LIFE Project Number

LIFE07 ENV/FIN/000133

Progress Report

Covering the project activities from 01/01/2010 to 09/06/2010

Reporting Date

30/06/2010

LIFE+ PROJECT NAME or Acronym

Monitoring and assessment of carbon balance related phenomena in Finland and northern Eurasia

Data Project

Project location	Helsinki
Project start date:	01/01/2009
Project end date:	31/12/2012
Total budget:	2155627 €
EC contribution:	1046759 €
(%) of eligible costs	49.09

Data Beneficiary

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List of abbreviations

AMSR-E	Advanced Microwave Scanning Radiometer – Earth Observing System
ASCAT	Advanced Scatterometer
ASD	Analytical Spectral Device
AVHRR	Advanced Very High Resolution Radiometer
CEA-LSCE	Commissariat à l'énergie atomique – Laboratoire des Sciences du Climat et de l'Environnement
CO2	Carbon dioxide
CORINE	Coordination of information on the environment
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
ENVISAT	Environmental Satellite
EO	Earth Observation
ESA	European Space Agency
EU	European Union
FMI	Finnish Meteorological Institute
GAW	Global Atmospheric Watch
GMES	Global Monitoring of Environment and Security
GSE	GMES Services Element
JSBACH	Jena Scheme for Biosphere-Atmosphere Coupling in Hamburg
MERIS	Medium Range Imaging Spectroradiometer (onboard ENVISAT satellite, ESA)
mmu	minimum mapping unit
MODIS	Moderate Resolution Imaging Spectroradiometer (onboard Terra and Aqua Satellites, NASA)
NDVI	Normalized Difference Vegetation Index
QuikSCAT	Quick Scatterometer
SCA	Snow Covered Area
SMMR	Scanning Multichannel Microwave Radiometer
SSM/I	Special Sensor Microwave Imager
SWE	Snow Water Equivalent
SYKE	Suomen ympäristökeskus (Finnish Environmental Institute)

1 Progress

1.1 Actions

1.1.1 Action 1: Project management and monitoring

Following activities can be listed as main progresses of action1 since 31.12.2009:

- 2nd Management board meeting
- 2nd Steering group meetings
- Project meetings
- Quarterly meetings
- 2nd Monitoring report of steering group
- Update: Envisaged activities for SnowCarbo Actions for 1.1.2009-31.12.2011
- Update: SnowCarbo web-pages
- SnowCarbo online newsletter
- SnowCarbo Poster
- Dissemination

The list of completed from 01.01.2009 till 09.06.2010 SnowCarbo project deliverables can be given below,

- *Action 1*- First Year Progress Report
- *Action 1*- 1st Monitoring Report
- *Action 1*- 2nd Monitoring Report
- *Action 1*- Inception Report
- *Action 4*- In situ data collection and processing
- *Action 5*- 1st Data document (SYKE)
- *Action 6*- 1st Progress report on methodology
- *Action 7*- Filtered time-series with preliminary techniques and progress report on filtered time-series (years 2001-2008)
- *Action 9*- Data exchange document
- *Action 2 & 3*- 1st EO data document years 2001-2008
- *Action 11*- Land Cover Data Needs for Carbon balance mapping

1.1.2 Action 2: Satellite data processing by FMI

Gridded Weekly SWE (mm)

The final parametrization and validation of program codes for the SWE product has been completed, after extensive debugging. A first run of the 30 year SWE dataset is underway. Verification and validation using the complete dataset will follow. Once completed, the full dataset will be made available through the project web pages.

Soil freezing

A timeseries –based investigation of backscatter changes due to freezing events has been completed for Finland using QuikScat data. An analysis of several years was conducted in locations where in situ data on soil freezing is available. The analysis shows that a clear freeze event is detectable in the backscatter as a drop in the sigma0 value after a stable unfrozen period in summer, and before a rise in backscatter due to snow cover. However, the following conditions should be met: (1) the snow cover during freezing is dry and/or very shallow, (2) vegetation cover is sparse. Condition (1) implies the method may fail occasionally if wet snow conditions mask the freezing event. Condition (2) results from vegetation masking the relatively weak response of freeing soil; a method to compensate for vegetation cover will be studied in the next phase, but it is probable a timeseries investigation will be unable to detect soil freezing for areas with dense forestation.

1.1.3 Action 3: Acquisition and extension of GMES-services GSE Polar View and GSE Land

Datasets for years 2001-2008 were completed and "1st EO-data document (years 2001-2008)" was prepared and delivered on schedule. MODIS and AVHRR data from year 2009 is collected to internal archives but has not yet been processed.

1.1.4 Action 4: In-situ data collection and processing by FMI

The tasks of Action 4 have progressed as planned. The initial and boundary data field sources for the models have been selected and the 1st data document has been completed. The measurements of the validation data has continued at the flux and concentration measurement stations of Finnish Meteorological Institute. The longest flux data sites have been running over 10 years and there have been slight changes in the flux calculation programs. The data from these sites, Sodankylä and Kaamanen, will be calculated according to the latest procedures in order to ensure homogeneous datasets. The processing of the data into a form appropriate for model evaluation will be conducted during the latter half of 2010. No major problems are foreseen in these tasks.

1.1.5 Action 5: In-situ data collection and processing by SYKE

An in-situ campaign was performed in Sodankylä between 12/03-23/03/2010. The measurements included the reflected spectrum of sunlight under clear sky and characterization of snow conditions during the measurements. The data from the field campaign is currently being checked, processed and included in the existing datasets.

1.1.6 Action 6: Methodology development and implementation by FMI

Degree of coupling between the climate model REMO and the land surface model JSBACH was decided. The approach of intended offline coupling (i.e. one-way coupling) requires 1) as the first step a REMO2008 run to determine fine scale regional climatic variables such as air temperature, surface pressure, radiation and precipitation; 2) as the second step the JSBACH model is forced with the climatic variables to produce the land vegetation CO2 exchange rate;

and finally 3) the exchange rate together with mapped data for anthropogenic and ocean CO2 sources the REMO2008 is driven in a version distributing the tracers to the atmosphere inside the model domain. Furthermore, since last meeting the required boundary data pre-processing codes in order to create boundary fields for regional domain are collected, their use learned and the required steps are taken for a trial set of data for year 2002. The REMO2008 tracer model is subsequently run with the relevant boundaries and its performance assured. JSBACH model domain was also restricted to that of REMO and it calculates the CO2 balance for relevant land points. However, the JSBACH derived fluxes are not yet processed into the form appropriate for subsequent tracer-REMO2008 runs, neither were the meteorological drivers derived from REMO2008 climate data.

Consequently the following working steps include 1) modifying the JSBACH output into form suitable for subsequent REMO-tracer runs 2) running the first trials with coupled REMO-JSBACH with the existing JSBACH standalone model 3) modifying the JSBACH output into more frequent output timestep from the daily standard 4) writing the 1st Progress report on methodology 5) initializing the sequence of REMO-JSBACH model runs including the required data flows between the models 6) performing the first trials by using the land cover data (from the Action 11) finally 7) utilizing the data from the Actions 3, 4, 5 and 11 will be reviewed according to the status of the models and the results of the initial runs.

Possible obstacles include inability to modify the time step in which case the daily time step will be chosen. On the other hand, a break through in the work done in MPI Hamburg on two-way coupling of the two models may bypass the work steps related to time steps and sequence of one-way coupled runs.

1.1.7 Action 7: Methodology development and implementation by SYKE

Multiple NDVI and SCA products per day were combined to one daily estimate after the masking of clouds. In addition, weekly NDVI composites were produced using the maximum composite technique.

Further filtering and gap-filling of NDVI and SCA time series is in progress. In order to facilitate the generation of time-series for homogenous sites of selected land cover types (deciduous forest, coniferous forest, open bogs and agricultural areas), the fraction of each land cover class within a MODIS pixel was calculated from CORINE Land Cover 2000 for Finland.

The software TIMESAT version 2.3 (Jönnson & Eklund 2004), developed for seasonality extraction and noise removal by function fitting, was used for filtering of NDVI time-series from homogenous sites near C02 flux measurement stations and for a small spatial subset of the data around the phenological station in Kevo. Function fitting methods, such as Gaussian function and logistic function fitting, which are implemented in TIMESAT, were recognized as suitable for noise removal in vegetation index time series, especially for boreal ecosystems (Jönnsen & Eklund 2002, Beck et al. 2006).

However, the use of TIMESAT for our current NDVI time-series requires some additional pre-processing, e.g. the software requires equal time steps for processing and longer gaps due to clouds need to be pre-filled. Further works concentrate on the handling of snow cover information and the definition of threshold values for the extraction of start and end of growing season.

Scientific cooperation on time series analysis has been established between the SNOWCARBO project and Lars Eklund from Lund University (Department of Physical Geography and Ecosystems Analysis)..

1.1.8 Action 8: Demonstration and validation by FMI

Detailed planning of system functionality validation at Sodankylä-Pallas site has been started. The CO2 flux data and CO2 concentration data are available for functionality validation. CO2 concentration data measured at the Pallas GAW site is combined with trajectory information up to year 2008. All the flux and concentration data is processed and checked for quality according to standards developed in the international measurement networks sites.

1.1.9 Action 9: Demonstration and validation of EO services

The Action depends on the modeling results as well as the results from Actions 7 and 11, where time-series of the satellite driven environmental variables and land cover datasets are produced. The demonstration will start with straight forward comparison (correlation) of time-series from in-situ measurements, satellite driven data and modeling results. Tools are being prepared for comparisons to be used with modeling data as soon as it becomes available.

1.1.10 Action 10: Generation of carbon assessment end-products

Activities will be started in 2012.

1.1.11 Action 11: Evaluation of required Northern-Eurasian land cover information

Detailed land cover information covering intensive in-situ monitoring areas using satellite data (IRS P6 LISSIII, SPOT 4 XS, LANDSAT 5 TM) together with ancillary GIS and in-situ data is produced. This includes

- CORINE land covers compatible data covering Finland (national lc)
- Tailored land covers data sets covering Sodankylä and its surroundings (Local lc)
- Regional land cover information for the whole of modelling area is under production.

Challenges:

- Revision of land covers data in eastern and south-eastern part of working window (Russia etc.)
- Assignment of surface parameters for revised land covers data

1.1.12 Action 12: Dissemination

- SnowCarbo presentation at the life + climate change seminar which was held on the 18-19 January, 2010 in Helsinki
- Kari Luojus, Jouni Pulliainen, Chris Derksen, Helmut Rott, Thomas Nagler, Rune Solberg, AndreasWiesmann, Sari Metsämäki, Eirik Malnes and Bojan Bojkov," Investigating the feasibility of the globsnow snow water equivalent data for climate research purposes" IGARSS 2010,July 25-30,2010, Hawai-USA(accepted).
- Törmä, Härmä, Markkanen, Hatunen, Arslan: "Revising the land cover and use classification of northern areas for climate modeling", SPIE European Remote Sensing Symposium, September 2010 Toulouse .
- The SnowCarbo web pages have been updated.

- Project poster describing SnowCarbo project, background and objectives.
- Online Newsletter no.1

1.1.13 Action 13: Auditing

This action is only performed at the end of the project.

1.1.14 Action 14: Project advisory co-operation

Within the Action 14 of the project, a post-doctoral researcher (Martin Ménégoz) has been recruited since November, 2009. The main goal of its work consists in evaluating the direct and indirect (via soil carbon fluxes) effects of black carbon deposition on Arctic snow during the 20th and 21st centuries. He is currently working simultaneously on two axes: the first one concerns the representation of the effect of black-carbon deposition on the snow cover in a General Circulation Model (GCM), and the second one concerns the evaluation of black-carbon budget in the Arctic atmosphere.

The land surface model ORCHIDEE (Krinner et al., 2005), component of the coupled climate-aerosol-chemistry model LMDZ-INCA, is used here to achieve the objectives of the first axis. The parameterization of Krinner et al. (2006), describing the mineral dust impact on snow-cover over Nothern Asia is currently adapted to assess the impact of black-carbon aerosol on snow albedo and therefore on snow depth, snow-cover extent and snow-cover duration. This parameterization is based on the work of Wiscombe and Warren (1980) for pure snow and Warren and Wiscombe (1980) for snow containing aerosols. Concerning this first axis, validation of ORCHIDEE snow representation is planned, comparing simulations with both local in-situ data (snow albedo, snow depth, snow grain size, snow temperature, Action 5 of the project) and regional satellite data (snow cover extent and snow depth, Action 2 of the project). These comparisons will be performed within cooperation between LSCE-LGGE, FMI and SYKE scientists, opening the opportunity to discuss and interpret some of the data which are recorded within the SNOWCARBO project. In this context, Gerhard Krinner and Martin Menegoz (LGGE, Grenoble, France) went to the FMI (Helsinki, Finland) to take note of the data which has been or will be recorded during the SNOWCARBO campaigns.

Concerning the second axis, an evaluation of the actual black-carbon sinks and sources in the Arctic atmosphere has been made, and has been presented during the last project meeting (March, 10th, 2010). This work is based on simulations performed with the chemical-transport global model simulations MOCAGE (Météo-France, see Ménégoz et al., 2009). It has been shown that except during the winter, the black-carbon atmospheric concentration is high in the Arctic region: During the summer, local biomass burning emission – especially concentrated in Northern Eurasia – strongly affects the Arctic black-carbon budget. During the spring and the fall, this is the transport of aerosols from the polluted Northern hemisphere area which represents the main source of black-carbon in the Arctic region. Due to its relative high latitude, Europe is the main polluted region which affects the Arctic atmosphere, followed by East-Asian polluted areas. The Northern-American emissions do not affect much the Arctic atmosphere. Concerning the estimation of the future black-carbon budget of the Arctic atmosphere, we plan to use the LMDZ-INCA simulations which will be performed in the context of the next IPCC exercise. These simulations will take into account the evolutions of black-carbon emissions during the next century.

References:

Krinner, G. N. Viovy, N. de Noblet-Ducoudré, J. Ogé, J. Polcher, P. Friedlingstein, P. Ciais, S. Sitch, and I. C. Prentice, 2005: A dynamic global vegetation model for studies of the coupled atmosphere-biosphere system. Glob. Biogeochem. Cyc., 19, GB1015.

KRINNER, G., O. BOUCHER, AND Y. BALKANSKI, 2006: ICE-FREE GLACIAL NORTHERN ASIA DUE TO DUST DEPOSITION ON SNOW. CLIM. DYN., 27, 613-625.

Ménégoz, M., D. Salas y Melia, M. Legrand, H. Teyssèdre, M. Michou, V-H. Peuch, M. Martet, B. Josse, and I. Dombrowski-Etchevers, 2009: Equilibrium of sinks and sources of sulphate over Europe: comparison between a six-year simulation and EMEP observations, Atmos. Chem. Phys., 9, 4505-4519.

Wiscombe, W.J. and Warren, S.G., 1980: A Model for the Spectral Albedo of Snow. I: Pure Snow, Jour. of the Atmosph. Sci., Vol 37, 2711-2733.

Warren, S.G. and Wiscombe, W.J. , 1980: A Model for the Spectral Albedo of Snow. I: Snow Containing Atmospheric Aerosols, Jour. of the Atmosph. Sci., Vol 37, 2734-2745.

1.1.15 Action 15: After Life+ Communication plan

The detailed plan for communications and actions after the end of the Life+ project will be made during the last project year in 2012.

1.2 Availability of appropriate licences and authorisations

All necessary software licences and authorisations to use observation data and models are available for the project team.

1.3 Envisaged progress until next report

Envisaged progress until next report can be found under **Timeline** in the project website Project website: http://snowcarbo.fmi.fi