The Atmosphere Flagship Programme in Ny-Ålesund: Activities in 2016-17
A project description.

The application is prepared by **Christina A. Pedersen, Roland Neuber, Hans-Christen Hansson, Vito Vitale, Boris Ivanov and Grzegorz Karasiński**, from the Atmosphere Flagship Scientific Committee on behalf of the Ny-Ålesund Atmosphere Flagship Programme.

Description of relevance to SSF's strategic objectives

The Atmosphere Flagship programme is one of the four Ny-Ålesund flagship programmes identified and updated in the current Ny-Ålesund Science Plan, as adopted by NySMAC in September 2015. The main goal of the Atmosphere Flagship initiative is to coordinate the various atmosphere research and monitoring activities conducted by more than ten institutes in Ny-Ålesund. Most of the ongoing research work is complementary. Therefore, coordination of the research work, for example in the analysis and evaluation of the data has considerable potential. Thus this proposal aims at achieving scientific progress beyond the possibilities of the individual institutes by a closer coordination of the atmosphere research work already performed in Ny-Ålesund.

Relevance to existing and new collaborative networks/flagships (when relevant)

This application is building on previous Atmosphere Flagship activities and particularly it is following recommendations and agreements achieved at the Potsdam workshop in 2014 (SSF Grant 236782/E10) and the Atmosphere Symposium during the Ny-Ålesund week at the Fram Centre in Tromsø in September 2015 (SSF Grant 246733/E10). Institutes and scientists working in Longyearbyen, Barentsburg and Hornsund participated and contributed during both meetings.

Scientific justification

To facilitate and encourage the cooperation within the atmosphere flagship, the participants of the Symposium in Tromsø suggested forming smaller work groups focusing on specific scientific questions of common interest. It was widely agreed that the formation of such work groups needs to be transparent and participation in the groups will be open at any time to all researchers and research groups. New groups may also form over time, e.g. on topics not listed below, but included on the Atmosphere Flagship web page (http://nysmac.npolar.no/research/flagships/atmosphere.html). The following work groups are now prioritized:

WG1. Clouds, local – regional short term processes
WG2. Long-term observations and trends in temperature, precipitation, clouds and radiation
WG3. Boundary layer meteorology
WG4. Aerosols (black carbon) and snow, including snow albedo feedback
WG5. Atmospheric aerosols
WG6. Variability in surface UV irradiance and ozone column

Each of these work groups plans to organize at least one work group meeting in 2016 and/or 2017. More details on the work within each work group are given below. Anticipated outputs from the work group meetings are joint publications and jointly organized field work. During the next Ny-Ålesund Seminar, which is expected to be in 2017, the work groups will present progress and results.

Within the Atmosphere Flagship there is a strong interest to collect and make available meta data on ongoing monitoring as the accessibility of meta data will promote the exchange of data among sites and institutions, thus increasing the network character of the Atmospheric Flagship activity. The meta data will include links to the measurement data, how and where they are available. Within the Ny-Ålesund community and NySMAC there have already been work to establish such a meta data base, and Norwegian Polar Institute has developed a template that will be used. This meta data base will be compatible with the RiS portal, and could feed into systems that will be developed under SIOS.
In particular, there has been an initiative of gathering meta data of meteorological surface measurements in Svalbard (in and around Longyearbyen, Ny-Ålesund, Hornsund, Svea, Barentsburg, and Pyramiden, as well as in uninhabited regions).

The main anticipated and quantifiable output of this proposal is:

- Establishment of work groups focusing on specific scientific questions
- Several independent work group meetings in 2016 and 2017, and an overall symposium in fall 2017
- Planning and organization of joint field work
- Jointly published papers
- Establishment of an online meta data base for atmosphere data (as part of the planned Ny-Ålesund Monitoring meta data base)

By facilitating the interaction and exchange between the scientists in Ny-Ålesund in their ongoing research, monitoring, field experiments and data evaluation, the quality as well as the possibility to perform ground breaking research will be considerably enhanced.

Below follow short descriptions of the anticipated research work for the above mentioned work groups.

(1) Work group on clouds, local – regional short term processes
This work group focuses on three scientific questions concerning local and near regional processes affecting the formation and type of clouds, and their impacts, namely: (i) How does the local orography affect cloud formation and type?; (ii) What are the regional driving forces for cloud formation and type?; (iii) How does the aerosol affect the local and regional cloud formation?

Detailed observations of clouds and aerosols that are already being made from Ny-Ålesund and Zeppelin Observatory will be used together with an expanding network of meteorological observations from a range of surface types in the region around Ny-Ålesund to investigate cloud processes over Ny-Ålesund and to learn to what extent they are representative of cloud processes over the broader region. This group will work on joint publications based on ongoing data collection by several partners and on identifying and filling gaps in observations of regional cloud and aerosol properties.

Participants: SU (H.-C. Hansson), AWI, KOPRI (S. J. Park, B.-M. Kim), CNR (M. Busetto, D. Cappelletti), NCAOR (Satheesan), NPI (S. Hudson), NIPR (M. Shiobara),
LaMP (Clermont-Ferrand, O. Jourdan), NILU (Hermansen), U. Tokyo (M. Koike), IGF PAS.
Potentially UniCologne, UniFrankfurt.
Modelling groups have to be invited and will included MetNo, UniOslo, AWI, CNRS

(2) Work group on long-term observations and trends in temperature, precipitation, clouds and radiation.

The scope of this work group is to put the various atmospheric observations in a broader temporal and spatial context. Focus activities will be (i) the analysis of atmospheric long-term measurements in terms of climate change, (ii) the combination of observations in the Svalbard region, (iii) the interpretation of Svalbard observations with regard to the broader Arctic. The expanded approach includes hind-cast studies of available local and regional observations of meteorology, clouds, and radiation fluxes to detect trends and to investigate possible driving forces and feedbacks causing observed trends. Relevant oceanographic records as sea surface temperature, salinity and sea ice properties (e.g. ice extent, sea ice thickness etc.) should also be included in the analysis. Furthermore, an exchange with the work group on clouds is necessary in the evaluation of long term trends.

The work group will schedule an integrative meeting in 2016, bringing together the experimental scientists presenting their long-term observations and invited modeling groups who may contribute to the interpretation of the observed trends (e.g. on topics such as transport to the Arctic, radiative transfer, and the hydrological cycle). Additionally, it is planned to (i) contribute to the meta data collection (see above), (ii) provide information on the accessibility of the actual meteorological data, and (iii) broaden the meta data collection by including further observational parameters.

Participants: AWI (M. Maturilli), NP, AARI (Ivanov Boris),Saint-Petersburg University (Pavel Sviashchennikov), MET-Norway (D. S. Vikhamar, K. Isaksen), SU (HC Hansson), CNR (M. Mazzola, B. Petkov), NCAOR (Satheesan), NIPR (M. Shiobara), Chiba U. (T. Takano), Tohoku U. (K. Yamada), Kyushu U. (H. Okamoto, K. Sato, T. Hashino), IGF PAS (G. Karasiński as coordinator of IGF meteo team).

(3) Work group on boundary layer (BL) meteorology.

This work group focuses on determining the processes and describing theoretically the local boundary layer. Current and near future research activities aim to improve the understanding of (i) the stable boundary layer, (ii) influence and occurrence of micrometeorological phenomena, (iii) influence of surface types and properties on the BL structure, (iv) coupling between local and synoptic processes. These efforts shall reduce the gap between boundary layer properties in models and the orographically influenced observations in Ny-Ålesund. Therefore this work group is linked to those of aerosol and clouds via the comparability of measurements at different sites (namely the Zeppelin Observatory to the column above the village) and also contributes to the understanding of the representativeness of Ny-Ålesund. Hornsund Station is performing corresponding systematic lidar sounding of the atmosphere. One of the focuses is the determination of atmospheric boundary layer height, which could be analyzed in comparison to the Ny-Ålesund observations.

The work group will arrange a meeting to improve cooperation, and agree on strategies for measurement sites and evaluation schemata for 2017, as activity is on-going at some stations (CNR, AWI) and even increasing in others (KOPRI, NCAOR).

Participants: AWI (C. Ritter), CNR (A. Viola), KOPRI (S. J. Park, T.-J Choi), NCAOR (Satheesan), IGF PAN (G. Karasiński, M. Bloch)

(4) Work group on aerosols (black carbon) and snow, including snow albedo feedback.

Aerosols including black carbon (BC) in the Arctic are mainly due to long range transport, which is deposited onto the surface mainly through precipitation, but also through dry

deposition. This work group will mainly focus on the effect on albedo of snow which can be a crucial climate feedback, and will combine measurements on (i) sources attribution (biogenic vs. fossil sources), (ii) deposition rate onto the snow surface, (iii) the amount of BC in the snow, including its vertical distribution. Several atmospheric and snow physical parameters are already recorded by different groups and institutes at different locations around Ny-Ålesund, Barentsburg, Svea, Pyramiden, and Hornsund. Atmospheric and snow BC content, as well as some chemical parameters have also been measured at several places and data will be collected and merged.
This work group will be in close contact with another of the Ny-Ålesund Flagship Programmes, namely the glaciology flagship, as well as another project proposal submitted to SSF, C2S3 (Community Coordinated Snow Study in Svalbard). This project, if funded, will gathering different groups focusing on snow related to BC, chemistry (major ion, pH, water isotope) and microbiology. By this, the interactions between snow and atmosphere are fully integrated, especially for the BC component, which will allow us to better describe and understand the link between aerosol content in the atmosphere and in the snow, in general.

This group will meet to combine measurements to work on joint publications. If C2S3 also gets funding, it will become an integrated part of this work group.

Participants: CNRS (H. W. Jacobi), NP (J.-C. Gallet, C. A. Pedersen), SU (J. Ström), CNR (V. Vitale, R. Salvatori), AARI (B. Ivanov), Saint-Petersburg University (P. Sviashchennikov), NIPR (K. Goto-Azuma, Y. Kondo), MRI (T. Aoki), U. Tokyo (M. Koike), University of Silesia (E. Łupikasza), IGF PAS (B. Luks and colleagues), NILU.

(5) Work group on atmospheric aerosols
Aerosol research both in-situ and via remote sensing has already a long tradition in Ny-Ålesund. Long-term data sets of chemical, optical and microphysical properties of aerosol exist and are being continued to monitor the temporal and spatial distribution of these, and to understand pollution pathways, removal processes and interaction with clouds, trace gases and radiation. From common campaigns and fieldwork a very good cooperation between the groups already exists, but a workshop in 2016 is urgently needed with the aim of writing jointly papers on existing data. A strong biomass burning event in Canada, which occurred over Ny-Ålesund during the week after 9. July 2015, provides a unique opportunity to gather all aerosol groups in Ny-Ålesund and the rest of Svalbard to prepare a joint publication. Such an effort will also stimulate more regular aerosol closure studies and, hence, increase our knowledge of the direct forcing of aerosol.

This work group will be connected to the boundary layer in WG3 (comparability of measurements by different groups, new particle formation events) and to radiation and work related to understand the representativeness of Ny-Ålesund in WG2. Due to the increasing research in the direction of aerosol-cloud interactions a close cooperation between the cloud and aerosol working groups is also suggested to address the indirect forcing. This work will be extended to Hornsund Station, and the research focused on atmospheric aerosol optical properties and pollution transport to the Arctic.

Participants: SU (R. Krejci, H.-C. Hansson), CNR (A. Lupi), U. Florence (R. Udisti), KOPRI (Y. J. Yoon, K.-T. Park), NCAOR (Satheesan), AWI (C. Ritter), NIPR (M. Shiobara, Y. Tobo), IGF PAS (G. Karasinski, M. Bloch).
Potentially NILU, FMI, University Helsinki, NIPR (Y. Kondo), U. Tokyo (M. Koike).

(6) Work group on Variability in surface UV irradiance and ozone column.

This work group will analyze the variations in the ozone column and solar UV irradiance observed at the ground. The enhanced variability in atmospheric conditions at Svalbard causes the corresponding variability in the air transparency that, combined with the specific surface features characterized by sea surface and complex relief of the snow-covered land, leads to significant changes in the solar UV irradiance reaching the Earth's surface. Svalbard provides a great opportunity for studying the short- and median-term variations in the ozone column since the polar day allows us to obtain continuous time series within a period of several months. The main goal of the planned study will be the relationship between the UV variations on one hand, and the changes in the ozone column and the meteorological factors, on the other. The field irradiance measurements will be analyzed together with the environmental parameters provided by different measurement techniques. The stations in Ny-Ålesund and the rest of Svalbard are equipped with diverse instruments measuring the surface UV irradiance and ozone column.

This work group will bring together the different actors for measurement intercomparisons and common publications.

Participants: CNR (B. Petkov), NILU (T. Svendbly), AWI (M. Maturilli), IGF PAS (G. Karasiński, P. Sobolewski,), NP, AARI

Budget:

Direct costs

6 work group meetings: 6 WG x 40 kNOK= 240 kNOK

This will cover: lunches, coffee, dinner, and some funds for travel (for those requesting it)

Atmosphere Symposium in 2017: 40 kNOK

This will cover: venue, lunches, coffee, dinner for the Symposium

Travel for guest visits: 2 pax x 6 WG x 5 kNOK/WG = 60 kNOK

Meta data base 1 month x 60 kNOK/month = 60 kNOK

This will employ an undergraduate student for one month to collect and punch the atmosphere monitoring meta data in the meta data base.

Total direct costs applied for in this application: 400 kNOK

In-kind contribution

6 work group meetings: venue costs of 6 WG x 40 kNOK = 240 kNOK

Worktime (CAP, RN, HCH): 3 persons x 0.5 month x 84 kNOK/month = 126 kNOK

Worktime (VV, GK, BI): 3 persons x 0.25 month x 84 kNOK/month = 63 kNOK

Travel to meetings*: 6 WG x 40 kNOK/WG = 240 kNOK (*modest estimate)

Total in-kind contribution: 669 kNOK