11th Ny-Ålesund Science Managers Committee Seminar

National Research Council of Italy

Rome, 9 -11 October 2013

Abstracts

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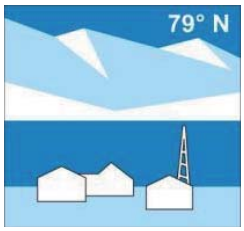

The 11th Ny-Ålesund Science Managers Committee take place on 9-11 October 2013 at the CNR-National Research Council of Italy Headquarters in Rome, Italy.

Seminar description

The seminar brings together scientists who have Svalbard and Ny-Ålesund (78°55'N, 11°56' E) in particular as a base for their research and monitoring activities.

The aim of the meeting is to exchange scientific results, advancements, ideas and experiences to inspire each other and develop Ny-Ålesund further.

The seminar wants to foster the following topics:

- Flagship programs
- SSF funded projects
- Implementation of Ny-Ålesund monitoring activities
- NySMAC and SIOS: Status and future developments

Scientific programme committee

Stefano Aliani - CNR, Institute of Marine Science (Italy)
Karoline Bælum - Svalbard Science Forum, The Research Council of Norway (Norway)
Steve Coulson UNIS - The University Centre in Svalbard (Norway)
Geir Wing Gabrielsen - Norwegian Polar Institute (Norway)
Nalan Koc - Norwegian Polar Institute (Norway)
Jack Kohler - Norwegian Polar Institute (Norway)
Maarten Loonen - University of Groningen (The Netherlands)
Roland Neuber - Alfred Wegener Institute (Germany)
Jon Børre Ørbæk - The Research Council of Norway (Norway)
Masaki Uchida - National Institute of Polar Research (Japan)
Vito Vitale - CNR, Institute of Atmospheric Science and Climate (Italy)

Organizing committee

NySMAC Secretariat

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CNR - Department of Earth System Science and Environmental Technologies

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Luigi Mazari Villanova
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11th NySMAC Seminar

PROGRAMME

Wednesday, 9th October 2013

8:00 - 9:00	Registration and logistic information	
9:00 - 9:30	Welcome	Luigi Nicolais - President of CNR Enrico Brugnoli – Director of Dept. Earth System Science and Environmental Technologies of CNR Representative of the Italian Minister of Foreign Affairs Nick Cox - NySMAC Chair

9:30-10:00	Geir W. Gabrielsen	Implementation of Ny-Ålesund monitoring activities

Ny-Ålesund monitoring activities (marine) Chair: Geir Wing Gabrielsen		
	10:00-10:20	**Seaweed Biology in Kongsfjorden: from genes to communities** Kai Bischof
	10:20-10:30	**Sea glacier interface in inner Kongsfjorden** Stefano Aliani, Federico Giglio, Leonardo Langone and Stefano Miserocchi
	10:30-11:00	Coffee Break

Ny-Ålesund monitoring activities (terrestrial) Chair: Maarten J.J.E. Loonen		
	11:00-11:20	**Relationships between biosphere and cryosphere in a Climate Change Frame at Ny-Ålesund - CCT** Nicoletta Cannone, Francesco Malfasi, Roberto Gambillara and Mauro Guglielmin
	11:20-11:30	**Carrying capacity of Arctic tundra for geese** Maarten J.J.E. Loonen
	11:30-11:40	**Towards an international Arctic snow ecosystem monitoring station** Catherine Larose, Aurélien Dommergue, Hans-Werner Jacobi, Jean-Luc Jaffrezo, Jean Martins, Joël Savarino, Didier Voisin and Timothy M. Vogel
	11:40-11:50	**Long-term monitoring of tundra herbivores and the arctic fox: Ny-Ålesund as a platform for studying species interactions and responses to climate change** Åshild Ønvik Pedersen and Eva Fuglei
	11:50-12:00	**Carbon fluxes in Arctic plant species: photosynthetic performances, isotopic signature and VOCs emission** Angela Augusti, Nicoletta Cannone, Francesco Malfasi, Emanuele Pallozzi, Enrico Brugnoli and Carlo Calfapietra
	12:00-12:10	**Vegetation quadrats in Ny-Ålesund: the response of vegetation succession to the environment changes in ecosystem** Cheng-Sen Li, Yi-Feng Yao, Fang Peng and Shu-Nan Cao
	12:10-13:30	Lunch

Ny-Ålesund monitoring activities (atmosphere I) Chair: Roland Neuber		
	13:40-14:00	**Long-term monitoring of clouds and aerosols by ground-based remote sensing instruments operated by NIPR in Ny-Alesund** Masataka Shiobara, Makoto Kuji, Masanori Yabuki, Hiroshi Kobayashi, Kazuma Aoki, Toshiaki Takano, Hajime Okamoto, Makoto Koike and Jinro Ukita
	14:00-14:10	**Methanesulfonate and sulfate concentration in the Artic aerosol sampled at NyÅlesund: role of sea ice and hemispheric circulation mode on their temporal evolution** Silvia Becagli, Daniele Frosini, Christian Lanconelli, Angelo Lupi, Mauro Mazzola, Mirko Severi, Rita Traversi, Vito Vitale and Roberto Udisti
	14:10-14:20	**The vertical structure of turbulence in the stable atmospheric boundary layer: observations and novel interpretations** Taejin Choi, Christian Lanconelli, Angelo Lupi, Mauro Mazzola, Armando Pelliccioni, Francesco Tampieri and Angelo Viola

	14:20-14:30	**Photochemically reactive compounds in atmospheric aerosol at Ny-Ålesund** Rita Traversi, Silvia Becagli, Maurizio Busetto, Giulia Calzolai, Daniele Frosini, Christian Lanconelli, F. Lucarelli, Angelo Lupi, Mauro Mazzola, Boyan Petkov, Mirko Severi, Vito Vitale, Riccardo Zanini and Roberto Udisti
	14:30-14:40	**WindLiDAR measurements in the Arctic boundary layer** Sonja Burgemeister, Christoph Ritter, Marion Maturilli, Roland Neuber and Alexander Schulz
	14:40-14:50	**Sources and properties of aerosol particles upon Ny-Ålesund: results of integrated vertical profile measurements and electron microscopy analyses** Beatrice Moroni, Silvia Becagli, Ezio Bolzacchini, Maurizio Busetto, Silvia Castellini, Luca Ferrero, Daniele Frosini, Christian Lanconelli, Angelo Lupi, Mauro Mazzola, Rita Traversi, Roberto Udisti, Vito Vitale and Davide Cappelletti
	14:50-15:00	**Changes in Temperature and Radiation at the Arctic BSRN Station Ny-Ålesund** Marion Maturilli and Andreas Herber
	15:00-15:10	**Broadband radiation measurements at Ny-Ålesund (1993-2013): from data to products** Christian Lanconelli, Marion Maturilli, Masataka Shiobara, Mauro Mazzola, Angelo Lupi, Rosamaria Salvatori and Vito Vitale
	15:10-15:45	Coffee Break
The Svalbard Integrated Arctic Earth Observing System (SIOS): Status and future developments **Chair: Vito Vitale**		
	15:45-16:15	**Svalbard Integrated Earth Observing System (SIOS)** Jon Børre Ørbæk, Kine Stenersen, Bo Andersen, Nicole Biebow, Cynan Ellis-Evans, Piotr Glowacki, Kim Holmén, Sergey Priamikov, Ragnhild Rønneberg, Hyoung Chul Shin and Vito Vitale
	16:15-16:30	**The Svalbard Integrated Arctic Earth Observing System (SIOS) – Towards a Governance and Observatory Model** Georg Hansen, Christine Daae Olseng, Halvard Ranestad Pedersen, Vito Vitale, Hans-Christen Hansson, Nicole Biebow and Jon Børre Ørbæk
	16:30-16:45	**Towards a SIOS observational integration plan** Roland Neuber, Karoline Baelum, Ragnhild Rønneberg, Christine Daae Olseng, Jon Børre Ørbæk and Georg Hansen
	16:45-17:00	**Russian research activities on Spitsbergen archipelago and its future developmens** Sergei Priamikov and Irina Solovyanova
	17:00-17:15	**Discussion**
Svalbard Science Forum (SSF) activities and SSF – Ny-Ålesund cooperation Chair: Kim Holmén		
	17:15-17:45	**Added value through cooperation. News and information from Svalbard Science Forum (SSF) and the Research in Svalbard (RiS) database** Karoline Bælum, Halvard R. Pedersen and Kirsten Broch Mathisen
	17:45-18:00	**Data exchange between SSF and national Arctic research websites** Sogtao Ai, Zemin Wang, Hong Geng and Changyun Zhao
	18:00-18:15	**Discussion on the role of SSF to reinforce cooperation**

Thursday, 10th October 2013

Ny-Ålesund monitoring activities (ice) Chair: Steve Coulson		
	08:30-08:50	**Measuring Ny-Ålesund glaciers using remotely piloted aircrafts** Stian Solbø and Rune Storvold
	08:50-09:00	**The Austre Lovénbreen basin: a small valley glacier observatory monitored since 2006** Florian Tolle, Eric Bernard, Jean-Michel Friedt, Albane Saintenoy, Christelle Marlin and Madeleine Griselin
	09:00-09:10	**Precise glacial volume estimation for polythermal glaciers in Svalbard** Songtao Ai, Zemin Wang, Hong Geng and Changyun Zhao
	09:10-09:20	**Nitrate Dynamics in the Arctic Winter Snowpack** Mats P. Björkman
	09:20-09:30	**How old is the youngest tectonics in Svalbard?** Paola Cianfarra and Francesco Salvini

Monitoring the Marine - Terrestrial Environment of Kongsfjorden Chair: Karoline Bælum		
	09:30-09:50	**Birdmap: tracking the migration and wintering areas of arctic birds with new technology and large scale research cooperation** Børge Moe and Sveinn Are Hanssen
	09:50-10:00	**A natural anti-predation experiment: predator control and reduced sea ice increases colony size in a long-lived duck** Sveinn Are Hanssen, Børge Moe, Bård-Jørgen Bårdsen, Frank Hanssen and Geir Wing Gabrielsen
	10:00-10:10	**Endocrine disruption by persistent organic pollutants and heavy metals in Arctic seabirds** Olivier Chastel, Paco Bustamante, Jan Ove Bustnes and Geir W. Gabrielsen
	10:10-10:20	**Migratory connectivity and the role of parasites** Cecilia A.M. Sandström and Maarten J.J.E. Loonen
	10:20-10:50	Coffee Break

Ny-Ålesund monitoring activities (space/atmosphere II) Chair: Marion Maturilli		
	10:50-11:10	**ISACCO-Ionospheric Scintillations Arctic and Antarctic Campaign Coordinated Observations** Giorgiana De Franceschi, Vincenzo Romano, Lucilla Alfonsi and Luca Spogli
	11:10-11:20	**Building a state-of-the-art space geodetic observatory in Ny-Ålesund: A fundament needed to detect minute changes in the Earth system over time** Oddgeir Kristiansen
	11:20-11:30	**Measurement of Cosmic Radiation with Emphasis on Neutrons at High Geomagnetic Latitudes** Vladimir Mares, Ferdinand Bergmeier, Gerhard Donth and Werner Rühm
	11:30-11:40	**New insights for multimedia distribution of PAHs and PCBs at Ny-Ålesund of the Arctic** Linke Ge, Hui Gao, Peng Zhang, Xindong Ma, Zhen Wang, Ziwei Yao and Guangshui Na
	11:40-11:50	**Source apportionment of individual soot particles by electron microscopy** Stephan Weinbruch, Nathalie Benker, Konrad Kandler, Martin Ebert and Roland Kallenborn
	11:50-12:00	**Seasonal variability of ice nuclei at Svalbard** Heinz Bingemer, Joachim Curtius, Martin Ebert and Stephan Weinbruch
	12:00-12:10	**Size distribution, chemical composition and source apportionment of aerosol collected at Ny Alesund (Svalbard Islands) in 2010 and 2011 summer campaigns** Roberto Udisti, Silvia Becagli, Maurizio Busetto, Giulia Calzolai, Davide Cappelletti, Daniele Frosini, F. Lucarelli, Angelo Lupi, Miriam Marconi, Mauro Mazzola, Beatrice Moroni, Mirko Severi, Rita Traversi, Angelo Viola and Vito Vitale
	12:10-13:30	Lunch

13:30-15:30 POSTER SESSION	
1	**Permafrost Monitoring at Bayelva site close to Ny-Ålesund** Conrad Kopsch and Julia Boike
2	**Introduction of a new project: Study of carbon cycling at moss tundra** Masaki Uchida, Ayaka Mo Kishimoto, Noriko Oura, Mitsuru Hirota, Yasuo Iimura and Takayuki Nakatsubo
3	**Sympagic-pelagic connectivity: The role of acrylate and DMSP in sea ice and pelagic organisms** Martin Græve
4	**Arctic cloud detection by means of hyperspectral infrared interferometry: validation with ground-based observations** Domenico Cimini, Filomena Romano, Mariassunta Viggiano, Elisabetta Ricciardelli, Francesco Di Paola, Christoph Ritter and Marion Maturilli
5	**Perfluoroalkyl substances in air, snow and surface water of the Arctic** Zhiyong Xie, Wenying Mi, Zhen Zhao, Renate Sturm and Ralf Ebinghaus
6	**Basal topography of Kronebreen, NW Svalbard** Jack Kohler, Kirsty Langley, Kenichi Matsuoka and Megan O'Sadnick
7	**Distribution chracteristic of dechloranes in multi-matrices of Ny-Ålesund of the Arctic** Na Guangshui, Wei Wei, Ma Xindong, Qiu Lina, Gao Hui, Ge Linke, Wang Zhen and Yao Ziwei
8	**On the spatial-temporal distribution of icequakes observed on the GSN station KBS, Ny-Ålesund** Andrea Kohles, Christopher Nuth, Joannes Schweitzer and Christian Weidle
9	**THE GCOS Reference Upper-Air Network (GRUAN) in Ny-Ålesund** Marion Maturilli, Galina Dick and Markus Ramatschi
10	**Arctic Research Collaboration form Radiosonde Observing System Experiment (ARCROSE)** Marion Maturilli, Markus Kayser, Roland Neuber, Klaus Dethloff, Annette Rinke, Jun Inoue and Alexander Makshtas
11	**A Digital Glacier Database for Svalbard** Max König, Christopher Nuth, Jack Kohler, Geir Moholdt, Rickard Pettersen and Angela Von Deschwanden
12	**Persistent toxic substances in Kongfjorden sea water and coastal sediments (Svalbard, Norwegian Arctic): levels and fluxes** Stefania Giannarelli, Sandro Francesconi, S. Vignali and Beatrice Muscatello
13	**Sensitivity of trace and rare earth elements as dust source prozie in Svalbard glaciers** Jacopo Gabrieli, Andrea Spolaor, Tonu Martma, Jack Kohler, Mats Bjorkman, Elisabeth Isaksson and Carlo Barbante
14	**Cultivable alginate lyase-excreting bacteria associated with the Arctic brown alga** *Laminaria* Yu-Zhong Zhang
15	**Photosyntethic characteristics of vascular plants under primary succession stages in a High Arctic glacier foreland, Svalbard** Yukiko Tanabe and Masaki Uchida
16	**Halogens and biological component in Spitsbergen snow: understanding the role of sea ice** Andrea Spolaor, Jacopo Gabrieli, Antonella Penna, Silvia Casabianca, Olga Mangoni, Maria Saggiomo, Tonu Martma, Jack Kohler, Mats Bjorkman, Elisabeth Isaksson, Paul Vallelonga, John M.C. Plane and Carlo Barbante
17	**Snowpack characteristics of Broggerhalvoya** Mauro Valt, Rosamaria Salvatori and Jacopo Gabrieli
18	**Recent measurements and trend of 6 halocarbons measured at the Zeppelin Observatory at Ny-Ålesund in Svalbard, Norway** Ann Mari Fjaeraa, Cathrine Lund Myhre, Ove Hermansen, Chris René Lunder and Norbert Schmidbauer
19	**SnowTerm: a thesaurus on snow and ice** Paolo Plini, Rosamaria Salvatori, Mauro Valt, Valentina De Santis and Sabina Di Franco
20	**Three years of atmospheric observations ar the Amundsen-Nobile Climate Change Tower in Ny-Ålesund – Svalbard** Angelo Viola, Mauro Mazzola, Francesco Tampieri, Christian Lanconelli, Alessandro Conidi, Ilaria Pietroni, Stefania Argentini and Vito Vitale

21	**Sources and fate of snow nitrate in the European high Arctic** Francesca Spataro, Antonietta Ianniello, Rosamaria Salvatori, Alessandro Mei, Giulio Esposito, Mauro Valt and Mauro Montagnoli
22	**Snow spectral library: six springs at Ny-Ålesund** Rosamaria Salvatori, Mauro Valt, Paolo Plini, Valentina De Santis and Alessandro Mei
23	**The influence of cruise ship emissions on air pollution in Svalbard** Sabine Eckhardt, Ove Hermansen, Henrik Grythe, Markus Fiebig, Kerstin Stebel, Massimo Cassiani, Are Baecklund and Andreas Stohl
24	**Monitoring Arctic Phytoplankton (MAP)** Willem van de Poll, Anita G.J. Buma, Else N. Hegseth, Klaas Timmermans, Philipp Fischer, and Christian Wiencke
25	**Italian Arctic Data Center: a digital infrastructure to manage the data acquired in the Arctic region** Simona Longo, Corrado Leone, C. Elefante, Stefano Nativi, Vito Vitale and Angelo Viola
26	**Svalbard Integrated Earth Observing System (SIOS)** Jon Børre Ørbæk, Kine Stenersen, Bo Andersen, Nicole Biebow, Cynan Ellis-Evans, Piotr Glowacki, Kim Holmén, Sergey Priamikov, Ragnhild Rønneberg, Hyoung Chul Shin and Vito Vitale
27	**The AWIPEV Underwater Observatory, a forward looking technology for longterm monitoring studies in Ny-Ålesund** Philipp Fischer, Christian Wiencke, Max Schwanitz, Ragnhild Asmus, Markus Brand, Burkard Baschek, Friedhelm Schröder, Maik Grunwald, Reiner Loth, Jakon Klaus-Stöhner, Michael Boer, Tobias Boehme

15:30-16:00	Coffee Break

Ny-Ålesund monitoring activities (space/atmosphere III) Chair: Christoph Ritter		
	16:00-16:10	**Major, trace and Rare Earth (REEs) elements in aerosol samples collected at Ny-Ålesund (Svalbard Islands) during the 2010 sampling campaign** Mirko Severi, Ornella Abollino, Silvia Becagli, Giulia Calzolai, David Cappelletti, Daniele Frosini, Agnese Giacomino, Franco Lucarelli, Mary Malandrino, Miriam Marconi, Beatrice Moroni, Silvia Nava, Rita Traversi and Roberto Udisti
	16:10-16:20	**Investigating the atmospheric relationship between Carbonyl Sulfide and CO2 using solar FTIR spectroscopy and a Chemical Transport Model** Yuting Wang, Mathias Palm, Nicholas Deutscher, Thorsten Warneke, Justus Notholt, Ian Baker, Joe Berry, Parvadha Suntharalingam, Elliott Campbell and Adam Wolf
	16:20-16:30	**Atmospheric Mercury Measurements in the Arctic Troposphere** Francesca Sprovieri, Ivano Ammoscato, Giulio Esposito and Nicola Pirrone
	16:30-16:40	**Measurements of Optical properties of Atmospheric Aerosols within Atmospheric Boundary Layer at Ny-Ålesund** S. Suresh Babu, Jai Prakash Chaubey, K. Krishna Moorthy, Mukunda Gogoi, Manoj M. R., Sobhan Kumar Kompalli, Anoop Tiwari and S. Rajan
	16:40-16:50	**Chemical size distributions from size-segregated samples collected at the Gruvebadet laboratory** Giulia Calzolai, Silvia Becagli, Massimo Chiari, Daniele Frosini, Costanza Ghedini, M. Giannoni, Franco Lucarelli, Silvia Nava, Francesco Rugi, Rita Traversi, Roberto Udisti, Riccardo Zanini, P. Sartori, M. Masiol and Daniele Ceccato
	16:50-17:00	**Aerosol profiles and Ship plumes over Ny-Ålesund during 2011-2012 field campaigns** Luca Ferrero, Davide Cappelletti, Beatrice Moroni, Vito Vitale, Roberto Udisti, Maurizio Busetto, Christian Lanconelli, Mauro Mazzola, Angelo Lupi, Silvia Becagli, Rita Traversi, Daniele Frosini, Giorgia Sangiorgi, Maria Grazia Perrone and Ezio Bolzacchini

Friday, 11th October 2013

Flagship activities (atmosphere)	Chair: Christian Lanconelli	
	08:40-09:00	**Remote sensing measurements at AWIPEV for an aerosol closure experiment** Christoph Ritter, Roland Neuber and Andreas Herber
	09:00-09:10	**Intercomparison of ultrafine aerosol measurements at the Zeppelin Station** Angelo Lupi, Maurizio Busetto, Hans-Christen Hansson, Radovan Krejci, Peter Tunved, Johan Ström, Mauro Mazzola, Christian Lanconelli, Roberto Udisti, Silvia Becagli, Rita Traversi and Vito Vitale
	09:10-09:20	**Current and future boundary layer measurements at AWIPEV** Alexander Schulz, Georg Jocher, Christoph Ritter, Marion Maturilli, Sonja Burgemeister, and Roland Neuber
	09:20-09:30	**Mean profiles of wind at CCT: similarity laws and the boundary layer height** Christian Lanconelli, Angelo Lupi, Marion Maturilli, Mauro Mazzola, Armando Pelliccioni, Francesco Tampieri and Angelo Viola
	09:30-09:40	**Short-term variations in the ozone column over Ny-Ålesund** Boyan Petkov, Vito Vitale, Mauro Mazzola, Kerstin Stebel, Christian Lanconelli, Angelo Lupi and Angelo Viola
	09:40-09:50	**Chemical composition of PM10 marine aerosol collected from Tromsø to Svalbard Islands during the AREX 2011 cruise** Roberto Udisti, Silvia Becagli, Ezio Bolzacchini, Massimo Chiari, Luca Ferrero, Daniele Frosini, Miriam Marconi, Silvia Nava, Maria Grazia Perrone, Giorgia Sangiorgi, Mirko Severi, Rita Traversi, Waldemar Walczowski, Riccardo Zanini and Tymon Zielinski
	09:50-10:30	Coffee Break
Flagship activities (terrestrial/marine)	**Chair: Masaki Uchida**	
	10:30-10:50	**Structure and function of terrestrial microbial communities in the High Arctic** Stefano Ventura, Luigi P. D'Acqui, Roberto De Philippis, Ondrej Komarek and Katja Sterflinger
	10:50-11:00	***Warnstorfia exannulata*, an aquatic moss in Ny-Ålesund and its seasonal growth responses** Cheng-Sen Li, Cai-Qing Guo, Ryszard Ochyra, Peng-Cheng Wu, Rodney D. Seppelt, Yi-Feng Yao, Lin-Gen Bian and Su-Ping Li
	11:00-11:10	**Measurements of Greenhouse gas fluxes over permafrost at Ny-Ålesund, the Arctic** Taejin Choi, Jaeill Yoo, Bang Yong Lee, Young Jun Yoon, Angelo Viola, Mauro Mazzola, Francesco Tampieri and Vito Vitale
	11:10-11:20	**Springtime phytoplankton dynamics in the Arctic Krossfjorden and Kongsfjorden (Spitsbergen) as a function of glacier vicinity** A.M.-T.Piquet, W.H. van de Poll, R.J.W. Visser, C. Wiencke, H. Bolhuis and Anita G.J. Buma
	11:20-11:30	**Oxygen isotope – salinity relationship in Kongsfjorden: implications to freshwater variability** Manish Tiwari, K.P. Krishnan and S. Rajan
Roundup for a basic core monitoring programme	**Chair: Geir Wing Gabrielsen**	
	11:30-11:45	**Monitoring activities at Dirigibile Italia** Vito Vitale
	11:45-12:00	**Overview of Monitoring activities at AWIPEV Base** Roland Neuber *et al.*

	12:00-12:15	**Monitoring at Sverdrup and Zeppelin Station** Christiane Hübner
	12:00-13:00	**General discussion on how to increase cooperation and conclusion**

13:00 **End of the 11th NySMAC seminar**

	14:30 - 17:00	**Side meeting on needs and scopes of a core Ny-Ålesund monitoring programme and future actions to implement**

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NY-ÅLESUND MONITORING ACTIVITIES (MARINE)

Seaweed Biology in Kongsfjorden: from genes to communities

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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 project aims at a holistic understanding of seaweed ecosystem function spanning from the environmental control of gene expression to energy flow through trophic levels.

Research on whole transcriptome analysis is currently focusing on the sugar kelp *Saccharina latissima* as an abundant model species under the combined stressors of elevated UV-B radiation and temperature. In addition the responses of seaweeds to increased CO_2 are addressed. In the frame of this global change scenario species-specific acclimation patterns are studied on the physiological base in order to predict shifts in the competitive strength of a respective species, potentially resulting in a changing seaweed community.

Community analyses currently conducted in comparison to the 1996-98 surveys indicate a considerable change in seaweed biomass off Hansneset / Bloomstrand but no obvious biodiversity change. The biomass maximum was shifted from 5 to 2.5m depth and overall biomass increased. Depths limits of dominant kelp species will be investigated further. In parallel photosynthesis-irradiance measurements of biomass dominant seaweed species along the depth gradient will serve as a base for calculating primary production rates of the Arctic kelp forest in Kongsfjorden. Furthermore, recruitment and reproductive success as a function of depth, age and size of specimens of target kelp species will be assessed. As spores, young sporophytes and gametophytes form the most susceptible life stages of an alga, it is crucial to know their physiological limits, thus determining recruitment success.

Finally, the effects of abiotic and biotic factors (e.g. detached kelps, bioturbation and consumers) on the structure, diversity, and function of soft bottom communities are studied by using manipulative experiments in the field and laboratory. Previous results show that the exclusion of bioturbating species (e.g. lugworms), but not the exclusion of consumers enhanced productivity and diversity, and changed the species composition of the infauna in the field.

All of these data will be integrated into the network analysis subproject , which finally will lead for the first time to an advanced trophic model for the benthic foodweb and also allow for more solid predictions on the impact of environmental change on the Kongsfjord ecosystem.

Upcoming studies on seaweeds at Kongsfjorden will address the physiological phenomenon of cross-acclimation. Furthermore, studies on seaweed adaptation strategies towards the extreme seasonality at this high Arctic site will be emphasized in the future.

Sea glacier interface in inner Kongsfjorden

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The interface between the ocean and glaciers' ice tongues deserve attention for the effects they may have on hydrologic properties and general circulation of the ocean. In the inner part of Kongsfjorden, many glaciers reach the sea and Kongsfjorden also has the peculiar feature that under some conditions, veins of warm (about 5°C) and salty (up to 35) water from the West Spitzbergen Current (WSC) may enter the fjord and touch the glaciers' front in a relatively ice-free sea environment. This is a unique opportunity to study ocean glacier interface. Here we report data on end-summer hydrological properties at glaciers' front after a 10 years time lag as well as time series of currents, particle fluxes and OC and $CaCO_3$ data from sediment traps in mooring Dirigibile Italia (MDI).

The mooring was deployed starting from Sept. 2010 to monitor input of waters through this passage toward the glaciers and is still at sea. SBE 19 CTD casts have been performed in September 2001 and 2003 and repeated in September 2010 and 2011 using small boats to deploy instruments. A seismic survey was performed in the inner part of the fjord to describe the morpho-bathymetrical features and surficial seismo-stratigraphy.

In 2000, a very thin layer of fresh water was found in the northernmost part of inner fjord only (Fig.1) and a regular decreasing gradient of temperature was along a almost continuous glacier front. In 2010, glaciers retreated and the temperature did not show a similar gradient and intrusions of veins of cold water at 20 m depth were recorded, which was not in 2000. TS diagram also highlighted low salinity water masses that were not found in 2000. Further analysis will show if they depend on glaciers melting, runoff or rainfall.

Particle fluxes were low through the first 10 months, while in July and August increased up to 72 g m^{-2} d^{-1}. Due to the low organic content and the more negative values of $\delta^{13}C$, the origin of these flux peaks is likely related to the increased runoff during the summer season. On the other hand, during May and June, both OC content and stable isotopes suggest a vertical rain of particles by biological production.

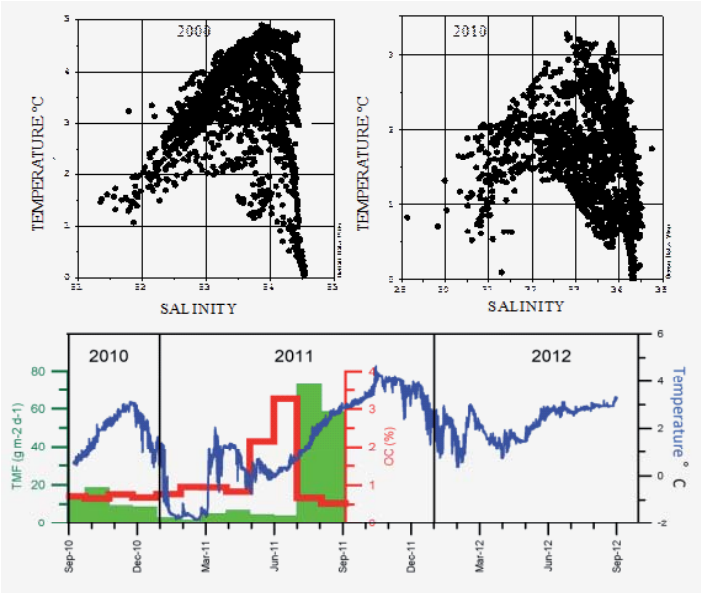

Figure 1. Upper: TS plots in 2000 and 2011 from CTD casts in inner fjord. Freshwater was higher in 2010. Lower: Time series from mooring MDI in 2010-2012. Temperature at the bottom, total mass flux (g m-2 d-1) and Organic Carbon (%) from sediment trap.

NY-ÅLESUND MONITORING ACTIVITIES (TERRESTRIAL)

Relationships between biosphere and cryosphere in a Climate Change Frame at Ny-Ålesund CCT

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During the summer 2012 the Insubria Research group started a research programme focussed on the characterization of the vegetation, the active layer and the underlying permafrost around the CCT tower and in the surrounding of Ny Alesund coupled with the first measurements of CO2 fluxes of the analyzed ecosystems (vegetation + underlying active layer). In the brief preliminary campaign (5/08-17/08) we performed 11 ERT (electrical resistivity tomographies) with 2 or 1 m of span for determining the active layer thickness and its spatial variability along a transect at Strandvatnet and very close to the coast and, above all on a 50X50 m grid of (6 lines every 25 m) close to the CCT (figure 1). Active layer thickness result highly variable ranging between less than 1 m up to more than 8 m. In correspondence of the main vegetation communities of shrubs as *Salix Polaris*; *Cassiope Tetragona*, Dryas Octopetala and of grasses and herbs like Saxifraga Oppositifolia and Carex Rupestris and also on barren soil and on saturated mosses located with different active layer thickness conditions were selected 11 plots to measure the CO2 fluxes through an IRGA systems. The first results of these CO2 measurements show that, at least in the analysed period, the NEE (Net Ecosystems Exchange) was controlled by the different type of vegetation and that, probably because the advanced phonological state the NEE were almost always positive and only in the case of *Dryas Octopetala* was negative. For each plot a simplified soil profile were described and the different horizons within the upper part of the active layer were sampled. During this summer a longer period of CO2 measurements is going on in the same plots around the CCT and within the CALM (Circumpolar Active Layer Monitoring) grid of 50X50 that has been established close to the CCT. The results of the field measurements are still in processing and will contribute both to the understanding of the relationships among permafrost (and its active layer), vegetation and CO2 fluxes in a Climate Changing scenario.

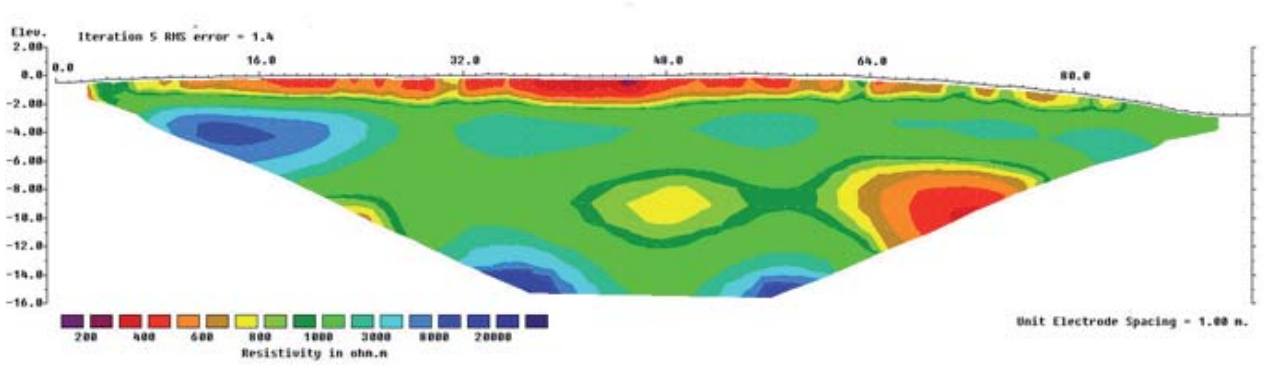

Figure 1: Example of ERT along one of the six lines (North on the left and South on the rigth of the figure and located in the middle of the CALM grid). (in the Y axes the 0 correspond to the absolute elevation of 55 m asl) Resistivity values above 2000 ohmm should represent frozen ground.

Carrying capacity of Arctic tundra for geese

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How many geese can be accommodated on Arctic tundra? How does goose grazing affect vegetation composition and productivity. What are the chances for overgrazing? The dramatic increase in goose numbers on Arctic tundra has led to an increased grazing pressure. Their grubbing activity has been described as habitat destruction, but also the grazing alters vegetation composition and productivity. The concept of grazing lawns maintained by herbivores has become an unstable state and carrying capacity decreases over time.

Only in a long term study, we can fully appreciate the trophic interactions of plants, herbivores and predators. In the high arctic terrestrial ecosystem on Spitsbergen, the effect of grazing by barnacle geese has been studied for over 25 years. Here we report on changes which ultimately might limit densities of arctic breeding geese.

Towards an international Arctic snow ecosystem monitoring station

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Seasonal snow cover extends over a third of the Earth's land surface, covering up to 47 million km^2 and is also an important feature of the Arctic. Snow cover can be considered as a dynamic habitat with a limited lifetime that acts as a medium and a mediator transmitting and modifying interactions among microorganisms, plants, animals, nutrients, the atmosphere and soil. Snow cover influences global and regional energy and moisture budgets, thereby influencing climate. The influence of seasonal snow cover on soil temperature, soil freeze-thaw processes, and permafrost has considerable impact on the carbon exchange between the atmosphere and the ground and the hydrological cycle in cold regions. Snow cover acts as both an energy bank by storing and releasing energy and a radiation shield due to its high radiative properties that reflect as much as 80-90% of the incoming radiation in the case of fresh snow. This high surface albedo reduces absorbed solar energy and lowers snow surface temperature. The snowpack is a receptor surface and storage compartment for nutrients, soluble inorganic and organic matter and contaminants that may or may not be attached to insoluble particles delivered by wet and dry deposition. Nutrients exist in the atmosphere as trace gases such as SO_2, CO_2, NO_X, N_2O or HNO_3 and as aerosols such as pollen, sea salt particles, mineral dust and sulfates. Physical metamorphism, phase changes and chemical transformations, which are modulated by interactions with the atmosphere and soil systems, control both the dynamics and the duration of the snow cover. Thus, snow cover is an important factor in the functioning of Arctic, and by extension, global ecosystems.

Microorganisms exist in several extreme cold environments such as glacial ice, sea ice, Arctic biofilms and snow, supercooled clouds and Antarctic permafrost. Due to the cold conditions and the limited supply of liquid water, snow and ice have long been considered as entrapment and storage systems for microorganisms. However, this view started to change with a number of studies that examined microbial diversity, ecology, and function in the cryosphere.

The Arctic environment is undergoing changes due to climate shifts and long-range transport of contaminants experiencing increased human activity. Climate change may alter microbial functioning by increasing growth rates and substrate use due to increased temperature. This may lead to changes of process rates and shifts in the structure of microbial communities. Biodiversity may increase as the Arctic warms and population shifts occur as psychrophilic/psychrotolerant species disappear in favor of more mesophylic ones. In order to predict how ecological processes will evolve as a function of global change, it is essential to identify which populations participate in each process, how they vary physiologically, and how the relative abundance, activity and community structure will change under altered environmental conditions.

We propose to develop an international snow ecosystem monitoring station that studies microbial, chemical and physical dynamics of the Arctic seasonal snowpack. We intend to include year-round flux measurements and to perform intensive experiments and measurements during targeted sampling periods.

Long-term monitoring of tundra herbivores and the arctic fox: Ny-Ålesund as a platform for studying species interactions and responses to climate change

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Climate change is expected to have profound effects on arctic terrestrial ecosystems1. In Svalbard the mean seasonal temperatures have increased across the entire archipelago, most dramatically in winter and spring2. The increase in temperature and the expected shift in onset of spring and length of summer season will have direct effects on plant production and community structure3,4. 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 (e.g.5,6). In contrast, winters with more snow and higher frequency of 'rain-on-snow' events will influence herbivore population dynamics negatively7-9. Our understanding of the population dynamics of the endemic Svalbard reindeer (Rangifer tarandus platyrhynchus), the arctic fox (Vulpes lagopus) and the migratory Svalbard-breeding pink-footed goose (Anser brachyrhynchus) and Barnacle goose (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 reindeer8,9. The barnacle goose population has increased over the last decades10,11, and reproductive success is positively related to temperature12, suggesting further population growth in response to climate change (e.g.5). Arctic fox population dynamics are driven by intrinsic bottom-up limitations related to the density of Svalbard reindeer carcasses in late winter13,14. Correspondingly, the reproductive success of geese is low after winters with high densities of reindeer carcasses14. Thus, as a result of climate change, new or strongly modified trophic interactions may dominate the overall responses of the terrestrial ecosystem1. The simple terrestrial ecosystem of the Ny-Ålesund research platform offers unique opportunities to track population changes of the herbivore and predator guild through long-term monitoring data and to study trophic interactions among the guilds and their responses to climate variability. The goal of this presentation is to combine the long-term monitoring data series from the Ny-Ålesund area on resident and migratory herbivores (Svalbard reindeer and barnacle goose) and their shared predator (arctic fox) to present a conceptual ecosystem model and preliminary results from an ongoing study focusing on species interactions and population dynamical responses to climate variability.

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Carbon fluxes in Arctic plant species: photosynthetic performances, isotopic signature and VOCs emissions

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One of the most important effect of global warming, in Arctic regions, is the permafrost degradation with consequent increase of soil active layer. A possible consequence of such degradation can be an increase in soil respiration with release of organic carbon stored in permafrost soils. On the other hand, climate change and, in particular, increasing temperature and CO2 concentration, may have, in those regions, positive feedbacks on photosynthetic activity. Not only the balance between photosynthesis and respiration, but also the monitoring of the different components of C flux is of great interest.
The goal of the experimental campaign carried out in Ny-Ålesund during summer 2013 has been to study C fluxes on target plant species. We focused our attention on the most representative species at the site near the Amundsen-Nobile Climate Change Tower (CCT), characterized by a significant level of permafrost degradation. Photosynthetic performances at different CO2 concentration, incident light and temperature were measured on Salix Polaris, Dryas octopetala, Saxifraga oppositifolia, Carex rupestris. On the same species, Volatile Organic Compounds (VOCs) emitted from leaves were sampled and analyzed for their content, since quantitative determination of these compounds is considered to estimate the percentage of C lost by the system. Plant and soil samples have been collected to analyze 13C isotope composition, to obtain an overview of the carbon isotope signature along the continuum plant-soil. Measurements have been carried out manipulating temperature, CO2 concentration and light conditions to monitor the response of those arctic species to climate and atmospheric variations.
Measurements of C assimilation and VOC emission will be compared between sites with different level of permafrost degradation and associated to soil respiration and C isotope signature. This, together with C flux measurements at plot level and with C data at large scale from the CCT, will allow to follow the fate of C under global warming conditions and will be the basis for long-term monitoring in this tundra ecosystem.

Vegetation quadrats in Ny-Ålesund: the response of vegetation succession to the environment changes in ecosystem

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Five vegetation quadrats were designed and established in the area of Ny-Ålesund, Svalbard in July, 2011 and another four were constructed there in 2012. They are 1 m×1.5 m in size and occupied the different environments respectively, including the exposing and fresh area at the frontier of Midre lovénbreen glacier (No. 1), the area of efflorescent glacial drift (No. 2), the areas of human activities (No. 3) close to the Yellow River Station, Ny-Ålesund, the tundra wetland (No. 4) at the eastern part of Ny-Ålesund, and the slope of small hill (No. 5) on London Island. The rest four quadrats were located on the exposing land at the frontier of Austre lovénbreen successively (Nos. 6, 7, 8 and 9). In each quadrat, the area of 1 m×1 m in size is for the dynamic monitoring of tundra vegetation (plant taxa and quantity) and the other two areas of 0.5 m×0.5 m are used for the investigation of soil characteristics (soil temperature, humidity, pH value and N, P, K elements, and heavy metal) and microbe. These quadrats serve the designed studies of natural condition for ever. The data of vegetation, soil chemical elements and microbe will be accumulated year after year and form the data pool of natural life and environments in Ny-Ålesund since beginning of the investigation. As the studied area of quadrates is at the key point in the ecological system linking continent, ocean, glacier and air current, the data of land life and continental environments may play an important role of understanding the ecosystem and its dynamic variation in Ny-Ålesund under the global changes, combining the research data of ocean, glacier and air current. These quadrats are open for the colleagues from other countries for the collaborative works.

Figure: the positions of quadrats (Nos. 1 to 9) in Ny-Ålesund.

NY-ÅLESUND MONITORING ACTIVITIES (ATMOSPHERE I)

Long-term monitoring of clouds and aerosols by ground-based remote sensing instruments operated by NIPR in Ny-Ålesund

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Atmospheric aerosol has a potential to change the global climate by the direct and indirect effects on radiation balance in the planetary atmosphere-surface system. Aerosol optical properties are essential parameters for estimating the direct effect of aerosols. The indirect effect by aerosol-cloud interactions may vary with aerosol microphysical properties and their vertical structure in cloud formation/dissipation processes. In order to monitor the optical properties and vertical structures of aerosols and clouds in the Arctic atmosphere, National Institute of Polar Research (NIPR) has been operating remote-sensing measurements at Ny-Ålesund (78.9N, 11.9E), Svalbard since 2000. The remote-sensing system includes Sky-radiometer (Prede, POM-02), Micro-pulse Lidar (MPL, NASA-upgraded SESI model), and All-sky Camera (Prede, PSV-100). In 2012, polarization lidar measurement began with SigmaSpace MPL-4-pol model for measuring depolarization ratio of clouds. In the fall of 2013, a newly developed cloud radar will be installed and start measurements at Ny-Ålesund. The radar uses 95GHz FMCW and includes Doppler measurements. In addition to the regular operations for remote sensing, we plan intensive observation campaigns combined with in-situ measurements for boundary layer clouds in 2014 and 2015. In this paper, we will show preliminary results from the ground-based measurements for clouds and aerosols and a possible in-situ measurement campaign planned in the GRENE Arctic Program Atmospheric Research Project.

Methanesulfonate and sulfate concentration in the Artic aerosol sampled at Ny-Ålesund: role of sea ice and hemispheric circulation mode on their temporal evolution

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The oceanic production of dimethyl sulfide (DMS) results from biotic processes involving most components of the food web. In the Arctic, phytoplankton and ice algae contribute to the production of dimethylsulfoniopropionate (DMSP), the precursor of DMS. Some DMS near the ocean surface diffuses into the atmosphere or is ventilated by wave action. Once in the atmosphere, DMS is oxidized to produce sulfate and methanesulfonate (MSA) both in heterogeneous and homogeneous phase by photochemical reaction. These sulfur components can act as precursors of cloud condensation nuclei or they can increase the size of particles on which they condense, increasing the particle's hygroscopicity and, in turn, enhancing their activity as CCN.

Aerosol sampling was carried out at Ny Ålesund (Svalbard Islands, 78.9°N, 11.9°E). The location of the sampling site (Gruvebadet station) is about 1 km far from the village and in suitable position in relation to Kongsfjorden prevailing winds, then avoiding the contamination from the village. The results here reported are related to PM10 samples collected on Teflon filters and analysed by ion chromatography.The technique is sufficiently sensitive, accurate and reproducible to be applied to very low atmospheric load of aerosol particles, typical of remote polar regions.

The MSA and nssSO42- concentrations were analysed as a function of speciation (e.g, acidic species or ammonium salt), size distribution and pathways of air masses. NssSO42- at Ny Ålesund are meanly arising from long range anthropic sources and present a relative maxima in spring; conversely, MSA arises from local source and peak in mid-summer. Since the decline in sea ice coverage in the Arctic over the past decade, there has been a 22% increase in annual primary productivity that has been attributed to a longer phytoplankton growing season (Arrigo et al., 2008). Modeling results reported in Gabric et al. (2005) suggest that an increase in DMS production would result from the retreat of the ice cover and its accompanied increase in primary production. In order to better understand the link between MSA concentrations in the aerosol, biogenic activity and sea ice extent and evaluate the effect of transport processes from surrounding oceanic areas, the atmospheric MSA values were compared with sea ice extent north of 70°N, general circulation mode pattern (Arctic Oscillation) and meteo-synoptic conditions during the days with the highest MSA concentrations.

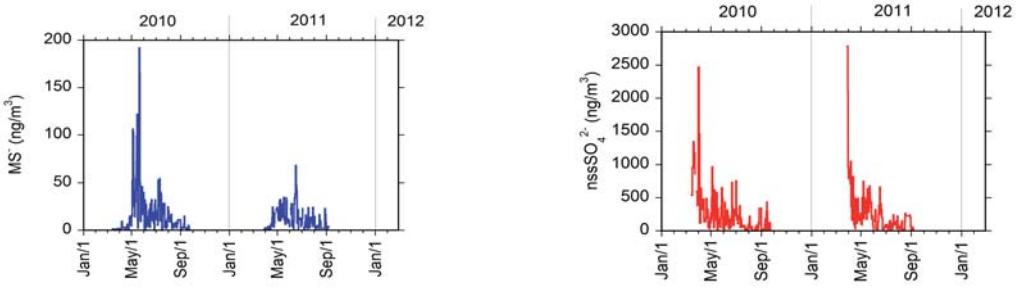

Figure 1: NssSO42- (plot on the left) and MSA (plot on the right) evolution for the years 2010 and 2011.

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The vertical structure of turbulence in the stable atmospheric boundary layer: observations and novel interpretations

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Turbulence in the atmospheric boundary layer is since half of the past century a key benchmark for theories aiming to describe high Reynolds number geophysical flows and to design parameterizations useful in applications (having in mind for instance weather and atmospheric composition forecasts, and climate simulations).
The range of parameters covered by observations has been widened in the recent years, as well as the performances of numerical simulations, so that existing paradigms have been tested, limits puts into evidence, and novel ideas has been forwarded. In particular, the standard formulation of the Monin-Obukhov Similarity Theory (Monin and Yaglom, 1971) needs to be extended in order to deal with conditions of very low sensible heat and momentum fluxes at the ground, frequently encountered at the polar regions.
The Amundsen Nobile Climate Change Tower (CCT) at Svalbard is a 32 m high observation platform particularly suited for investigating the energy balance at the surface and the turbulence characteristics in the planetary boundary layer under different conditions based on the measurement of turbulence at multiple levels using fast response instruments. Therefore, we first concentrate on periods when continuous and simultaneous measurements of mean parameters at four heights and of turbulence second order moments at three heights were made.
Using the new data set, some key ideas from literature are tested and limits and extensions of presently used parameterizations are discussed.

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Broadband radiation measurements at Ny-Ålesund (1993-2013): from data to products

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The instrumental setup of the Amundsen-Nobile Climate Change Tower (CCT) includes a four component net radiometer, a high precision pyranometer and a pyrgeometer to accurately measure the downwelling and upwelling broadband radiation from top of the tower. The dataset, available since the end of 2009 joined one of the longest dataset within Baseline Surface Radiation Network (BSRN, 1993) that is operated by the AWIPEV station in Ny-Ålesund.
An overview of the radiative regimes will be presented, considering the orographic shadowing of Mt. Zeppelin on shortwave components, principally to describe the effects of cloudiness on the net balance and reflectance features of the area that is alternatively covered by low vegetation and snow during the year. A set of automatic cloud identification (cloudId) algorithms will be applied to BSRN as well as CCT data, based on both shortwave full (global and diffuse) and partial (just global) set of incoming components, and on longwave broadband radiation to cover wintertime period. The results of the procedures were validated with respect to whole sky imagery, synoptic observations and lidar measurements.
Clear sky events were used to parametrize on a daily base the radiation components under cloud-free sky, providing reference to compute cloud radiative effects. Net radiative balance and albedo subdivided for clear and cloudy conditions, provide opportunity to discuss their response to direct and diffuse illuminations, as well as the effects of the spectral features of the solar radiation.

WindLiDAR measurements in the Arctic boundary layer

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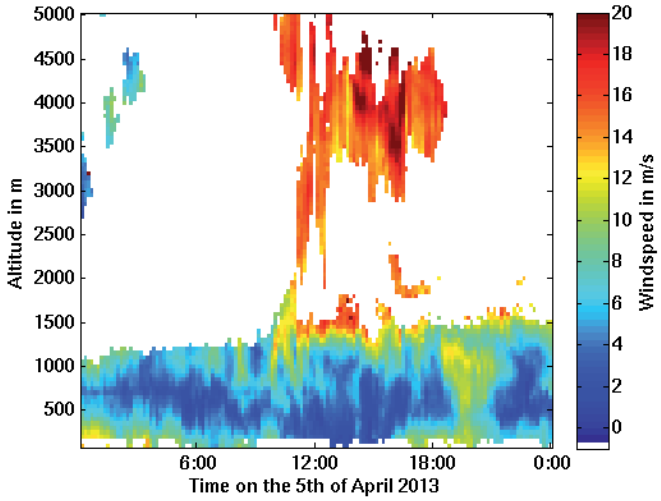
Since December 2012 the AWI-Potsdam operates a commercial wind-lidar (WindCube 200, Leosphere, France) on the roof of the AWIPEV observatory in Ny-Ålesund which runs unattended and continuously. It uses the Doppler effect of an eyesafe laser at 1.5 µm wavelength to measure the 3-dimensional vertically resolved wind with typically 10min temporal resolution. The resolution in altitude is 50m. Its range depends on weather conditions and can reach up to 5km. Between 200m and 800m data coverage so far is about 97%.

In the first part of this contribution we validate its performance against the wind measurements of our radiosonde and the tethered balloon. Apparently, the wind-lidar is able to capture the wind speed well and the wind direction even better than the Vaisala TTS111 tether-sondes. The correlation between the windspeed measured by the radiosonde and the windspeed measured by the wind-lidar is 0.95. For the winddirections, the correlation is 0.78. However, the fact that the radiosonde drifts with the wind while the wind-lidar measures stationary above the observatory challenges a direct comparison at high wind speeds.

In the second part a statistical analysis of the wind in Ny-Ålesund for winter (and hopefully summer as well) is given. The omnipresent wind shear in Kongsfjord (at the surface the wind blows frequently from E-SE and rotates between 500m and 800m altitude to its synoptic flow) is discussed. During winter and spring additionally jets are observed which can last up to several hours. An overview of jet occurrences and their relation to surface based inversions is given.



Sources and properties of aerosol particles upon Ny-Ålesund: results of integrated vertical profile measurements and electron microscopy analyses

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Aerosols and their interactions with cryosphere, clouds and sea can have a significant impact on the radiation balance in the Arctic. The study of the nature, properties and vertical distribution of aerosol particles in the lower troposphere is, thus, essential for the understanding of key processes in the Arctic climatic system.

On these grounds, an intensive field campaign was carried out at Ny-Ålesund in spring (April) 2011 and summer (June-July) 2012 in the framework of the PRIN (Progetti di Rilevante Interesse Nazionale) 2009 "ARCTICA" project. Size-segregated particle samples were collected at the Gruvebadet observatory, about 1 km South-West the Ny-Ålesund village, both at ground level (~ 50 m a.s.l.) and along vertical profiles (up to ~ 1,000 m a.g.l.). In this latter case a helium-filled tethered balloon equipped with time resolved instruments for particle number, black carbon and ozone concentration measurements was employed. Particles were collected on polycarbonate filters using a four-stage DEKATI sampler (cut-off diameters D_p: < 1μm, 1-2.5 μm, 2.5-10 μm and > 10 μm) at ground level, and a two-stage miniaturized Sioutas SKC cascade impactor (cut-off diameters D_p: < 1 μm and > 1 μm) in the balloon samplings. Individual particle size, morphology and chemical composition were investigated by scanning electron microscopy coupled with energy dispersive microanalysis (SEM-EDS). The elemental atomic ratios were calculated and then compared with those of pure minerals and phases to obtain distinct particle classes.

Silicates (quartz, feldspars, chain and sheet silicates), carbonates (calcite, dolomite), metal particles (Fe, Ti, Cu, mixed Fe-Cr-Ni and Fe-Zn oxides), sulfate (gypsum, alkali-sulfates) and chloride (halite and sylvite) salts are the main particle groups in the samples. Except for Cu oxide, which is from vehicular/combustive sources, they are all from soil (silicates, carbonates, Fe, Ti and mixed metal particles) and from sea spray (sulfate, chloride) natural sources.

The chemical properties of particles change depending on the air mass origin and provenance. In particular, compositional data of evaporites suggest the co-precipitation in cold conditions, while the silicates and the metal oxides reveal distinct geological units of provenance. In this latter case, integrated air mass back trajectories and aerosol particle number concentration profiles indicate long range transport from different magmatic/metamorphic source regions. Grain size distribution and morphology reflect the variable influence of transport (*e.g.*, sorting of silicates) and hygroscopicity (*e.g.*, size and shape of sulfates) in the evolution of different particle types. The presence of very small metal and chloride/sulphate particles attached onto silicate and carbonate particles was also evidenced. It may affect the optical and hygroscopic properties of the carrier particles and their potential to form clouds.

In conclusion, SEM methods revealed distinct distributions of number, size and geochemical properties of different particles classes in the aerosols. They reflect distinct behaviours and spatial/temporal evolution of the constituent particles, along with the common occurrence of dust inputs from regional to long range sources. All these features have to be taken into account when approaching the modelling of atmospheric processes in a such complex environment.

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Changes in Temperature and Radiation at the Arctic BSRN Station Ny-Ålesund

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The Arctic Baseline Surface Radiation Network (BSRN) station Ny-Ålesund (79°N, 12°E), Svalbard, operates surface radiation measurements since 1992, complemented with surface and upper air meteorology. The long-term observations reflect ongoing changes in the Arctic climate system. Indeed, during the last two decades the annual mean surface temperature in Ny-Ålesund has increased by about +1.4 degrees per decade.

This general warming has obvious effects on the local environment. BSRN albedo values indicate that snow melt season starts about 1 week earlier than 20 years ago. The reflex radiation measurements also document the special surface situation of spring 2012, when the ground instead of snow was covered by solid ice after heavy rainfall during the winter season.

The measurements of incoming radiation indicate changes in the atmosphere itself. The shortwave radiation has increased (decreased) during the summer months (springtime period), respectively, suggesting a change in cloud coverage. By far the strongest changes are found in the downwelling thermal radiation during polar night. Generally, the longwave radiation budget is affected by three atmospheric components: clouds, water vapour and temperature. An increase of about 14 Wm^{-2} per decade indicates changes in the Arctic humidity or cloud coverage during wintertime, with clouds being either larger in volume or modified in composition. Although the largest changes in the total radiation budget are found during the summer months, the longwave radiation changes during wintertime seem to have more impact on the Ny-Ålesund climate, as the largest temperature increase is also observed for the winter months.

Related studies are planned on local cloud coverage, based on ceilometer and radiosonde data since 1992, as well as the integration of the observations in the broader context of Arctic Amplification analyses.

Photochemically reactive compounds in atmospheric aerosol at Ny-Ålesund

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The Arctic troposphere is a unique chemical reactor, especially during polar sunrise. During spring in fact, it is affected by emissions both from human activity in the mid/high latitude areas and from natural sources in the Arctic Ocean; moreover, in this season, light-induced chemical reaction are likely to occur causing changes in atmospheric composition (e.g. Barrie et al., 1988).
Such a synergy of meteorological patterns and extreme variations in solar radiation starting in spring make difficult to disentangle the factors of the production and removal of many environmentally relevant chemical compounds. Therefore, here we present some data and preliminary results concerning the atmospheric concentration levels of chemical compounds which are relevant to better understand the photochemical activity and the oxidizing capacity of sea-level atmosphere in the high Arctic.
Daily PM10 aerosol samples were continuously collected at Gruvebadet station (Ny-Ålesund, 78.9°N, 11.9°E) during the spring-summer period (March-September) along three consecutive years (2010-2012) and were analysed for ion, metal and EC/OC (elemental/organic carbon) content. Here we focus on nitrate, nitrite, selected organic anions (oxalate, acetate, propionate, formate, glycolate and pyruvate) and OC, because of their sensitivity to oxidation processes and to the dynamic atmospheric production/consumption triggered and/or mediated by solar radiation. Most of the determined organic anions show very low concentration (often close to their detection limit) in all the years, with the exception of oxalate, which is always dominant among the organic anions, as also found by Kawamura et al., (2007) in aerosol samples from a Canadian Arctic site. Their temporal evolution is studied in comparison both with the broad band UV solar irradiance data (in order to evaluate the effect of the photochemistry on the studied compounds) and with the size distribution data in the nm-range (in order to check a possible relationship between nucleation events and the concentration of species potentially contributing to new-particle formation such as nitric and organic acids). Moreover, correlations with other chemical markers are studied, together with backtrajectory analysis, in order to spot the long-range transport events delivering these compounds together with pollutants from the highly anthropised areas of the Northern hemisphere.

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THE SVALBARD INTEGRATED ARCTIC EARTH OBSERVING SYSTEM: STATUS AND FUTURE DEVELOPMENTS

Svalbard Integrated Earth Observing System (SIOS)

Status under the preparatory phase and challenges towards implementation

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The Svalbard Integrated Earth Observing System (SIOS) is a distributed research infrastructure of global significance on the ESFRI Roadmap, localized in and around Svalbard. Building on the extensive research infrastructure already in place, SIOS will upgrade, operate and make available a regional state-of-the-art Arctic observing system for long-term measurements in an **Earth System Science** perspective. **The SIOS Knowledge Centre** will establish and manage shared resources and joint activities. It will develop methods for how observational networks are to be designed and implemented. The Centre will lay the foundation for better coordinated services for the international research community with respect to access to infrastructure, data and knowledge management, sharing of data, logistics, training and education. **The joint services offered by SIOS** will generate added value for all partners beyond what their individual research can provide. The services will benefit the international polar research community as a whole and will make SIOS the leading polar research infrastructure in the Arctic.

The SIOS Preparatory Phase project elaborates the **Statutes** (reflecting the governance and the administrative and legal plans) for the new joint organisation, the **Scientific & technical description** (status, needs, tasks and strategy) for the whole research infrastructure, the **Business plan** for the organisations first five years and further upgrade (reflecting the fact that all investments will come from the participating countries, not the EC), the **Governance** in the form of rules of procedure (policies on access, data, logistics etc. and by laws) and an **Infrastructure strategy plan** for the upgraded observing system.

An overview of the multitude of reports connected to the scientific, technical and financial case for SIOS, which is elaborated under the SIOS Preparatory Phase Project to produce the necessary knowledge base on which the final decision making process by the SIOS Stakeholders will depend, is presented in the poster/ talk.

The Svalbard Integrated Arctic Earth Observing System (SIOS) – Towards a Governance and Observatory Model

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The Svalbard Integrated Arctic Earth Observing System (SIOS) is a Norwegian proposal for European large-scale infrastructure facilities through the European Strategy Forum for Research Infrastructure (ESFRI). The aim of the initiative is to establish an observational system addressing all important elements of an Arctic contribution to the Earth System, from solid earth and ocean via the terrestrial surface and the atmosphere to solar-terrestrial coupling in the upper atmosphere and beyond. The Svalbard archipelago in the European Arctic and surrounding marine areas already house numerous observatories and monitoring instruments from countries all over the world, but a common overarching structure for optimum management and coordination is still missing.

SIOS aims at providing such an infrastructure, offering a common policy and concrete approach to data management, scientific and observational management and development, logistical and other support services, and comprehensive access to the research infrastructure under the SIOS umbrella. This will materialize through the SIOS Knowledge Centre, which will be established in Longyearbyen, Svalbard, and form the centre piece of the new infrastructure.

Important elements of the governance structure besides the staff of the Knowledge Centre will be an (internal) Science Board, a Station Managers' Forum, an (external) Advisory Board, and an assembly of all participating research institutions. Functions of the various structures and their relation to existing bodies, such as the the Ny-Ålesund Science Managers Committee and Svalbard Science Forum, are currently being worked out and will be presented for the SIOS Policy board in spring 2014.

An important aspect of the ongoing preparatory work focuses on an appropriate organization and management of the large number of observatories and stand-alone instruments that are expected to form the basis of the SIOS infrastructure. This is very challenging due to the wide scope of scientific disciplines and observational techniques involved in SIOS.

Towards a SIOS observational integration plan

Roland Neuber[1], Karoline Baelum[2], Ragnhild Rønneberg[3], Christine Daae Olseng[4], Jon Børre Ørbæk[4], Georg Hansen[5]

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The existing and planned observational capacities of SIOS members on Svalbard are divers and distributed with respect to locations, scientific disciplines, physical spheres, institutional structures, and other aspects. Accordingly, a great need of integration arises, which on one hand needs to take into account the specifics of a large range of scientific disciplines, of polar research, international cooperation beyond Europe, and more. On the other hand, integrating the observational capacities opens up a huge potential of novel research and knowledge –and especially if satellite data are included more in the work. Within SIOS the scientific observations should be coordinated with the goal to produce "added values" by making infrastructure available across disciplines, locations and institutions.
For the Kongsfjorden International Research Base in Ny-Ålesund four flagship programmes have been developed recently by NySMAC and SSF. Each programme identifies also here needs for observational integration.
Observational integration within SIOS can be fundamentally discriminated for the two areas of scientific work, namely Field expeditions (on land or on sea but outside of established stations and permanent installations), and Long term observations. For long term observations SIOS should utilize already existing structures and affiliate with them. This includes particularly established observational networks which we find in fields like meteorology, oceanography, geophysics and others, as well as in organisational structures like SAON/ISAC, INTERACT/SCANNET, AMAP and others.
For Ny-Ålesund the previously established Flagship Programmes could be further developed to become an integral part of SIOS.
Observational coordination could be organized according to:

- Disciplines or compartments, like "atmosphere", "ocean", "cryosphere", "terrestrial systems"
- Platforms, like "land based", "sea borne", "air borne", "space borne"
- Location, like Ny-Ålesund, Longyearbyen, Barentsburg, Hornsund, Hopen/ Bjørnøya, others
- Scientific Topics

The Ny-Ålesund scientific community is invited to contribute substantially to the further development of the SIOS observational integration plan, which should become effective after the formal establishment of SIOS, planned autumn 2014.

Russian research activities on Spitsbergen archipelago and its future developments

Sergei Priamikov and Irina Solovyanova

Arctic and Antarctic Research Institute, Russia

Russian research activities on Spitsbergen archipelago are aimed on studies and monitoring of processes and status of Environment in the area of Spitsbergen archipelago. 10 institutes from: Russian Academy of sciences (RAS), Russian Federal Service for Hydrometerology and Monitoring of Environment (Roshydromet) and Mimistry of Natural Resourses and Environment (MNR). These Institutes are the following:

RAS (Moscow): Institute of Archeology -IA, Institute of Geography -IG, Seismological Service –SS,

Cola Region Science Center of RAS (**Murmansk**): Polar Geophycal Institute - PGI,

Marine Biological Institute -MMBI, Polar Alpine Botanical Garden -PABG

Roshydromet: Arctic and Antarctic Research Institute -AARI (Saint-Petersburg),

North-West Branch of "Typhoon" Research Centre - NWT (Saint-Petersburg),

"Barentsburg" Environment Monitoring Observatory – BO (Murmansk)

MNR: Polar Marine Geological Research Expedition -PMGRE (Saint-Petersburg).

Research activities of mentioned above institutes are funded by Ministry of Economy in accordance Governmental Interagency Commission on Spitsbergen decisions.

It was recognized that:

there is some overlapping in research activities of Russian institutes on Archipelago.

There are very good chances to develop Science cooperation with foreign institutes in Spitsbergen studies.

There is need to update research infrastructure and share using lab facilities for all ten institutes on compatible studies.

Taking in mind these reasons it was proposed to establish Russian Science Centre on Spitsbergen (RSCS) with main goal to improve Russian research activities on Archipelago on the basys of development better coordination and cooperation in research and use joint research infrastructure. This initiative provide very good opportunity to establish collaboration in studies with other research sites on Spitsbergen, especially in Ny-Ålesund with NySMAC.

SVALBARD SCIENCE FORUM (SSF) ACTIVITIES AND SSF—NY-ÅLESUND COOPERATION

Added value through cooperation. News and information from Svalbard Science Forum (SSF) and the Research in Svalbard (RiS) database

Karoline Bælum[1,2], Halvard R. Pedersen[1,2], Kirsten B. Mathisen[1,2]

[1]The Research Council of Norway
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The Svalbard Science Forum (SSF) is a part of the Research Council of Norway (RCN) and promotes coordination and collaborative efforts in research activities in Svalbard. Our objective is to contribute to the development of Svalbard as a platform for international research cooperation in the Arctic.

SSF Strategic Objectives:

- Increased cooperation within Svalbard research
- Increased coordination of activities
- Open sharing of data
- Reduced environmental impact

SSFs tasks include managing the database "Research in Svalbard" (RiS) which contains information relating to more than 2200 Svalbard related projects. RiS is established in cooperation with the Norwegian Polar Institute and is a valuable source for information on previous, current and future research activities in the region. SSF is always working towards helping researchers and management and hopes to simplify and combine the RiS registration, Kings bay registration and booking and application to the Governor of Svalbard in the new and improved RiS Portal which will be launched in 2014.
The SSF organises workshops and administers three funding schemes targeted towards the Svalbard research community. The deadline for all the funding programs are 16th is of October 2013. This winter a workshop on new technology will be arranged by the SSF and several SSF funded workshop will take place.

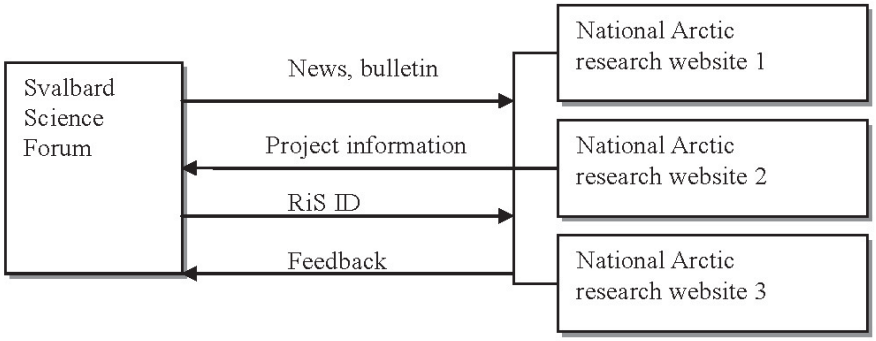
The activity of the four SSF initiated flagship programs in Ny Ålesund (Glaciology, Terrestrial Ecosystems, Atmosphere and the Kongsfjorden System) will have increased activity in the coming year thanks to this NySMAC seminar and a SSF funded workshop planned for October/November. Hopefully this development will lead to the initiation of a basic monitoring program for Kongsfjorden and surrounding areas.

Data exchange between SSF and national Arctic research websites

Songtao Ai[1], Zemin Wang[1], Hong Geng[1], Changyun Zhao[2]

[1]*Chinese Antarctic Center of Surveying and Mapping, Wuhan University, P.R.China*
[2]*Hubei Arctic & Antarctic Scientific Expedition Association, Wuhan, P.R.China*

The Svalbard Science Forum (SSF) promotes coordination of and collaborative efforts in research activities in Svalbard. As a platform for international research cooperation in the Arctic, SSF stimulated the Arctic researches. But SSF has little connection with other national Arctic research websites. For example, China has an Arctic research management information system, where already including online project proposal, expert review and approving confirmation. If some internet interfaces are open to other national Arctic research websites, it will be convenient for the researchers to submit a new RiS project and for the national administrations to view the progress of projects in SSF. Of course some online securities should be considered and the national websites should be authorized before data exchange. Then the database "Research in Svalbard" (RiS) which contains information relating to more than two thousand Svalbard-based projects can be extended to much more potential users.



With the data exchange, this connection work has the following online advantages:

- RiS project registration automatically from national Arctic research websites to SSF, and RiS project infomation sharing from SSF to the other.
- Online news and bulletin information distribution from SSF to the other.
- RiS projects feedback from national Arctic research websites to SSF.

NY-ÅLESUND MONITORING ACTIVITIES (ICE)

Measuring Ny-Ålesund glaciers using remotely piloted aircrafts

Stian Solbø and Rune Storvold

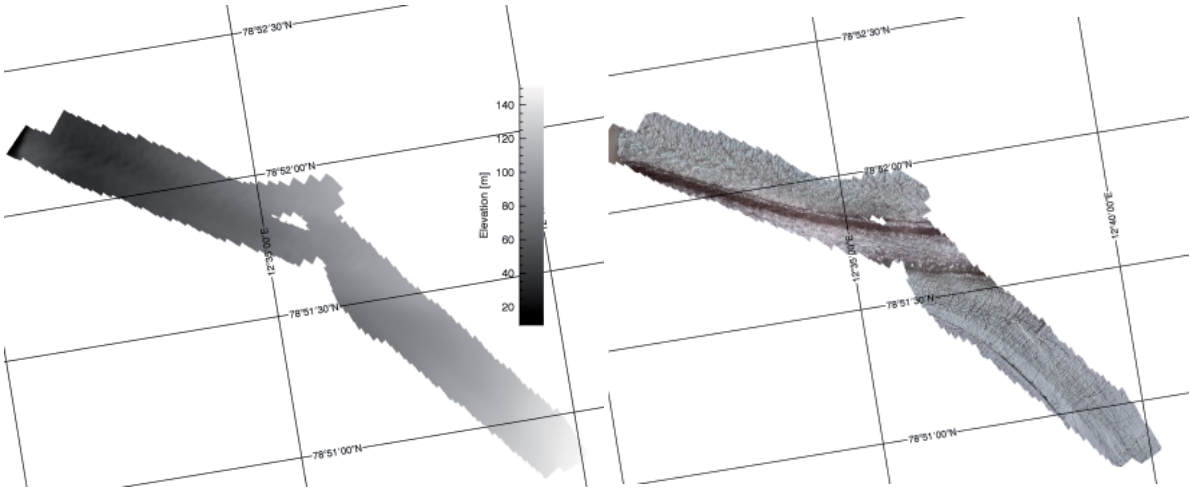
Northern Research Institute (Norut)

The remoteness of most Svalbard glaciers makes it difficult to perform regular in situ monitoring, especially in the melting season. Terminus areas (into the sea) and crevassed areas are in practice only accessible from the air. However, the availability of manned aircraft suitable for aerial mapping is limited on Svalbard. Hence, satellites are the source of remote sensing data used in practice for glacier monitoring. Though the spatial and temporal resolution of satellite images makes studies of smaller glaciers challenging, and the high probability of cloud coverage is a limitation on optical satellite data, especially for glaciers in surge. During the last few years, scientists from Norut have been operating remotely piloted aircraft systems (RPAS) regularly on the glaciers in the vicinity of Ny-Ålesund.

In this presentation we will present the first results of the analysis of the data, with emphasis on elevation profile measured along the centerline of the Kongsvegen glacier, and 3D modeling of the glacier terminus for dynamic mass loss estimation.

We will present the payload instrumentation, and its performance for glacier properties measurements. The principles for data processing will be reviewed.

Further, we will discuss the opportunities and challenges for RPAS operations out of Ny-Ålesund. We will present plans for future measurement campaigns, and identify the need for in-situ measurement and auxiliary measurements for a thorough validation of the RPAS based glacier measurements, which will require collaboration with other institutions working on glaciers in the Ny-Ålesund area.



The Austre Lovénbreen basin: a small valley glacier observatory monitored since 2006

Florian Tolle[1], Eric Bernard[1], Jean-Michel Friedt[2], Albane Saintenoy[3], Christelle Marlin[3], Madeleine Griselin[1]

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Since 2006, an extensive monitoring program has been conducted on Austre Lovénbreen. This small valley glacier is located 6 km to the South-East of Ny-Ålesund. Its 10 km^2 basin is well outlined by mountainous ridges and all outflows are clearly channeled through a solid rock bar. These characteristics allow for a global input - output approach of all key elements driving cryospheric and glaciological dynamics.

Recurrent measurements are being conducted involving:

- a network of 36 ablation stakes for mass balance monitoring
- 20 automatic temperature loggers recording hourly data
- 12 time-lapse cameras providing 3 pictures a day
- 2 automatic gauging stations
- 8 permafrost boreholes in the moraine area

Besides these on-site permanent devices, other fieldwork include DGPS monitoring, Ground Penetrating Radar transects, terrestrial laser scanning, snow cover drilling, and water sampling.
Overall the data acquired offers the possibility to follow the glacier dynamics at a very fine spatial and temporal scale. It also brings to light the key factors influencing these dynamics (air temperature and precipitation, radiation, snow cover). Results show that the mass balance of the glacier has always been negative over the last years. Some years like 2011 stand out with a very negative mass balance clearly due to a lack of accumulation more than to an increased ablation. High summer temperatures, especially when combined with rain, have the most influence on the glacier. Depending on their intensity and their recurrence, they are the main drivers of the glacier's global trend. When these factors occur after a winter with a thin snow cover, they have an even stronger effect. The most intense even though short rain events occurring late in the season are sometimes responsible for a substantial part of the year's balance. It has also to be noted that for most of the years, there is a clear link between the annual snow maximum and the resulting mass balance.
At present, Austre Lovén glacier basin is a well-instrumented regularly-maintained observatory. This effort should be pursued in the coming years and could include increased collaborative works with researchers of the area. Recent developments should lead to an integration of land and fjord processes in a joint perspective. Freshwater outflows, sediment budget and coastal processes are of particular interest in that aim.

Precise glacial volume estimation for polythermal glaciers in Svalbard

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The glaciers in Svalbard are mostly small polythermal glaciers. On these polythermal glaciers, the radio wave velocity (RWV) of ground penetrating radar (GPR) is variable. But the glacial volume estimation usually used a single RWV for one whole glacier in order to simplify the calculation. How about the difference between the actual volume and the estimated result? We used a RWV model, derived from common mid-point (CMP) profiles of GPR measurement, to simulate the RWV for each GPR trace. Then a relative accurate volume of one glacier was acquired. From which we found the difference among those volumes calculated from a single RWV, three RWVs and our RWV model. In general, our RWV model for polythermal glaciers refined the volume estimation and enhanced the precision in mass change study.

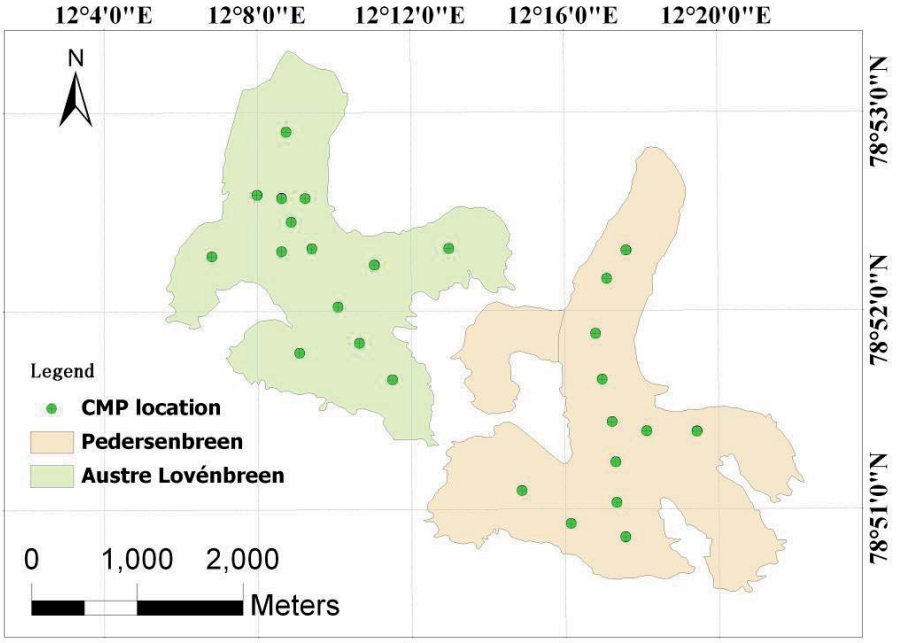


Figure 1: The distribution of CMP profiles.

Nitrate Dynamics in the Arctic Winter Snowpack

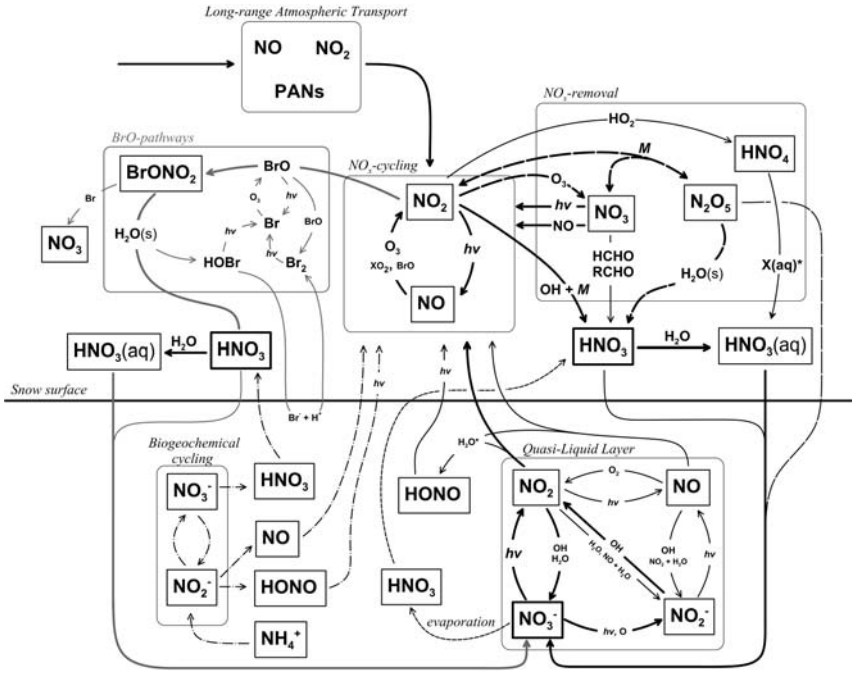
Mats P. Björkman

Norwegian Polar Institute and University of Oslo

Snow can cover extensive parts of the northern hemisphere's land masses and by this, set the condition for the terrestrial life in the north. The snow cover also acts as a large reservoir for atmospheric nutrients, such as the reactive nitrogen compounds: nitrate (NO3-) and ammonium (NH4+), on their transit into terrestrial systems. The NO3- found in snow and ice originates from atmospheric nitric acid (HNO3), or particle bound nitrate (p-NO3-), which dissolves upon contact with snow. The HNO3 in turn is belived to be the main sink of a range of atmospheric reactive nitrogen compounds (as nitric oxide, nitrogen dioxide and peroxyacyl nitrates) and where the deposition rate of HNO3 is important for the overall atmospheric life time of these oxidized nitrogen's. However, the snowpack NO3- reservoir has proved to not be an ultimate sink. Before its release to downstream ecosystems during snow melt, the snowpack NO3- is involved in an active atmospheric cycling. The understanding of NO3- depositional, post-depositional, and melt processes are therefore of importance when investigating; the nutrient availability in the Arctic, interpreting ice core records, and assessing the chemistry of the Arctic atmospheric boundary layer.

For Ny-Ålesund snow the NO3- deposition was found to be dominated by the incorporation and scavenging of HNO3 and p-NO3 during precipitation, and where this wet deposition shows large inter-annual variations due to sporadic events with high NO3- delivery. Similar events of enhanced deposition were also evident for nitrate dry deposition due to elevated atmospheric HNO3 and p-NO3- concentrations and favourable boundary layer stabilities. Compared to wet deposition the dry deposition was found to be modest and only contributed to around 14% of the total NO3- winter deposition. However, this dry deposition outnumbered any post-depositional loss of nitrate (as NO3- photolysis or HNO3 evaporation) during a surface snow spring campaign. Furthermore, the porous snow allows atmospheric processes to occur within its intra pore space, leading to a rapid re-deposition of oxidized nitrogen released from deeper buried snow layers or the soil below. Apart from wet and dry deposition, the only other process relevant for the overall NO3- budget was found to be the final release of ions during snowmelt, which leads to a near complete removal of snow derived NO3- from the small glaciers around Ny-Ålesund.

This study is a sum-up of a 4 years PhD work, were the fieldwork has been funded through SSF and were several of the long-term monitoring programs in Ny-Ålesund has been used. Furthermore, the project has benefitted from extensive collaboration with several of the institutes working in Ny-Ålesund (CNR IIA, CNR ISAC, NILU, AWI, NPI and ITM).



Nitrate processes important for Ny-Ålesund snow.

How old is the youngest tectonics in Svalbard?

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Svalbard locates along the De Geer Transform Fault that separates the kinematics of North Atlantic and Arctic Ocean and are a continental rise along its north-eastern side. A fold and thrust belt of Paleogene age boards the Western margin of the Spitsbergen with a NNW-SSE trend. The last recognized tectonic event in the area is dated back to Oligocene times. Nervertheless evidences for younger tectonics of Neogene-Quaternary ages exist and include:(i) the occurrence of Quaternary volcanism and thermal springs in the northern part of Spitsbergen; (ii) the existence of moderate to stronger magnitude earthquakes; (iii) tectonically controlled glacier and fluvial drainage; (iv) uplift rate from GPS measurements higher than those predicted by postglacial rebound models.

In this work we present the results from a multiscalar study performed in the Brøgger Peninsula (NW Spitzbergen) where the northermost part of the West Spitzbergen Fold and Thrust Belt crops out with a local NNE to NE vergence. The study span from the outcrop scale investigations to the satellite image analysis.

Structural field data analysis showed the presence of a main N-S fracture system with faults and associated cleavage compatible with a general right-lateral sense of shear. This system offset the E-W and NW-SE compressional faults of the Oligocene thrust and fold tectonics. The N-S fault and fracture system are characterized by the presence of near surface to sub aerial mineralizations on their surfaces, including kinematic indicators as well as the presence of deformed Quaternary clastic, unconsolidated deposits within their shear zones. Field investigations also revealed the existence of N-S step alignments in the marine tarraces and fluvio-glacial deposits. Those steps locates along the northern projection of the N-S trending faults cutting the Meso-Cenozoic rocks.

A lineament domain analysis was done in the Brøgger Peninsula to further highlight the Neogene-Quaternary tectonics in Svalbard. The analysis revealed the existence of cluster of azimuthal sets of lineament, called domains. Three main lineament domains exists in the Brøgger Peninsula oriented NNW, WNW and NW. Lineaments of the NNW domain are spatially clustered along the main ice drainage network thus suggesting/supporting their tectonic control. This domain is compatible with the N-S, right lateral, fault system with its associated fracturing identified during the structural field investigations. The WNW and NW domains show a uniform spatial distribution and may easily relate to the compressive Oligocene fault and fracture system associated with the building up of the Western Spitzbergen Fold and Trust belt.

On the basis of these data a tectonic model is presented suggesting that the found NNW lineament domain in the Brøgger Peninsula reflects the deeper structural grain of the crust related to the offshore active transtensional regime with dextral movement, along the De Geer Fracture Zone.

This tectonic pattern propagates inland on the Western margin of the Spirtzbergen superposing the older tectonic transpression responsible for the building up of the Western Spitzbergen Fold and Thrust Belt.

MONITORING THE MARINE-TERRESTRIAL ENVIRONMENT OF KONGSFJORDEN

Birdmap: Tracking the migration and wintering areas of arctic birds with new technology and large scale research cooperation

Børge Moe and Sveinn Are Hanssen

Norwegian Institute for Nature Research, Norway

Marine habitats in the Arctic and North Atlantic are under pressure from several anthropogenic factors, including climate change, pollution, harvesting, over-exploitation and habitat destructions. To understand the potential impacts on marine biodiversity, there is an urgent need to determine distributions and habitat preferences of potentially vulnerable species. Seabirds spend more than half of the year away from their Arctic breeding grounds, but their migrations and non-breeding distributions are poorly understood. We have used new logger technology, small light-level geolocators, to track the migration and non-breeding distribution of several seabird species breeding in Svalbard, with Ny-Ålesund as the main study site. By cooperating with other research groups using the same methods at different breeding colonies in the North Atlantic, we have covered large parts of the breeding range of different Arctic seabirds. Here we will outline the study model and present recent results for selected species, including previously unknown wintering areas and migration routes as well as sensitive marine hotspots. The results show that seabird migration connects Svalbard with distant marine areas, even at the southern hemisphere, and highlight the importance of international management for ensuring global ocean health.

A natural anti-predation experiment: Predator control and reduced sea ice increases colony size in a long-lived duck

Sveinn Are Hanssen[1], Børge Moe[2], Bård-Jørgen Bårdsen[1], Frank Hanssen[2], Geir W. Gabrielsen[3]

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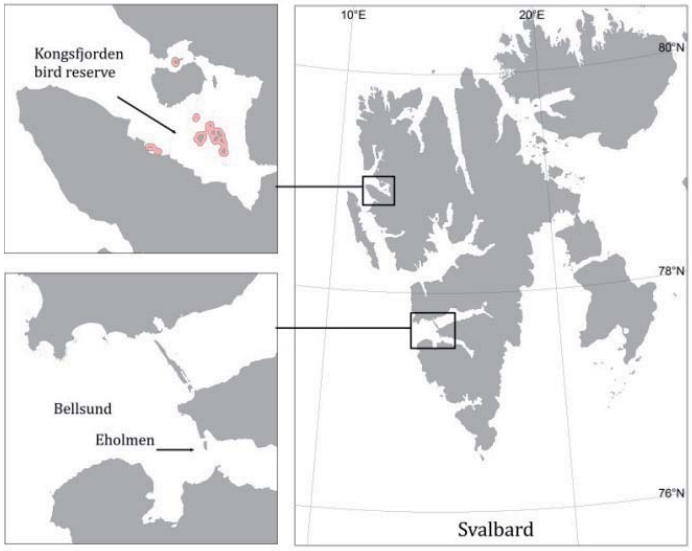
Anthropogenic impact on the environment and wildlife are multifaceted and far-reaching. On a smaller scale, controlling for instance predators has been increasing the yield from local natural prey resources. On a larger scale, human-induced global warming is worldwide and it is even more pronounced in the scarcely populated northern latitudes. The clearest indication of a changing Arctic climate is an increase in both air and ocean temperatures leading to reduced sea ice distribution in the Arctic. Population viability is for long-lived species dependent upon adult survival and recruitment. Predation is the main mortality cause in many bird populations, and egg predation is considered the main cause of reproductive failure in many birds.



To assess the effect of predation and climate, we compared population time series from a natural experiment where a trapper/down collector has been licensed to actively protect breeding common eiders *Somateria mollissima* (a large seaduck) by shooting/chasing egg predators, with time series from another eider colony located within a nature reserve with no manipulation of egg predators. We found that actively limiting predator activity led to an increase in the population growth rate and carrying capacity with a factor of 3-4 compared to that found in the control population. We also found that population numbers were higher in years with reduced concentration of spring sea ice, probably because breeding islands are less accessible to predators when ice is lacking. We conclude that there was a large positive impact of human limitation of egg-predators leading to higher population growth rate and a large increase in size of the breeding colony. We also report a positive effect of warming climate in the high arctic as reduced sea-ice concentration was associated with higher numbers of breeding birds.

Endocrine disruption by persistent organic pollutants and heavy metals in Arctic seabirds

Olivier Chastel[1], Paco Bustamante[2], Jan Ove Bustnes[3], Geir Gabrielsen[4]

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In addition climate change, Polar Regions are subjected to both natural (heavy metals) and anthropogenic (metals and persistent organic pollutants (POPs such as pesticides and PCBs) inputs due to global transport of elements in the atmosphere and through oceanic circulation. In the Arctic, high contaminant levels have been documented in several top predators such as polar bears, whales, seals and several seabirds. Because of structural similarities with endogenous hormones, abilities to interact with hormone transport proteins, or abilities to disrupt hormone metabolism, many POPs can mimic or in some cases block the effects of the endogenous hormones. In either case, these chemicals disrupt the normal actions of endogenous hormones and, thus, have become known as endocrine-disrupting chemicals. However, very little is known about the potential effects of environmental pollution on the stress response. This endocrine mechanism allows the individual to cope with short- and long-term adverse and unpredictable changes in environmental condition (food shortage, inclement weather, presence of predators, social aggressive interactions). Since contaminants may impair the stress response, it is crucial to pay more attention to the contaminant/ stress susceptibility relationships, because Arctic seabirds are often facing short-term (inclement weather, food shortage) or longer-term stressors (climate change). I this talk, I will present the main results of the AWIPEV project ORNITHO-ENDOCRINO which aim at assessing the effects of persistent organic pollutants (PCBs and pesticides as well as emerging persistent organic pollutants such as brominated flame retardants (BFRs) and perfluorinated compounds (PFCs)) and heavy metals (mercury) on the stress axis of an arctic-breeding seabird, the Black-legged kittiwake (Rissa tridactyla) in the Kongsfjord, Svalbard. This research project also investigates how contaminants disrupt endocrine mechanisms involved in the phenology (timing of breeding) and reproductive investment (clutch size, parental behaviour) via an impaired release of corticosterone (stress hormone). This is done by testing the susceptibility of the reproductive hormones (LH and sex steroids for the timing of breeding and prolactin for parental behaviour) to the contaminants/ corticosterone interactions. This project, funded by the French Polar Institute (IPEV) relies on the long term collaboration between CEBC, University of La Rochelle and the Norwegian partners (NP and NINA) on the eco-physiology of polar seabirds.

Migratory connectivity and the role of parasites

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Migratory animals annually experience at least two different parasitic faunas and are expected to enhance spread of diseases between habitats and facilitate cross-species transmission. But recent research shows that migration also allows the host to decrease the disease levels in the population by leaving behind both infected habitats and sick individuals. The objectives of this study were to determine the risk of infection by parasites and pathogens in relation to habitat and migration strategy, to elucidate the interaction between infection and body mass, and to identify the transmission route of the zoonotic parasite Toxoplasma gondii to the high Arctic. We examined immune system activity and parasitic infestation of individuals from sedentary and Arctic migratory populations of wild geese, as well as 32 hand-raised barnacle goslings from both temperate and Arctic regions. Specific and non-specific immune system parameters were quantified from a single blood sample. Sedentary goslings in the Netherlands were weighed significantly less, displayed more pathological changes, greater parasitic infestations, and higher non-specific immune activity compared to their Arctic conspecies. Adult geese were seropositive against T. gondii at all locations, while young geese were seropositive to T. gondii only during spring migration. We suggest that T. gondii enters the Arctic ecosystem with migratory birds, which are infected on wintering grounds. Further, we suggest that migration reduces pathogen pressure in Barnacle geese, as goslings raised in the Arctic showed minor effects of pathogens and faster growth compared to the sedentary population.

NY-ÅLESUND MONITORING ACTIVITIES (SPACE/ATMOSPHERE II)

ISACCO-Ionospheric Scintillations Arctic and Antarctic Campaign Coordinated Observations

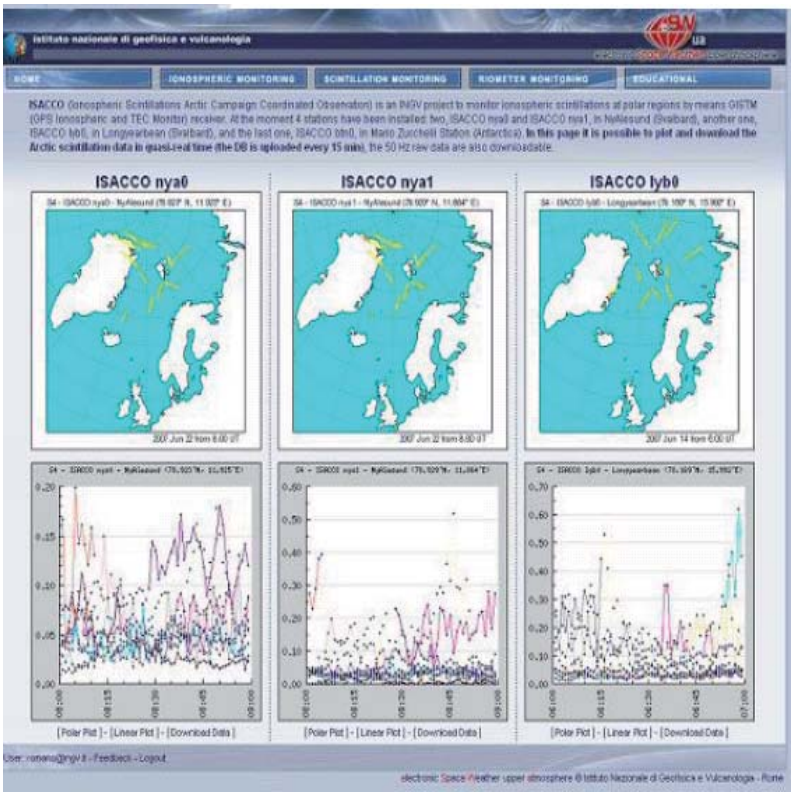
Giorgiana De Franceschi, Vincenzo Romano, Lucilla Alfonsi, Luca Spogli

Istituto Nazionale di Geofisica e Vulcanologia, Rome (Italy)

The ISACCO project was born in 2003 with the goal to monitor the ionospheric scintillations by means of the first GISTM (GPS Ionospheric Scintillations and TEC Monitor) receiver deployed at Ny Ålesund. Nowadays the project counts three similar receivers in the Arctic (Longyearbyen and Ny Ålesund, Svalbard Islands) and other three receivers in Antarctica (Mario Zucchelli station and Concordia station). ISACCO is still ongoing to contribute to the international efforts to assess the scintillations weather and climatology at both the poles. There is a great interest in the field motivated by the necessity of a better scientific understanding, but also pushed by the GNSS (Global Navigation Satellite System) users' needs. In fact, the GNSS technology is widely used all over the world (precise positioning, agriculture, drilling, etc…) and its reliability can be severely jeopardized by scintillations.

In this frame ISACCO is asked to participate to many international initiatives, such as EC (FP7, ERC) and ESA projects. Among the others we want to highlight the GRAPE (GNSS Research and Application for Polar Environment) Expert Group, endorsed by SCAR (Scientific Committee on Antarctic Research). GRAPE wants to create and maintain distributed networks of specialized GPS/GNSS Ionospheric Scintillation and TEC Monitors at high latitudes to identify and quantify the mechanisms that cause scintillation and to develop ionospheric scintillation climatology, tracking and mitigation models to improve prediction capabilities of space weather.

In this context some scientific results and technological achievements obtained on the base of the Arctic observations will be presented to give a synthetic but wide scenario of ten years of activity in the field.



Building a state-of-the-art space geodetic observatory in Ny-Ålesund: a fundament needed to detect minute changes in the Earth system over time

Oddgeir Kristiansen

Geodetic Institute, The Norwegian Mapping Authority

The new state-of-the-art observatory that the Norwegian Mapping Authority (Kartverket) is establishing in Ny-Ålesund, will be a part of a global network that allows us to monitor the Earth system.

In this paper we will present the value of precise measurements and the power of modern geodesy. How improvements in measurements have pushed geodesy beyond the traditional disciplinary boundaries and into research domain such as climate and atmospheric science. Geodetic observations can measure changes in the Earth's shape, rotation and gravity field that offer unique insights into dynamic processes and mass transport in the Earth system such as; millimetre per year changes in the sea-level, ice melting, and tectonic motion. This paper will assess what modern space geodesy can provide, today and in the future. Today geodesy delivers precision to one part per billion, however it can be envisioned in the foreseeable future a precision of one part per trillion. We will present some result from Ny-Ålesund and will address how NMA will take part in the future development of geodesy.

Measurement of Cosmic Radiation with Emphasis on Neutrons at High Geomagnetic Latitudes

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Air crew members and airline passengers are continuously exposed to cosmic radiation during their flights. Particles ejected by the sun ("Solar Particle Events" – SPE's) during periods of high solar activity contribute to this exposure. In rare cases the dose from a single SPE might even exceed the annual dose limit of 1 mSv above which dose monitoring of air crews is legally required. Because neutrons contribute the largest fraction of all particles from secondary cosmic radiation to effective dose of air crew, we measure the energy distribution of secondary neutrons at the AWIPEV station by means of a Bonner sphere spectrometer. Location at high geomagnetic latitudes is important because the intensity of these particles during an SPE is expected to be much higher than for example at mid-latitudes or close to the equator, due to the shielding of the Earth's magnetic field. If successful the project will provide first experimental data on the time-dependent energy spectrum of neutrons produced in the atmosphere during and after an SPE.
In 2013 the Bonner sphere spectrometer was upgraded by replacing the formerly used SP9 ^{3}He proportional counters by larger LND ^{3}He proportional counters. Test measurements performed on the Zugspitze mountain (altitude 2650 m) showed that the upgraded spectrometer will probably provide a factor 4 larger count rate.
Here the system is described in detail and first results obtained with the upgraded spectrometer will be shown and compared to previous data and spectra obtained on the Zugspitze mountain.

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New insights for multimedia distribution of PAHs and PCBs at Ny-Ålesund of the Arctic

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Remote polar areas with high latitude regions and low temperatures have been receiving acute attention in studying the transport and behavior of persistent organic pollutants (POPs). When latest deposition and evaporation processes of POPs occurred, the warming climate and increasing human activities in the areas also changed their distribution and accumulation trends. Thus, it urges new insights into the environmental distribution of POPs so as to assess their polar behavior. In the present work, multimedia samples were collected from Ny-Ålesund (78°55'N, 11°56'E), Svalbard of the Arctic in July 2012, to investigate the levels and trends of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs), two typical groups of POPs. Concentrations of 30 PCBs and 16 PAHs in 13 soil, 13 plant, 7 reindeer dung and 16 air samples as well as 8 seawater and 8 sediment samples were measured. Their concentration profiles were shown in Fig. 1.

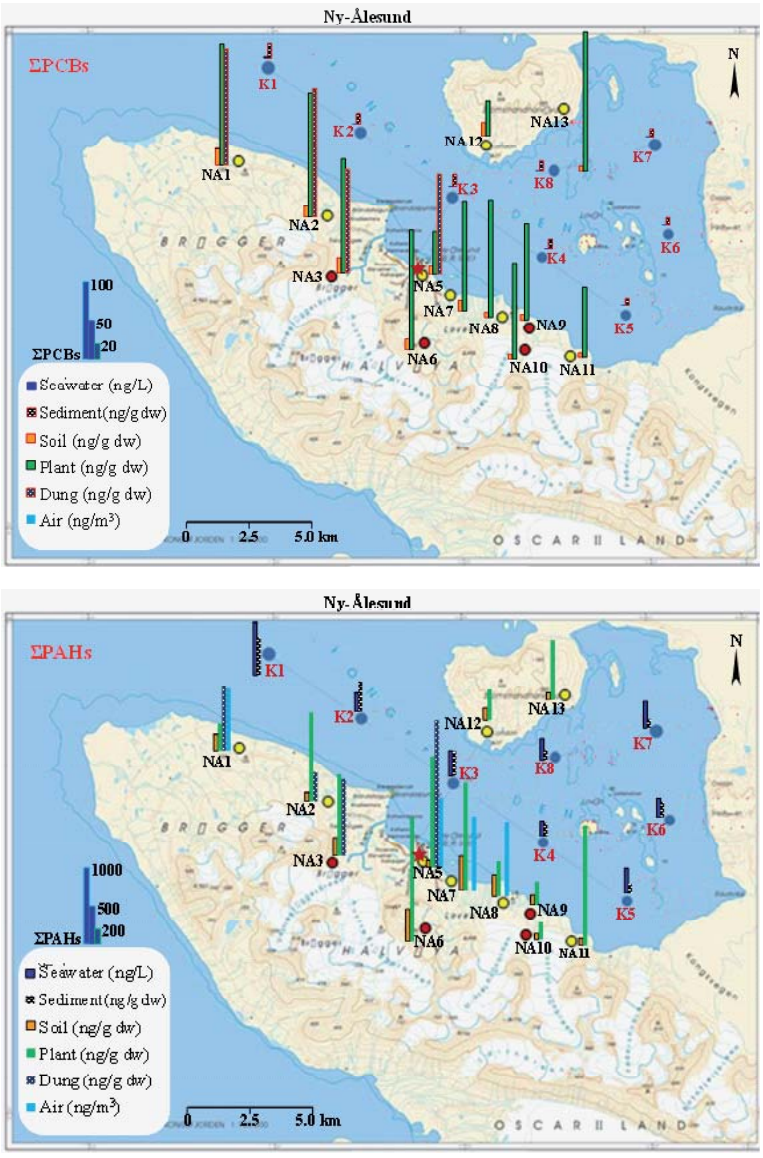

Figure 1: Multimedia concentrations of 30 PCBs (ΣPCBs) and 16 PAHs (ΣPAHs) at Ny-Ålesund of the Arctic.

The average PCB concentration in soils was 6.16 ng/g dry weight (dw) (range 2.95 ~ 10.85 ng/g), less than that in plant (mean 65.50 ng/g) and dung samples (mean 72.00 ng/g). In the three compartments, the average PAH concentrations were 197.70 ng/g, 868.12 ng/g and 1141.53 ng/g, respectively. The PCB and PAH levels were higher than those in the samples collected from the same area in 2007, which indicated more pronounced deposition and increased pollution of the POPs. In air sampled by passive and active air samplers, the average PCB and PAH concentrations in particle phase (0.051 ng/m3 and 836.73 ng/m3) were at an order of magnitude greater than those in gas phase (0.004 ng/m3 and 81.14 ng/m3), respectively. At Kings Bay of the area, mean concentrations in seawater and sediment respectively were 0.19 ng/L and 6.40 ng/g for PCBs as well as 332.30 ng/L and 246.00 ng/g for PAHs. Furthermore, not only PCBs but also PAHs behaves the highest concentrations at the site K1 and the lowest concentrations at the site K5, which might attribute to inlet of mud and sand along with melting water from glaciers.

In conclusion, the results presented here suggested the new distribution characteristics of PCBs and PAHs in the multimedia environment of the area. Further, this will be testified by the composition profiles of individual PCBs or PAHs.

Acknowledgements: The study was supported by the Chinese Polar Environment Comprehensive Investigation & Assessment Programmes (2012-02-01, 2013-04-01, 2013-04-03), Marine Public Welfare Scientific Research Projects (201105013), Foundation of Polar Science Key Laboratory (KP201208) and Polar Strategic Research (20120320), China.

Source apportionment of individual soot particles by electron microscopy

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Soot is an important component of the Arctic aerosol, as it has strong impacts on the atmospheric radiation balance and on ecosystems. First, is strongly adsorbing and thereby changing the atmospheric radiation balance. Second, soot deposited on the surface may decrease the albedo of snow and, thus, lead to increased melting. Third, soot particles may act as carrier for persistent organic pollutants which are transported to the Arctics and become enriched in the ecosystem. At the Zeppelin Mountain station in Ny Ålesund, an annual cycle in black carbon (BC) concentrations was observed by Eleftheriadis et al. (2009). In the time period from 1998 – 2007, the monthly averages reached a maximum of ~ 80 ng/m^3 in February/ March and minimum concentrations of 0 – 10 ng/m^3 from June to September. In addition, a small decreasing trend of about -9.5 ng/m^3 per decade was observed from 2001 to 2007. The BC sources are located in Northern and Central Russia during winter and in Eastern Europe during summer (Eleftheriadis et al., 2009). Based on electron microscopical investigation of individual particles, Weinbruch et al. (2012) pointed to cruise ships as source of soot during the summer season. The source regions reported by (Eleftheriadis et al., 2009) could not be verified by Weinbruch et al. (2012). In addition, the role of local and regional soot sources (e.g., coal burning on Svalbard) is not clear. Therefore, we try to develop a chemical/mineralogical fingerprint for the different soot sources on Svalbard. Preliminary transmission electron microscopy (TEM) work has shown that the presence of nanometer-sized lead inclusion within soot agglomerates seems to be a fingerprint for coal burning in Longyearbyen. Minor contents of potassium within soot may serve as fingerprint for biomass burning. A fingerprint for soot from Diesel engines still has to be developed. The nanostructure of primary particles is currently investigated by us as a potential fingerprint for Diesel soot.The organic particulate phase in the atmosphere is considered an important carrier for long-range transported organic pollutants (i.e. polycyclic aromatic hydrocarbons =PAH). The role of the particulate phase has earlier been identified as important source for Arctic organic pollution (Halsall et al. 1997). However, soot, as pollutant carrier is still not sufficiently investigated for the Arctic atmosphere. The results of a pilot study where electron microscopically characterisation of particles were combined with trace analytical methods will be presented.

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Seasonal variability of ice nuclei at Svalbard

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Ice nuclei (IN) are inevitable ingredients for the formation of rain from mixed-phase clouds over large areas of the earth. Any attempt to model the formation of clouds and rain as a cause-and- effect relationship requires information on the number concentration of ice nuclei as a function of supercooling and supersaturation for a situation given. However measurements of ice nuclei are scarce, and there is no information available on the 'climatological' variability of IN and their properties.
Within the EU FP7 Collaborative Project BACCHUS (Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding, coordinated by ETH Zurich) starting in December 2013 we propose to measure the number concentration of IN at Svalbard for a period of 2-3 years in a near-daily frequency. Svalbard will be one of several sites to monitor cloud-active aerosols (Figure 1). IN number concentration (and partly composition) will be established as function of season, airmass history, and aerosol chemical and physical data.

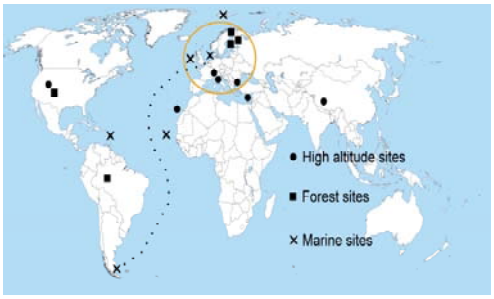

Figure 1: BACCHUS monitoring sites.

Figure 2: IN counter FRIDGE.

Samples will be collected automatically by electrostatic precipitation of aerosols on silicon substrates (Bundke et al., 2008) and will be analyzed in the lab at Frankfurt by the IN counter FRIDGE (Klein et al, 2010), an isothermal static vapor diffusion chamber (Figure 2) , addressing the deposition and condensation nucleation modes. Elemental and morphological analysis of individual IN in selected samples will be done by Environmental Scanning Electron Microscopy (ESEM, Zimmermann et al., 2008).

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Size distribution, chemical composition and source apportionment of aerosol collected at Ny-Ålesund (Svalbard Islands) in 2010 and 2011 summer campaigns

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The Arctic is undergoing relevant variations of marine and coastal eco-systems (especially, in extension and thickness of the annual and permanent sea ice and in the permafrost superficial structure), as a consequence of the present climate positive forcing. Arctic aerosol plays a relevant role in the complex climate-environment feedbacks by scattering and absorption processes of the solar radiation and by cloud formation, so affecting the albedo and the hydrological cycle. However, large uncertainties affect the quantitative evaluation of such effects, as well as the sign of the variation. In order to improve our knowledge on the Arctic aerosol, two sampling and measurement campaigns were carried on 2010 and 2011 at Ny Alesund, Svalbard Islands, from March to September. Direct observations included absorption (black carbon) and nephelometric (aerosol optical properties) measurements, and high-resolved aerosol particle sizing. Sizing was carried out by an integrated system (TSI SMPS and TSI-APS), able to give a 106-size-classes spectrum (10 nm - 10 um) every 10 minutes. Size-segregated aerosol was collected by two PM10 low-volume samplers (on Teflon filters for inorganic components and on quartz filters for EC-OC measurements), two multi-stage impactors (4-stage (>10, 10-2.5, 2.5-1, < 1 um) and 12-stage (> 10 um to 0.040 um), for ions, principal metals and elements analysis), and a medium-volume PM10 collector (for trace metals content). Here, we will show the most relevant results obtained by the on-site measurements of the optical and physical (size) aerosol properties and by the chemical analysis of the PM10 and multi-stage aerosol samples. In particular, a Positive Matrix Factorization (PMF) multivariate statistical analysis was carried out on the 2010 PM10 samples, collected with a 24-h resolution. Preliminary results show that 6 sources account for the majority of the aerosol contributions: primary marine (sea salt) particles, secondary marine (biogenic nss-sulphate and MSA) emissions, secondary long-range (mainly anthropogenic) transport, nitrate, and two crustal sources (one from local emissions and the other from long-range transport). The differentiation between local and long-range transport dust was accomplished by the REEs speciation: dust from continental source were characterised by a higher light REEs / heavy REEs ratio. Cluster backward trajectories analysis shows large contributions of air masses coming from North Russia and North Europe, especially in spring.

NY-ÅLESUND MONITORING ACTIVITIES (SPACE/ATMOSPHERE III)

Major, trace and Rare Earth (REEs) elements in aerosol samples collected at Ny-Ålesund (Svalbard Islands) during the 2010 sampling campaign

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Aerosols and their interactions with clouds and snow surface can have a significant impact on the radiative balance in the Arctic. This holds true especially for the spring season when the Arctic environment is climatologically very sensitive and intrusion of air masses with a high aerosol load from northern continental regions is favoured. In particular, the atmospheric transport from the highly industrialized areas at mid latitudes of the Northern Hemisphere represents a major delivery pathway of trace metals as well as ionic species to the remote Arctic environment. In order to achieve a better knowledge of the timing and impact of such processes, a continuous aerosol sampling during spring and summer seasons was carried out at Ny-Ålesund (Svalbard Islands) using PM10 low-volume (24 h resolution) and medium-volume (96 h resolution) samplers with Teflon filters. The samples chemical characterization was carried out by Ion Chromatography (IC) and Inductively Coupled Plasma – Sector Field Mass Spectrometry (ICP-SFMS). Here, preliminary results on the metal aerosol content are reported. In order to improve the sensitivity of the ICP-SFMS technique for the daily PM10 samples, an APEX desolvatation system, equipped with an ACM module able to reduce the oxide interferences, has been employed as a sample introduction system. Such a set-up has made possible the quantification of trace metals at sub-ppb levels. Na, K, Ca, Al, Zn and Fe were the metals showing the highest concentrations (at ng/m^3 level), while the other elements were present at few pg/m^3 levels. The enrichment factors, calculated considering Al as crustal reference, are higher than 100 for Zn, Mo, As, Cd, Hg, Pb, pointing out their dominant anthropic origin. The chemometric investigation on the experimental results shows an evident separation between spring and summer arctic PM_{10} samples. Principal Component Analysis evidences a strong correlation among Al, Mn, Ti and Fe, as expected for metals mainly coming from crustal sources (both from local inputs and long-range transport). A correlation among As, Cu, Hg, K, Na and Pb is evident. As, Cu, Hg and Pb could be attributed to long range transport of pollutants from anthropized areas in North America and North Europe. Another PCA factor includes Cr, Ni and V. This factor could be related to emissions from fossil fuel, coal and heavy oil combustion processes. REEs fingerprint (including the so-called Europium anomaly) was used in differentiating local from long-range transport sources (mainly from North Europe in spring).

Investigating the atmospheric relationship between Carbonyl Sulfide and CO2 using solar FTIR spectroscopy and a Chemical Transport Model

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Atmospheric inversions based on CO2 concentration measurements alone can only determine net biosphere fluxes, but not differentiate between photosynthesis (uptake) and respiration (production). Carbonyl sulfide (OCS) is also taken up by plants during photosynthesis but not emitted during respiration, and therefore is a potential means to differentiate between these processes.

The stark contrast in conditions between seasons at high latitudes leads to a significant seasonality of terrestrial CO2 exchange. Especially during the polar day, the strong photosynthesis of boreal forests results in the rapid drawdown of both CO2 and OCS. This effect is most clearly seen in the measurements in the Arctic region. In addition, some studies indicate that the Arctic ecosystem is shifting from a CO2 sink to source, due to the increase of the respiration under a warmer climate. Therefore, the Arctic is of particular importance for understanding the progresses of photosynthesis and respiration.

Solar absorption Fourier Transform InfraRed (FTIR) spectra contain information about the absorption of both gases in the atmosphere. Here, we investigated simultaneous measurements of OCS and CO2 measured at 3 sites via FTIR spectrometers. These northern-hemispheric sites span a wide range of latitudes and all have multiple year time-series. The sites include Ny-Ålesund (79°N), Bremen (53°N) and Paramaribo (6°N). CO2 total columns were retrieved by GFIT and then calculated to CO2 column-average dry-air mole fractions. OCS profiles were obtained using SFIT4, and tropospheric columns are calculated. Both retrieved CO2 and OCS show clear seasonal variation, and the seasonal amplitude in Ny-Ålesund is the biggest. (fig. 1).

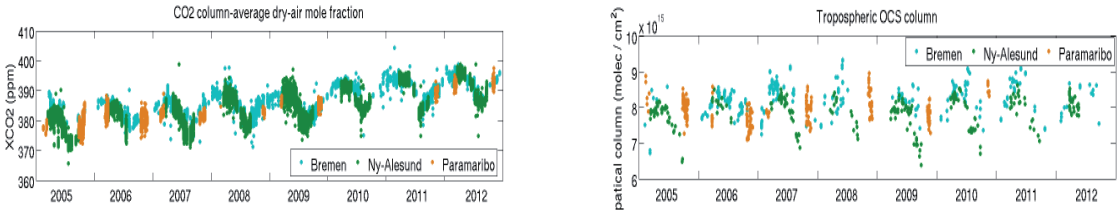

Figure 1: Time series of retrieved column OCS and XCO2 at the 3 sites.

We simulated OCS and CO2 with the GEOS-Chem model using different fluxes, and compared to our measurements. The OCS simulation with the initial fluxes underestimates the seasonal amplitude, while after increasing the plant uptake by 2, the result matches the measurements well. The seasonal amplitude of CO2 simulated with CASA NEP flux is too small comparing to the measurements. The Simple biosphere model (SiB) which simultaneously models biospheric fluxes of both OCS and CO2, was introduced to GEOS-Chem. And the new simulations match the measurements better.

Atmospheric Mercury Measurements in the Arctic Troposphere

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The Arctic region is surrounded by some of the most industrialized regions of North America, Asia, and Europe. The pollutants emitted from these regions, via long-range transport, reach these arctic regions and their lifetime in the troposphere depends on local chemistry and removal processes. Mercury exists in different physical and chemical forms and inter-conversions between different species influence its distribution patterns and biogeochemical cycling. The current estimated mean global tropospheric mercury residence time of the order of one year is sufficient for long-range atmospheric transport, explaining its global distribution, even in remote environments such as the Arctic and Antarctica which are considered to be the last pristine environments of the earth relatively uninfluenced by human activities. In addition, mercury has unique characteristics that include the transformation to more toxic and water-soluble compounds that may potentially become bioavailable. These chemical-physical properties have placed mercury on the priority list of an increasing number of International, European and National conventions, and agreements, aimed at the protection of the ecosystems including human health (i.e. GEO, UNEP, AMAP, UNECE, HELCOM, OSPAR), as well as stimulated a significant amount of research including experimental and modelling studies in order to understand the mercury cycle in Polar environment and its impact to these ecosystems. The discovery of the arctic springtime phenomena, termed as “Atmospheric Mercury Depletion Events” (AMDEs), currently observed at both poles, during which elemental gaseous mercury (Hg0) may be converted to more reactive forms [Gaseous Oxidized Mercury (GOM) and/or Particulate Bound Mercury (PBM)], through photochemically initiated reactions involving halogens, that may accumulate in polar ecosystems, provided a great impetus to atmospheric mercury chemistry in Polar Regions and the use of high-time resolution mercury speciation instrumentation to elucidate this systematic phenomenon which could result in an important net input of atmospheric mercury into the polar surfaces. In addition, recent studies highlight that a fraction of deposited mercury may be re-emitted back into the atmosphere during and after snowmelt. The mechanism of the conversion of Hg0 into GOM and/or PBM is, however, not well understood neither are the role played by snow and ice surfaces of these regions, and the host of chemicals existing therein. In addition, the ratio between deposition and reemission is an important parameter that determines the impact of mercury in the Polar environments. This work presents atmospheric mercury studies conducted in the Arctic troposphere during the last decade and our current knowledge of the mercury chemistry in the arctic troposphere.

Measurements of optical properties of atmospheric aerosols within atmospheric boundary layer at Ny-Ålesund

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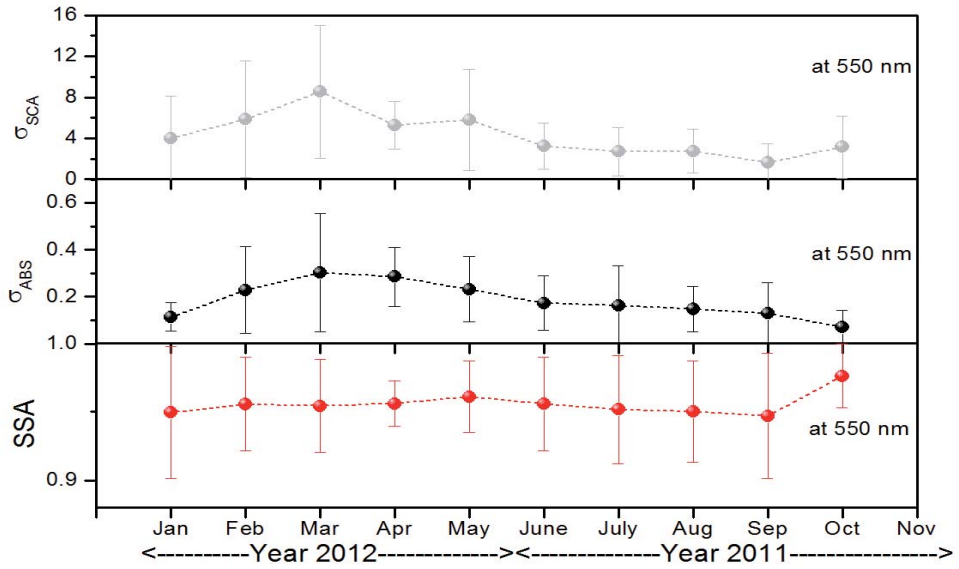
The Zeppelin station has provided long-term observation of aerosol properties at an elevated location (~ 475 m msl), above the convective atmospheric boundary layer (ABL) which is typically of few hundred meters over the Polar Regions. In the light of the above, current study presents the measurements of aerosol optical properties [as shown in Figure 1] measured from Gruvebadet at Ny Alesund in Norwegian Arctic region, which is at a low elevation of ~10 m msl; and within ABL. These measurements, together with Zeppelin station provide the long-term data from the two heights, enabling to examine the vertical heterogeneity in aerosol properties. This also provides insight into the role of occurrence of local surface pollution (shipping emissions, increased scientific activities and increased tourism) and might help in quantification of local (inside the polar front during summer months) and long range transport. Our measurements demonstrated that the aerosol concentrations within boundary layer are significantly influenced by local and regional transport especially in summer months. The spectral measurements of scattering and absorption coefficient are used to estimate the Single Scattering Albedo (SSA), shown in Fig.1, depicted more or less steady SSA at ~ 0.95, except during November. The results and implications would be discussed.



Chemical size distributions from size-segregated samples collected at the Gruvebadet laboratory

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Atmospheric aerosols are known to have important effects on natural environment; many properties of aerosol particles play a role in determining the nature and the relevance of such effects. In particular, both chemical composition and particle dimensions influence the interaction between particles and solar/terrestrial radiation, thus affecting the Earth radiation budget. Further, these properties play a role in the cloud and fog formation induced by aerosol and in the effects connected to the modification of the microphysical cloud properties, in the long-range transport processes and in the deposition patterns of anthropogenic pollutants over the polar areas.

The study of the chemical composition of aerosols as a function of particle dimensions can help in the identification of the main aerosol sources and can give information on the atmospheric processes occurring during atmospheric transportation.

In this work, we report the results on size distribution of the Arctic aerosol sampled at Ny Ålesund, at the recently installed Gruvebadet station. The collection of size-segregated samples was achieved with a Small Deposit area Impactor (SDI) by Dekati Ltd, a 12-stages cascade impactor with cut points in the range from 45 nm to 8.5 μm). Sampling was performed with a 4-days resolution on nuclepore and kapton foils.

Size segregated samples were analyzed for elemental characterization by means of simultaneous Particle Induced X-ray Emission – Particle Induced γ-ray Emission (PIXE-PIGE) measurements at the INFN-LABEC laboratory in Florence. PIXE is an unrivaled technique for the study of the dust component of aerosol, due to its high sensitivity to all crustal markers, except oxygen and carbon. PIGE was coupled to PIXE to get a more accurate estimate of light elements. It is worthy to highlight that these techniques do not need any sample pre-treatment, thus minimizing contaminations.

At Gruvebadet, the joint effort of different research groups has allowed the installation of a wide set of instruments for the study of different aerosol properties; in particular, results on the chemical compositions of the daily PM10 samples were also used to identify interesting and representative events to be deeply characterized by means of the analysis performed on the multi-stage impactor samples.

Results from the study on such events will be shown. In particular, the measurements on size-segregated samples allowed the identification of both local and long-range transport episodes, evidencing contributions from dust, sea spray and anthropogenic aerosol. Therefore, they have demonstrated to be an important tool for aerosol source identification. Further, some preliminary results on seasonal aerosol modes trends will be shown.

Aerosol profiles and Ship plumes over Ny-Ålesund during 2011-2012 field campaigns

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Aerosols are fundamental for understanding climate change (IPCC, 2007; Kaufman et al., 2002). The effects of aerosols on the Earth's radiation budget depend mostly on size and chemical composition and a fundamental role is played by the Black Carbon fraction and the aerosol vertical distribution (Samset et al., 2013).
Thus, aerosol vertical profiles were conducted over Ny-Ålesund along 1 spring campaign (2011) and 2 summer campaigns (2011 and 2012) in the framework of the of the 2009 "ARCTICA" project and of the CICCI program (Cooperative Investigation of Climate-Cryosphere Interaction; http://ny-niflheim.nilu.no/cicci//).
A helium-filled tethered balloon was fitted with: a miniaturized electrical nanoparticle detector (miniDiSC); a novel micro-Aethalometer (AE51, Magee Scientific) for Black Carbon (BC) absorption measurements; an Optical Particle Counter (GRIMM *1.107*; 31 size classes between 0.25 to 32 μm); a meteorological station (LSI-Lastem and Vaisala Tethersonde TTS 111) and a miniaturized cascade impactor (Sioutas SKC with 2 impaction stages: <1 μm, >1 μm) to collect samples of particulate matter.
Main results evidenced a bimodal aerosol stratification along height with highest frequencies at 100-300 m and 600-700 m. Moreover, finest particles (d_p<250 nm) were layered mainly closer to the ground, where they showed higher concentration compared to accumulation mode particles (250-1000 nm). At the same time a decrease of BC concentration was observed. The thermal structure of the lower troposphere (ground-level and high altitude thermal inversions) favored this phenomenon. As a results aerosols of different sizes were layered in a different way in the lower troposphere.
Ship impact over Ny-Ålesund was also estimated analyzing 112 vertical profiles carried out in summer. From these the ship plumes development over Ny-Ålesund was valuated: BC and aerosol data reached values as high as 100-1000 times higher than background, due to the ship emissions in the port and in the harbour. Thus the shipping emission can heavily affect the environment of the Ny-Ålesund area and evidenced their role in the pollution of the Arctic regions.

References:
IPCC: Climate Change 2007
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Samset et al. (2013). Atmos. Chem. Phyis., 13, 2423-2434.

FLAGSHIP ACTIVITIES (ATMOSPHERE)

Remote sensing measurements at AWIPEV for an aerosol closure experiment

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Lidar measurements of aerosol and trace gases both in the troposphere and the stratosphere as well as photometer measurements during summer and winter have been performed by AWI in Ny-Ålesund for many years. In this presentation latest measurements of AWI's KARL lidar and sun photometers are presented. For the lidar the ability and constrains of measurements below 1km altitude due to overlap effects are discussed and an error analysis is performed. Sun photometer measurements both in Ny-Ålesund and at the Zeppelin station as well as Ceilometer (Vaisala CL51) profiles have been employed to improve the evaluation of KARL data for aerosol retrievals within the boundary layer.
The precision of the remote sensing data of the KARL lidar and the sun photometers located in the village and on the Zeppelin station will be investigated. This is an important prerequisite for aerosol closure experiments, which are requested by the Ny-Ålesund Atmosphere Flagship Programme.
Finally aerosol optical depths (AOD) from the photometers are used to estimate the percentage of aerosol located within the boundary layer as well as possible fluctuations on a minute to minute scale. Such information is important for comparison of the different aerosol in situ measurements around Ny-Ålesund.

Intercomparison of ultrafine aerosol measurements at the Zeppelin Station

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Routine year-round ultrafine size distribution measurements are performed since 2000 at the Zeppelin station, located 470 m asl. Actual experimental setup scans the size from 6 nm up to 900 nm using a Differential Mobility Particle Sizer (DMPS) and a TSI 3010 CPC giving the size distribution in 22 channels.
Since 2010, similar measurements along the spring and summer season are performed, at the Gruvebadet Lab facility (70 m asl) in the old mine building at the foot of the Zeppelin mountain. The experimental set up, a TSI Scanning mobility particle sizer (SMPS) model 3034, gives the size distribution from 10 nm up to 487 nm, in 54 channels.
Measurements performed at two different levels should able us to better define the aerosol ultra fine population characteristics inside the boundary layer, its seasonal behavior, and the relative influence of long distant transported natural or antrophogenic aerosols, but also to better quantify the influence of local sources e.g. cruise ships.
In order to be able to compare measurements carried out at the two stations, an intercomparison campaign was performed during the period March 27 to April 4 2013. First preliminary results are shown in fig. 1.
The results of the intercomparison will be presented . In addition , a new method to retrieve information of fine aerosol size distribution parameters in term of multi-lognormal fit is presented and compared with other already well known retrievals.

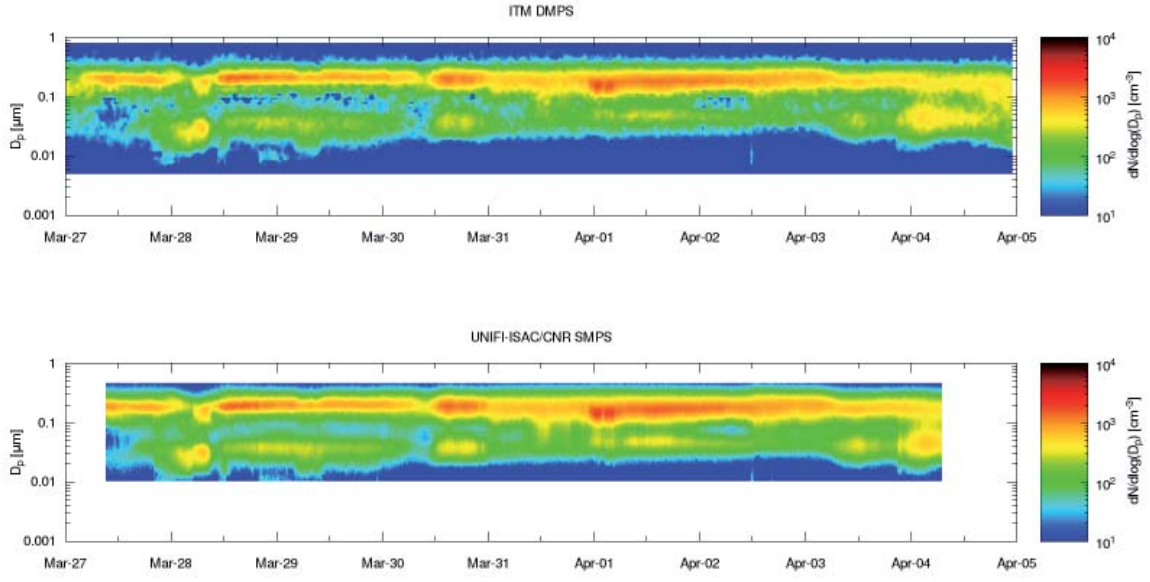

Figure 1: Contour plot of the total particle concentration as a function of time and particle size during the nine day intercomparison campaign at the Zeppelin station with the DMPS (above) and the SMPS (below).

Current and future boundary layer measurements at AWIPEV

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In this presentation an overview of boundary layer (BL) measurements at the AWIPEV station is given. Radiosounding profiles from 2003 to 2011 have been analyzed to obtain the BL altitude at stable, near-neutral and unstable conditions. It was found that during winter months the BL height can frequently be derived by surface based inversions. A statistics of their occurrences, altitudes and temperature depths is given. Normally they are up to 65m (75%-quantile) altitude and less than 1.8K (75%-quantile) deep. During summer the BL altitude can frequently be obtained by the "parcel method" (the altitude to which convective rising air parcels starting from the ground get.) Again a statistic for summer conditions is given. Even during unstable conditions the BL altitude is normally below 490m (75%-quantile).
In the second part katabatic outflows from the Broeggerbreen glacier south-west of Ny-Ålesund are discussed. During these events flux measurements by Eddy-Covariance method become wrong. These outflows are the main local disturbance in our Eddy-Covariance data detected so far. Nevertheless knowledge of small-scale disturbances of BL measurements in Kongsfjord is needed for the future. AWI will install a new weather mast at the old pier to measure conditions over the sea and estimate the spatial extend of the Broeggerbreen outflows. Further, additional flux estimates should be conducted at this site.
Moreover new equipment as a radiometer, a wind lidar and our sounding systems will be used to derive a vertical column of meteorological properties and analyze the interaction between synoptic and local effects on the BL.

Mean profiles of wind at CCT: similarity laws and the boundary layer height

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From the wind velocity and mean temperature profiles measured at Climate Change Tower CCT since 2009 (at heights of 33, 10, 5 and 3 m) a selection of well controlled cases has been studied in order to determine seasonal variations of the roughness length and to test surface layer profiles expressed as function of z/L, being L the Obukhov length determined from the turbulent fluxes measured by a sonic anemometer placed at 7.5 m height.
This approach corresponds to the widely used Monin-Obukhov Similarity Theory (MOST).
The dependence of the roughness length on the snow coverage and on the wind direction has been retrieved using almost neutral profiles. Moreover, the shape of the similarity function for wind has been evaluated in different stability conditions.
For selected time periods, vertical profiles of wind and temperature have been taken using a tethered balloon sounding system. The system is made by six meteorological sondes, equally spaced along the tethered line, up to about 800 m. The balloon was operated nearby the tower.
Merging tower and balloon data allows us to investigate the structure of the entire boundary layer and possibly the atmosphere aloft.

Short-term variations in the ozone column over Ny-Ålesund

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Location of Ny-Ålesund provides a grate opportunity to get continuous time series of ozone column over comparatively long period determined by the polar day. The diurnal ozone variations observed at the station have been related to the corresponding solar UV irradiance changes and the results led to the conclusion that the registered daily amplitudes, reaching sometimes values of about 40 DU, seem to represent real ozone column variations rather than being artefacts caused by instrumental and/or methodological errors. Two time series of the ozone column observed during the 2009 and 2010 polar summers have been studied by means of the nonlinear time series analysis tools. The features of the recurrence plots and assessment of the minimum embedding dimension of the reconstructed phase space together with the correlation dimension and Lyapunov exponents characterising the attractor confirm the assumption that the ozone variations observed at Ny-Ålesund can be considered one-dimensional projection of a chaotic system. This supposes that the short-term ozone column variations turn out to be connected with 4 or 5 atmospheric parameters throughout nonlinear relationships. The estimated Lyapunov exponents assume a satisfactory prediction of the ozone time patterns for no more than 8 – 12 hours.

Chemical composition of PM10 marine aerosol collected from Tromsø to Svalbard Islands during the AREX 2011 cruise

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One of the most debated topics in the climate-environment interaction is the role of the aerosols in controlling the Earth radiation budget. This is particularly relevant in the polar areas, where the surface albedo could be higher than the cloud albedo, due to the presence of snow cover and sea ice. As a consequence, the cumulative aerosol forcing could be positive. Besides, the aerosol forcing depends from the size and chemical composition of the particles. For instance, little, spherical and white sulphuric acid droplets have scattering and absorption properties completely different from large sea salt or sub-micrometric black carbon particles. Finally, there is a scarce knowledge of the aerosol chemical composition in polar coastal and marine areas, due to the relative little number of monitoring stations.

In order to contribute to fill this knowledge gap, an intensive sampling campaign was carried out in the sea area between Norway and Svalbard Islands (Norwegian and Greenland Seas), in the framework of the AREX 2011 oceanographic cruise aboard Oceania ship. In the period June 20th – August 12th 2011, 79 12-h PM10 samples for ionic and metal composition and 42 24-h PM10 samples for Elemental and Organic Carbon fractions (EC and OC) were collected on Teflon or quartz filters, respectively. The sampling devices (low volume sequential samplers with PM10 sampling heads) were located in a platform 7-m high over the ship deck in the bow section, in order to minimize the contamination risk from ship engine emissions. The very low values measured for heavy metals and EC fraction, possibly used as fuel combustion markers, suggest that the contamination levels could be considered negligible.

Here we report the spatial distribution of the most significant aerosol components along longitudinal (Tromsø – Svalbard Islands) and latitudinal (east-to-west route in the Norwegian Sea and along the western side of the Svalbard Islands) transects. In particular, the atmospheric concentration of secondary marine aerosol (sulphuric acid and methanesulphonic acids (MSA) from phytoplanktonic emissions) was plotted as a function of the ship position. Besides, the spatial and temporal distribution of sea spray components (Na, Mg, chloride), N-cycle compounds (nitrate and ammonium salts), dust markers (Ca, Al, Fe, Mn, Ti) and selected heavy metals possibly coming from anthropic emissions were measured. Finally, EC and OC fractions were measured, in order to gain information on some C-cycle primary and secondary emissions.

FLAGSHIP ACTIVITIES (TERRESTRIAL/MARINE)

Structure and function of terrestrial microbial communities in the High Arctic

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Our European team has set up a pan-Arctic study of selected microbial communities of diverse extreme habitats in the terrestrial Arctic, in the process of adaptation to climate warming mediated by water regime. The first step of the study, as well as the base for the whole study being a long term research commitment in Svalbard; while the second and third steps have been two INTERACT sponsored visits to Arctic Station (Disko), and to Zackenberg Station, Greenland, which took place during 2012 and 2013.
General objective of the pan-Arctic survey is the study of three selected types of microbial communities colonizing extreme habitats in the terrestrial Arctic ecosystem. The selected communities are Bacterial Soil Crusts (BSC), epilithic and endolithic microbial communities, and cyanobacterial communities of springs and seepages. All three communities are dependent from alternating seasonal cycles of water availability, along with other peculiar constrains. Extended periods of extreme dryness limit the vegetative period to a small fraction of the Arctic summer for BSC and stone colonizing communities, while extensive UV irradiation challenges their survival; under the long lasting summer sun, temperature can also substantially increase due to the low albedo of these communities, which form thin, dark pigmented aggregates, spread on large surfaces, while in winter these communities will be exposed to extreme low temperature and blasting winds without any protection. Also melt water seepage cyanobacterial mats experience cyclic water availability which conditions their structure and biodiversity, in contrast to spring mat communities which live continuously underwater but subjected to an annual freezing and thawing alternation. A special case is represented by phototrophic communities of homoeothermic springs in which winter dark ecophysiological conditions alternate with summer photosynthesis.
We hypothesised that water represents the key factor controlling the development of those communities and that they are composed by a restricted number of well adapted cyanobacterial and fungal species all over the Arctic; in each specific habitat type, the dominating populations would be selected primarily by the relative degree of water and/or humidity cyclic availability, then by the temperature cycles, the lithotype or mineral substrate, and the exposure. We also hypothesised that common patterns of development and biodiversity of those microbial communities exist through the Arctic and in more general terms in all environments where these structures dominate; and that those Arctic communities are less isolated than the corresponding communities in the Antarctica, but still represent specialised communities whose members are largely autoctonous and in part related to northern Scandinavian populations. To verify this hypothesis, the research team will investigate the macro and micro structure, the EPS content and the related hydrodynamic properties, and the community composition of BSC in the initial stages of development; will investigate protosoil formation and development in relationship to the presence of bacterial soil crusts; the team will identify and characterize the dominating members of fungal and cyanobacterial populations colonising exposed rock surfaces in different microclimatic conditions; and finally we will identify community members of mats in seepages and spring and characterize their photosynthetic behaviour.
A deeper knowledge of polar BSC structure and performances, epilithic colonisations, and spring communities could possibly lead to the identification of types of fungal and cyanobacterial species, and BSC structures unique to the Arctic. The phylogenetic and taxonomic study of cyanobacterial and fungal strains will contribute to clarify the issue regarding the controversial existence of autoctonous and/or cosmopolitan taxa; in this respect, the comparison with related Antarctic species will be essential, also to more precisely quantify the degree of isolation of the Arctic ecosystem. At least for cyanobacteria, the description of new taxa from extreme habitats will contribute to check the recently formulated hypothesis on the evolution of sister cyanobacterial genera driven by adaptation to extreme life conditions. The results are also expected to be useful to better understand the role of homologous structures in the temperate European region, how these structures could be protected, how they could contribute services for the rehabilitation of low buffered fragile habitats in alpine and arid regions, promoting and preserving a dynamic ecosystem equilibrium under rapidly changing conditions. Once the functional constrains and dynamics of BSC in all environments where they dominate will be known, artificial BSC could be developed and used as environmental tools for the remediation of degraded soils. The study on the EPS could also lead to find out polymers possessing peculiar characteristics that could be exploited for biotechnological applications.

Warnstorfia exannulata, an aquatic moss in Ny-Ålesund and its seasonal growth responses

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The moss, *Warnstorfia exannulata* (Schimp.) Loeske, was first reported forming a carpet beside a water pool in Ny-Ålesund (78°56'N) in 1959. Fifty years later, it was found growing as an aquatic in a pool in 2008. The moss is sensitive to seasonal changes, with a pattern of seasonal growth: summer stems with densely arranged leaves and lateral branches, while winter growth with short-leaved stems and no lateral branches. The stem is 0.7-3.7cm (average 1.87cm) in winter and 2.0-12.5cm (average 6.28cm) in summer, and the annual growth of the stem is about 3.6-12.3cm long (average 7.6cm). The mean daily increase in stem length is 0.68mm in summer and 0.07mm in winter. Based on the mean annual growth rate of stem, the longest specimens of 25-28cm in length without basal part showed their life span up to 8 years. When compared the curve joining the tips of lateral branches with the curve of daily temperature changes in the summer of 2007. The growth of the aquatic moss showed its changes in accordance with the temperature changes in the same period. World distribution is discussed and global distribution mapped. Global warming may cause the moss living in aquatic condition in Arctic. The aquatic moss, as a proxy of environment, becomes an indicator of climate changes and may reveal the changes in history.

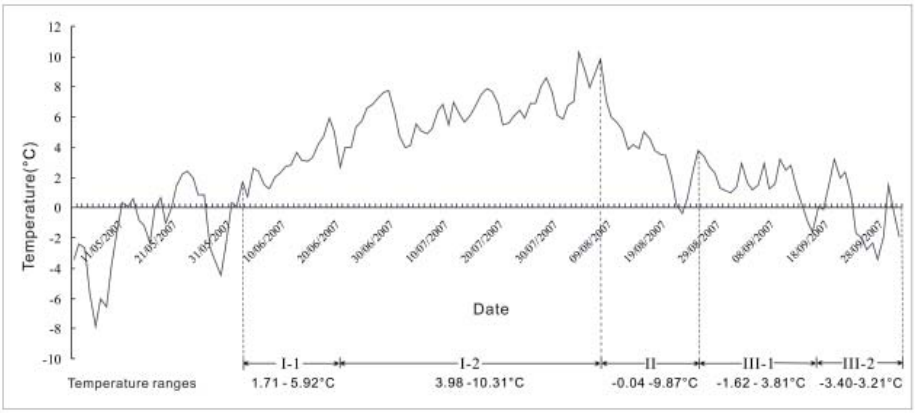

Figure 1: Daily temperature ranges in 2007.

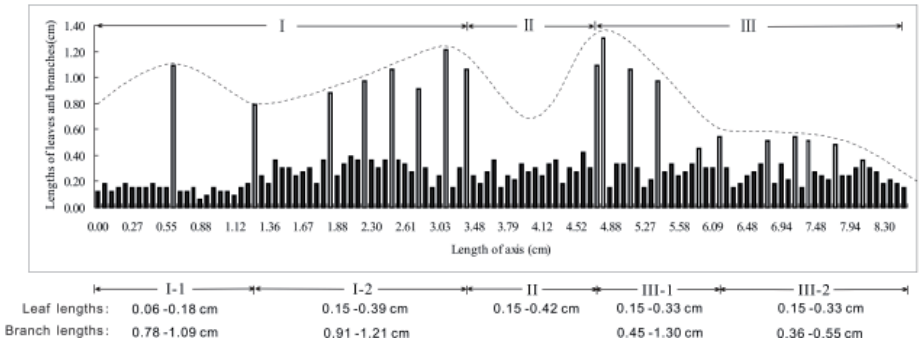

Figure 2: The growth lengths of leaves and lateral branches in 2007
and their responding to the daily temperature changes (Climatic Change 119(2): 407-419, 2013).

Measurements of Greenhouse gas fluxes over permafrost at Ny-Ålesund, the Arctic

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A 32 m walk-up experimental platform, Amundsen Nobile Climate Change Tower (CCT) was established to deeply investigate atmospheric boundary layer process including energy budget at the surface and the role played by aerosols, clouds, air/snow/ice/soil (permafrost and vegetation) interaction in determining this budget at the high Arctic. Since May 2012, through collaboration between KOPRI (Korea) and CNR (Italy), measurement system of greenhouse gas fluxes was added to CCT. Greenhouse gas flux measurements are simultaneously performed at Alaska, USA (64°N/165°W) and Cambridge Bay, Canada (69°N/105°W) by KOPRI. Open- and closed- path eddy covariance system, measuring directly the exchanges of CO2, CH4, energy and momentum between the atmosphere and permafrost, was installed at a height of 21 m of CCT. It consists of 3-D sonic anemometer, open-path CO2/H2O analyser, open-path CH4 analyser and closed-path CH4/CO2/H2O analyser. Data are sampled at a rate of 10 Hz and stored at a data logger, backed up at a laptop computer through RS232 communication and transferred to KOPRI via the internet. The eddy covariance system is continuously operating and the data access is also provided to the CNR ISAC. System maintenance and instruments calibration are made twice a year, usually in May before growing season and in September before winter. The purpose of the measurement is to evaluate whether the permafrost at high Arctic region (Ny Alesund, Svalbard) is a sink or source for the atmospheric carbon, and how the sink or source is affected by the Arctic warming as in the other KOPRI sites with different climate, vegetation and topography mentioned before. The aim of the study is to contribute to the better understanding of carbon cycle over the Arctic. We will present preliminary results on greenhouse gas fluxes including system operation from the measurement over one year.

This research was supported by NRF-C1ABA001-2011-0021063. The research was supported and funded by the Italian Ministry of Foreign Affairs in the frame of bilateral project Italy- Korea 2013-2015.

Springtime phytoplankton dynamics in the Arctic Krossfjorden and Kongsfjorden (Spitsbergen) as a function of glacier vicinity

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The hydrographic properties of the Kongsfjorden – Krossfjorden system (79°N, Spitsbergen) are affected by Atlantic water incursions as well as glacier meltwater runoff. In the present study we tested the hypothesis that glaciers affect phytoplankton dynamics as early as the productive spring bloom period. During two campaigns in 2007 (late spring) and 2008 (early spring) we studied hydrographic characteristics and phytoplankton variability along 2 mini-transects in both fjords, using HPLC derived pigment fingerprinting followed by CHEMTAX, molecular fingerprinting (DGGE) and sequencing of 18S rDNA. The sheltered inner fjord locations remained colder during spring as opposed to the outer stations. Vertical light attenuation coefficients increased from early spring onwards, at all locations, but in particular at the inner locations. During the end of spring, meltwater input had stratified surface waters everywhere, although decreased surface salinities were observed much earlier. The outer fjord and mid Kongsfjorden location showed on average higher chl a levels as compared with the inner fjord locations. Based on HPLC-CHEMTAX, diatoms and *Phaeocystis* sp. were replaced by small nano- and picophytoplankton during late spring, coinciding with low nutrient availability. The innermost stations showed higher relative abundances of nano- and picophytoplankton throughout, notably of cyanophytes and cryptophytes. Molecular fingerprinting revealed a high similarity between inner fjord samples from early spring and late spring samples from all locations, while outer samples from early spring clustered separately. Sequence data were dominated by clones related to *Alveolata* (*Dinophyceae*, *Syndiniales*, and *Ciliophora*), followed by *Haptophyceae* (mostly *Phaeocystis* spp.), Stramenopiles (mostly *Bacillariophyta*) and *Viridiplantae* (e.g.*Mantionella squamata*). We conclude that glacier influence, mediated by early meltwater input, modifies phytoplankton biomass and composition already during the spring bloom period, in favor of low biomass and small cell size communities. This may affect higher trophic levels especially when regional warming further increases meltwater period and -volume.

Oxygen isotope – salinity relationship in Kongsfjorden: implications to freshwater variability

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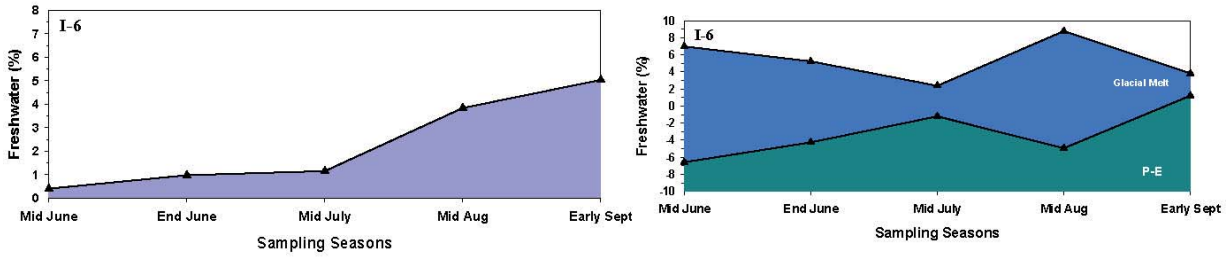
The objective of this study (*RiS Id*. 5944) is to quantify variability in freshwater influx to the Kongsfjorden System by undertaking long-term, systematic measurement of the oxygen stable isotope ratio ($\delta^{18}O$) and salinity of seawater. Additionally, the present study will provide a more accurate $\delta^{18}O$-Salinity slope as water samples from different depths and location over a long period of time will be collected. It would help to more accurately determine past salinity variability from the fjord. Indian flagship program of Kongsfjorden monitoring is aimed to understand the effect of climate change using several physical, chemical, and biological parameters. This study complements it by providing the isotopic perspective.



Results from the first year of the study show that most of the variability is limited to the top 100 m. The spatial variability shows that the effect of freshwater from glacial melting was affecting the station I-9 and I-6 much more that the stations I-1 and I-3. We obtained δ18O-Salinity Slopes for both the inner (Stations I-6 and I-9) and the outer (Stations I-1 and I-3) fjord. The inner and outer fjords yield a slope of 0.20 and 0.28 based on a r2 value of 0.30 and 0.38 respectively. The correlation coefficient values are low, which may be because the dataset comprises of samples from different depths collected during different periods nevertheless correlation is significant at the 99.5% level as determined by Student's T-Test. Solving the equations representing the conservation of mass, salinity, and isotope reveal that fraction of freshwater in the near surface waters of Kongsfjorden increases to 5% by early September with varying contribution from glacial meltwater and a balance of evaporation and precipitation as shown in the figure above. Negative freshwater percentage indicates that the evaporation is much stronger than precipitation resulting in lower net freshwater content despite high glacial meltwater influx.

ROUNDUP FOR A BASIC CORE MONITORING PROGRAMME

Monitoring activities at Dirigibile Italia: status and perspectives

Vito Vitale[1]

on behalf of the Italian research community operating observing platforms at Dirigibile Italia

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As contribution to the vision of Ny-Ålesund as a supersite devoted to study the complex Arctic System with a comprehnsive multidisciplinary approach, the Department of Earth and Environment (CNR-DTA) promoted in 2008 the construction of the Climate Change Tower Integrated Project (CCT-IP – www.isac.cnr.it/~radiclim/CCTower). Overarching goal of CCT-IP is to explore the complex dimension of the system at the boundaries of the different components, where interactions are stronger, e.g. at the air-snow-land interface, and in the first layer of ocean, atmosphere and geosphere, assessing processes through which they are coupled. Key elements of the project are the observing platforms: the 34 m height Amundsen-Nobile Climate Change Tower (CCT), the physico-chemical Lab at sea level (Gruvebadet), and the mooring deployed in the inner part of Kongsfjorden. A large set of instruments allow to continuously collect information on radiation and energy budget, surface albedo, turbulent fluxes of heat and moisture (on land), dynamic structure of the ABL, gas fluxes at the snow/air interface, aerosol chemical, size and optical characteristics, sedimentation, heat and mass fluxes in the air-sea-ice interfaces.

Experimental setup and measurements implemented will be presented together with future plan and cooperation perspectives allowed by the new facilities, with the aim to identify Italian activities that could contribute to an overall monitoring programme at Ny-Ålesund as well as to European and international networks.

Overview of Monitoring activities at AWIPEV Base

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The Arctic research base AWIPEV is in operation year-round thereby facilitating a suite of climate monitoring activities. The location at the western coast of Spitsbergen results in a comparatively mild climate due to the warm West-Spitsbergen current. It places Spitsbergen and Ny-Ålesund at a node of the Arctic climate change development. The AWIPEV climate monitoring activities cover the compartments atmosphere, permafrost soil, and ocean (the Kongsfjord) with permanently installed instrumentation.

At the dedicated Atmospheric Observatory of the AWIPEV Base we collect continuously meteorological parameters, incoming and outgoing radiation at the surface, and vertical profiles of several key climate parameters, including ozone and aerosols. Remote sensing techniques are employed to observe aerosols and trace gases using spectrometers, microwave-radiometers, and lidar. The stratospheric observations are carried out in co-operation with the University of Bremen.

The German Research Centre for Geosciences (GFZ) operates two satellite receiving antennas in Ny-Ålesund, as well as two GNSS stations and a high rate GPS receiver, in cooperation with Kings Bay AS, Kartverket and NILU/NPI, while the BfS runs a gammy radiation sensor.

All observations contribute to pan-Arctic and international networks and the data produced is made available through the respective data banks. These include the WMO GAW programme with the Baseline Surface Radiation Network (BSRN), the Network for the Detection of Atmospheric Composition Change (NDACC), the Permafrost network, and the COSYNA Coastal Observing System for Northern and Arctic seas. The observatories are foreseen to become a vital part of the SIOS infrastructure.

This paper presents some main findings of 20 years of observations.

More information about the observatories, online data displays, and links to data sources can be found at http://www.awipev.eu

Monitoring at Sverdrup and Zeppelin Station

Christiane Hübner

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This talk will give an overview over research facilities and monitoring series maintained by the Norwegian Polar Institute (NPI) in Ny-Ålesund.
NPI in Ny-Ålesund provides two research stations: the Sverdrup Station and the Atmospheric Observatory at the Zeppelin Mountain. All instruments are maintained all year round by the Sverdrup Station staff. In addition, logistical services as field equipment, boat transport, two small workshops and offices are provided for visiting researchers.
At Sverdrup Station a platform on the roof offers space for optical instruments and other instruments and samplers that can be located within the settlement. At the moment a SAOZ, GUV and PFR are installed by the Norwegian Institute for Air Research (NILU), as well as a multifilter radiometer UV-RAD from the National Research Council, Italy. In addition, precipitation samples are taken for Dartmouth College, UK (Isotopes), University in Tokyo (Black Carbon), IAEA (isotopes) and NILU (mercury and sulphure & nitrogen compounds). One room is rented by the University of Oslo for higher atmosphere studies (all sky imagers, GPS stations). Daily weather observations combined with data from an automatic weather station are sent to the Meteorological Institute of Norway (DNMI). Sverdrup Station also provides room for computers and network access for instruments located on the tundra closeby, including two magnetometers (University in Tromsø and New Hampshire University, USA), a hydrological gauging station (Norwegian Water Resources and Energy Directorate and a Seismic station (University of Bergen and cooperation partners).
At the Zeppelin Observatory the main focus is on atmospheric monitoring and major users are NILU and Stockholm University (SU).
Air parameters measured by NILU are: elementary mercury in air, ozone, aerosol black carbon, CO, CO2, methane, water vapour, sulphure dioxide, sulphate, ammonia, nitric acid, nitrate, magnesium, calcium, kalium, chloride, halogenated greenhouse gases (30-40 compounds), isotopes, heavy metals in air (SO4, Mg, Pb, Cd, V, Mn, C), persistent organic pollutants (POPs) in air, pesticides, bromated flame retardants, isotopes of black carbon, wind speed, wind direction, air pressure, and temperature.
SU monitors following parameters: Aerosol size distribution, density of aerosol particles, particle size distribution, aerosol light scattering, integral aerosol number density, soot, and CO2.
Other long-term measurements by other institutions: Lead 211 in air (The Finish Meteorological Institute), University of Tokyo (black carbon in air), Korean Polar Research Institute (DMS in air, Condensation Particle Counter), Greenhouse gases (CO2, CH4, CO, 13CO2, H2, N2O, sulphure hexafluorides (SF6), 18O in Co2; National Oceanic and Atmospheric Administration, USA), POPs (Environmental Canada) and a pollentrap (Bjerknes Centre).
There are also radiation stations from the Alfred Wegener Institute (AWI) and NPI, as well as a fog monitor from National Institute for Polar Research, Japan installed.
All data series obtained at Zeppelin Observatory are open and available latest a year after measurement.
Other monitoring series include sea ice abundance and thickness, glaciers (several parameters, incl mass balance), population dynamics of seabirds, and terrestrial mammals.

POSTER SESSION

Permafrost Monitoring at Bayelva site close to Ny-Ålesund

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Since 1998 we record hourly data from the Bayelva site close to Ny-Ålesund, Svalbard. The scientific goal is to establish a long term- permafrost observational site to investigate the observed warming of permafrost and potential causes. The site records weather components (radiation components, temperature, humidity, wind speed and direction, snow) and soil temperature and moisture in the seasonally thawing surface layer (active layer). In 2007, additional instruments were added: an eddy covariance system and a 10 m permafrost temperature profile. From 1998-2012, the site was powered by a wind generator and solar panel and data were stored and retrieved every 6- 8 weeks by AWIPEV station's personnel. Often, the power system failed in these extreme conditions and thus the data record is not continuous. In 2012, this site was equipped with a 220 V power supply and data transfer cables that are buried in the soil. Data are transferred hourly to Potsdam and loggers and sensors can be accessed and programmed remotely from AWI. Due to this major improvement, we have a data record without gaps since 2012. Rapid transfer of data also facilitates the use of data in PhD thesis, as well as online databases.

Introduction of a new project: study of carbon cycling at moss tundra

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Current climate change predictions indicate that warming will be more pronounced at high latitudes in the Northern Hemisphere. The Arctic terrestrial ecosystem is believed to be extremely susceptible to climate change, and major ecological impacts are expected to appear rapidly. Responses of the ecosystem carbon cycle to climate change are of crucial importance, because of the large carbon stock in Arctic soils and possible feedback effect on global atmospheric CO2. However, because of the diverse responses of ecosystem components to climate change, overall response of the ecosystem carbon cycle to climate change is difficult to predict.

Since 1994, we have conducted field and laboratory studies of the ecosystem carbon cycle in a deglaciated area (drier site) in Ny-Ålesund, Svalbard. This project aims to clarify the carbon cycle pattern in this area and to construct a compartment model for future prediction of climate change impacts on the cycle. For these purposes, changes in plant species composition, plant and microbial biomasses, and soil carbon flows were examined along a successional series. Since 2011, we have started carbon cycle study at moss tundra under the same concept. The moss tundra is characterized as wetter site and thick peat forming community. We selected study site in Stuphallet where located about 7 km north-west of Ny-Ålesund. Mosses such as Sanionia uncinata, Tomentypnum nitens, Campyliadelphus stellatus and Campylium sp dominated and a few vascular plants such as Saxifraga cespitosa, S. oppositifolia and Cardamine nymanii grew sporadically with mosses in the area. Snow melting water flew in the area and flew out to the Kongsfjorden. Peat accumulated more than 1 m but average thickness of active layer was about 30 cm.

We will introduce our study plan and report some preliminary results such as carbon accumulation and CO2 exchange of the moss tundra.

Sympagic-pelagic connectivity: the role of acrylate and DMSP in sea ice and pelagic organisms

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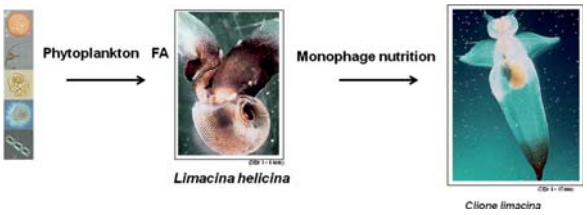
The summer minimum sea ice extent in the Arctic is shrinking and estimates of sea ice thickness indicate a rapid decrease in volume. Less extensive ice cover will lead to higher total primary production, which has the potential to increase the overall secondary production in the Arctic. However, altered climate conditions will affect timing, quantity and quality of food sources with extensive implications for grazers. Depending on the grazer's ability to adapt to these new conditions, some organisms will be favored more than others, resulting in ecological winners and losers. At this trophic position the production of metabolic energy is crucial and has got a major impact on the entire food web. Storage lipids in form of wax esters, triacylglycerols and diacylglycerol ethers and highly unsaturated fatty acids (omega 3/ omega 6 FA) are adjusting screws for storage energy and food quality in the Arctic marine food web.
The pteropod *Clione limacina* is the most abundant gymnosome of the pelagic food web in temperate and polar waters. It is recognised as an important food for baleen whales and several fish species (Lalli and Gilmer 1989). The order Gymnosomata is unique, because it comprises a number of species, which are monophagous feeders. Feeding studies have revealed that *C. limacina* feeds exclusively on the thecosome *Limacina helicina* in polar waters, and on *L. retroversa* in temperate oceans. Almost all developmental stages of *C. limacina* in polar waters are dependent on the availability of *L. helicina*. Another exceptional feature is the high amount of diacylglycerol ethers (DAGE, [1-*O*-alkyldiacylglycerols]) and a high proportion of odd-chain length fatty acids in lipids of *C. limacina*, which may account for up to one-third of the total fatty acids. Kattner et al. (1998) proposed that the biosynthesis of odd-chain fatty acids results from the ingestion of dimethylsulfoniopropionate (DMSP), which can have high concentrations in many phytoplankton species (Keller et al. 1989). The propionate moiety of DMSP may serve as starter molecule for the biosynthesis of odd-chain fatty acids. However, the biosynthetic pathway for the production of such high amounts of odd-chain fatty acids, as well as their function, has not been validated and needs to be further clarified. Besides the general biochemical aspect, *Limacina helicina* plays also a major role as a key organism to investigate the ocean acidification and the sulfur cycle due the accumulation of DMSP.



In this upcoming study we will focus on the unique Arctic zooplankton food chain **Phytoplankton** – *Limacina helicina* – *Clione limacina* and their capability to adapt their current life history strategies and physiology to a changing Arctic. In this case, due to its very sensitive aragonite shell, *Limacina helicina* will be very vulnerable, when the pH-value will decrease. Moreover the monophagous pteropod *Clione limacina*, feeding exclusively on *L. helicina*, will probably lose its prey and therefore not survive the entire global changes. We will focus in our study on and combine field and laboratory investigations to ultimately arrive at an improved understanding of the basic lipid metabolism and physiological adaptations of these Arctic key species.

- to establish a functioning food chain consisting of phytoplankton *(POM)-Limacina helicina Clione limacina* at the Marine Laboratory in Ny Ålesund.
- to carry out feeding experiments with labeled food or food compounds to reveal the formation of odd chain fatty acids and DAGE.
- to investigate the role of DMSP or its cleavage products on the formation of lipids and fatty acids in this specified food chain.

Arctic cloud detection by means of hyperspectral infrared interferometry: validation with ground-based observations

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Clouds play a key role on the radiation budget of the Earth. However, the polar cloud feedback in climate sensitivity remains poorly understood. Polar satellite measurements provide frequent revisit over the Arctic, but cloud detection is challenging at high latitudes. In fact, the ability to detect cloud presence from passive satellite measurements in the polar regions is complicated by the following aspects:

- little thermal and visible contrast between clouds and snow/ice surface
- persistence of atmospheric temperature inversion (ambiguous temperature-height relationship)
- low optical thickness
- presence of liquid, ice, and mixed-phase clouds
- cold background temperatures (low signal-to-noise ratios)

During polar nights, cloud detection is even more difficult, because the scarcity of sunlight makes information on texture unavailable. Moreover, techniques based on differential reflectance in the visible and near infrared are not usable during winter months. Therefore, an approach relying on infrared (IR) observations only must be used. A variety of threshold methods based on multi- and hyper-spectral observations have been proposed recently with encouraging results, although problems still exists with thin clouds and weak inversions. As such, uncertainties related to surface emissivity may play an important role, since spectral emissivity for ice/snow surfaces may differ significantly depending upon microphysical properties. Furthermore, in particular cases the spectral emissivity of ice/snow surfaces may resemble spectral signatures of clouds when observed from satellite, and could potentially confuse detection techniques relying on thresholds.
Thus, we show the effect of realistic sea/ice/snow emissivity spectra on simulated radiances in the IR range often used for cloud detection (700-1200 cm -1). We also analyze the impact of surface emissivity uncertainties on the performances of currently available polar night-time cloud detection techniques based on multispectral and hyperspectral observations. Finally, we propose modifications to the current techniques and validate the results using simultaneous data from the Cloud Profiling Radar (CPR) aboard CLOUDSAT and ground-based observations from few highly instrumented sites in the Arctic, including Ny-Ålesund.

Perfluoroalkyl substances in air, snow and surface water of the Arctic

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Perfluoroalkyl substances (PFASs) may reach ecologically sensitive Arctic environment via atmospheric and/or oceanic long range transport. They are subject to a variety of processes in the Arctic environment such as degradation, bioaccumulation and interaction between the atmosphere, snow, water and soil. Additionally, climate change may significantly influence the transport and environment fate of PFASs in the Arctic. As a part of collaborative German-French program at AWIPEV joint French-German Arctic Research Base (AWIPEV) in N-Alesund, Svalbard, this project is proposed to investigate the occurrence and long term trends of PFASs in arctic air, water and snow.

Integrated high-volume air samples were taken at German station using a high-volume pump operated for 7 days to obtain a volume of ~2000 m3. A glass fiber filter is used to trap the airborne particles and the gaseous contaminants are collected with a PUF/XAD-2 resin column. Surface snow samples were collected on the glaciers in Ny-Ålesund and seawater samples were obtained in Kongs Fjord. All samples were analyzed for neutral and ionic perfluorianted compounds. Data achieved from this study may improve models to predict the environmental progression and assess the effect of climate change on the long-range transport and the fate of the PFASs in the Arctic ecosystem.

Basal topography of Kronebreen, NW Svalbard

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Kronebreen, a tidewater outlet glacier draining the icefield Holtedahlfonna in the Kongsfjord area of NW Svalbard. Kronebreen is one of the fastest non-surging glaciers in Svalbard, with average annual velocities around 450 m/yr. As a result of rapid and accelerating flow, the lower 10 km of the glacier are heavily crevassed. While velocities have been recorded in a number of ways, it has not been possible to calculate ice fluxes or do ice-flow modeling since the bed has never been successfully mapped. Earlier airborne radar campaigns failed to detect the bed in the lower reaches of the glacier, due both to radar clutter from the extremely rough surface, and most likely to water within the glacier.

In 2009 and 2010, ice thickness data were successfully obtained using a10 MHz impulse dipole radar suspended beneath a helicopter. Using a helicopter allows both relatively long antennas to be used, and more data stacking due to the slower flying speed. Certification for use of the radar on the helicopter was not required since the entire system was mounted to a frame suspended by the helicopters long line. The radar was controlled with a laptop in the cabin connected via wifi and remote desktop to the radars computer.

These new thickness data are combined with surface elevation maps, older ice depth data from the upper icefield, and fjord bathymetric data to create an expanded bed map of the area. Analysis of the new data will give a better understanding of Kronebreen's retreat history, and help in making predictions of when and how quickly further retreat may occur.

Distribution Characteristics of Dechloranes in Multi-matrices of Ny-Ålesund of the Arctic

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The Arctic is one of the least polluted areas on the earth, where human activity is less and atmospheric pollution is mild relatively. The majority of organic compounds were from the effect of global distillation (called "Grasshopper Effect"). With the rising of temperature, this process of volatilization – deposition – revolatilization will continue to occur, it makes these organic contaminants migrate to remote polar regions. Many studies have shown that traditional persistent organic pollutants were detected in the Arctic, and while, the reports about the emerging organic pollutants are seldom. Therefore, we sampled and analyzed Dechloranes (DPs) in multi-matrices of Ny-Ålesund of the Arctic Area, aimed to study the distribution characteristics and lay the foundation for the understanding of global migration and transformation of DPs resulting from human activities and climate change.

Surface soil, sediment, moss, reindeer dung, seawater and gas were collected simultaneously in July, 2012 at Ny-Ålesund Area. All samples were kept in aluminum foil and stored at -20 °C. Before analysis, soil, sediment, moss and reindeer dung samples were freeze-dried, ground and sieved (80 mesh).

All samples were pretreated by automatic solid extraction or liquid-liquid-extraction respectively, then purified by multiplayer silica columns. Dechloranes were analyzed using an Agilent 6890 gas chromatograph -5973B mass spectrometry (GC/MS) in negative chemical ionization mode (NCI) and equipped with a DB-5HT capillary column (15 m×0.25 mm, 0.10 μm).

DP can be detected in almost of samples, and the average concentration of DP in seawater, sediment, soil, moss, reindeer dung and atmospheric samples were 0.013~0.191 ng/L, 0.17~8.75 ng/g,0.11~4.59 ng/g, nd~0.134 ng/g, nd~0.722 ng/g and 0.24~5.01 pg/m3, respectively. Dec 602, Dec 603, Dec 604 were not detected in seawater, the average concentration of Dec 602 in reindeer dung, soil and sediment were nd~17.12 pg/g, nd~2.85 pg/g and nd~1.43 pg/g, respectively. The average concentration of Dec 603 and Dec 604 were nd~0.92 pg/g, nd~0.44 pg/g in moss, nd~0.89 pg/m3, nd~3.14 pg/m3 in atmospheric samples, nd~5.48 pg/g, nd~141.87 pg/g in reindeer dung, nd~8.59, nd~73.15 pg/g in soil and nd~0.34 pg/g, nd~9.30 pg/g in sediment, respectively.

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On the spatial-temporal distribution of icequakes observed on the GSN station KBS, Ny-Ålesund

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Using seismic signals to monitor glacier activity has become a popular approach in recent years. In this study we use several years of seismic data recorded on permanent broadband stations on Svalbard to locate and analyze icequakes in the northwestern and southern part of the archipelago. In the area around Kongsfjorden close to the seismic station KBS we observe a high number of seismic events. There is clear evidence that they are of glacial origin with three spatial icequake clusters related to different glaciers in the area, one of them Kronebreen. We select a number of master events and apply automatic detection methods to the continuous KBS record in order to obtain a more complete catalog. The icequake clusters show a clear seasonal variability, i.e. much more events are observed from late summer on to end of autumn, in accordance with expected variability of glacier activity. Furthermore, seismic signals show a clear peak in the amplitude spectrum between 1 and 3 Hz, a characteristic feature which has been observed at calving glaciers in Alaska and on Greenland. A second type of glacier-related seismic emission is observed which are tidally modulated tremor-like signals. Their occurrence is correlated with the time of tidal maxima as well as the tidal range in Ny-Ålesund. In order to better understand the source mechanisms of icequakes in the area and to link local and regional glacier-related seismicity, we installed a temporary local seismic network around Kronebreen in spring 2013. We also observe clusters of icequakes in southern Spitsbergen around Hornsund and within the area of the Nathorstbreen system, which had a major surging phase recently.

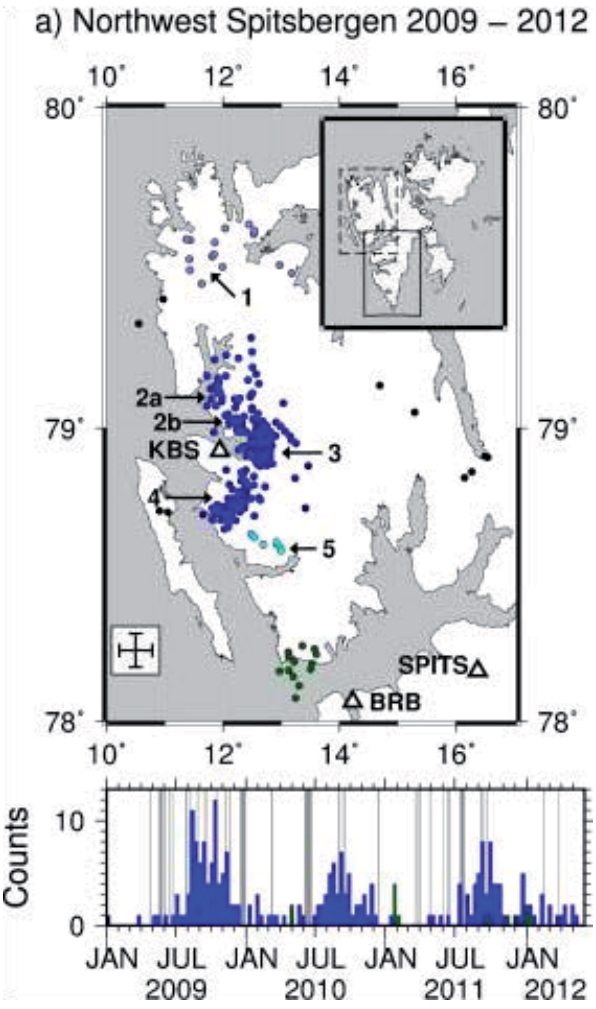

Figure 1: Locations of seismic signals recorded from the KBS station related to glacier activity in northwest Svalbard. The lower plot is an example of a timeseries of detections showing most activity during late summer.

The GCOS Reference Upper-Air Network (GRUAN) in Ny-Ålesund

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GRUAN stands for Global Climate Observing System Reference Upper Air Network, an international climate reference observing network initiated by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU). Its objective is to collect highly precise long-term data on the vertical distribution of atmospheric parameters.

The highest priority is on the climate variables temperature, water vapor and pressure in the altitude range between the surface and the middle to upper stratosphere. Currently the largest challenge is the observation of water vapor in the upper troposphere and lower stratosphere, and great efforts are being undertaken to expand the current capabilities to observe this climate variable using in situ sounding instrumentation.

The AWIPEV research base with its radiosounding program is the world's first measurement station to be certified according to the standards of GRUAN. Additional calibration measurements on ground have been implemented prior to each radiosonde launch, and extended metadata collection allows for traceability of the measurements. Since April 2012, the Ny-Ålesund radiosonde data are available as GRUAN data product. Also weekly ozone sondes are fed into the data stream, and the GRUAN ozone profile product will soon be available.

Within GRUAN, data redundancy is an important issue. Regarding water vapor, an important backbone of all other measurements will be the integrated water vapor column retrieved by GNSS (Global Navigation Satellite System) radio occultation. In Ny-Ålesund, a GNSS receiving system is operated by GFZ as part of the AWIPEV research base. GFZ is also building up the GRUAN GNSS Data Central Processing Centre.

All GRUAN data products are intended to provide long-term high quality climate records, to constrain and calibrate data from more spatially-comprehensive global observing systems (including satellites and current radiosonde networks), and to fully characterize the properties of the atmospheric column.

Arctic Research Collaboration for Radiosonde Observing System Experiment (ARCROSE)

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The Arctic Research Collaboration for Radiosonde Observing System Experiment (ARCROSE) is intended as a pilot study, combining intensified radiosonde observations at 3 central Arctic sites (Ny-Ålesund, Tiksi, and the RV Mirai placed at 77.5N, 173W) during a 4-week campaign period in September 2013. The effect of the intensified observations on data assimilation will be evaluated to potentially propose a future observing network, leading to a better understanding of the uncertainty of the Arctic atmospheric circulation. The activity contributes to the preparation phase of the Year of Polar Prediction (YOPP) 2017/2018, which is intended as intensive observational and modeling period to advance polar prediction capabilities.
During the intensive core period between 10 and 24 September, there will be 6 radiosonde launches per day (6, 9, 12, 15, 18 and 00 UTC) in Ny-Ålesund, and 8 [4] launches per day from RV Mirai [Tiksi], respectively. The additional radiosonde data are subject to data assimilation by the Earth Simulator (Observing System Experiment). Emphasis of the analyses will be on the Arctic Ocean region where Arctic cyclones frequently pass. The higher observation frequency is expected to improve both numerical weather prediction and reanalyses, allowing to determine predictability and identify key sources of forecast errors in polar regions.
ARCROSE is a collaboration of the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI), the Japanese National Institute of Polar Research (NIPR), the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), and the Russian Arctic and Antarctic Research Institute (AARI).

A Digital Glacier Database for Svalbard

Max König[1], Christopher Nuth[2], Jack Kohler[1], Geir Moholdt[2], Rickard Pettersen[3], Angela von Deschwanden[1]

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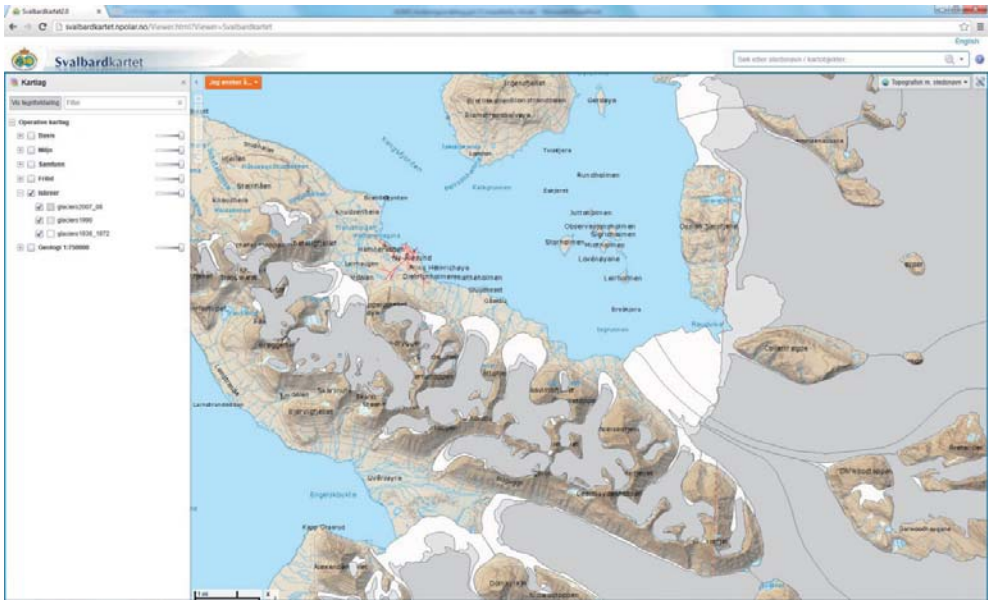
The archipelago of Svalbard with the most recent from the late 2000s contains 33 775 km2, with a large number of small valley glaciers as well as large areas of contiguous ice fields and ice caps. While a first glacier inventory was compiled in 1993, there has not been a readily available digital version. Here we present a new digital glacier database, which is available through the GLIMS and the CryoClim project. Glacier outlines have been created for the years 1936, 1966-71, 1990, and 2001-2010. For most glaciers, outlines are available from more than one of these years. A complete coverage of Svalbard is available for the 2001-2010 dataset. Glacier outlines were created using cartographic data from the original Norwegian Polar Institute topographic map series of Svalbard as basis by delineating individual glaciers and ice streams, assigning unique identification codes relating to the hydrological watersheds, digitizing center-lines, and providing a number of attributes for each glacier mask. The 2001-2010 glacier outlines are derived from orthorectified satellite images acquired from the SPOT-5 and ASTER satellite sensors. The datasaet shows that at present, 68% of the glaciated area of Svalbard drains through tidewater 5 glaciers that have a summed terminus width of 740 km. The glaciated area over the entire archipelago has decreased by an average of 80km2 a−1 over the past 30 yr, representing a reduction of 7%.

The original glacier data base and documentation is available at http://data.npolar.no/metadata/dataset/89f430f8-862f-11e2-8036-005056ad0004 or can be viewed at http://svalbardkartet.npolar.no



Persistent toxic substances in Kongsfjorden sea water and coastal sediments (Svalbard, Norwegian Arctic): levels and fluxes

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Persistent organic pollutants (POPs) are chemicals with long-lifetime in the environment, and therefore have the potential to be transported over long distances.
As the environmental behaviour of POPs depends on complex interaction of many factors, any significant environmental alteration is likely to affect their distribution and fate. Temperature as well as many other mechanisms are known to influence their distribution in the environment: the capacity of the environmental compartments to degrade or accumulate POPs (land cover characteristics, uptake rates, and bioaccumulation dynamics), the atmospheric circulation patterns (wind and oceanic current patterns, precipitations distribution), the spatial and temporal evolution of primary and secondary sources (e.g. release rates from contaminated soil), and the kinetics of the air-surface exchange (i.e. partitioning and degradation rates).
Sea ice, as well snow melting, can be well considered an indicator of climate change and it is also a significant POPs reservoir, and influences the contaminant dispersion through the sea ice trajectories.

Site	Data	Lat (N)	Long (E)	Depth (m)
A	4/6 and 30/8/2012	78° 55.920	11° 56.696	45
B	1/6 and 4/9/2012	78° 58.474	11° 35.271	150
C	1/6 and 4/9/2012	78° 59.304	11° 56.805	200
D	4/6 and 6/9/2012	78° 56.236	12° 23.670	45

Kongsfjorden is situated in the northern part of the island of Spitsbergen (Norwegian Arctic). Surface and depth water, as well as sediments, were collected at four sites during two sampling campaigns between June and September 2012, which means before and after ice and snow melting. The sampling stations in Kongsfjorden were 4 (A-D; Figure 1), characterized by different degrees of “runoff” glacial and different anthropogenic impact. In particular, station A, the old harbor in Ny Alesund, is affected by melting and is the site with the greater human impact. Station B, near the entrance to the fjord, is the least influenced by both anthropogenic activities and by the melting of the ice. The Stations C-D are strongly influenced by water “runoff” and the station D is also characterized by particularly high sedimentation flows.
The present investigation reveals the results of the analysis of these samples for their PAH, OCP and PCB content. Twelve of 16 PAHs, seven of 29 PCBs and four of 14 OCPs were determined in the sea waters. Total PAH, PCB and OCPs concentrations in the sea waters were from 50 to 500 ng/L, 5 to 30 ng/L and 10 to 150 ng/L respectively. The presence in the basin (thousands of kilometers distant from industrial centers) of POPs is testimony to the fact that these compounds are transported over vast distances with air masses and deposited in regions devoid of any human pressure. Temporal trends of POPs show increasing concentrations or a tendency to leveling off depending on the matrix (sea water or sediment) and location, but no uniform picture for the Arctic emerges.

Sensitivity of trace and rare earth elements as dust source proxies in Svalbard glaciers

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The polar ice sheets and glaciers have been shown to archive both natural and anthropogenic emissions, recording evidence of human activity and natural processes. Trace elements may therefore be useful for characterizing atmospheric transport pathways for dust and contribute to better assessments of different parameters of the climate system. As they are mostly transported in the atmosphere in the particulate phase, the trace and rare earth element content of atmospheric particulate matter reflects the characteristics of the original site of provenance, so they are an extraordinarily useful geochemical tool for source fingerprinting studies. The successively dated snow and ice layers deposited in the glaciers of the Polar Regions have proven to be valuable archives for studying the biogeochemical cycles of trace elements in the Earth system.

Despite the sensitivity of trace and rare earth elements as dust proxies, few reliable data are reported in the literature for Arctic snow and ice. Moreover, to our knowledge, no trace element profiles have been published for firn/ice core retrieved from the Svalbard glaciers.

Here we present the first comprehensive data on the occurrence of 28 trace elements (TE) and 17 rare earth elements (REE) in the seasonal snow and shallow firn layers from the Holtedahlfonna (79.1°N, 1150 m a.s.l.) and Staxrudfonna (79.3°N, 950 m a.s.l.) glaciers (Spitsbergen, Svalbard). Despite the atmospheric warming and the consequent recent acceleration of melting of the Svalbard glaciers, the seasonality of trace element deposition is partially preserved in the firn layers.

Cultivable alginate lyase-excreting bacteria associated with the Arctic brown alga *Laminaria*

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Although some alginate lyases have been isolated from marine bacteria, alginate lyases-excreting bacteria from the Arctic alga have not yet been investigated. Here, the diversity of the bacteria associated with the brown alga *Laminaria* from the Arctic Ocean was investigated for the first time. Sixty five strains belonging to nine genera were recovered from six *Laminaria* samples, in which *Psychrobacter* (33/65), *Psychromonas* (10/65) and *Polaribacter* (8/65) were the predominant groups. Moreover, 21 alginate lyase-excreting strains were further screened from these *Laminaria*-associated bacteria. These alginate lyase-excreting strains belong to five genera. *Psychromonas* (8/21), *Psedoalteromonas* (6/21) and *Polaribacter* (4/21) are the predominant genera, and *Psychrobacter*, *Winogradskyella*, *Psychromonas* and *Polaribacter* were first found to produce alginate lyases. The optimal temperatures for the growth and algiante lyase production of many strains were as low as 10–20 °C, indicating that they are psychrophilic bacteria. The alginate lyases produced by 11 strains showed the highest activity at 20–30 °C, indicating that these enzymes are cold-adapted enzymes. Some strians showed high levels of extracellular alginate lyase activity around 200 U/mL. These results suggest that these algiante lyase-excreting bacteria from the Arctic alga are good materials for studying bacterial cold-adapted alginate lyases.

Photosynthetic characteristics of vascular plants under primary succession stages in a High Arctic glacier foreland, Svalbard

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Photosynthetic characteristics of vascular plants and the nutrients of the soil water were investigated to know initial colonization and establishment after deglaciation in High Arctic. The study area was located in the deglaciated area of Austre Brøggerbreen, Ny-Ålesund in Kongsfjorden, Svalbard, Norway. Two sites that represented different stages of succession after glacier retreat in this area were selected: transient stage and late stage. These sites were separated by a floodplain. Leaf photosynthetic characteristics were measured for the four vascular plants (*Salix polaris, Saxifraga oppositifolia, Silene uralensis, and Cerastium arcticum*) at the two sites corresponding to different stages of succession in July 2010 and 2013. *Salix polaris* and *Saxifraga oppositifolia* are common pioneers in the transient stage of succession, on the other hand, *Silene uralensis and Cerastium arcticum* are rare in the transient stage but common in the late stage. All of the measurements were performed at the peak bloom period of the each plant because the photosynthetic rate varies depending on the leaf age. Light — rETR (relative electron transport rate) curves were determined using a PAM fluorometer (PAM-2100), Walz) with control and analysis software under seven stepwise actinic light intensities and saturating pulse. The photosynthetic rate was expressed as the rETR, and rETRmax (maximum rETR) was calculated by the fitting equations.
The maximum yield of PSII (photosystem II; PSII yields under no actinic light) indicated that the four vascular plants were in the healthy non-stressed condition in both the transient and late stages of succession. However, rETRmax obtained by the measurements of light-photosynthesis curve were different between the common pioneer plants (*Salix polaris, Saxifraga oppositifolia*) and otherwise (*Silene uralensis, Cerastium arcticum*) depending on the stages of succession. The common pioneer plants were measured at the almost same rETRmax in the both transient and late stages, but the value of the other two plants were lower in the transient stage than in the late stage. In addition to this, we discuss about the nutrients (dissolved inorganic nitrogen and phosphate) in the soil at the different transient stages of succession.

Halogens and Biological component in Spitsbergen snow: understanding the role of sea ice

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The halogens atmospheric chemistry has received increased attention in the last twenty years since they are directly involved in the ozone reactions. Bromine has the main reservoir in the ocean, and the sea spray aerosol is considered the main driver for its concentration in the snow. However, additional source could become predominant and enriching bromine in the depositions. One additional source is represented by bromine explosion that can occur above the first year sea ice. The emission of bromine in gas phase, can enrich this element compared to the seawater abundance. Iodine in the polar region is associated with the biological productivity and the increase of primary production could lead to an increase of iodine emission. Studies suggest the retreat of sea ice could increase the primary production and associated iodine emission into the atmosphere. Considering that both elements could be directly linked to the sea ice dynamic, we drilled two shallow cores with the aim to study the linkage between iodine and bromine and sea ice. In 2012, a first shallow core has been drilled at the top of the Holtedhalfonna (79° 09'N, 13° 23' E, at an altitude of 1150 m.a.s.l.), while in 2013 a second core has been drilled in the Staxrudafonna (79°50'N, 11°45'E, at an altitude of 920 m.a.s.l.). The first drilling site was in average located 100 km from the sea ice edge, while the second is located closer, approximately 40 km. Iodine (I) and bromine (Br) measurements in the first core suggest that changing of I concentrations can be linked to the retreat of spring sea ice extension, while bromine enrichment, indexed to the Br/Na seawater mass ratio, appears to be influenced by changes in the seasonal sea ice extension. We present the first comparison between halogens in surface snow and Arctic sea ice extension, especially from the region closer to Svalbard Archipelago. Although further investigation are required to characterize potential depositional and post-depositional processes, these preliminary findings suggest that I and Br can be linked to variability in the March-May sea ice extension and seasonal sea ice surface area. Considering the likely role of the biological production controlling the iodine emission and the suggested relationship between primary production and sea ice extension, we develop a preliminary study investigating the biological component in the snow. In particular, pigment spectra, morphological and molecular analyses have been performed on the Svalbard snow to characterize the microalgae communities.

Snowpack Characteristics of Brøggerhalvøya

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The National Research Council of Italy established in 1997 the research station "Dirigibile Italia " in Ny Alesund. Since then, several research groups have carried out about 200 stratigraphic profiles of the snowpack in the framework of specific research projects.

Some of the stratigraphic profiles were made systematically in experimental snow-fields close to Ny Alesund village to monitor the evolution of the snowpack during certain periods of time while some other were made in selected sites along the coast and on Austre Broggerbreen, Midtre Lovenbreen, Kongsvegen and Holtedhalfonna Brøggerhalvøya glacier to study the spatial variability of the snowpack in different environmental contest. The identification and classification of the different layer of the snowpack were carried out according to international standards and stored with the software data management services available at Avalanche Italian centers, according to national standards. At the moment, these stratigraphic profiles can represent a valuable dataset of the characteristics of seasonal snow covers in the Svalbard region.

In this paper, data derived by the 102 snow profiles, carried out from 1998 to 2013 in different sites (corresponding to more than 1500 snowlayers) are analyzed in term of grain size, grain types, hardness, and density of each layer.

The most frequent snow crystal types were Runded Grain (RG), mainly due to a wind transport, followed by Faceted Cristals (FC) and Depth Hoar grains (DH) due to the kinetic growth. The layers of Depth Hoar were thicker than all other layers and also formed by crystals with larger size than the average (E = 2.8 mm). Ice mass (IF) and fusion grains (Melt Form, MF) were also very abundant in the snow pits along the coast and occasionally even present in the snow pits carried out at high altitude.

The average density of the snowpack layers measured during the field surveys (April-May) was 343± 44 kgm^{-3}: this value has proven to be lower than the mean snow density values observed for seasonal snow cover in other Svalbard areas.

The average values of snow density, for each different type of crystal shapes, were calculate as well as average hardness values of the different snow layers recognized in the snowpits.

Analyzing the whole stratigraphic dataset it is possible to point out effectively the seasonal snow characteristics in an Arctic area; the preliminary results seem to confirm an Arctic Snow Climate Maritme for the Ny Alesund area as evidenced for the area around Longyearbyen by other authors.

The collection of snowpack stratigraphic profiles of the Brøggerhalvøya area will also provide useful information to the modeling processes of the snowpack in polar environments.

Recent measurements and trends of 6 halocarbons measured at the Zeppelin Observatory at Ny-Ålesund in Svalbard, Norway

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Time series and background trends of 6 halocarbons; HCFC-22, HCFC-141b, HCFC-142b, HFC-125, HFC-134a and HFC-152a, from ground based atmospheric in-situ measurements taken at the Zeppelin Observatory at Ny-Ålesund in Svalbard are presented here. The Zeppelin Observatory is a monitoring site contributing to Advanced Global Atmospheric Gases Experiment (AGAGE) network among other networks and program. The site is located at 78° 54' N, 11° 53' W, an ideal location for studying hemispheric background trends. However, the mixing ratios of atmospheric trace gases in the Arctic are also influenced by long-range transport from mid latitude source regions. In particular, the meteorological conditions during winter and early spring are favourable for transport of air masses from mid-latitude industrialised areas into the Arctic (Stohl, 2006). The study employs measurements from January 2001 to December 2011 and daily averaged data are employed to retrieve annual mean values and long term trends. All 6 components reveal positive trends in the background mixing ratios. The mixing ratios of HFC-125, HFC-134a and HFC-152a have increased by as much as 360%, 206% and 2037% respectively since 2001. The annual means for the HFC-125 and HFC-134a are shown in Figure 1. The compounds show pollution events, but the transport events are few and the peak values are relatively low due to the remote location of the Zeppelin Observatory. This work is carried out by NILU as a part of the national monitoring programme on commission of national *Climate and Pollution Agency*.

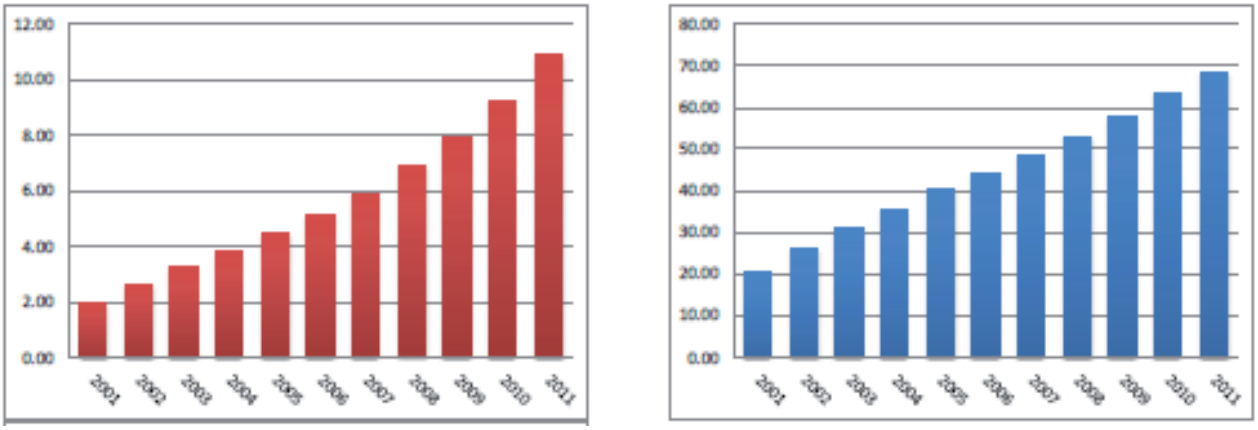

Figure 1: Development of the annual means of HFC-125 (red) and HFC-134a (blue) at the Zeppelin Observatory for the period 2001-2011.

SnowTerm: a thesaurus on snow and ice

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In 2003, a research project was presented at the Ny Ålesund Scientific Managers Commitee (NySMAC); the project title was "PolarTerm – A Terminological Reference System as a Support to Polar Research Activities"; it was published both on the 12th Edition of the Ny-Ålesund Newsletter in June 2003 and on the Polarnet Technical Report 1/2003. From that time to present the project evolved towards a more complex and enriched version.

The project as it is now aims at developing a reference multilingual scientific and technical vocabulary (SnowTerm), covering the terminology of a specific knowledge domain such as the polar and the mountain environment, thus supporting the knowledge management activities and the access to research results.

SnowTerm is part of a more extended set of thesauri dealing with environment in general (EARTh) and with specific domains such as GIS and remote sensing (EOSterm), geothermal energy (GeothermThes), environmental disasters management and restoration (NatRiskVoc).

The thematic areas covered at present by SnowTerm deal with snow and ice physics, morphology, and radiometry, remote sensing and GIS in cryosphere environment, sea ice, avalanches, glaciers, safety.

The methodology used for the development of the thesaurus includes the identification, acquisition and harmonisation of controlled multilingual terminologies and the development of a complete basic reference list of terms.

SnowTerm contains at present around 3.700 terms in English and Italian. Other linguistic equivalents are available for the sea ice terminology

For the development of the hierarchical structure the same classification scheme already in use for the development of the CNR EARTh Thesaurus has been used. The hierarchical setup is based on facets; according to its intrinsic features, the structure can be used as a semantic reference system, stable and partially independent from the context.

A thematic structure clustering terms in themes representing specific sectors is under development; the possibility of applying different thematic schemes could allow the exploration of concepts according to different perspectives, which may emphasize particular and contingent aspects.

SnowTerm is accessible online at http://thesaurusonline.iia.cnr.it/tematres/snowterm/; a SKOS/RDF version to be used within the framework of the Semantic Web is under development. The RDF encoding of information allows it to be shared between computer applications in an interoperable way and allows knowledge organization systems to be used in distributed, decentralised metadata applications.

Three years of atmospheric observations at the Amundsen-Nobile Climate Change Tower in Ny-Ålesund - Svalbard

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The Amundsen Nobile - Climate Change Tower (CCT) is an important scientific platform operating in Ny-Ålesund Svalbard since 2009. A consistent set of meteorological sensors is installed at different heights to collect long time series of the parameters that affect the climate and its variability. The CCT represent the unique infrastructure operating in the Svalbard conceived to provide continuous and detailed measurements of the physical parameters to understand the relationship between processes and phenomena that occur within the first tenths of meter of the atmosphere above the ground.
In this contribution some features observed during the first three years of measurements (Nov 2009-Nov 2012), are presented. The main physical characteristic of the near-surface atmospheric layer, by means of vertical profiles, seasonal characterization of the low level atmospheric circulation, turbulent fluxes at the surface, radiation and energy balance for different meteorological conditions, such as snow and cloud coverage, are described. This preliminary analysis is the basic classification to validate the Monin-Obukov similarity theory for different environmental conditions at high latitudes. Examples of monthly and seasonal statistics are shown in order to define the basis for a climatological dataset that is being organized; a description of the information structure is presented to show the approach to discover visualize and access the data collected.

Sources and fate of snow nitrate in the European high Arctic

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Nitrogen oxides (NO_x=NO+NO_2) play a key role in the cycling of reactive nitrogen (ultimately deposited as nitrate) and in affecting the oxidizing capacity of the atmospheric boundary layer, due to their connections with ozone (O_3) and hydroxyl radical (OH). Tropospheric nitrogen oxides (NO_x) are produced by biomass burning, combustion processes, microbial activity in the soil, and lightning, downward transport from the stratosphere and high-flying aircraft and can reach pristine Arctic environments by long-range transport, from mid-latitudes often in form of more long lived compounds such as peroxyacetyl nitrates (PANs).
Atmospheric nitrate (NO_3^-), occurring as gaseous nitric acid (HNO_3) and particulate nitrate (p-NO_3^-), is the final product of the oxidation of atmospheric NO_x and is formed trough (1) the reaction between nitrogen dioxide (NO_2) and hydroxyl radical, (2) the oxidation of NO_2 to N_2O_5 followed by hydrolysis on particles and/or (3) the oxidation of NO_2 to NO_3 followed by H abstraction from reduced species and/or (4) from $BrONO_2$/$ClONO_2$ hydrolysis (in Arctic environments, this mechanism is important during ozone depletion episodes). Both HNO_3 and p-NO_3^- are thermodynamically stable and highly soluble forms and, thus, the ultimate sinks of these species are wet and dry depositions.
Recently, microbial activity has been proposed as further source of snow NO_3^-. The arctic snow contains several microorganisms, which can cause the formation of gaseous nitrogen monoxide (NO), nitrous acid (HONO) and HNO_3 during the whole year, through the assimilation of ammonium (NH_4^+). However, this process has to be studied more deeply.
Once NO_3^- is deposited on snow surface, it can also undergo post-depositional processes causing its significant mass loss. These post-depositional processes include the evaporation of nitric acid (HNO_3) and the photolysis of snow NO_3^-. In particular, the photolysis of snow NO_3^- cause the production and, then, the emission of reactive nitrogen species, such as NO, NO_2 and HONO, altering potentially the overall budget of radical species (HO_x = OH + HO_2), NO_x, and O_3 and, thus, the tropospheric oxidative properties.
Post-depositional processes are also affected by the chemical and physical properties of the atmosphere (intensity of solar radiation, temperature, and the concentration of gaseous and particulate pollutants) and snow (temperature, hardness, density, reflectance, specific surface area, size and shape of snow grains and penetration of UV radiation, snow accumulation rate, pH, and ionic strength). The evolution of size and shape of snow grains and the metamorphism of snow surface cause the changes of specific surface area and, thus, the magnitude of emission/deposition processes and the concentration of impurity in the snow. In addition, the snow pH can prevent the emission of acidic chemical species such as HONO and HNO_3. Therefore, although snow NO_3^- concentration can be easily determined, its interpretations and source partitioning is still uncertain due to the contribution from different sources, time periods and locations.
Here the results, obtained by a field experiment performed during the spring of 2010, are reported in order to identify the sources and sinks of snow nitrate at Ny-Ålesund and to evaluate the potential future developments of scientific and technological frameworks.

Snow Spectral Library: Six Springs at Ny-Ålesund

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Snow covers can be effectively monitored using remote sensed images especially if merged with spectroradiometric data coming from field survey; field data, in fact, allow to directly correlate snow spectral behaviour with its physical characteristics (snow grain size and type as well as surface roughness).
From 1998, six measurement campaigns during Spring season were performed in Ny Ålesund area in order to collect spectral signatures and physical snow data of different target surfaces. Sampling sites were selected in shadowless plain areas in order to avoid influences of topography and to accurately identify them on the remote images.
Spectral data were collected with portable spectroradiometer (Fieldspec 3-ASD) operating in the spectral range between 350-2500 nm. At the same time snow data were collected, quantitatively categorized and registered following the international classification for seasonal snow on the ground. Therefore each radiometric measurement was associated to the characteristics of the snow surface layer. In some sampling sites, also a complete snow profile was made.
Spectral signatures, snow data, ancillary information as well as site and target images have been collected and managed in a spectral library. The spectral library, including more than 150 spectra, represents the place where knowledge in radiometric domain and snow science meet each other. Specific web pages have been created to disseminate snow and spectral data.
Spectral library data have been already used to classify snow cover in Landsat TM and Aster images; results of this merging process allow to emphasize spatial distribution of snow types and to realize snow thematic maps for Ny- Ålesund area. Moreover, the classification of the snow covers represents an important dataset to investigate gaseous exchange processes at air/snow interface and to support studies on radiation balance.

The influence of cruise ship emissions on air pollution in Svalbard

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We have analyzed whether tourist cruise ships have an influence on measured sulfur dioxide (SO2), ozone (O3), Aitken mode particle and equivalent black carbon (EBC) concentrations at Ny Ålesund and Zeppelin Mountain on Svalbard in the Norwegian Arctic, during summer. We separated the measurement data set into periods when ships were present and periods when no ships were present in the Kongsfjord area, according to a long-term record of the number of passengers visiting Ny Ålesund. We show that when ships with more than 50 passengers cruise in the Kongsfjord, measured daytime-mean concentrations of 60-nm particles and EBC in summer show enhancements of 72 and 45% relative to values when no ships are present. Even larger enhancements of 81 and 72% were found for stagnant conditions. In contrast, O3 concentrations were 5% lower on average and 7% lower under stagnant conditions, due to titration of O3 with the emitted nitric oxide (NO). The differences between the two data subsets are largest for the highest measured percentiles while relatively small differences were found for the median concentrations, indicating that ship plumes are sampled relatively infrequently even when ships are generally present but carry high concentrations. We estimate that the ships increased the total summer mean concentrations of SO2 , 60-nm particles and EBC by 15, 18 and 11%, respectively. Our findings have two important implications: Firstly, even at such a remote Arctic observatory as Zeppelin, the measurements can be influenced by tourist ship emissions. Careful data screening is recommended before summer-time Zeppelin data is used for data analysis or for comparison with global chemistry transport models. However, Zeppelin remains one of the most valuable Arctic observatories, as most other Arctic observatories face even larger local pollution problems.Secondly, given landing statistics of tourist ships on Svalbard, it is suspected that large parts of the Svalbard archipelago are affected by cruise ship emissions. Thus, our results may be taken as a warning signal of future pan-Arctic conditions, if Arctic shipping becomes more frequent and emission regulations are not strict enough.

Monitoring Arctic Phytoplankton (MAP)

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Arctic coastal phytoplankton abundance and productivity is characterized by strong seasonal and inter annual variability and is expected to change due to global warming. Phytoplankton monitoring can be used as a tool to document these changes. Current knowledge on phytoplankton biomass and composition is fragmented and incomplete due to logistical challenges. The MAP project aims to couple physical and physical/chemical monitoring data (CTD, nutrients) with detailed phytoplankton observations from the fixed AWIPEV monitoring site in Kongsfjorden, Spitsbergen. This fjord has both Atlantic and glacial influences, that change in magnitude over the season. Phytoplankton taxonomic composition will be assessed from HPLC determined pigments. Sampling from the fixed site facilitates data collection with a 1-2 week resolution, also covering previously under sampled periods of fall, winter and early spring. A diagnostic bio-optical carbon fixation model will be developed to estimate depth integrated carbon fixation characteristics from pigment based taxonomic information and environmental data. To this end, carbon fixation and photoacclimation characteristics will be determined during lab experiments with relevant Arctic phytoplankton species. The model will be validated with carbon fixation characteristics in natural Kongsfjorden assemblages. The project will provide information on seasonal and inter annual changes in taxon-specific productivity in coastal Arctic waters. Moreover, the bio-optical model can be used as a general tool for monitoring changes in phytoplankton productivity in Arctic coastal waters.

Italian Arctic Data Center
A digital infrastructure to manage the data acquired in the Arctic region

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In the Arctic is warming faster than anywhere else on Earth, and this causes rapid environmental changes.
The National Research Council of Italy (CNR) and other research institutions, are deeply involved in the study of climate change in this area and since 1998 CNR is supporting and coordinating the research projects and activities carried out by scientific community operating at Ny-Ålesund, one of the permanent settlements in the Svalbard archipelago.
The numerous and complex interactions between atmosphere, ocean, cryosphere and biosphere on a broad spectrum of temporal and spatial scales, are largely responsible for the phenomenon that goes under the name of "arctic amplification" and the Arctic research community is trying to answer to the fundamental questions of the climate system variability by providing observation, data analysis, theory and modeling.
In this contest the amount of information and data collected in the arctic region, as well as the request of accessing to them has been increasing in the last decades. Therefore, new approches must be provided to manage such information, that cannot be limited to small close community, but have to look forward to the optimized use of the resource for a wide scientific community.
In this context our project aims to develop conceptual and numerical models that can integrate data information and enable discovery, visualization and access to the data collected in the polar region. The CNR will establish a new distributed cyber(e)-infrastructure to collect, manage, publish and share polar research results. This will be a service-based infrastructure built on Web technologies to implement resources (i.e. data, services and documents) discovery, access and visualization; semantic-enabled functionalities will be provided too. The new infrastructure will be provided with SOS service which allows real-time updates on data and metadata directly from remote sensors.
The architecture applies the "System of Systems" principles to build incrementally on the existing systems by supplementing, but not supplanting their mandates and governance arrangements. This allows keeping the existing capacities as autonomous as possible.
This cyber(e)-infrastructure implements multi-disciplinary interoperability following a Brokering approach, supporting SCAR data policy, and in agreement with European and international standards, including GEO/GEOSS, INSPIRE. The Brokering approach will be empowered by a technology developed by CNR, advanced by the FP7 Euro GEOSS project, and recently adopted by the GEOSS Common Infrastructure (GCI).

The AWIPEV Underwater Observatory, a forward looking technology for longterm monitoring studies in Ny-Ålesund

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Without any doubt, there are large gaps in the knowledge of the abiotic and biotic processes in the Arctic. Since several years, marine scientist therefore discuss the need of an underwater monitoring station in Ny-Ålesund to continuously record the main hydrographical parameters like temperature, salinity, light, current as well as biological relevant parameters like Chl-A and PAR continuously and year round for ecological and modelling studies. In 2012, the AWI together with the HZG installed the AWIPEV Underwater Observatory in Ny-Alesund in front of the Old Pier. The system comprises a land-based FerryBox System (Fig. 1; 4H-Jena) with sensors for temperature, salinity, pH, oxygen and chlorophyll A. Additionally, an underwater unit (Fig. 2) profiling between 11m water depth and the surface provides data on temperature, salinity, pH, oxygen, Chl A and turbidity data as well as a continuous video stream and pulsed stereo-photographic images (every 30 min) for fish and jellyfish community studies. The system is operated year round and is fully remote controlled via the COSYNA (Coastal Observation System of the Northern and Artic Seas) Program, operating a similar underwater observatory system since 2012 in the southern North Sea of Helgoland Island.

The Arctic Sea is well known as most critical with respect to anthropogenic-induced changes in water temperature (climate change), marine chemistry (ocean acidification) and changes in the community structure even in higher tropic levels. Many of these effects are most prominent in the Arctic Ocean and its coastal environments. With this new technology, we aim at a better understanding of the underlying mechanism and ecological processes due to the continuous availability of important hydrographical, chemical and biological data year round in a sufficiently high sampling frequency. The AWIPEV underwater monitoring station in Ny-Ålesund is specifically designed as long-term cooperation project (RIS ID: 5742) and is open for other projects to join this online monitoring initiative. Both, the FerryBox system and the underwater profiling sensor unit power, network and seawater interfaces to support additional external sensors and experimental system for future cooperation partners. Cooperation projects on additional chemical analysis (NIOZ-Netherlands), benthic production (Max-Plank Institute Bremen-Germany) and ocean acidification (Laboratoire d'Océanographie Villefrance-France) are in planning for 2014 resp. projected for the next years.

Figure 1: FerryBox at the Old Pier in Ny-Ålesund.

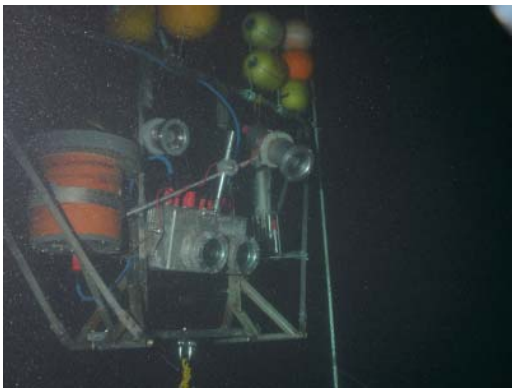

Figure 2: Underwater sensor unit RemOs1 (temperature, salinity, pH, oxygen, Chl A, turbidity, video stream, pulsed stereo-photographic images).

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