late spring. On the other hand, the effect of the Atlantic waters was more relevant in the bottom layer at the entrance of the fjord, especially during the summer season.

The actual bioavailability of trace elements for the marine ecosystem has been assessed by analysing the solid speciation patterns of heavy metals in surface sediments. Total concentrations of several elements were determined in two granulometric fractions and their bioavailability evaluated by both applying a sequential-selective extraction procedure and using a biomimetic approach based on proteolytic enzymes. The results indicated overall that the anthropogenic impact of trace elements in the investigated area is negligible, although a minor enrichment with respect to crustal values was found for As, Cd, Cr, Ni, and V. Enrichment of trace elements in the <63-µm fraction compared to the coarser one was evident for As, Cd, Cr, and Ni. The evaluation of the bioavailable fractions showed that a large part of the total content of trace elements cannot enter the aquatic food chain and emphasised the risk of overestimating the environmental impact of heavy metals if the assessment is only based on total concentrations.

Title	Ship Traffic Particulate Matter Emissions – First Results

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Presentation preference (O=oral, P=poster)	P

The aim of the project "Ship Traffic Particulate Matter Emissions" (SHIPMATE) is to determine the contribution of ship emissions to particulate matter (PM) measured at Mt. Zeppelin station by source apportionment methods. The project will identify days that were influenced by local ship emissions in order to preserve the usefulness of the observatory for regional trends of atmospheric constituents. The measurement of a large number of pollutants and aerosol components (receptor species) which act as markers of different local/regional anthropogenic and biogenic PM sources were conducted at the Zeppelin observatory during 2015 with a focus on the summer period (April to September). Data analysis using Enrichment Factor (EF) analysis and Positive Matrix Factorization (PMF) analysis will identify the time series (record) of the ship-related PM source. EF analysis is a classical approach for use in data screening and to support assumptions for PM sources for which little information is available. Soil samples taken at Kongsfjord will be the reference material (crustal composition) for EF analysis. A total of 15 samples were taken from the top soil along a transect from the shoreline to Sherdahlfjellet. Soil samples were analyzed at NILU laboratories for trace metals (Figure 1).

A

B

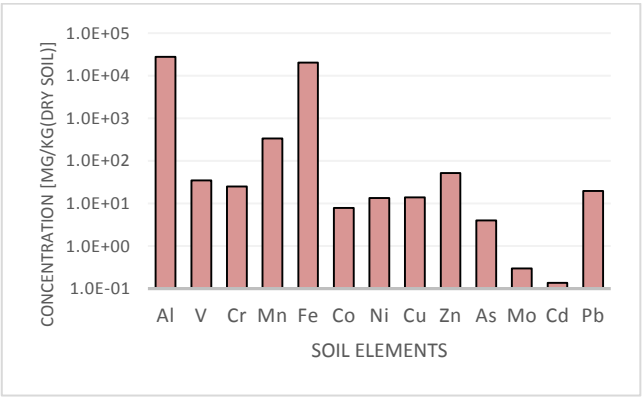

Figure 1. Sampling site map and soil composition: A) Transect of the soil sample collection at Sherdahlfjellet (dotted line), B) Soil composition of heavy metals (concentration on log scale).

Once the full set of analyzed chemical components is available, PMF will be used for the source identification of ship PM emissions. Passenger number data at Ny-Ålesund harbor from Kings Bay AS will be utilized to evaluate results from the PMF analysis. For days with identified ship pollution events, the meteorological situation will be analyzed by using wind measurements at Mt. Zeppelin, back-trajectories calculated by HYSPLIT, and LIDAR measurements of the boundary layer height.

Title	**Life and light in the dead of night: unexpected levels of biological activity during the polar night offer a new perspective on Arctic ecosystems**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	KS

Presentation preference (O=oral, P=poster)	O

Marine ecosystems are generally considered bottom-up controlled systems with strong physical forcing and high seasonality in primary production regimes. In polar regions, where photosynthetic active radiation (irradiance, 400-700 nm, E) is extremely low during winter, the seasonality of primary production is enhanced. Consequently, polar organisms are generally thought to be largely inactive during the polar night due to reduced food supply. This perception derives from primary production rates close to zero resulting in little newly produced food available for pelagic and benthic grazers, and low E that seemingly prohibit feeding by visual predators, including zooplankton, fishes, and seabirds. In addition, well-documented life-history traits of herbivorous marine zooplankton, such as accumulation of lipids, extensive seasonal vertical migrations, and diapause further suggest an ecosystem tightly tied to the short productive season during the summer months. Recently, based upon a multidisciplinary ecosystem-scale study from the polar night in Kongsfjorden during the last three winters, an entirely different view was presented. Instead of an ecosystem that had entered a resting state, Berge et al (subm, in press) documented a system in which abundances, activity levels, and biological interactions across most trophic levels and phyla were high. The ability to be "ready" for spring rather than utilizing as much of the autumn season as possibly seems a broad ranging adaptation of Arctic organisms. Accordingly, organisms use either endo- or exogenous cues that are yet to be understood for initiating the "spring" part of their annual routines, often before any light is available to cue on. Ultimately, and at a time when predicting ecosystem response to Arctic change is a high priority, this requires a different perspective and thinking regarding ecosystem resistance and resilience.

Figure 1 (from Berge et al, *in press*). All pictures taken from the bridge of RV *Helmer Hanssen.* Knowledge and levels of illumination during the polar night are both inversely correlated with latitude. Photo: G Johnsen (NTNU) and J Berge

Title	**Seaweed Biology in a changing Arctic: The long-term program on Arctic benthic algae**

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Presentation preference (O=oral, P=poster)	O

Kongsfjorden hosts a diverse seaweed community forming the base of the benthic foodweb and providing habitat and shelter for a vast diversity of associated fauna. Seaweed model species as well as seaweed communities are intensively studied with reference to their general adaptive and functional traits, as well as their responses to global environmental change. Our long-term project aims at a holistic understanding of seaweed ecosystem function spanning from the environmental control of gene expression to energy flow through trophic levels and connectivity among benthic habitats.

Here we report on the results of benthic biomass and species composition surveys in 1996-98 and 2012-14, indicating a considerable change in seaweed biomass, vertical distribution limits and species richness at the study site of Hansneset, all possibly correlated to the recent increase in winter temperatures and summer melting of glaciers. The seaweed biomass maximum was shifted from 5 to 2.5m depth, overall biomass increased and the invertebrate and seaweed community changed. Future surveys will be conducted in intervals of approx. five years to separate climate related signals against a background of high inter-annual variability.

Furthermore, the outcome of a preliminary network analysis will be presented, which comprises a trophic model for the benthic foodweb and also allows for more solid predictions on the impact of environmental change on the Kongsfjord ecosystem. The impact of the increase of sedimentation and temperature in combination with grazing on the recruitment success of kelps will be shown. We will further present first data on detached kelp as modulator of structure and function of soft bottom communities and on the physiological phenomenon of cross-acclimation in the kelps *Alaria esculenta* and *Saccharina latissima*.

With respect to the seaweed ecosystem we will introduce our monitoring strategy under the Kongsfjord Ecosystem Flagship program and highlight important topics for future seaweed research in Kongsfjorden, which will entail the prediction of the changes in the underwater light climate as resultant from sea ice loss and increased terrestrial run-off and the related consequences to seaweed productivity, and the modulation of seaweed ecosystem functioning by seasonal drivers.

Title	**Water vapor in Hornsund – comparison of lidar, sun photometer and satellite sensors data**

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Presentation preference (O=oral, P=poster)	O

Water vapor is one of the main greenhouse gases in the Earth's atmosphere. Monitoring of water vapor content is very important, especially in Arctic region. In recent years, there was a major development of satellite remote-sensing techniques. Due to characteristic of satellite orbit, large quantity of data are available for polar regions. This is important due to the low population of the Arctic, which is associated with a sparse infrastructure and research stations, in comparison to other Earth regions.

Studies on the water vapor content in the atmosphere are also conducted in Polish Polar Station at Hornsund fjord (77.00°N, 15.55 °E, 10 m asl). Since 2005, sun photometer CIMEL, which is part of AERONET allows to determine total integrated column water vapor content. Ground-based Raman lidar system, installed in 2009, provides vertical profiles of water vapor mixing ratio. Comparison of measurements from these two devices with data from satellite sensors such as MODIS and AIRS will be presented at Symposium.

Title	**Long-term monitoring of persistent organic pollutants (POPs) in air at Zeppelin station**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

Abstract:

Persistent organic pollutants (POPs) can undergo long-range transport, are toxic, bioaccumulative and persistent in the environment. For many of the POPs, long-range transport via air is the most important source to pollution in remote areas where there are few or no local sources. Due to their presence in remote areas and their harmful impacts on the environment, monitoring of POPs in the Arctic is of high priority. Air monitoring of POPs are part of the Norwegian national monitoring programme of long-range transported air pollutants, conducted by NILU on the behalf of the Norwegian Environment Agency, and the Ministry of Climate and Environment. The monitoring has been ongoing at Zeppelin since the beginning of 1990s and is one of the longest time series of POPs available on a global scale. The purpose of the monitoring is to increase the knowledge on long-range transported POPs as a source to the Norwegian and Arctic environment and to monitor any changes in their levels over time.

Air samples are collected at the Zeppelin observatory on a weekly basis (i.e. 48-72 h per week, 52 samples per year) using high-volume air samples (V=600 m^3 per 24 h). POPs associated to particles are collected on glass fiber filter (GFF) and POPs in gas phase are collected on polyurethane foam (PUF) adsorbents. The GFF and PUFs are soxhlet extracted, cleaned up and analyzed using GC-MS at NILU. Targeted compounds are hexachlorobenzene (HCB), hexachlorohexanes (HCHs), DDTs, chlordanes (CHLs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane (HBCD), polycyclic aromatic hydrocarbons (PAHs), and per- and polyfluorinated alkyl substances (PFAS). Results are reported in annual reports to the Norwegian Environmental Protection Agency as well as to international conventions, programmes and networks such as the European Monitoring Evaluation Programme (EMEP) under the Convention on Long-range Transboundary Air Pollutants, and the Arctic Monitoring and Assessment Programme (AMAP) etc. Data are stored and publically available in the EBAS database (http://ebas.nilu.no). As a compliment to the active air sampling, a European passive air monitoring network (MONET) organized by RECETOX (Czech Republic) also collects air samples for POPs at Zeppelin. The MONET network collects samples using PUF passive air samplers deployed for one-three months giving time weighted average concentrations for the exposure period. The MONET network has collected air samples at Zeppelin using PUF-PAS since 2009. Targeted compounds are HCB, HCHs,

DDTs and PCBs. Herein we present long-term trends from the active air samplers and compare the data from the active and passive air samplers.

The long-term monitoring data show declining time-trends for HCHs, DDTs, CHLs, and PCBs at Zeppelin. The largest reductions in air concentrations since 1990s are observed for HCHs with half-lives around 4 years. The reductions are not as significant for DDTs, CHLs, and PCBs due to more fluctuating concentrations. The decline seems to have slowed down in recent years indicating a tendency towards equilibrium with other media. In contrast, an increase in concentrations during the last 10 years has been observed for HCB. The results show that the air concentrations of POPs respond to regulatory actions and management such as bans or restrictions. Nevertheless, re-emission from secondary sources and climate forcing may represent important confounding factors for interpreting monitoring data.

Title	**Precipitation in Arctic and associated synoptic atmospheric conditions.**

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Presentation preference (O=oral, P=poster)	O

Precipitation in Arctic has significant importance in modulating the hydrological cycle, mass balance and radiative effects. The local synoptic scale disturbances and associated atmospheric conditions influence the precipitation characteristics in Arctic largely. Climate models predict a higher rate of increase in precipitation in Arctic than the global rate. The rapidly changing local atmospheric conditions due to global warming may significantly contribute to this higher rate of increase. During 2013-14, a Micro Rain Radar (MRR) was installed at Ny-Alesund, which gives the profile of the precipitation. In this study, the vertical distribution of precipitation and total precipitation rate observed from the MRR during 2013 and 2014 are studied in lines of spatial and temporal changes in synoptic atmospheric patterns. Statistical analysis of the precipitation events is performed to capture the temporal precipitation variability in Arctic. The MRR products are compared with the other available precipitation products as well for understanding the uncertainities involved in precipitation measurements.

Title	**Winter vertical migration: using Kongsfjorden as an insight into pan Arctic behaviours**

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Presentation preference (O=oral, P=poster)	O

Diel vertical migration is accepted to be the largest migration, by biomass, on the planet. The behaviour is driven by sunlight and food, with populations sinking in the day to avoid the threat of visual predators and surfacing at night to feed on phytoplankton layers. In the Arctic, where 24 hour darkness takes place in the winter, it has been assumed that this behaviour ceased and populations entered a state of diapause. It has recently been shown that this is not the case, and populations remain active in terms of migration throughout the Polar Night. However, the details of winter behaviour are still unknown and poorly understood.

This study is primarily based on eight years of Acoustic Doppler Current Profiler (ADCP) data from Kongsfjorden, Svalbard. Using fine scale calculations of solar and lunar elevation and illumination, we have described the shift in the response of zooplankton from one that is solar dominated in the autumn and spring, to one that is controlled by the moon in the depths of winter. The full moon initiates surface avoidance that can be detected as a circalunar cycle. Similarly, the lunar altitude creates a new regime of vertical migration, but on a lunar day cycle around the time of the full moon. Both these behaviours represent a complex response to the overall surface illumination by zooplankton.

The extensive dataset from Kongsfjorden is extended further by an Arctic wide set of ADCP data. Using Kongsfjorden as a case study for behaviour detection, it has been seen that this response to the moon is replicated across the Arctic Ocean in open water, fjord, ice covered, shelf, deep waters, and shallow systems. This changes our current understanding of a quiescent Polar Night, and instead suggests an active surface community right throughout the winter.

Title	**Observed summer biomass variability and associated biophysical coupling in Kongsfjorden**

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Presentation preference (O=oral, P=poster)	O

Abstract

The present study is an investigation to understand the observed biomass variability with an earlier intrusion of Atlantic waters and a progressive warming inside Kongsfjorden during the summer season from 2011 to 2013. The physical, chemical and biological coupling in Kongsfjorden is explored. The 100 m column integrated Chl_a showed higher values in the central and outer Kongsfjorden during the peak summer months of August and September and was in the range of 1-3 μg/L in 2011, 0.4-2.25 μg/L in 2012 and < 0.5 μg/L in 2013. The concurrent biomass and nutrient data corresponded very well both temporally and spatially. Meanwhile the volume, temperature and salinity of the fjord water was found increased due to a progressive increase in warmer and saline Atlantic water intrusion and thereby resulted in watermass variabilities inside Kongsfjorden from 2011 to 2013. Increased chlorophyll a was seen mainly in the region of the intermediate and surface watermasses during summer. The combination of a compensating surface flow to the subsurface intrusion of AW and the strong southeasterly surface winds resulted in a corresponding net outflow of the surface fresh water layer in Kongsfjorden. Hence a decreased freshwater volume was found inside the fjord in 2013 compared to 2011 and 2012.

Title	**Quantifying influence of regional air pollution on atmospheric measurements in Ny-Ålesund**

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Presentation preference (O=oral, P=poster)	O

The Zeppelin station outside Ny-Ålesund is a prominent monitoring station for studying background air and pollution in the Arctic. It is crucial to ensure the highest data quality attainable for the station. We present an approach for quantifying the influence of local and regional sources and sinks that can cause misinterpretations of the dataset by mimicking variability that could otherwise be attributed to long-range transport events.

For SO_2 local and regional sources studied include the coal-fired electric power plants in Longyearbyen and Barentsburg (to the SE of Ny-Ålesund) and ship traffic. Cruise ships produce local pollution in the summer but there is also a more diffuse source from the fishing fleets that frequent adjacent waters. In the winter and spring the transport of polluted air masses from Europe and the former Soviet Union, can be observed. The relative influence of these sources needs to be quantified.

The SO_2 data collected by NILU in the village during the project Local Air Quality Monitoring 2008-2010 in Ny-Ålesund have been analysed in combination with the integral aerosol number density and size distribution measured by Stockholm University at the Zeppelin station. The potential transport of pollution has been studied using the kinematic trajectory model FLEXTRA (Version 3.0) air mass trajectories analysis.

The UV Fluorescence SO_2 analyzer (model 100E) and aerosol data measured using two Condensation Particle Counters (TSI CPC 3025 and TSI CPC 3010) have been used for the period from 14.07.2008 to 24.08.2010. The detection limit of the SO_2 instrument was 0.4 ppb. The SO_2 concentration in the near pristine Ny-Ålesund environment was frequently below this value. All instances with values above the detection limit have been explored with FLEXTRA. The performance of the model varies with meteorological conditions, and the position errors of 20% of the travel distance are typical for trajectories.

The hours with peak concentration have been sorted according to the prevailing wind direction. Three main wind directions have been observed E-SE, NW-N and SW. The flow from NW-N may bring local pollution from ship traffic or the power plant. The air from the sea brought in by these winds may also contain biogenic SO_2 from the photochemical oxidation of DMS. Thus boundary layer nucleation events and SO_2 peaks could have non-anthropogenic origin. A correlation between the diurnal cruise ship traffic maximum and maximum number of particles has been found. Due to the ambiguity regarding particle origin, the hours with wind from NW-N direction have not been assessed further in this study. The flow from SW is mainly attributed to katabatic flow from nearest glaciers Vestre Brøggerbreen and Austre Brøggerbreen. Such local wind systems may be in-effective in dispersion processes due to low wind speed and local recirculation processes.

The hours with prevailing SE wind direction have been particularly scrutinized. When episodes of pollution brought from SE are followed by subsiding winds or SW winds (local circulation) trajectory analysis have been performed.

Average values of SO_2 measured by monitor increase every summer and winter and decrease every autumn and spring. The possible reasons for these features are wintertime long-range transport and summertime ship traffic or DMS emissions. As expected, FLEXTRA-trajectory analysis revealed that most of pollution brought by SE flow may be of long-range and/or regional origin (83% of total number of peaks from SE and SW). This group of measurements is characterized by high mean and median concentrations of SO_2: 1.96 $\mu g/m^3$ and 1.70 $\mu g/m^3$ for wind from SE and 2.30 $\mu g/m^3$ and 1.80 $\mu g/m^3$ for wind from SW, respectively. However, 17% of the total number of hours with peak concentration from SE and SW may be only due to regional pollution, as no long-range source of pollution is likely based on the trajectory analysis. The mean and median concentrations of SO_2 are significantly lower for this group of measurements: 1.71 $\mu g/m^3$ and 1.50 $\mu g/m^3$ for wind from SE and 1.48 $\mu g/m^3$ and 1.40 $\mu g/m^3$ for wind from SW, respectively. A significant feature discovered for these regional pollution periods is found for the nucleation mode particle data (d=10-40nm). The mean concentration of ultrafine particles for the time of year when sunlight is present has been almost 3 times higher for the group of measurement with absence of long –range transport than for the group of measurements for which the trajectories showed possibility of long-range transport. This indicates that the measured air masses contained fresh nucleation mode particles, which is consistent with regional emissions of particle precursors (e.g. SO_2).

Title	**Seabird monitoring in Kongsfjorden in a regional, national and international perspective**

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Included in session (KS=Kongsfjorden System; **or** PS=Ny-Ålesund research in a Pan-Svalbard perspective)	KS or PS

Presentation preference	O

Several seabird species have been monitored in Kongsfjorden for more than two decades. This long term monitoring indicated that trends in colony sizes in Kongsfjorden varied among species and have changed through time. Svalbard seabird population dynamics may show important regional (i.e. among fjords), national (i.e. Svalbard vs. mainland Norway) and international variation. However, trends in Kongsfjorden seabird populations may also reflect large-scale environmental changes and seabird population dynamics throughout the Arctic.

Title	**Event-based observations of stable water isotopes in precipitation in Ny-Ålesund to support interpretation of Svalbard ice core data**

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Presentation preference (O=oral, P=poster)	P

A better understanding of past climate variability is necessary to accurately assess its present-day state and improve the credibility of the future climate change scenarios. Ice core records are known to store valuable information about previous climate and the past composition of the atmosphere. The analysis relies heavily on the stable water isotope ratios ($\delta^{18}O$ and δD) in precipitation because of their relationship to the condensation temperature of the water vapor. It makes the isotopic series from the ice cores important tools when trying to extend the instrumental records further back in time. The reliability of the inferred T- $\delta^{18}O$ (or δD) relationship and hence the ice-core data interpretation is highly dependent on a thorough understanding of the physical processes involved in accumulation. It was determined empirically for a number of locations that T- $\delta^{18}O$(δD) relationship is approximately linear at the annual time scale. However, the final isotopic composition of the snow precipitating at the core site is influenced by a number of other factors, not necessarily linked directly with the ambient temperature. Variations in moisture origin, moisture transport pathways and processes forming precipitation may cause considerable variations of the T- $\delta^{18}O$ (or δD) gradient. The resulted bias may show persistence on much longer, than synoptic, time scales, in response to persistence of a particular factor - the source of bias.

The goal of the event-based sampling of precipitation is to extend the existing program for a regular monitoring of the isotopic composition of precipitation in Ny-Ålesund. The Norwegian Polar Institute has successfully run this monitoring since 2009. In order to ensure that samples of precipitation are collected on a regular basis and regardless of, or with a minimal impact of weather conditions, location of the sampling site was chosen to be within the area of Ny-Ålesund. At present the technical personnel of the Sverdrup station collects the samples directly on the roof of the station.

Sampling of precipitation during each precipitation event, along with measurements of air- and cloud base temperature available from the Ny-Ålesund meteorological station, will aid in investigating the local relation between air temperatures and the isotopic composition of local precipitation. Analysis of T- $\delta^{18}O$(δD) relationship at synoptic time scales will enable to identify the processes (environmental conditions) contributing most to its deviations from the climatic mean. Combined with the regional climate modeling and trajectory analysis (HYSPLIT modeling), such data potentially promote a better quantitative interpretation of ice core data from Svalbard. A validation of regional climate models fitted with isotope diagnostics is also anticipated.

Title	**Vertical mixing of Aerosol in the Planetary Boundary Layer at Ny-Ålesund, Svalbard (Spitzbergen)**

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Presentation preference (O=oral, P=poster)	P

Aerosol is an important component of the atmosphere. Its vertical distribution in the planetary boundary layer (PBL) is an index of the mixing that occurs between the tracers transported in the free atmosphere and those of local origin.

The present work aims to investigate the influence of the boundary layer structure and dynamics on the vertical distribution of aerosol. The main issue is related to the height of PBL: the question is whether some decoupling occurs between the surface layer and the atmosphere aloft when the PBL is hallow or the mechanical mixing due to the synoptic circulation provides an overall vertical homogeneity of the concentration of the aerosol irrespective of the stability conditions.

To this end, the aerosol concentration and size distribution measured near the surface are compared to the ones measured at 500 m height. The surface turbulent fluxes are examined, then the radiosoundings, the meteorological objective analysis of IFS-ECMWF and the meteorological simulations from the NWP model Bolam are used to evaluate the stability and the dynamics of the first km of the atmosphere above the measuring station.

We have selected five months for the investigation: the period from April to August 2013, characterized by different weather and PBL features and by the full availability of data. Moreover, detailed analysis of one day is reported, chosen in order to put into evidence some special features.

PBL properties have been studied with the use of observation data of Amundsen-Nobile Climate Change Tower (CCT) financed by The Department of Earth System Science and Environmental Technologies of the Italian National Reaserach Council and located about 2 Km NW off the village of Ny-Ålesund (about 79 N, 12 E), in the Svalbard Islands (Norway).

Aerosol measurements were performed at Mount Zeppelin laboratory (474 m a.s.l.), just SW the CCT, equipped with a Differential Mobility Particle Sizer, able to analyze particles in 32 classes in the range $0.003 - 0.9$ μm, with an acquisition time of 20 minutes, and at Gruvebadet Laboratory, with a Scanning Mobility Particle Sizer, which analyzes particles in 52 classes in the range $0.01 - 0.49$ μm, with an acquisition time of 10 minutes. From the size spectra, the Geometric Mean Diameter has been computed.

The synoptic situations during the investigation period have been studied with objective analysis data of IFS-ECMWF. The NWP model Bolam, which is the model of CNR-ISAC, has been used to simulate the atmospheric dynamical and physical processes in more details. The Bolam-simulated data have been used to provide the input to the Lagrangian model Flexpart, that simulated backward trajectories. These trajectories helped to study the origin zones of the aerosol observed in Ny-Ålesund.

The observation and simulation data have been used both with a statistical (monthly) approach and a single case-study (one day) approach in order to investigate atmospheric conditions, PBL properties, and aerosol vertical distribution.
Although different local conditions occurred during the examined periods (in terms of surface turbulent fluxes), the vertical distribution of the aerosol shows minor changes. Moreover, the number concentration ratios appear to be weakly dependent on the surface stability.
The case study support the same conclusion, i.e. that in spite of the fact that the estimated depth of the PBL (from Bolam simulations) is less than the height of the mountain station, and that surface fluxes change during the day, the aerosol behavior is quite similar in the two observing stations.
Thus, the large scale transport results to be the dominant factor in determining the concentration and size of the aerosol in the entire layer examined here, with a depth of about 500 m, while the vertical distribution turns out to be only weakly affected by the local heat and momentum fluxes measured near the ground.

Title	**Biological rhythms, sleep and cognitive performance of high arctic residents during summer and winter**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	Any specific session is present. The authors want to propose for the future a new line of research to be included in the activities in Ny-Alesund

Presentation (O=oral, P=poster)	P

As stated by Leon an coworkers (2011), one of the main issues in polar research on humans is how physical, physiological, psychological, social and cultural adaptations to the hostile, confined and isolated conditions affect the crew's performance on assigned duties. The human circadian clock regulates the temporal organization of physiological functions in accordance with the day-night alterations and the seasonal change in photoperiod. The variation in exposure to daylight across the 24h cycle is a primary zeitgeber, helping to synchronize the different endogenous circadian functions and the sleep-wake pattern. The absence of this circadian fluctuation in exposure to daylight during winter-over in Antarctica seems to result in sleep problems and sleep-wake rhythm disturbances (Owen et al., 1992; Usui et al., 2000; Kennaway et al. 1991). Results from Antarctic experiment of Pattyn and coworkers (2009) have shown a dissociation between the rhythmic secretion of cortisol and melatonin, with a delayed melatonin secretion and slow wave sleep onset, whereas cortisol secretion followed a normal pattern. Furthermore, performance on the psychomotor vigilance task was severely impaired. These findings suggest that, for attentional performance, the preserved circadian rhythmicity of cortisol, hence the normal functioning of the "wake" system could not counteract the disturbed "sleep" system, with the delayed melatonin secretion and slow wave sleep. Similarly to the findings on the interaction between mood and sleep quality, it has been shown that changes in mood during the austral winter were preceded by changes in sleep characteristics, and that mood changes affected sleep quality during an overwintering period (Palinkas et al., 2000). Previous research also showed that free-running circadian cycles led to different patterns of performance (Steel et al., 1995), the concurrent measure of sleep quality, circadian rhythmicity and performance could allow a more detailed unravelling of existing interactions between potential disturbances of these systems. Available results on cognitive performance investigations in Antarctica reveal a mixed picture. Whereas the sensory deprivation has been suggested to affect the fundamentals of perception (Suedfeld, 1998), more complex investigations using task simulations did not show any serious performance deterioration (Sauer et al., 1999). Furthermore, the available reports show some contradictory evidence, with some researchers reporting decreased performance (Tereljak et al., 1985; Barabasz & Barabasz, 1986; Pattyn et al., 2009), others not evidencing any cognitive change (Derayapa, 1971; Taylor & Duncum, 1987; Rosnet et al., 2000) and still others measuring an actual improvement (Defayolle et al., 1985). However, anecdotal reports of real-life performance decrements, such as poor decision-making and

potentially dangerous lapses in judgment have been reported for Antarctic personnel (Palinkas, 1992; Wood et al., 1999). The present proposal aims at identifying variations in physiology and cognitive performance during the overwintering period. This might be the measurement of desynchronization in different biological rhythms and decrement of cognitive performance, but also of strategic shifts in these variables, that could have an adaptive function. The assessment of sleep quality and circadian rhythmicity will allow to identify whether previously described disturbances are replicated here, and how these relate to the quality of cognitive performance and general human performance in polar environments.

Title	Connecting Aerosol Size Distributions at Three Arctic Stations

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	O

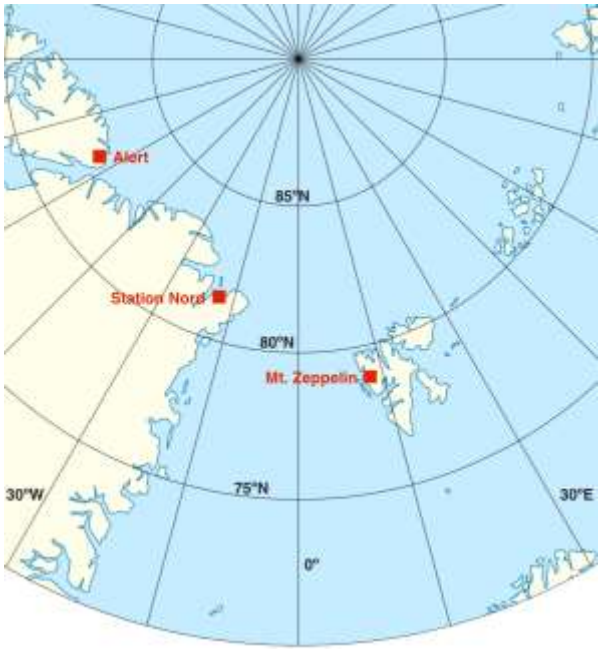

Figure 1: Map showing the arctic stations at which the aerosol size distributions were measured and compared (source of background map: wikipedia.org)

Aerosols play an important role in Earth's energy balance through direct interactions with the incoming solar radiation, as well as through processes that involve clouds and outgoing terrestrial radiation. Previous studies of aerosols in the arctic have shown that there is a distinct annual cycle of aerosol properties, with the greatest mass concentrations during the arctic haze period in the spring. In the arctic summer, on the other hand, the condensation sink is at minimum due to effective wet removal processes, allowing for events of aerosol nucleation to take place. Little is known about the spatial extent of these events as no previous studies have directly compared and linked aerosol measurements from different arctic stations during the same times. Although the arctic stations are hardly affected by local pollution, it is normally assumed that their aerosol measurements are indicative of a rather large area. It is, however, not clear if that assumption holds all the time, and how large may that area be.

In this study, three different datasets of aerosol size distributions from Mt. Zeppelin in Svalbard, Station Nord in northern Greenland and Alert in the Canadian arctic (see Fig. 1), are analyzed for the measurement period of 2012-2013. All stations are 500 to 1000 km from each other, and according to

the back-trajectory calculations, the travel time from one station to the other is typically between 2 to 5 days. The meteorological parameters along the trajectories are analyzed in order to estimate their role in the modification of the aerosol size distribution while the air is traveling from one field station to another. In addition, the exposure of the sampled air to open waters assessed, due to the increased fluxes of heat, moisture, gases and particles, that are expected to affect the aerosol size distribution more than when the air is traveling over a frozen sea.

The results show that the general characteristics of the monthly median aerosol size distributions and their annual variation, are not very different in all three stations, with Alert and Station Nord being more similar. This is more pronounced when looking into the cases for which the trajectory calculations indicated that the air traveled from one of the latter stations to the other. The probable causes for the measurements at Mt. Zeppelin to be less in-line with the other stations are the greater exposure to ice-free water all year round. In addition, the air sampled at Mt. Zeppelin is sometimes decoupled from the air at sea level. This results in a greater potential contribution of long-range transport to the aerosols that are measured there, compared to the other low-altitude stations.

Title	**The next step for snow research in Ny-Ålesund: towards a coupled snow-atmosphere long term sampling site**

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Presentation preference (O=oral, P=poster)	O

Snow is one of the main interfaces between the atmosphere and Earth surface and is the dominant component in the Arctic terrestrial water cycle. It has a low thermal conductivity and a high albedo, thus playing a crucial role for Earth energy budget. The albedo of snow is determine by the size of the snow grains and the amount of impurities, such Black carbon (BC). BC is originated from combustion of fossil fuel and biomass burning, it has been highlighted in the past decade by many nations as a research priority in the view of climate warming, as well by IPCC. First, BC sources control along with the environmental conditions BC physical properties, its aging and therefore its deposition rate on the snow surface, so the radiative effect on the albedo of snow. Second, both BC and snow physical properties are linked and their vertical gradient in the snowpack are of interest for Earth energy budget. Third, both snow physical properties and BC content will drive the melting rate of the snowpack, with potential further positive feedbacks if BC stays at the surface during the snow melting. Several BC projects have been run by NPI during that last 10 years and we will show some of the main findings.

In Ny-Ålesund, several groups are working on snow and atmosphere sciences but still there is no existing common sampling site and strategy on a long term basis. The objective of this talk is to demonstrate that need by taking the example of BC. We will also extend the benefit of coupling snow and atmosphere sampling to other fields of sciences, such as permafrost, chemistry and terrestrial ecosystem, thematics that are all represented in Ny-Ålesund and in which snow is playing crucial role.

Title	**«Rain-On-Snow» events and its Influence on the Environment: the example of the Svalbard reindeer**

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Presentation preference (O=oral, P=poster)	P

Snow is one of the main interfaces between the atmosphere and Earth surface, and is the dominant component in the Arctic terrestrial water cycle. In Svalbard, due to the strong oceanic influence, there are repeated winter warming events that significantly impact snow cover, so-called "Rain-On-Snow" (ROS) events. ROS leads to the formation of a denser snowpack with ice lenses and in the most extreme cases, the formation of a basal ice layer at the contact between snow and ground. These ice lenses or ground-ice can have a dramatic impact on plant growth and quality, and can affect the foraging ability of terrestrial animal populations.

We have been monitoring during the last 15 years the amount of snow and ground-ice around the peninsula Brøggerhalvøya, as well as the population of the Svalbard reindeer, an endemic species. Here we show that snow and ice can be clearly consider as a driver of the population of the Svalbard reindeer, and to a certain extent, as a driver of the Svalbard ecosystem. We emphasize the need for more data and particularly the need to include the study of the effect of snow and ice on plants to complete a simple food chain model approach, all to evaluate the vulnerability of an Arctic ecosystem to climate and climate change.

Title	Update on Sea Ice Monitoring in Kongsfjorden, Svalbard

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Presentation preference (O=oral, P=poster)	O

Sea ice affects the energy exchange at the atmosphere-ocean interface, and it is crucial for the Arctic marine ecosystem. Beyond that, the existence and changes of Arctic sea ice have also direct implications for the society, such as for shipping and oil and gas exploration. While sea ice in the entire Arctic is studied and monitored with ship expeditions, drifting stations, moored sonars, and remote sensing, observations at coastal sites and fjords give the possibility to study and monitor Arctic sea ice in more detail over months and years under conditions where thermodynamic ice growth dominates (versus dynamic growth). Results from sea ice monitoring in Kongsfjorden are also of interest for several other scientific studies conducted in Ny-Ålesund and surroundings. Inner Kongsfjorden is commonly covered with seasonal landfast sea ice at times in winter and spring. In recent years, the duration of time with sea ice in Kongsfjorden has been shorter, and the extent less. However, interannual variability of fast ice scenarios in Kongsfjorden is high. Therefore sea ice changes cannot be detected with observation only over a few years. Scientists from the Norwegian Polar Institute have observed fast ice in Kongsfjorden systematically since 2003. From some earlier years, sporadic information from process studies exists. Key elements of the monitoring at Kongsfjorden are sea ice extent observations, in-situ sea ice thickness, snow thickness and freeboard measurements. Occasionally, additional data are collected and samples are taken, often as a part of process studies. The presentation will give an overview on the monitoring setup, and updated results will be presented.

Title	**Structure from motion: a low cost, very high resolution method for surveying glaciers using GoPros and opportunistic helicopter flights**

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Presentation preference (O=oral, P=poster)	P

The capability of structure from motion techniques to survey glaciers with a very high spatial and temporal resolution is a promising tool for better understanding the dynamic changes of glaciers. Modern software and computing power allow us to produce accurate data sets from low cost surveys, thus improving the observational capabilities on a wider range of glaciers and glacial processes. In particular, highly accurate glacier volume change monitoring and 3D movement computations will be possible.

Taking advantage of the helicopter flight needed to survey the ice stakes on Kronenbreen, NW Svalbard, we acquired high resolution photogrammetric data over Kronebreen and the well-studied Midre Lovenbreen in September 2013. GoPro Hero 2 cameras were attached to the landing gear of the helicopter, acquiring two images per second. A C/A code based GPS was used for registering the stereoscopic model. Camera clock calibration is obtained through fitting together the shapes of the flight given by both the GPS logger and the relative orientation of the images. A DEM and an ortho-image are generated at 30cm resolution from over 600 images collected. On Midtre Lovenbreen, the comparison with a 2005 LiDAR DEM (5 meters resolution) shows an absolute error in the direct registration of about 6 m in 3D which could be easily reduced to 1.5 ±1 m by using fine point cloud alignment algorithms on stable ground. Due to the different nature of the acquisition method, it was not possible to use tie point based co-registration. A combination of the DEM and ortho-image is shown with the point cloud in figure 1 below.

Repeat Surveys are acquired to survey the annual volume change and movement. These measurements are then compared to the annual glaciological stake mass balance and velocity measurements to assess the precision of the method to monitor at an annual resolution.

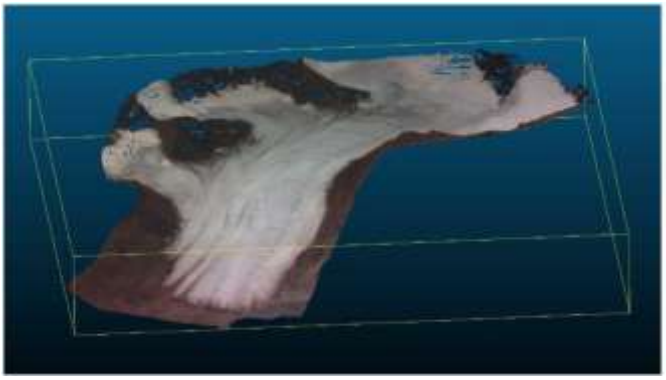

Figure 1. Point Cloud computed from the survey over Midtre Lovenbreen

Title	**Environmental impact of polycyclic aromatic hydrocarbons in Svalbard – a refined perspective**

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Presentation preference (O=oral, P=poster)	O

The intensity of shipping, cruise ship tourism and off-shore oil exploitation is predicted to increase in the Arctic in the wake of climate change and subsequent retraction of ice cover (AMAP, 2007; Peters et al, 2011). This will inevitably lead to elevated background levels of polycyclic aromatic hydrocarbons (PAHs), as well as to increased risks of oil spill accidents and platform blow-outs causing acute PAH contamination. PAHs include different groups of compounds, *i.e.* parent PAHs, alkylated PAH homologues and PAH metabolites. Each group contains a plethora of compounds thus creating a vast analytical challenge. Alkylated PAH homologues constitute the larger fraction of PAH in crude oil, produced water and natural coal (Danion et al, 2011; Laumann et al, 2011; Sundt et al, 2011), and they occur more frequently than their parent homologues in contaminated sediments, waters and oil exposed organisms (Granberg et al, unpublished; Miles et al, 2007; Pampanin & Sydnes, 2013). Studies show that alkylated PAHs bioaccumulate to a higher extent than their parent counterparts (Irwin et al, 1997), while their ability to biomagnify was only recently shown in nature (Harris et al, 2011). Genotoxic effects have also been attributed to alkylated, rather than parent PAHs in organisms from bacteria to sea otters (Harris et al, 2011; Lindgren et al, 2014; Sundt et al, 2011).

Current knowledge on PAH fate and effects in the Arctic is limited. Existing experimental data focuses on acute exposures of parent PAHs, and is mainly derived from exposures performed under conditions with varying degrees of ecological relevance. Field investigations almost exclusively report on the 16 US-EPA certified parent PAHs while completely excluding the alkylated homologues and PAH metabolites. Consequently background levels and baselines for PAHs, alkylated PAHs and PAH metabolites have not yet been established in Arctic marine ecosystems. When aiming to predict impacts of change in chronic PAH exposures and risks associated with oil spills in the future Arctic, accurate data on PAH/alkylated PAH field concentrations, PAH degradation rates, formation of toxic PAH metabolites and the coupling between PAH fate and effects, will be essential.

During two field seasons we have investigated concentrations and toxicity of PAHs in marine food chains on Svalbard (Kongsfjord and Krossfjord) and in Tromsø. The objectives were to 1) establish background concentrations of PAHs, alkylated PAHs and PAH metabolites in short Arctic and sub-Arctic food chains (sediment/seston-invertebrates-Eider duck/Glaucous gull), 2) couple PAH/alkylated PAH levels with genotoxic and physiological responses in invertebrates, seabirds and seabird eggs, 3) determine if organisms inhabiting naturally coal laden Svalbard sediments/ mud flats are adapted to high PAH levels and thus are less PAH sensitive than naïve organisms. Along with preliminary data

we aim to present and share concepts and ideas regarding research needed to accurately predict environmental impacts of petroleum related activities in Svalbard.

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Title	**DNA damage in arctic avian predators: baseline, sensitivity to stress and association to contaminant exposure**

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Presentation preference (O=oral, P=poster)	O

Contaminants are transported to the arctic mainly by air masses, but also by ocean currents and rivers. Here, they accumulate in organisms and biomagnify up the food web reaching high concentrations in the top predators, sometimes resulting in toxicological effects. Seabirds have been important study organisms and considered good indicators of the oceans health as they feed on different trophic levels, come from different evolutionary lineages and may be sensitive to human induced environmental changes. While the well-known and regulated pollutants are slowly decreasing in the environment, they are still found in highest concentrations compared to new compounds that are emerging due to their increased use in our modern society. These pollutants are known to elicit a wide range of negative effects on wildlife (e.g. enzyme-, immune-, endocrine- and vitamin systems). So far there are few standardized methods for testing contaminant effects in seabirds.

The field of genotoxicity can provide new information about the effect that pollutants have on an organism's DNA. DNA damage can be measured as a result of different stressors on an organism, and may be an interesting biomarker as an organism's genome is vital for a wide range of different functions and systems. The comet assay is a well-established and sensitive method for assessing DNA damage. It involves embedding cells in agarose gel followed by electrophoresis where fragmented DNA will migrate in the gel. It is inexpensive and relatively easy to use. It is frequently used in human toxicology on different types of cells, on other mammals, crustaceans, mollusks and fish. However, few studies have been conducted using the comet assay in assessing genotoxicity in avian wildlife. Also, little is known regarding baseline DNA damage in various species, the sensitivity to stress-induced damage and the relationship between contaminants and degree of DNA damage. The comet assay measures the effect of oxidative stress on DNA; the more stress, the more damage. Seabirds are exposed to an increasing load of stress due to climate change, lack of food and also pollution.

The aim of this Master project is threefold:

i) to quantify baseline DNA damage in different arctic seabirds,
ii) to quantify sensitivity to stress-induced DNA damage, and
iii) to analyse the relationship between contaminant levels and amount of genetic damage.

Field work was conducted in June- July 2015. Blood was sampled from glaucous gull *(Larus hyperboreus),* black legged kittiwake *(Rissa tridactyla),* the common eider *(Somateria mollissima)* and the arctic skua *(Stercorarius parasiticus).* The eider is a benthic feeder eating mostly mollusks and inhabiting the lowest trophic level of my study species. The black legged kittiwake feeds in the pelagic system on fish and crustaceans, and represents an important part both in terms of biomass and food consumption. The arctic skua's main feeding strategy is steeling food from other species as they fly in from their feeding ground, but some will also predate on other eggs and chicks. The glaucous gull is

also a top predator feeding on chicks and eggs, but more of a generalist feeder eating fish, crustaceans, and carcasses. The glaucous gull is red-listed as it is affected by various changes in the environment in addition to high levels of pollutants on Bjørnøya.

Measures of DNA damage will be conducted at the University of Oslo this summer, and contaminant analyses will be done at NILU in September. On the basis of feeding ecology and previous contaminant findings, species differences in pollution loads are predicted, with highest contaminant levels in birds of high trophic levels as a consequence of biomagnification. I predict a positive relationship between contaminant levels and amount of DNA damage as several contaminants are known to cause oxidative stress, which is an important mechanism of DNA breaks. High levels of contaminants may also negatively affect the ability to withstand stress to the DNA as well as repair mechanisms.

This study is done as a part of the "Avian Toxicology", or AVITOX project, involving national and international collaborators, aiming to "generate new knowledge about anthropogenic impacts on marine ecosystems." Here, the effects of climate change and pollutants will be assessed.

Title	**Arctic Skua migration: linking individual consistency, migratory connectivity and contaminant loads**

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Presentation preference (O=oral, P=poster)	O

Seabirds are often used as model species in ecotoxicological studies as they are near the apex of most marine food chains, and therefore bioaccumulate high concentrations of certain pollutants. Most seabirds that breed in temperate and Arctic regions are migratory, and therefore spend a considerable part of the year away from their breeding areas thereby functioning as biovectors. Several studies have implied that migration may have considerable effects on seabird ecotoxicology. In this study, we have studied migration strategies in the arctic skua Stercorarius parasiticus. It breeds in arctic and subarctic areas, and in Svalbard and Northern Norway, it spends the nonbreeding part of the year (September through May) away from the breeding grounds. We have used Global Location Sensor (GLS) loggers to track the migration strategies of the same individuals over several years. This has revealed different individual wintering areas spanning large parts of the Atlantic Ocean. We report that the individual birds repeatedly target the same winter area year after year. We have analyzed various pollutants such as heavy metals and PCBs to look for individual differences in contaminant load related to different wintering areas.

Title	**Ammonia oxidation potentials and ammonia oxidizers of topsoil under moss–polar willow vegetation in Ny-Ålesund**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	TE

Presentation preference (O=oral, P=poster)	P

Nitrification, i.e., two-step oxidation of ammonia to nitrate via nitrite, is a unique microbial process in the nitrogen (N) cycle. Ammonia oxidation to nitrite is the rate limiting step in nitrification, in which both bacteria and archaea are involved. The purposes of this study were to evaluate ammonia oxidation potentials (AOPs) and to elucidate diversities of ammonia-oxidizing bacteria (AOB) and archaea (AOA) in soils at moss–polar willow (*Salix polaris*) vegetation in Ny-Ålesund, Svalbard, Norway. Topsoil was collected at twelve plots covered with surface crust, moss, and vascular plants (typically, *S. polaris*) with different coverage. Mineral subsoil was also collected at a plot after removing the crust and topsoil. AOP was measured as the nitrite production (ammonia oxidation) rate with sufficient substrates under shaking incubation at 10°C. AOPs of the topsoil was lowest at a crust plot (2.3 ± 0.7 ng N g^{-1} dry soil (ds) hr^{-1}; ± SD) and was highest at a plot fully covered with moss and *S. polaris* (14.1 ± 1.8 ng N g^{-1} ds hr^{-1}). A low AOP was also found in the subsoil (1.1 ± 0.1 ng N g^{-1} ds hr^{-1}). Soil DNA analysis of AOB and AOA was conducted for the topsoil with relatively high AOPs (3 plots) and the subsoil. The ammonia monooxygenase subunit A (*amoA*) genes of AOB and AOA were analyzed by a quantitative PCR and a pyrosequencing method. The copy numbers of AOB-*amoA* of the topsoil showed a range of 1.6–3.3 × 10^5 copy g^{-1} ds and that of the subsoil was 6.4 × 10^4 copy g^{-1} ds, one order smaller than the topsoil. Meanwhile, the copy numbers of AOA-*amoA* were similar between the topsoil and subsoil, 7.1–9.8 × 10^6 copy g^{-1} ds, which was several-tenfold larger than the AOB-*amoA* copy numbers of the topsoil. AOB and AOA had a diverse variety in both the topsoil and subsoil.

Title	**HALOGENATED AND ORGANOPHOSPHORUS FLAME RETARDANTS ON PARTICLES IN THE ARCTIC ATMOSPHERE**

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Presentation preference (O=oral, P=poster)	P

The use of most polybrominated diphenyl ether (PBDEs) flame retardants (FRs) in consumer products and construction materials was banned by the European Union and phased out in the United States by 2008. PBDEs are now listed by the Stockholm Convention on Persistent Organic Pollutants in Annex A, which calls for elimination of their production and use. However, there is a continuing need for FRs due to stringent flammability standards both in the USA and Europe and, as a result, there may be a shift to using non-regulated FRs. Several replacement FRs have been recently detected in the environment, including brominated benzoate and phthalate esters and organophosphorus esters.

We collected high-volume air particle samples at a site in the Arctic (78.22^{o}N, 15.65^{o}E, on Svalbard) during 2012-2013 for analysis of brominated FRs (BFRs) and organophosphorus FRs. Sample volumes typically ranged from 600 – 750 m^3. Some BDEs and other BFRs have been observed in this region in earlier research. The BFRs found most often and in greatest average abundance include BDE congeners 47 (0.69 pg m^{-3}), 99 (0.56 pg m^{-3}) and 209 (1.10 pg m^{-3}), collectively representing ~44% of total BDE; other chlorinated or brominated FRs found included 2-ethylhexyl-2,3,4,5-tetrabromobenzoate (TBB), *bis*(2-ethylhexyl)-tetrabromophthalate (TBPH), decabromodiphenyl ethane (DBDPE) and Dechlorane plus (DP). The concentrations ranged from 0.3 pg m^{-3} for DBDPE to 6 pg m^{-3} for TBB. The organophosphorus FRs found most often and in greatest abundance include *tris*(2-chloroethyl)phosphate (TCEP), *tris*(1-chloro-2-propyl)-phosphate (TCPP), *tris*(1,3-dichloro-2-propyl)phosphate (TDCPP), triphenyl phosphate (TPP), tri-*n*-butyl phosphate (TnBP), *tri*(butoxyethyl)phosphate (TBEP), *tris*(2-ethylhexyl)phosphate (TEHP), and 2-ethylhexyl diphenyl phosphate (EHDPP). The concentrations of the OPFRs were often about 10 times or more greater than any of the halogenated FRs. The most abundant OPFR average concentration was TnBP (145 pg m^{-3}) and ranged from 9 pg m^{-3} to 788 pg m^{-3}.

The BDEs with low concentration (< 0.05 pg m^{-3}) were congeners 10, 7, 30, 71, 85, 126, 154, 153, 138, 184, 181, 201, 204, 203, 196, 205, 208, 207; non-BDE BFRs with low concentrations included tetrabromo-*p*-xylene (pTBX) and pentabromo ethyl benzene (PBEB).

Title	**Pelagic long-term surveys in Kongsfjorden, Svalbard**

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Presentation preference (O=oral, P=poster)	O and/or P

Kongsfjorden is an established reference site for arctic marine studies and represents the most important environmental monitoring location in the Arctic. This open fjord functions as a climate change indicator in the Arctic because it is influenced by variable climate signals related to advection of Atlantic water from the West Spitsbergen Current and Arctic water from the shelf region. The inner part of the fjord is rather "Arctic" because it is influenced by glacial run-off from large tidal glaciers. Because of the dual Atlantic/Arctic inputs, the fjord has pelagic communities that are comprised of a mixture of boreal and arctic flora and fauna.

Purpose of the pelagic survey has been to 1) Monitor long-term changes in oceanography, phytoplankton and zooplankton communities in Kongsfjorden in relation to variation in ocean climate, 2) Provide baseline on phytoplankton and zooplankton communities, and 3) Investigate how seasonal and inter-annual variations in hydrography affect the pelagic communities.

A transect with sampling stations from the inner basin to the shelf break has been sampled in July each year since 1996. Since 2008, the transect has been connected to Haugarten (AWI) in Fram Strait, by adding three stations off the shelf. The extended transect with established stations is known as KongHau. Physical and zooplankton parameters have been collected since the start, whereas sampling phytoplankton was added in 2009 and nutrients in 2011.

The total abundance of copepods increased during the three warming periods in Kongsfjorden (2001-2002, 2006-2007, 2011-2013), although most of this increase was because of increased abundance of small copepods, such as *Oithona* sp., *Triconia* (*Onacea*) sp. and *Pseudocalanus* sp. The relative composition of *Calanus* copepods in Kongsfjorden during summer (July) changed with regard to Atlantic influence. The Arctic *Calanus glacialis* tended to be more abundant during "cold years", when the influx of Atlantic water was low (1999, 2000 and 2008), whereas the smaller Atlantic *C. finmarchicus* increased in "warm" years with a strong influx of Atlantic water. Unusually strong inflow of Atlantic water during winter since 2005/2006 led to increased abundance of *C. finmarchicus* in the subsequent years (except for 2008). The larger *C. glacialis* contains more lipids (energy) than the smaller *C. finmarchicus*. Shift towards smaller Atlantic species because of warming creates unfavourable feeding conditions for planktivorous seabirds such as the Little auk (*Alle alle*).

Protist plankton composition indicates dominance of dinoflagellates during summer (2009) at all stations in Kongsfjorden, with highest stock in Fram Strait. Standing stock of *Calanus* sp. is much

larger than the stock of primary producers, which indicates strong top-down control as well as advection of *Calanus* into the fjord. Phytoplankton uses nutrients during their growth, which tends to deplete nutrients in surface waters during summer, as shown in 2013. However, ammonium was elevated inside Kongsfjorden due to high heterotrophic activity and possibly remineralisation of fresh organic matter associated with the glacier/freshwater zooplankton death trap.

Long-term data sets are extremely important for our understanding of climate-related changes in the Arctic environment and its biological communities. This pelagic long-term series with set stations in Kongsfjorden represents the longest of its kind in the Arctic. The Norwegian Polar Institute is responsible institution for this survey, which is conducted in collaboration with IOPAS, UNIS and UiT. All the data are stored in the marine database at NPI. The Kongsfjorden long-term survey is an integral part of MOSJ - Environmental monitoring – Svalbard and Jan Mayen (www.mosj.npolar.no/), and the relative abundance of *C. glacialis* and *C. finmarchicus* in Kongsfjorden is used as an indicator in the Management plan for the Barents Sea (www.environment.no).

Title	**Monitoring past and recent ecosystem changes in Kongsfjorden using benthic foraminifera**

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Presentation preference (O=oral, P=poster)	P

The overall objective of this project is to monitor and quantify past and recent ecosystem effects of environment and climate changes using the response of benthic foraminifera to different physical environmental forcing in Kongsfjorden. Such information is vital in order to evaluate the full range of the eco- and ocean-climate systems. Benthic foraminifera are good monitors of environmental changes because they are very abundant in the surface sediments and very diverse even in Arctic coastal and fjord settings. Furthermore they have a short life cycle enabling to respond quickly to changes, e.g. with regard to variations of the influence of Atlantic Water in Kongsfjord. After death the shells of the benthic foraminifera are preserved in the sediment enabling baseline studies of pre-impacted conditions back in time. Analysis of surface sediment samples taken during the summers from 2005 to 2008 show a benthic foraminiferal fauna consisting of Arctic species. The individual species variations in the fauna are caused by changes of the salinity of the water masses and the amount of available food. A short marine sediment core from Kongsfjorden covering the last 2.000 years has also been investigated. The Arctic benthic foraminiferal fauna show a decreasing glacial influence probably due to an overall enhanced inflow of Atlantic water to the fjord throughout this period. Superimposed on this overall signal the productivity also fluctuated reflecting the variations of Atlantic water flowing into the fjord.

Title	**Svalbard ice and snow as archives for climate and pollution**

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Presentation preference (O=oral, P=poster)	O

Over the last two decades scientists from Norwegian Polar Institute together with colleagues from several other nations have retrieved ice cores, spanning several hundreds of years, from three major glacier-ice caps in Svalbard; Lomonosovfonna, Austfonna and Holtedahlfonna. These cores are providing information on both the spatial variability component in addition to the temporal record of both climate and pollution.

We have used the $\delta^{18}O$ records from two of these ice cores; Lomonosovfonna and Holtedahlfonna, to reconstruct the winter surface air temperatures. Our approach to reconstructing past winter SAT variations utilizes a technique called 'scaling'. It refers to the equalization of the mean and standard deviation of a proxy time series (here ice core ^{18}O) to the corresponding values of an instrumental temperature record over a common period of overlap. This approach rely implicitly on the simplifying assumption of a stable in time linear relationship between a "predictor" proxy and "predict and" climate series. As a target for reconstruction we utilize winter (December-January-February) SAT derived from the homogenized Longyearbyen monthly temperature record which starts in 1911 and Vardø series that has been extended back to 1840. Analysis of the derived reconstructions suggests that the winter climate evolution of Svalbard and northern Norway of the last millennium can be divided in three major sub-periods. The cooling stage in Svalbard (ca. 1020-1800) is characterized by a progressive winter cooling of approximately 1 $^{\circ}C$ $century^{-1}$ and a lack of distinct signs of abrupt climate transitions. During the 1800s, which according to our results was the coldest century in Svalbard, the Little Ice Age – associated winter cooling was of the order of 4$^{\circ}C$ compared to the 1900s. The rapid warming at the beginning of the 20th century is already well documented in the instrumental data and was accompanied by a parallel decline of sea ice extent in the study area. One of the most striking features of the reconstruction is a lasting pre-1300 period of warm winters where DJF temperatures were comparable, within error, to those that were observed in Svalbard in the 1930s and in the most recent decade. The inference that climate conditions during that period were as warm as the present is indirectly corroborated by evidence stemming from the other types of proxy data from the Lomonosovfonna ice core. Repeated sampling during field campaigns of 2000-2007 have demonstrated that such a degree of melt, as was observed in the Medieval times, has been exceeded only in the recent decade.

In the most recent ice core from Lomonosovfonna drilled in 2009 the records of the two nitrogen species, nitrate (NO_3^-) and ammonium (NH_4^+) suggest that during the 20th century both records are influenced by anthropogenic pollution from Eurasia. In pre-industrial times NO_3^- is highly correlated with methane-sulfonate (MSA) on decadal time-scales, which we explain by a fertilising effect.

Some major ions, black carbon and various other ice chemistry data show a clear east-west zonal gradient across the archipelago suggesting a different origin for air masses arriving in different sectors of Svalbard.

Title	Interactions between snow and atmosphere in the Arctic

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Presentation preference (O=oral, P=poster)	O

In the past 30 years, the temperatures in the Arctic have been rising twice as fast as the global mean temperatures. The inherent regional feedback processes are often summarized under Arctic Amplification and some of them are essentially related to changes in the cryosphere and are assumed to be mainly driven by changes in albedo: The earlier melting of the sea ice or snow exposes the underlying surfaces with a much reduced albedo like ocean or soil strongly enhancing the radiative forcing at the surface. While such feedback processes have been reproduced in global models, the respective role of changes in the seasonal snowpack is hardly constrained by reliable observations. Large uncertainties regarding the magnitude of such an influence remain and are difficult to verify with models that have not been validated using detailed observational records. Snow chemistry also plays a role in the context of Arctic Amplification. The most investigated subject is the role of black carbon (BC) and its impact on snow albedo and melting. Increased anthropogenic emissions have led to increase BC concentrations in the Arctic atmosphere as well as in the snow. However, other chemical compounds like sea salt components may also play a role in altering snow properties. For example, the reduction in sea ice of the Arctic Ocean may enhance the formation of sea salt aerosols and their deposition on the snow may accelerate snow metamorphism leading to another positive feedback on snow albedo.

Ny-Alesund (Svalbard) is a key site for Arctic research including a large variety of snow observations performed by different institutes and groups. While parts of the data have been analyzed in different directions, a full scientific exploitation, however, is still hampered because complete and quality-controlled data sets are difficult to access. In this presentation, I will address the potential of Ny-Alesund regarding observed long-term trends in snow physics and chemistry.

Title	**An introduction to the Norwegian Mapping Authority's ionospheric research at high latitudes**

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Presentation preference (O=oral, P=poster)	P

The Norwegian Mapping Authority (NMA) operates networks of GNSS receivers throughout Norway, including several islands and Svalbard. The measurements from these are used in many ways, including monitoring the ionosphere.

We will present the research interests of the NMA with regards to the polar ionosphere, and give an overview of our research assets at Svalbard.

We will also present some results from an analysis of ionospheric disturbances, with a focus on their effects on GNSS positioning. The analysis is based on data for the entire year of 2012, for 10 receivers at latitudes from 59 to 79 degrees North. The results show that elevated Rate Of TEC Index (ROTI) values occurs mainly in the cusp and nightside auroral oval regions. Elevated ROTI values are more common in the cusp, but in the nightside auroral oval they are stronger. The 3D position error is strongly correlated with ROTI for receivers that are affected by space weather, and increases exponentially with increasing ROTI.

Title	**Vegetation mapping of Brøgger Peninsula and the Ny-Ålesund town area utilizing very-high resolution WorldView2 satellite data**

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Presentation preference (O=oral, P=poster)	O and P

The overall objective of this paper is to present and discuss the most recently developed vegetation map for Ny-Ålesund town area and larger parts of Brøgger Peninsula, Arctic Norway. The map is based on data from the high-resolution satellite WorldView-2, acquired at 19th of August 2013. The WorldView-2 satellite was launched in October 2009, and is the first high-resolution 8-band multispectral commercial satellite available. The satellite provides 46 cm panchromatic resolution data and multispectral resolution of 1.85 m. The multispectral bands collect ground data in the visible and in the near-infrared parts of the spectrum. Image processing performed in this study involves automatic image classification, (2) spectral similarity analysis, (3) ancillary data analysis, (4) contextual correction, and (5) standardization of the final map products. The vegetation map developed is differentiated in 17 vegetation units. In the initial classification of the WorldView-2 image a dendrogram is worked out, displaying the spectral relationship between the initially separated 24 classes. Information in the dendrogram combined with the JM-distance analysis is used to reduce the number of classes from 24 to the final number of 17 classes. The map product is in digital format, which gives the opportunity to produce maps in different scales. Maps from the town area of Ny-Ålesund and larger part of Brøgger Peninsula are developed in this study.

Title	**Tromsø Geophysical Observatory activities in Ny-Ålesund and Arctic – past, current and future activities**

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Presentation preference (O=oral, P=poster)	O

Tromsø Geophysical Observatory (TGO) is responsible for continuation of the long time series inherited from the Auroral Observatory in Tromsø when the University of Tromsø was established in 1972. TGO operates a large variety of instruments for investigating the upper atmosphere and represents a continuous tradition and presence in the high Arctic that goes back to the very first Norwegian polar expeditions such as Vøringen and the first interantional polar year. In Ny-Ålesund observations have been performed continuously since 1966 when operations where relocated from Isfjord radio.

In this presentation we give a brief overview of our past activities in Ny-Ålesund. Then our current measurements of geomagnetic and ionospheric activity as well as future plans are presented. We illustrate how the current and future activities in Ny-Ålesund are in accordance with our mandate of maintaining long geophysical time-series, and how they are important in conjunction with other measurements performed in Longyearbyen, Hopen, Bjørnøya, Jan Mayen and on the Norwegian mainland. Furthermore, we present how our measurements in Ny-Ålesund are important for our scientific goals as well as their growing importance for space weather monitoring which is becoming increasingly important for society as commercial activity increases in the high North.

Title	**36 years of meteorological measurements in Polish Polar Station at Hornsund**

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Presentation preference (O=oral, P=poster)	O

Since 1979 Polish Polar Station at Hornsund (77°N 15°33'E) is whole year manned station. From the 1st of July 1979 in the Station has been started meteorological observation. Due to political instability systematic measurements are dated since the 15th of August 1982. The Station is part of Norwegian meteorological service and is registered at World Meteorological Organization with the number 01003.

Through these years many observers has been performing the observations and few measurement regimes were applied. From XXI century i.e. the 1st of January 2001, whole measurements are made automatically and only cloud type and cover as well as weather phenomena are observed by human. It is common that in such long dataset there are errors and gaps. In relative humidity there are noticeable trends due to changes in measurement methods i.e. wet-bulb temperature and electronic measurement of electric capacity change. Our goal was to validate the data, correct errors and fill gaps. Most error correction was able due to redundancy (e.g. air pressure is noted also with correction to the mean sea level and its absolute change is also noted) and physical dependency of some quantities (e.g. dew point temperature is connected with temperature, relative humidity and air pressure). In the result we got homogenous time series called Htermin of measurement and observations done everyday at 0, 3, 6, 9, 12, 15, 18 and 21 o'clock UTC (Coordinated Universal Time).

Our motivation was to use the data for lidar laboratory purposes, therefore temperature, relative humidity and air pressure at the Station level were validated. Additionally during the validation process other corresponding meteorological components were also corrected i.e. dew point temperature, water vapour partial pressure, pressure reduced to mean sea level, values of absolute air pressure change and the pressure tendency.

Apart to the validation and homogenization of the dataset, also evaluation of the data was performed. The results are related to the climate change and seasonal characteristics of the climate in the vicinity of Polish Polar Station at Hornsund.

Title	Comparing model output and observations on a regional scale

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Presentation preference (O=oral, P=poster)	O

The Norwegian Young sea ICE cruise (N-ICE2015) with the RV Lance has the objective to understand the effects of the new thin, first year, sea ice regime in the Arctic on energy flux, ice dynamics and the ice associated ecosystem, and local and global climate. Drifting in the ice North of Svalbard between January and June 2015, the expedition offers a unique possibility to combine the observations in the sea ice with the long-term observation operated in Ny-Ålesund. Looking at Arctic Amplification from a regional perspective is necessary to understand processes and feedbacks which are not resolved in larger climate models.. The combination of similar measurements from this year's N-ICE 2015 research cruise and at the same time at Ny-Ålesund offers the opportunity of comparing model output with field observations under different aspects.

The combined dataset for this study consists of atmospheric observations taken at both sites with similar instruments: balloon-borne radiosondes, broadband longwave and shortwave radiation sensors, a weather mast measuring temperature, humidity and wind at 2 m, 4 m and 10 m, an eddy-covariance system, a ceilometer, a micro-pulse-lidar, plus occasionally operated instruments such as a tether balloon.

The analysis of the measurements allows the retrieval of various atmospheric parameters like, e.g. surface fluxes, which can be directly compared with the output of the HIRHAM5 model and other regional climate models. On the one hand, the data will help to improve model parameterizations and to design research campaigns in the future, e.g. by suggesting new instruments which are needed to study polar atmosphere. On the other hand, the combination of the Ny-Ålesund and N-ICE observations will set the observations of both sites into a larger regional context of the European Arctic, referring to measurements over land and over sea ice.

Title	**Intrinsic chemical transformation in ice and its environmental effects – The fate of pollutants trapped in ice media**

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Presentation preference (O=oral, P=poster)	P

Generally, most chemical processes are slowed down as temperature decreases. However, several chemical reactions can be accelerated in frozen environment. The bioavailability, mobility, toxicity, and environmental fate of metals or inorganic elements are controlled by their redox speciation. Although the chemical processes in ice play an important role on various Earth's system, they have rarely investigated. Here, we want to introduce our previous investigation and future sesearch topic about unique chemical transformation in ice phase.

Firstly, we investigated the production of bioavailable trace elements (Fe(II)aq and Mn(II)aq) from the dissolution of iron and manganese oxide particles in water and ice. The dissolution of metal (iron and manganese) oxides particles in ice phase was significantly enhanced compared to those in aqueous solution both in the presence and absence of light although the dissolution rate was enhanced under UV irradiation. We also investigated both the reduction of Cr(VI) and the simultaneous transformation of Cr(VI) and As(III) in ice in comparison with those in aqueous solution. The reduction of Cr(VI) by various organic acids (electron donors) was negligible in ambient aqueous solution but was significantly accelerated in ice. The simultaneous reduction of Cr(VI) and oxidation of As(III) in ice phase proceeded stoichiometrically, whereas their mutual conversion was insignificant in aqueous solution. The enhanced redox transformation in ice phase is ascribed to the freeze concentration effect (when solution is solidified the existed organic and inorganic compounds are highly concentrated in unfrozen liquid-like regions) in ice crystal grain boundaries. These results imply that understanding the redox conversion of various inorganic/organic compounds in ice phase may provide newer views and insights on the environmental chemical processes in the icy environments (e.g., upper troposphere, permafrost, polar/high latitude environment and mid-latitudes during winter season) where the freeze-thaw cycles repeat. We also found that the oxidation of iodide to form I_3^- and I_2 is greatly accelerated in frozen solution, which is even more enhanced under natural solar irradiation. The release of gaseous I_2 upon thawing the irradiated ice was detected by using cavity ring down spectroscopy. The ice-enhanced generation of I_3^- and I_2 is ascribed to the freeze concentration of iodide and dissolved O_2 trapped in polycrystalline ice grain boundaries. This finding proposes a previously unrecognized source of gaseous I_2 through abiotic process in polar region.

Based on the our previous research, we want to investigate the fate of pollutants(Hg and POPs) trapped in Arctic ice media such glacier, sea ice, permafrost, and sea salt aerosol and its impact on polar region.

Title	Future bathymetry of Kongsfjord

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Presentation preference (O=oral, P=poster)	O

Tidewater glaciers have a major influence on fjord circulation. During the summer melt season subglacial rivers discharge at or near the base of tidewater glacier fronts; the relatively low density of these waters forces them to rise rapidly, entraining large volumes of ambient fjord water. Small organisms entrained in the rising plume are brought to the surface, ensuring a steady supply of zooplankton and nutrients at the glacier front. Given that tidewater glaciers around the world are retreating, we seek to determine the impact on fjord circulation, and thereby on the fjord ecosystem, when tidewater glaciers retreat so much that they terminate on dry land. In the newly-funded project TIGRIF, we will model circulation in Kongsfjord, first with the present fjord bathymetry, and then with the bathymetry that will result when tidewater glaciers are gone. To properly model future fjord circulation, we are mapping the subglacial topography of all tidewater glaciers (Kronebreen, Kongsbreen, Conwaybreen, and Blomstrandbreen) draining into Kongsfjord, using ice-penetrating radar. Since the glaciers are all heavily crevassed, the radar must be airborne; here we use a 10-MHz impulse dipole radar suspended beneath a helicopter. Preliminary results show that the extent of the fjord system would be significantly increased with full retreat of Kongsbreen and Kronebreen; beds of these glaciers are below sea level many kilometers upglacier of their present fronts.

Title	**Measurements of BC mass concentration, microphysical characteristics of near-ground aerosol and its chemical composition in Barentsburg (Svalbard) in 2011-2014**
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Presentation preference (O=oral, P=poster)	O

The Arctic region is a very important indicator of global climate changes occurring on our planet. According to the IPCC-2007 report, in assessment of the role of various atmospheric constituents in radiative forcing, the problem of aerosol and black carbon (BC) is characterized by the lowest level of scientific understanding. The detailed knowledge of spatiotemporal peculiarities of BC and aerosol mass concentrations for the Arctic region allows one to determine such radiative-important characteristics of carbonaceous aerosol as BC fraction, single scattering albedo (SSA), and other parameters of radiative forcing used for assessment of climate changes.

Since 2011 the V.E. Zuev Institute of Atmospheric Optics SB RAS (Tomsk) and the Arctic and Antarctic Research Institute of the Russian Federal Service for Hydrometeorology and Environmental Monitoring (St. Petersburg) conduct field investigations of the near-ground aerosol characteristics in Barentsburg (78.1°N, 14.2°E) in the spring and summer seasons. The instrumentation includes the following devices: 1) Grimm 1.108, 1.109, and AZ-10 optical counters of particles (measurement of the number N_A (cm^{-3}) and mass M_A ($\mu g/m^3$) concentrations of aerosol and size distribution in the range of particle diameters of 0.3-34 μm); 2) MDA-02 four-wave aethalometer (measurement of the mass concentration M_{BC} ($\mu g/m^3$) of the absorbing matter (Black Carbon) in aerosol. In 2014, the instrumentation was supplemented with the TSI-3563 integrating nephelometer for measurement of the total aerosol scattering and aerosol backscattering (wavelengths of 450, 550, 700 nm) and the AE-33 seven-wave aethalometer (Magee Scientific Co.). The devices were placed in the work room of the Hydrometeorological Observatory. Air sampled from outside at a height of 5 m from the underlying surface then comes by pipes into the measurement cells of the devices. The measurements are conducted in the mode of round-the-clock hourly monitoring with the 20-min data averaging.

To study the chemical composition of particles, near-ground aerosols and gas mixtures are sampled regularly with the use of the unified method (filtering system) accepted in international monitoring networks. The following filters are used for the sampling: PTFE Teflon filter (№1); polyamide filter (№2), and Whatman impregnate filters with the alkaline (№3) and acid (№4) basis. Air samples are taken on the outside of the Laboratory Building of Hydrometeorological Observatory for 12-14 hours at an air flow rate of 11-13 l/min. The chemical analysis of aerosol and gas components in the air samples is conducted under laboratory conditions. The mass concentrations of Na^+, K^+, Ca^{2+}, Mg^{2+}, NH_4^+, Cl^-, NO_3^-, HCO_3^-, and SO_4^{2-} ions are determined in water extracts of aerosol filters. The concentrations of the gas components SO_2, HCl, HNO_3, NH_3 are calculated from the analysis of the corresponding ions.

The observation series of aerosol, Black Carbon, and ion concentrations are determined, and the seasonal and annual average values along with the standard deviations are estimated. Peculiarities of the seasonal and annual variability of aerosol characteristics are analyzed. The ranges of variability of the mean annual aerosol concentrations for the period since 2011 till 2014 are M_A = 0.85-6.10 $\mu g/m^3$, N_A = 4.31-10.9 cm^{-3}, and M_{BC} = 0.12-0.24 $\mu g/m^3$. The mean values of aerosol characteristics and the ion chemical composition are compared with the data of observations in different regions of the Russian Arctic and Subarctic. When observations series will become long enough, these studies allow to develop the empirical optical and microphysical models of aerosol in the region of the polar scientific station.

Title	**Direct observations of Arctic cloud particle content using a Counterflow Virtual Impactor**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

This initiative aims at reducing the uncertainty related to the climate forcing caused by aerosol particles through their modification of Arctic low level clouds. The novelty of this project is to deploy a ground based "cloud harvester" so called Counterflow Virtual Impactor (CVI) for the first time in the Arctic covering the full annual cycle. With the CVI mounted on the Zeppelin station (475m alt.), it is possible to sample and analyze the cloud particles in real-time. That is, explicitly study the content involved in cloud formation. By letting the clouds engulf the station we can study the cloud microphysical properties in-situ, while comparing with other pertinent cloud properties obtained by ourselves or through international collaboration at the Ny-Ålesund research village, Svalbard (78 deg. N.). Example of these are aerosol properties, cloud geometry, and radiative properties. To place a CVI on the ground is a very cost effective approach in comparison to using an airborne platform, and it allows us to obtain data covering many aspects of the cloud. Of the climate forcing components listed by the IPCC, aerosol-cloud interactions is listed with the largest uncertainties, yet comparable in magnitude to climate forcing by carbon dioxide. Ultimately, this project will lead to new knowledge about the processes controlling cloud properties in the Arctic and lead to new numerical formulations of aerosol-cloud interaction to be used in Earth system models.

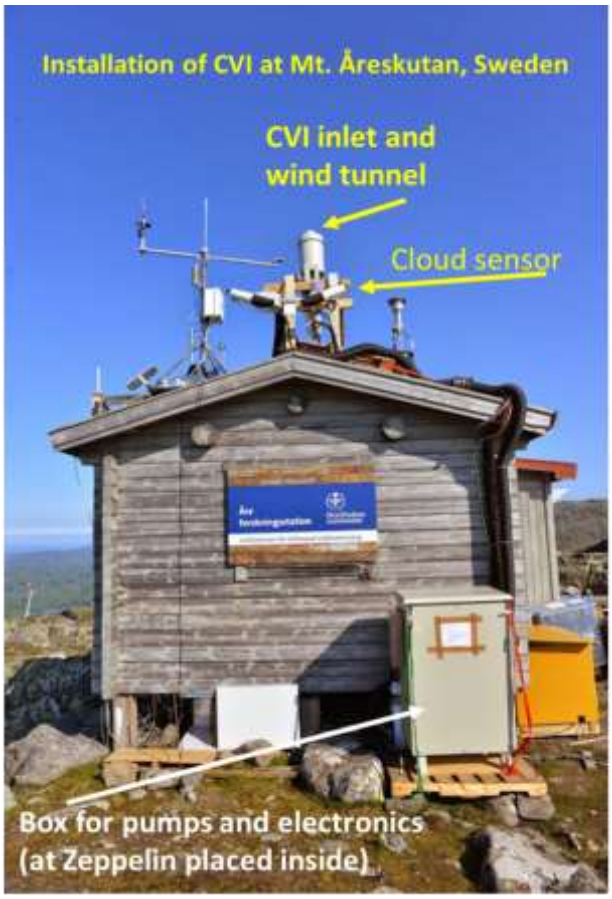

Figure 1. CVI installed at Åreskutan (63N, 13E), Sweden

Title	**Annual variation of the cloud fraction and base height at Ny-Ålesund with ground-based observations**

Author's full name	Makoto KUJI[1], Mayu Miyagawa[1], Masanori Yabuki[2], Masataka Shiobara[3]
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

Cloud fractions were retrieved with an all-sky camera in Ny-Ålesund, Svalbard, Norway (78.9˚N, 11.9˚E) from 2005 to 2008 on a scene-by-scene basis. As a result of statistical analyses on a monthly-average basis, the mean cloud fraction was 7.7 out of 10.0 during this period. The seasonal variation was also obtained such that they had a minimum value (5.9) in March and a maximum one (8.6) in August. The observation was carried out from March to October due to the limitation of the sunshine duration. The results were then compared to the Micro Pulse LIDAR (MPL) measurements and Eye observation, both of which could be available all through the year. The comparison showed a good consistency with the mean values 7.2 (MPL) and 6.7 (Eye) and the same seasonal variation, i.e., the minimum in March and the maximum in August. The MPL also provided the cloud base height (CBH) statistics, which showed that there dominated lower level clouds with CBH up to 1 km all through the year during the period. Figure 1 shows the inter-annual variation of cloud fractions in addition to cloud base height. Further, we investigated the relationship between the cloud fractions and other meteorological properties such as visibility, relative humidity and Arctic Oscillation Index. We will show the results and discuss the variation.

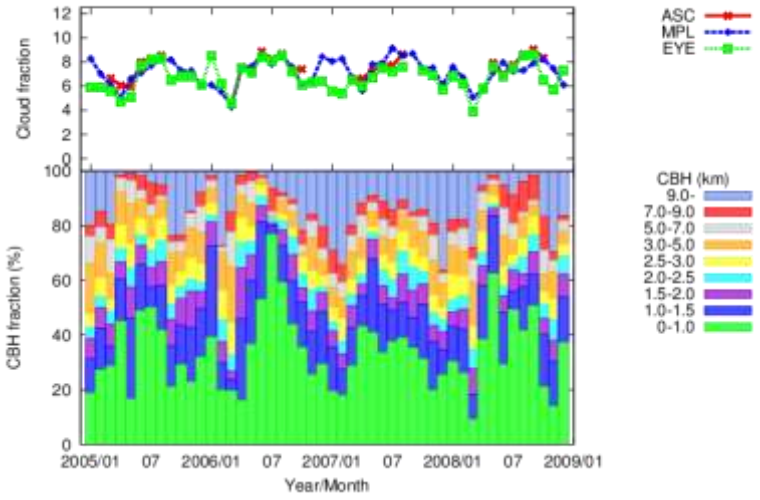

Fig. 1 Inter-annual variation of cloud fractions and cloud base height (CBH) observed at Ny-Ålesund from 2005 to 2008. The upper panel shows monthly-averaged cloud fraction from All-sky camera (ASC), MPL, and Eye observation (EYE), respectively, and the lower one illustrates the binned cloud base height fraction estimated from MPL.

Title	**Understanding of the atmospheric methane evolution and change over the last decades with focus on the Arctic region**

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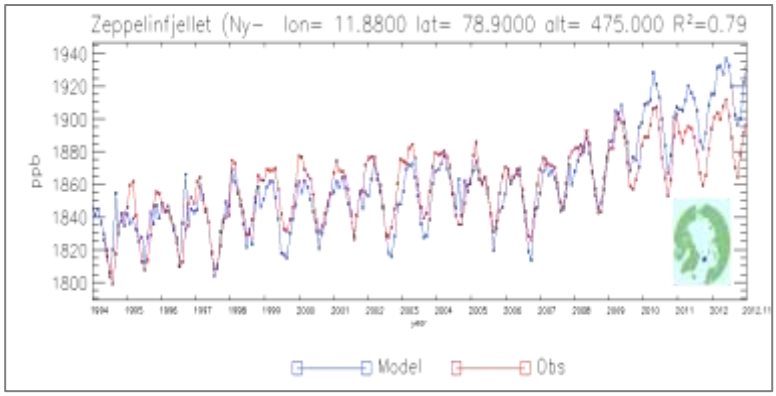
Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	O

The methane (CH4) concentration is increasing in the atmosphere, both globally and in the Arctic region since ~2005. The explanation to this is currently not well understood. There are huge reservoirs of CH_4 in the Arctic; both methane hydrates in seabed sediments, and organic material in land- and marine-based permafrost which can be partly converted to CH_4 after permafrost thaw. All are vulnerable to destabilization in a warming climate.

Final results from the GAME project (Causes and effects of **G**lobal and **A**rctic changes in the **ME**thane budget), will be presented. One goal of GAME is to improve the understanding on how emissions in different regions, transport and chemical processes contribute to observed changes in atmospheric methane distribution the last 40 years, with particular focus on the Arctic. The work is an integrated study combining new measurements at Zeppelin Observatory, Svalbard, analysis of existing and ongoing methane observations and other relevant species, and Chemical Transport Modelling (CTM). The Oslo CTM3 model is used to calculate distribution and changes over the last 40 years, globally. The study include evaluation of different methane sources and source regions, and chemical processes affecting OH distribution and changes, including changes in anthropogenic and natural emissions from different sources.

The modelled and observational based monthly mean values from Zeppelin Observatory are compared in the Figure to the right. The agreement is remarkably good, and the presentation will provide and overview of the main contributing sources, and their changes over the time period explaining the main development of the observations at Zeppelin Observatory. In total 18 emission sectors is included in the global model calculations.



The Norwegian Research council through the project GAME and grant no. 207587 (Causes and effects of **G**lobal and **A**rctic changes in the **ME**thane budget) is highly acknowledged for their support of this work.

Title	**Troposphere halogens in Ny-Ålesund by DOAS measurements**

Author's full name	Yuhan Luo
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

Reactive halogen radicals (RHS) play key roles in multiple troposphere chemical reactions, especially in polar regions, which influence the atmosphere oxidizing capability and the source and sink of numerous species. However, as it has the character of quite short lifespan and active chemical properties, it is hard to determine the exact volumn and the rapid change in the real environment. In this research, we present direct spectroscopic observations of BrO and O4 (which is used to calculate the aerosol optical depth) employing the modified Differential Optical Absorpsion Spectroscopy (DOAS) technique over Ny-Ålesund. The preliminary results of column densities and aerosol distributions are discussed. Future more, the source of rapid change halogens in the boundary layer are speculated to be the sea ice with enriched halogen ions.

Title	**Number size distributions and concentration during multiannual measurements campaign at Ny Alesund**

Author's full name	A. LUPI[1], M. BUSETTO[1], M. MAZZOLA[1], C. LANCONELLI[1], F. GIARDI[2], S. BECAGLI[2], R. UDISTI[2], V.VITALE[1], A. VIOLA[1] and H.C. HANSSON[3]
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	O

Measurements of total particle number concentrations and particle size distributions in the diameter range 0.01-0.489 micron were carried out at the Gruvebadet Laboratory at Ny Alesund during four long campaigns in 2010, 2011, 2013 and 2014 (generally from April to beginning of September). The measured size distribution are fitted with multimodal lognormal modes (an overview of retrieved fitted results are shown in figure 1), and statistical daily and monthly based aerosol characteristics are presented, showing two well defined period, both defined by different aerosol regimes, one concerning the "Arctic Haze" with a significant accumulation mode predominance (usually April and May months), and the other typical of summer months, with a relative predominance of particles having smaller diameter. Some insights about new particle formation (NPF) event are also presented, together with a brief comparison with NPF event recorded at the Zeppelin station, almost 400 meter above the Gruvrebadet Laboratory.

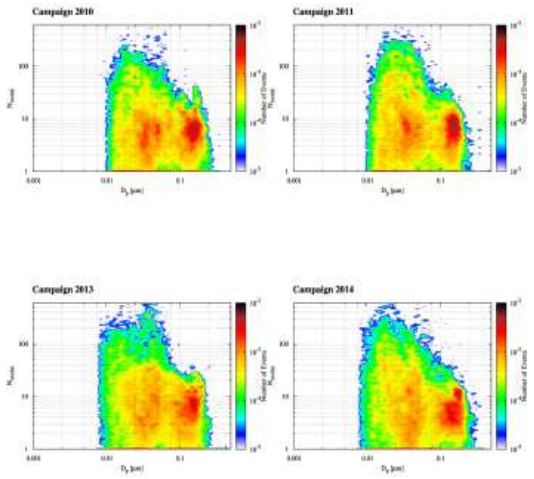

Figure 1: Probability density function of geometrical mean diameter versus the modal number concentration of fitted lognormal size distributions for the four years.

Title	**Atmospheric Flagship Workpackage "Meteorology network, long term data sets"**

Author's full name	Marion Maturilli
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	PS

Presentation preference (O=oral, P=poster)	O

Climate change is the key research topic in Ny-Alesund and Svalbard. Many projects rely on meteorological data as background for their studies, while others have long-term meteorological data series in their focus. With several Nations operating meteorological surface measurements, we aim to draw maximum benefit by combining the different data sets and provide information about their availability and accessibility. This includes all meteorological observations in and around Ny-Alesund, e.g. automated weather stations on various glaciers, as well as the measurements from e.g. Hornsund, Barentsburg and Pyramiden.

An overview is given on the status of metadata collected so far.

Title	**Arctic Warming, Moisture Increase and Circulation Changes Observed in the Ny-Ålesund Homogenized Radiosonde Record**

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Presentation preference (O=oral, P=poster)	O

At Ny-Ålesund, radiosondes have been launched on a daily basis since 1993 in support of synoptic observations. The obtained radiosonde measurements 1993 to 2014 have now been homogenized accounting for instrumentation discontinuities and known errors in the manufacturer provided profiles. The first upper-air climatology of wind, humidity and temperature above Ny-Ålesund is presented from the homogenized data record, forming the background for the analysis of changes detected during the 22-year period. Particularly during the winter season, a strong increase in atmospheric humidity and temperature is observed, with a significant warming of the free troposphere in January and February of up to 3 K per decade. This winter warming is even more pronounced in the boundary layer below 1 km, presumably amplified by local conditions including e.g. orographic effects or the boundary layer capping inversion.

Also the largest contribution to the increasing atmospheric water vapour column originates from the lowermost 2 km of the atmosphere where specific humidity inversions are frequently observed. Yet, no increase in the water vapour contribution by humidity inversions is detected. Instead, we find an increase in the humidity content of the large scale background humidity profiles to be responsible for the observed increase in winter integrated water vapour.

The observed difference in the frequency occurrence of wind directions in the free troposphere between the first and second half of the 22-year period implies that the large scale synoptic flow over Svalbard has changed over the years. During the winter season, the tropospheric flow is found to occur less frequent from northerly directions and to the same amount more frequent from the South. We conclude that changes in the atmospheric circulation lead to an enhanced advection of warm and moist air from lower latitudes to the Svalbard region in the winter season, causing the warming and moistening of the atmospheric column above Ny-Ålesund.

Title	AGAP: an Atmospheric Gondola for Aerosol Profiling

Author's full name	M. Mazzola [(1)], D. Cappelletti [(2, 1)], M. Busetto [(1)], C. Lanconelli [(1)], A.P. Viola [(1)], L. Ferrero [(3)], E. Bolzacchini [(3)], A. Lupi [(1)], V. Vitale [(1)]
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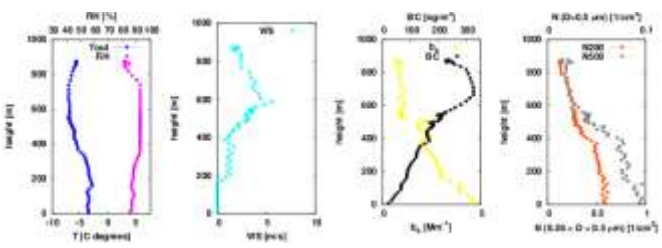
Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

The important role of the atmospheric particles on human health and climate is well recognized. For this reason the temporal and spatial variability of their physical and chemical properties are currently measured worldwide using different techniques. The vertical distribution of the particles is also important in determining the transport of aerosols and their effect on climate. Unfortunately, most remote sensing techniques provide only optical information and/or only on the integrated vertical column (e.g. satellite measurements). Tethered balloons can carry instrumentation payloads for determining particle characteristics. In the Arctic region, the use of tethered balloon technique is particularly suitable because the profiles can cover the full vertical extent of Atmospheric Boundary Layer.

A tethered balloon was lifted from the Gruvebadet laboratory up to about 1000 m a.g.l. during September 2014 and April 2015, with a custom scientific payload including an optical particle counter (Dp>280 nm, 20 channels), a nephelometer for particles scattering coefficient b_{sca} and an aethalometer for particles absorption coefficient b_{abs} (both at $\lambda \sim 550$ nm), as well as a pump-filter system for aerosol collection. Ozone concentration and meteorological parameters were also measured onboard. The temporal resolution of the measurements varies between 1 s for b_{sca} and meteo, 6 s for the size distribution and 1 minute for b_{abs}. Two preliminary campaigns were conducted in spring 2011 and summer 2012. These campaigns allowed to test part of the instrumental setup and to conceive a new dedicated payload.

The experiments accounted different measurement procedures: (i) flying the balloon continuously up and down up to 1000 m to in order to provide profiles of the aerosol properties along the vertical, and (ii) measuring at a fixed height, defined on the basis of previous observed profiles. A total of about 100 profiles were obtained, allowing the definition of typical situations for these two seasons, as well as to identify specific episodes. In many cases the profiles present decreasing or stable number of particles and b_{sca}, while increasing b_{abs} (see figure). On other cases, the structure of the profile presents stratifications, evident in particular in the b_{abs} measurements.



Title	**Geomorphological features of Kongsfjorden area (Ny-Ålesund, Blomstrandøya and Ossian Sarsfjellet)**

Author's full name	Enrico Miccadei[1], Tommaso Piacentini[1], Claudio Berti[2], Ruggiero Casacchia[3], Oliver Grant[4], Anne Hormes[5], Henriette Linge[4], Roberto Sparapani[3]
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Included in session	TE

Presentation preference (O=oral, P=poster)	P

Ice retreat since the last glaciation has triggered drastic changes in high latitude environments where periglacial processes, as well as landslides and slope-fluvial processes are overprinting pre-existing glacial landforms. Our study focuses on the understanding of the role of bedrock geology, climate, local conditions on the development of landforms with special focus on slopes' evolution in the Kongsfjorden area (Svalbard, Norway) as a high geomorphological sensitivity environment. The study is part of a project on the geomorphological effects induced by glacier retreat in high geomorphological sensitivity glacial, periglacial or mountain environments.

We present the preliminary results of two campaign (2013-2014) of geomorphologic survey on selected areas along the fjord: Ny Ålesund area, Blomstrandøya and Ossian Sarsfjellet. Field work was performed with the support of CNR Polar Network and of Dirigibile Italia Station. Field work has been integrated with aerial photo interpretation (1998-2008 ortho-photos, provided by Norwegian Polar Institute). The study led to the production of the geomorphological maps of the Ny Ålesund area, Blomstrandøya and Ossian Sarsfjellet. The Ny Ålesund area landscape is mostly affected by landform resulting from the recent retreat of the glaciers flowing into the Kongsfjorden (i.e. Brøggerbreen, Lovénbreen) and by the superimposed periglacial and gravity induced landforms. The Blomstrandøya landscape is connected to the superimposition of the marine, periglacial and gravity induced landforms over the Holocene-LIA retreat of the Kongsfjorden glacier. The Ossian Sarsfjellet landscape is related to the very recent retreat of the Kongsbreen and to the interplay among glacier (E side), lacustrine environment (Sarsvatnet) and bedrock scarps (W side).

The data emerging from the study areas show a strong control of bedrock geology over the evolution of first order glacial landforms with areas of steep valley sides and areas of broad, subdued relief. After the ice retreat, slope processes affect the landscape according to both local relief energy and bedrock geology. Moreover, the mapping serves as the base for a cosmogenic dating campaign, focused in reconstructing the glaciers retreat (since the little ice age) in the framework of the recent climatic changes that are affecting the Svalbard region.

Title	**Forthcoming reconstructions for the past ocean conditions in Kongsfjorden over the last millennium based on improved paleo proxy methods**

Author's full name	Arto Miettinen, Katrine Husum, Rahul Mohan
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	KS

Presentation preference (O=oral, P=poster)	P

Over the last decades, the thickness and extent of sea-ice in the Arctic Ocean and marginal seas have been decreasing whereas ocean temperatures have been increasing. In this context, Kongsfjorden is oceanographically and climatically important sensitive area as it is persistently influenced by the northernmost North Atlantic Current. The knowledge of past ocean conditions is important, because it helps to a) define the baselines for the natural climate change helping us to set the recent observed changes in the long-term natural climate context, b) improve the global climate models enabling more precise climate projections for the future.

The object of our project is to reconstruct past oceanic changes in Kongsfjorden using the improved paleoceanographical proxies from surface sediment samples and sediment cores. The benthic foraminifer and diatom flux values in sediment cores will be used as proxy for paleoproductivity. Quantitative methods based on diatoms and transfer functions will be used for the reconstructions of paleo sea-ice concentration and sea surface temperature. Additional quantitative methods based on planktic and benthic foraminifera and transfer functions will be applied for the reconstructions of sub surface temperature and bottom water temperature.

In order to improve the calibration datasets for these above-mentioned proxies, we took surface sediment samples from five sites from Kongsfjorden during MOSJ 2014 cruise. In addition, two ca. 40-cm-long marine sediment cores for the paleoreconstructions were taken during the same cruise. We anticipate that these sediment cores will be able to show the variations of different water masses and paleo productivity, and sea-ice variability in the area associated with the Atlantic water inflow over the last millennium.

Title	**Mercury Fractionation in the Sediments of Kongsfjorden**

Author's full name	Mahesh Mohan, Chandini P.K., Gopikrishna V.G and Kannan V.M.
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	KS

Presentation preference (O=oral, P=poster)	P

Mercury (Hg), a transboundary pollutant is highly toxic to biota. Arctic region is more prone to such pollutants and the recent studies showed that in the case of Hg Arctic sea will only take about 35 years to reflect changes in atmospheric Hg levels. Hence, monitoring of Hg in Arctic is highly significant. The sediment samples (15 nos.) were collected from Kongsfjorden and were analysed for total mercury (THg) as well as various mercury fractions. The mean concentration of THg is 0.198mg/kg dry wt. where as the maximum concentration observed was 2.45mg/kg dry. wt. The various fractions of Hg were analysed to assess the role of organic matter, sulphur, iron and concentration of THg on the transformation and transport of Hg. The water soluble Hg fraction (F1) of Kongsfjorden sediments varied from 6.65% to 41.47% with a mean of 15.74%. Hg in human stomach acid soluble fraction (F2) varied from 6.91% to 49.47% with a mean of 20.47%. The sediments showed high range (4.43% - 84.72%) of organic matter bound mercury (F3) with a mean of 22.09%. The elemental mercury fraction (F4) was observed in the range of 2.4% to 93.74% where as a low mean value was noticed for mercury sulphide fraction (F5) (12.38%). The high concentration in fractions F1 to F4 indicate the availability of mercury for transformations and transport. The bioavailable fractions (F1-F3) are high. The main source of mercury in the Kongsfjorden sediment could be the deposition of oxidised gaseous mercury during the Atmospheric Mercury Depletion Events.

Title	**Sedimentation rate in Kongsfjorden using ^{210}Pb/^{210}Po based dating technique**

Author's full name	[1]Mahesh Mohan, [1]Sreelakshmi U., [1]Gopikrishna V.G., [2]G.G. Pandit, [2]S.K. Sahu, [2]M. Tiwari, [2]P.Y Ajmal.
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Presentation preference (O=oral, P=poster)	O

Sedimentation rate is an important parameter in aquatic ecosystem studies as it determines the water system dynamics. The sedimentation rates are influenced by the changes in the glacial inputs into the fjord. Kongsjorden sediment is glaciomarine in nature. The recent studies have indicated the retreat of glaciers due to climate change and subsequent increase in melt water outflow with high content of sediments. The present study analyses the sedimentation rate in Kongsfjorden, Ny-Ålesund. A sediment core (approximately 30 cm) was collected from near Conwaybreen (Lat 78.993 and Long 12.3). The vertical profile of core sediment was analyzed using ^{210}Pb/^{210}Po dating technique where concentration of ^{210}Po was measured using alpha spectrometry in order to calculate the ^{210}Pb since both of them are in secular equilibrium. Total ^{210}Pb activity ranged from 13.76 mBq/g to 119.14 mBq/g. The profile of total ^{210}Pb of the core changed with depth and hence the variation of sedimentation rate along the sediment core is been observed. The sedimentation rate ranged between 0.22-0.37 cm/year during the last 112 years. The average sedimentation rate obtained was 0.28 cm/y and it increased during the last 20 years. The increase in sedimentation rate may due to increased influx of melt water containing terrigenous material. For comprehensive understanding, we intend to continue the study by carrying out similar observations within this fjord as well as other fjords.

Title	From east to west – satellite cal-val for glacier mass balance in Svalbard

Author's full name	Geir Moholdt[1], Kirsty Langley[2], Thomas V. Schuler[2], Thorben Dunse[2]
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	G

Presentation preference (O=oral, P=poster)	O

Field-based glacier monitoring programs provide unique climate records of local glacier changes, but cannot be easily extrapolated to other regions due to marked differences in glacier morphology, ice dynamics and climate conditions. For example, glaciers of western Svalbard are of a more alpine and maritime character than those of eastern Svalbard. Both these regions need to be sampled in order to determine realistic estimates of glacier mass balance and sea-level contribution for the archipelago as a whole. In 2004, the Norwegian Polar Institute and the University of Oslo started an annual glacier monitoring program on Austfonna ice cap, Nordaustlandet, with the aim of filling this data gap and developing robust techniques for regional mass-balance estimation by means of glacier-climate modelling and remote sensing. Satellite altimetry has been of particular interest due to its ability to measure accurate surface elevations at regular intervals over large scales. Through annual field campaigns on Austfonna, we have carried out a wide range of calibration and validation (cal-val) experiments for coincident airborne and satellite altimetry measurements. These include corner reflectors, surface profiling of satellite tracks with GPS and ground-penetrating radar, as well as traditional glaciological measurements from stakes, snow pits, shallow cores and automatic weather stations. In this presentation, we will show how these data compare with satellite altimetry from ICESat and CryoSat-2 over Austfonna, and how we can apply that knowledge to determine regional glacier mass balance - from east to west on Svalbard, and eventually around the Arctic.

Title	Metrology for the arctic

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Included in session	PS

Presentation preference (O=oral, P=poster)	O

Multitudes of measurements are needed to understand the environment and its evolution. In the arctic, the higher accuracy required to quickly capture faster trends, the extreme range and conditions of sensors exposure; a robust comparability asked by the different measurement networks, the need of dedicated calibration procedures, together with the logistical problems associated with such remote location, motivate the proposal for a dedicated joint effort to address metrology experience and activities.

Dedicated procedures for sensors calibration and well understood and defined uncertainty evaluations require collaborative efforts between metrologists working in National and Designated Institutes of Metrology and researchers operating in the arctic, to jointly improve the data quality under an interdisciplinary and multidisciplinary approach. Arctic stations measurements, integrated projects and networks as well as scientific infrastructures, can benefit from the opportunity to perform calibration and traceability also on site. The Ny-Ålesund international research base and community offers a unique infrastructure to directly link metrological traceability to environmental measurements. A metrology laboratory operating in Ny-Ålesund is also proposed based on key aspects: to directly involve the users experience in defining the calibration procedure of the instruments; to allow specific testing and analysis of the effects due to extreme conditions; to avoid logistical problems associated with transports and location; to improve the comparability of the measurement results performed by staff of different nations, numerous systems and research groups, towards a unique traceability to standards. The availability of such a metrology laboratory on site, moreover, will extend awareness on metrological needs and benefits in this field, giving way to wider perspectives.

The general aim is to give a metrological robustness to measurement related to environmental and climate studies to improve comparability and representativeness of datasets and possibly evaluate and reduce measurement uncertainty. This will benefit the quality and comparability of data available in the immediate short period as well as for the future generation of climatologists.

The proposal will initially deal with temperature (of air, water, ice, soil, permafrost), pressure, radiance (direct solar radiation, albedo...), to be then extended to air quality, biology, atmospheric and marine environment research. The talk will present the proposal, together with the opportunities offered by promoting joint research projects under the framework of the European Metrology Programme in Innovation and Research (EMPIR).

Title	How does European aerosol emissions affect the Arctic climate?

Author's full name	Acosta Navarro, J. C.[1,3]& Varma, V[2, 3], Riipinen, I.[1,3], Seland, Ø.4, Kirkevåg, A.[4], Struthers, H. [1, 2, 5,] Iversen, T.[4], Hansson, H.-C.[1, 3], Ekman, A. M. L.[2,3]
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First author's email	The talk will be given by HC Hansson, hc@aces.su.se

Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	O

The Arctic is warming considerably faster than the rest of the globe1 having long-lasting consequences for the ecosystems and human exploration of the region. The exact reasons behind this Arctic amplification are still inconclusive. Due to air quality measures, anthropogenic emissions of particulate matter and its precursors have drastically decreased in parts of the Northern hemisphere during the past three decades5. We show that the sulfate aerosol reductions in Europe have modified the atmospheric heat transport towards the Pole and that the decrease in aerosol burden over Europe can explain a significant fraction of the recent Arctic warming. The primary reason for this is that the aerosol induced positive radiative flux perturbation at the top of the atmosphere over mid-latitudes has been compensated by an increased poleward dry-static heat transport. This response is contrary to the decrease in poleward dry-static heat transport associated with increased atmospheric concentrations of CO2. The results reveal a unique inherent link between air quality regulations in the Northern hemisphere, general circulation and Arctic climate.

Title	**Identification and Quantification of Bisphenol S in the sediments of Kongsfjorden Using High Resolution Mass Spectrometry**

Author's full name	K.K. Nejumal,[1] Mahesh Mohan[1], K.P. Krishnan,[2] D. Dineep,[3] U.K. Aravind,[4] C.T. Aravindakumar,[1,3*]
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	KS

Presentation preference (O=oral, P=poster)	O

Emerging pollutants are wide class of chemicals they include pharmaceuticals and personal care products (PPCP), endocrine disrupting compounds, surfactants, nanomaterials etc. Bisphenol S is regarded as endocrine disrupting compounds. The impacts of these organic pollutants in the different ecosystems are unknown. In this study, Bisphenol S is identified from sediment samples collected from Kongsfjorden using Liquid Chromatography Quadruple Time of Flight Mass spectrometric (LC-Q-ToF-MS) analysis after the sample improvement using QuEChERS extraction. Chromatographic separation was achieved by using a mobile phase containing acetonitrile and water with 0.1 % formic acid in a C18 column. Bisphenol S is identified in negative ionization mode in mass spectrometry. Bisphenol S is having m/z value 249.0223 and the major fragments are 155.881, 108.0212 and 92.0212. We performed the Limit of Detection (LOD = 0.0097 ppm), Limit of Quantification (LOQ = 0.0295 ppm) and linearity analysis for the quantification of Bisphenol S in sediment sample. From the analysis, it is concluded that the amount of Bisphenol S in 1g of sediment is 2.1 ppm. Bisphenol S is used as a plasticizing agent and their presence in the environment is identified as a crucial problem. In addition to this, there are indications of the presence of a number of other organic chemicals such as sotradecol, 4-methoxy benzene sulfonic acid, p-heptyl acetophenone, 4-undecylbenzenesulfonic acid, 2-hydroxy-5-[(4-hydroxyphenyl) sulfonyl] benzenesulfonic acid and 4-tridecyl benzene sulfonic acid. More confirmatory work on these compounds is under progress.

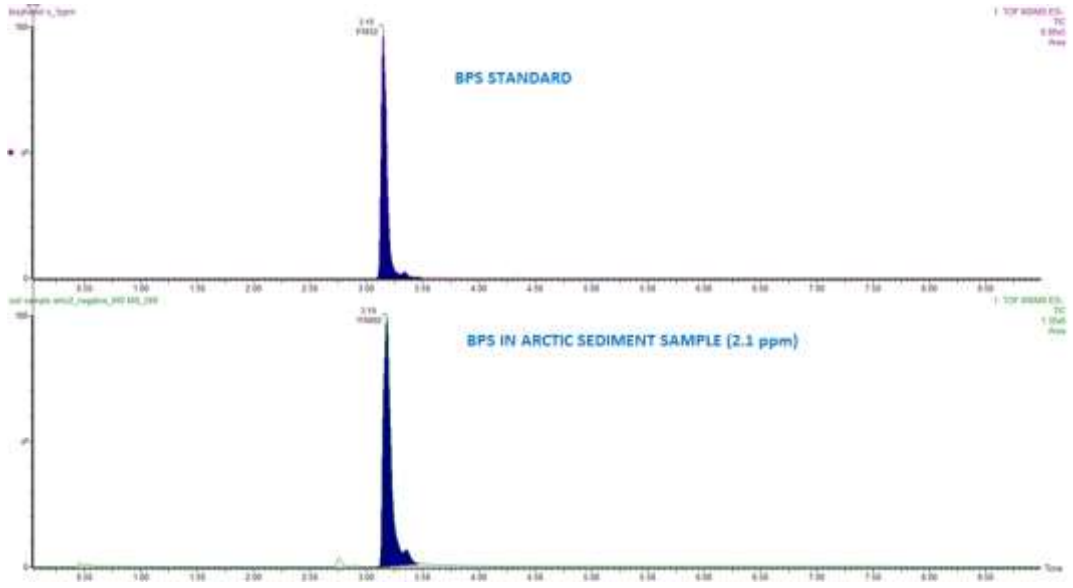

Figure:1 identification of BPS in Arctic Sediment collected from Kongsfjorden

Title	**High resolution glacier dynamics and calving from GNSS and passive seismology**

Author's full name	Christopher Nuth(1), Jack Kohler (2), Kenneth Bahr (1), Andreas Köhler (1), Giuseppa Buscaino (3)
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	G

Presentation preference (O=oral, P=poster)	P

Predictions of the glacier contribution to sea level over the next century (IPCC AR5) are strongly dependent upon simple glacier models that are able to project individual glacier mass changes globally and through time. These models are flexible and robust, but not yet equipped to handle the fine scale processes responsible for glacier sliding dynamics and subsequent iceberg calving. In the Ny-Ålesund area, an assortment of glacier types (e.g. tidewater, land-terminating, surging, non-surging, polythermal) are accessible, making the area a prime laboratory for better characterizing the physical interactions and feedbacks between climatic forcing and glacier dynamic responses. We apply advanced observation techniques to produce high temporal resolution records of glacier calving and 3D glacier displacements. In particular, we aim to generate continuous calving records for the glaciers in Kongsfjord, and in particular for the fast-moving glacier Kronebreen, through innovative, multi-disciplinary monitoring techniques, combining fields of seismology and bioacoustics to detect and locate individual calving events autonomously and further to develop methods for the quantification of calving ice volumes directly from the seismic and acoustic signals. Moreover, high precision GNSS (Global Navigation Satellite System) instruments on the glacier provide cm to mm accuracy that resolve hourly glacier velocity, uplift, and subsequently subglacier water storage continuously, over seasons and years. The availability and combination of these records provide a unique opportunity to investigate fine temporal scale feedback processes between glacier dynamics with the external climatic and oceanic forcings.

Title	**Chronobiology of polar organisms: Melatonin and polar lighting effects on an arctic "living fossil"**

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Presentation preference (O=oral, P=poster)	P

The overall aim of this project is to characterize circadian organization in a polar invertebrate the tadpole shrimp, *Lepidurus arcticus*. No work on the circadian biology of this fascinating group has been published, and their behavioral rhythmicity in the high arctic is of great interest from an eco-evolutionary perspective.

Although the existence of circadian clocks is accepted as ubiquitous feature of life, and their physiological mechanisms are becoming well understood, the role of circadian clocks in extreme environments (e.g. caves, the deep sea and the polar regions) has received very little attention. This branch of the field is of particular importance because it places the adaptive value of circadian timing in proper evolutionary perspective. Work in reindeer by K. Stokkan and coll. (Nature, 2005; Cur. Biol., 2010) suggests that circadian clocks may be weakened as part of the adaption to exploit continuous illumination in the polar summer, but studies on birds and ground squirrels suggest that depending on ecological context circadian rhythms may be maintained. No data on this topic have been gathered from a high arctic invertebrate. *Lepidurus a.* is the ideal model in which to develop this aspect because of its presence in melt-water pools in Svalbard, and because conspecifics can also be found at different latitude in Norway. Hence it will possible to develop a latitudinal comparison of both behavior and genetic aspects, and (beyond the scope of this proposal) crossing experiments to assess heritability of circadian traits can also be envisaged.

A preliminary experiment has been conducted during the arctic summer, the locomotor activity of single animals groups of four animals was recorded. Animals were monitored in different photoperiod: six single animals and three groups of animals in natural condition and three single animals in continuous darkness. This first study on the behavioral analysis of the locomotor activity rhythms in *Lepidurus a.* certainly deserves further investigation. The data presented here emphasizes that *Lepidurus a*, recorded individually and in groups in natural condition during the arctic summer, do not show circadian rhythm (Pasquali, 2015).

Our aims for the future studies are: 1) to explore rhythmicity in *Lepidurus a.* during the arctic summer outdoors, and to compare this rhythmicity under a field-laboratory imposed light dark cycle. This will allow us to determine whether behavior is under circadian control, and if so whether this continues under constant illumination; 2) to determine whether *Lepidurus a.* expresses homologues of 'clock genes' known to govern circadian biology in modern arthropods and in vertebrates; 3) to investigate the possible role of melatonin in seasonal and circadian biology in *Lepidurus a*. While melatonin production by the pineal is a key aspect of vertebrate circadian organization, its role invertebrates and unicells has remained highly controversial. Very recently this debate was given new impetus by the finding that melatonin controls larval swimming behavior in larvae of an annelid worm (Cell, 2014),

suggesting that there may indeed be an ancestral role for melatonin. We will therefore investigate melatonin effects in our behavioral assay, collect samples for assay of melatonin levels in *Lepidurus a.*, and explore our transcriptomic data to determine whether genes for the key enzymes control melatonin synthesis may be present in this ancient lineage.

Title	**Decades of tundra ecosystem monitoring suggest ecosystem-based monitoring as the future paradigm**

Author's full name	Åshild Ønvik Pedersen, Eva Fuglei, Virve Ravolainen
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	TE

Presentation preference (O=oral, P=poster)	O

Climate change is expected to have profound effects on arctic terrestrial ecosystems. In Svalbard the mean seasonal temperatures have increased across the entire archipelago, most dramatically in winter and spring. The increase in temperature and the expected shift in onset of spring and length of growth season will have direct effects on plant productivity, community composition and structure and in the long term on greening of the tundra. Such climate driven changes likely allow herbivore populations to increase in response to coincident improvements in food availability and increased nest site availability for ground breeding birds. In contrast, winters with more snow and higher frequency of 'rain-on-snow' events will influence herbivore population dynamics negatively. Our understanding of the population dynamics of the endemic Svalbard reindeer (*Rangifer tarandus platyrhynchus*), the arctic fox (*Vulpes lagopus*) and the migratory Svalbard-breeding geese (e.g. *Anser brachyrhynchus* and *Branta leucopsis*) populations has improved substantially in recent years. Studies from both the Ny-Ålesund area and in Central Spitsbergen have shown 'rain-on-snow' events, causing ground ice and inaccessible pastures, to be the main driver of the population dynamics of Svalbard reindeer. The goose populations have increased over the last decades, and reproductive success is positively related to onset of spring, suggesting further population growth in response to climate change. Arctic fox population dynamics are driven by intrinsic bottom-up limitations related to the density of Svalbard reindeer carcasses in late winter. Correspondingly, the reproductive success of geese is low after winters with high densities of reindeer carcasses. As a result of climate change, new or strongly modified trophic interactions may dominate the overall responses of the terrestrial ecosystem.

An emerging challenge for future monitoring is to distinguish effects of different climate-driven factors such as winter ground ice and summer forage availability (quality and quantity) on the herbivore populations and their shared predator. By monitoring selected state variables such as spatial and temporal extent of ground ice, snow pack properties, and forage biomass and quality in an appropriate study design, causal relationships between herbivore dynamics and abiotic and biotic drivers of change can be established. The establishment of «*Climate-ecological Observatory for Arctic Tundra- COAT*» is a response to the international calls for ecosystem-based climate impact observatories in the terrestrial Arctic and will be essential in developing integrated food-web based monitoring of the terrestrial ecosystem. In this regards selection of the Ny-Ålesund research platform as a COAT site hosts unique opportunities to track population changes of herbivores and their predator through long-term monitoring data and to study interactions among them and responses to climate variability in a simple terrestrial high-Arctic ecosystem.

Title	**The roughness length evaluation at Ny-Alesund: a preliminary results**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

Abstract

The climatological characterization or numerical modeling of the Arctic regions needs, for the accurate simulations, the evaluation of the roughness length z_0 . In the parameterizations of the PBL features, mean wind profiles, variances of turbulent variables are dependent on z_0. In case of ideal horizontally homogeneous conditions and of negligible heat flux, the logarithmic wind profile is the best approach to simulate the observed data. In such cases, a strictly neutral conditions are the most appropriate to evaluate the roughness length to each observed wind direction. The knowledge of neutral conditions turn out important for the determination of the parameters necessary to obtain vertical wind profiles in stable and unstable conditions.

In this work, a strict selection of neutral conditions has been performed using one year wind profile data collected at the Ny-Alesund site. The presented results derives by a profile selection based from 288 wind profiles, all of them corresponding to vertical almost constant direction and friction velocity u*. The number of selected neutral profiles and of average values of meteorological parameters are provided in following table

WD	Np	WS (m/s)	T (°)	U* (m/s)
ESE	120	**11.24**	**4.83**	**0.44**
SW	62	**5.41**	**2.10**	**0.39**
NW	100	**9.44**	**-5.33**	**0.34**

The selected profiles are observed in three main wind direction: East- Southeast (WD=(90°-135°), South-West (WD=180°-270°) and North-West (WD= 270-360°). The total number of neutral profiles for each sector are 120 from the (SSE), 62 from SW and 100 from NW. Two different procedures have been used to determine the roughness length (labelled 'fit' and 'class' in Table 1) in order to evaluate the most proper value of the von Karman constant too.

The values of z_0 calculated with different formulations are consistent with the characteristics of the site, but they can be very different depending on methods used in the analysis. The z_0 cover a wide range of values. In the table 1 the average values of z_0 in mm for the three directions are given.

The results show a very high average value of the roughness, z_0 = 70.5mm, for SW direction.

WD	zo (mm) (FIT)	zo(mm) (Clas)
ESE	1.27	3.02
SW	0.67	70.45
NW	1.04	3.02

Table 1: z_0 from different (Fit and Classic) methods and wind directions

These results provide a clear indication on some fundamental aspects :

1. The values of z_0 are dependent by the formulation chosen in the calculation
2. The estimation of z_0 depends from the value of k that can be different from 0.41

Title	**Variability in solar UV irradiance and atmospheric ozone column observed at Ny-Ålesund: current results of the U-VIVA RiS project**

Author's full name	Boyan H. Petkov[1], Vito Vitale[1], Mauro Mazzola[1], Angelo Lupi[1], Christian Lanconelli[1], Angelo Viola[1], Kerstin Stebel[2], Georg H. Hansen[2]
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

Solar ultraviolet (UV) radiation strongly affects a variety of chemical reactions in the atmosphere, which form the ozone layer that, on the other hand, absorbs in a large spectral band of UV irradiance (UV-C, 100-280 nm and UV-B, 280-315 nm). Such an interaction between both factors determines the thermal structure of the stratosphere that plays an important role in the atmospheric dynamics and, hence, in the processes governing the climate. For that reason, the monitoring of the UV radiation reaching the Earth's surface and the total ozone is considered one of the major issues in the atmospheric investigations. The RiS project "UltraViolet Irradiance Variability in Arctic (U-VIVA)" is aimed to contribute the studies in this research field. The main project instrument performing field measurements at Ny-Ålesund from 2008 is the UV radiometer UV-RAD, developed at ISAC-CNR on the basis of narrow-band filters, which registers the irradiance at seven spectral components and allows the estimation of the total ozone amount. The results exhibit strong day-to-day variations in UV radiation observed within daylight period of the year, which highlight differences of more than three times among the daily irradiance doses registered within a few days. Such behaviour can be mainly accounted for the very changeable meteorological conditions at Ny-Ålesund and especially for the strong variations in the cloud cover characteristics.

The ozone column was found to be a subject of large diurnal variations, which were compared with the corresponding changes in the surface UV-B irradiance in order to exclude the hypothesis about their artificial origin due to the measurement or instrumental errors. An analysis performed through the methods developed by the theory of non-linear dynamical systems leads to the conclusion that the observed diurnal variations can be considered a result of 6-dimentional deterministic process. This occurrence assumes an interaction of the ozone column over Ny-Ålesund with five other atmospheric parameters that determine the short-term ozone behaviour. Such an analysis shows also that these variations can be predicted with a reasonable accuracy for a 10 – 20 hours period.

Title	**Reconstruction of the mass balance of Ariebreen (Hornsund, Svalbard) in years 1983-2008**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	G

Presentation preference (O=oral, P=poster)	O

Because of their high sensitivity to air temperature and precipitation changes glaciers are an important indicator of climate change. Most of the glaciers of Spitsbergen are subject to pronounced recession, since at least the thirties of the twentieth century, and most probably since the end of the Little Ice Age. The retreat accelerated in the late twentieth century. Most of the field-based studies of Svalbard glaciers are focused on large- and medium-sized glaciers, whereas smaller glaciers are studied less frequently, partly due to their simpler dynamics and lower impact on global sea level rise. However, given that the glaciers with surface area lower than 1 km2 compose around 40% of the total number of glaciers on Svalbard, their influence on landscape, water resources and local ecosystems should not be underestimated. The main goal of this work is to reconstruct the surface mass balance of Ariebreen, a small mountain glacier in Hornsund by applying a positive degree-days model to a long-term series of meteorological observations at the Polish Polar Station Hornsund. Some of the model parameters are calibrated using a more sophisticated energy balance model, that is optimized over one season with a PSO method. Our results show highly negative surface mass balance over the investigated period and the importance of snow drift redistribution over the glacier surface.

Title	**Long-term observations of air surface exchange of elemental mercury in the Norwegian Arctic**

Author's full name	Katrine Aspmo Pfaffhuber, Lars R. Hole, Torunn Berg, Andrei Ryjkov, Ashu Dastoor
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	O

Mercury, with its many different species, has a complicated biogeochemical cycle. Quantification of the air surface exchange of mercury is crucial for understanding both the Arctic and global Hg cycle. In background ecosystems, the exchange of elemental mercury is primarily controlled by physicochemical properties of the soil, biological processes in the soil, atmospheric chemistry and meteorological conditions. Methods most commonly applied to assess fluxes of Hg at arctic locations are flux chambers and micrometeorological methods, both with advantages and challenges. In this study, elemental mercury exchange between the surface and overlying atmosphere; termed flux, has been monitored at 79°N in Ny-Ålesund, Svalbard from spring 2008 and has been running almost continuously until present. The system setup consists of a vertical GEM concentration gradient at two heights and a micrometeorological method to determine the eddy diffusivity applying the aerodynamic method. The measurement site is located close to Kongsfjorden and practically at sea level.

Our 7-year data record show that the fluxes are generally quite small, and during the dark snow covered period, surface snow acts a net sink of elemental mercury. However, at polar sunrise during spring, the area experiences repeated atmospheric mercury depletion events, followed by deposition of oxidized mercury species. Photo-reduction of the previously deposited Hg, results in that the net flux direction changes and the snow-covered surfaces acts as a large source of elemental mercury to the overlying atmosphere. Following snowmelt, the net flux approaches zero, and the remainder of the year the surface becomes a small sink for elemental mercury. Complexation of deposited Hg to the sparsely vegetated Arctic soil may prevent reduction of Hg and thus emission to the atmosphere. The annual cumulative flux is strongly positive; hence, surface emission exceeds deposition by far. This result indicates that there may still be large challenges associated with the aerodynamic flux gradient approach. Moreover, additional mercury species or fractions are contributing significantly to the deposition. However, calculating dry deposition of gaseous oxidized mercury and particulate mercury from available concentration data and literature deposition velocities in addition to measured wet-deposition rates cannot account for the elemental mercury emitted from snow.

Title	**Sub-sea emissions of methane and light hydrocarbons from Arctic Ocean to atmosphere**

Author's full name	Stephen Platt[1], Ove Hermansen[1], Norbert Schmidbauer[1], Anna Silyakova[2], Benedicte Ferré[2], Jürgen Mienert[2], Cathrine Lund Myhre[1]
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Included in session	AS

Presentation preference (O=oral, P=poster)	P

Sub-sea release of light hydrocarbons such as ethane, propane, and methane are a relatively poorly constrained source of these gases to the atmosphere. The release of methane (CH_4) presently stored in vast hydrate deposits under the seafloor is also a potential climate tipping point. Significant hydrate deposits are located in shallow waters in the Arctic where they may destabilise and be released to the atmosphere due to surface warming. Therefore the Methane Emissions from Arctic Ocean to Atmosphere (MOCA, http://moca.nilu.no/) project was established. Oceanographic and atmospheric measurement techniques were applied over areas of shallow water around Svalbard during summer 2014. Oceanographic measurements included the deployment of 63 measurement stations (temperature, salinity, density, oxygen, fluorescence, turbidity, etc.), water column sampling (CH_4, nitrate, phosphate, silicates), and echo sounding (to detect gas flares). Atmospheric on-line measurements were performed aboard the research vessel Helmer Hanssen (CH_4, CO_2, CO, meteorological parameters) and during a flight campaign (CH_4, etc., Fig. 1). Air samples were collected for quantification of other hydrocarbons (ethane, propane, etc.). Atmospheric measurements are compared with data from the nearby Zeppelin Mountain station (Ny Ålesund, Svalbard, Fig. 1). Back-trajectory analysis and FLEXPART modelling are used to rule out non-local sources and constrain source strengths. Here we present an overview of all of these activities and the first results from MOCA. We demonstrate that there are hotspots of activity where hydrocarbons are being emitted from the ocean, while in some areas emissions are surprisingly well contained by local biological and hydrological conditions.

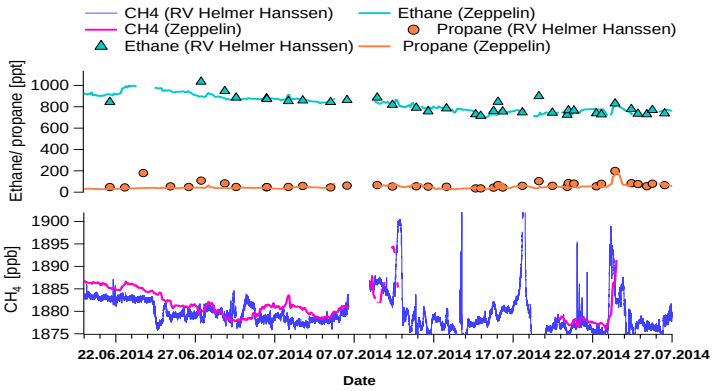

Figure 1: Time series of methane, ethane, and propane from the Zeppelin observatory and the RV Helmer Hanssen

Title	**Analyzing snowfall on the glaciers Holtedahlfonna and Kongsvegen, in the Kongsfjorden area**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	G

Presentation preference (O=oral, P=poster)	P

Snow is a crucial parameter in glacier mass balance modelling since the albedo contrast between snow and ice strongly affects the energy balance. Distributed energy balance models at the landscape scale typically do a reasonable job at extrapolating or interpolating parameters such as temperature from measurement sites, but snowfall is a more difficult parameter to specify, in the absence of dense measurement networks. Here we analyze hourly sonic ranger data obtained at four Automatic Weather Stations (AWSs) situated on two large Svalbard glaciers, Holtedahlfonna (~400 km2) and Kongsvegen (~100 km2), with data covering the period from 2007 to 2013. The four glacier AWSs are situated in different region of glaciers (ablation/equilibrium line altitude/ accumulation) and at different altitudes. We identify and analyze precipitation events, comparing them across the sensor network, to precipitation data from the nearby reference meteorological site in Ny-Ålesund, and to output from a regional climate model. In spite of difficulties in quantifying precipitation and accumulation because of the complex effects of wind, this analysis shows that they can provide a valuable source of ground-based observations for comparisons to the models on synoptic timescales. Results show that interannual variability of precipitation matches among different sites, but that there are variations in the pattern over synoptic timescales at the different sites. These results will be used to improve energy balance modelling efforts for the glaciers in the Kongsfjord catchment basin.

Title	**Seasonal variation of aerosol water uptake and its impact on the direct radiative effect at Ny-Ålesund, Svalbard**

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Presentation preference (O=oral, P=poster)	P

Water uptake or hygroscopicity is one of the most fundamental properties of atmospheric aerosols. Aerosol particles containing soluble materials can grow in size by absorbing water in ambient atmosphere. Hygroscopic growth depends on the dry size of the particle, its chemical composition and the relative humidity in the ambient air. One of the typical problems in aerosol studies is the lack of measurements of aerosol size distributions and optical properties in ambient conditions. In this study we try to bridge the gap between measurements performed under dry conditions and aerosol properties in the humid atmosphere. To do this we utilize a hygroscopic model which calculates the hygroscopic growth of aerosol particles at Mt Zeppelin station, Ny-Ålesund, Svalbard during 2008.

A hygroscopic growth model was built on the κ-Köhler theory (Petters and Kreidenweis, 2007). The monthly chemical composition of the aerosol particles is represented by observations of inorganic ions obtained from the Norwegian Institute for Air Research (NILU) and filter sample analysis for the organic and elemental carbon (OC/EC) concentration (Silvergren et al., 2014). The assumed components are: soluble and insoluble organics, sulfate, sea salt and soot. Internally mixed aerosol particles with homogenous chemical composition are assumed. After using the hygroscopic model, the radiative properties and radiative influence of the aerosols on the Arctic environment are studied using a Mie scattering model (Wiscombe, 1979) and a radiative transfer model (Richiazzi et al., 1998).

The evaluation of the hygroscopic model calculations with HTDMA measurements from September 2007- August 2008 (Silvergren et al., 2014) and the Mie scattering model calculations with humid nephelometer measurements during a 90 days campaign at Zeppelin station (Zieger et al., 2010) show a good agreement. Sensitivity tests show that the model calculations are more sensitive to relative humidity and particle's size than its chemical composition. The hygroscopic growth of aerosol particles in ambient atmosphere increases the annual mean scattering coefficient by about a factor of 5 compared with calculations on completely dry aerosols. Hygroscopic growth should therefore be considered in all comparisons between in situ measurements, satellite products and model predictions of aerosol optical thickness. Our results also indicate that the RH profiles and variation are key parameters needed for correct predictions of aerosol optical properties.

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Title	aerosol properties from the 2014 haze season derived by lidar

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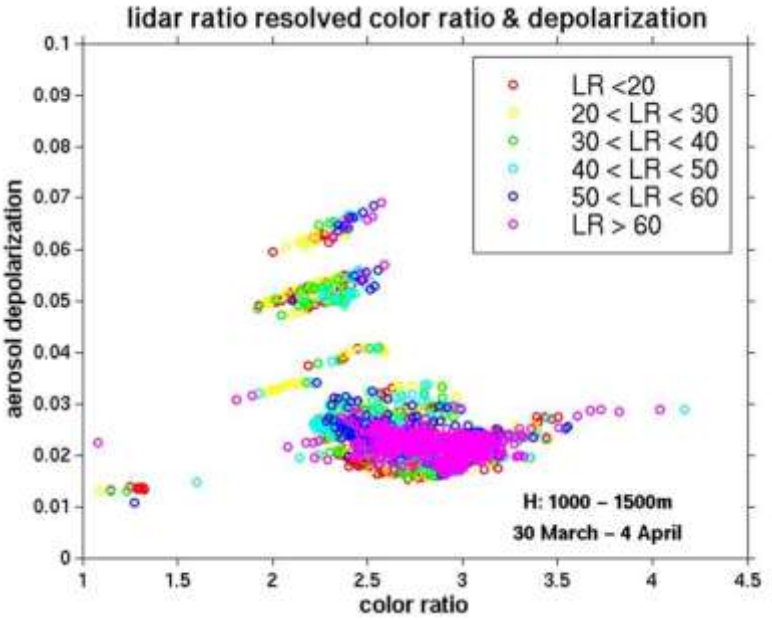
Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	O

In this contribution a statistic of lidar derived aerosol properties will be given. The data comprises the period from late March to end April 2014, contemporary to the iAEREA campaign in Ny-Ålesund and Longyearbyen. Analysed parameters are aerosol backscatter (β^{aer}) and extinction (α^{aer}), aerosol depolarization (δ^{aer}, measure of the aerosol's asphericity), the colour ratio ($CR(\lambda_1,\lambda_2) = \beta^{aer}(\lambda_1) / \beta^{aer}(\lambda_2)$, measure of particle size), and the lidar ratio ($LR(\lambda) = \alpha^{aer}(\lambda) / \beta^{aer}(\lambda)$). Backscatter values between 3 – 9 10^{-7} m^{-1} sr^{-1} at 532nm have been found for Arctic haze. Higher values could be identified as subvisible clouds. For this relatively less polluted 2014 season we found only few case with an aerosol depolarization > 7% and the majority of aerosol events showed a color ratio (CR(355nm, 532nm) between 1.7 and 2.5. The lidar ratio was typically larger for 532nm (around 50sr) than for 355nm (around 38sr), which is in agreement to measurements of earlier years.

One striking result is that the LR, which depends on the chemical composition and hence the refractive index, hardly depend neither on the aerosol size (color ratio) nor on the shape (depolarization), as depicted in the Fig. below. This means that on a scale with 60m / 10 min resolution both the larger and smaller or more or less spherical particles can contain dark components (soot, silicate) or bright ones (ice, sea salt, sulphate).



This work shall be compared to the ground-based in situ aerosol measurements at Gruvebadet and Zeppelin station for a contribution to the aerosol closure program. Moreover comparison to AOD and lidar data in Longyearbyen (iAREA) and Hornsund is aspired for the representativeness of Ny-Ålesund.

Title	**Increase in elemental carbon values between 1970 and 2004 observed in a 300-year ice core from Holtedahlfonna (Svalbard)**

Author's full name	Meri M. Ruppel [1], Elisabeth Isaksson [2], Johan Ström [3], Emilie Beaudon [4], Jonas Svensson [1,5], Christina A. Pedersen [2], Atte Korhola [1]
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Presentation preference (O=oral, P=poster)	Oral

Black carbon (BC) is a light-absorbing particle that strongly warms the atmosphere. The climate effects of BC are amplified in the Arctic where its deposition on light surfaces decreases the albedo and causes earlier melt of snow and ice. BC has even been estimated to be more important to the Arctic melting than greenhouse gases. Despite its suggested significant role in Arctic climate warming there is little information on BC concentrations and deposition in the past. Here we present results on operationally-defined elemental carbon (EC, proxy for BC) concentrations and deposition on the Holtedahlfonna (Svalbard) glacier between 1700 and 2004. The inner part of the 125 m deep ice core from Holtedahlfonna (79°8'N, 13°16'E, 1150 m a.s.l.; ca. 40 km northeast of Ny-Ålesund) was melted, filtered through a quartz fibre filter and analysed for EC using a thermal-optical method. The EC values started to increase after 1850 and peaked around 1910, similar to ice core records from Greenland. Strikingly, the EC values again increase rapidly between 1970 and 2004 after a temporary low point around 1970 reaching unprecedented values in the 1990s. This rise is not seen in Greenland ice cores. In addition, the rise seems to contradict atmospheric BC measurements indicating generally decreasing atmospheric BC concentrations since 1989 in the Arctic. For example changes in scavenging efficiencies, post-depositional processes and differences in the vertical distribution of BC in the atmosphere, are discussed for the differences between the Svalbard and Greenland ice core records, and the Holtedahlfonna ice core and atmospheric measurements in Ny-Ålesund. In addition, the divergent BC trends between Greenland and Svalbard ice cores may be caused by differences in the analytical methods used, including the operational definitions of quantified particles, and detection efficiencies of different-sized BC particles. Regardless of the cause of the increasing EC values between 1970 and 2004, the results have significant implications for the past radiative energy balance at the coring site. The results suggest that recorded melting of the Holtedahlfonna glacier can be better explained by increasing measured summer temperatures (Svalbard airport) and the increasing EC concentration trend together, than by increasing temperatures alone.

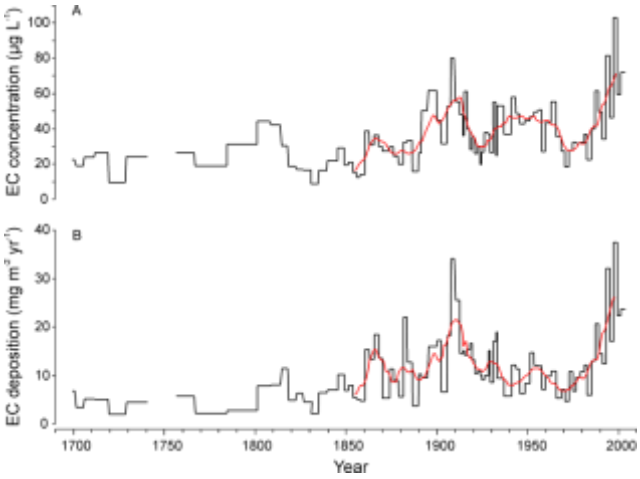

Figure 1. EC concentration and deposition in the Holtedahlfonna ice core. A) EC concentration (µg L^{-1}) and B) EC deposition (mg m^{-2} yr^{-1}) with 10 year running averages (red).

Title	**Monitoring of aerosol optical depth and water vapor content of the atmosphere in Barentsburg with the help of SPM and SP-9 sun photometers**

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Presentation preference (O=oral, P=poster)	P

Measurements of aerosol optical depth (AOD) and total water vapor content of the atmosphere were initiated in 2011 on the territory of Russian Scientific Center "Spitsbergen" (Barentsburg settlement) with the use of multiwavelength sun photometers (Fig. 1). Measurements in 2011-2014 were performed using SPM portable sun photometer. The SP-9 photometer had been operated since 2015 in automatic (unattended) mode. The photometric observations are performed in daylight period of the year (April-September) in the wavelength range of 0.34–2.14 μm.

In the report, we present the characteristics of sun photometers, operating in a wider wavelength range compared to their analogs. Based on measurements in IR wavelength range (1-2.14 μm), we additionally determine two independent AOD components, caused by attenuation of radiation by finely and coarsely dispersed aerosol. The statistical characteristics of AOD in Barentsburg are compared with average data in background regions of ocean and Siberia. The specific features of seasonal and interannual variations and spectral dependence of atmospheric AOD during four-year period of observations are discussed.

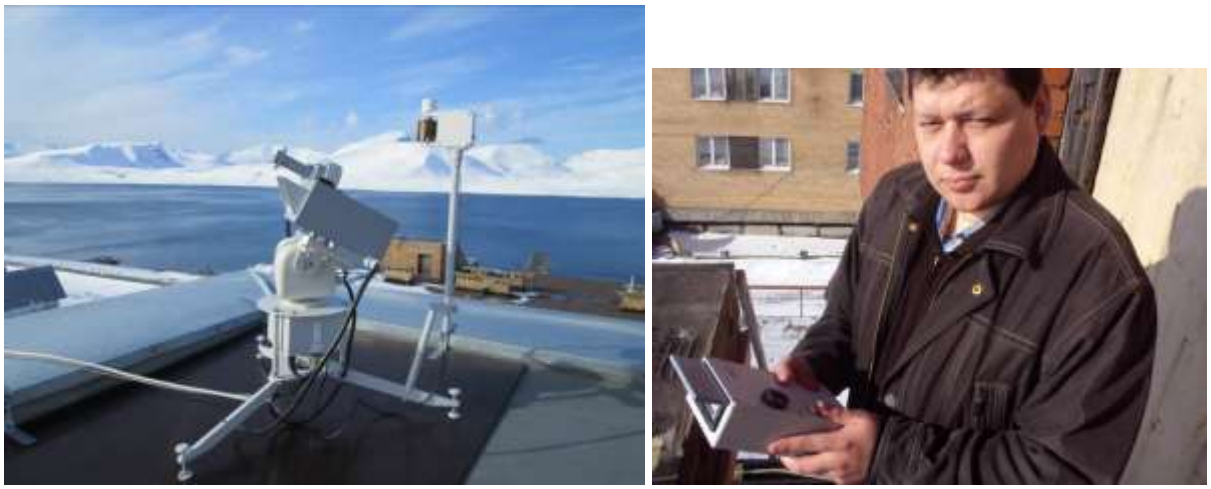

Fig. 1. External view of SP-9 and SPM sun photometers

Title	**Continuous reflectance characterization of snowed surfaces in Ny-Ålesund**

Author's full name	Salzano Roberto*, Salvatori Rosamaria*, Lanconelli Chrisitan**, Esposito Giulio*, Giusto Marco*, Montagnoli Mauro*, Di Nino Roberto*, Mazzola Mauro**, Viola Angelo**.
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Presentation preference (O=oral, P=poster)	P

The Global Change studies are a primary objective for the scientific community and polar areas are priority targets in order to characterize the Earth dynamics. Furthermore, the detection and the description of the snow and ice surfaces are important tools required for monitoring changes through time. The continuous monitor of the cryosphere represents a critical issue which, at the moment, we can supply with specific satellite missions. There is a scientific gap on the relationship between remote sensed images and field data. Fulfilling this gap, it could be possible to derive from remote sensed images not only the spatial distribution of snow/ice covers but also information about their physical characteristics. In particular, using images collected by optic passive sensors, that measure the surface reflectance in the wavelength between 400 and 2500nm, it could be possible to derive information on micro-physical characteristics of the snow surface or on the presence of liquid water in the first layer of the snow pack.

The aim of this work is to present the field activity carried out in Ny-Ålesund (Svalbard islands, Norway) where different apparatus were set up in order to solve the problems associated to the continuous monitoring of surfaces in polar regions.

The activity was held in the framework of the Italian Research Program in Antarctica (project STRRAP-B) during the summer period of 2014 and 2015. The field surveys were performed using two different approaches: continuous full-range measurements and continuous multispectral observations. The first one was persecuted using a VNIR spectroradiometer deployed at the CNR - Climate Change Tower. The instrumentation (ASD Fieldspec 3) was integrated with a optic head rotating support and it permitted the spectral acquisition of the upwelling and downwelling radiation. This instrument covers the Vis-NIR spectral range (350-2500nm) with a 1nm resolution and it was deployed during both the summer periods. The second approach was based on 2014 experience and supported the development of a second instrument (Snow Ice Continuous REflectance Monitor) with three fixed-band albedo at 860, 1240 and 1640 nm. Both measurements were hemispheric, in the 350-2200nm wavelength range, but while the first set up is based on a mechanical rotating motor, the second is constituted by a twin system facing up and down. While the first approach obtains asynchronous spectral albedo, the second one provides synchronous spectral albedo on bands selected considering sensors deployed on satellites. Furthermore, both systems are integrated with cameras devoted to acquire sky and ground images. These pictures were used for characterizing the cloud coverage and the snow cover/roughness and for quality checking the available datasets.

The field activities started in mid April in order to provide a base reference for characterize snow albedo in stable cloudy and clear-sky conditions. Moreover, the first results permitted the characterization of spectral variations during the melting period. This study represents a first attempt to associate snow metamorphism to spectral variations and it supports the identification of relevant correlations with meteorological parameters.

Title	**Austfonna mass balance in a Pan-Svalbard perspective**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	G

Presentation preference (O=oral, P=poster)	O

To date, glacier mass balance measurements on Svalbard are heavily biased to the relatively easily accessible Western part of Svalbard, whereas the bulk of ice is located in the East. So far, the only exception is the dataseries of glacier mass balance and related quantities from the 8200 km2 Austfonna ice cap. Annual field measurements have been performed since 2004, predominantly based on project funding. Here, we present results from this work concerning the state of balance of the ice cap and its inter-annual variability along with observations of an ongoing dynamic instability of one of the ice cap's largest outlet glaciers (Basin-3).

We discuss Austfonna in the context of Pan-Svalbard and show that due to its size and dynamical activity, Austfonna is a major player in the pan-Svalbard mass balance.

Based on our work using a numerical weather forecast model (WRF) as well as an intermediate complexity model (ICM), we further demonstrate the significance of Austfonna mass balance monitoring for assessing the Pan-Svalbard glacier mass balance.

Title	**Ny-Ålesund atmospheric boundary layer**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	O+P

Due to the complexity and heterogeneity of the Kongsfjord environment several additional small-scale and micrometeorological effects like near surface external gravity waves (Jocher et al 2012), flux dependency on prevailing synoptical regime (Jocher et al 2014), disturbed temperature profiles (Lüers & Barreis 2012), occurrence of very low surface based inversions and strongly varying boundary layer height (Schulz 2012) and high temporal variability of the horizontal wind-field (Burgemeister 2013) are present in comparison to the undisturbed arctic boundary layer over the arctic ocean. These effects influence each measurement site with focus on boundary layer in a different way what complicate the comparability and representativeness of the different scientific stations around the village Ny-Ålesund. A comparison of several meteorological data sets acquired from 03th Oct. 2013 to 2th Oct. 2014 at five different sites around Ny-Ålesund illustrates high differences of the local wind fields, near surface temperature and humidity variability. Especially the weather station on the old pier which was installed in autumn 2013 by the AWI make it now possible to quantify the effect of the open fjord to the local atmospheric boundary layer which significantly influences wintertime temperatures due the energy input of the open water.

Furthermore heterogeneities of the active soil layer result in site and therefor footprint depending turbulent flux characteristics which will be shown with summertime data from two eddy covariance stations installed close to Ny-Ålesund and at Bayelva.

The results of these comparisons illustrate the need of comprehensive synthesis of the different measurements to increase the understanding of the local Kongsfjord system which is indispensable for Pan-Svalbard research topics and comparison studies like NICE.

The aim of this talk is to push forward the collaboration with other boundary layer projects in the Kongsfjord region. For this reason AWI conducted summertime field campaign in Ny-Ålesund during July 2015 to identify research gaps and develop long-term strategies.

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Title	**Lidar Observations of Tropospheric Aerosols and Clouds over Ny-Aalesund**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	O

The information on spatial distributions or microphysical properties of aerosols and clouds is crucial for the studies on the climatic impacts of the aerosols and their indirect effect. Ground based lidar is an instrument that can provide the information continuously. Observations of tropospheric aerosols and clouds by Mie/depolarization lidar have been made for more than a year at Ny-Aalesund since March 2014 by using a pulsed Nd:YAG laser and its wavelengths 1064 nm and 532 nm. The backscattering coefficients at these two wavelengths, and depolarization ratio at 532nm of aerosols and clouds are obtained by the lidar observations. Figure shows the results of aerosols for more than a year. Fig. (a) shows the mean backscattering coefficient of aerosols (BC) at 532 nm, and (b) shows mean particle depolarization ratio of aerosols (PDR) at 532 nm in 1 km intervals (0.4 km for the lowest height interval) to 5 km in altitude since March 2014 to May 2015. There is a maximum in BC (Fig. (a)) at spring as indicated by previous studies on Arctic aerosols. In our results, in addition, there is another maximum at autumn in PDR (Fig. (b)). The second maximum at autumn is also found in color ratio (BC at 1064 nm divided by BC at 532 nm, not shown).

The clouds are also observed by cloud radar, which is operated near the lidar system by Chiba University. The microphysical properties of clouds and their relation with aerosols are going to be studied by using both lidar and radar simultaneously.

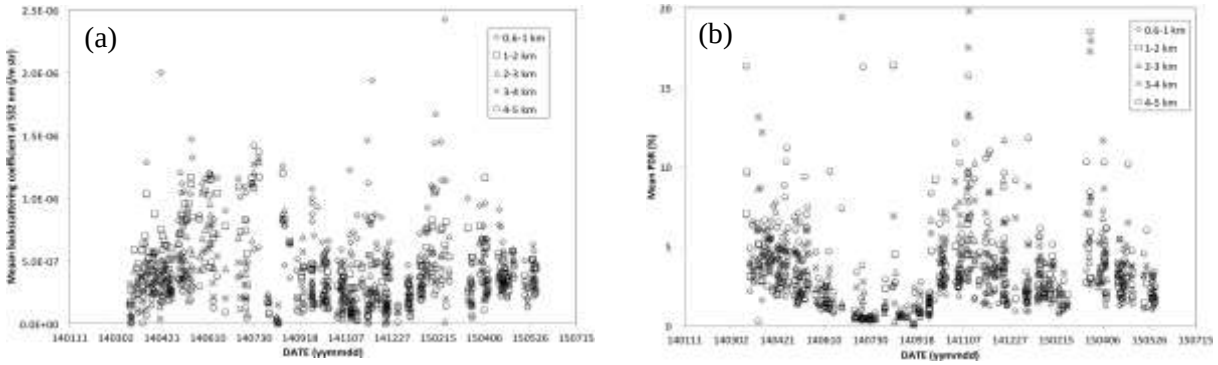

Figure (a) Mean BC at 532 nm in /(m str) , (b) Mean PDR at 532 nm in %

Title	**A case study on microphysical characteristics of Arctic clouds based on simultaneous measurements with a polarized Micro-Pulse Lidar and a 95-GHz Cloud Radar at Ny-Ålesund, Svalbard**

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Included in session	AS

Presentation preference (O=oral, P=poster)	O

Ground-based active and passive remote-sensing measurements for clouds using Micro-Pulse Lidar (MPL), All-Sky Camera and Sky-Radiometer have been conducted in Ny-Ålesund, Svalbard (78.9˚N, 11.9˚E) on a long-term basis since early 2000's. Further in addition, several new measurements have started with a polarized MPL (PMPL, Sigma Space MPL-4-Pol) in August 2013 and a 95GHz FMCW Doppler Cloud Radar (FALCON-A, developed by Chiba University) in September 2013 for cloud microphysics and phase classification, and a dual frequency microwave radiometer in June 2014 for precipitable water and liquid water path. In this paper, results from preliminary analyses with simultaneous lidar-radar measurements will be presented in regard to microphysical properties of Arctic clouds observed at Ny-Ålesund (e.g., Fig. 1).

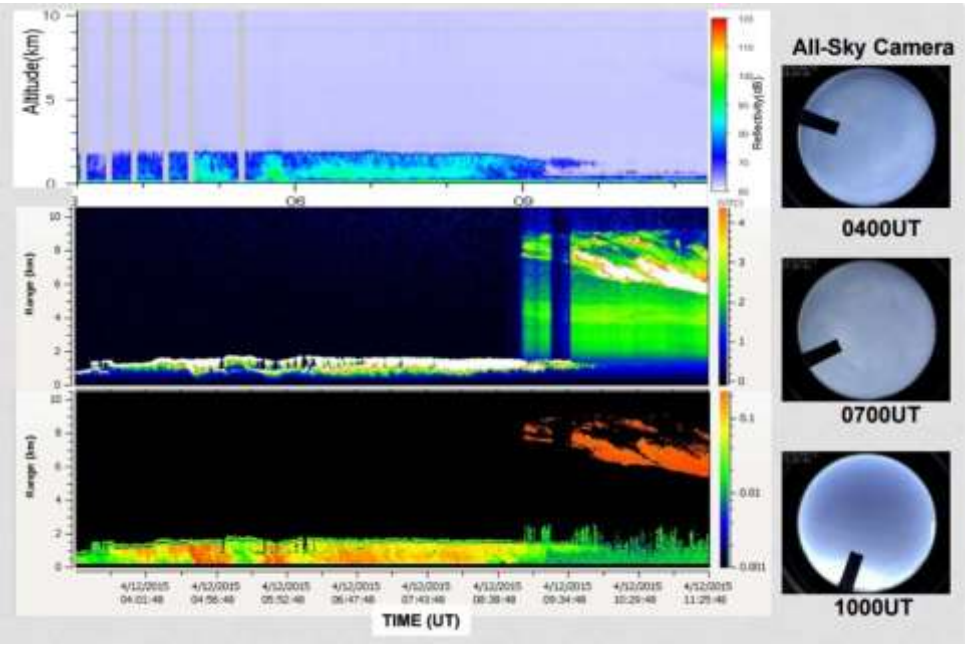

Fig. 1 An example of simultaneous measurements with the cloud radar (FALCON-A), polarized MPL (PMPL) and all-sky camera for stratus and cirrus observed on 12 April 2015 at Rabben Station in Ny-Ålesund. Top left: FALCON-A measured cloud reflectivity at 95 GHz. Middle left: PMPL measured relative backscatter at 532 nm. Bottom left: depolarization ratio from PMPL. Right panels show all-sky images for 0400UT (top), 0700UT (middle) and 1000UT (bottom) on the day, respectively.

Title	**Hygroscopicity and cloud forming properties of Arctic aerosol during one year**

Author's full name	Sanna Silvergren[3], Ulla Wideqvist[2] , Johan Ström[2], Staffan Sjögren[1], and Birgitta Svenningsson[1]
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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

The Arctic aerosol has a strong seasonal variation in terms of number concentration. During the Arctic haze from February to May, aerosol numbers increase significantly. When the sunlight returns and the precipitation start, a period of cleaner air begins which lasts until fall. Long-term aerosol measurements of hygroscopicity and cloud forming properties are scarce in the Arctic region. Previous campaign studies suggest that local production of organic rich aerosol particles occur during the summer (Leck *et al,* 2002) and model calculations have indicated that these could be important for cloud droplet formation (Lohmann and Leck, 2005). A relationship between the number of CCN and aerosol sulphate content have been shown by Bigg and Leck (2001). In addition, ice nuclei concentrations influence the CCN concentration (Lance *et al,* 2011).

We are now presenting the chemical composition, hygroscopicity, CCN activity of aerosols collected at the Zeppelin station during one year.

From September -07 to August -08 twelve filters were collected with a high-volume sampler (PM10 cut-off) at the Zeppelin station, located at 474 m above sea level on Svalbard's west coast, a site that has been assessed as virtually free from local, anthropogenic particle emissions. The chemical composition was assessed from additional small filters with OC/EC analysis and ion chromatography (IC). The results are shown in figure 1. The water-soluble fraction was extracted and analyzed with respect to the ability to interact with sub- and supersaturated water vapor. For this we used a Hygroscopic Tandem Differential Mobility Analyser (H-TDMA) coupled with one or two Cloud Condensation Nuclei Counters (CCNC).

The kappa values derived from averaged CCNC measurements in figure 2 show that the cloud forming properties vary during the year. The fall aerosol particles are clearly more efficient CCN than the spring aerosol. Both are periods dominated by accumulation mode particles in number concentrations. The summer months have size distribution shifted to Aitken mode and these particles are slightly more favourable as CCN than spring aerosol of same size.

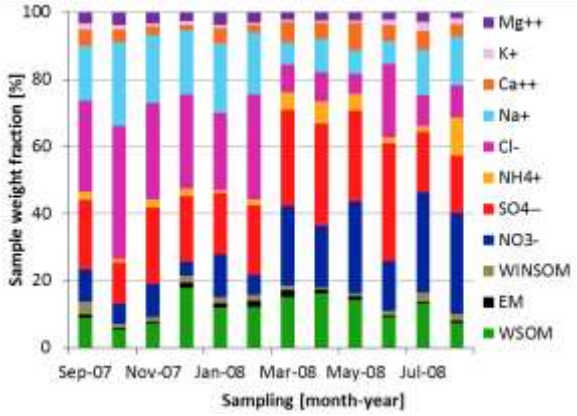

Figure 1. Chemical composition of Arctic aerosol.

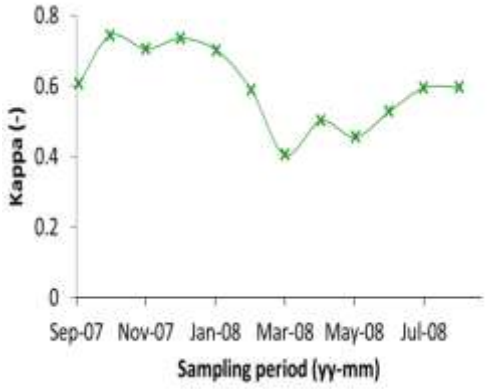

Figure 2. Annual CCN properties (preliminary results).

To investigate whether the statement that sulphate and/or organics are important for the CCN population is consistent with our results we plotted the relative amount of aerosol constituents against the kappa values. Sulphate, nitrate and ammonium had a weak negative correlation while sodium and chloride rich aerosol resulted in better CCN properties. It is not surprising that sodium chloride is efficient as CCN and is important to note that it is found mainly in coarse particles. However, in contradiction to previous findings no correlation between organic content and CCN efficiency was seen and more unexpectedly magnesium showed a slight positive correlation to the kappa value.

In addition to these results, the kappa values derived from growth factors at 90% relative humidity and a closure between chemical composition and hygroscopicity and CCNC will be presented.

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Title	**Seasonal diversity in bacterial sequences retrieved from water samples of Kongsfjorden, Svalbard, Norway**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	KS

Presentation preference (O=oral, P=poster)	O

The high-latitude Kongsfjorden (79°N), situated at the west coast of the Svalbard Archipelago, represents a unique site for seasonal studies of the marine ecosystem in the European Arctic. Temporal variation (June and October 2012) in structure and diversity of bacterial communities of the inner zone of Kongsfjorden was studied through phylogenetic analysis. Clone libraries of 16S rRNA gene fragments were constructed using environmental DNA collected from the depth showing high autotrophic biomass (30 m). The 16S rRNA gene sequences obtained for June were affiliated to Gammaproteobacteria (42%), Alphaproteobacteria (37%), Bacteroidetes (19%) and Verrucomicrobia (2%). In October, Alphaproteobacteria (84%) was the dominant class followed by Gammaproteobacteria (10%) and Bacteroidetes (6%). Most members of Alphaproteobacteria, Gammaproteobacteria, Bacteroidetes and Verrucomicrobia were closely related to environmental clone sequences from polar ocean/fjord environments. All sequences affiliated to Alphaproteobacteria belonged to the SAR 11 clade pointing towards significance of this globally ubiquitous group in the fjord water. Sequences affiliated to the phylum Verrucomicrobia were found exclusively in the month of June suggesting the availability of polysaccharides containing algal exudates during this season. The bacterial richness in June (Chao1: between 9.0 and 22.9) was higher than in October (Chao1: 4) as revealed by rarefaction analysis and the Chao1 richness estimator. Similarly, Shannon biodiversity indices in June (between 1.7 and 2.2) were higher than in October (between 0.8 and 1.2). Pairwise comparison of the clone libraries indicated that the structural differences in the bacterial community of June and October were statistically significant ($p < 0.01$), thus suggesting that the bacterial community varied over time and appeared to be affected by glacial meltwater composition. Despite these differences, our data also support the theory that a common core group of bacterial community exist within a variety of marine realms of polar habitats.

Title	**The trend analysis of the UV measurements at Polish Polar Station, Hornsund, 77° 00' N, 15° 33' E) for the period 1996-2014**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	PS

Presentation preference (O=oral, P=poster)	O

The erythemal UV measurements at Hornsund were carried since 1996 up to 2001 by the SL biometer and since 2005 up to now by the Kipp and Zonen biometer. To estimate instrument sensitivity decrescence, due to its aging, the UV data have been homogenized by a comparison of the observed erythemal dose rates taken during clear-sky days in spring with the hypothetical ones based on the radiative model simulations. The following input data were used for the calculation of correction factor: daily values of total ozone (from NOAA satellite observations), aerosol optical depth (from ground based observations by the CIMEL instrument), and prescribed seasonal values of snow albedo (monotonically decreasing values between 0.6 in early spring up to 0.3 in the mid June). The trend analysis of the monthly means of UV Index and the monthly mean daily doses for the period 1996-2014 shows statistically significant positive trends (about 1-2% per year) in the UV index in July, August and September whereas the negative trends in the daily doses (about –1% per year) are found in May, June and July. The maximum UV index and daily dose reached ~3.5 and ~3000 J/m^2 in late spring for the period 1996-2014, respectively. UV index over 3 was found every late spring for a few days in that period.

Title	**Estimation of sub-ice melting during winter time in Pedersenbreen, Svalbard**

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Presentation preference (O=oral, P=poster)	O

Svalbard-type glaciers, also called polythermal glaicers, are still melting inside during the winter time. The water runoff from the polythermal glacier usually refreeze into ice. So some ice-ponds can be seen in front of the glaciers in Spring time. There is a tipical ice-pond appeared every Spring in front of Pedersenbreen, Svalbard (Fig.1 left). Obviously this ice-pond represents the water runoff from the sub-ice melting inside Pedersenbreen. Once the volume of these ices is calculated, the amount of sub-ice melting in the winter time can be inferred.

In April 2014, a RTK-GPS measurement was carried out around the ice-pond in front of Pedersenbreen (Fig.1 right). From which the area of the ice-pond was calculated into 0.0787 km^2, and the perimeter was 1.343 km at that time. The total area of Pedersenbreen is 6.2 km^2 at the same period, so we can infer that the mean net mass loss is about 2.4~3.6 cm in the winter time, assuming the mean ice thickness of the ice-pond at 2~3 m. While the average net mass balance of Pedersenbreen is about -0.32 m per-year between 1990 and 2009, the sub-ice melting is contributing probably 15% or more in the net mass balance of a whole year. With the future high precise measurement of sub-ice-pond topography, the contribution of the sub-ice melting will be calculated more accurately.

Fig. 1 the ice-pond in front of Pedersenbreen (left) and its scope measured with RTK-GPS(right)

Title	***Methylobacter tundripaludum* SV96; a methane filter in the Arctic environment and a model organism for Arctic adaptation.**

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Presentation preference (O=oral, P=poster)	P

Terrestrial permafrost soil ecosystems in the Arctic are major carbon storages and natural green house gas sources globally. Methane oxidizing bacteria (MOB) are ubiquitous in terrestrial, marine, and freshwater ecosystems and constitute the largest biological CH_4 sink. In high-Arctic regions the genus *Methylobacter* (gammaproteobacteria) and in particular the species *M. tundripaludum* is a biological CH_4 filter. *M. tundripaludum* was originally isolated from Arctic peat soil in Ny-Ålesund, Svalbard and is currently the only published high-Arctic MOB in pure culture. It has been shown to be the dominating active MOB in the Svalbard peatland soil by molecular studies. It has a circumpolar distribution and is present in different low temperature environments. All these data point to the ecological importance of *Methylobacter*. We will present data from our studies of *M. tundripaludum* including isolation and cultivation, ecosystem presence, CH_4 oxidation capacity related to temperature and CH_4 concentration, and temperature adaptation of cell metabolism.

Title	**Environmental pollution impact on radiation properties of snow cover (Barentsburg area)**

Author's full name	P. Sviashchennikov[1,2], Ivanov B.[2,1], Yrazgildeeva A.[1,2], Kurochkin Y.[1], Chistyakov K.[1], Divin D.[3], Hudson S.[3]
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Included in session: PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium	PS or AS

Presentation preference:	O

The value of the albedo of snow, glacier and sea ice surface is associated with the texture and structure of the surface layer of snow cover, the peculiarities of the vertical redistribution of contaminations in this layer (mineral or organic particles of various concentrations, the size and shape) and temperature/radiation regime of the atmosphere surface layer. Identifying links with the albedo characteristics of natural and anthropogenic contamination is very important. For example, the results of mathematic modeling the evolution of ice sheets, sea ice and snow cover demonstrate the high sensitivity of the model to this parameter. Original results in the framework of this problem were obtained by researches from AARI, NPI and SPbSU during the 2008-2013 years on Svalbard in the vicinity of the Russian mining settlement Barentsburg. Information on the impact of cloud and snow cover contamination conditions on the characteristics of the reflection spectrum and penetrates deep into the snow cover short-wave radiation were obtained.We present original results showing the relationship of "albedo-contaminations" and the influence of anthropogenic factors. The estimation of solar radiation that penetrates deep into the snow, and the impact of contamination on its redistribution in the snow thickness were obtained. Climatic system in polar areas is the most sensitive to external impacts, including anthropogenic factors. At present Russian and foreign climatologists actively discuss the problem of current global warming and possible reasons for this phenomenon. According to the opinion of some part of scientists the main reason for current warming is the concentration of carbon dioxide in the atmosphere constantly growing due to the burning of hydrocarbon fuel. The high content of anthropogenic aerosols in the vicinity of large industrial objects leads to a direct effect on the radiation balance of the underlying surface. However, the anthropogenic impact on the climatic system connected with mining and burning of mineral coal significantly impacts the fluxes of short-wave and long-wave radiation which causes significant climatic changes which occur both in the immediate proximity of the pollution source and at various distances. The Russian mining settlement of Barentsburg serves an example of such impact. Coal mining started there in 1931, and has been going till the present time with the interruption due to the World War II. As a result of industrial activity a large quantity of aerosols enters the atmosphere in the form of soot generated by thermal power plant operation and coal particles blown away from coal stockpiles (open type of storage) and piles of rock located in the immediate proximity of the settlement. Afterwards these particles settle on the snow surface causing the penetration of a large amount of carbon particles into the depth of the snow cover. On Svalbard high black carbon content in snow is common for the areas in the vicinity of mining settlements (Forsström et al., 2009; Aamaas et al., 2011; Sviashchennikov et al., 2013). There is a decrease in atmospheric transparency, reduction of surface albedo, changing the solar radiation penetrating deep into the snow cover (Gerland et al., 1999). Thus, the radiation balance of the underlying surface changes significantly due to the anthropogenic impact.

Title	**Reconciling aerosol light extinction measurements from spaceborne lidar observations and in situ measurements in the Arctic**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	AS

Presentation preference (O=oral, P=poster)	P

In this study we investigate to what degree it is possible to reconcile continuously recorded particle light extinction coefficients derived from dry in situ measurements at Zeppelin station (78.92N,11.85 E; 475m above sea level), Ny-Ålesund, Svalbard, that are recalculated to ambient relative humidity, as well as simultaneous ambient observations with the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) aboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite. To our knowledge, this represents the first study that compares spaceborne lidar measurements to optical aerosol properties from short-term in situ observations (averaged over 5 h) on a case-by-case basis. Finding suitable comparison cases requires an elaborate screening and matching of the CALIOP data with respect to the location of Zeppelin station as well as the selection of temporal and spatial averaging intervals for both the ground-based and spaceborne observations.

Reliable reconciliation of these data cannot be achieved with the closest-approach method, which is often used in matching CALIOP observations to those taken at ground sites. This is due to the transport pathways of the air parcels that were sampled. The use of trajectories allowed us to establish a connection between spaceborne and ground-based observations for 57 individual overpasses out of a total of 2018 that occurred in our region of interest around Svalbard (0 to 25 E, 75 to 82 N) in the considered year of 2008. Matches could only be established during winter and spring, since the low aerosol load during summer in connection with the strong solar background and the high occurrence rate of clouds strongly influences the performance and reliability of CALIOP observations. Extinction coefficients in the range of 2 to 130Mm-1 at 532nm were found for successful matches with a difference of a factor of 1.47 (median value for a range from 0.26 to 11.2) between the findings of in situ and spaceborne observations (the latter being generally larger than the former). The remaining difference is likely to be due to the natural variability in aerosol concentration and ambient

relative humidity, an insufficient representation of aerosol particle growth, or a misclassification of aerosol type (i.e., choice of lidar ratio) in the CALIPSO retrieval.

Reference: Tesche, M., Zieger, P., Rastak, N., Charlson, R. J., Glantz, P., Tunved, P., and Hansson, H.-C.: Reconciling aerosol light extinction measurements from spaceborne lidar observations and in situ measurements in the Arctic, Atmos. Chem. Phys., 14, 7869-7882, doi:10.5194/acp-14-7869-2014, 2014.

Title	Springtime atmospheric chemistry of Ny Ålesund, Svalbard

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Included in session	AS

Presentation preference (O=oral, P=poster)	P

Photochemical processes and heterogeneous reactions significantly influence the springtime tropospheric chemistry of Arctic region. To better understand these processes, a snapshot campaign was conducted during the 2012 spring in Ny Ålesund through simultaneous collection of trace gases (NO_2, HCl, SO_2, PAN) and aerosols. Air measurements were carried out using Denuder and filter system at the Gruvebadet research facility, situated nearly 1.5 km south of the Ny-Ålesund village. The study of major ions (Na^+, Mg^{2+}, Ca^{2+}, NH_4^+, SO_4^{2-},Cl^-, NO_3^-) was carried out using an ion chromatograph. Among the gaseous species, PAN (org-nitrate), which is regarded as a source species in Arctic, showed the highest average mixing ratio of 35.5 pmol/mol, whereas the gaseous HCl accounted for lowest average (7.3pmol/mol). In comparison to the HNO_3 (sink species), major dry deposition was through particulate nitrate (pNO_3^-) with mean mixing ratio of 147.5 pmol/mol, which formed the primary source of snow nitrate. The concentration of pNO_3^- was three times higher than the values observed by its gaseous precursors, HNO_3, NO_2 and PAN indicating the interaction of these precursor species with the aerosols. This interaction probably enriched the aerosol mass with NO_3^-, which constituted 36.8% of total aerosol mass, followed by NH_4^+ which constituted 15.3%. The molar ratio for pNO_3/HNO_3 was the highest, followed by pNO_3/PAN ratio, indicating that the particulate nitrate was mostly formed by the reaction between HNO_3 and aerosols. The aerosols were NH_4^+-rich and completely neutralized, resulting into alkaline conditions. These alkaline aerosols and the prevailing high humidity conditions favored the uptake of HNO_3 in sea salt aerosols with the subsequent release of HCl, leading to the formation of ammonium nitrate aerosols over ammonium sulphate. Principal Component Analysis of the data indicated that three major factors influenced the phase transformations of nitrogen species between the aerosols and precursor gases. The first factor was the sea salt influence on the heterogeneous reactions of aerosols releasing HCl, the second factor being the oxidation of HNO_3 to form NO_3^- and the third factor was the thermal decomposition of PAN. The present observations indicate that the chemistry of the Polar Regions, although "cleaner", is nonetheless extremely complex and the role of meteorological conditions in influencing various reactions could be significant.

Keywords: aerosols, trace gases, interaction, heterogeneous reactions, arctic

Title	Cryosphere monitoring in the Austre Lovénbreen basin

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	G

Presentation preference (O=oral, P=poster)	O

Located about 6km southeast of Ny-Ålesund, the small basin of the Austre Lovén glacier has been studied since the foundation of Corbel station in the 1960's. Until recently these research efforts proved rather discontinuous even though they allowed for a better knowledge of the field and provided a long history of data in times when it was scarce. Since 2006, a renewed effort by a team comprising researchers from different disciplines is undergoing. Steps were taken to increase links with other teams working in the area, and applications were recently filled to register this study site in 2 long term monitoring networks in glaciology and hydrology.

Classic monitoring protocols were established and are now maintained in order to measure the glacier's mass balance through an ablation stakes network. An automatic weather station was set up high in the basin. In addition over the course of the years, more specific experimentations were conducted. A network of automatic cameras covering most of the glacier area was established. 20 automatic temperature loggers were deployed on the glacier itself. DGPS and GPR (Ground Penetrating Radar) campaigns were conducted yielding accurate digital elevation models (DEM) of the glacier and a precise mapping of its bedrock. Comparisons of DEMs have been made with data acquired by Chinese teams allowing for a comparison of the glacier surface evolutions. Over the last few years, terrestrial laser scanning (TLS) was used to generate high-accuracy surface models in hardly accessible areas such as the steep slopes surrounding the glacier basin. Spring and summer data acquisition grant the possibility to compute seasonal snow volumes and year to year comparisons reveal rock movements. Outflows of the basin are monitored with 2 automatic gauging stations and permafrost related hydrology is observed in the moraine with 8 boreholes. The most recent developments were aiming at using photogrammetry methods to derive surface models with simple camera pictures. It was done with pictures taken from the ground or from a camera hanging from a kite.

Mass balance results over the last 7 years show a global negative trend. 2011 and 2013 were extreme years with negative mass balances exceeding a meter in water equivalent. A lack of winter accumulation seems to be the main driving factor of such years. Conversely, 2014 was the first slightly positive year, which can mainly be attributed to a thick snow cover in spring, especially in the ablation area, and to a fairly dry and rather cold summer.

Title	**Metabolic and trophic interactions modulate methane production by Arctic peat microbiota in response to warming**

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Presentation preference (O=oral, P=poster)	O

Arctic permafrost soils store large amounts of soil organic carbon (SOC) that could be released into the atmosphere as methane (CH_4) in a future warmer climate. How warming affects the complex microbial network decomposing SOC is not understood. We studied CH_4 production of Arctic peat soil microbiota in anoxic microcosms over a temperature gradient from 1 to 30 °C, combining metatranscriptomic, metagenomic, and targeted metabolic profiling. The CH_4 production rate at 4 °C was 25% of that at 25 °C and increased rapidly with temperature, driven by fast adaptations of microbial community structure, metabolic network of SOC decomposition, and trophic interactions. Below 7 °C, syntrophic propionate oxidation was the rate-limiting step for CH_4 production; above this threshold temperature, polysaccharide hydrolysis became rate limiting. This change was associated with a shift within the functional guild for syntrophic propionate oxidation, with Firmicutes being replaced by Bacteroidetes. Correspondingly, there was a shift from the formate- and H_2-using Methanobacteriales to Methanomicrobiales and from the acetotrophic Methanosarcinaceae to Methanosaetaceae. Methanogenesis from methylamines, probably stemming from degradation of bacterial cells, became more important with increasing temperature and corresponded with an increased relative abundance of predatory protists of the phylum Cercozoa. We concluded that Arctic peat microbiota responds rapidly to increased temperatures by modulating metabolic and trophic interactions so that CH_4 is always highly produced: The microbial community adapts through taxonomic shifts, and cascade effects of substrate availability cause replacement of functional guilds and functional changes within taxa. However, the fate of the produced CH_4 relies on the response of CH_4 oxidizing bacteria. *Methylobacter tundripaludum* was first isolated from Solvatn, Ny-Ålesund, but have later been confirmed to be the dominating CH_4 oxidizing bacterium in a range of Arctic wetland, tundra, lake and sub-glacial sediment ecosystems in Svalbard, Canada, Siberia and Greenland. Our preliminary results show that these organisms are remarkably flexible, responding rapidly to increased temperatures and CH_4 concentrations by substantially enhanced growth and oxidation. Thus, this species holds the promise to balance the expected increase in CH_4 production at elevated temperatures by oxidizing it to CO_2.

Title	**Insights from size distribution and chemical composition of aerosol collected at Ny Alesund during the 2010-2014 spring-summer campaigns.**

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Included in session	AS

Presentation preference (O=oral, P=poster)	O

The evaluation of the effects of the polar aerosol on the feedback processes between climate forcings and environmental responses is affected by a large uncertainty, yet. Main uncertainties include the relative cloud/snow surface albedo and the scarce spatial coverage of size distribution and chemical composition of aerosol at high latitudes. In order to improve our knowledge on the atmospheric load and chemical composition of Polar aerosol, several measurements and sampling campaigns were carried out both in Antarctica and in the Arctic since 2005. In particular, in the Arctic, since 2010 to present, a continuous all-year-round PM10 sampling campaign is ongoing at Thule (North Greenland) and spring-summer campaigns (March to September) were annually carried out at Ny Alesund (Svalbard Islands, Norway; 78°56' N, 11°56'E; 50 m a.s.l.). In the latter site, aerosol was collected by several systems (PM10 samplers, multi-stage impactors (4- and 12-stage Dekati samplers)) and on different substrates (Teflon filters, quartz filters, polycarbonate and Teflon membranes). Besides, shorter measurement and sampling campaigns were carried out by using a tethered balloon, up to about 1.000 m altitude, in order to study the effect of the PBL dynamics on the aerosol atmospheric load and chemical composition. Chemical analysis includes: ions composition (inorganic anions and cations and selected organic anions, including light carboxylic acids and MSA), elemental composition (by PIXE analysis), main and trace metals (including Rare Earth Elements - REEs, by ICP-HR-MS), Pb isotopic ratios (by ICP-QMS) and Elemental/Organic Carbon fractions (EC/OC, by Sunset thermo-optical analysis). Besides, continuous measurements of particle size-distribution (TSI-SMPS and TSI-APS; 6 nm – 20 um; 10 min resolution) and Black Carbon (by Particle Soot Absorption Photometry – PSAP) were carried out during the sampling periods. Specific chemical markers (such as REEs elements for dust, MSA for biogenic emissions, selected heavy metals for local and long-range anthropic sources), Positive Matrix Factorization (PMF) statistical analysis and Back-Trajectory Cluster Analysis were used in order to identify possible aerosol source areas and to evaluate reliable source apportionment. The most relevant results are here shown, with particular attention to: 1. nucleation (by SMPS measurements) and long range transport (by APS measurements) events; 2. intra- and inter-annual trends of the most relevant markers for anthropogenic and natural sources; 3. Characterization of long-range or local dust deposition; 4. evidences of phytoplanktonic blooms by specific marine biogenic markers; 5. reconstruction of the different contributions (anthropogenic, sea spray, crustal, biogenic) to the sulphate budget.

Title	**Modelling the long-term mass balance and firn evolution of glaciers around Kongsfjorden, Svalbard**

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Included in session (KS=Kongsfjorden System; G=Glaciology; TE=Terrestrial Ecology; PS=Ny-Ålesund research in a Pan-Svalbard perspective; AS=Atmosphere Symposium)	G

Presentation preference (O=oral, P=poster)	P

We analyze the long-term (1961−2012) distributed surface mass balance and firn evolution of the Kongsvegen and Holtedahlfonna glacier systems near Ny-Ålesund, in northwestern Svalbard. We couple a surface energy balance model to a firn model, with forcing provided from regional climate model output. In situ observational data are used to calibrate model parameters and validate the output. The simulated area-averaged surface mass balance for 1961−2012 is slightly positive (0.08 m w.eq. yr^{-1}), which only fractionally compensates for mass loss by calving. Refreezing of percolating water in spring/summer (0.13 m w.eq. yr^{-1}) and stored water in fall/winter (0.18 m w.eq. yr^{-1}) provides a buffer for runoff. Internal accumulation, i.e. refreezing below the previous year's summer surface in the accumulation zone, peaks up to 0.22 m w.eq. yr^{-1}, and is unaccounted for by stake observations. Superimposed ice formation in the lower accumulation zone ranges as high as 0.25 m w.eq. yr^{-1} . A comparison of the periods 1961−1999 and 2000−2012 reveals 21% higher annual melt rates since 2000 and a 31% increase in runoff, which can only in part be ascribed to recent warmer and drier conditions. In response to firn line retreat, both albedo lowering (snow/ice albedo feedback) and lower refreezing rates (refreezing feedback) further amplified runoff.

Title	IASOA: International Arctic Systems for Observing the Atmosphere

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Presentation preference (O=oral, P=poster)	P

IASAO is an international group that advances coordinated and collaborative research objectives from independent pan-Arctic atmospheric observatories through (1) strategically developing comprehensive observational capacity, (2) facilitating data access and usability through a single gateway, and (3) mobilizing contributions to synergistic science and socially-relevant services derived from IASOA assets and expertise. Observatories that are participating in IASOA are Alert, Barrow, Cherskii, Eureka, Ny-Alesund, Oliktok Point, Pallas, Sodankyla, Summit, Tiksi, and Villum. This poster will explain the mission of IASOA and various activities that this group has undertaking to advance Arctic atmospheric science. These activities include the creation of a comprehensive data portal and the organization of groups devoted to synergistic research efforts in aerosols, atmosphere-surface exchanges, surface energy/radiation balance, clouds, trace gases, and regional science.

Title	**Modelling snow ice and superimposed ice on landfast sea ice in Kongsfjorden, Svalbard**

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Presentation preference (O=oral, P=poster)	P

Snow ice and superimposed ice formation on landfast sea ice in a Svalbard fjord, Kongsfjorden, is investigated with a high resolution thermodynamic snow and sea ice model (HIGHTSI), applying meteorological weather station data as external forcing. It is shown that sea ice formation occurs both at the ice bottom and at the snow/ice interface. Modelling results indicated that the total snow ice and superimposed ice which form at the snow/ice interface is about 14 cm during the simulation period, accounted about 15% of the total ice mass and 35% of the total ice growth. Introducing a time dependent snow density improves the modelled results, and a time dependent oceanic heat flux parameterization yields reasonable ice growth at the ice bottom. The weather conditions, in particular air temperature and precipitation, as well as snow thermal properties and surface albedo are the most critical factors for the development of snow ice and superimposed ice in Kongsfjorden. While both warming air and higher precipitation lead to increased snow ice and superimposed ice forming in Kongsfjorden, the processes are more sensitive to precipitation than to air temperature.

Title	**Automatic detection of snow avalanches on Svalbard using satellite-borne radar remote sensing**

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Included in session	TE
Presentation preference	O

The infrastructure and people living and travelling in an around Svalbard's main settlement area Nordenskiöld Land are directly affected by both naturally and artificially triggered avalanches. Avalanche research is needed to get a profound understanding of the avalanche activity in space and time and is of great value for avalanche warning services. As the mountainous Archipelago of Svalbard experiences almost four months of polar night during winter, satellite-borne radar remote sensing is an applicable technique to identify avalanches (Fig. 1) as it is weather and light independent. The increased surface roughness of the avalanche debris fields cause an increased backscatter signal making the avalanches detectable in these images (Fig. 2). Though, performing manual detection can be very time-consuming.

We designed a method to automatically detect avalanche debris fields in RADARSAT-2 UF mode images, as well as in the recently launched Sentinel-1A EW swath mode images. RADARSAT-2 acquires images with high spatial resolution (3*m*) and low temporal resolution (every 24 days), whereas Sentinel-1A obtains images with low spatial resolution (40*m*) in EW mode, high temporal resolution (twice per day) and a repeat period of 12 days. By applying a threshold and filter on the difference in radar backscatter between an image acquired after the avalanche and a reference image, avalanche debris fields are successfully located. The results can in the future be used for operational avalanche monitoring or map frequency and locations where avalanches occur (Fig. 3). The Sentinel-1A EW mode, which is the preferred mode for Svalbard, is not as well suited as Sentinel-1A IW mode, but our study shows that it can be used to detect large avalanches.

Figure 1: Slab avalanche at Lindholmhøgda, Svalbard – March 20th, 2015.

Figure 2: RADARSAT-2 UF mode image from 2013.06.10 at Dryadrebreen, Svalbard. Showing a bright tongue-shaped feature consistent with an avalanche debris field.

Figure 3: Automatic detection applied on RADARSAT-2 UF mode images from 2013.06.10 and 2013.09.14. A threshold of 2.5*db*, followed by a filter to eliminate speckle is applied on the difference in backscatter of the two images.

Title	**Organophosphate flame retardants and plasticizers in air and snow of the Arctic**

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Presentation preference (O=oral, P=poster)	P

Organophosphate esters (OPEs) are used on large scale as additive flame-retardant agents, plasticizers or both in diverse products, such as application in plastic material, lubricants, and electronic goods. The annual European consumption of OPEs as FRs was 91.000 tons in 2006 (www.efra.com). The global consumption of OPEs amounted to 500.000 tons in 2011, and is expected to reach 680.000 tons in 2015. The broad application of OPEs and the fact that they are utilized as additives may result in their diffusive release into the environment by volatilization, leaching and abrasion. Studies in Europe, North America and Asia have reported the widespread occurrence of OPEs in wastewater(8-10), surface water(11-15), ground water and seawater. Recently, OPEs were measured in the atmospheric particles from the North Sea, Great lakes, the Mediterranean Sea, the Pacific transect and in the Arctic, indicating they may undergo medium or long range transport via atmosphere. The concentrations of OPEs were generally 2 to 3 orders of magnitude higher than those of brominated flame retardants in the air, highlighted the importance for further research on the global occurrence and environmental fate of OPEs in both source and remote regions.

In this work, we present the concentrations of OPEs in air and snow in Ny-Alesund (78°55'24"N, 11°55'15"E), the Arctic in 2012. Atmospheric particle dry deposition and wet deposition with snow into the Arctic are estimated for OPEs with their mean concentrations. This work demonstrates that several OPEs may belong to new generation of persistent organic pollutants which can settle down in the Arctic, and might be an emerging concern for the Arctic ecosystem.

Title	**The interannual change of cloud and the radiative contribution at Ny-Ålesand.**

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Included in session	AS

Presentation preference (O=oral, P=poster)	O

Downward radiative flux is important factor for climate change and the global warming. GCM predicted that the Arctic region is more sensitively to the global warming than tropic region (Washington and Meehl, 1989). Cloud is one of the important factor for surface radiative budget, however the knowledge is insufficient.

This study investigates the interannual trend of cloud and the contribution at Ny-Ålesand (78.925°N, 11.9300°E). The data of surface radiation budget, surface air temperature, temperature and moisture vertical profiles are observed as the Baseline Surface Radiation Network (BSRN; Ohmura et al., 1988). Cloud is estimated by the visual observation, all-sky imager by the National Institute of Polar Research (NIPR), the micropulse lidar (MPL) by the Micro Pluse Lidar Network (MPLNET), and CloudSat. The estimation method of all-sky imager is from Yabuki et al. (2014). We assumed that the cloud base is the altitude with the normalized relative backscattering (NRB) larger than 0.2. Surface radiative flux and cloud data are used with monthly mean. Radiative contribution of cloud (CRC) is estimated by the below formula [1].

$$CRC = \frac{F_{obs}^{all} - F_{cal}^{clear}}{F_{obs}^{all}} [\%], \quad [1]$$

F_{obs}^{all} is the observed surface radiative flux under all-sky condition. F_{cal}^{clear} is the calculated surface radiative flux assumed clear-sky condition. If CRC is positive, cloud warms the surface. The radiative transfer is calculated with mstrnX (Sekiguchi and Nakajima, 2007), which is a broadband two-stream approximation model. CRC is calculated at 11UTC because the vertical profiles of air temperature and humidity in radiative transfer model is retrieved by the radiosonde observation at around 11UTC. The accuracy of calculation is ensured by the comparison with observation under clear-sky, the correlation coefficient is larger than 0.99 and the RMSEs = -2.63±4.0 and -5.83±11.8 W/m^2 for downward longwave (L_d) and shortwave radiation (S_d), respectively.

Figure 1 indicates the interannual changes of the cloud base height (CBH) and cloud frequency (CF) estimated by MPL. CBH and CF indicate increasing and decreasing trends with 95% confidence level by Mann-Kendall rank correlation test, respectively. The interannual changes of CBH and CF are mainly caused in spring and summer season, respectively. Both trends are significantly in daytime. The trends of decreasing CBH and increasing CF are mainly caused of the interannual change of low clouds (defined as CBH lower than 2km). The interannual changes of CRC for L_d and S_d show weak decreasing and increasing trends, however the trends do not satisfy 95% confidence level. In the Arctic region, the increment of non-precipitating cloud and decreasing of precipitation cloud are reported (Eastman and Warren, 2010). It is suspected that the inverse trends of CRC to CBH and CF is caused of decreasing of precipitating cloud, which is optically thick and large contribution to surface radiative budget.

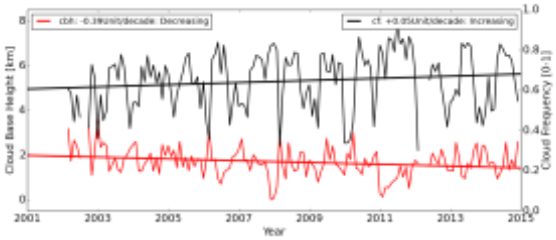

Fig. 1. The interannual changes of cloud base height (red) and cloud frequency (black).

Title	**Size resolved CCN concentration measurements in the Arctic – two case studies during summertime 2008**

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Presentation preference (O=oral, P=poster)	P

The Arctic region is one of the most vulnerable areas to climate change. To understand the atmospheric processes behind this vulnerability, measurement data are needed. Data describing the cloud formation potential are of particular interest, since the indirect effect of aerosols is still poorly understood in the climate system. In this paper we present for the first time size resolved cloud condensation nuclei (CCN) data obtained in the Arctic. The measurements were conducted during two periods in the summer 2008: one in June and one in August at the Zeppelin research station (78° 54' N, 11° 53' E) on Svalbard. Trajectory analysis showed that air masses originating from the Arctic dominated during the measurement period in June 2008 while the measurements in August 2008 were dominated by mid-latitude air masses. CCN supersaturation (SS) spectra obtained on the 27th of June before the size resolved measurements started and spectra from the 21st and 24th of August conducted before and after the measurements showed similarities between the two months. From the ratio between CCN concentration and the total particle number concentration (CN) as a function of dry particle diameter (D_p) at a SS of 0.4 %, the activation diameter corresponding to CCN / CN=0.50 (D_{50}) was estimated. D_{50} was 60 nm and 67 nm for the examined period in June 2008 and August 2008, respectively. To the D_{50} corresponding hygroscopicity parameter κ values were estimated to be 0.4 and 0.3 for June and August, respectively. These values can be compared to hygrosopicity derived estimated from bulk chemical composition, for which κ was calculated to be 0.5 for both June and August 2008. While the agreement is reasonable, the difference indicates a size-dependence in the particle composition and is likely explained by a higher fraction of sea salt in the bulk aerosol samples.

Title	**Aerosol physical and chemical properties measured during the 2014 iAREA campaign on Spitsbergen**

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Presentation preference (O=oral, P=poster)	O

Measurements of aerosol optical and chemical properties are of a great importance due to their high impact on climate change, which is mostly manifested in sensitive Arctic regions. Model results show that the annual mean temperature is expected to increase with the highest factor over polar latitudes as soon as within few decades.

A closure study of aerosol properties in the Arctic requires solving the discrepancies in measurement techniques, spatial and temporal resolution as well as hygroscopic growth of aerosols. Considering remote sensing and in-situ instruments, they apply optical or physical and chemical properties respectively resulting in measurements of different quantities which might be compared after transformation by means of theoretical equations or empirical parameterizations of data.

Among most recent studies performed in the Arctic on such aerosol issues are intensive field campaigns in 2014 and 2015 carried out under the iAREA project (Impact of Absorbing Aerosols on Radiative Forcing in the European Arctic), which was created in order to estimate the impact of absorbing aerosols on the Arctic atmosphere in Europe.

The 2014 field campaign was carried out in Ny-Alesund (78°55′N, 11°56′E) and Longyearbyen (78°13′N, 15°33′E) – towns located on Spitsbergen Island. Moreover, we used data from Polish Polar Station in Hornsund (77°00′N, 15°33′E) situated in the southern part of Spitsbergen.

During the campaign aerosol single scattering properties were provided with a few instruments which might be generally referred to as in-situ and remote sensing measurements. Regarding the first group: aethalometers, nephelometers, photoacoustics extinciometers as well as particle counters were operating. Furthermore, we included lidar, sun photometer data into the group of remote-sensing measurements.

During the campaign period a daily chemical weather forecast was provided. The on-line tropospheric chemistry model – GEM-AQ was used as a computational tool. Aerosols are modelled with a sectional module based on Gong et al. (2003) with 5 aerosol types: sulphate, black carbon, organic carbon, sea-salt and soil dust, size-segregated into 12 logarithmically spaced bins. The aerosol module includes parameterizations of nucleation, condensation, coagulation, sedimentation and dry deposition, in-cloud oxidation of SO2 and scavenging, and below-cloud scavenging of aerosol species by rain and snow.

Due to a low signal to noise ratio being a consequence of little values of the single scattering properties all data from in-situ measurements were averaged over 30 min. Taking into account the spatial variability Longyearbyen seems to exhibit higher levels of extinction, scattering, and absorption coefficient comparing to Ny-Alesund. It is likely to be connected with the coal mining as well as higher emissions regarding size of the town. Temporal variability of aerosol scattering and extinction coefficient in both stations indicates 3 event days with significant increase of extensive optical properties. We found that during these 3 events relative mass of the sulphates and water soluble particles were significantly reduced. However, taking into account the results of GEM-AQ model a high overestimation of aerosol concentration might be seen, where the average is equal to about 6 µg/m3 whereas in-situ measurements indicates mean value on a level of 1.8 µg/m3.

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