European Partnership in Polar Climate Science
PolarCLIMATE

PolarCLIMATE Project: One Year Report

Submission deadline: 16 March 2012

Important :

- The document is to be filled in by the project coordinator and should be returned to ESF as a Word (.doc) document.

1. Overview of the PolarCLIMATE project

Title and Acronym: Sensitivity of Svalbard glaciers to climate change (SvalGlac)

Project Coordinator: Jacek A. Jania, University of Silesia, Poland;
Francisco Navarro, Technical University of Madrid, Spain

Principal Investigators: Friedrich Obleitner (UI), Austria;
Rein Vaikmäe (IG TUT), Estonia;
John Moore (AC), Finland;
Dieter Scherer (TU), Germany;
Daniela Mansutti (IAC), Italy;
Jacek A. Jania, (US), Poland;
Francisco Navarro (UPM), Spain;
Veijo Pohjola, (UU), Sweden;

Associated Partners: Jon Ove Hagen (UiO), Norway; Carleen Reijmer (IMAU), The Netherlands; Andrey Glazovskiy (IGRAS), Russia; Xiao Cheng (BNU)), China; Regine Hock (UAF), USA

Project start and end dates: 1.03.2010-28.02.2013

Project website: http://svalglac.eu/

Scientific & technical personnel involved in the Project

Personnel directly funded under the PolarCLIMATE budget
(Name, position, contract start/end dates; estimated percentage of work time dedicated to the programme)

Austria
Dr. Florian Karner, 1.01.2011-31.12.2011, 100% of full time working hours during year 2011,
Walter Steinkogler, field assistant, 1.04.2011-30.04.2011, 6% full time working hours during year 2011.

Estonia
Dr. Tõnu Martma, Senior Scientists, 1.01.2011-31.12.2011 - 10% of work time in 2011,
Hannes Martma, technical support, 1.01.2011-1.07.2011 – 100% of work time in the period.

Finland
Torsetn Malm, MSc Student, 6 months - 100% of work time in the period.

Germany
Roman Finkelnburg, PhD-Student, 1.01.2011–31.12.2011, 30% of work time in 2011,
Dr. Marco Möller, PostDoc, 1.01.2011–31.12.2011, 80% of work time in 2011.

Italy
Dr. Edoardo Bucchignani, Eng., software engineer, 27.07.2011– 27.02.2012, 50% of work time in the period.

Poland
Dr. Małgorzata Błaszczyk, Eng., PostDoc, 22.11.2011-10.12.2011, 9% of work time in 2011,
Dr. Mariusz Grabiec, PostDoc, 22.11.2011-10.12.2011, 9% of work time in 2011,
Dr. Joanna Szafraniec, PostDoc, 10.06.2011-9.12.2011, 18% of work time in 2011,
Lidia Falkowska-Winder, support, 22.11.2011-10.12.2011, 10% of work time in 2011,
Mr Dariusz Puczko, MSc, scientist, 1.04-30.04.2011; 1.10-31.10.2011, 20% and 25% of work time in the indicated periods respectively,
Mr Bartłomiej Luks, M.Sc, technician, 1.10-31.10.2011, 45% of work time in the period.

Spain
None

Sweden
None

Personnel funded through sources other than the PolarCLIMATE budget
(Name, position, nature of involvement)

Austria
Florian Bilgeri, field assistant, funded by Österreichische Polarforschungsgesellschaft, Julius-Payer Stipendium
Estonia
Prof. Dr. Rein Vaikmäe, Professor, Head of Department, PI, Partly founded by the Estonian Ministry of Education targeted research project for Polar climate research (coordination, data analysis and interpretation).
Dr. Tõnu Martma, Senior Scientist, Partly founded by the Estonian Ministry of Education targeted research project for Polar climate research (ice-core sample analysis, data processing and interpretation),
Germany
Roman Finkelnburg, PhD-Student, 1. – 31. December 2011, DFG funding (directly related to SvalGlac; data collection, analysis and interpretation)
Finland
Prof. Dr. John Moore, Professor, PI (coordination, data analysis and interpretation),
Dr. Martina Schäfer, PostDoc (field work, data analysis and interpretation).
Italy
Dr. Edoardo BUCCHIGNANI, Eng., permanently employed at the Centro Italiano Ricerche Aerospaziali (enrolled within the SvalGlac project for writing and testing the computational code).
Norway

Prof. Dr. Jon Ove Hagen, Professor, Associate Partner (Austfonna mass balance)
Prof. Dr. Thomas V. Schuler, Assistant Professor (AWS-data, precipitation modelling),
Dr. Thorben Dunse, PostDoc (Austfonna dynamics, Snow radar, dynamics modelling),
Torbjørn Østby, PhD-student (energy balance modelling of Austfonna).

Poland

Prof. Dr. Piotr Głowacki, Associate Professor (field work coordination, mass balance of S Spitsbergen glaciers, data analysis and interpretation),
Dr. Małgorzata Błaszczyk, Eng., PostDoc (inventory of glaciers, remote sensing studies on fluctuation of tidewater glaciers and geometry changes, data analysis and interpretation),
Dr. Mariusz Grabiec, PostDoc (field work, studies on snow accumulation, modelling, GPR sounding, internal structure and drainage of glaciers, data analysis and interpretation),
Dr. Joanna Szafraniec, PostDoc (field work on water and sediment discharge from land based glacier, fractalanalysis of shapes of glaciers, data interpretation,
Dr. Leszek Kolondra, Eng., Senior Research Scientists (mapping of fluctuation of tidewater glaciers, survey data analysis on glacier dynamics),
Jarosław Hałat, MSc Student (field assistant, water discharge measurements from land based glacier, data analysis),

Russia

Dr. Andrey Glazovsky, Senior Research Scientist, Associate Partner (coordination, data analysis)
Dr. Ivan Lavrentiev, Research Scientist (field work, data acquisition and interpretation)
Dr. Yury Macheret, Senior Research Scientist (data interpretation and consulting)

Spain

Mrs. Alba Martín, PhD Student, funded by Ministry of Science and Innovation, 50% time devoted to SvalGlac project (preparation of catalogue of radio-echo sounded glaciers on Svalbard and corresponding ice volume estimates).

Sweden

Prof. Dr. Veijo Pohjola, Professor, PI, (coordination, field work, data analysis and interpretation),
Prof. Dr. Rickard Pettersson, Associate Professor (field work, data analysis and interpretation),
Dr. Björn Claremar Carlsson, PostDoc (field work, data analysis and interpretation).

The Netherlands

Prof. Dr. Carleen Reijmer, Assistant Professor, Associate Partner (coordination, field work, data analysis and interpretation)
Ward van Pelt, PhD Student (field work, data analysis and will continue to work on SvalGlac related subjects for his PhD),
Wim Boot, technical support.

Progress report and scientific highlights (please describe the progress made and the scientific highlights since the beginning of the project and/or since last year)

Coordination activity

The SvalGlac Coordination Secretariat has been involved in preparation of the previous year comprehensive report to the ESF, maintenance of the project web site http://svalglac.eu (with contribution of Technical University of Madrid, Spain and input from other PIs). Link to the TU Berin Knowledge Base portal http://www.klima.tu-berlin.de/KB/SvalGlac/ has been maintained and links to web sites of Partners dedicated to the SvalGlac Project have been established and maintained. Secretariat provided assistance in preparation of a contribution of the SvalGlac to the European Polar Newsletter No. 7-June 2011 (pages 10-11) containing brief presentation of the project and first year achievements. Prof. Francisco Navarro, Co-coordinator participated in the PolarCLIMATE Networking Meeting in Bologna (Italy) in June 2011, presenting progress of the project accompanied by Prof. Friedrich Obleitner, Prof. Rein Vaikmäe representing the SvalGlac international team. The project's Steering Committee Meeting was prepared and held in Oslo, Norway on 30th October 2011 (hosted by the University of Oslo). Besides brief reporting of progress in activity of working groups and national teams, preliminary planning of publications consistent with the project proposal for reporting of final results has been initiated. Better coordinated field activity in spring 2012 has been planned with sharing of logistics in regions of

concentrated activity of different groups.

Preparation and development of data bases

Meteorological, glaciological, cartographical and remote sensing data bases (created in 2010) have been developed and supplemented in 2011. Recent and archive meteorological and glaciological data and meta-data information for the Hornsund area in S Spitsbergen are available publicly by the web site: http://www.glacio-topoclim.org/.

The basic catalogue of radio-echo sounded Svalbard glaciers was completed as a common effort of Spanish (UPM) and Polish (US) teams. New phase of the GPR data collection by field survey, from archives of different SvalGlac partners and other researchers external to the SvalGlac project has been developed. All the information collected has been uploaded into a GIS base, and have been prepared for use in computing of glacier ice volume (with corresponding error estimates). For the Southern Spitsbergen it is nested in the glacier inventory developed by use of recent satellite images and digital terrain model (DTM). The glacier inventory has been also used for other glaciological analyses.

Questionnaire with unified information on meteorological stations (including automatic weather stations – AWS) and available data sets has been prepared for implementation (Austrian, German, Polish, Norwegian, Swedish and Dutch teams). Similarly template on reporting of snow cover study sites and shallow ice coring has been prepared.

Inventory of tidewater glaciers in Svalbard has been updated using information retrieved from satellite images from last five years. Retreat rate of all glaciers ending down into the sea was updated as part of the inventory (Polish team – US).

Pool of the radio-echo sounding (RES) equipment available for SvalGlac field activities was listed and made available for partners of the project.

Field work

Field studies were conducted within selected key regions of the SvalGlac project during end of winter/spring season and in summer 2011. Monitoring infrastructure on glaciers (AWSes, mass balance stakes, GPS velocity stations, time lapse cameras, etc.) has been maintained and developed. Radar soundings of glaciers together with precise GPS survey were done on selected glaciers. Observations and measurements of mass balance, snow cover thickness and structure and shallow ice coring were done on the key glaciers. Supplementary observations for calibration and validation of remote sensing data and models were performed.

Field campaign in spring (April – May 2011) was done on glaciers in NE Svalbard, in central Spitsbergen and along the western zone of Spitsbergen (from NW to S).

NE Svalbard

Two field campaigns of the German team, scheduled for May and July/August 2011 as part of the research activities on Nordaustlandet were successfully completed. In particular, data from the two automatic weather stations were retrieved. Snow pits both on Vestfonna and De Geerfonna were done and analysed together with measurements of mass balance stakes. These data complement a series now covering four ablation seasons allowing for detailed modelling of surface processes on Vestfonna over almost half a decade.

In spring 2011, field investigations on the Austfonna Ice Cap were conducted by the Norwegian, Swedish and Dutch teams, with support from the Norwegian Space Centre and European Space Agency (ESA) as CryoSat CalVal campaign, and through the EU-project Ice2Sea. Network of mass balance stakes over the ice cap was maintained and servicing of three Automatic Weather Stations was done. Elevation profiles across the ice cap were performed by the precise GPS system together with measurements of the snow distribution by high frequency radar. Ten continuously working GPS stations, distributed along the flow line of two fast-flowing outlets from the ice cap were checked and maintained. A more detailed study of the dynamics of two fast flowing units of the ice cap (Basin No. 3 and Duvebreen) has been started in 2011. Dynamic change in the Basin No. 3 marine terminating outlet was observed.

Central Spitsbergen

In spring 2011, regular maintenance work of the equipment installed on Nordenskiöldbreen – Lomonosovfonna was carried by the Dutch (IMAU), Swedish (UU) and Norwegian (NPI) colleagues collaboratively. The maintenance work consisted of visiting and replacing GPS stations and servicing the automatic weather station. On Nordenskiöldbreen, a number of snow pits was sampled and a shallow ice core was drilled. Moreover, about 10 km of snow radar profiles were retrieved. An attempt was made to do deep radar measurements, which unfortunately failed.

NW Spitsbergen

Field work on Kongsvegen was done in April 2011 by Austrian-Norwegian team (UI, NPI). The mission was devoted to maintenance of AWSes, continuation of glaciological measurements, performance of eddy covariance measurements and detailed snow investigations. Studies of Kronebreen were carried by Norwegian (NPI), Swedish (UU) and Dutch (IMAU) joint team. This monitoring program is an extension of the IPY-GLACIODYN project.

W Spitsbergen

Russian team (IGRAS) had performed RES measurements on three valley glaciers on Nordenskiold Land using VIRL-6 radar with central frequency 20 MHz in spring (17 April - 2 May) 2011. On the Tungebreen (2.63 km^2) ice thickness was measured along 12.5 km of 9 RES profiles. The Gleditschfonna (2.53 km^2) ice thickness and internal structure was studied along 19.5 km of profiles. Only a few RES profiles on Fridtjovbreen were done to examine its current hydrothermal state. Polythermal structure of the glacier has been confirmed with entirely temperate ice under the firn layer in the accumulation area (upper parts of its main tributaries) and two-layer structure in the lower part (ablation area) down to its front.

SW Spitsbergen

From early April to early May 2011, extensive fieldwork in Hornsund area was done with the logistic support of the Polish Polar Station. It was a joint Spanish-Russian-Polish-Finnish campaign, aimed at RES of several glaciers in this area, using VIRL7-20 MHz GPR. Both airborne (helicopter) and surface-based echo soundings were done. The ground-based profiling focused on Amundsenisen (52.5 km of GPR profiles) and Recherchebreen (48.8 km of profiles). The helicopter-borne radar echo-sounding consisted of 111.3 km of profiles, over Hansbreen, Paierlbreen and Austre Torellbreen with precise GPS positioning of their tracks. Moreover, spatial variability as well as internal structure of snow cover on Hansbreen and Amundsenisen was studied by the 800 MHz RES equipment by the Polish team (US & IGF). The high frequency GPR profiling of Hansbren (c. 80 km) and Amundsenisen (c. 66 km) was done. Radar survey was supported by snow pits analysis and shallow (up to 5 m depth) coring. GPR profiles were positioned by DGPS method that allows collecting valuable data on the most recent topography of studied glaciers simultaneously. On Amundsenisen one of the profiles followed along the NASA laser altimetry track from 1996 and 2002 as well as the GPS track from 2005. Results could give an opportunity to evaluate changes of geometry of Amundsenisen over 2 decades. Obtained snow data supplements classical mass balance monitoring on Hansbreen, which was continued in 2011, and are an important dataset for validation and calibration for modeling of snow cover distribution.

Servicing of the AWS equipment on Hansbreen and time lapse cameras for year-round record of state of the glacier's calving terminus was done. GPS measurements of Hansbreen flow rate have been continued. Similarly, classical surface mass balance observations on Hansbreen for the snow season 2010/11 has been measured and calculated.

In spring 2011, a new time-lapse camera was installed to record frontal part of Paierl Glacier (UoL, US &IFG) for studies of glacier dynamics and calving intensity. Pictures have been collected in the summer and are currently analysed. A second camera for stereoscopic analyses has been added in September 2011. Pictures from both cameras will be collected in 2012.

Summer campaign (by the US team) in the Hornsund area was devoted to water drainage and water balance of the land based Werenskiold Glacier. Water and sediment discharge in the Glacier River was monitored using automatic measurements, supplemented manually twice a day in July and August 2011. Special traps for estimation of the river bed load transport were experimentally used. Discharges of supraglacial streams and streams outflowing from the glacier on its marginal zone were measured two times during the field season. The measurements were carried out with SEBA F1 universal current meter. Simultaneously, water samples were taken for suspended matter and dissolved matter. Field measurements of physical and chemical parameters of water, with special reference to the Radon (^{222}Rn) content, and sampling of water from subglacial outflows were done for studies on component of water discharge from the underneath of glacier (thanks to cooperation with University of Luxembourg).

Seasonal maintenance of automatic instruments on Hansbreen and Paierlbreen was done in the final period of summer. Observations of other tidewater glaciers in the area were conducted, including photogrammetric survey of the Samarinbreen front position and sea water depth close to its terminus (in cooperation with University of Colorado and Institute of Oceanology, Polish Academy of Sciences).

Data analysis from field work, laboratory and remote sensing

Data from previous and last year field activity have been processed, analysed and interpreted. Laboratory analyses of samples from snow pits and shallow cores have been continued in the second year of the project.

Remote sensing studies of different aspects of state of selected Svalbard glaciers and glacial processes have been significantly developed. Results were used for modelling purposes, presented during conferences, published and prepared for publication (see list in the corresponding section below).

Results of field work by the German team from NE Svalbard were elaborated and interpreted. A compilation of all snow pit data over recent years provided important insights on the spatial pattern of accumulation on Vestfonna as did an analysis of shallow firn cores. Results were published. Data from studies on elevation gradients of air temperature over the ice cap were analysed and results are in preparation. Air temperature on monthly and daily basis have been found to be highly correlated between AWS measurements on western Nordaustlandet and the reference weather stations at Svalbard-Lufthavn and Ny-Ålesund. An analysis of the multi-decadal evolution of the surface areas of Vestfonna and De Geerfonna was completed and published by the German team in cooperation with other SvalGlac partners and associated scientists.

Measurements of glacier movement in the Basin No. 3 of Austfonna by the Norwegian team reveal considerable acceleration, superimposed on a strong seasonal signal of ice flow variability. Following summer maxima, velocities remain well above those observed in the previous pre-summer minimum and may indicate a beginning of a surge advance as the mean winter velocity has doubled over the last three years. The mean surface mass balance of the ice cap Austfonna is close to zero for the years 2004-2010. However, the overall mass balance is negative due to the calving loss. The geometry has shown a clear pattern of internal thickening (ca. 0.5 ma^{-1}) and peripheral thinning (up to 2 ma^{-1}), triggering the discussion of dynamic instability or recent precipitation increase.

Last year's and previous field studies on Kongsvegen (NW Spitsbergen) by the Austrian team in cooperation with other partners resulted in the elaboration of the near-surface small-scale spatial and temporal variability of momentum, sensible and latent heat exchange processes and reviewing a decade of energy and mass balance investigations at the glacier. Data on daily and seasonal glacier velocity change on Kronebreen, as measured using FORMOSAT-2 imagery and in situ continuous GPS survey, were analyzed and elaborated by the Norwegian and Dutch teams.

RES studies by the Russian team of three valley glaciers on central western Spitsbergen using the VIRL-6 radar provided new data on their thickness and internal structure. The ice thickness of the Tungebreen is 43.4 m in average and the maximum measured ice thickness reached 88 m. On the most of RES profiles internal reflection horizons (IRH) were recorded. Thickness of temperate ice layer reaches 60 m in the upper part of the glacier where ice is temperate from surface to bedrock, while average values are around 25-30 m. While Fridtjovbreen is completely temperate in the accumulation area (upper parts of its main tributaries) and has two-layer structure in the lower part down to its front, in the case of Gleditschfonna, preliminary analyses suggests the cold ice structure with absence of IRH. Maximum ice thickness of 63.6 m was noted and an average value is c. 30 m.

Field campaign by the Spanish-Polish-Finnish team in the Hornsund area (SW Spitsbergen) provided substantial progress in knowledge on tidewater glaciers thickness in their badly crevassed frontal parts thanks to the helicopter-borne RES. The data will be used for increase of precision in estimation of calving flux. New ground RES data for Recherchebreen reveal complicated internal hydrothermal structure of the glacier.

Data from time lapse cameras and velocity measurements of the Hansbreen frontal part proved continuation of calving during fall and beginning of winter (until December) and almost complete absence of calving events during second part of winter and early spring (to late May). Presence or lack of the sea ice cover does not affect calving. Short-time speed up and slow down events in glacier movement were noted during winter. Some of them could be caused by heavy rain episodes associated by increase of air temperatures above zero during dark winter. Detailed observations of calving modes have been done. Large calving events affecting wide portions of semi floated tongue of Paierlbreen were documented time lapse pictures during summer 2011.

Intensive laboratory studies of stable isotopes in snow and ice samples were done during reported period. In March 2011, Estonian team worked in the Norwegian Polar Institute cold room in Tromsø collecting samples from Svalbard shallow cores for stable isotope analyses in the Tallinn laboratory. Similarly, samples for stable isotope analysis from Jan Mayen ice core were collected in the Rovaniemi (Arctic Center/Melta) cold room in April 2011. Samples from the shallow core from Noredenskilold Glacier collected by the Swedish and Dutch team are analysed in Tallinn for the O^{18} record. The observational records are now 3 to 5 years long and results are currently being published. Continuation of analyses of the Lomonosovfonna 2009 ice core has been performed. Deuterium and oxygen isotope values are measured until 34 m depth. It is worth to note that in the Estonian IG TUT Laboratory in Tallinn new Picarro L2020-i Analyser for Isotopic H_2O was installed. The Laboratory participated in the IAEA Water Isotope Inter Laboratory Comparisons WICO 2011 and the IAEA-TEL-2011.

Extensive and different type remote sensing studies were performed in 2011.

The MODIS snow product MOD10A1 data were used to create a dataset of monthly mean albedo profiles over the Vestfonna ice cap by the German team. These profiles were used in the calibration and validation of an albedo model.

Actualization of South Spitsbergen glaciers inventory were done by the Polish Partner (US) on the base of new satellite images (ASTER and Landsat scenes from 2010) and the DEM SPOT 2008. Front retreat of fourteen glaciers terminating in Hornsund Fiord was analyzed in the following periods: 1899 – 1936 – 1960/1961 – 1976 – 1990 – 2001 – 2005 – 2010 using historical maps, aerial photos and satellite remote sensing data. Othophoto map with terminus positions was prepared for publication (as result of cooperation with other projects). Retreat rate of Hornsund tidewater glaciers increased in recent decades together with trend in increase of air temperature. Reduction of general area of all tidewater glaciers by about 171 km^2 since 1899 was changing in varying pace with an average aerial retreat rate of 1.6 km^2a^{-1}. Recession rate increased from c. 1 km^2a^{-1} in the first part of the 20^{th} century up to c. 3 km^2a^{-1} in the last decade.

Remote sensing data together with analyses of field observations permitted the US group made an update of calculation of calving flux to Hornsund from tidewater glaciers as c. 0.75 km^3a^{-1} (w.eq.) and to estimate melt water outflow from glaciers to the fiord as c. 0.87 km^3. Thus both liquid and solid forms are giving c. 1.5 km^3 (w.eq.) freshwater delivery to Hornsund fiord annually during the recent period 2005-2010.

Examination of recent satellite images by the US team made possible an update of the tidewater glacier inventory for the entire Svalbard with more precise evaluation of their recession. Basing upon such data a new estimation of retreat rates and iceberg flux from Svalbard Archipelago during last ten years was also made (c. 9.8 $km^3 a^{-1}$ w.eq.).

Analysis of last surges of Paierlbreen and Mendelejevebreen for estimation of long term geodetic mass balance and influence of surges on calving flux from Southern Spitsbergen glaciers were conducted on the basis of archive satellite data (1995-2010), DEMs from different periods and updated bathymetry data (2008-2010) on their forefields (cooperation of US, IGF and UiO).

Fractal analysis of the planar shape of Spitsbergen tidewater glaciers was done (US group). Preliminary result suggests that surge type glaciers have higher fractal dimension. Studies on physical basis of such relation are developed.

Study on segmentation of satellite radar images (SAR) in order to delineate glacial zones on glaciers (snow, superimposed ice and bare ice) were initiated and developed (cooperation of IAC and US teams). Moreover, remote sensing studies on delineation of equilibrium line on South Spitsbergen glaciers from visible and near IR satellite images were started in 2011 by the US group and are in progress.

Modelling

Modelling of different aspects of climate and glacier processes has been intensively developed during reported year by particular partner and in close cooperation between them.

<u>German Partners</u>

The simulation period for atmospheric modelling by the Polar Weather Forecast and Research model (PWRF) was extended to a full decade (2001-2010). The nesting strategy for the three spatial resolutions (30 km, 10 km, 2 km) was improved by a so-called cascaded nesting approach to avoid inhomogeneity in the parent domains while benefiting from the two-way nesting in the child domains concurrently. The simulations for the 30 and 10 km domains are already finished, while those for the 2 km domains will be finished within the next three months.

A statistical albedo model for Vestfonna ice cap has been developed. It is especially intended for further usage in mass balance reconstructions and future mass balance projections. A paper regarding this model is in preparation. A climatic mass balance (CMB) model, i.e. surface mass balance plus meltwater refreezing, has been developed for Vestfonna ice cap and applied for the period 2000-2009.

A physically-based snowdrift model for Vestfonna ice cap has been set up. Calibration and validation runs are currently in progress, and a related manuscript for a scientific paper is also in preparation.

The cooperation with other SvalGlac partners regarding a dynamical modeling of Vestfonna ice cap using the ELMER model has been continued. The future climatic mass-balance fields used for driving the model will be calculated by using an altered version of the CMB model.

<u>Finnish Partners</u>

Progress has been made on the modelling project of Vestfonna ice-cap. A first paper about an inverse method inferring basal drag coefficients from surface velocities in 1995 has been published in January 2012.

Italian Partners

Modelling process of Amundsenisen ice field in southern Spitsbergen has been continued and developed. Further steps have been implemented or tested:

- extension of the ice field model with inlet/outlet boundary conditions enforcing explicitly gravity effects and related improvement of the numerical code,
- acquisition of geometry of real space domain (Amundsenisen ice field) by the Spanish team and grid generation for finite volume discretization of the hydrodynamics LES model of the conjectured subglacial lake,
- completing debugging of the ice thermo-dynamical numerical code, Glen's law n=1,
- mesh refinement analysis of the ice field finite volumes discrete model, Glen's law n=1,
- construction of the numerical code of the LES hydrodynamics model of the subglacial lake and debugging of the lake numerical code,
- implementation of the numerical code for the coupling of the ice field and lake momentum and energy equations (jump conditions, remapping of variables required within front-tracking approach to moving boundary formulation); debugging of the numerical code for moving front model,
- calibration of the eddy viscosity/diffusivity coefficients in the LES lake model via numerical simulation and comparison versus velocity magnitude of similar subglacial lakes, already investigated in the literature,
- extension of the numerical code to the description of ice with Glen's law for n=3, debugging and mesh refinement of the related ice finite volumes discrete model,
- beginning of calibration of sliding coefficient at the bottom boundary condition to ice field model and of water content parameter of temperate ice with comparison versus observed ice outlet velocities.

Polish Partners

Stochastic Transfer Function methods were used for analysis of relations between snow cover dynamics and AO and NAO indices. Results have been published (IGF group).

Modelling of changes in subglacial drainage system of three glaciers in Southern Spitsbergen was done basing upon DTM of bedrock topography and DTMs of glacier surface in 1936, 1990 and 2008. Stabilization of drainage pattern during period of ice thinning and significant dependence of flow channels from bedrock topography was found (US group).

Norwegian Partners have started modelling the dynamics of the Austfonna and Vestfonna ice caps with application of different models (ELMER, SICOPOLIS, PISM) in cooperation with other SvalGlac partners.

Spanish Partners

The 3-D full-Stokes model of the steady-state dynamics of the Amundsenisen Icefield (Southern Spitsbergen) was completed, and these data were supplied to the Italian partner in order to develop more refined 2-D models of the moving boundary in the zone of the suspected subglacial lake. Advances have been done in the 2-D modelling of Hansbreen calving dynamics, using a full-Stokes dynamical model coupled to a Benn-type calving law. A paper on the subject is nearly completed.

Swedish and Dutch Partners

This team has started downscaling experiments with the climate model WRF using the AWS data from SvalGlac partners to calibrate and validate the modelling work.

Changes in the work plan or in the Consortium composition (please add new cooperation with researchers from other research institutes)

The Austrian Partner has developed new cooperation with: the University Bergen (J. Reuder) on common turbulence measurements on Kongsvegen Glacier in spring 2010; the AWI (G. Ritter, G. Jocher) for common evaluation of Kongsvegen turbulence data and development of corresponding manuscript; the University of Upsala (B. Claremar) on common evaluation of WRF model output data and development of corresponding manuscript; the NPI (E. Isaakson, M. Björkman) to initiate common studies on use of Kongsvegen snow measurements for snow chemistry; the SLF-Davos for common measurement and evaluation of Kongsvegen snow data; the Research and Training Centre for Forests, Natural Hazards and Landscape, Innsbruck, Austria for common measurement and evaluation of Kongsvegen snow data; the CICCI consortium (J. Burkhardt, NILU) on cooperative micrometeorological studies on Kongsvegen glacier during spring field work; the IMAU (R. Giessen, J. Oerlemans) for support of development of a new glacier global mass balance model by providing Kongsvegen meteorological data.

The Estonian Partner has developed cooperation with Paul Scherrer Institut (Switzerland), Norwegian Polar Institute (Norway) and Uppsala University (Sweden).
The German Partners do not report significant differences between the original work schedule and the status of research reached in 2011. A minor change concerns the field campaigns in future. Due to logistical restrictions imposed by the Governor of Svalbard, and also due to financial constraints only one field campaigns is planned to carry out in May 2012 to dismount the measurement stations. The modified work plan will not cause negative scientific impact.
The Italian Partner has extended Modelling Working Group by invitation of Dr. Rossella Cossu and Dr. Andrea Di Mascio, permanent senior research scientists at the IAC, Rome with expertise on segmentation of SAR images and hydrodynamics and numerical solution of moving boundary problems respectively. Moreover, Dr. Maria Mercede Cerimele got retired since September 2011.
Following contacts with the Remote Sensing Working Group (Dr. Jacek Jania and Dr. Malgorzata Blaszczyk, US), the interest came out to experiment the in-house segmentation method and code for SAR images co-authored by R. Cossu. This investigation is in progress and is oriented to detect glacier zones and investigate on their time evolution. A. Di Mascio is going to support the study of feasibility of further investigations within future projects, focusing on the characterization of cryosphere and its evolution in Svalbard.
The Polish Partners developed cooperation with the University of Luxembourg (Prof. Dr. Antoine Kies) on studies of subglacier component of meltwater discharge using record of physical and chemical parameters and Radon (^{222}Ra) content in water and supercooling phenomena in subglacier drainage system. New cooperation has been started with the Institute of Oceanology, Polish Academy of Sciences in Sopot (Prof. Dr. W. Walczowski and others) on field studies of bathymetry of maritime forefields of tidewater glaciers and interaction between sea factors and calving ice-cliffs in 2011. Studies have been significantly developed basing upon existing cooperation within the AWAKE project (Polish-Norwegian Fund) and are planned to be continued in future. Cooperative studies on dynamics of frontal part of tidewater glaciers and calving intensity fluctuations during year basing upon longer series of time lapse photos have been developed in cooperation with the University of Colorado, Boulder, USA (Ethan Welty, PhD Student and Prof. Dr. Tad Pfeffer).

Budgetary issues (please indicate here deviation from the planned expenses of the project, investments outside the project or money for additional research support, etc...)

Austria
SvalGlac money could be saved by getting support for a field assistant by the achievement of a grant from JULIUS-PAYER Stipendienprogramm der Österreichischen Gesellschaft für Polarforschung (Kongsvegen Snow Microstructure, KOSNOMIC).

Germany
Funding from BMBF sources for the research of the German partners C. Schneider (RWTH Aachen University) and D. Scherer (TU Berlin) is complemented by DFG sources from a running research project. There are no deviations from the original financial plans.

Italy
In order to be able to cope with possible cut of third year activity funding due to PNRA structural change (see remark in the section “Comments on the interaction with funding agencies, challenges or any problems encountered during the reporting period’), participation to Oslo SSC meeting has been charged to institutional funds owned by D. Mansutti.

It is worth to note synergy in preparation and running of different projects in the same / similar area as NW Spitsbergen and using common platform, as for example the Polish Polar Station, and share logistic costs between projects and/or Partners to reduce expenses.

Scientific publication and outreach (please mention published papers related to the project or outreach

and education activities (e.g. conference attendance etc...)

Scientific papers:

Beaudon, E. L.Arppe, U.Jonsell, T.Martma, M. Möller, V.A.Pohjola, D.Scherer, J.C.Moore. 2011: Spatial and temporal variability of net accumulation from shallow cores from Vestfonna ice cap (Nordaustlandet, Svalbard). *Geogr.Ann*., 93(A), 287-299, doi: 10.1111/j.1468-0459.2011.00439.x

Braun, M., V.A. Pohjola, R. Pettersson, M. Möller, R. Finkelnburg, U. Falk, D. Scherer & C. Schneider (2011): Changes of glacier frontal positions of Vestfonna (Nordaustlandet, Svalbard). *Geogr. Ann*., 93(A), 301-310, doi: 10.1111/j.1468-0459.2011.00437.x.

Divine, D., E.Isaksson, F.Godtliebsen, T,Martma, H.Meijer, J.Moore, V.Pohjola, R.S.W. van de Wal. 2011: Thousand years of winter surface air temperature variations in Svalbard and northern Norway reconstructed from ice core data. *Pol.Res*., 30, 73-79, DOI: 10.3402/polar.v30i0.7379.

Divine, D., J. Sjolte, H.A.J. Meijer, R.S.W. van de Wal, T. Martma, V. Pohjola and F. Godtliebsen. 2011: Modeling the regional climate and isotopic composition of Svalbard precipitation using REMOiso model: a comparison with available GNIP and ice core data. *Hydrological Processes*. 25(24), 3748-3759, DOI: 10.1002/hyp.8100

Dunse, T., R. Greve, T. V. Schuler and J. O. Hagen. 2011. Permanent fast flow versus cyclic surge behavior: numerical simulations of the Austfonna Ice Cap, Svalbard. *J. Glaciol*., 57(202), 155-162.

Dobiński W., M. Grabiec, B. Gądek. 2011: Spatial relationship in interaction between glacier and permafrost in different mountainous environments of high and mid latitudes, based on GPR research. *Geological Quarterly 55(4): 15-27.*

Grabiec, M., D. Puczko, T. Budzik, G. Gajek. 2011**:** Snow distribution patterns on Svalbard glaciers derived from radio−echo soundings. *Polish Polar Research, 32(4)*, 393 - 421

Luks, B., M. Osuch, R. Romanowicz. 2011: The relationship between snowpack dynamics and NAO/AO indices in SW Spitsbergen. Physics and Chemistry of the Earth*,* 36(13): 646-654. DOI:10.1016/j.pce.2011.06.004

Mansutti, D., E. Bucchignani. 2012: Numerical results propedeutical to the simulation of a subglacial lake at Amundsenisen, *IAC Reports* No. 201 (2/2012).

Möller, M., R. Finkelnburg, M. Braun, R. Hock, U. Jonsell, V.A. Pohjola, D. Scherer, C. Schneider 2011: Climatic mass balance of the ice cap Vestfonna, Svalbard: A spatially distributed assessment using ERA-Interim and MODIS data. *Journal of Geophysical Research*, 116, F03009, doi:10.1029/2010JF001905.

Möller, M., R. Möller, E. Beaudon, O.-P. Mattila, R. Finkelnburg, M. Braun, M. Grabiec, U. Jonsell, B. Luks, D. Puczko, D. Scherer & C. Schneider 2011: Snowpack characteristics of Vestfonna and DeGeerfonna (Nordaustlandet, Svalbard) – a spatiotemporal analysis based on multiyear snow-pit data. *Geogr. Ann*., 93(A), 273-285, doi: 10.1111/j.1468-0459.2011.00440.x.

Pohjola, V.A., P. Christoffersen, L .Kolondra, J.C. Moore, R. Pettersson, M. Schäfer, T. Strozzi and C.H. Reijmer. 2011. Spatial distribution and change in the surface ice-velocity field of Vestfonna ice cap, Nordaustlandet, Svalbard, 1995-2010 using geodetic and satellite interferometry data. *Geogr. Ann*., 93(A), 323-335, doi: 10.1111/j.1468-0459.2011.00441.x.

Schäfer, M., Zwinger, T., Christoffersen, P., Gillet-Chaulet, F., Laakso, K., Pettersson, R., Pohjola, V.A., Strozzi, T., Moore, J.C. 2011: Sensitivity of basal conditions in an inverse model: Vestfonna Ice-Cap, Nordaustlandet/Svalbard, *The Cryosphere Discuss*., 6, 427-467, doi:10.5194/tcd-6-427-2012, 2012 (submitted in 2011, under review for *The Cryosphere*)

van der Wel, L. G., H. J. Streurman, E. Isaksson, M. M. Helsen, R. S. W. van de Wal, T. Martma, V. A. Pohjola, J. C. Moore, and H.A.J Meijer. 2011. Using high resolution tritium profiles to quantify the effects of melt on two Spitsbergen ice cores. *J. Glaciol*., 57(206), 1087-1097.

Vasilenko, E.V., Machío, F., Lapazaran, J.J., Navarro, F.J. & Frolovskiy, K. (2011). A compact and lightweight multipurpose ground-penetrating radar for glaciological applications. *J. Glaciol*., 57 (206), 1113-1118.

Papers submitted, in print and manuscripts in preparation:

Błaszczyk M., J. Jania, L. Kolondra: Fluctuations tidewater glaciers in Hornsund Fjord (Southern Svalbard) since beginning of the 20th century (in preparation).

Bucchignani, E., D. Mansutti, F. J. Navarro, J. Otero, P. Glowacki, Numerical modelling of Amundsenisen Icefield for compatibility check of a subglacial lake (in preparation).

Dunse, T., T. V. Schuler, J. O. Hagen, and C. H. Reijmer: Seasonal speed-up of two outlet glaciers of Austfonna, Svalbard, inferred from continuous GPS measurements. *The Cryosphere* (in press).

Cossu, R., D. Mansutti, M. Blaszczyk: Delimitation of glacier zones in Svalbard using SAR images. MASCOT 11, *IMACS Series in Computational and Applied Mathematics* (submitted).

Claremar, B., F. Obleitner, C. H. Reijmer, V. Pohjola, A. Waxegård, F. Karner and A. Rutgersson: 2011: Applying a meso-scale atmospheric model to Svalbard glaciers. *Advances in Meteorology*, special issue "Svalbard meteorology" (submitted - in review).

Grabiec M., Jania J.A., Puczko D., Kolondra L., Budzik T.: Surface and bed morphology of Hansbreen a tidewater glacier in S Spitsbergen. *Polish Polar Research* (submitted)

Grabiec M., Jania J., Budzik T., Puczko D., Gajek G., Kolondra L.: Development of subglacial drainage system in relation to geometry changes of Spitsbergen glaciers. *Cold Regions Science and Technology* (submitted).

Jocher, G., F. Karner, F. Obleitner, J. Reuder, C. Ritter, R.Neuber, K. Dethloff, Th. Foken: The near-surface small-sclae spatial and temporal variability of momentum, sensible and latent heat exchange in the Svalbard region: a case study*, Advances in Meteorology*, special issue "Svalbard meteorology" (submitted - in review).

Karner, F., F. Obleitner, Th. Krismer, W. Greuell, J. Kohler: Reviewing a decade of energy and mass balance investigations at Kongsvegen glacier, Spitzbergen, (in preparation)

Sund M., Błaszczyk M., Eiken T., Jania J.: The implications of surge and tidewater glacier dynamics related to climate change response of Svalbard glaciers (in preparation)

Conferences:

Bilgeri, F., W. Steinkogler, F. Karner, F. Obleitner, R. Fromm, J. Kohler: Snow investigations at Kongsvegen glacier, Svalbard. 10th Ny Ålesund Seminar, 25-26 October 2011, Oslo, Norway.

Błaszczyk M., Jania J.: Iceberg flux from Svalbard tidewater glaciers to surrounded seas. Workshop Ocean influence on climate and cryosphere in the Arctic, 28-30 November 2011, Sopot, Poland.

Błaszczyk M., Jania J., Kolondra L., Walczowski W., Babiker M.: Fluctuations of tidewater glaciers and calving rate in Southern Spitsbergen in recent decades. Workshop Ocean influence on climate and cryosphere in the Arctic, 28-30 November 2011, Sopot, Poland.

Bucchignani, E., D. Mansutti, F. J. Navarro, J. Otero, P. Glowacki: Numerical modelling of Amundsenisen Icefield for compatibility check of a subglacial lake. Preliminary tests. Geophysical Research Abstracts, EGU General Assembly 2012, Vienna, Austria, Geophysical Research Abstracts, Vol. 14, EGU2012-8148.

Claremar, B., A. Waxegård, V. Pohjola, A. Rutgersson, C. Reijmer, R. Hock, U. Jonsell, F. Obleitner: Applying the WRF model at Svalbard glaciers: validation and improvements. GS Nordic Branch Meeting 2011, 27-29 October 2011, Oslo, Norway

Cossu, R., D. Mansutti, M. Blaszczyk: Delimitation of glacier zones in Svalbard using SAR images, M.A.S.C.O.T. 2011, Oct. 19-21, 2011 Rome, Italy.

Divine, D., Isaksson, E., Martma, T., Pohjola, V., Meijer, H. A. J., van de Wal, R. S. W., Moore, J., Godtliebsen, F.: Updated chronology of the Lomonosovfonna ice core, Svalbard: implications for paleotemperature reconstruction. Geophysical Research Abstracts, EGU General Assembly 2011, Vienna, Austria, Geophysical Research Abstracts, Vol. 13, EGU2011-9883.

Divine, D., J. Sjølte, E. Isaksson, H.A.J. Meijer, R.S.W. van de Wal, T. Martma, V. Pohjola, C. Sturm, F. Godtliebsen: Modelling the regional climate and isotopic composition of Svalbard precipitation using REMOiso: a comparison with available GNIP and ice core data. IGS Nordic Branch Meeting 2011, Oslo, Norway.

Dunse, T., T.V. Schuler, J.O. Hagen, and C.H. Reijmer: Continuous GPS surface velocity measurements on two fast flowing outlet glaciers of Austfonna, Svalbard - IGS Nordic Branch Meeting 2011, Oslo, Norway.

Finkelnburg, R., F. Maussion, D. Scherer: Eine regionale Reanalyse der atmosphärischen Bedingungen in der europäischen Arktis (Svalbard) der Dekade 2001-2010. - 30. Jahrestagung des Arbeitskreis Klima, 2011, Graz,

Austria.

Jania J.A., M. Grabiec, M. Błaszczyk: Odpowiedź lodowców polarnych na współczesne zmiany klimatu. Sympozjum „Współczesne zmiany środowiska abiotycznego i biotycznego obszarów polarnych", 6 June 2011, Warszawa, Poland.

Jania J.A., M. Błaszczyk, P. Glowacki, M. Moskalik: Estimation of calving flux from Svalbard glaciers with potential contribution of surge events. Arctic Science Summit Week (ASSW 2011) & Science Symposium, 27 March – 1 April 2011, Seoul, Korea.

Jania J., Ignatiuk D., Puczko D., Sikora S., Kostka S., Walczowski W.: Short term and season al changes in dynamics of Hansbreen a tidewater glacier in southern Svalbard. Workshop Ocean influence on climate and cryosphere in the Arctic, 28-30 November 2011, Sopot, Poland.

Karner, F., F. Obleitner, J.Kohler: Verification of re-analyses model output data in an Arctic glacier environment. EGU, General Assembly 2011, Vienna, Austria.

Karner, F., F. Obleitner, F. Bilgeri, J. Kohler: High resolution meteorological measurements on Kongsvegen glacier (Svalbard). GS Nordic Branch Meeting 2011, 27-29 October 2011, Oslo, Norway.

Karner, F., F. Obleitner, F. Bilgeri, J. Kohler: Mesoscale meteorological measurements on Kongsvegen glacier (Svalbard). 10th Ny Ålesund Seminar, 25-26 October 2011 Oslo, Norway.

Kolondra L., Błaszczyk M.: Mapping of front position changes of tidewater glaciers of Hornsund Fiord (S Spitsbergen) basing upon satellite remote sensing and archive maps (poster). Workshop Ocean influence on climate and cryosphere in the Arctic, 28-30 November 2011, Sopot, Poland.

Lapazaran, J.J., F. Machío, F.J. Navarro, M. Petlicki: Radioecosondeo y cambios del volumen de hielo 1936-1990-2007 del glaciar Ariebreen (Spitsbergen, Svalbard). VIII Simposio de Estudios Polares, 7-9 Sept. 2011, Palma de Mallorca, Spain, USB abstracts book, p. 60.

Malm T., T. Zwinger, M. Schäfer, R. Stenberg, J. Moore: Local High Resolution Wind Simulation over Blue Ice Areas at Dronning Maud Land, EAAIS - IGS Nordic Branch Meeting 2011, Oslo, Norway.

Möller, M., R. Finkelnburg, M. Braun, R. Hock, U. Jonsell, V.A. Pohjola, D. Scherer & C. Schneider: A spatially distributed assessment of the climatic mass balance of Vestfonna ice cap (Svalbard) in the period 2000-2009. - IGS Nordic Branch Meeting, 2011, Oslo, Norway.

Navarro F.J.: Ice sheet mass balance and sea level. SERCE-POLENET Meeting (16-7-2011), International Symposium on Antarctic Earth Sciences, University of Edinburgh, 10-16 July 2011, Edinburgh, UK.

Navarro, F.J., J. Otero, J.J. Lapazaran, P. Glowacki: Un modelo numérico tridimensional de la dinámica del campo de hielo de Amundsenisen, Svalbard, Congress on Numerical Methods in Engeneering 2011, 14-17 June 2011, Coimbra, Portugal, APTMAC, CD-ROM book, p. 192.

Otero, J. , F.J. Navarro, J.J. Lapazaran, E.V. Vasilenko, P. Glowacki: A three-dimensional dynamical model of Amundsenisen icefield, Svalbard, European Geosciences Union General Assembly 2011, Vienna, Austria, Geophysical Research Abstracts, Vol. 13, EGU2011-6257.

Otero, J., F.J. Navarro, J.J. Lapazaran, M. Grabiec, D. Puczko: Modelling the seasonal and long-term variations of the calving front position of Hansbreen, Svalbard. International Symposium on Interactions of Ice Sheets and Glaciers with the Ocean, Scripps Institution of Oceanography, 5-10 June 2011, La Jolla, California, USA.

Schäfer M., T. Zwinger, V. Pohjola, R. Pettersson, F. Gillet-Chaulet, T. Strozzi, M. Möller, John M.: Basal drag pattern inferred from surface velocities for Vestfonna ice-cap (Svalbard) with a Full-Stokes model in 1995 and 2008 - IGS Nordic Branch Meeting 2011, Oslo, Norway.

Scherer, D., R. Finkelnburg, F. Maussion: A regional atmospheric reanalysis for studying weather and climate in Svalbard. - 11th Annual Meeting of the European Meteorological Society, 2011, Berlin, Germany.

Vaikmäe, R., T. Martma, E. Isaksson, D. Divine, V. Pohjola, H. Meijer: The ice-core stable isotope records from small Arctic ice caps as proxis of climatic and evironmental changes EGU General Assembly 2011, Vienna, Austria, Geophysical Research Abstracts, Vol. 13, EGU2011-8934.

Career development of young scientists

Machío, F. 2011: Aplicaciones de la radioecosonda al estudio del régimen dinámico, térmico e hidráulico de los glaciares , PhD thesis, Universidad Politécnica de Madrid (Supervisor: F. Navarro).

Möller, M. 2011: Observation and modelling of glacier mass balances in Patagonia and Svalbard - Application and enhancement of temperature-index based modelling approaches. Ph.D. thesis, Fakultät für Georessourcen und Materialtechnik, RWTH Aachen.

Laska M. 2011: Metamorfoza pokrywy śnieżnej w okresie ablacji na Lodowcu Hansa (Spitsbergen) [Snow cover methamorphosis on Hans Glacier (Spitsbergen) during ablation period – in Polish]. M.Sc. thesis, Faculty of Earth Sciences, University of Silesia, Sosnowiec.

Malm T. 2011: Local High Resolution Wind Simulation over Blue Ice Areas at Dronning Maud Land. M.Sc. thesis.

Tymrowska P. 2011: Dynamika strefy klifowej lodowca Hansa na podstawie powtarzanych zdjęć naziemnych [Dynamics of the ice-cliff zone of Hans Glacier basing upon terrestrial time lapse photos – in Polish]. M.Sc. thesis Faculty of Earth Sciences, University of Silesia, Sosnowiec.

Outreach

Maintenance and updating of information on the project progress at the web site of the project http://svalglac.eu/ and web sites of the project Partners (Spain http://www.krios-hyperion.com/, Austria http://imgi.uibk.ac.at/iceclim/eb_group/proj_svalglac.htm, Germany http://www.klima.tu-berlin.de/KB/SvalGlac/ - the access to KB is restricted to registered users, Sweden http://www.geo.uu.se/glaciology/).

Popular lectures and presentations to stakeholders:

E. Kaup, T. Martma - Lecture "Kuidas aitavad polaaruuringud selgitada mineviku kliimat ja prognoosida ookeanitaseme tõusu" Science Night, 23 September 2011, Tallinn, Estonia.

F. Navarro - Invited lecture “Health State of the Cryosphere” (8-11-2011) within the workshop “*The Protection of the Environment in International Spaces”*, organized by Universidad Internacional de Andalucía, Baeza, Jaén, Spain, 7-9 November 2011.

J. Jania – Invited presentation “Arctic Science in Poland Short Overview of Discoveries and Challenges”.Scientific Session on *“Arctic in Transition: Challenge, Risk and Opportunity”,* Institute of Geophysics of the Polish Academy of Sciences, 28 February 2011, Warszawa, Poland.

J. Jania – Invited presentation “Importance of studies of the Arctic Region for non-Arctic countries”. Conference on *“A More Accessible Arctic: Implications for Regional Governance and Sustainable Development”*, Canadian Embassy in Warsaw & Polish Institute of International Affairs, 1 March 2011, Warszawa, Poland.

D.G!

Comments on the interaction with funding agencies, challenges or any problems encountered during the reporting period

Here you are free to add any new developments or important aspects that the program management should take note of.

During 2011 the Italian funding agency PNRA, has undergone a structural change that has, obviously, meant also a change of the related scientific committee and funding offices. At this time, Italian PolarCLIMATE IPs are not yet informed about the availability of the budget for the third year of activity. Nevertheless, the present unit is committed to carry on the tasks outlined in the original proposal.