# SVALI PhD students and Post docs

*Funded positions by the Stability and Variations of Arctic Land Ice (SVALI) Nordic Centre of Excellence (NCoE)*

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# Foreword

This report intends to give an overview of the wide range of PhD and Post Doc projects that are running within the Nordic Centre of Excellence (NCoE) SVALI, The Stability and Variations of Arctic Land Ice. The SVALI scientific program and activities are also presented through these projects.

The SVALI partners are involved in monitoring, process observations and modelling of the cryosphere in the North-Atlantic and Arctic areas. The aim is to obtain a standardisation of measurements and monitoring for analyses of cryospheric data with international rather than national scope, and for systematic application of Earth System Modelling and other advanced technologies that are used for investigations of the state of the cryosphere.

The universities within the NCoE SVALI have established a formal long-term collaboration to operate a Nordic Graduate School in Cryosphere Science and Earth System Modelling through joint courses, summer schools, workshops and cross-border integration of PhD projects and postdoctoral activities.

The graduate school is a core part of SVALI activities. The aim is that each student has a supervisor from at least two SVALI institutes, preferably from different countries, to strengthen the cooperation and linkages between the SVALI partners, and to increase research mobility within the Nordic countries.

All the PhDs and Post docs funded by SVALI are presented in this report. We also give an overview of associated PhDs at the partner institutions. The associate students are not directly funded by SVALI, but work within SVALI-related topics and benefit from the cooperation with the SVALI students. In addition to the scientific project descriptions, we also provide contact information for all the PhD students and Post docs. We hope that this report will help PhD students, Post Docs and other scientists working on similar topics to find each other and to take contact for collaboration within SVALI and beyond.

Oslo, August 2013

Jon Ove Hagen

Project leader

# Theme 1: Observing the present - baseline and changes

**WP 1.1: Ice-volume/mass changes**

Measure ice surface elevations and assess the current rate of change of ice-volume/mass of each glacier region to establish a benchmark for future measurements and input to modelling future ice mass changes and dynamic response.

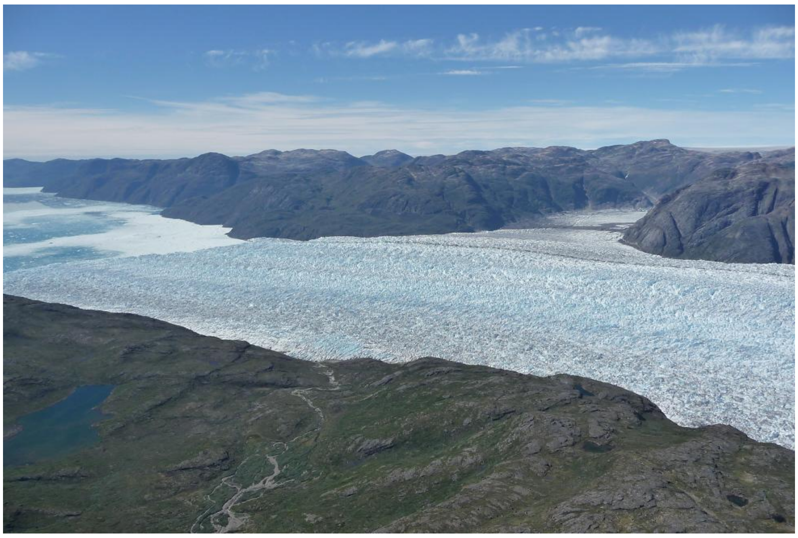
**WP 1.2: Changes in ice-dynamics**

Observations of ice velocities and velocity variations with in-situ measurements and remote sensing to assess the effect of changes in melt water input and calving rates on ice-dynamics, such as speed-up of ice-streams and other areas of fast-flowing ice.

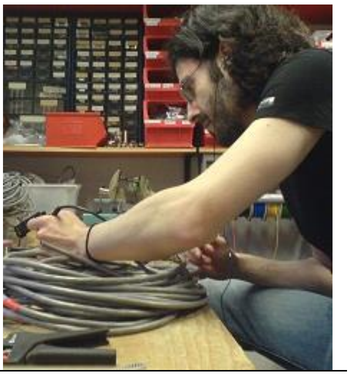
**WP 1.3: Surface mass balance changes**

Establish a data set of Nordic mass-balance observations. Perform an intercomparison of glaciological observational methods. Explore the utilization of models in support of observations and estimation of the spatial distribution of surface mass balance. Estimate the mass loss from surface mass balance and perform regional comparison of mass balance and climate.

**Theme leader: Andreas Ahlström, GEUS, Denmark**



## Improving Greenland ice sheet surface mass budget models of the accumulation zone



Charalampos (Babis) Charalampidis
Geological Survey of Denmark and Greenland (GEUS)

Theme 1: Observing the present – baseline and changes
Work package 1.3: Surface mass balance changes

Task 1.3a: Conducting one or more measurement campaigns on the Greenland ice sheet
Task 1.3b: Improving parameterizations of near-surface snow layer characteristics in a melt model
Task 1.3c: Modelling the surface energy and mass budget of the Greenland lower accumulation zone

The main scientific goal of his project is to better comprehend the near-surface processes of the lower accumulation zone of the Greenlandic Ice Sheet. The significance of water retention and refreezing is particularly important in Greenland as a large surface area is expected to become subject to melting conditions in a warming climate. The study will be based on data collected at several locations, mostly in the southern part where surface melt and refreezing are substantial. The aim is to improve the modelling capabilities by means of further understanding the connection between atmospheric boundary layer forcings and ice thermodynamics on a local scale, which ultimately could be extrapolated over the entire ice sheet. This result could be implemented in estimates of the Greenland surface runoff contribution to sea-level rise. Besides the scientific goals, this project serves to tighten the collaboration between the two Nordic institutions that he is employed at.

## Glacier Isostatic Adjustment (GIA) and GRACE in Iceland

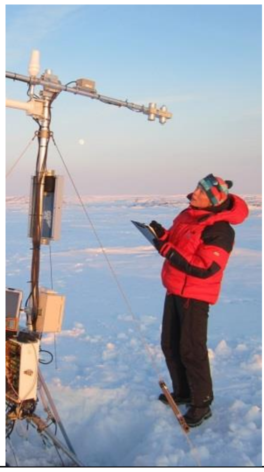
Alexander Jarosch

Iceland Meteorological Office

Theme 1: Observing the present - baseline and changes

Task 1.1d: Ice-mass changes deduced from GRACE
Task 1.1e: Understanding and unifying the space-based results of terrestial ice-volume/mass changes around the N-Atlantic
Task 1.1f: Improved understanding of glacial isostatic adjustment in the N-Atlantic area

The main focus of the postdoctoral project is to develop detailed numerical models of glacial isostatic adjustment in Iceland. In particular, new estimates of current surface deformation (from GPS and InSAR measurements), and new observations and simulations of ice volume changes will be used to refine numerical models of crustal structure and mantle dynamics in Iceland. In addition, the project aims to include results from ongoing work including: (i) extention of glaciation history back to the Little Ice Age; (ii) extraction of uplift rates from observations of sea-level; and (iii) analysis of gravity changes due to ice-mass variations.



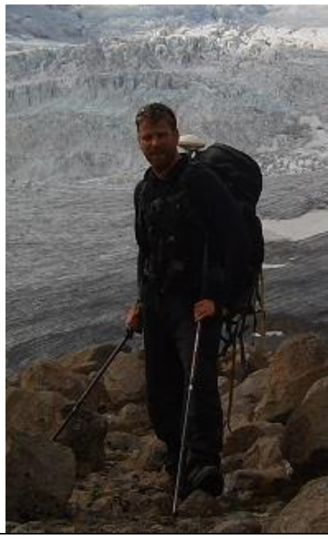
## Modelling the Upernavik glacier complex

Signe Hillerup Larsen

Geological Survey of Denmark and Greenland (GEUS)

Theme 1: Observing the present – baseline and changes
Work package 1.2: Changes in ice-dynamics
Work package 2.2: Calving Processes

The Upernavik glacier complex is located in the southern part of Melville Bay in northwest Greenland. It consists of four outlet glaciers from the Greenland ice sheet, terminating in Upernavik Isfjord at speeds of about 2 -3 km/yr. The overall goal of the PhD-project is to compile observations from the area and investigate how they can be incorporated into physics based parameterizations and used in numerical models of the Upernavik Glacier complex to improve our understanding of the glacier dynamics, calving and fresh water flux into the fjord.



## Remote sensing of glaciers

Eyjólfur Magnússon

Institute of Earth Sciences, University of Iceland

Theme 1: Observing the present - baseline and changes

Task 1.1c: Remote sensing of ice surface elevation changes
Task 1.2a: Assessment and comparison of methods for ice velocity measurements

The main focus will be to derive information of ice surface elevation changes (Task 1.1c) and the flow of the ice masses (Task1.2a). There will be collaboration and common interpretation of data with other researchers working on Task 1 (IMO, DTU-Space, UiO) and data provided to colleagues working on understanding processes (Theme 2, in particular calving work at UNIS) and predicting future evolution (Theme 3).

The objective is to apply remote sensing to define the present geometrical and dynamical reference state of glaciers and to observe ongoing changes in ice surface elevation and flow in order to deduce changes in glacier geometry, ice volume and mass balance in response to current climate change.

## Cryosphere monitoring from satellites and aircraft

Johan Nilsson

DTU Space, National Space Institute, Denmark

Theme 1: Observing the present – baseline and changes
Work package 1.1: Ice-volume / mass changes

1.1c: Remote sensing of ice surface elevation changes by satellite gravity and altimetry, and airborne lidar.
1.1e: Understanding and unifying the space-based results of terrestrial ice-volume/mass changes around the N-Atlantic

The goal of the project is to investigate the present-day elevation changes in the ice covered land regions in the arctic (Greenland, Svalbard and Iceland) using a battery of different remote sensing data, with a main focus on the CryoSat-2 mission data. The main focus of the PhD will be developing software and algorithms for utilizing the CryoSat-2 data over ice-sheets and ice-margins. This to obtain elevation change in both the spatial and temporal domain. This also includes error characterization, characterization of radar waveform, data validation and comparison with other satellite missions and airborne campaigns.

## Remote sensing and glaciology

Solveig Havstad Winsvold

Department of Geosciences, University of Oslo, Norway

Theme 1: Observing the present – baseline and changes
Work package 1.1: Ice volume/mass changes: The baseline datasets from this project are needed for several applications in the specified tasks in work package 1.1.

This PhD is about observing glaciers using time-series of remote sensing data. A glacier describes unique surface and perimeter patterns in time. When using combined multi-temporal satellite images, each pixel on a glacier is given a specific temporal signature that can be used for classification purposes. Better understanding of the temporal signature of glaciers and glacier surface types using time-series of multisensory satellite images is needed. For SAR-images this means exploration of glacier surface characteristics using the variation in backscatter in a time-series during a year or combinations of years. For optical satellite images this means using the temporal signature retrieved from several years, or several images within a season, to detect mismatches and unreasonable changes in glacier variations in relation to time. The temporal signature can be used for preparation of methods and analysis for future satellite sensors, Sentinel-1 (SAR-sensor) and Sentinel-2 (optical sensor). In a multi-sensor perspective, the Sentinels and Landsat-8 will significantly improve the temporal resolution of satellite acquisitions in the world. Together with an existing archive of sensor data this opens up for development of new analysis methods of glacier and snow surfaces due to better revisit times of the satellites.

# Theme 2: Understanding the physical processes

**WP 2.1: Glacial and subglacial hydrology**

Quantify the effect of climate variations on subglacial hydrology and glacial runoff. Develop improved parameterisations of feedbacks between water flow at the base of glaciers and ice dynamics in glacier models. Carry out field studies in glaciated watersheds in Iceland, Norway and Svalbard and the subglacial laboratory in Norway.

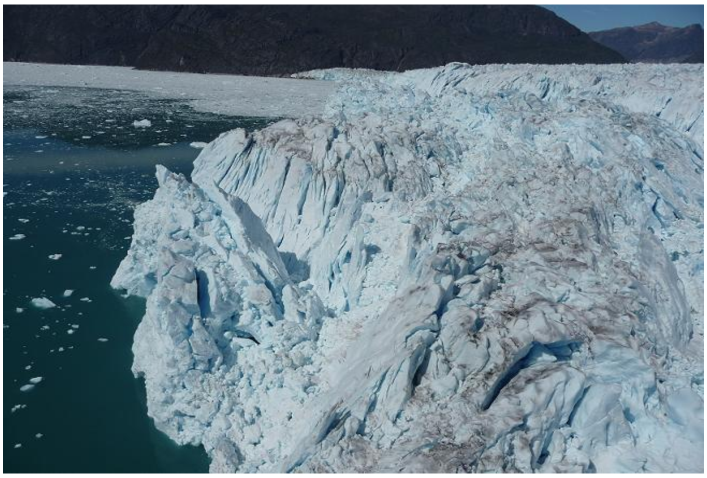
**WP 2.2: Calving Processes**

Quantify mass loss from calving outlet glaciers. Identify the contributing processes and their relative importance. Develop and implement improved calving models. Develop improved parameterisations of calving losses for large-scale glacier models.

**WP 2.3: Interaction of atmospheric, cryospheric and hydrological processes at glacier surfaces**

Improve the knowledge of surface mass and energy balance processes through modelling of the atmosphere, cryosphere and hydrological systems. This will include studies of water retention and firn hydraulics, glacier groundwater dynamics, energy exchange processes and surface albedo, as well as studies of snow precipitation and redistribution.

**Theme leader: Tómas Jóhannesson, IMO, Iceland**



## Modelling the fracture and calving of ice

Sue Cook

University Centre of Svalbard (UNIS), Norway

Theme 2: Understanding the physical processes
Work package 2.2: Calving processes

The calving of icebergs is an important mass loss process in many glaciers worldwide, particularly the Greenland and Antarctic Ice Sheets. Currently little is known about the controlling factors on calving rates, and the effect of climatic processes on the fracturing of ice. The aim of this project is to develop a physically realistic model of a calving glacier, which may be used to investigate environmental influences on calving and predict the rate of mass loss in tidewater glaciers. This will be performed using the Elmer finite element modelling software, to produce a full-Stokes model with focus on refining the basal sliding conditions and the effect of internal fracturing on ice dynamics. The results can be used to improve the boundary conditions applied in large scale ice sheet models, and refine future sea level rise predictions

## Glacier hydrology

Bergur Einarsson

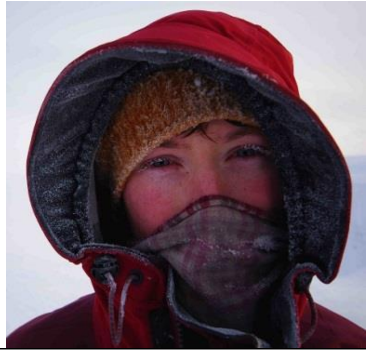
Icelandic Met Office

Theme 2: Understanding the physical processes
Work package 2.1: Glacial and subglacial hydrology

Task 2.1a: The effect of melt water input on variations in subglacial water pressure
Task 2.1b: The role of the basal hydraulic system in diurnal and seasonal glacial runoff variations
Task 2.1e: Develop sliding parametrisations for a dynamic ice-flow model
Task 3.2b: Implement a subglacial model in an ISM that is coupled to an ESM

The main focus of the research project is on analysing discharge time-series from selected hydrological stations operated by the Icelandic Meteorological Office and carry out modeling to shed light on the development of the subglacial hydraulic system and the subglacial hydraulic pressure. The hydrological stations selected are close to glacier margins showing clear diurnal and seasonal variations related to variations in the subglacial discharge component. Runoff from areas outside the glacier, but within the watersheds of the hydrological stations, will be estimated with the hydrological model WaSiM and subtracted from the discharge time-series to extract the runoff from the glaciers. Observations of ice-velocity are also available from seasonal stake measurements on Hofsjökull ice cap in central Iceland and from a continuous GPS-station that has been operated as part of the project during the summer of 2011 on the Northern part of Hofsjökull. The GPS-station is also planned to be operated during the summers of 2012 and 2013 at the same location. Variations in icevelocity will be analyzed in terms of subglacial water pressure variations obtained from the analysis of the hydrological data. The goal of the study is to interpret these results in terms of a model for calculating variations in basal sliding from meltwater input to the basal hydraulic system. The study is a part of the Nordic Centre of Excellence SVALI, supported by the Nordic Top-level Research Initiative and will include collaboration with research groups within SVALI that are involved in the development of Earth Systems Models with the aim to improve the physical representation of glaciers in such models.

## Subglacial processes and subglacial hydrology



Pierre-Marie Lefeuvre

Department of Geosciences, University of Oslo, and
Norwegian Water Resources and Energy Directorate

Theme 2: Understanding the physical processes
Work package 2.1: Glacial and subglacial hydrology

Task 2.1a The effect of melt water input on variations in subglacial water pressure.
Task 2.1b The role of the basal hydraulic system in diurnal and seasonal variations in subglacial hydrology.
Task 2.1d Investigate the role of higher order stresses on the subglacial hydraulic system.
Task 2.1e Develop sliding parametrisations for a dynamic ice-flow model

The PhD particularly focuses on Engabreen, an outlet glacier from the Svartisen Ice Cap, Northern Norway, where the Svartisen subglacial laboratory is located. A major aim of the thesis is to study stress bridging around subglacial channels and its impact on the evolution of the drainage system at the glacier bed. To capture the changes in the hydrological system and its relationship with ice dynamics, modelling of melt and runoff as well as measurements of basal sliding will be undertaken. This work will provide substantial material for interpreting several years of local basal pressure records. With colleagues from the CSC - the IT Center for Science Ltd, a simple theoretical model will be developed to study the effect of stress bridging on the effective pressure and results will be matched with observations. In parallel, a strong partnership with other SVALI researchers from Theme 2.1 (CIC, Centre for Ice and Climate and IMO, Icelandic Met. Office) will offer the possibility to correlate subglacial conditions to surface velocity measurements at Engabreen. To sum up, this project will try to increase our knowledge of the subglacial environment and its relationship to glacier dynamics.

# Title not given yet

Horst Machguth

Department of Civil Engineering, Technical University of Denmark

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Theme 2: Understanding the physical processes
Work package 2.3: Integration of atmospheric, cryospheric and hydrological processes at glacier surfaces

Task 2.3b Ice sheet surface albedo

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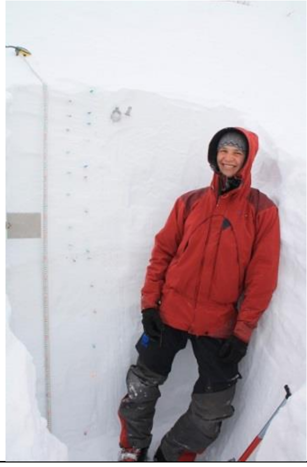


## Improved parametrization of water retention and refreezing in Arctic glaciers

Sergey Marchenko

Department of Earth Sciences, University of Uppsala, Sweden

Theme 2: Understanding the physical processes
Work package 2.3: Integration of atmospheric, cryospheric and hydrological processes at glacier surfaces

Task 2.3a Water retention and firn hydraulics
Task 2.3b Ice sheet surface albedo
Task 2.3c Energy exchange processes, snow precipitation and redistribution on ice fields

The work is aimed at the processes of water retention and refreezing in glaciers in different climatic and glaciological conditions, and improving numerical schemes for mass balance and climate models. Analysis of the existing field data (temperature, density measurements, data from ice cores), results of controlled experiments in the lab and field work should provide a dataset for quantitative estimation of the processes under different conditions and become the basis for further generalizations.

## Ice dynamics and glacier hydrology

Alexandra Messerli

Centre of Ice and Climate, Niels Bohr Institute,
University of Copenhagen, Denmark

Theme 2: Understanding the physical processes
Work package 2.1: Glacial and subglacial hydrology

Task 2.1a The effect of melt water input on variations in subglacial water pressure.
Task 2.1b The role of the basal hydraulic system in diurnal and seasonal variations in subglacial hydrology.
Task 2.1e Develop sliding parametrisations for a dynamic ice-flow model
Task 1.2b Assimilation of in-situ data from GPS and geodetic cameras with data from radar and optical remote sensing
Task 1.2c Comparison of ice-velocities inferred from different methods
Task 1.2d Assessment of annual velocity changes versus long-term trends

The focus of the PhD is to improve our process understanding between the interaction of glacier hydrology and ice dynamics. This is to further develop the inclusion of a more accurate representation of glacial hydrology into large scale ice sheet models. The work is based around WP 2.1 as well as looking into other areas of the SVALI framework from themes 1 and 3. Most of the work will be carried out at Engabreen and in the Svartisen Subglacial Laboratory (SSL). Here the aim is to use the vast array of observations to allow for a more complete understanding of the interaction between hydrology and ice dynamics. This will be done by using pressure, seismic, basal sliding and hydrological discharge measurements at the SSL along with a GPS survey of surface ice velocity. It is hoped that other major experiments will be carried out at Engabreen, one of which is generating a Jokulhaulp and second using a terrestrial long range laser scanner to monitor ice motion at the surface during a Jokulhaulp and the spring speed-up event. This work is in collaboration with the Norwegian Water Resources and Energy Directorate (NVE) and also working closely with other PhD students from the SVALI project based at the NVE and the Icelandic Met Office.

# Theme 3: Understanding present changes and predicting the future

### WP 3.1 Formulate glacier-atmosphere interactions in ESMs and validate with available data

Further develop a physically based model of the interface between glaciers and atmosphere (boundary layer). Acquire or produce dynamically downscaled climate runs (CMIP5) for each glacier region and provide for use within the centre. Analyse statistically downscaled ensembles of RCMs as inputs to glacier models. Analyse high resolution precipitation output and snow scheme in ESMs.

### WP 3.2 Advance ESMs with new and improved physical processes

The results from Theme 2: glacial and subglacial hydrology, calving and surface processes will be implemented in the ESMs at FMI and DMI.

### WP 3.3 Estimate future changes in terrestrial ice, including an analysis of uncertainties

Initialize and run coupled climate-ice sheet ESM models, with the new improvements, to estimate past variations and future changes in land ice volumes and the impact these may have on the earth system.

Glacier simulations of past ice volume histories will be tested against available data about glacier extent to derive realistic spin-up states for simulations of future changes. Mass balance will both be calculated from downscaled climate reconstructions and from ESM control climate and climate change simulations. The obtained simulated and reconstructed crustal ice loading will be used to study glacier isostatic adjustments in WP1.1.

The role of higher order stresses on the response of glaciers to climate change will be explored as well as the natural and anthropogenically induced variability and stability of glaciers within the Earth system in the past and under different anthropogenic carbon emission scenarios. Crustal movements and past sea level rise rates will be used to constrain coupled earth system ice sheet models.

**Theme leader: Guðfinna Aðalgeirsdóttir, University of Iceland**

## Climate modeling over Svalbard and ice–air interaction processes

Björn Claremar

Department of Earth Sciences, University of Uppsala, Sweden

Theme 3: Understanding present changes and predicting the future
Work package 2.3: Interaction of atmospheric, cryospheric and hydrological processes at glacier surfaces

The main focus will be to dynamically downscale re-analysis data with the atmospheric model WRF over Svalbard. Focus will be analysis of temperature, wind and precipitation in the context of mass-balance studies. The data can also serve as forcing to local mass-balance models for ice sheets. The distribution of precipitation, temperature and wind can increase the understanding of the ice dynamics in the Svalbard area. The aim is also to improve the atmosphere–cryosphere interchange process descriptions in the WRF model and to upscale the improved parameterization into ESMs within the SVALI network.

The objectives in the process understanding include implementation of water retention and refreezing in the WRF model (in collaboration with colleagues in Task 2.3), improved albedo routines for the snow and glacier surfaces and possibly improved turbulence description, especially during stable atmospheric stratification.

## Ice-sheet modelling and coupling to mass-balance models

Rupert Gladstone

Arctic Centre, University of Lapland, Finland

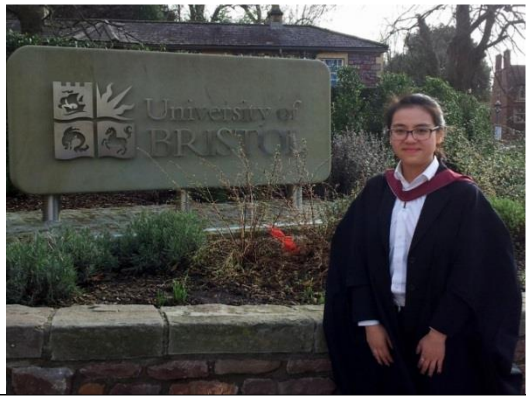
Theme 3: Understanding present changes and predicting future changes

The main task will be to model dynamics of the Nordaustlandet ice caps in Svalbard using the finite element suite ELMER developed at the CSC, Espoo. This Full Stokes ice-flow model will be applied to the Austfonna ice cap, similar to an already existing application for Vestfonna. Coupling between the ice flow and mass balance models, and prognostic runs for scenarios of future climate will be performed. In a latter step, CFD simulations of blowing snow, driven by down-scaled climate data to improve the mass-balance distribution may be conducted.

## Coupled climate and ice dynamics of the Nordaustlandet ice caps

Yongmei Gong

Arctic Centre, University of Lapland, Finland




Theme 3: Understanding present changes and predicting future changes
Work package 3.3: Estimate future changes in terrestrial ice, including an analysis of uncertainties

3.3f: Providing estimate of future changes in terrestrial ice for dissemination
3.3b: Understanding ice sheet volume response to idealized perturbations
3.3c: Advanced glaciological modelling in the context of ESM –the role of higher order stresses on the response of glaciers to climate change
3.3e: Stability of ice sheets in future climate

One goal is a model of the Austfonna ice cap with emphasis on the fast flowing and calving glacier boundaries of the 7$^{th}$ largest ice cap in the world. The modelling efforts will provide process studies that will aid parameterization efforts for Earth System Models including ice sheet dynamics. One main point of the project is to exchange mutually on the gained knowledge on numerical techniques in order to enable the possible widest range of models applied to both icecaps and in consequence a comparison between the results obtained with SIA (SICOPOLIS), Shallow Shelf (Biscicles), First order (Schoof-Hindmarsh model also in Bisicles) and FS (Elmer/Ice). This would be in particular important with respect to paleo-simulations that – on a realistic basis – cannot be done using the computationally expensive FS model and would be in need of an economic solution, such as SIA. In the context of this project we, nevertheless, focus on present day and near-future developments.

# Sensitivity of coupling of surface-mass balance models to ice-flow models (Nordaustlandet, Svalbard)

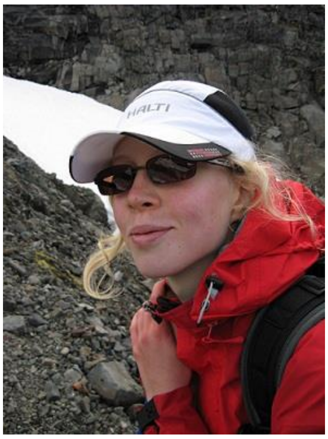
# Report on the factors controlling inter-annual variability and trends in surface melt over Greenland

Martina Schäfer

Finnish Meteorological Institute, and Arctic Centre, University of Lapland, Finland

Theme 3: Understanding present changes and predicting the future
Work package 3.1.: Formulate glacier–atmosphere interactions in ESMs and validate with available data

I am working on two different topics within the work package 3 now at FMI in Helsinki. First, I will continue my modeling work (Elmer/Ice) on the Vestfonna ice-cap/Nordaustlandet (Svalbard) which I have started at the Arctic Centre/University of Lapland in Rovaniemi/Finland also within SVALI. After having focused earlier on the fast flowing outlets and the understanding of their changes in flow-regime (main topics: inverse method to infer basal drag from surface velocities and temperature issues), my research interest is now the coupling between surface mass balance models and ice-flow models. In collaboration with Marco Möller from Geographisches Institut, RWTH Aachen we are undertaking a sensitivity study about such coupling for future prognostics on the century scale. Second, I will be looking in factors controlling inter-annual variability and trends in surface melt over Greenland together with Ilona Välisuo and others at FMI. We will use remote sensing data, in-situ measurements and reanalyses for surface melt and atmospheric forcing.



## Dynamics and thermodynamics of glaciers and ice sheet using observations and modelling

Ilona Välisuo

Finnish Meteorological Institute, and

Department of Physics, University of Helsinki

Theme 3: Understanding present changes and predicting the future

My background is cryosphere and hydrosphere physics and meteorology. My special interests are in atmospheric boundary layer physics and my work in SVALI is strongly related to the coupling between glaciers and atmosphere. The main focus of my studies is in investigating the connections between weather and climate conditions and the surface energy and mass balance of glaciated areas. My current research activities consist of simulating the effects of temperature and precipitation forcing on Midtre Lovébreen, Svalbard, using the Elmer glacier model and weather observations. I am also involved in a study that investigates the factors controlling inter-annual variability and trends in surface melt over Greenland using reanalysed products and satellite observations. Our aim is to provide more detailed information of the relationship between weather or climate and state of the glaciated areas and promote the connections between atmospheric and cryospheric research.

## APPX 1.

Contact information for SVALI funded PhD students and Post docs.

| Name | Email | Telephone | Affiliation |
|---|---|---|---|
| | *PhD students* | | |
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## APPX 2.

| Name | Theme | SVALI funding period (dd/mm/yyyy) | Host institute(s) | Degree granting institute | Collaborating instutes | Supervisor/ responsible scientist | Supervising committee |
|---|---|---|---|---|---|---|---|
| Charalampos Charalampidis | 1 | 15/02/2012-14/02/2016 | GEUS | UU | UU | Dirk van As (GEUS) | Dirk van As (GEUS)<br>Veijo Pohjola (UU),<br>Rickard Pettersson (UU) |
| Bergur Einarsson | | 15/04/2011-14/04/2014 | IMO | UoI | NVE, CIC, DMI | Tómas Jóhannesson (IMO) | Tómas Jóhannesson (IMO),<br>Helgi Björnsson (UoI),<br>Gwenn E. Flowers (Simon Fraser University in Canada) |
| Yongmei Gong | | 01/12/2013-30/05/2014 | AC | UH | UiO, UU, CSC | John Moore (AC) | John Moore (AC)<br>Rupert Gladstone (AC)<br>Martina Schäfer (AC),<br>Thomas Zwinger (CSC)<br>Matti Leppäranta (HU) |
| Signe Hillerug Larsen | 1 | 01/07/2013-30/06/2015 | GEUS | UCPH | CIC | Andreas Ahlstrøm (GEUS) | Signe Bech Andersen (GEUS)<br>Christine S. Hvidberg (CIC) |
| Pierre-Marie Lefeuvre | 2 | 01/11/2011-31/10/2014 | NVE, UiO | UiO | CPHU, CSC, IMO | Miriam Jackson (NVE) | Miriam Jackson (NVE),<br>Gaute Lappegard, Statkraft (UiO),<br>Jon Ove Hagen (UiO) |
| Sergey Marchenko | 2 | 01/09/2011-31/08/2015 | UU | UU | UNIS; Utrecht University (NL) | Veijo Pohjola (UU) | Rickard Pettersson (UU),<br>Veijo Pohjola (UU)<br>Carleen Tijm-Reimer (Utrecht University),<br>Carl-Egede Boggild (Arctic Techology Center, DTU) |
| Alexandra Messerli | 2 | 01/09/2011-31/08/2014 | CIC, UCPH | UCPH | NVE, UIO, IMO | Aslak Grinsted (CIC) | Aslak Grinsted (CIC)<br>Miriam Jackson (Co-supervisor) (NVE),<br>Dorthe Dahl-Jensen (CIC) ,<br>Nanna Karlsson (CIC) |
| Johan Nilsson | 1 | 01/12/2011-30/11/2014 | DTU Space | DTU | UMB | René Forsberg (DTU Space) | René Forsberg (DTU Space),<br>Cecilie Rolstad Denby (UMB),<br>Louise Sandberg Sørensen (DTU Space) |
| Ilona Välisuo | 3 | 01/10/2011-30/09/2014 | FMI | HU | DMI, GEUS, UiO | Heikki Järvinen (HU) | Heikki Järvinen (HU)<br>Marianne Sloth Madsen (DMI) |
| Solveig Havstad Winsvold | 1 | 01/01/2013-01/12/2016 | UiO | UiO | NVE | Andreas Kääb (UiO) | Andreas Kääb (UiO)<br>Jon Ove Hagen (UIO),<br>Liss Marie Andreassen (NVE) |

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## APPX 4.

List of SVALI partners and acronyms for them.

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|---|---|
| AC | Arctic Centre, University of Lapland, Rovaniemi, Finland; |
| CIC | Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, Denmark; |
| CSC | Center of Scientific Computing, Espoo, Finland; |
| DTU | Technical University of Denmark, Copenhagen, Denmark; |
| FMI | Finnish Meteorological Institute, Helsinki, Finland; |
| GEUS | Geological Survey of Denmark and Greenland, Copenhagen, Denmark; |
| HU | University of Helsinki, Helsinki, Finland; |
| IMO | Icelandic Meteorological Office, Reykjavik, Iceland; |
| NVE | Norwegian Water resources and Energy Administration, Oslo, Norway; |
| UCPH | University of Copenhagen, Copenhagen, Denmark; |
| UiO | University of Oslo, Department of Geosciences, Oslo, Norway; |
| UMB | Norwegian University of Life Sciences, Department for Geomatics, Ås, Norway; |
| UNIS | University Centre in Svalbard, Norway; |
| UU | Uppsala University, Department of Earth Sciences, Sweden. |