

10th Ny-Ålesund Seminar

25-26 October 2011, Kjeller, Norway

The Ny-Ålesund Seminar is supported by the Norwegian Research Council





The 10th Ny-Ålesund Seminar takes place on **25 - 26 October 2011** at Lillestrøm Centre of Expertise - Kunnskapsbyen Lillestrøm - in Kjeller, Norway. The meeting will be organised by NILU, the Norwegian Institute of Air Research.

Meeting description

The seminar brings together scientists who have Ny-Ålesund (78°55'N, 11°56' E) as a base for their research. The aim of the two day meeting is to exchange experience and share advancements from research and monitoring activities in the Arctic. The meeting wants to encourage collaborations between researchers related to the four flagship programs:

Kongsfjord System Flagship Atmospheric Research Flagship Terrestrial System Flagship Glaciology Flagship

Scientific programme committee

Dr. Geir Wing Gabrielsen - Norwegian Polar Institute, Kongsfjorden System flagship leader (FL)
Dr. Roland Neuber - Alfred-Wegener Institute, Germany, Atmospheric Research FL
Dr. Maarten Loonen - Arctic Centre, Univ. of Groningen, The Netherlands, Terrestrial System FL
Dr. Jack Kohler - Norwegian Polar Institute, Glaciology Flagship
Dr. Christiane Hübner - Svalbard Science Forum

Local organizing committee

Dr. Kerstin Stebel - Norwegian Institute of Air Research Ove Hermansen - Norwegian Institute of Air Research Dr. John Burkhart - Norwegian Institute of Air Research Mike Kopernus (web) - Norwegian Institute of Air Research Edel Braathen (secretary) - Norwegian Institute of Air Research Paul Berg (deputy director) - Norwegian Institute of Air Research

The Ny-Ålesund Seminar is financially supported by the Norwegian Research Council.

Programme for Tuesday, 25th October 2011

08:00- 09:00		Registration	
08:50-09:00		Welcome by Paal Berg, Dept. Director of NILU	
09:00-09:05		Info / Logistics	
Atmo	Atmospheric Research Chair: Roland Neuber		
08	09:05-09:30	Atmospheric Research in Ny-Ålesund - a flagship programme	
		Roland Neuber, Johan Ström, and Christiane Hübner	
09	09:30-09:45	Chemical size distributions and bulk composition of Arctic aerosol sampled at Ny Ålesund	
		G. Calzolai, S. Becagli, C. Ghedini, F. Rugi, D. Frosini, S. Nava, M. Chiari, F. Lucarelli, R.	
		Traversi, and R. Udisti	
11	09:45-10:00	The Eyjafjallajökull eruption: Chemical characterisation of the ash plume at Spitsbergen	
		M. Kriews, I. Stölting, D. Wilhelms-Dick	
12	10:00-10:15	In-situ cloud measurements performed at Zeppelin Station in May-June 2011	
		M. Shiobara, A. Uchiyama, A. Yamazaki, and H. Kobayashi	
	10:15-10:45	Coffee break	
13	10:45-11:00	Long term mercury measurements at Zeppelin Mountain	
		Katrine Aspmo Pfaffhuber and Torunn Berg	
14	11:00-11:15	20 Years Climatology of NO $_3^-$ and NH $_4^+$ wet deposition at Ny-Ålesund, Svalbard	
		R. Kühnel, T. Roberts, M. Björkman, W. Aas, E. Isaksson, K. Holmen, and J.Ström	
16	11:15-11:30	SUVEX: Crusise-ship SO $_{2}$ emissions in Ny-Ålesund measured with imaging cameras	
		Kerstin Stebel, Fred Prata, Are Bäcklund, and Ove Hermansen	
Gene	ral session Ch	air: Roland Neuber	
17	11:30-11:45	Joint Russian-Norwegian investigations of long-term climate variability on West	
		Spitzbergen.	
		Svyashchennikov P.N., Førland E., Popov A.V., <u>Ivanov B.V</u> .	
18	11:45-12:00	Activities of Czech research team in central part of Svalbard	
		Tomáš Tyml , Josef Elster, Oleg Ditrich	
	12:00-13:00	Lunch	
Gene	ral session, con	t. Chair: Maarten J.J.E. Loonen	
	13:00-13:25	The idea behind the Ny-Ålesund Flagship Programmes	
		Kim Holmen	
19	13:25-13:40	Svalbard Science Forum and the Research in Svalbard (RiS) database	
		Christiane Hübner	
20	13:40-13:55	The SIOS Project: The basic idea and current status	
		Georg Hansen and Karin Refsnes	

Programme for Tuesday, 25th October 2011, cont.

Terre	Terrestrial Flagship session Chair: Maarten J.J.E. Loonen		
	14:00-14:25	Terrestrial Flagship	
		Maarten J.J.E. Loonen	
21	14:25-14:40	Top down control in terrestrial arctic ecosystems	
		Maarten J.J.E. Loonen & Jouke Prop	
22	14:40-14:55	Key functions and microorganisms driving organic carbon transformation in high Arctic	
		Peatlands of Svalbard	
		Svenning, Mette M., Vigdis L. Torsvik' Christiane Graef, Alexander Tveit, Anne Grethe	
		Hestnes, Tim Urich and Peter Frenzel	
23	14:55-15:10	Molecular identification of arctic moss species for ecosystem and biodiversity studies	
		M. Stech, B. Cornelder, E.W. Kolvoort, C.B. Mennes, S. Veldman, J.D. Kruijer	
	15:10 -16:10	Poster session	
Kong	Kongsfjord System Flagship session Chair: Geir Wing Gabrielsen		
	16:10-16:35	Kongsfjord system flagship	
		Geir Wing Gabrielsen	
24	16:35-16:50	Oceanographic timeseries, particle fluxes and seabed mapping into inner Kongsfjord, W	
		Spitsbergen (Svalbard Archipelago))	
		Aliani S., Del Bianco F., Gasperini L., Giglio F., Langone L., Miserocchi S.	
26	16:50-17:05	The significance of depth and substrate inclination for sublittoral hard bottom community	
		structure in glacial Kongsfjorden (Svalbard, Arctic) – an underwater imagery approach	
		J. Laudien and JB. Orchard	
27	17:05-17:20	EPOCA 2010 mesocosm CO ₂ enrichment experiment in Arctic waters	
		Ulf Riebesell, Michael Meyerhöfer, Jean-Pierre Gattuso and the 2010 Svalbard team	
28	17:20-17:35	Polar seabirds in a changing environment: A mechanistic approach	
		Sabrina Tartu, Aurélie Goutte, Fréderic Angelier, Céline Clément-Chastel, Børge Moe, Claus	
		Bech, Jan Ove Bustnes, Geir Gabrielsen, Olivier Chastel	
17:35 - 18:35		Discussion on instrumentation needs for a Climate Supersite Ny-Ålesund (SIOS)	
		Georg Hansen and all	

Programme for Wednesday, 26th October 2011

Atmo	Atmospheric session: part II - Chairs: Kim Holmen / John F Burkhart		
30	08:30-08:50	CICCI/VAUUAV	
		John F Burkhart, Timothy S Bates, Patricia Quinn, Rune Storvold, Andreas Bodo Herber, Vito	
		Vitale, Sergey Lesenkov	
31	08:50-09:05	Exploring the relation between Black Carbon and precipitation using observed	
		concentrations in air at the Zeppelin station and model derived precipitation.	
		Johan Strom, Peter Tunved, and Radovan Krejci	
32	09:05-09:20	High resolution meteorological measurements on Kongsvegen glacier (Svalbard)	
22	00.20 00.25	F. Karner, F. Obleither, F. Bilgeri and J. Konler	
33	09:20-09:35	vertical profiles of aerosol properties and ozone measured over Ny-Alesund during spring	
		and summer 2011	
		L. Ferrero, D. Cappelletti, B. Moronii, V. Vitale, R. Odisti, M. Busetto, C. Lanconelli, M.	
		Graeser M. Eierz, C. Mocnik and F. Bolzaschini	
25	00.25 00.50	Bronortios of Arstis Hozo derived by remote sensing over Ny Ålesund	
55	09.55-09.50	C Pitter M Stock A Hoffmann A Herber and P Neuber	
26	00.50 10.05	Characterization of the boundary layer structure in Ny Alexand Syelbard, the first two	
50	09.30-10.03	vears of measurements at the Amundsen Nobile Climate Change Tower (CCT)	
		Viola A. P. I. Dietroni E. Tampieri M. Mazzola C. Lanconelli S. Argentini I. Diliberto and	
		M Busetto	
10.05	-10.20		
27	10.20 10.45	Management and modelled exceed contraining coefficient at New Ålegund, retrievel of real	
57	10.30-10.45	refractive index	
		V Vitale B Ildisti M Busetto C Lanconelli M Mazzola A Luni S Becagli D Frosini C	
		<u>V. Vitale</u> , N. Ouisti, W. Busetto, C. Lanconeni, W. Wazzola, A.Lupi, S. Becagii, D. Hosini, C. Ghedini	
39	10:50-11:05	Effects of relative humidity on aerosol light scattering in the Arctic	
33	10100 11100	P. Zieger, R. Fierz-Schmidhauser, M. Gysel, J. Ström, S. Henne, K. E. Yttri, U. Baltensperger, E.	
		Weingartner	
40	11:05-11:20	Observed impact of aerosols on Arctic cloud emissivity	
		Henrik Grythe	
41	11:20-11:35	Controlled Meteorological Balloons launched from Ny-Ålesund	
		Lars R. Hole, Anniken C. Mentzoni, <u>Tjarda Roberts</u> , and Paul Voss	
42	11:35-11:50	The OPTIMISM project (observing dynamical and thermodynamical processes impacting	
		the sea-ice mass balance from in situ measurements). Current status and future plans.	
		Vivier F, Lourenco A, Bouruet-Aubertot P, Beauverger M, Cuypers Y, Dausse D, Eymard	
		L,Gascard J-C, Jardon F, Martin N Weill A, Dechambre M, Bonnefoy F, Ferrant P Gentaz L,	
		Rousset J-M, Alessandrini B, Loisil R, Amarouche N, Barrois H, and Panel J-M	
	11:50-13:10	Lunch and poster session	

Programme for Wednesday, 26th October 2011, cont.

Kong	Kongsfjord system / Glaciology Flagship - Chair: Jack Kohler	
	13:10-13:35	Glaciology Flagship
		Jack Kohler
44	13:35-13:50	Daily and seasonal glacier velocity change on Kronebreen, Svalbard, as measured using
		FORMOSAT-2 imagery and in situ continuous GPS
		Jack Kohler ; Etienne Berthier; Carleen H. Reijmer; Christopher Nuth
45	13:50-14:05	Characterisation of AIRborne Microbial Communities
		Fritz A., Sattler B., Tilg M., Psenner R.
46	14:05-14:20	Data issues in a moving environment: remote and in situ tools to monitor glacier dynamics
		and their hydrological consequences in the Austre Lovènbreen basin (Spitsberg 79°N).
		Florian Tolle, Eric Bernard, Jean-Michel Friedt, Albane Saintenoy, Christelle Marlin,
		Madeleine Griselin
47	14:20-14:35	Hydrological and geochemical approach to understand the glacier-permafrost subglacial-
		system interactions in a glaciated catchment of Western Spitsbergen
		Christelle Marlin, Emerick Delangle, Madeleine Griselin, Mélanie Quenet, Eric Bernard, Jean-
		Michel Friedt and Florian Tolle
	14:35-15:00	Coffee break
48	15:00-15:15	Local and spatial variability of snow characteristics at Kongsvegen glacier, Svalbard
		F. Bilgeri, W. Steinkogler, F. Karner, F. Obleitner, R. Fromm and J. Kohler
50	15:15-15:30	Ground based interferometric radar data of Kronebreen calving front, Svalbard.
		C. Rolstad Denby , R.Gundersen, and R. Norland
51	15:30-15:45	Lipids in the Cryosphere
		Birgit Sattler, Helga Reicher, Michaela Schober, Wolfgang Sattler

Poster presentations

52	Using Unmanned Aerial Systems for Climate and Environmental research in Ny-Ålesund
	Stian Solbø and Rune Storvold
53	Bipolar climatology of ionospheric scintillation at solar minimum
	Lucilla Alfonsi, Luca Spogli, <u>Giorgiana De Franceschi</u> , Vincenzo Romano, Marcio Aquino, Alan Dodson, Cathryn
	N. Mitchell
54	Eddy Covariance measurements in Ny-Ålesund, Svalbard, Norway
	Georg Jocher, Christoph Ritter, Roland Neuber, Klaus Dethloff, and Thomas Foken
55	Mercury in the European Arctic: what do we know from observations in Ny-Ålesund, Svalbard?
	Torunn Berg, Lars R. Hole, Katrine Aspmo Pfaffhuber and Anne Orderdalen Steen
56	Meteorological Profiling of the Arctic Boundary Layer
	Marion Maturilli, Jürgen Graeser, Klaus Dethloff, Moritz Mielke, and Annette Rinke
57	Climatology of Surface Radiation and the Meteorological Column - Longterm Observations in Ny-Ålesund
	Marion Maturilli, Siegrid Debatin, Andreas Herber, Gert König-Langlo, and Roland Neuber
58	Distribution and budget of reactive nitrogen compounds (NO _y) in European high Arctic: atmospheric effects
	and air-snow interactions
	<u>F. Spataro</u> , A. Ianniello, R. Salvatori, G. Esposito and M. Valt
59	Performance of CryoWing UAS as a platform for repeat measurements of surface reflectance
	Wiley Bogren, John Burkhart, Stian Solbø, and Rune Storvold
60	Water soluble compounds in Ny Alesund aerosols.
	Roberta Zangrando, Clara Turetta, Elena Barbaro, Piero Zennaro, Natalie Kehrwald, Jacopo Gabrieli, Andrea
	Gambaro, Alberto Marcellini, and Carlo Barbante
61	Atmospheric Aerosol at the Svalbard Islands in Year 2010. Elemental Mass Size Distributions from Size-
	Segregated Samples: (I) Sea-Salt Componets
	P. Mittner, <u>D. Ceccato</u> , P. Sartori, M. Masiol, B. Pavoni, V.Vitale, A. Lupi, M. Busetto, S. Becagli, and R. Udisti
63	Atmospheric Aerosol at the Svalbard Islands in Year 2010. Elemental Mass Size Distributions from Size-
	Segregated Samples: (II) Sulphur Compounds
	P. Mittner, <u>D. Ceccato</u> , P. Sartori, M. Masiol, B. Pavoni, V.Vitale, A. Lupi, M. Busetto, S. Becagli, R. Udisti
65	Atmospheric Aerosol at the Svalbard Islands in Year 2010. Elemental Mass Size Districtions from Size-
	Segregated Samples: (III) Crustal Elements and Minor Elements
C7	P. Mittner, <u>D. Ceccato</u> , P. Sartori, M. Masiol, B. Pavoni, V.Vitale, A. Lupi, M. Busetto, S. Becagli, R. Udisti
6/	Emerging persistent organic pollutants in arctic air, surface water and snow in Ny-Alesund, Svalbard
	Zhiyong Xie, Axel Moller, Guangcai Zhong, Zhen Zhao, Catherine Larose, Renate Sturm, Aurelien Dommergue,
60	
68	Temperature and atmospheric stability in Ny-Alesund: 1990 to 2010
66	I.J. Koberts and W. Tych
69	Preliminary results on snow surface reflectance and its dependence on grain size studies at Ny Alesund
	R. Salvatori , <u>C. Lanconelli</u> , M. Busetto ,A. Mei, M. Valt ,and V. Vitale

Poster presentations, cont.

71	Middle energy neutron spectrometer with narrow diagram of acceptance
	Yu. V. Balabin, E. A. Maurchev
72	CLUES FOR NEOGENE-QUATERNARY TECTONICS IN SVALBARD
	P. Cianfarra, and F. Salvini
73	Isotopic Signatures of Soil Organic Carbon and its Relation to Vegetation in a Successional Glacier Foreland
	in Ny-Ålesund, Svalbard
	Miyuki KONDO, Masao UCHIDA, Masaki UCHIDA, Toshiyuki OHTSUKA, Shinpei YOSHITAKE, Hiroshi KANDA,
	Hiroshi KOIZUMI and Takayuki NAKATSUBO, Yasuyuki Shibata
74	Evidence of Heterotrophic Microbial Decomposition of Preaged Carbon in Arctic soil; Insights from
	molecular level natural radiocarbon analysis of phospholipid fatty acids (PLFAs)
	Masao Uchida, Miyuki Kondo ¹ Masaki Uchida, Yoshiyuki Takahashi, Motoo Utsumi, Hidetoshi Kumata,
	Yasuyuki Shibata

75	Long-term monitoring of Kongsfjorden fast ice
	Pavlova, O., Gerland, S. and Moe, B.
76	A study of Kongsfjorden fast ice evolution using a one-dimensional model
	Wang, C., Wang, K., Gerland, S., Cheng, B., and Pavlova, O.

77	A Digital Glacier Database for Svalbard	
	Max König, Christopher Nuth, Jack Kohler, Geir Moholdt and Rickard Pettersen	
79	Microbial and Chemical Variability in, and Elution from, a High Arctic Glacial Snow Pack.	
	Jakub Zarsky, Mats P. Björkman, J. Rafael Kühnel, Elisabeth Isaksson, Andy Hodson, Birgit Sattler, Roland	
	Psenner	
79	Laser Induced Fluorescence Emission (L.I.F.E.): In Situ Non-Destructive Detection of Microbial Life on	
	Supraglacial Environments in the Kongsfjord	
	Birgit Sattler, Markus Tilg, Michael Storrie-Lombardi, Roland Psenner	

Atmospheric Research in Ny-Ålesund - a flagship programme

Roland Neuber¹, Johan Ström², Christiane Hübner³

¹Alfred Wegener Institute for Polar and Marine Research, Potsdam ²Norwegian Polar Institute, Tromsø (now at Stockholm University) ³Svalbard Science Forum, Longyearbyen

In Ny-Ålesund, long term measurements of several atmospheric key parameters from the surface level up to the ozone layer have been performed for decades. Such comprehensive data sets are available from very few sites in the Arctic and the data are continuously fed into global networks. Ny-Ålesund offers the possibility to perform continuous atmospheric measurements both close at sea level and at 475 m of altitude within a relatively pristine environment. Also, its location under the magnetospheric cusp makes it a unique place for observing the solar wind and magnetosphere interaction on the dayside.

In order to optimally use these excellent conditions for atmospheric research and to improve cooperation within the Kongsfjorden science community, the following general flagship goals have been developed:

- develop the optimal utilization of available instruments and data sets,

- establish and further develop common research infrastructures,

 investigate the representativeness of measurements in Ny-Ålesund for climate change research and atmospheric process studies.

The flagship programme states the following future research priorities:

- Long term observations of key parameters concerning climate change
- Planetary boundary layer (PBL) research
- Studies and monitoring of long range transport of pollutants
- Arctic ozone layer and UV research
- Ionospheric / magnetospheric research
- Validation and synergistic analyses of satellite data

The flagship programme aims to establish a unique international long-term atmospheric monitoring and observation platform supported by all research institutions represented in Ny-Ålesund and thus to realize a supersite, allowing investigations of the complex Arctic System with a multidisciplinary approach. Interdisciplinary observations will be performed elucidating interaction processes on sea-, snow- and ice surfaces and the atmosphere. Special emphasis will be laid upon the impact of climate change on the Arctic environment.

Furthermore, means of better integration of atmospheric research within Ny-Ålesund, Svalbard as well as on a circumpolar level are discussed, and possibilities for interdisciplinary cooperation with other flagships are pointed out. Finally, three appendixes give an overview over atmospheric stations in Ny-Ålesund, atmospheric parameters measured in Ny-Ålesund, and the atmospheric monitoring satellites in operation in 2010-2020.

The programme was developed during and following a workshop organized by Svalbard Science Forum in November 2008 and is available as No. 22 of the Brief Report Series of Norsk Polarinstitut.

Chemical size distributions and bulk composition of Arctic aerosol sampled at Ny-Ålesund

G. Calzolai¹, S. Becagli², C. Ghedini², F. Rugi², D. Frosini², S. Nava¹, M. Chiari¹, F. Lucarelli¹, R. Traversi², and R. Udisti²

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Aerosol size distribution is among the most important properties of the polar remote aerosols, as it gives valuable information on the aerosol sources and on the atmospheric processes that occur during atmospheric transportation and modify the aerosol properties. Moreover, both size distribution and chemical composition play a crucial role in the interaction aerosol-solar radiation and in the aerosol ability to induce cloud and fog formation and to modify the microphysical cloud properties, thus affecting the Earth's radiation budget, the long-range transport processes and the deposition patterns of anthropogenic pollutants over the polar areas.

We report here some results on size distribution and bulk chemical composition of the Arctic aerosol sampled at Ny Ålesund in March – September 2010, at the Gruvebadet station. The sampling site is located sufficiently far from the village (about 800 m) and in a sector usually not affected by winds coming from the village direction, in order to minimize contamination. Anyway, a meteo-trigger system turns off the long-term samplers if wind direction or too low wind velocity make possible the transport or the diffusion of pollutants from the village.

Aerosol sampling was carried out by means of several collectors:

- a PM10 sampler (24-h resolution) with Teflon filters, for ions and metal determination;
- a 4-stage impactor (4-days resolution) with polycarbonate (>10, 10-2.5, 2.5-1 mm fractions) and Teflon (< 1 mm) filters, for ions and metal size-segregated analysis;
- a 12-stages impactor (4-days resolution) with polycarbonate filters, for elemental characterization;
- a TSP medium-volume collector with quartz fibre filters, for carbonaceous fractions (EC and OC) measurements.

Moreover, a SMPS (Scanning Mobility Particle Sizer), working in the range 6 - 500 nm, and an APS (Aerodynamic Particle Sizer), able to count the atmospheric particulate in the range 0.5 - 20 mm allowed the study of particle number size distribution. The two instruments were synchronized in order to obtain a unique spectrum of 106 size-classes in the range 6 nm – 20 mm every 10-minutes.

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Cations, inorganic anions and selected organic anions (acetate, formate, oxalate and methanesulphonate) were determined by Ion Chromatography in the clean room at the Department of Chemistry taking care to avoid any contamination during filters handling and analysis.

Samples collected by the 12-stages impactor were also analyzed by PIXE (Particle Induced X-ray Emission) analysis for elemental characterization at the LABEC laboratory of Florence. PIXE is unrivalled for the direct measurement of the mineral dust fraction in the aerosol, as it is highly sensitive to all the crustal elements except oxygen and carbon. Moreover, it does not need any sample pre-treatment, thus minimizing contaminations.

Chemical compositions have been compared with the high-resolution particle size-distribution, meteo conditions and back-trajectory reconstruction in order to perform the source apportionment and to understand changes in source intensities and transport processes during the March- September 2010 period.

The highest aerosol loadings were found in spring, and the ions represent about 50% of total aerosol mass. Long-range transport processes were evidenced and some episodes were clearly characterized by means of the analysis performed on the multi-stage impactor samples.

A new aerosol sampling campaign in the same site started in March 2011 and is scheduled to finish at the end of September 2011.

The Eyjafjallajökull eruption

Chemical characterisation of the ash plume at Spitsbergen

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A major pathway of trace metals as well as ionic species to the Arctic environment is the atmospheric transport from the highly industrialized areas at mid latitudes of the northern hemisphere. Through dry and wet deposition airborne pollutants reach the marine environment as well as the snow covered land areas. The scavenging of aerosol bound chemical substances by rain and snow has been postulated as the most important process for cleansing the atmosphere. The aim of this study was the investigation of trace metal and ion deposition via snow and rain in the high Arctic.

In April 2010 there was an eruption of the volcano Eyjafjallajökull on Island. The ash plume spreads over large areas in Europe. In May 2010 the ash plume reached the Arctic. At the AWIPEV station in Ny Ålesund aerosol-, totaldeposition- and wet only samples are obtained on a routinely base.

In our contribution we will present results from our investigations of the samples mentioned above. Data will be shown for the sampling period from March-July 2010.

- High-Volume-Aerosol Sampler equiped with a single stage impactor (cutoff diameter: 2 μm).
 Aerosols are sampled on filters. Subsequently we perform a wet chemical oxidativ digestion.
- Totaldeposition sampler for coverage of wet- and dry deposition with following investigation of soluble and insoluble element distribution after wet chemical oxidativ digestion.
- Wet only sampler for coverage the wet deposition with subsequent wet chemical oxidativ digestion.

Element analyses were performed by Quadrupol ICP-MS, ICP-TOF-MS and ICP-OES. As tracers for mineral dust AI, Fe and rare earth elements, for seasalt Na and Mg and as predominatly anthropogenic elements Cd, Cr, Cu, Ni, V and Pb were analysed.

The concentration range varied from ng/kg for anthropogenic and rare earth elements elements to μ g/kg or mg/kg for mineral dust and seasalt tracers. The data obtained from March to July 2010 show a strong variability. There are strong distinctions in aerosol composition and aerosol concentration as well as for the deposition samples before and after the volcano ash plume reached Spitsbergen.

In-situ cloud measurements performed at Zeppelin Station in May-June 2011

M. Shiobara (NIPR), A. Uchiyama (JMA/MRI), A. Yamazaki (JMA/MRI), H. Kobayashi (U. Yamanashi)

In the Arctic, we have been continuing ground-based remote-sensing measurements for clouds and aerosols using a sky-radiometer, a micro-pulse lidar and an all-sky camera in Ny-Ålesund (78.9N, 11.9E), Svalbard. In addition to the regular operations, we have performed an intensive observation campaign for boundary layer clouds in May-June 2011. This campaign aimed at mixed-phase clouds to investigate their optical and microphysical properties and cloud-aerosol interaction processes, mainly from cloud radiation measurements and active remote-sensing at the surface, and in-situ cloud microphysics measurements at Zeppelin Station located at a 474meter-high mountain-side of Ny-Ålesund. The instrumentation for in-situ measurements includes conventional cloud microphysics probes, i.e., DMT CAPS and Gerber PVM-100 that have been originally designed for airborne-use and in this campaign modified for ground-use with a ventilation system, and a newly developed cloud particle microscopic imager. The Rion KR-12A aerosol particle counter and the TSI 3007 condensation particle counter were placed in the ropeway cabin for measuring particle number and size distribution to see the difference between in-cloud and below-cloud conditions. We will present preliminary results from the insitu cloud measurements acquired for several days during the May-June 2011 field experiment.

Long term mercury measurements at Zeppelin Mountain

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²NTNU – Norwegian University of Science and Technology, Trondheim, Norway

Mercury is known to circulate between the earth's different environmental compartments through a complex biogeochemical cycle, and human activity has introduced additional processes that have increased the rate of distribution between the compartments. Briefly, global cycling of mercury involves natural and anthropogenic emission, dispersion in the atmosphere where chemical transformation may occur, dry and wet deposition to aquatic and terrestrial surfaces and finally re-emission. In the Arctic, mercury has an especially complex cycle including a unique scavenging process (atmospheric mercury depletion events), biomagnifying food webs, and chemical transformations such as methylation.

Mercury is emitted to the atmosphere by a variety of natural and anthropogenic processes. Once released into the atmosphere, mercury can undergo long-range transport allowing it to be carried by air currents to remote areas far from emission sources. In the atmosphere, mercury exists predominantly as gaseous elemental mercury (GEM). NILU has been monitoring GEM continuously during the past 12 years, and this is the second longest Arctic time series existing. This presentation will show results and discuss time trends in the atmospheric concentration of mercury. We will evaluate source and sink regions of mercury to Zeppelin and discuss how this is influenced by climate change.

20 YEARS CLIMATOLOGY OF NO₃⁻ AND NH₄⁺ WET DEPOSITION AT NY-ÅLESUND, SVALBARD.

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INTRODUCTION

Human activities release reactive nitrogen such as NH_3 and NO_x (NO + NO₂) to the atmosphere through energy production, fertilizer production and cultivation of crops (Galloway et al. 1995; Galloway et al. 2004; Grice et al. 2009; Peters et al. 2011). Nitrogen enriched air masses can be transported into remote, nutrient-limited regions, such as the Arctic, (Dickerson 1985) where the deposition of reactive nitrogen can significantly affect local ecosystems.

This work presents a 20 years climatology of nitrate (NO₃⁻) and ammonium (NH₄⁺). It is based on a dataset of weekly precipitation observations by the Norwegian Institute for Air Research (NILU). Sampling of the chemical composition of precipitation have been performed by the Norwegian Institute for Air Research (NILU), facilitated logistically by the Norwegian Polar Institute (NPI), since 1980 in Ny-Ålesund on behalf of the Norwegian Climate and Pollution Agency. (Fagerli and Aas 2008). The deposited mass of nitrogen per m² through NO₃⁻ and NH₄⁻ was characterised, as part of the NSINK programme

(http://nsinkproject.group.shef.ac.uk/NSINK/Home.html).

A solid (16 September – 2 June) and liquid (3 June – 15 September) precipitation season was defined in accordance with the average form, in which precipitation occurred during the periods. The deposition samples were divided into the categories "weak" (< 2 mg N/m²) and "strong" (> 2 mg N/m²). Nitrate deposition occurred mainly during the solid season, whereas ammonium deposition occurred equally both in the solid and liquid season. Weak- and strong samples showed a ratio of occurrence of 9/1. However, the contribution to the deposited mass of nitrogen through weak- and strong samples had a ratio of 1/1. A strong interannual variability was observed due to strong samples.

The mean annual sum of total nitrogen deposition (nitrate + ammonium) was 74 mg N/(m² yr). Weak samples contribute an annual baseline of nitrogen deposition of approximately 17 mg N/(m² yr) that can be augmented by strong samples. Rapid and direct transport is likely the key factor for these strong samples.

ACKNOWLEDGEMENTS

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SUVEX: Crusise-ship SO₂ emissions in Ny-Ålesund measured with imaging cameras

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During the summer months in Svalbard many cruise ships enter the harbours of Ny-Ålesund and travel around the coastal regions. To estimate their SO₂ emissions in summer 2009 a ten days pilot study was preformed with a new fast ultra-violet imaging camera (EnviCam). The main goals of the experiment were to demonstrate the utility of a UV camera to measure ship emissions, the ability to make rapid movie sequences of emissions and to quantify these in terms of emission rates (in gs⁻¹).

The camera system consists of a highly sensitive CCD array (1344 x 1024 pixels) with high quantum efficiency in the UV region from 280 nm onward. A highly transmissive UV filter in front of the camera can be used to isolate the SO_2 gas feature of interest. The NILU UV camera was mounted at various locations around Ny Ålesund to optimize viewing geometry and to test the ability of the camera to view ship emissions from different distances. Here, we describe details of the detection technique and results from the SUVEX experiment.

During the campaign, sequences of several minutes to 10's of minutes were made while a cruise ship was steaming in or out of the fjord. Several examples are shown here, e.g. fromt the large cruise liner MS Costa Magica with approximately 3500 passengers, with estimated emissions of 10-18 gs⁻¹.

The cruise ship data are compared - in a qualitative way - with observations of local air quality measurements of SO_2 and NO_2 from the monitoring station in 'Hyttebyen' in the centre of Ny-Ålesund.

Meanwhile, the camera system has been further developed into a two-filter system and it has been equipped with an additional UV spectrometer, thereby improved observations could be made in Ny-Ålesund during the next cruise ship seasons.

Joint Russian-Norwegian investigations of long-term climate variability on West Spitzbergen.

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Regular meteorological observations on Svalbard archipelago, implemented by the Russian researchers, was commenced 1931 in the mining settlement of Grumant. One year after, during the II IPY the site was switched to the Barentsburg settlement, where it has been remaining by now. In the period 1911-1930 the Norwegian station called "Spitzbergen-Radio" (later Green Harbor) was in operation, just 2 km south of Barentsburg. Thus, the area of Barentsburg settlement can be considered as a point of the longest time-series of standard meteorological observations on Svalbard. For instance, the station at Longyearbyen saw first measurements only in 1916. Isfjorden-Radio meteorological station operated from 1935 until 1975. Station in Ny-Ålesund settlement started working in the early 1960s. Therefore, Barentsburg meteorological observations series are the most representative to implement an objective XX century Spitzbergen climate change analysis. All the stations mentioned above are noticeable for being situated on the west coast of the main island of Svalbard archipelago. However, in the period 1947-1957 in another Russian mining settlement called Pyramiden, which is situated in Billefjorden, a meteorological station was in operation, which data have been inaccessible for researchers until recently. In the August of 2011, thanks to the close cooperation with the Norwegian Meteorological Institute (met.no), the automatic weather station was installed at the historical site of the former station. The data from this source are quite crucial as they provide information about the meteorological regime of the West Shpitzbergen Island's central part and help estimating the spatial peculiarities of archipelago's climate change.

Spitzbergen climate change research has been basing on the official sources of information (World Date Centre, Obninsk; AARI and Murmansk state archives; met.no and the Internet open sources). The main attention was given to the creation of homogeneous SAT (surface atmospheric temperature) time-series. The series were elaborated considering such crucial issues as change in the number of readings per day and their schedule. Moreover, Barentsburg station changed its site and elevation at least 3 times. That is why special investigations have been implemented to estimate the series homogeneity numerically.

The preliminary estimates of SAT variability did not reveal a significant trend for the whole observation period, however, series analysis for the periods 1950-2000, 1960-2000, 1970-2010, 1980-2010 showed existence of significant positive trends, especially regarding the last period. Revealed peculiarities are consistent with the reports on the enhanced warming in the Arctic in the end of XX and beginning of XXI centuries.

Activities of Czech research team in central part of Svalbard

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In 2007, the first Czech expedition established a research station in the vicinity of Russian settlement Pyramiden (northernmost Billenfjorden, Petuniabukta area). Research was conducted under the auspices of the project "Biological and climate diversity of the central part of the Svalbard Arctic archipelago" – the Czech contribution to the Network for ARCtic Climate and Biological DIVersity Studies (ARCDIV). The research project (terminating at the end of 2010) was focused on: (1) study of biological diversity and productivity in selected biotopes; (2) study of climate and ecological factors affecting diversity and productivity in selected biotopes; and (3) study of littoral ecosystems and relationship between parasites and hosts.

One of the most important results of research, focused on vascular plants, is a description of changes of high arctic vegetation in Brucebyen after 70 years. Phycological part of our team compared Arctic and Antarctic cyanobacteria from the genus *Phormidium* by molecular and morphological methods. Fluke *Gymnophalus* sp. was found to manipulate behaviour of bivalve *Mya truncata*. These findings can help to understand to the life cycle of this parasite.

The new starting project called "CzechPolar – Czech polar stations: construction and logistic expenses" builds up on the previous project, especially in the field of biology and climatology, and includes a new section of research focused on geology, geomorphology and hydrology. Main goal of this grant project is establishing of a new Czech polar station. A location of the new station is still in discussion. This project is supported by a grant of the Ministry of Education, Youths and Sports of the Czech Republic.

Svalbard Science Forum and the Research in Svalbard (RiS) database

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Svalbard Science Forum (SSF) was initiated in 1998 by the Norwegian government in order to promote Svalbard as a national and international research platform. Its tasks are research facilitation and coordination as well as information for researchers, managers and the public. SSF is part of and chaired by the Research Council of Norway. The board consists of representatives of national and international research partners in Svalbard.

SSF contributes in the development of science plans for Svalbard and the coordination of research according to these. It functions as networking and meeting place for researchers and brings researchers together, eg. by dedicated workshops. In cooperation with the Norwegian Polar Institute (NPI), SSF provides funding - the Arctic Field Grant - to carry out fieldwork in Svalbard. From 2012, SSF will in addition provide funding for researchers organized workshops and seed money for projects that result from SSF flagship programmes or in other ways contribute to enhanced collaboration and research coordination.

SSF has, in cooperation with NPI, established the Research in Svalbard database (RiS) in which researchers can register their information on current, planned and previous research activities in Svalbard. RiS thus functions as archive for all research activities in Svalbard since 1998, including projects, data sets and publications. The database is currently under further development into a unified project planning and administration tool, combining all information, application for permissions, and booking of research facilities, thereby facilitating access for researchers to Svalbard.

Website: <u>www.svalbardscienceforum.no</u> E-Mail: <u>post@svalbardscienceforum.no</u>

The SIOS Project: The basic idea and current status

Georg Hansen and Karin Refsnes

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The Svalbard Integrated Arctic Earth Observing System (SIOS) is an initiative of the Norwegian government to develop all research infrastructure on Svalbard relevant for Earth System studies into a coordinated international observational system matching Earth System models. The initiative was accepted for the Updated Roadmap of the European Strategy Forum for Research Infrastructures (ESFRI) in 2008. In 2010, a preparatory phase project funded by the European Commission was started, with the aim to develop a governance, investment and business model, as well as strategies for remote sensing, internal and international cooperation. SIOS spans over a wide spectrum research fields, ranging from solar-terrestrial coupling via atmosphere-ocean-land-cryosphere interaction processes to geophysical-biological coupling and anthropogenic impacts, .e.g. long-range transported pollution. In the frame of the preparatory work, the existing infrastructure is reviewed in the light of the requirements put forward by Earth System models. This process will result in proposals for an upgrading and extension of observational infrastructure and for the establishment of an overarching infrastructure facilitating data access, exchange and utilization. Furthermore SIOS aims at building up a close regional cooperation in the European Arctic, function as an Arctic node for other environmental ESFRI initiatives and intends to function as a core element of the envisaged pan-Arctic Sustained Arctic Observing System (SAON). Institutions from 14 countries representing all the major platforms on- and offshore have joined the Preparatory Phase initiative.

Top down control in terrestrial arctic ecosystems

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In a food web, every trophic level competes within its own level for resources like nutrients, space and water, but each trophic level is also influenced by the amount of food (bottom-up control from the lower trophic level) and predation (top-down control from the higher trophic level). Though the concept is simple, the role of competition and trophic interactions in shaping ecosystems are often not fully recognized. It takes a long term study to quantify all interactions as some are only obvious under specific conditions. In this presentation, we present details on a terrestrial arctic ecosystem showing competition within trophic levels and feedback controls between trophic levels. Key species in this system is the herbivorous barnacle goose. Within its trophic level, it competes with other geese and reindeer. As herbivore, it changes the arctic tundra and for predators like arctic foxes, great skua's and polar bears, it is an important food source. We will focus on top down control which was not obvious when we started our studies some decades ago.

KEY FUNCTIONS AND MICROORGANISMS DRIVING ORGANIC CARBON TRANSFORMATION IN HIGH ARCTIC PEATLANDS OF SVALBARD

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Keywords: Arctic organic soil, methane, methanotrophs, community structure and metatranscriptomics.

The greenhouse gas methane (CH₄) is produced and consumed by microorganisms. Changes in their activities may eventually cause a climate feedback and even modest changes in CH₄ emission to the atmosphere may result in significant effects on the global climate. The metabolism of organic carbon to substrates for CH₄ is a cascade of complex reactions catalysed by a set of different soil organisms. Release of methane to the atmosphere depends on the balance between methane producing, strictly anaerobic methanogenic archaea in anoxic soil layers, and the methane oxidising bacteria (methanotrophs) in oxygenated surface layers.

The methanotrophs function as a biological filter for CH_{4.} Controlling the release of this powerful greenhouse gas, they provide an important ecosystem service. *Methylobacter tundripaludum*SV96 originally isolated form the site Solvatn, Ny-Ålesund, has in several studies been identified as a key methanotroph with circumpolar distribution. It's activity is documented both in SIP (stable isotope probing) experiments and *in situ* metatranscriptomics studies.

In a non-targeted study of the active soil layers of two permafrost ecosystems close to Ny Ålesund, Spitsbergen 78°N, we have documented the genetic potential and functional gene transcription of microorganisms in these soils. Bacteria dominate the soils (70-80% of SSU rRNA) with high numbers of Actinobacteria and Deltaproteobacteria, while Alveolata constitute the largest eukaryotic superphylum. Interestingly, less than 0.2% of the SSU rRNA reads of the top layers were from methanogenic Archaea. Metagenomic reads indicated a large and diverse set of genes for carbon polymer binding and hydrolysis, and genes encoding enzymes involved in the degradation of complex lignocellulosic plant material were abundant.

With these studies we have gained new insights into the microbiology of the arctic permafrost affected wetland soils, and results from these studies will be presented.

Molecular identification of arctic moss species for ecosystem and biodiversity studies

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Mosses (Bryophyta) contribute significantly to the biodiversity of arctic terrestrial ecosystems. Hence, research on ecology and biodiversity in the arctic tundra often involves moss species. However, identification difficulties have hampered the proper use of many moss taxa, especially those forming complexes of closely related, morphologically similar species. In arctic environments identification of mosses is furthermore complicated due to extremely deviating morphologies caused by the harsh environment. DNA sequence analyses allow new insights into the circumscriptions and relationships of closely related species and provide new molecular species identification tools (DNA barcoding approach). However, an increasing number of studies of moss (and liverwort) species reveals incongruence between morphological species circumscriptions and molecular data, and an even higher genetic than morphological diversity, leading to the recognition of 'cryptic' species. In the present study we evaluate the suitability of DNA sequence markers to identify species in two species complexes of the moss genera *Calliergon* and *Racomitrium*, which are important components of arctic wet and dry tundras, respectively. Clear species circumscriptions based on molecular and morphological characters should result in improved identification tools for these taxa and serve as a basis for tackling other difficult species complexes in the Arctic. We furthermore present an example of applying molecular species identification as a tool to answer an ecological research question, i.e. to analyse the diet of an arctic herbivore, Barnacle Goose, in the Kongsfjorden area around Ny-Ålesund. For this study, sequences from DNA extracted from goose droppings were generated by classical and next generation sequencing. The molecular diversity found in the droppings is being compared with the morphological diversity as inferred from microscopic analyses of plant fragments.

OCEANOGRAPHIC TIMESERIES, PARTICLE FLUXES AND SEABED MAPPING INTO INNER KONGFIORD, W SPITSBERGEN (SVALBARD ARCHIPELAGO)

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This work aims to describe some preliminary results of an oceanographic/marine geological study of the inner part of the Kongsfiord, an inlet on the west coast of Spitsbergen, in the Svalbard Achipelago. Data collected during two campaigns include: 1) chirp-sonar sub bottom profiles; 2) few undisturbed sediment cores; 3) time-series of sediment traps, temperature, salinity and currents from mooring MDI (Mooring Dirigibile Italia); 4) several CTD casts.

We present collected data and a preliminary interpretation, that enable us to define main subjects addressed by our researches.

A seismic survey was performed by Benthos Chirp III 3-7 kHz sub-bottom profiler in the inner part of the fjord on September 2010. Acquired high-resolution seismic lines cover around 130 nautical miles in water depths ranging from 2 to 350m. Seismic reflection data penetrated the sedimentary sequence up to 15 m below the seafloor, and allowed us to describe seismic facies and thickness of the uppermost sedimentary sequence, entirely due to glacio-marine processes. Chirp-sonar data were also used to compile a morphobathimetric map of the area. Up to 12 interface gravity cores, and several Van Veen grabs samples were collected in key points to calibrate seismo-stratigraphic analysis.

First analysis of our data indicates that the inner part of the fjord, close to the calving line, shows the maximum sediment accumulation rate; here, a thin (<10m) stratified body made of medium-fine sediment thickness can be observed. Based on differences in acoustic facies, probably reflecting different dominant sedimentary processes, we classified 4 sectors in our working area: 1) acoustically well-laminated with continuous parallel reflector; 2) parallel, irregular-transparent reflectors; 3) transparent-chaotic reflectors; 4) continuous, highly reflective. We are now ground-thruthing geophysical data through the analysis of sampled sediment, with the final purpose of inferring sedimentary processes.

Stratigraphic analysis of the collected cores will be used to reconstruct the recentmost depositional history of this interesting area, controlled by the interplay between the glaciomarine sediment supply and oceanic current inflows. A mooring has been deployed in September 2010 and successfully recovered in September 2011. Water temperature, direction and speed of marine currents, has been collected every 30 minutes as well as monthly vertical fluxes of particles by PPS4/3 sediment traps. Yearlong series temperature at 100 m depth ranged from freezing point in winter to about 5 C in summer.

Currents speed at 25 m depth was about 10 cm/s and mainly directed toward inner fiord. Echo intensity from Nortek acoustic currentmeter provided insights of particulate in the water column. Its trend superimposes to sediment trap series.

Total mass fluxes from sediment trap presented a clear seasonal variability with minimum in January -February and maximum during summer.

CTD casts has been performed in September 2002, 2003, 2010, 2011 within the Kongsfjord from Ny Alesund to Lovenoyane and to the ice tongues therein.

The intrusion of warm oceanic water into the fiord was always visible up to Lovenoyane area. After the sill of this ancient moraine, the ocean lost heat flowing along glacier's front.

In late summer temperature ranged from 5°C in the outer part at 20 m depth to about 1°C in the northernmost part of inner Kongsfiord close to Conwaybreen glacier.

Anomalies in sound speed were found in Chirp profiles as clues of subsurface lenses of warm ocean waters at about 25 m depth.

We are grateful to DTA CNR for the grant that sustained this study, to the Italian Base "Dirigibile Italia" in Ny Alesund for field work support, and Roberto Sparapani for his professional help and friendship. We also wish to thank the Norsk PolarInstitutt and Kings Bay for logistics and the Open Source Community for the software we got from the web.

The significance of depth and substrate inclination for sublittoral hard bottom community structure in glacial Kongsfjorden (Svalbard, Arctic) – an underwater imagery approach

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The macroepibenthos inhabiting six depth zones between 30m and 200m was analyzed in order to reveal the structure of sparsely known deeper sublittoral hard bottom communities of glacial Kongsfjorden. In total 60 still images derived from six hours' video recorded at the remotely operated vehicle station Kongsfjordneset were assessed quantitatively. A total of 27 species/taxa were found. Around two-thirds of the mainly suspension-feeding species have an arcto-boreal distribution, while the rest are cosmopolitans. The overall mean epibenthos abundance was 33 ind. m-2 with maximum values at 150m depth (97.9 ind. m-2). While a few species were only found inhabiting particular depth zones, the bulk of the taxa inhabited the whole depth range, characterized by a rather constant salinity of 34.5 and a temperature ranging between 0.2°C and 2.8°C. Encrusting red algae, an unidentified sponge and the sea anemone Urticina eques characterize the assemblage of the shallow zone, the sea anemones Hormathia spp. are important below 30m, while Serpulidae are characteristic for the community below 50m and the demosponge Haliclona sp. is a key species in 100m and 200m depth. Cluster analysis and non-metrical multidimensional scaling based on abundance data showed differences between the assemblages along the bathymetric gradient, but only in the shallow in relation to the substrate surface inclination. Shannon diversity (H', abundance) ranged between 0.39 (150m) and 0.98 (30m). As surface and tidal currents are muted with increasing depth, key species gradually change with fragile (i.e. Serpulidae) substituting more robust ones in line with the 'Physical control hypothesis'. The gradual change in the more uniform deeper sublittoral is apparently predominantly biologically controlled.

EPOCA 2010 mesocosm CO₂ enrichment experiment in Arctic waters

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Due to its naturally low carbonate saturation states the Arctic Ocean is considered particularly vulnerable to ocean acidification. If CO_2 emissions continue to rise at current rates, half of the Arctic Ocean will be undersaturated with respect to calcium carbonate and, therefore, corrosive for calcareous organisms within the next three to four decades. While recent studies have demonstrated sensitivities of some Arctic species to ocean acidification, no information is presently available on community- and ecosystem-level responses. As a first attempt to closing this gap, an off-shore mesocosm system (KOSMOS) developed at IFM-GEOMAR was deployed in the Kongsfjord off Spitsbergen - about 1000 nautical miles south of the North Pole - in June/July 2010 and was used to conduct a pelagic CO_2 enrichment experiment. IFM-GEOMAR, which provided the logistics for this experiment, received support from the Greenpeace vessel M/S ESPERANZA, transporting the mesocosms and assisting during deployment and recovery.

In nine 15m long mesocosms, each enclosing about $50m^3$ of seawater, stepwise addition of CO_2 saturated seawater was applied to achieve CO_2 concentrations ranging from ca. 180 to 1400 µatm. Half way through the experiment inorganic nutrients (5, 2.5, and 0.32 µmol L⁻¹ nitrate, silicate, and phosphate, respectively) were added to the enclosed, nutrient-poor waters. In the framework of the EU integrated project EPOCA a team of 35 scientists from 12 institutes monitored the mesocosms over a period of 35 days. In total 45 parameters were measured daily and over 15000 samples analysed to cover aspects ranging from viral, bacterial, phytoplankton and zooplankton abundances, compositions, biomasses, and productivities, carbon and nutrient dynamics and stoichiometry, vertical particle fluxes, to the production of climate relevant gases and air/sea gas exchange. In bringing together a wide range of scientific expertise this study provides a comprehensive data set on pelagic ecosystem and biogeochemical responses to ocean acidification in Arctic waters.

Polar seabirds in a changing environment: A mechanistic approach

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Abstract

The timing of breeding is a life-history trait that can greatly impact fitness, because successful reproduction depends on the match between the food requirements for raising young and the seasonal peak in food availability. Accordingly, reproductive phenology has been regarded as 'fingerprint' of the ongoing climate change and in temperate areas, an advancement of the timing of seasonal activities is observed in most taxa. In Polar Regions, however, seabird long term phenological responses show a tendency for a reverse pattern (i.e. delayed phenology) and in Svalbard for example, two abundant seabird species adjusted their timing of breeding in opposite directions. To understand how Polar seabirds respond to large-scale changes, it is essential to study the mechanisms involved. Indeed, the major stepping stone from environmental variables to reproduction is via a cascade of hormonal processes and it is therefore these processes that determine the extent and rate at which birds adapt to changes in their environment. For several years, the AWIPEV project ORNITHO-ENDOCRINO has successfully collaborated with several Norwegian researchers to address the mechanisms underlying the onset of reproduction in an Arctic seabird, the kittiwake. Our main prediction was that poor foraging condition early in season will be associated with a delayed onset of reproduction and elevated stress hormones levels (corticosterone). By means of miniaturized GPS, we tracked the foraging areas used by prelaying kittiwakes. Data obtained showed that birds were using a large offshore area west of Svalbard but that the distance to foraging grounds varied dramatically (from 180 km up to 600 km) from one season to the other. Extended prelaying foraging trips were associated with a delayed onset of breeding, a poor reproductive success and increased corticosterone and decreased LH levels (breeding readiness). We then went further into endocrine mechanisms and found that females but not males bearing high baseline corticosterone levels showed reduced ability to release LH and were more likely to skip breeding. This highlights clear sex-differences in physiological sensitivity to environmental stressors. We then tested whether egg-laying date was mechanistically linked to corticosterone levels and found that an experimental reduction of corticosterone release was paralleled by a significant advancement of egg laying in females

associated with an enhanced breeding success. For the next years, we will focus with our Norwegian partners on the endocrine effects of persistent organic pollutants and heavy metals on the breeding phenology of Polar seabirds. The influence of contaminants as endocrine disruptors on the stress response is poorly studied and our project will aim at filling this gap. This project will be conducted in the Arctic, Svalbard and extended to Antarctica (ANR-funded project *PolarTop*). Endocrine studies will be conducted in several seabird species and we will investigate how migratory strategies and winter distribution affect the uptake of pollutants. We believe that such a project will significantly contribute to the study of contaminants on polar ecosystems and will strengthen further a fruitful collaboration between France and Norway.

CICCI/VAUUAV

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During spring 2011 an intensive investigation of climate-cryosphere interaction was conducted in Svalbard, Norway. A primary objective of the campaign was to investigate processes related to the deposition of aerosols to the Arctic cryosphere. Moreover, the campaign provided a first-time opportunity to test several novel data acquisition platforms. Of interest to this session are the three Unmanned Aerial System (UAS) platforms that flew cooperatively with oversight from the Norwegian Civil Aviation Authority (CAA). The campaign presented the unique opportunity for a CAA to regulate UAS platforms; both private and foreign government-owned aircraft (Norway, USA, and Russia). Further, it highlighted challenges, both political and logistical, related to conducting such an operation. We present an overview of the 'Coordinated Investigation of Climate-Cryosphere Interaction' campaign, and highlight the novel and valuable contributions from each of the UAS platforms. Our presentation includes an overview of the different platform capabilities, a discussion of the scientific merits of the platforms, insight into the political process for UAS operations in the Arctic, and a summary of the acquired contributions toward the goals of the CICCI project. http://niflheim.nilu.no/cicci

Exploring the relation between Black Carbon and precipitation using observed concentrations in air att the Zeppelin station and model derived precipitation.

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The study compare the long time series of BC measurements at the Zeppelin station with integrated precipitation during 10 days back trajectories calculated using the HYSPLIT model. Data is compared with recent observed values of wash out ratios obtained in Ny-Ålesund. The analysis shows a very strong relation between the observed atmospheric concentrations with the calculated precipitation along the transport route to Svalbard. Derived values of washout ratios are in reasonable agreement to previously published values.

High resolution meteorological measurements on Kongsvegen glacier (Svalbard)

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Detailed meteorological measurement data are still scarce at high Arctic glaciers, which are still essential to better understand their response to regional climatic developments and the use of related model data on the other hand. A network of six meteorological stations was established along the flow line of Kongsvegen glacier. Two of them are equipped as energy balance stations to investigate the snow/ice/atmosphere interaction processes in the accumulation and ablation area of the glacier. Similarly detailed measurements were rarely performed elsewhere and we here present some basic results covering the first observational year.

The air temperatures in the glacier domain range from ca. -30°C to +5°C. Notably, air temperature can be positive at almost any time of the year and at any elevation of the glacier. Typical along glacier temperature gradients are close to the moist adiabatic gradient and more stable atmospheric conditions are found during winter. Wind speed increase towards the tongue of the glacier indicating a persistent katabatic regime. Correspondingly, wind direction is characterized by an outstanding directional persistency, which is less pronounced at higher elevations. Disturbances by strong synoptic events occur at any time of the year, which is particularly frequent during winter. Humidity is rather uniformly distributed over the glacier, while the radiation components show distinct elevation gradients in terms of increasing shortwave insolation and albedo, as well as decreasing long-wave components on the other hand. Net radiation decreases towards the higher parts of the glacier.

The data are also put in context to those measured concurrently at the climate station Ny-Alesund (11m asl.), which is essentially interesting regarding future mass and energy balance modelling. Moreover, the data are of interest for enhanced investigation of the boundary layer characteristics above the glacier and interactions with other wind regimes, which has already been addressed in the CICCI campaign and will be a major focus in the near future. Finally, the data are also valuable for validation of regional atmospheric model output, remote sensing derivatives and for the interpretation of high resolution snow measurements, which have been conducted in parallel.

Vertical profiles of aerosol properties and ozone measured over Ny-Ålesund during spring and summer 2011

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Keywords: Vertical profiles, aerosol size distribution, black carbon, ozone

Aerosols and related phenomena 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, chemical composition and vertical distribution of the particles.

In the Arctic these aerosol properties are typically obtained from measurements at ground while they are scarce along the vertical profile in the planetary boundary layer (PBL). The only little information is available from occasional airplane campaigns.

In order to shed more light on the processes that involve aerosol in the PBL and to evaluate their direct effect on radiation and climate change we performed systematic vertical profile measurements of aerosol properties during spring and summer 2011 over Svalbard (Ny-Ålesund), in the frame of the CICCI field spring 2011 campaign. Together with several aerosol parameters, vertical profiles of the ozone mixing ratio were recorded with high resolution in the layer one kilometre above the ground level. The general aim of this activity is to trace the presence of structures in the ABL possibly related to local sources as well as to long range transport.

Measurements were carried out with a tethered balloon fitted with an instrumentation package consisting of: 1) OPC system (OPC GRIMM *1.107*; 31 size classes between 0.25 to 32 μ m), 2) a miniaturized electrical nanoparticle detector (miniDiSC), 3) a novel micro-Aethalometer (AE51 and AE52 prototype, Magee Scientific), 4) a miniaturized cascade impactor (Sioutas SKC with 2 impaction stages: <1 μ m, >1 μ m), 5) a fast ozone monitor (2Btech) adapted to low temperature conditions, employed to measure tropospheric ozone profiles, 6) a meteorological station (Vaisala Tethersonde TTS 111).

Overall, during the spring tethered balloon activity we recorded 84 aerosol (number concentration, size distribution) and meteorological profiles and 57 ozone profiles. During summer 18 profiles were measured for all parameters. We also collected 9 particulate matter samples to determine aerosol chemical composition along height. These samples will be analyzed by ion chromatography and scanning electron microscopy (SEM); black carbon measurements along height allows to better define the aerosol chemistry along vertical profiles. During spring multilayered structures of aerosol concentration were found.

This talk will be devoted to present the main features of the aerosol and ozone vertical structures in the PBL. Some specific case studies, such as for example the influence of cruise ships and the contribution of local sources will also be outlined.

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IPCC: Climate Change 2007

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Properties of Arctic Haze derived by remote sensing over Ny-Ålesund

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Aerosols and their interactions with clouds and the surface can have a significant impact to the radiation balance in the Arctic. This holds true especially for the spring season when the Arctic environment is climatologically very sensitive.

For this reason it is important to monitor occurrences, pathways and properties of Arctic aerosol on a long term.

Therefore, the Alfred Wegener Institute operates, among other instruments, a multiwavelength aerosol Raman lidar (KARL) and a sun photometer in Ny-Ålesund, Svalbard (78°55'N, 11°55'E) since several years. The lidar was upgraded recently and will be shortly introduced.

In this contribution a case study of Arctic Haze from 2008 is discussed, when an aerosol cloud moved over Ny-Ålesund in the lower free troposphere at about 3km altitude for several hours. The lidar data was evaluated using a statistical approach and shows a uniform aerosol cloud in terms of color ratio (size), modest depolarization (almost spherical shape) and lidar ratio. Backscatter and extinction coefficients from the lidar are inverted by Mie theory to derive an index of refraction and a size distribution. As it is characteristic for Arctic Haze slightly absorbing aerosol in the accumulation mode has been found, although the determination of the imaginary part of the refractive index from remote sensing data alone is challenging.

The lidar data were compared to AOD and a size distribution derived by photometer, where a reasonable agreement was found, and interpreted in terms of air trajectories.

While a multi-wavelength lidar can successfully retrieve aerosol microphysics a closer combination between remote sensing and in situ sampling of aerosol is highly desired for a better understanding of the aerosols' impact on the climate system. In Ny-Ålesund such a closure experiment should be possible as the majority of aerosol events seem to occur in the lowest 1km altitude and will be, hence, in reach of the Zeppelin station. The possibilities for such a combination between in situ and remote sensing data will be briefly discussed.
Characterization of the boundary layer structure in Ny Alesund – Svalbard: the first two years of measurements at the Amundsen Nobile Climate Change Tower (CCT)

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Micrometeorological observations have been taken on the CCT since the beginning of 2010: wind, temperature (fast and slow response sensors), and radiative fluxes at different heights in order to characterise the thermodynamic structure of the atmospheric boundary layer.

A statistical analysis has been carried out to identify the general features of the atmospheric circulation patterns, the seasonal variations, and the (broad) relationships with the synoptic weather patterns. The analysis highlights three main flow directions: SSW, ESE, N. Each direction is related to different weather patterns and affected by the local topographic features. Typical wind intensities are associated to the different directions, being higher from ESE than from SSW.

Intense winds correspond usually to almost steady conditions (i.e. almost the same direction is kept for several hours). As usual, low winds correspond to almost random variable directions.

Further classifications of the data have been made distinguishing among seasons, in order to differentiate the meteo/climatic conditions like the presence/absence of snow, the radiation balance, the cloudiness and the link between the dominant advection and local circulations.

By this classification nearly homogeneous data sets have been retrieved, useful to proceed in further specific analysis of the boundary layer structure. A preliminary comparison between some Monin-Obukhov Similarity Theory predictions and selected data sets is presented as an anticipation of further work.

Measured and modelled aerosol scattering coefficient at Ny-Ålesund, retrieval of real refractive index

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Keywords: aerosol, scattering coefficient, size distribution, refractive index.

Aerosol plays an important role in the energy budget of the Earth-atmosphere system, both directly, by scattering and absorption, and indirectly, modifying the clouds optical properties and life-time (IPCC, 2007). Relatively high aerosol concentration were found even in the Arctic region during spring and early summer, when the Arctic-haze phenomena takes place

In the framework of the Italian PRIN, the Climate Change Tower Integrated Project and the international Cooperative Investigation of Climate-Cryosphere Interaction (CICCI), continuous measurements of aerosol scattering and absorption coefficients, size distribution and chemical analysis were performed during the periods April-July 2010 and 2011 at Ny-Ålesund.

In the present contribution, we show the values of the scattering coefficient b_{sca} at 530 nm measured by a Radiance Research M903 nephelometer, and those derived applying Mie theory to the size distribution measured with a TSI SMPS-APS system (0.01 $\mathbb{D}m < d < 20 \mathbb{D}m$), and preliminary retrieved values of effective real refractive index.

To calibrate the Radiance Research M903 an intercomparison with a TSI three wavelength nephelometer model 3563 belonging to the Indian Space Research Organization connected to the same inlet was carried out in June 2011.

Mie calculation were performed from the merged size distribution of SMPS and APS, where the conversion between aerodynamic and geometric diameter has been evaluated assuming three predefined values of the particle density \mathbb{Z} (1.5, 1.7 and 2.0 g/cm³), and for non absorbing particles with the imaginary part of refractive index set to zero.

Two kinds of errors affecting nephelometer measurements are taken into account. The first is that due to the non-ideal lambertian emission of the lamp (illumination error), while the second is due to the limitations of the field-of-view of the detector (truncation error), the combined effect causing an underestimation of b_{sca} . In order to compare the values of retrieved b_{sca} and those measured by nephelometer, these uncertainties were taken into account in the Mie evaluations, following the results

provided in Müller et al. (2009); the non-absorbing condition were applied filtering the nephelometer measurements with a single scattering albedo greater the 0.95.

The determination of the most suitable values of the real refractive index was done using an iterative procedure that varies n_r untill the percentage difference between measured and estimated b_{sca} was less then 1%.

The figure reports the results for April, the 7th and the 8th, in its upper part shows the number size distribution obtained with a density of 1.5 g/cm³ in the middle part the measured b_{sca} and total volume concentration for a density of 1.5 g/cm^{3.} and in the lower part the retrieved real refractive index obtained for all the trhee considered densities. This latter part of the figure shows that the real refractive index increase with increasing density and that for density of 1.5 g/cm^{3.} varies between 1.4 and 1.6.

Effects of relative humidity on aerosol light scattering in the Arctic

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Aerosol particles experience hygroscopic growth in the ambient atmosphere. Their optical properties especially the aerosol light scattering - are therefore strongly dependent on the ambient relative humidity (RH). In-situ light scattering measurements of long-term observations are usually performed under dry conditions RH<30-40%. The knowledge of this RH effect is of eminent importance for climate forcing calculations or for the comparison of remote sensing with in-situ measurements.

This study combines measurements and model calculations to describe the RH effect on aerosol light scattering for the first time for aerosol particles present in summer and fall in the high Arctic. For this purpose, a field campaign was carried out from July to October 2008 at the Zeppelin station in Ny-Ålesund, Svalbard. The aerosol light scattering coefficient $\sigma_{sp}(\lambda)$ was measured at three distinct wavelengths (λ =450, 550, and 700 nm) at dry and at various, predefined RH conditions between 20% and 95% with a recently developed humidified nephelometer (WetNeph) and with a second nephelometer measuring at dry conditions with an average RH<10% (DryNeph). In addition, the aerosol size distribution and the aerosol absorption coefficient were measured.

The scattering enhancement factor $f(RH,\lambda)$ is the key parameter to describe the RH effect on $\sigma_{sp}(\lambda)$ and is defined as the RH dependent $\sigma_{sp}(RH,\lambda)$ divided by the corresponding dry $\sigma_{sp}(RH_{dry},\lambda)$. During our campaign the average $f(RH=85\%, \lambda=550$ nm) was 3.24 ± 0.63 (mean \pm standard deviation), and no clear wavelength dependence of $f(RH,\lambda)$ was observed. This means that the ambient scattering coefficients at RH=85% were on average about three times higher than the dry measured in-situ scattering coefficients. The RH dependency of the recorded $f(RH,\lambda)$ can be well described by an empirical one-parameter equation.

We used a simplified method to retrieve an apparent hygroscopic growth factor g(RH), defined as the aerosol particle diameter at a certain RH divided by the dry diameter, using the WetNeph, the DryNeph, the aerosol size distribution measurements and Mie theory. With this approach we found, on average, g(RH=85%) values to be 1.61±0.12 (mean ± standard deviation). No clear seasonal shift of $f(RH,\lambda)$ was observed during the 3-month period, while aerosol properties (size and chemical composition) clearly changed with time.

While the beginning of the campaign was mainly characterized by smaller and less hygroscopic particles, the end was dominated by larger and more hygroscopic particles. This suggests that compensating effects of hygroscopicity and size determined the temporal stability of $f(RH,\lambda)$. During sea salt influenced periods, distinct deliquescence transitions were observed. At the end we present a method on how to transfer the dry in-situ measured aerosol scattering coefficients to ambient values for the aerosol measured during summer and fall at this location.

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Observed impact of aerosols on Arctic cloud emissivity

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IPCC indicate that the main bulk of uncertainties on anthropogenic forcing are within aerosolcloud interactions. The aim was to measure how aerosols increase emissivity of clouds in the Arctic, thereby increasing Arctic surface temperatures.

Until recently this effect has been thought to be insignificant, but recent studies indicate that in the Arctic, many clouds may be susceptible to changes in emissivity. This is due to Arctic cloud characteristics having naturally on average low LWP and few CCN so that many Arctic clouds are sensitive to changes in emissivity. Thus, this may be a climatologically significant effect in Arctic regions (Lubin & Vogelmann 2006)

With measurements from Ny Ålesund, long term measurements of clouds, radiation and aerosols are examined. A statistical approach is then used to investigate differences in longwave surface forcing from clean and polluted instances.

When investigating low clouds with small liquid water paths over Ny Ålesund a significant warming effect of \$[3.2-4.3]\$ \$W/m^2\$ is found in the presence of high accumulation mode aerosols, compared to low accumulation aerosol concentrations. This is comparable to recent findings by Garret & Zhao (2006).

The annual surface heating of this effect is linked to the frequency of thin clouds, and is established to have a potential of (\$0.24-0.29 W/m^2\$), which is the same order of magnitude as the modeled results, supporting that the frequency of affectable clouds is probably as low as modeled results indicate Alteskjær et. al. (2010).

Controlled Meteorological Balloons launched from Ny-Ålesund

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Controlled Meteorological Balloons (CMET) were successfully launched from Ny-Ã...lesund in August 2010 and May 2011 in a project funded by the Research Council of Norway. Five balloons were launched during each campaign, and the latter campaign was coordinated with with the Coordinated Investigation of Climate-Cryosphere Interactions (CICCI), (transport.nilu.no/projects/vauuav) . After several years of development, CMET balloons have been adapted to polar environment and they are now a promising tool for studies and monitoring of tropospheric pollution transport into polar regions. The payload weight has been substantially reduced and is around only 250 g. It includes a GPS for positioning and an Iridium modem for data transmission. Standard meteorological parameters are observed along the path and chemical sensors may be installed in the near future. The standard CMET balloon consists of zero-pressure balloon (~300-500 liters at sea level) which itself contains a much smaller (~100 liter) superpressure balloon. Transferring helium between the superpressure balloon and the zero-pressure balloon regulates the volume (and density) of the system, leading to controlled ascent and descent. The CMET design is ideally suited for long-duration flights because the helium released from the high pressure balloon is retained. The balloons can drift at semi constant altitude or they can be set to carry out repeated soundings along the flight. In the August 2010 campaign we focused on long flights, but carried out some soundings up to 6000 masl over the North Atlantic. The balloons drifted for up to 3 days and approached the east coast of Greenland. Observed drift trajectories were compared with modelled trajectories from the FLEXPART transport model forced by the global ECMWF atmospheric model. In general, modeled wind speeds were higher than those observed, and the observations suggested much larger diurnal amplitudes in parameters such as humidity and air temperature in the marine boundary layer than those predicted by the ECMWF model. In the May 2011 campaign we focused on close to surface flights and repeated soundings in the marine boundary layer along the east coast and west coast of Svalbard. Most of the launches were timed with UAV flights in the Kongsfjorden area which were part of the CICCI campaign. The analysis of the May results is underway but will probably be very useful for mesoscale model analysis.

CMET project: page www.science.smith.edu/cmet.

The OPTIMISM project (observing dynamical and thermodynamical processes impacting the sea-ice mass balance from in situ measurements). Current status and future plans.

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Arctic sea ice declines both in extent and volume, at a rate outpacing the most pessimistic climate model predictions. Observations are key not only to assess ongoing changes, but also to improve our understanding and parameterization of physical processes that govern heat exchanges between the ocean, sea-ice, and atmosphere, in order to improve the predictive capabilities of climate models. In situ observations are also critical for the calibration and validation of satellite observations which provide a synoptic view of the Arctic. While sea ice extent is routinely monitored from space, remote sensing of ice thickness is still in its early stage with dedicated missions recently launched (e.g., CryoSat-2) for which in situ data are needed to relate raw measurements to geophysical parameters.

The OPTIMISM project (2009-2013), supported by Agence Nationale de la Recherche, IPEV and CNRS/INSU, brings together scientists and engineers from 5 laboratories in France covering the fields of ocean and atmospheric sciences, hydrodynamics, and radar altimetry.

A main objective of the project is to develop an autonomous, reasonable cost, system providing real-time measurements not only of ice thickness and heat content, but also of heat fluxes at the ocean-ice-atmosphere interfaces, which are needed to assess the sea-ice mass balance.

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These challenging technological developments build upon the "Ice-T" (Ice-Thickness) prototype buoy developed at LOCEAN, intended to both thin and thick ice conditions. In particular, a short meteorological mast, dubbed "BEAR" (Budget of Energy for Arctic Region) has been developed to monitor radiative and turbulent heat fluxes, and validated during a short spring campaign in Ny-Alesund, by comparison with observations from Italian and German programs. BEAR has recently been implemented on the Ice-T buoy and the complete system is to be installed in Ny-Alesund's harbour for wintering as of October 2011. Although this is a one-year deployment, the instrument could be relevant to contribute to observational efforts for a continuous monitoring of Kongsfjorden.

Field works target the study of processes both in multi-year ice and in first-year ice. Regarding the former, data have recently been collected with Ice-T as part of the North Pole Environmental Observatory (NPEO, J Morison et al.) co-located with POPS data from JAMSTEC and a GPS array from U. Alaska Fairbanks.

Process studies in first-year ice focus on the coastal polynya of Storfjorden, Svalbard, a region of intense ice production, where brine-enriched, dense water forms and eventually spills toward the deep ocean. Field observations, in collaboration with a Norwegian program, and supplemented by numerical modelling works, will focus on the impact of ocean mixing and of the surface energy budget on the sea-ice balance and dense water formation.

Daily and seasonal glacier velocity change on Kronebreen, Svalbard, as measured using FORMOSAT-2 imagery and in situ continuous GPS

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Glacier response to climate change is often heralded by changes in the velocity field. Remote sensing can be used to map changes in glacier speed. Visible satellite imagery provides high resolution products in convenient to use format, but is hampered by the presence of clouds. The high-resolution (2-m pixel nominal resolution in panchromatic mode) FORMOSAT-2 satellite has a daily revisit capability, allowing programmed acquisitions to capture occasional periods with few or no clouds. Here we use FORMOSAT-2 to derive glacier-wide velocities on the lower 10 km of Kronebreen, Svalbard's fastest-moving glacier, which has peak summer season speeds of up to 2 m d^{-1}. We present FORMOSAT-derived velocity fields for the summer melt seasons of 2007 to 2011, obtained using 4-8 images, the exact number depending on the year. We also compare the data from 2009 onward to 3-hourly measurements of speed made using a number of in situ code-phase GPS units deployed at various points on the glacier tongue. The FORMOSAT-derived data have good spatial resolution and show how velocity increases start at the front of the glacier and move upstream. The GPS data have high temporal resolution and show how the glacier reacts to meltwater inputs. The GPS data are also used to verify the spatial variability of the remote-sensing data since the receivers are located along the flow line as well as on a transect across the flow line.

Characterisation of AIRborne Microbial Communities

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Microorganisms are omnipresent in the atmosphere, mainly associated with aerosols. Next to the impact of aerial microbiota by influencing the atmospheric environment itself as cloud and ice condensation nuclei, respectively, or due to an alteration of atmospheric chemistry, airborne microorganisms can overcome geographic barriers and are able to inoculate new habitats. Therefore a big sampling campaign (from 2011 to 2012) on different locations is undertaken to ascertain the role of the incoming airborne microbial communities for isolated cold environments, e.g. alpine or polar regions. We intend a thorough characterization of airborne microbial communities in the Austrian Alps (especially in Tirol and Salzburg) and on two glaciers near Ny-Alesund (Midtre Lovenbreén, Vestre Broggerbreen) to gain a full understanding of the airborne fraction and there role as "seed populations" for these undisturbed environments characterized by a relatively low human impact. Numerous studies described the microbial biota of sea ice, ice sheets, ice caps and glaciers. Yet, to understand the carbon input, activity, biodiversity and biogeography of microorganisms in these oligotrophic habitats it is important to estimate the input of settled airborne communities (Pearce at al., 2009). However, up to now there is a lack of knowledge about the diversity and dynamics of airborne bacteria and fungi. In this study we document atmospheric microbial abundance and community composition with new molecular methods combined with traditional culturedependent methods to gain an understanding of the incoming aerial microbial fraction to various "inner alpine" and polar locations. Another important approach of this study is a strong outreach component where we give pupils from different schools the opportunity to participate in fieldwork, to work in a lab and to discuss the results together with scientists. Therefore we are working closely with teachers from schools in Austria and accomplish excursions and sampling campaigns on different glaciers together with young people. On the strength of past experience this creates a "win-win-situation" where we can spark kids interest in science by integrating young people into research with there helpful suggestions and questions and break down barriers with the outcome of institutional partnerships.

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Data issues in a moving environment: remote and in situ tools to monitor glacier dynamics and their hydrological consequences in the Austre Lovénbreen basin (Spitsberg 79°N).

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The precise quantification of glacier movements over time is one of the goals of glaciology. Understanding how and where ice is appearing, melting, and what happens once itâ€[™]s gone are at the core of the Hydro-Sensor-FIOWS program (IPY #16, IPEV 304, ANR 0310) that just ended and will be one of the aspects of the new Cryo-Sensors program. Obtaining a precise digital elevation model (DEM) of a glacier surface is not straightforward. When using old datasets, caution should be applied to the interpretation made of the results as the variability tends to increase. Recent monitoring techniques (DGPS, airborne Lidar) do provide a higher level of accuracy but still require a good knowledge of technology and its drawbacks, as well as field-specific issues (i.e. snow cover). Mass balance computations have been applied to Austre Lovénbreen using such techniques. When compared to ablation stakes measurements, results show striking differences, especially in accumulation areas. In areas where stakes do record accumulation, DEM differences account for ablation only. And the ablation measured using DEM seems greater than the vertical velocity of the glacier. Could it be possible that these two techniques do record processes occurring at the same time but at different scales? While stakes are measuring surface ice evolution only, DEM calculations are documenting the general trend of the glacier. It is possible that new ice is appearing in the upper cirques of the glacier while at the scale of the basin, the glacier is in a global retreat trend. We are currently attempting to instrument the glacier in order to confirm our hypothesis and to quantify its extent. In an effort to precisely compute the volume of ice constituting today's glacier, the surface DEM had to be complemented with a model of the bedrock on which the glacier is flowing. Ground Penetrating Radar (GPR) was used to get precise elevation values of the ice-rock interface. The difference between surface and bedrock DEM allowed us to evaluate the ice volume of the glacier. Bedrock DEM also gave us a unique view of underlying geomorphology and of its potential consequences on hydrology. The question of slopes and the dynamics of newly deglaciated areas will be approached in the upcoming program. Slopes do account for 35% of the glacier basin area. Permafrost in the slopes and at the slopes/glacier interface are points of great interest and are not easy to monitor. Terrestrial Laser Scanning (TLS) techniques will be used to get a better understanding of processes occurring on the slopes (rockfall, rockslides, creeping). TLS will also provide data on snow accumulation on the slopes and therefore bring an insight on the importance of this term in the hydrological budget.

Hydrological and geochemical approach to understand the glacierpermafrost subglacial-system interactions in a glaciated catchment of Western Spitsbergen

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The freshwater fluxes flowing from High Arctic glaciers mainly depend on climatic indicators (T, P) but also on other parameters like the thermal state of glacier, the water routing within and below the glacier, the permafrost distribution and the hydrodynamic characteristics of the moraines and rock structures forming the catchment. Using hydrological and geochemical methods, the objective of the presentation is to show the relationships existing between the hydrological response of a small glacier of the Brogger peninsula (Austrelovenbre glacier), the climatic conditions and these other parameters.

In the framework of the Hydrosensor Flows program (IPEV 304, ANR hydrosensor flows), we have studied since 2007 the Austrelovenbre glacier basin. Downstream, this basin has two well-defined outlets that concentrate all water fluxes: one connected to the glacier and the other influenced by the groundwater discharge in the proglacial moraine. The hydrological response of the river system has been studied by continuous monitoring of climate (T, P) and hydrological parameters (Q, T, Electrical conductivity) at hourly intervals. In addition, geochemical measurements have performed on water samples (major chemical elements, Sr, ¹⁸O, ²H, ³H, ³⁴S) in order to discuss the water origin, the water routing in the catchment and the water-rock interaction processes.

The main outlet of the glacier (Goule River) shows hydrographs (Q vs time curve) with two dynamics: a daily cyclicity and several isolated flood events. The daily fluctuations are induced by air-temperature variations. Most main flood events mainly result from rainfall events. When rainy events occur during warm periods or at the beginning of the freezing period, the floods may be highly amplified. The inertia of the basin has been approached using the correlation methods: the Q autocorrelation data indicate the runoff has a quite high « memory effect » (32 days). This may reveal that meltwater infiltrated into shallow aquifers and is gradually restored as a base flow to streams. As expected, the mineralization of stream water is rather low during the summer due to glacier and snow melting. However, high mineralized waters (ca. 700-800 μ S/cm) flow out before and after the summer. The composition in major elements and in stable isotopes indicates that the streams water actually comes from the water mixture of three reservoirs: snow/ice mainly during July and August, subglacial system (all year round) and supra-permafrost aquifer (July to September). The progressive discharge of subglacial water and supra-permafrost groundwater is therefore responsible of high concentrations in dissolved elements. The dominant major elements are Ca (abundant element in the geological formations) and S (due to pyrite oxidation and jarosite dissolution).

The second outlet displays smoothed hydrographs almost with no variations. The Q-curve therefore results from (1) the discharge of the supra-permafrost aquifer within the proglacial moraine, (2) the snow melting and (3) the permafrost thawing. The geochemical results confirm these origins of the stream water.

Local and spatial variability of snow characteristics at Kongsvegen glacier, Svalbard

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During spring 2011 multi-parameter measurements of physical snow properties have been performed at several sites at Kongsvegen glacier (79N, 13E). The investigation was performed at transects along and across the flow line of the glacier and considers snow that was accumulated during winter 2010/11. We introduce preliminary analyses of snow structural data that were collected with different instruments and methods. This also allows consideration of some methodical issues.

The general snow conditions in the accumulation area (e.g. 650m asl.) are characterized by a mean density of ca. 350kgm⁻³ and a mean snow temperature of -12°C, the latter increasing towards the underlying glacier ice. Standard stratigraphic snow pit analyses show a distinct layering of the snow pack reflecting major precipitation events and subsequent metamorphosis. Visual inspection of the measured profiles of hardness, grain size and crystal type suggests some principal correlations of the signatures that have to be investigated more quantitatively. A particularly hard and dense layer was found ca. 70cm below the surface and is followed by a rather complex structure further down. At sites representing the ablation area (e.g. 400m asl.) this layer was identified at a depth of 50cm below the surface.

The same layer is clearly identified by measuring the structural strength employing a Snow Micropen[®] probe. Further down in the snow pack these data show a highly resolved sequence of weak and solid layers, which can be hardly attributed to the otherwise observed stratigraphic features in a straightforward manner. These measurements were also performed in a gridded mode to assess spatial variability different within an area of 15x30m2. Analysis indicates a remarkable correlation between the records.

Near infra-red imagery allows for retrieval of specific surface area of snow grains along vertical pit sections. These profiles resemble the principal structure derived by the micropen, in particular the hard layers. Intercomparison of snow density measurements employing three different methods (standard sampling vs. dielectric methods) indicates a high consistency of the data.

Some of these data can already be put in a context to long-term observations. This indicates that the specific conditions during the investigation period were fairly representative for the last decade. Future studies will be directed towards enhanced statistical processing of the signatures to assess the dominant patterns of snow variability in several scales. This may also involve additional data that have been collected at the glacier during the measurement campaign. Thus considering meteorological data and relevant surface parameters, we aim at reconstructing the evolution of the fine-scale structure of the snow pack employing physically based snow models. An overall important issue these efforts is to establish potential links to other research directions as may be related to e.g. snow chemistry or surface exchange processes.

Ground based interferometric radar data of Kronebreen calving front, Svalbard.

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Data of temporal variation of calving event and velocity directly from the calving fronts are very valuable because they inform about calving processes, which are still poorly understood. However, such data are rare, due to the dangers and difficulties connected to measuring. Ground based interferometric radar at high temporal rate (2 Hz) has successfully been used in the IPY GLACIODYN project for velocity measurements and monitoring of calving events at Kronebreen, Svalbard for four test seasons (2007, 2008, 2009 and 2010). The radar is placed ~4 km from the glacier, and the antenna lobe covers a width of ~700 m of the front. Daily terrestrial optical photogrammetry and continuous visual observation are conducted to facilitate the interpretation of a 116 hour radar data record from August/September 2008. The calving front geometry is extracted from the optical images, and its effect together with the movement of the glacier is identified in a plot of the amplitude of the radar return signal. Detection of calving events is demonstrated by change detection image processing in the radar data set, and 92 % of the total calving events are confirmed from visual observations and registration. Velocities determined from tracking of permanent scatters in the radar data gives an average velocity for the period of 3.2 md-1, and we find in generally good agreement between our measurements and visual observations. In our experimental data set we have observed electromagnetic interference in the radar back scatter data from the calving front, and we explain this to be due to multipath scattering and tidal cycles. The radar has also successfully been tested from Ny-Ålesund research station, 15 km from the glacier front. Continuous radar monitoring of the calving activity of Kronebreen is therefore possible, and seasonal variations can be identified. A new and improved version of the radar is under development, which can map velocities in range and cross range.

Lipids in the Cryosphere

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Lipids play an important structural and functional role in cell membranes of cold adapted microorganisms to maintain an adequate level of fluidity and flexibility which is a prime requirement for survival in cold environments. Those lipids comprise a large group of chemically heterogeneous compounds, the majority of which include esters of fatty acids as part of their structure. Due to the necessity of flexible cell membranes cold loving bacteria comprise a high level of unsaturated fatty acids. Here we show a characterization of various cryospheric compartments along Midtre Lovénbreen, Svalbard, according to the composition of fatty acids. The cryospheric ecosystems are represented by ice cores, bioaerosols, cryoconite material, proglacial lake water and cyanobacterial mats from the glacier forefield. The highest total quantity of fatty acids has been found in cyanobacterial mats whereas the least amount of FA has been detected in bioaerosols collected in 1,5m height. The composition of fatty acids has been found to be similar in all compartments except from atmospheric samples. Bioaerosols were the only medium where saturated fatty acids were dominating. In particular, palmatic acid (16:0) showed the highest quantity present which is the most common fatty acids in bacteria, plant and animal cells. Only three fatty acids have been detected in all habitats: 16:0 (saturated), 18:109c and 18:206, 9c (both unsaturated). Since the inoculation of oligotrophic environments is limited to rather few sources the origin of living communities (terrestrial, aquatic) can be investigated according to the composition of fatty acids. Furthermore, lipid compositions in ice cores could possibly be read as proxies for past climatic conditions

Using Unmanned Aerial Systems for Climate and Environmental research in Ny-Ålesund

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Unmanned aerial systems (UAS) are ideal tools for bridging the gap between satellite and insitu measurements. The recent technological advances have given a vast selection of suitable UAS sensors on the market, and several civilian UAS platforms have been tested and proved in arctic conditions. Further, Ny-Ålesund has shown to be one of the best suitable locations for UAS operations in the high-arctic region. For the last 5 years Norut's CryoWing UAS has been conducting measurements of the climate and cryosphere from Ny-Ålesund, utilizing different sensors and payloads. We will provide an overview of these campaigns, present scientific results and discuss lessons learned. We will also give an overview of the scientific sensors for the CryoWing platform and discuss the possibility for future sensors and payloads.

Bipolar climatology of ionospheric scintillation at solar minimum

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The aim of our work is to describe the "scintillation climatology" of the high latitude ionosphere over both hemispheres under quiet conditions of the near-Earth environment. For climatology we mean to assess the recurrent features of the ionospheric irregularities dynamics and evolution by means of long data series, trying to catch correspondences with scintillation occurrence, experienced by radio signals passing through such irregularities. To this scope, high-rate sampling data of ionospheric scintillation from the project ISACCO (lonospheric Scintillation Arctic/Antarctic Coordinated Campaign Observations) have been analyzed. The network consists of GISTM (GPS Ionospheric Scintillation and TEC Monitor) receivers located in the Svalbard Islands (Norway) and in Antarctica. GISTMs are able to acquire data at high sampling rate (50 Hz) and compute the internationally adopted scintillation indices ($\sigma\Phi$ and S4) from L1 GPS frequency and the Total Electron Content (TEC) along the ray-path from the L1 and L2 frequencies. Currently the network includes four receivers in the northern hemisphere and two in the southern one that, even if not geomagnetically conjugated, allow an investigation whose strength relies on the different coverage of the high latitude ionosphere. In our case, the northern array allows the observation of sub-auroral, auroral, cusp and cap sectors, while the southern one covers essentially the cusp and cap regions. The method adopted is the Ground Based Scintillation Climatology (GBSC), which produces maps of scintillation occurrence and of TEC relative variation to investigate ionospheric scintillations scenario in terms of geomagnetic and geographic coordinates, Interplanetary Magnetic Field conditions and seasonal variability. By means of such a novel and original description of the ionospheric irregularities, our work provides insights to speculate on the cause-effect mechanisms producing scintillations, suggesting the roles of the high latitude ionospheric trough, of the auroral boundaries and of the polar cap ionosphere in hosting those irregularities causing scintillations over both the hemispheres at high latitude.

Eddy Covariance measurements in Ny-Ålesund, Svalbard, Norway

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The coupling behaviour of the atmospheric boundary layer with the free troposphere in different situations shall be investigated with the aim to improve their parameterization in regional climate models. Since September 2010 an eddy covariance measurement system is operating in Ny-Ålesund (position: N 78° 55.287', E 011° 54.851') for determining the sensible and latent heat flux and the shear stress near the earth's surface. The main motivation is to get more knowledge about the energy balance in the atmospheric boundary layer and the annual behaviour of the single components of the energy balance. A radiometer (for temperature and humidity profiles) and a wind Lidar (for 3D wind profiles) will support the eddy covariance measurements to achieve a complete as possible view on the conditions of the atmospheric boundary layer and to observe the entrainment behaviour between the atmospheric boundary layer and the free troposphere.

In our eddy covariance system we are using a CSAT3 3D sonic anemometer from Campbell Scientific to obtain the fluctuations of the wind components and the temperature (the sonic velocity depends on the temperature; the actual temperature can be calculated this way). A Licor 7500 measures the humidity parameters by using the absorption of IR light. All these values are sampled with a frequency of 20 Hz. To get a complete view on the conditions and a general background at the measurement site, a second mast was built up not far away in the main wind direction lee of the eddy covariance system. The following additional quantities are collected with a lower frequency (1 Hz): wind velocity, wind direction, temperature, air pressure, absolute and relative humidity (all in 2 meters height), and the surface temperature and snow height (in winter times); we also built up a small temperature profile measurement on this mast (3 instruments in 1.5, 1 and 0.5 meters height) and a small soil profile next to the mast with measurements of temperature in 1 and 10 cm soil depth, a heat flux plate in 10 cm depth and a TDR (Time Domain Reflection) instrument for measuring the soil humidity.

One selected preliminary result is the detection of external gravity waves in 1 - 2 m height, generated by strong radiative cooling during clear polar night and special wind conditions. This leads to a decoupling of the processes at the surface and above the "wave layer". For exact conclusions about the vertical energy transfer, the different layers have to be observed separately.

The whole eddy covariance system is portable and can be operated autonomously, using a hydrogen fuel cell, if required. This gives the option to install the system on other appropriate places of interest

Mercury in the European Arctic: what do we know from observations in Ny-Ålesund, Svalbard?

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Atmospheric mercury speciation measurements were startet up in April 2007 at the Zeppelin air monitoring station. Based on the second longest time series of composite gaseous elemental mercury (GEM), gaseous oxidized mercury (GOM) and particulate bound mercury (HgP) measurements available from an Arctic site a clear seasonal variation was uncovered. It is well accepted that parts of GEM is converted to RGM and PHg during the annual recurring springtime phenomenon AMDE. Increased PHg concentrations occurred almost exclusively during intense AMDEs from March through April. Increased RGM concentration denotes more mercury deposited to the Ny-Ålesund environment than first anticipated.

Gaseous elemental mercury (GEM) fluxes have been measured since February 2008 using a GEM flux gradient method. GEM emission occurred almost exclusively over a snow covered surface. The highest GEM emission was observed during the spring AMDE period, consistent with the simultaneous deposition of GEM, GOM and HGP. No significant emission fluxes were observed over soil during polar summer.

Meteorological Profiling of the Arctic Boundary Layer

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The planetary boundary layer (PBL) is the lowest part of the atmosphere, where exchange processes of momentum and heat occur between the Earth's surface and the atmosphere. In the Arctic, the boundary layer is characterized by a frequent occurrence of temperature inversions, thus being a stable layer that effectively suppresses the vertical motion of air. To characterize the state and variability of the Arctic boundary layer, we apply aerological soundings at the AWIPEV research base in Ny-Ålesund, Spitsbergen. Here, the focus is set on the meteorological profiling with a tethered balloon system. Similar measurements were also implemented on the North Pole drifting ice station NP-35. The experimental set-up includes up to 6 tethersondes mounted along the tether, allowing the continuous profiling of the meteorological parameters pressure, temperature, humidity, and wind over the time period of several hours. Commonly, the balloon is positioned in about 800 to 1200 m altitude, with the sondes distributed in constant interspace. With this technique, vertical resolution is limited in favour of the high temporal resolution that allows the detection of the strengthening and degeneration of ground based and elevated inversions. The results are used as auxiliary information for other atmospheric measurements or e.g. to validate the boundary layer representation in the regional climate model HIRHAM under different atmospheric stability conditions. The regular Ny-Ålesund radiosonde observations are complemented by the meteorological profiling with a tethered balloon system on campaign basis. So far, operation of the tethered balloon system took place in spring 2005, autumn 2005, and every spring since 2006. Clearly, the operation of the tethered balloon is limited by the meteorological conditions (e.g. too much wind or danger of icing). Generally, the Ny-Ålesund observations show the dynamic formation and degeneration of ground based inversions. The sea ice covered Central Arctic is an ideal laboratory for investigations of the stable stratified boundary layer, surface based inversions and low-level jets and its interaction with the underlying surface. During the International Polar Year (IPY) 2007/2008, we had the possibility to participate in the 35th Russian North Pole Drifting Ice Station Expedition, and to perform tethered balloon measurements on the Arctic sea ice. As expected, in most cases a surface based inversion of several degrees was observed, intermitted only by few events of neutral stratification. In some cases, also the occurrence of low-level jets has been observed. In addition to radio- and tethered balloon soundings, we present meteorological profiles measured by dropsondes launched from the AWI polar aircraft Polar-5 in the vicinity of Svalbard. Orographic differences between the sea ice surface and the Kongsfjord landscape are discussed in terms of their influence on the PBL.

Climatology of Surface Radiation and the Meteorological Column - Longterm Observations in Ny-Ålesund

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At the AWIPEV research base, surface meteorology and radiation are continuously measured since almost 20 years as part of the Baseline Surface Radiation Network (BSRN). The aims of the program are the monitoring of long-term trends in radiation fluxes at the surface and the providing of validation data for satellite determination of the surface radiation budget. Here, we present an overview of the different radiation parameters measured, and analyze their evolution. Local effects found in radiation data are considered as e.g. the correlation between cloud cover and soil properties. In addition, meteorological profiles up to 30 km are taken on a daily basis by radiosondes since 1991, providing a profound database for climate analysis. The talk will be highlighting seasonal and annual variations of the meteorological column, as well as potential climatic trends. Warming and cooling tendencies of different atmospheric layers are analyzed with focus on the planetary boundary layer and the lower stratosphere. The picture will be complemented by the meteorological surface observations. Overall, the climatology of the long-term radiation and meteorology observations is useful for several projects based in Ny-Alesund and the Svalbard region. The precise description of the dataset and its local influences will allow more precision for the general polar analyses.

Distribution and budget of reactive nitrogen compounds (NO_y) in European high Arctic: atmospheric effects and air-snow interactions

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Polar troposphere plays an important role in environmental concerns for global change. Climate records reveal pronounced warming trends and human and environmental implications and climate feedbacks in the Arctic and Antarctic regions warrant urgent attention. Furthermore, these areas are also characterized by several photochemical processes not fully understood, occurring at the surface and in the atmospheric boundary layer, such as the ozone (O_3) formation and depletion and the re-activation of snow nitrate (NO_3) .

Observations on atmospheric chemistry of reactive nitrogen (NO_y = NO_x+ HNO₃ + NO₃⁻ particles + PAN + etc.) in the polar regions are limited, due to uncertainties surrounding the NO_v distribution and budget, as they are transported into the polar sites, and the mechanism for the conversion between nitrogen oxides (NO_x) and NO_v. Several studies have shown that the photolysis of snow NO₃⁻ produces NO_x and nitrous acid (HONO) in snow interstitial air and that this production is sufficient to alter OH_x (HO+HO₂), NO_x and O₃ budgets in the overlying atmosphere. The current understanding of this process points towards the absorption of some NO_v species by snow surfaces, the presence and the subsequent reduction of NO_3^- in a surface phase, followed by photochemical release of NO_x and HONO. Although several field experiments have been carried out to quantify the emission fluxes of NO_x and HONO from the snow surface, little is known about the sources of snow NO₃⁻ and the air-snow interaction and deposition of NO_y. Inorganic nitrogen compounds, such as nitric acid (HNO₃) and NO₃⁻ particles, are likely the predominant precursors of snow NO₃. However, also other NO_v species can be deposited and converted to NO₃⁻ in the snow. Early studies in Arctic region pointed to the dominance of peroxyacetylnitrate (PAN) in the NO_v budget, and to its role as a major source of NO_x, but any fractionation associated with PAN decomposition to contribute to snow NO₃, the relative chemical mechanism, post-depositional processes and the role of oxidants are currently unknown. Recent studies have hypothesized that biotic processes within the snow can contribute to the snow NO₃, but their mechanisms are not fully understood. Furthermore, climate changes, such as changes in UV radiation, in concentrations of pollutants, in snow cover and in temperature, could affect the extent of these depositional and air-snow processes.

Measurement of atmospheric concentrations of NO, NO₂, HONO, HNO₃, NO₃⁻ particles and their fluxes above the snow surface and chemical and physical properties of snow (ionic analysis, specific surface area, density, temperature, irradiance) were carried out during spring time 2010 at Ny-Ålesund (Svalbard) as part of the PRIN2007 project "Dirigibile Italia: A platform for a multidisciplinary study on climatic changes in the Arctic region and their influence on temperate latitudes". This work aims to identify the atmospheric sources of snow NO₃⁻, to understand the mechanisms of the exchange reactions between snow and the atmosphere and to determine the atmospheric fluxes of nitrogen species above the snow surface.

Performance of CryoWing UAS as a platform for repeat measurements of surface reflectance

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The CryoWing Unmanned Aerial System was flown in three campaigns as a central part of the Variability of Albedo Using an Unmanned Aerial Vehicle (VAUUAV) project to measure variations in snow albedo at different spatial scales. Satellite sensors measure reflectance and albedo over a vast spatial scale, often repeated at regular intervals. However spatial variations cannot be resolved below the pixel scale of the sensor, and observations are limited to the specific time of the satellite overpass. Using data collected during the 2010 VAUUAV field campaign at Summit, Greenland, this assessment examines the success of the Cryowing platform in repeating reflectance measurements at a spatial scale that bridges the scale of ground-based and satellite-based measurements. Stability parameters describe the ability of the platform to repeat reflectance observations, both in terms of angle and position. Observations were first screened for those having an observation angle within 10 degrees of nadir, thus exposing the dataset to a smaller degree of variability from surface anisotropy. The percentage of observation points retained at this threshold varied from just over 7% in short sections of straight flight with a strong tailwind, up to greater than 95% on long, sustained sections of straight flight. Normalized overlap rate is a parameter developed to describe the positional accuracy of repeat passes, defined as the number of overlapping observation footprints in the season, normalized by the total number of passes through the same programmed section of flight. The normalized overlap rate varied from 5% up to 60%. Radiation transfer modelling through the libRadtran software package is used to estimate the effects of off-zenith attitude on irradiance observations.

Water soluble compounds in Ny Alesund aerosols.

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A significant percentage of organic matter (between 40 and 60%) in atmospheric aerosols consists of a numerous but still poorly understood class of hydrosoluble compounds known as water soluble organic carbon (WSOC). WSOC can significantly decrease the surface tension of aqueous solutions, affect the hygroscopicity of aerosols, and may be important in determining the ability of particles to serve as cloud condensation nuclei (CCN), with consequences for climate, optical properties of the atmosphere and air quality. The scientific activity performed at Ny Alesund during the 2010 campaign had the aim of better understanding the formation, the chemical composition and the transport processes of aerosol towards the arctic zone.

Sampling was performed using an high volume cascade impactor (TE 6000 series, Tisch Environmental Inc.) at the Gruvebadet supersite (78 55 07 N, 11 53 30E) (stage parameters: 4.2-10.2 μ m, 2.1-4.2 μ m, 1.3-2.1 μ m, 0.69-1.3 μ m, 0.39-0.69 μ m, 0.00- 0.39 μ m) from March to September 2010.

The following analytes were determined: levoglucosan and methoxy phenols (vanillic acid, isovanillic acid, homovanillic acid, syringic acid, conyferil aldehyde, ferulic acid, syringaldehyde, p-coumaric acid) as biomass burning tracers, acrylamide (antropogenic), amino acids (from primary producton); and rare earth elements (REEs) were analysed to better understand transport processes. Seasonal trends were obtained.

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Atmospheric Aerosol at the Svalbard Islands in Year 2010, Elemental Mass Size Distributions from Size-Segregated Samples: (I) Sea-Salt Components

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In the framework of the "Dirigibile Italia" collaboration, aerosol sampling has been performed continuously during year 2010, in the period March 19 – September 15, with a 12-stage SDI impactor and a 48 hours duration. Altogether, 42 size segregated samples with their blanks were collected on Nuclepore membranes. The full aerodynamic range varied from 40 nm to 12 μ m. A second campaign has been performed in 2011.

Subsamples and blanks were submitted (in vacuum) to absolute PIXE analysis at LNL, with the "FISAMB" set-up, with a spatially uniform 1.8 MeV proton beam. Gupix spectra analysis software was used.

Here and in the two other abstract, labeled respectively II and III, we present preliminary results concerning two samples: GB17 and GB02. The first sample displays almost exclusively sea-salt elements plus element S, whereas the second is much more complex. The present report is dedicated to the sea-salt part of both samples. The aim of the present work is to check the adequacy of our sampling, analytical and data handling methods in the peculiar environmental conditions. We note however that these methods were already successfully used in an Antarctic coastal site.

Blanks were used to evaluate and subtract, for each element, the mean value of the background, to evaluate a minimum detection limit and the contribution of the fluctuations on the blanks to the error.

Each point (i) in the Elemental Mass Size Distribution, EMSD, in defined by means of D_{g}^{i} , the geometric mean diameter, μ m, of SDI stage i, and of the ratio $DM_{i}/(InD_{i+1}^{T}-InD_{i}^{T})$, with DMi being the volume concentration and D_{i}^{T} aerodynamic cut diameter of stage i. The lognormal representation of the EMSD's makes use of a combination of lognormal functions, each one defining a size mode, characterized by three parameters: center, width and intensity, plus a level parameter.

Sample GB17. It consists almost purely of sea-salt elements, plus element S. The EMD's of K and Ca display well compatible shapes and an intensity ratio well compatible with the standard Ca/K sea-salt ratio. Na and Cl EMSD's can be conveniently compared by defining Cl(Na) as the Na EMSD multiplied by the Cl/Na sea-salt ratio. As compared to Cl, Cl(Na) displays an attenuation increasing with increasing diameter and attributed to Na X-ray absorption, whereas Cl displays a (chemical) depletion increasing with decreasing diameters. We thus build-up a new reference function Cl(Na)_{corr}, coinciding with Cl at large diameters, with Cl(Na) at low diameters and evaluated by interpolation at intermediate diameters. Shape and intensity of Cl(Na)_{corr} are well compatible with those of K and Ca, thus insuring a convenient representation of sea-salt elements.

Sample GB02. The presence of a significant crustal-like component in this sample (see abstract III) is expected to contribute to K and Ca EMSD's. Both Cl depletion, at low diameters, and Na absorption attenuation at large diameters are observed. We proceed, as for sample GB17, to build-up the reference function Cl(Na)_{corr}. Once this function is build-up, the sea-salt contribution to K and Ca EMSD's can be evaluate

Atmospheric Aerosol at the Svalbard Islands in Year 2010.Elemental Mass Size Distributions from Size-Segregated Samples: (II) Sulphur Compounds

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We only want to remind here that the two samples under consideration are very different from both the point of view of their respective aerosol containt and of that of the corresponding problems in the analysis of the data.

Lognormal representation of elemental mass size distributions for sulphur compounds.

A. Sample GB17. Three size modes of element sulphur, S, are observed in this case and, in addition, we consider the quantity sea-salt sulphur, ssS. This last quantity, which is indicated as S(K), is obtained by multiplying the observed concentration of element K associated to sea-salt, see abstract I, by the S/K sea-salt ratio. Element K was chosen as reference, because it is unaffected both by x-ray attenuation and, presumably, by chemical depletion. Moreover, there is no crustal contribution to K, in this case. The lowest S mode can be interpreted as the submicrometric S accumulation mode; the highest mode, largely, if not totally, corresponds to sea-salt sulphur, with some possible enrichment in S; the intermediate mode is more intriguing. Significant hints concerning the properties of the above three modes can come from a comparison with results obtained by part of us in a 2003/2004 Antarctic campaign at the clean coastal site Campo Icaro (lat. 78' 55" 37º N, long. 11' 55" 58º E, near the M.Zucchelli Italian Base, on the Ross Sea). As a matter of fact, in Antarctica the lowest and the highest mode were observed always, whereas a clear intermediate mode was observed in several cases. As an example, we consider the Antarctic sample AMG021, which displays a clear three-modal distribution, whose modes are similar (except for intensity) to those of sample GB17. The presence of the intermediate mode is however more explicit in the Antarctic sample than in the sample GB17. Understanding the nature of the intermediate mode requires more work. A possible connection with an enrichment in S, occurring on sea-salt particle surface, rather than in volume, and thus favoring lower particle diameters in the size distribution, is being investigated

B. **Sample GB2** displays a bimodal distribution very different from that of sample GB17. The submicrometric mode is considerably more intense (the ratio of the corresponding A parameters is ~10) and displaced towards larger diameters; the supermicrometric mode is much lower in intensity (the ratio of the corresponding A parameters is ~0.25). A major difference of sample GB2 with respect to sample GB17 consists in an important presence in the former and absence in the latter – of a crustal-like component and of several minor elements of presumable anthropogenic origin, which could possibly interact with the processes giving rise to the submicrometric S mode. As an example, we consider the size distribution of element V, whose parameters are quite near to those of the S submicrometric mode, thus indicating a possible connection between them.

Atmospheric Aerosol at the Svalbard Islands in Year 2010. Elemental Mass Size Distriutions from Size-Segregated Samples: (III) Crustal Elements and Minor Elements

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Experimental methods and data handling procedures are exactly the same presented in abstract I concerning the sea-salt components to which, therefore, reference should be made. We only want to remind here that the two samples under consideration are very different from both the point of view of their respective aerosol containt and of that of the corresponding problems in the analysis of the data.

Lognormal representation of elemental mass size distributions for crustal-like elements.

A.**Sample GB2**. The five elements Al, Si, Fe, Ti, Mn display a supermicrometric mode The values of center X_0 and, respectively, width, W, do appear well compatible among these elements, whereas the orders of magnitude of the ratios A_x/A_{Fe} , between the parameter A_x of element X and that of Fe are consistent with average crustal values. These facts indicate the presence of a crustal-like geochemical component, whose parameters are well distinct from those of the seasalt component presented in abstract I. The above elements, except Mn, also display a submicrometric mode, with compatible values of their respective X_0 and W parameters. Elements Mg, K, and Ca are also expected to contribute to the above crustal-like component. Their contribution to each distribution must however be superposed to that associated to the sea-salt component; it can thus only be evaluated and represented once the sea-salt contribution is subtracted. This process is now being performed.

B.**Sample GB17**. Only disperse points survive the respective MDL values, for the five crustal-like elements, described in sample GB02 above and cannot, in particular, be lognormaly fitted. The only exception is Fe, which is however incompatible with a crustal interpretation, in this case

Lognormal representation of elemental mass size distributions for minor elements

Sample GB2. Eight "minor" elements are detected. Five of them: V, Mn, Cu, Zn, Br display simple size distributions, with one or two easily fitted modes, all of them with X_0 values included in the interval 0.25<X₀<1.54. Mn has a further, supermicrometric, mode already

considered above as being compatible with a of crustal-like nature. The supermicrometric modes of Mn, Cu and Br display compatible values as XX respectively, the modes around $X_0 \approx 1.$, of the same elements. Zn and V display a possibly corresponding mode around X_0 0.51. Zn display a further mode at $X_0 = 1.54$. The structure of Ni and Pb is not easily representable. Cr is too poor (4 points over the MDL). Considered in abstract I, for its possible connection with a-mode of element S.

Sample GB17. No significant of minor elements was found in this sample.

General conclusions of the three abstract

SDI size-segregated sampling, PIXE absolute multielemental analysis and lognormal representation of the elemental EMSD's appear well adequate to face the large variety of conditions we met. A particular effort was devoted to correct the effects of Na x-ray absorption within the samples.

Emerging persistent organic pollutants in arctic air, surface water and snow in Ny-Alesund, Svalbard

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Abstract

Emerging persistent organic pollutants (ePOP) 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 ePOPs 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 ePOPs in arctic air, water and snow.

Integrated high-volume air samples were taken on the roof of IPEV 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-Alesund and seawater samples were obtained in Kongs Fjord in May of 2011. All samples were analyzed for neutral and ionic perfluorianted compounds, brominated flame retardants, dechlorane plus and current-use pesticides. 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 ePOPs in the Arctic ecosystem.

Temperature and atmospheric stability in Ny-Alesund: 1990 to 2010

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Temperature and atmospheric stability trends over 2 decades in Ny-Ålesund are inferred from analysis of temperature at Mt Zeppelin Station (474 m asl) and Ny-Ålesund (8 m asl), with the potential temperature difference providing a measure of local atmospheric stability over 1990-2010. The temperature difference (Zeppelin – Ny-Ålesund) exhibits an annual cycle with maximum in March and minimum end-May, reflecting the effect of radiative cooling that can cause very stable stratification to develop over winter. However, this is disrupted by winddriven mixing that exerts a strong year-round control on atmospheric stability. This wind control is augmented by diurnal influences on boundary-layer stability over the sunlit period.

Measurements of temperature and humidity with pressure along the Mt Zeppelin cableway were performed as a spot verification of the two-altitude measurements, and to investigate boundary layer evolution. Further insights into seasonality and trends are gained through Dynamic Harmonic Regression analysis of the datasets. Atmospheric stability, as inferred from the potential temperature difference, and its interseasonal amplitude exhibits variability over 1990 to 2010, with reduced atmospheric stability in the mid-2000's compared to the mid-1990's. These findings are discussed in terms of wind-forcing controls on atmospheric stability, and the sea-ice feedback mechanism.

Importantly, this study of Ny-Ålesund atmospheric stability over two decades acts to bridge insights from short campaign-based meteorological investigations to a wider inter-annual and decadal perspective. Initial analysis indicates a tendency towards lower atmospheric stability in the mid-2000's compared to the mid-1990's that may be of significance for processes impacting a wide range of research areas in Ny Ålesund. For example including: atmospheric (e.g. cloud and aerosol formation processes), and assessing air mass exposure at Mt Zeppelin; environmental (e.g. BrO-chemistry in the boundary layer) and ecological research (e.g. in dispersion of potential local summer sources of ammonia nutrient) at this important Arctic monitoring site.

With acknowledgements to NILU, met.no and NPI for provision of data

Preliminary results on snow surface reflectance and its dependence on grain size studies at Ny Ålesund

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Snow spectral reflectance measures can supply valuable information on snow cover characteristics especially analyzing near IR wavelength interval in which snow reflectance is inversely proportional to grain size.

During 2011 CICCI campaign, measurements of the snow reflectance were carried out with a portable spectroradiometer (FieldSpec, Analytical Spectral Devices, Boulder, CO, USA), that allows reflectance data in the 350-2500 nm spectral range to be acquired by three separate spectrometers, that operate in the ranges 350-1050 nm, 900-1850 nm and 1700-2500 nm, with 10 nm resolution.

FieldSpec automatically calculates the reflectance value as the ratio between the incident solar radiation reflected from the surface target and the incident radiation reflected by a reference white Spectralon[®] panel, to be regarded as a Lambertian reflector. For these measurements, a bare fiber optics with a FOV of 25° was used. Special care was taken that the radiometer was nadir viewing over the surveyed surface and sun-facing.

Field measurements were carried out mainly close to the CCTower (CNR ground site), following the triangular geometry designed for the common activities. This site has been the reference site also for the overflight activities planned in CICCI program. Weather conditions during the campaign were generally severe and the sky was very often overcast. These conditions interfere mainly at IR wavelengths where the solar radiation is absorbed by clouds causing an higher signal/noise ratio in this portion of the spectrum.

For each snow target, a nivological observation was performed, investigating the first 20 cm of the snow pack. Grain size and shape, density, temperature (at -2 and -10 cm of depth), were recorded together with a photographic documentation of the site.

Preliminary observations confirm the relation between snow characteristics and reflectance values in the infrared wavelength range even if the frequent snow precipitation events made the investigated surfaces very homogeneous in grain size and shape. Nevertheless it is possible to notice the decreasing of reflectance values in the range between 800-900 nm according to grain size increasing when their shape can be considered as a sphere (figure 1). On the contrary, fresh snow (stellar dendrite) shows high reflectance values also with large crystals (3-4 mm) due to the anisotropic distribution of the grain and

the presence of many reflective faces These preliminary observations are in accord with the results of the campaigns carried out at Ny Ålesund in previous years when the weather conditions were more stable and the signal/noise ratio was lower.

2011 campaign data analysis will benefit from the comparison with other CICCI ground teams data and will thus represent an useful tool for snow cover studies deriving from remote sensed images processing in the future, for example close to the open fjord, on a glacier, or on an ice drifting station.



Figure 1. Snow reflectance for different snow grain types and size.

Middle energy neutron spectrometer with narrow diagram of acceptance

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An instrument for spectrometry of neutrons has been designed. The original design scheme which is distinct from the widely spread Bonner type neutron spectrometer is used. Main difference is in angular selectivity that is absent in the Bonner spectrometer. Helium counters of thermal neutrons are used as detectors. The protection from thermal neutrons ensures the complete shielding of the counter from selected directions that has allowed creating of a spectrometer accepting radiation only from the given direction through a narrow gap. The important feature of the instrument is its angular directivity: the angle of acceptation does not exceed 30-40 degrees. Construction of a spectrometer (with the detailed representation of all materials which are included in it) has been simulated on GEANT-4 package. This has allowed us to investigate response of the instrument to neutrons and other particles of various energies from 0.1 eV up to 300 MeV before manufacturing. The working experimental sample of a spectrometer unit is manufactured and its calibration is carried out. Technical data of the instrument appeared in the consent with calculated. Measuring of the thermal neutron intensity at the ground has shown a significant anisotropy of neutron flux. Determination of a neutron spectrum over all the indicated energy diapason requires a solution of an inverse problem (deconvolution) like for Bonner spectrometer.
CLUES FOR NEOGENE-QUATERNARY TECTONICS IN SVALBARD

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Tre Svalbard locates along the DeGeer Transform Fault that separates the kinematic of North Atlantic and Arctic oceans and are a unique continental rise along the North Atlantic portion of this transform. A fold and thrust belt of Paleogene age boards the Western margin of the Spitsbergen with a NNW-SSE trend. The tectonic history of the Svalbard has been addressed in the geological literature since the beginning of the past century. The establishment of the plate tectonic theory rediscovered Svalbard geology in the light of the newly developed ideas. In the '60s the West-Spitsbergen fold and trust belt was related to the relative movements between Laurentia and Eurasia. Specifically, it was regarded to be a transpressive orogen developed at the intra-continental DeGeer Transform margin between the Barents and the Greenland Shelves. This setting was suggested by the necessity of a continental transform off the western margin of Svalbard needed to restore the relative openings of the North Atlantic-Arctic Ocean basins, and the Paleogene age of the fold-belt. Later structural studies suggested that convergent tectonics have been prevailing during much of the fold and thrust development. However this belt can hardly be regarded as a classical orogen resulting from an active continental margin for the lack of evidence for subduction, synorogenic magmatism, metamorphism or a thickened crust. On the other hand, it would be difficult to merely relate this fold and thrust belt to the DeGeer Transform Fault. According to Authors a transform fault should produce structures with vergence away from the fault on both sides, whereas the found direction of tectonic transport in North Greenland is the same as in Spitsbergen, i.e. to the E and NE. In this way the transform separation of North-Greenland and Spitsbergen should postdate the formation of the Tertiary North-Greenland and Spitsbergen fold and trust belt. This rises the question on possible Neogene-Quaternary tectonics in Spitsbergen. Evidence for this younger tectonics includes the occurrence of Quaternary volcanism and thermal springs in the northern part of Spitsbergen and the moderate seismicity in Nordaustlandet. Other clues supporting a recent tectonics derive from the analysis of satellite images and air photos, including the glacier and fluvial drainage suggesting a strong tectonic control. Moreover, authors have found in Ny Alesund an uplift rate from GPS measurements higher than those predicted by postglacial rebound models, again suggesting a tectonic contribution. Preliminary results from field work in the Brogger Peninsula confirmed the presence of Neogene-Quaternary tectonics. Marine terraces and fluvio-glacial deposits show several N-S elongated steps along the northern projection of N-S trending faults cutting the Meso-Cenozoic rocks. N-S trending faults have been systematically found in Devonian to Tertiary rocks. These faults are characterised by right-lateral, strike-slip movements and the presence of near surface to subaerial mineralizations on their surfaces, including kinematic indicators. N-S faults with the same kinematics show the presence of deformed Quaternary clastic, unconsolidated deposits within their shear zones. All the found brittle deformation evidence are compatible with the kinematics of the recent activity of the DeGeer Transform Fault.

Isotopic Signatures of Soil Organic Carbon and its Relation to Vegetation in a Successional Glacier Foreland in Ny-Ålesund, Svalbard

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High-latitude soil organic carbon (SOC) stocks are of particular interest because warming is expected to be greatest at high latitudes and induce acceleration of SOC decomposition. Soil in the deglaciated areas in Svalbard is not matured and has extremely lower OC contents compared with other Tundra soil such as Siberia and Alaska regions. Soil formation in the extreme environment would be strongly related to surface vegetation. Our objects in this study were to obtain elemental and isotopic signatures of SOC in a successional glacier foreland sites in Ny-Ålesund, Svalbard, and examine its relation to vegetation. In this study, down core profiles of SOC, nitrogen content, stable-carbon composition (δ^{13} C) and radiocarbon ages were investigated along three transects of different successional series of the deglaciated area from inland to sea front. The C and N contents of soil organic matter at soil surface tended to increase with the progress of succession and their δ^{13} C values gradually decreased in turn. On the other hand, no clear trend was found at deeper soils by the depth of 30 cm. Regardless of vegetation types, we found that δ^{13} C values was significantly correlated with C and N contents, suggesting relatively high contribution of carbon input from surface biomass. A series of geochemical signatures would give us an important implication on soil formation and SOC accumulation in immature soil environment appeared by recent deglaciation in Svalvard, Greenland, and high Mountain regions in the world under global warming.

Evidence of Heterotrophic Microbial Decomposition of Preaged Carbon in Arctic soil; Insights from molecular level natural radiocarbon analysis of phospholipid fatty acids (PLFAs)

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High latitude region including the Arctic has largest reservoir of soil organic carbon (SOC) in the Earth. Since the high latitude region would be significantly influenced with environmental change under global warming, fragile of soil carbon reservoir should be investigated. We investigated here the carbon source of soil respiration to evaluate vulnerability of the SOC and carbon cycle using molecular level natural radiocarbon analysis. Soil down core samples for compound specific radiocarbon analysis (CSRA) and compound specific stable carbon isotope analysis (CSIA) were collected from glacier retreat region, Svalbard islands, Norway Arctic. The soil CO₂ was also collected at the same site. Phospholipids fatty acids (PLFAs) were extracted from soils and then purified using preparative capillary gas chromatograph (PCGC) for CSRA. Then the isolated PLFAs were converted to CO2 after combustion and CO2 was reduced for making graphite target of an accelerator mass spectrometry (AMS) at NIES-TERRA and measured by microscale radiocarbon analysis (Uchida et al., 2004). Apparent radiocarbon ages of PLFAs in 0-10 cm and 20-25 cm were ca. 1980 yrs BP and ca. 8970 yrs BP, respectively. The result of PLFAs-radiocarbon data suggests that heterotrophic decomposition obviously exists. On the other hand, apparent radiocarbon ages of soil organic carbon (SOC) were from 8450 yrs BP to 14520 yrs BP in 0-5 cm and from 29120 yrs BP to 33370 yrs BP in 20-25 cm, respectively. By using isotopic mass balance model with radiocarbon contents of PLFAs and SOC, carbon source apportionment between modern and preaged carbon were quantitatively estimated in this study for the first time. In the conference, we will discuss their results in the light of soil carbon dynamics under climate instability in the Arctic region.

Long-term monitoring of Kongsfjorden fast ice

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Abstract: The fast ice evolution in Kongsfjorden, Svalbard is systematically monitored as a part of a long-term project at the Norwegian Polar Institute since 2003. The fast ice extent is visually observed each winter and spring from Zeppelin observatory on the mountain Zeppelinfjellet near Ny-Ålesund, and documented by ice maps and photographs several times a week. The thickness of the fast ice and its snow cover is measured from drillings at selected sites in the fjord, as long as the locations can be reached in a safe manner. The inner part of Kongsfjorden is usually covered by seasonal fast ice initially forming between December and March and persisting until May-June. The ice thicknesses are controlled by several parameters: onset of freezing, air and water temperatures, snow cover and wind. Thicknesses of ice do not exceed 1 m, which illustrates the effect of water from the West Spitsbergen Current. This presentation focuses on the entire time series, including so far unpublished data from the recent years... How the fast ice in the fjord can influence components of the ecosystem will be shown with an example about the effect of the ice on the abundance of Eider ducks (*Somateria mollissima*) in the fjord.

A study of Kongsfjorden fast ice evolution using a one-dimensional model

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Kongsfjorden is an Arctic fjord at the western coast of Spitsbergen. Parts of the fjord are covered by landfast ice each winter and spring. Systematic fast ice monitoring in this fjord was started in 2003. In this study, the seasonal evolution of fast ice in this fjord is investigated using a one-dimensional sea ice thermodynamic model, through comparing with in-situ observations from 2004 at four locations. Our observations and numerical experiments show that snow ice and superimposed ice, two secondary ice types, both contribute to the ice formation in this fjord. Snow ice and superimposed ice are both developed from surface snow during snow-ice transition. Snow ice forms when snow turns into ice due to flooding of ice floes by sea water, and consecutive refreezing. Superimposed ice develops from refreezing of melting snow, sleet or rain, which percolates down to snow-ice interface. Snow ice is connected to heavy snow load and negative freeboard, whereas superimposed ice is related to mild spell and warm air advection. Ignoring the formation of snow ice and superimposed ice generally leads to underestimate of total sea ice thickness. The parameterizations of snow ice formation in CICE and LIM ice models, however, yield clear overestimation of total ice thickness. Further investigation is needed to improve the parameterization of snow ice and superimposed ice formation.

A Digital Glacier Database for Svalbard

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The archipelago of Svalbard contains approximately 35,000 km² of glaciers, 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 will be available through the GLIMS project. Glacier outlines have been created for the years 1936, 1966-71, 1990, and 2007/8. For most glaciers, outlines are available from more than one of these years, a complete coverage of Svalbard, however, is not yet available for a single time epoch. Except for the 2007/8 data, 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 2007/8 glacier outlines are derived from orthorectified satellite images acquired from the SPOT-5 and ASTER satellite-borne sensors.

We also present shortly two further glacier products under development giving glacier surface type and glacier mass balance over time. See also http://www.cryoclim.net/cryoclim/index.php/Svalbard_glacier_products for more information

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Microbial and Chemical Variability in, and Elution from, a High Arctic Glacial Snow Pack.

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The snow cover plays a key role for glacial microbial communities as a habitat and reservoir for nutrients. However, the accumulation (via precipitation, dry deposition and wind drift) and following release of cells and nutrients from the snow to glacial, within glacial and downstream ecosystems is poorly understood in high arctic regions.

Our aim is to increase the understanding of microbial and chemical dispersal within different snow layers in a high arctic snow pack and to investigate the release of ions and bacteria with percolating melt water from the snow. Preliminary data show that ionic winter accumulation was strongly influenced by early start of snowmelt and warm periods before the start of the elution measurements. These warm events caused a snow depth depletion of 36% and with the melt water 79% of the total amount (mg/m²) of both NO₃⁻ and Cl⁻ was lost, as well as 85% of SO₄²⁻.

A snow profile describing snow layers and their individual concentrations reveals heterogeneity both among cell abundance and ionic concentrations. Future work will give information if some of these peaks come from individual snow or storm events.

The elution measurements shows a steady increase of bacterial cells during the sample period, while the ionic elution follows a decreasing pattern with an stabilizing low elution after the first five days. However, the elution concentrations were still higher than the bulk concentrations at the end of the experiment.

The low abundance of cells needs further analysis and paucity of cationic data will be corrected in future work. Nutrients and microbial cells shows opposite patterns during snow melt, were cells tend to be released in the end of the melt period while water-soluble ions goes with the first flow. These results are important for the development of supraglacial ecosystems and nutrient flow on arctic glaciers.

Laser Induced Fluorescence Emission (L.I.F.E.): *In Situ* Non-Destructive Detection of Microbial Life on Supraglacial Environments in the Kongsfjord Region

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Once thought to be barren of life, supraglacial environments are home to rich microbial communities most often dominated by photosynthetic cyanobacteria which account for high autotrophic production. 532 nm laser excitation of photosynthetic pigments in the cyanobacteria produces red autofluorescence activity commonly attributed to the presence of phycoerythrin. We report here on the first field use of laser induced fluorescence emission (L.I.F.E.) techniques to detect microbial life *in situ* on supraglacial environments of the Kongsfjord glaciers. The method avoids destruction of individual target organisms and does not disrupt either the structure of the microbial community or the surrounding ice matrix. The L.I.F.E. survey strategies may be of interest for orbital monitoring of photosynthetic primary productivity in polar and alpine glaciers, ice sheets, snow, and lake ice of the Earth's cryosphere. The findings open up the possibility of searching from either a rover or from orbit for signs of life in the polar regions of Mars and the frozen regions of exoplanets in neighboring star systems.