The interconnectedness and future plans - Atmosphere Flagship

Roland Neuber and the programme contributors

http://nysmac.npolar.no/research/flagships/
Contents of this talk

• Motivation and Goals
• Recent activities:
  – SSF funding for work group meetings, seminars, scientist exchanges
  – Planning and on site meetings
• Some scientific highlights
  teasers to the Atmosphere research session
• Outlook
Motivation:
Climate change in the Arctic

• The rapid change occurring in the Arctic is a challenge to the polar atmospheric sciences.
• Changes need to be recorded consistently in key climate parameters.
• Climate projections depend on process understanding and modelling.
• Various processes are interdepending.

-> various observations need to be combined
Atmosphere Flagship
General Activities:

• **Plan** for joint expeditions, observational periods, campaigns
• **Develop cross-station field activities**
• **Develop cross-station utilisation** and analyses of available data and ongoing measurements, plan joint publications

• Provide recommendations, e.g. for standard data processing, new lab facilities, etc.
• Contribute to pan-Svalbard activities (e.g. SIOS)
• Provide timeline for future activities
• Develop common lab infrastructure (e.g. metrology lab)
Atmosphere Flagship Workshops:

- 2014, October: Workshop in Potsdam, Germany and Goa, India
- 2015, September: Symposium in Tromsoe, Norway
- 2016, April: 1st on-site workshop
  October: Work group meetings in Kjeller, Norway; Xiamen, China
- 2017, May: 2nd on-site workshop
  November: Svalbard Science Conference, Oslo, Norway
SSF funded Atmosphere Flagship current Work Groups

- **WG1.** Clouds, humidity, precipitation
- **WG2.** Long-term observations and trends in temperature, precipitation, clouds and radiation
- **WG3.** Boundary layer meteorology
- **WG4.** Interaction of snow, atmosphere, and aerosols
- **WG5.** Atmospheric aerosol
- **WG6.** Variability in surface UV irradiance and ozone column
Further flagship work groups needed:

- Long range transport of trace gases
- Atmospheric composition and pollution
- Upper atmosphere studies including aurora studies
- ...

*Work Groups are regarded as flexible in number, scope and composition*
Atmosphere session today

• The Atmospheric Boundary Layer (2 talks)
• Clouds and Aerosols (3 talks)
• Snow and Aerosols (3 talks)
• Atmosphere Composition and UV (3 talks)
• Weather and Climate observations (4 talks)
• Ca. 30 Posters covering all ranges, from boundary layer to ionosphere
Atmospheric Observations in Ny-Aalesund

campaign-based process studies

longterm observations

AWIPEV, CAA, CNR, KOPRI, NCAOR, NILU, NIPR, NPI
but: How representative is the Ny-Ålesund site for the Svalbard region?
Long-Term Observations and Trend analyses

Anomaly of monthly mean surface air temperature (SAT) at 6 Svalbard meteo stations (Ny-Ålesund, Isfjord Radio, Barentsburg, Longyearbyen, Pyramiden, Hornsund)

B. Ivanov, AARI + met.no project: „Ivfjorden – past and present climate“
Poster 227
Meteorological Observations (WG Long-term Observations)

Pan-Svalbard Heterogeneity: temperature differences, seasonality and trends

Ny-Ålesund
Svalbard Lufthavn
Hornsund
Barentsburg
Pyramiden

met.no
Norway

Poland

Russia
Future plan: Combining atmosphere with glaciology and sea ice information
Meteorological Observations in the boundary layer
Meteorological Observations in the boundary layer

old pier 6.15 m\(_{\text{a.m.s.l.}}\) (AWI)

BSRN field 2.00 m\(_{\text{a.g.l.}}\) (AWI)

EC-NA 2.50 m\(_{\text{a.g.l.}}\) (AWI)

CC tower 2.00 m\(_{\text{a.g.l.}}\) (CNR)

EC-BA 3.00 m\(_{\text{a.g.l.}}\) (AWI)

Wind speed in m·s\(^{-1}\)

- \(\geq 12.5\)
- 10 - 12.5
- 7.5 - 10
- 5 - 7.5
- 2.5 - 5
- 0 - 2.5

Period:
- AWI stations: 03/10/2013 – 03/10/2014
- CNR station: 03/10/2013 – 30/09/2014

**ZEPPELIN station**
Aerosol microphysics, optical, chemical 
CCN 
Cloud residual properties 
Cloud microphysics 
Radiation 
Trace and GHG gases 
(concentrations & isotopes) 
Meteorology

**Gruvbadet**
Aerosol microphysics, optical, chemical properties 
Trace gas measurements

**Climate change tower**
Meteorology, radiation 
fluxes of mass and energy 
trace gases 
3D wind lidar

**Ny Ålesund**
Meteorology, radiation, soundings 
Remote sensing of aerosols and clouds 
Precipitation and atmospheric deposition
The Climate Change Tower Integrated Project (CCT-IP)

Zeppelin

CCT

Ny-Alesund

Ice-Buoy

Mooring

Permafrost borehole

Top of Boundary Layer

Flux and Process Measurements

http://www.isac.cnr.it/~radiclim/CCTower
AGAP (Atmospheric Gondola for Aerosol Profile)

2017 field activity: D. Cappelletti, M. Mazzola, J. Lysok, J. Gaesser, C. Petroselli, A. Zaldei
Institutes: University of Perugia, ISAC-CNR, AWI, Univ. Warsaw, IBIMET.CNR
March-May 2017 ~50 aerosol profiles
Morphochemical characteristics and mixing state of long range transported wildfire particles at Ny-Ålesund (Svalbard Islands)

Beatrice Moroni, PhD, David Cappelletti, Stefano Croci, Silvia Becagli, Laura Caiazzo, Rita Traversi, Roberto Udidi, Mauro Mazzola, Krzysztof Markowicz, Christoph Ritter, Tymon Zielinski

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Institutes:
Univ. Perugia
CNR
Univ. Firenze
Univ. Warsaw
AWI Potsdam
IOP, Sopot

biomass burning event of July 2015
Temperature inversion at 3.5km traps aerosol

Humidity gradient: test for hygroscopic growth:
@ 55%rh: $r_{\text{eff}} \approx 0.22\mu\text{m}$; $\text{RI} \approx 1.55 - i \times 0.013$
@ 90%rh: $r_{\text{eff}} \approx 0.45\mu\text{m}$; $\text{RI} \approx 1.49 - i \times 0.008$
Ny Ålesund
78°56’ N - 11°56’ E
Spitsbergen
Svalbard (Norway)

March-September
Measurements
since 2010

Gruvebadet
Observatory
800 m from Ny Ålesund
about 50 m a.s.l.

PM10; 4-stage Impactor
Source assessment of atmospheric lead by isotope ratios

Spring: North Europe - Russia; Summer: Canada - USA

Ny Alesund Aerosol 2010-14

Bazzano et al., Atm. Env., 2016
Biogenic aerosols: assessment of marine sources

Good correlation between MSA and PP, primed by sea-ice melting.

Relevant in studying the impact of past climate change on marine biogenic activity

Becagli et al., Atm. Env., 2016
WG4, Aerosols and snow: Precipitation in the Arctic

Arctic precipitation likely to be modified
- total accumulation
- number of events
- strength and frequency of extremes
- phase

Changes in arctic precipitation will have an impact on
- the regional climate
- glacier mass balances
- hydrological cycles
- atmospheric chemistry
- biogeochemical cycles
- ...

Precipitation measurements with gauges suffer a wind-induced negative bias and require rigorous correction.

-> Coordinated effort for corrected, reliable, and homogeneous time series
- IGE Grenoble
- Norwegian Meteorological Institute
- AARI, St. Petersburg
- St. Petersburg State University
- University of Silesia
- Institute of Geophysics, PAS
- NCAOR, Goa

Hans-Werner Jacobi,
Institute for Geosciences and Environmental Research IGE,
Hans-Werner.Jacobi@univ-grenoble-alpes.fr
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Snow Atmosphere interactions work:
Black Carbon (BC) monitoring in snow
Pilot study (SSF/SSG: «Community Coordinated Svalbard Snow Sampling (C2S3)»:
Sampling over 7 glaciers in Svalbard (see presentations on Thursday), for BC, snow physic, chemistry, water isotope and microbiology

In 2017: experimental campaign of variability of BC around Ny-Ålesund, by measuring air and snow BC content simultaneously
Snow Atmosphere interactions work

Future plans and collaborations:
• Develop a new site for common snow sampling in Ny-Ålesund, (multidisciplinary, see poster # 33): on going, will start winter 2017/2018 (NPI/AWIPEV)
• Discuss to expend/duplicate some work in Hornsund
• Idealy develop Gruvebådet site to better understand the deposition processes of aerosols by combining snow and air simultaneous measurements

Collaboration: France, Germany, Italy, Norway, Japan, Poland, Sweden, USA, UNIS
Work group 6: Variability in surface UV irradiance and ozone column

✓ Variability in atmospheric ozone at Ny-Ålesund from ozonesonde data;

✓ *UV Intercomparison and Integration in a High Arctic Environment (UV-ICARE)* project to harmonize data of UV irradiance and ozone column at four Svalbard stations: Ny-Ålesund, Barentsburg, Longyearbyen and Hornsund,
UV Intercomparison and Integration in a High Arctic Environment (UV-ICARE)

- A Svalbard Strategic Grants project (RCN/SSF)
- **Participants:** NILU (NO), ISAC-CNR (IT), IGF-PAS (PL), Univ. of South Bohemia/ Masaryk University (CZ)
- **Main goals:** Improved coordination and homogenization of UV data: inter-comparison of existing data, inter-comparison campaign with instruments from all stations/groups and implementation of common measurement, data analysis and data storage routines
- **Optional:** integration of UV measurements in Barentsburg in the network
- **Ongoing:** inter-comparison of longest UV data series (GUV, Robertson-Berger UV meter)
Upcoming activities

• Contribution to SIOS-SESS report
• Establishment of additional WGs
• Expanding Metrology lab in Ny-Aalesund
• Extend cooperation between sites on Svalbard e.g. Ny-Aalesund – Barentsburg – Hornsund
• YOPP: Special observation periods 2018
• MOSAiC
Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAIC) in 2019-20

Correlated observations on and around Svalbard
- Aircrafts out of Longyearbyen, Spring/Summer 2020
- Atmospheric observations
- Sea ice observations
- Ecosystem observations

www.mosaic-expedition.org

MOSAiC Implementation Workshop
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Thank You!