Report – field campaign spring 2010 – German SvalGlac Partners

(May 9th – May 26th 2010)

Participants on the spring 2010 field campaign:

- Roman Finkelnburg, TU Berlin
- Marco Möller, RWTH Aachen University
- Rebecca Möller, RWTH Aachen University
- Albert Polze, TU Berlin

Associated colleagues:

- Matthias Braun, University of Alaska Fairbanks
- Regine Hock, University of Alaska Fairbanks
- Veijo Pohjola, Uppsala University
- Dieter Scherer, TU Berlin
- Christoph Schneider, RWTH Aachen University

Conducted fieldwork:

- Repair and maintenance of 1 automatic weather station
    - on the NW ramp of Vestfonna (~370 m asl)
- Maintenance of 1 automatic weather station
    - on De Geerfonna (~240 m asl)
- Data download at automatic weather stations
- Maintenance of parts of the ablation stake network on Vestfonna (8 stakes on the NW ramp between ~240 and ~370 m asl). Stakes located above the AWS (>370 m asl) could not be visited due to logistical limitations.
- Digging of 2 snow pits at the AWS locations on Vestfonna and De Geerfonna for snow profile assessment (stratigraphy, density, temperature, hardness and grain type)

Preliminary results:

- Snow pack thickness at the AWS on Vestfonna (~370 m asl) was ~90 cm above glacier ice. This was more than in 2009 (~70 cm) but less than in 2008 (~110 cm).
- Snow pack thickness at the AWS on De Geerfonna (~240 m asl) was ~120 cm above glacier ice. This was comparable to 2009 and slightly less than in 2008 (~130 cm).
- Snow pack thickness on De Geerfonna seems to be higher than on comparable elevations on Vestfonna. It is suggested that differences are due to snow drift.
- Due to problems with snow depth sensors and a polar bear we lost all winter 2009/2010 data at the AWS on Vestfonna and continuous snow depth data at the AWS on De Geerfonna.

- Report on De Geerfonna AWS records: 96% of the air temperature measurements were below 0°C during this period (9/2009-4/2010) with a mean value of -9.9°C and a minimum of -33.4°C. The mean wind direction was SE (124°) with a mean wind speed of 5.9 m/s and a maximum of 25.8 m/s. The relative humidity was always above 70% with a mean of 93%. Net radiation measurements return a mean of -20.5 W/m².

Report – field campaign summer 2010 – German SvalGlac Partners

(August 12th – August 28th 2010)

Participants on the summer 2010 field campaign:

- Roman Finkelnburg, TU Berlin
- Marco Möller, RWTH Aachen University
- Christoph Schneider, RWTH Aachen University

Associated colleagues:

- Matthias Braun, University of Alaska Fairbanks
- Regine Hock, University of Alaska Fairbanks
- Veijo Pohjola, Uppsala University
- Dieter Scherer, TU Berlin

Conducted fieldwork:

- Maintenance of 1 automatic weather station
    - on the NW ramp of Vestfonna (~370 m asl)
- Maintenance and extension of 1 automatic weather station
    - on De Geerfonna (~240 m asl)
- Data download at automatic weather stations
- Maintenance of parts of the ablation stake network on Vestfonna (8 stakes on the NW ramp between ~240 and ~370 m asl). Stakes located above the AWS (>370 m asl) could not be visited due to logistical limitations.
- Maintenance of the ablation stake network on De Geerfonna (6 stakes between ~210 and ~270 m asl).
- Digging of 2 snow pits at the AWS locations on Vestfonna and De Geerfonna for snow profile assessment (stratigraphy, density, temperature, hardness and grain type)

Preliminary results:

- Fresh snow depth on Vestfonna was between ~5 cm (~240 m asl) and ~25 cm (~370 m asl) above glacier ice.
- Fresh snow depth on De Geerfonna was between ~25 cm (~210 m asl) and ~50 cm (~270 m asl) above glacier ice. Bare ice could sporadically be observed on the lower part of the glacier.
- Due to problems with snow depth sensors we lost the summer 2010 continuous snow depth data at both AWS (Vestfonna and De Geerfonna).
- Report on De Geerfonna AWS records: 58% of the air temperature measurements were above 0°C during this period (5/2010-8/2010) with a mean value of +0.8°C and a maximum of +15.9°C. The mean wind direction was N (7°) with a mean wind speed

of 2.9 m/s and a maximum of 15.8 m/s. The relative humidity was always above 42% with a mean of 85%. The net radiation measurements gave a mean of 16.9 W/m².

- Report on Vestfonna AWS records: 48% of the air temperature measurements were above 0°C during this period (5/2010-8/2010) with a mean value of -0.3°C and a maximum of +11.4°C. The mean wind direction was SE (152°) with a mean wind speed of 3.6 m/s and a maximum of 19.4 m/s. The relative humidity was always above 43% with a mean of 87%. Net radiation measurements return a mean of 22.6 W/m².

Project Progress – German SvalGlac Partners

(by October 20th, 2010)

General objectives:

- Investigation of mass and energy balance of Vestfonna and De Geerfonna (Nordaustlandet)
- Meteorological measurements
- Assessment of spatial variability in local and regional climate setting
- Synoptic weather pattern classification for the northern North Atlantic region
- Documentation and analysis of snow stratigraphy

Report on mass-balance studies:

A surface mass-balance model has been set up and calibrated for the ice cap Vestfonna. A 9-year surface mass-balance time series covering the mass-balance years 2000/2001 to 2008/2009 was modelled. It is the first assessment that has ever been done on the surface mass balance of the ice cap. Modelling is based on a spatially distributed approach combining temperature-radiation-index methods with remote sensing derived surface albedo and cloud cover information.

In situ data are provided a) by a net of 4 automatic weather stations operated on the ice cap since 2007 (3 of them by the German SvalGlac partners and 1 by the associated SvalGlac partner Regine Hock, USA) and b) by additional glaciological measurements during the same period (conducted by German and Swedish SvalGlac partners).

A related manuscript for a scientific article has been submitted to Journal of Geophysical Research on October 19th, 2010: *Möller, M., R. Finkelnburg, U. Jonsell, M. Braun, D. Scherer, V. Pohjola, R. Hock & C. Schneider: Surface mass balance of the ice cap Vestfonna, Svalbard – a spatially distributed assessment using ERA-Interim, weather station and MODIS data. Journal of Geophysical Research, submitted (2010JF001905).*

Report on atmospheric studies:

A regional atmospheric reanalysis has been done by using the Polar Weather Research and Forecasting (PWRF) model. The simulations are conducted with eight nested domains at spatial resolutions of 30, 10, and 2 km (cf. Tab.1). The area around Svalbard is covered by a 30 km domain (appr. 3000x3000km²). Whole Svalbard is covered by a 10 km domain, whereby certain areas (Nordaustlandet, Ny-ˇlesund, Lomonosovfonna, Longyearbyen, Hornsund, Hopen) have also a 2 km domain.

The simulation is made with consecutive daily re-initialized runs. The study demonstrates the general applicability of the model approach as well as requirements for further improvements.

Preliminary results (2008 and 2009 are available, 2007 and 2010 will be available soon) will be provided for validation with measurement data to all SvalGlac participants. After optimization of the model setup a ten year period will be simulated.

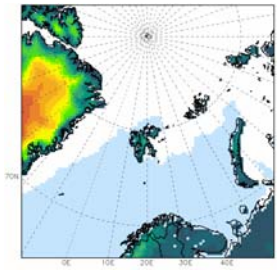
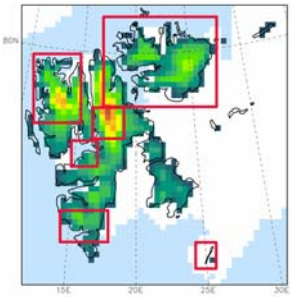
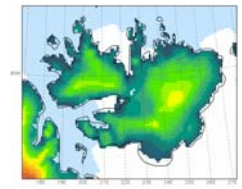
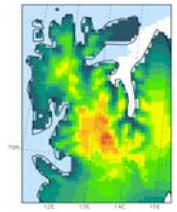
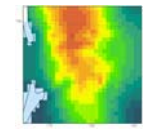
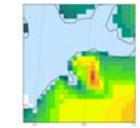
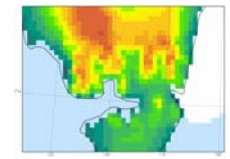
Parent Domain	30 km, 3h	
Svalbard	10 km, 1h	
Nordaustlandet	2 km, 1h	
Ny-ˇlesund	2 km, 1h	
Lomonosovfonna	2 km, 1h	
Longyearbyen	2 km, 1h	
Hornsund	2 km, 1h	
Hopen	2 km, 1h	

Table 1: Domain setting for regional atmospheric reanalysis with PWRF

Report on synoptic weather pattern classification:

Based on NCEP/NCAR reanalysis data a classification scheme of synoptic type air pressure patterns for the northern North Atlantic with Svalbard in the centre was developed. The approach using non-linear self-organizing map theory resulted in 9 different weather patterns with four of them occurring mainly in summer (June, July, August) while all weather patterns occur during the cold season (September – May) (Fig. 1).

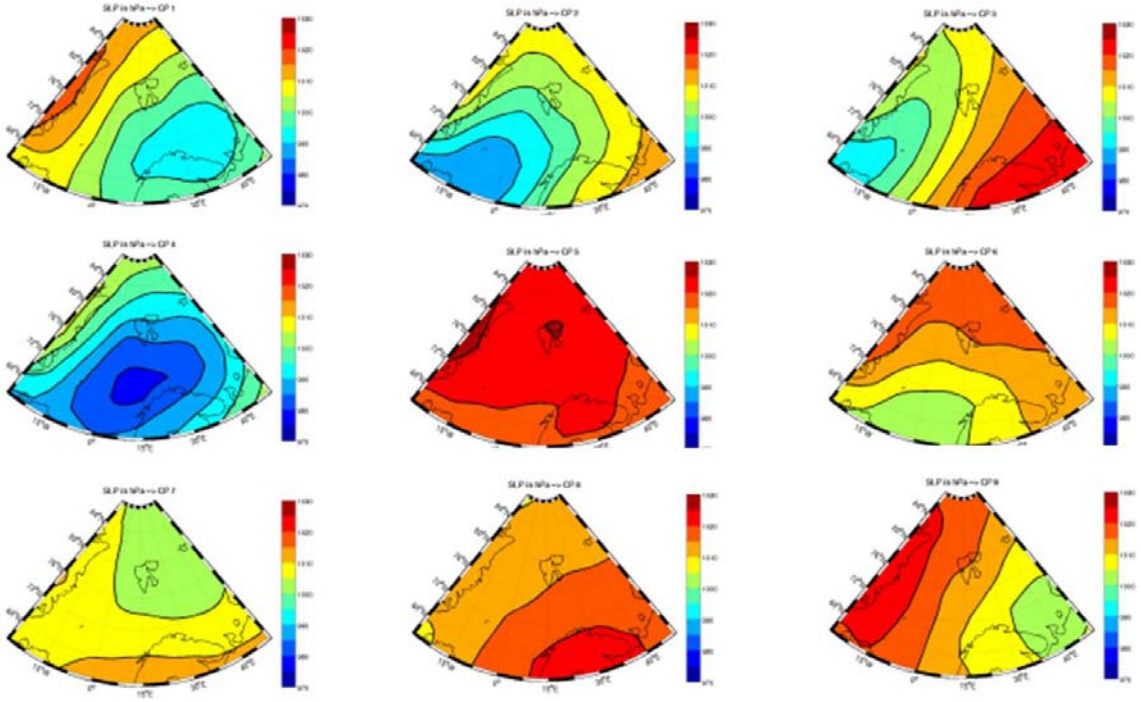


Figure 1: Weather patterns for the northern North Atlantic according to NCEP/NCAR reanalysis data classification using self-organizing maps.