LIFE Project Number

LIFE07 ENV/FIN/000133

Progress Report

Covering the project activities from 01/01/2009 to 31/12/2009

Reporting Date

31/12/2009

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

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1 Executive summary

1.1 General progress

The general progress in the project has been very good. All activities within the Actions have been started on time and the progress is inline with the planned project schedule.

1.2 Assessment as to whether the project objectives and work plan are still viable

The project objectives and the work plan are assessed continuously by the project team during the project meetings including management and steering group meetings. All project objectives are so far found fully viable.

1.3 Problems encountered.

The project team has not identified serious problems impacting the project objectives, work plan or schedule.

2 Administrative part

All meetings are planned and organized in close collaboration among project manager from FMI (Finnish Meteorological Institutes) and other representatives from SYKE (Finnish Environment Institute) and CEA-LSCE (Commissariat à l'énergie atomique – Laboratoire des Sciences du Climat et de l'Environnement). The project meetings in Finland are organized by FMI and SYKE respectively.

There are two changes in the project management structure:

Project Manager: Dr. Ali Nadir Arslan, FMI

Project Secretary: Ms. Ulla Haapanen, SYKE

2.1 Organigramme of the project team and the project management structure

The management and monitoring of the progress in the SnowCarbo project is carried out by management and steering groups, who will meet regularly during the project. The Management Board of the project is formed by

- project Principal Investigator (Prof. Jouni Pulliainen, FMI),
- Project Manager (Dr. Ali Nadir Arslan, FMI),
- Partner Coordinators (Mr. Olli-Pekka Mattila, SYKE and Dr. Philippe Ciais, CEA-LSCE),
- Project secretaries (Ms. Riikka Aikio, FMI and Ms. Ulla Haapanen, SYKE),
- Action Managers.

The project Steering Group includes

- Principal Investigator
- Project Manager, Partner Coordinators

- Institute Evaluators (Prof. Yrjö Viisanen, FMI and Dr. Yrjö Sucksdorff, SYKE)
- the representatives of the stakeholders (Statistics Finland, Ministry of Transport and Communications, Ministry of Environment, Ministry of Agriculture and Forestry).

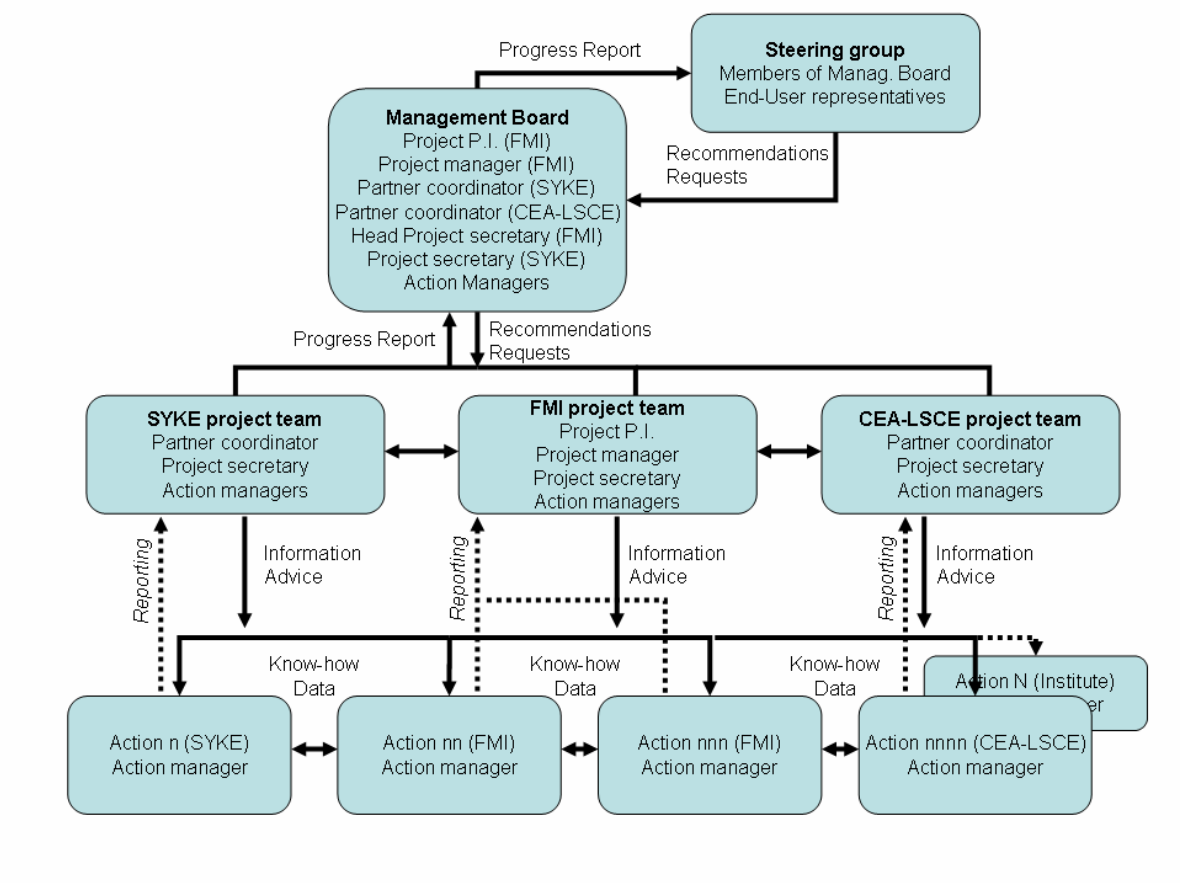

Figure 1. Organigramme of the SnowCarbo project.

2.2 Reports delivered since the start of the project

The list of the reports delivered since the start of the project can be listed as below

- In situ data collection and processing
- 1st In-situ data document
- Data exchange document
- 1st EO data document years 2001-2008
- 1st Monitoring Report
- Inception Report
- Land Cover Data Needs for Carbon balance mapping

All reports can be found at the SnowCarbo web-pages: http://snowcarbo.fmi.fi

3 Technical part

3.1 Actions

3.1.1 Action 1: Project management and monitoring

The activities in Action 1 have included arrangements of the official project meetings, coordination and monitoring of the project progress, preparation of the project deliverables according to the project plan, and monitoring of the project expenses.

The Management Board and the Steering Group meetings have been very successful with good discussions and exchange of opinions between the project managers and the representatives of the stakeholders. Project team meetings and working meetings between project team members have been used to ensure coordination of the project work and clarify any issues related for example to the deliverables between project Actions. At this very early stage of the project, the progress has been measured by discussions between the Principal Investigator, Project Manager, Partner Coordinators and the Action Managers.

Following activities can be listed as main progresses of action1:

- 8 Workgroups (from actions) are established in terms of close cooperation & communication among actions
- Project meetings monthly
- 1st Management Board meeting
- 1st Steering Group meeting
- Activity & Deliverable list updated by 28.10.2009
- SnowCarbo webpages are updated : more info in Action 12

3.1.2 Action 2: Satellite data processing by FMI

The outputs of the action contain three satellite data products

- Weekly Snow Water Equivalent (SWE) Grids
- Snow Melt Seasonal Grids (Dates of onset of snow melt and snow clearance)
- Date of Soil Freezing Grids

Weekly Snow Water Equivalent (SWE) Grids

Status: in progress

The software algorithms and production chain for the product have been created (MatLab environment). The product has been created for test years 1995-1998 and 2000 -2008. Product validation is underway through the comparison of test years 1995 – 1998 to available in situ data from Eurasia. During the validation process, several discrepancies were noted namely in error calculation of the SWE estimate, a by-product of the actual SWE value. Corrective actions are estimated to be completed during Dec. 2009. Once these are complete, a re-run for the test years will be made.

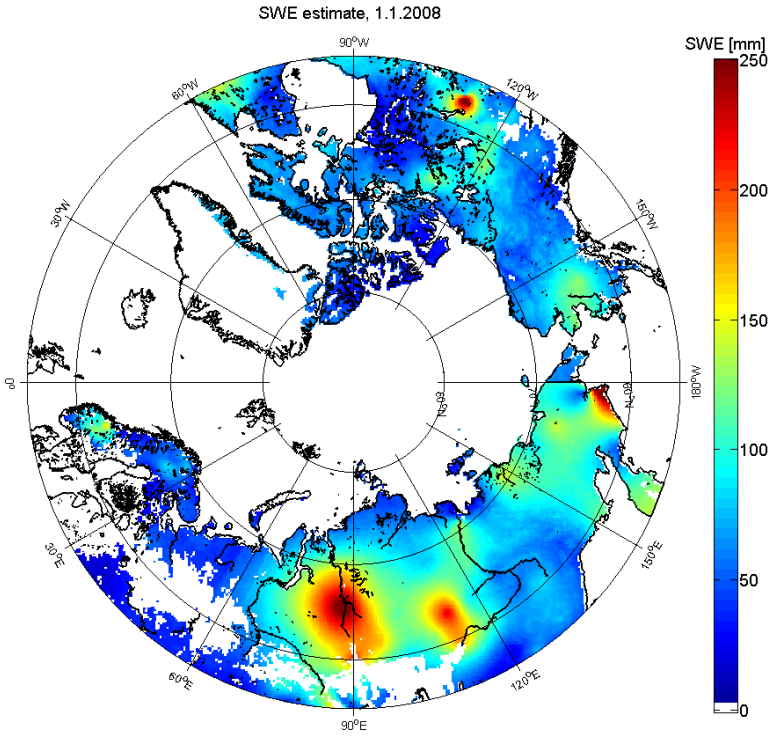

Figure 2: Gridded SWE in mm (0.25 degrees) for Northern Hemisphere, 1.1.2008 (Eurasia used for SnowCarbo). Weekly product is an average of seven similar grids. Projection: Polar Stereographic. Created with M_Map ©.

Completion of full 30 –year dataset product is estimated to be feasible within the schedule (KO+24 mo.). The errors detected in product validation are not seen as a source of significant delay.

Snow Melt Seasonal Grids (Dates of onset of snow melt and snow clearance)

Status: completed/in progress

Software algorithms and production chain for product have been completed for Date of Snow Clearance Product. A full dataset of 30 years (1978 – 2008) has been created. The product has been verified and validated in a journal publication (Takala et al., 2009).

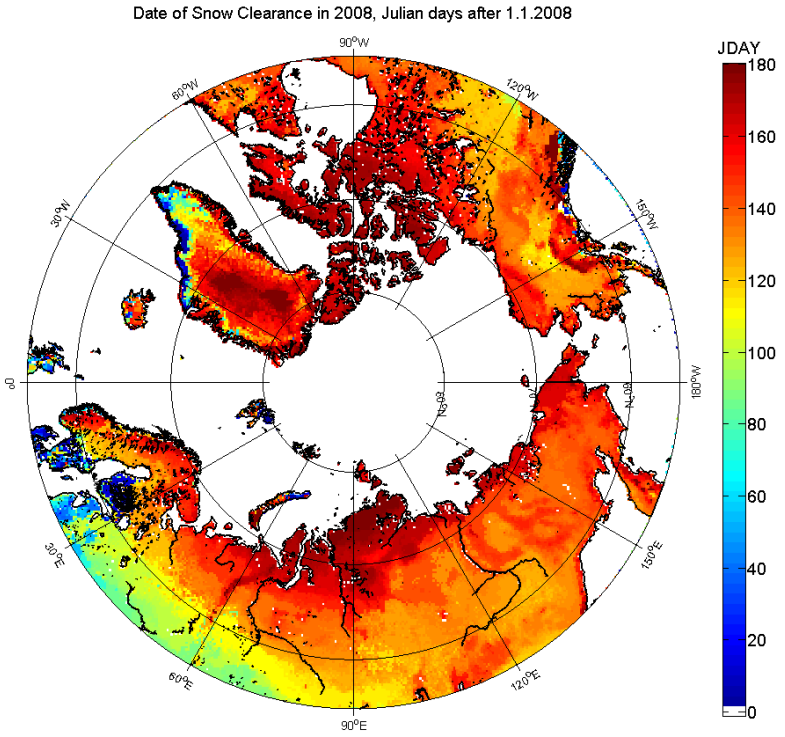

Figure 3 Gridded date of Snow Clearance for Northern Hemisphere in 2008 (Eurasia used for SnowCarbo). Projection: Polar Stereographic. Created with M_Map ©.

The theoretical and methodological basis of the Snow Melt Onset grids is founded on the same time series analysis and the same raw data as the Date of Snow Clearance. Essentially, the threshold and vector values determined from the timeseries are different. Modification of Snow Clearance software algorithms to this effect is underway. The full product will be created once these modifications are completed.

Completion of full 30 –year dataset product of both snow melt products is estimated to be feasible within the schedule (KO+24 mo.). The modification to software algorithms are expected to be completed during early 2010.

Date of Soil Freezing Grids

Status: started

The methodology for the product of Soil Freezing Date Grids is currently being studied. A dedicated person has been assigned to the task, with assistance as required from the project team. The final method will be chosen based on method feasibility, data availability, and initial validation and test results against available in situ observations of soil freezing. Possible identified methods include a time series analysis analogous to the snow melt products, and physical model inversion. The main options under study are

1. time series analysis of backscatter (sigma-0) variations

2. Backscattering model inversion based on Pulliainen et al., 1999

Although no prototype products are currently completed, it is estimated that the current schedule can be held. It is furthermore estimated that at least one of the methodologies under investigation will be applicable to the product, especially as the model inversion method has already been demonstrated (Albeit with a different satellite sensor, ERS-1). No significant obstructions have been detected in the methodology study to date that would delay the completion of the product.

Summary

Table1: Status of product availability

Product	Raw data available (years)	Product data available	Notes
Weekly Snow Water Equivalent Grids	1978 - present	Prototype datasets 1995-1998; 2000-2008	30-year dataset under production
Date of Snow Melt Onset Grids	1978 - present	-	Software update under progress
Date of Snow Clearance Grids	1978 - present	1978 - present	complete
Date of Soil Freezing Grids	1999 - present	-	Methodology under development

References:

Pulliainen, J., Manninen, T., and Hallikainen, M. (1998). Application of ERS-1 Wind Scatterometer Data to Soil Frost and Soil Moisture Monitoring in Boreal Forest Zone. IEEE Trans. Geosci. and Remote Sensing. 36: 849-863.

Takala, M., Pulliainen, J., Metsämäki, S., and Koskinen, J. (2009). Detection of Snowmelt Using Spaceborne Microwave Radiometer Data in Eurasia From 1979 to 2007. IEEE Trans. Geosci. and Remote Sensing, 47:2996-3007.

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

In this action the time span and spatial coverage of GMES services GSE Land and GSE Polar View are extended to cover the needs of SnowCarbo project. The aim of Action 3 is to provide a harmonized dataset of environment variables for the generation of time-series on intra-annual snow and vegetation evolvement, complemented by temperature information.

Progress since inception report

The processing of MODIS data for years 2001-2008 has been completed. Produced dataset contains the local MODIS Terra Level 1 archive with calibrated and rectified top of atmosphere products. Using the top-of-atmosphere data, NDVI and SCA estimates, as well as

cloud masks were calculated for each preprocessed scene. The produced dataset of environmental variables has been revised and found to be accurate.

Level 0 NOAA AVHRR archive is ready for years 2001-2008. the data archive was created as a combination of SYKE's operative archives and FMI's off-line AVHRR archives. The temperature data products are currently being processed.

The overall status and detailed characteristics of the produced datasets has been documented in the **1st EO-data** document.

Deliverables

1st EO-data document was completed at the end of November, 2009.

Envisaged progress

Completion of AVHRR data processing of years 2001 – 2009 is finalized in the beginning of 2010. As AVHHR temperature data will serve as complimentary data, the use will be further developed according to the needs of Action 6 and 7.

Collection and processing of MODIS data for year 2009 will be done in the beginning of year 2010 and for year 2010 at the end of the acquisition period in November. Progress and status of the produced datasets is documented in the 2nd EO data documents at the end of November, 2010.

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

The general objective of Action 4 (In-situ data collection and processing by FMI) is preparing two data sets: the input data and the validation data. The input data, which provides the boundary and initial conditions for the model runs, are collected from various global data sources and they are synthetized to global grids. The validation data (i.e. the in situ data set) such as, CO2 fluxes and concentrations, which will be used for assessing the reliability of the model predictions are routinely measured at several stations maintained by the FMI. The tasks of Action 4 have progressed as planned (Table 2). The initial and boundary data field sources for the models have been selected (Table 3). The 1st data document is completed by the due date (31/12/2009). The measurements of the validation data has been continuing in the flux and concentration measurement stations of Finnish Meteorological Institute. The processing of the data into a form appropriate for model evaluation will be started in early 2010 and no major problems are foreseen in the task.

Table 2: Activity list for Action 4 In situ data collection and processing by FMI

Action 4: In situ data collection and processing by FMI		
Activity	Due date	Completion (%)
1. The initial and boundary data field sources for the models will be selected.	28/02/2010	100%
2. 1st Data document will be completed.	31/12/2009	100%
3. Processing of data into a form appropriate for model evaluation.	31/12/2010	0%

Table 3: Gridded data sources to be used as an input for the model

Initial and boundary CO_2 concentration fields	TM3 model
Fossil fuel emissions	EDGAR4.0 database
Ocean sources	Takahashi database 2000
Initial and boundary fields for meteorology	ECMWF analysis data

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

The aim is to create in-situ dataset to support the Earth Observation (EO) data development and carbon balance modelling.

Progress since Inception Report

The spectral measurements from the spring 2009 campaign were added to the spectral databank. To plan for the next field campaigns the ASD spectral bank was searched for the numbers of measurements under different lighting and snow status conditions. The analysis revealed the need for following measurements:

- Measurements from the late stages of spring melting under clear sky conditions.
- Measurements from shadowed snow, both during the dry and wet snow conditions.
- More measurements on snow free target plants (mosses, lichen, heather, bare rock with dry and wet conditions)

The phenological dataset purchased from the Finnish Forest Research Institute has been evaluated. The dataset is unique, being the only in-situ observations of the phenology. The data exhibits some uncertainties:

- Uncertainty due to observers
- Uncertainty due to local climate
- Uncertainty in the observation methods

Even with the given uncertainties the dataset is useful in the derivation of phenological information from the satellite images, as well as in supporting the carbon balance analysis.

In-situ observations of the soil moisture, temperature and dielectric constant were conducted in Sodankylä in October 2009. The information is needed for interpretation of microwave satellite images. The observations were done under different conditions, first during snow-free conditions and later after a snow fall event. The measurements have not been analysed yet.

Deliverables

The 1st Data document was delivered in schedule and contains the description of the existing datasets and activity during the two field campaigns in 2009.

Constraints

No constraints that would delay the progress of the action have been encountered.

Envisaged progress

Next field campaign will be organized in spring 2010. Since the spectral measurements from snow are sought to be done during both wet and dry snow conditions there are likely to be two small field campaigns. Currently the most probable times would be mid-March and mid-May, but the weather conditions and snow status will determine the final schedule.

The existing datasets from snow courses and phenology will be used in the development of the time-series filtering and interpolation techniques in Action 7.

3.1.6 Action 6: Methodology development and implementation by FMI

Implementation of up to date version of REMO2008 model on computing facilities available for FMI personnel (CSC's facilities) is completed as well as implementation of the version taking tracer transport into account.

Necessary knowledge on pre-processing the boundary and initial data together with the codes needed has been gained (see action 4 on progress in collecting the gridded data). Available data pre-processors are possessed by the FMI personnel and for up to date data forms suitable for climate modeling (typically NCVIEW format) example scripts using CDO's (Climate Data Operators) are available.

Instead of actual coupling of the ecosystem model JSBACH with REMO for SNOWCARBO project we aim at forcing JSBACH offline. The work towards this aim is ongoing in FMI. However, during year 2009 researchers of MPI Hamburg started work aiming at total coupling. FMI follows the progress of the work that may be facilitated in the later phases of the project for evaluation of the results gained with offline coupling.

Necessary knowledge on controlling the input and output information streams is partly gained. However, understanding of certain technical steps of processing the input data into form suitable for pre-processors will be collected during the work that will be done after trial runs with existing standard data presently used by the models. These technical steps are related to suitable mapping of maps of surface characteristics into REMO grid. With a special complication of tile approach of land use used in JSBACH. Performing these steps will require intense co-operation with MPI Hamburg.

The progress made is in line with the schedule given in the first progress report.

3.1.7 Action 7: Methodology development and implementation by SYKE

Action 7 provides filtered and gap-filled time series of Snow Covered Area (SCA) and Normalised Difference Vegetation Index (NDVI). Carbon balance related features will be extracted from filtered and interpolated time series of vegetation index.

Progress since Interception report:

Unfiltered time-series of SCA and NDVI, in a gridded form, were processed for the years 2001-2008 from MODIS satellite data. The deliverable was finalised according to project plan by 30/11/2009. SCA and NDVI data sets are described in "1st EO-data document (years 2001 – 2008" (Deliverable action 3).

For the project's area of interest there are typically 1 -4, partly overlapping, MODIS observations during one day. This results in usually more than one SCA and NDVI product for a day. Therefore, these multiple estimates were combined to a daily estimate after masking of clouds.

In addition, weekly composites of SCA and NDVI were produced using mean and maximum criterion for SCA and NDVI, respectively. Compositing was used to reduce noise in both time

series. For example, the maximum composite techniques for NDVI time series is based on the assumption that non-optimal conditions (e.g. atmospheric, view and illumination geometry) mainly reduce the NDVI, thus the maximum within a period represents best the vegetation status.

The work on further filtering and gap-filling of NDVI and SCA time series is in progress. A literature review for noise reduction methods for time series has been prepared and first tests were applied on NDVI time series for sites near phenological stations and C02 flux measurement sites in Finland. 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.

Deliverable

The unfiltered time-series, in the gridded form, of snow covered area (SCA) and normalized difference vegetation index (NDVI), years 2001-2008 was completed on schedule.

Envisaged progress

The work on filtering and gap-filling of NDVI and SCA time series will be continued and a first version of filtered time series will be delivered by end of May. Carbon-balance related features (beginning, maximum and of growing season) will be extracted from this preliminary version of the filtered NDVI time series according to project plan.

3.1.8 Action 8: Demonstration and validation by FMI

Activities will be started in 2010.

3.1.9 Action 9: Demonstration and validation of EO services

The in-situ and EO- datasets and land cover information developed in Actions 3, 5, 7 and 11 will be used to demonstrate the usability of the datasets in estimating the carbon balance (estimates developed in Action 6).

Progress since Inception Report

Using several different data sources ranging from computer modelling to remote sensing images creates large quantities of data. This data needs to be shared between the project partners efficiently.

To share data of moderate size, an FTP- (File Transfer Protocol) server was set up at FMI. This server is used to share most of the data and it also archives the documents and presentations distributed via the project web-pages (set up in Action 12).

The satellite datasets (covering 10 years of ~250 images/year) are too large to be shared directly through the FTP- server. Therefore the images are archived on external hard drives. Selected images can be delivered through the FTP- server, but if larger quantities of images are needed, the hard drives can be delivered to the user. The external archives also have backup copies in case of equipment failure.

Deliverables

To allow data share between project partners an FTP- server was set up for the project. The data sharing methods were documented in the first deliverable of the action: ‘Document of the data exchange method’, delivered in 30/11/2009.

Constraints

The Action is dependent on the successful completion of Actions 3, 5, 6, 7 and 11.

Envisaged progress

The first steps in the demonstration can be started as soon as more data will be available. The methodology is planned and new innovative approaches looked for to evaluate and demonstrate the performance of the EO- products in capturing phenomena related to carbon balance.

The preliminary demonstrations are developed by 30/11/2009 and reported in the: '**Preliminary demonstration report'**.

3.1.10 Action 10: Generation of carbon assessment end-products

Activities will be started in 2012.

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

The aim is to study thematic content and spatial accuracy needed for carbon balance modeling and define significant land cover variables in Nordic areas.

Progress so far

The information needs in carbon balance modelling have been discussed between service providers of land cover information at SYKE and modelling group at FMI. Already available land cover data sets have been demonstrated and evaluated. The results of this have been reported and the first deliverable:" Land Cover Data Needs for Carbon Balance Mapping" was available late August 2009. These information will be updated during the project according to the discussions and modelling experiences.

In this evaluation it was recognized that available GlobCover and GLCCD land cover data do not represent Finnish landscape well. For example surface parameter forest ratio (FR) used in the modelling together with GLCCD data deviates significantly from forest ratio calculated using national land cover data (CLC2000) in Finland. Thus surface parameters in local land cover will be enhanced.

Present work

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 presently under production. Employed methods include estimation of land cover variables using rule-based predictive models.

Additionally large scale land cover information for the whole of modelling area is under production. Time series of TERRA MODIS products will be used. Unsupervised classification with class labelling using national data sets will be employed.

Expected results in 2010:

- Detailed, local land cover data over northern Finland
- New set of large scale, regional land cover data covering the whole of Nordic modelling area
- Accuracy assessment of produced data

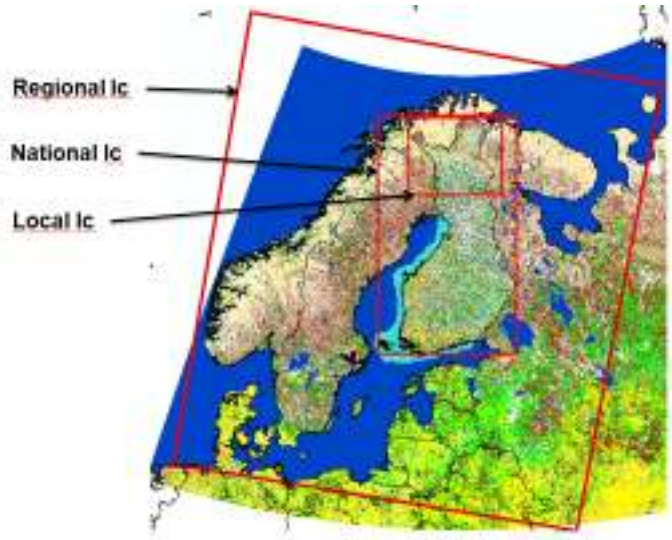

Figure 4. Different level of land cover data set for Snowcarbo

3.1.12 Action 12: Dissemination

From October 19, 2009 the project website layout has been revised. This was based on information or feedback from the users and external monitors. The website now contains only internal password protected pages and public pages. The user protected pages where eliminated. An internal document library page was established for internal purposes of sharing and exchanging files. Also to support the data exchange, an ftp server was set up. On October 20 2009, users where supplied with guidelines on how to upload files to the ftp server. Files on the ftp server are then uploaded to the project website.

3.1.13 Action 13: Auditing

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

3.1.14 Action 14: Project advisory co-operation

The aim of this work is to evaluate the direct and indirect (via soil carbon fluxes) effects of black carbon deposition on Arctic snow during the 20th and 21st centuries. An interesting question concerning the 20th century is whether strong black carbon emissions during the first half of the century contributed to the hitherto unexplained Arctic warmth. Concerning the 21st century, the question of the climatic effects of increased local pollution, e.g. through maritime traffic, is of great interest. This work started very recently (mid-November) with the recruitment of a post-doctoral researcher (Martin Ménégoz) for 18 months. Martin Ménégoz is climate modeller and specialist of aerosol-chemistry modelling. Our strategy consists of using the coupled climate-aerosol-chemistry model LMDZ-INCA to simulate atmospheric aerosol loadings and deposition in the Arctic during the period of interest. The climate model contains a representation of the effect of black carbon in snow on the its albedo. However, a

first necessary step will be to develop a parameterization of the evolution of black carbon concentrations in the snow during snow phase changes (sublimation, melt) and precipitation. The scenarios of Arctic aerosol loadings and deposition we will use will take into account local sources of pollution, in particular increasing maritime traffic in the Arctic. The reduction of the duration of the Arctic snow cover through black carbon deposition should also have an effect on the soil carbon balance. This is taken into account within our climate model suite, because the soil module contains a representation of soil carbon pools. The work is carried out in conjunction with a French project focussing on the Himalayan region; part of the initial work of this action was dedicated to establishing this collaboration.

3.1.15 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.

3.2 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

4 Annexes

4.1 Deliverables

The deliverables for the first 12 months of the SnowCarbo project are:

- Project website: http://snowcarbo.fmi.fi