

SNOWCARBO

Monitoring and assessment of carbon balance related phenomena in Finland and northern Eurasia
2009-2012



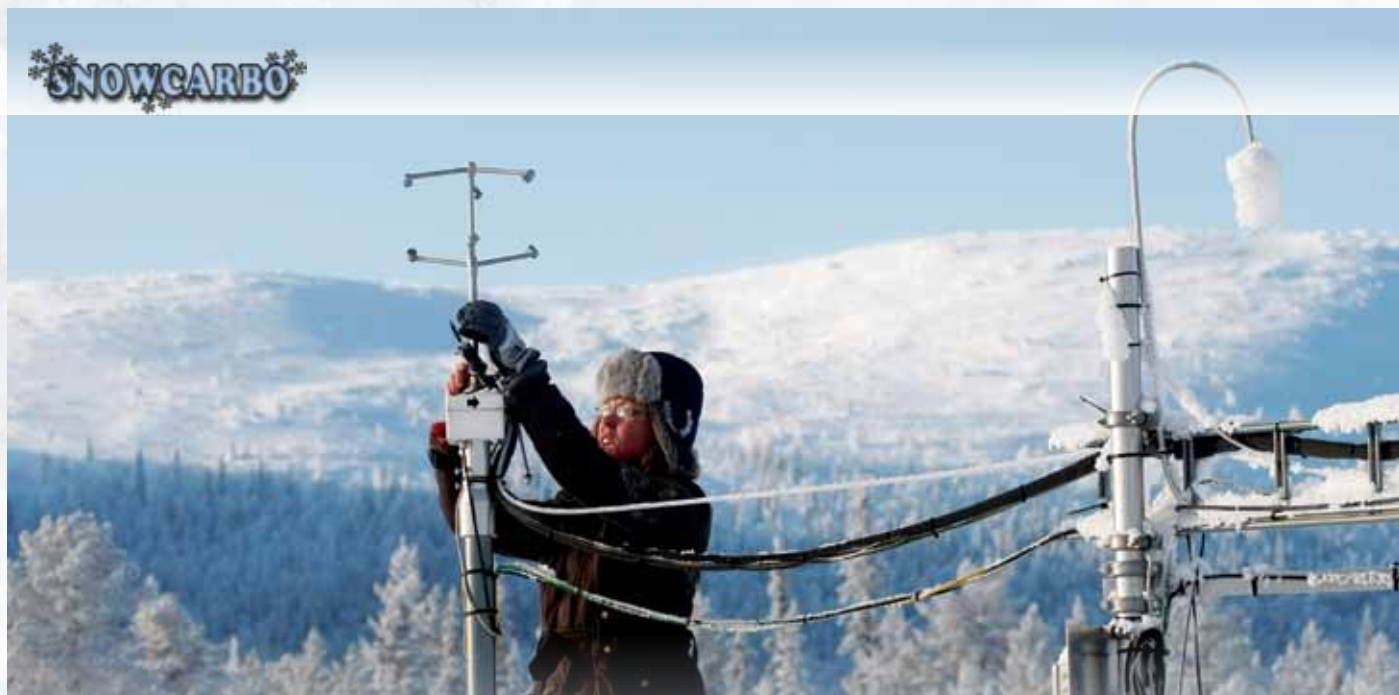
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ILMATIETEEN LAITOS
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OVERVIEW

The main objective of the SnowCarbo project is to implement and demonstrate a new innovative approach for the net carbon balance mapping in Europe and northern Eurasian region. This approach is based on a combination of different information sources describing snow evolution, phenology, land cover, CO₂ fluxes and concentrations. The implemented method combines local in situ observations and global Earth observation satellite data together with land cover class information in a new way. Snowcarbo aims to produce carbon balance maps over northern Europe and northern Eurasia by combining different data sources and modeling of CO₂ balance. The results can be implemented into the European and national adaptation strategies to the impacts of climate change and to support the formulation of the environmental legislations and regulations.

BACKGROUND

One of the key problems of the climate change prediction and monitoring is that the magnitudes of carbon sinks and sources of boreal forests are not accurately observed. They are currently measured with higher precision only at individual observation sites and the monitoring over large regions is very coarse. This handicaps the performance of climate models and the evaluation of anthropogenic influences on climate change. The mapping of carbon sinks is a major issue concerning the implementation of Kyoto protocol and concerning future climate treaties. By obtaining improved information on the magnitudes and locations of real natural carbon sources and sinks, and improvements in the assessment of the levels of anthropogenic sources, the future environmental legislation/regulations can be based on more realistic carbon emission figures.

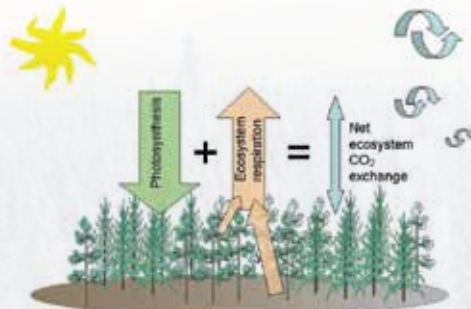
Analysis of the spatial variability and long-term trends in snow cover distribution together with observation data and climate change prediction models show that the models project changes in the spatial and temporal distribution of snow in the boreal and in the arctic terrestrial regions. Thus, changes in seasonal snow cover evidently lead to changes in CO₂ balance, as snow cover directly effects the respiration (carbon sources) and increase of forest and other vegetation biomass (magnitude of carbon sinks). Snow also impacts the vegetation, the ecology, and the subnivean environment, which is a habitat for many plant and animal species. Changes in the timing of snowmelt in the spring can affect the breeding of certain ground nesting species and the distribution of some plant communities.

The SnowCarbo project targets the development of new monitoring tools and methods to aid European and national adaptation strategies to climate change impacts, e.g. relevance to the Green Paper of European Climate Change Programme II: 'Adaptation to climate change in Europe - options for EU action'. The projects is also related to the Finnish Adaptation Strategy to climate change, the Intergovernmental Panel on Climate Change (IPCC) and the Framework Convention on Climate Change (FCCC).

OBJECTIVES AND EXPECTED RESULTS

The objective of the SnowCarbo project is to implement and demonstrate a new innovative approach for the net carbon balance mapping in the Europe and northern Eurasian region. The approach is to combine in-situ and satellite observations of snow evolution, phenology, CO₂ fluxes and CO₂ concentrations together with land cover classification to feed mathematical CO₂ models. The annual maps of

carbon balance produced by SnowCarbo can be used to aid the definition of the European and national adaptation strategies to climate change impacts and to support the formulation of the environmental legislation and regulations. SnowCarbo utilizes earlier work conducted at SYKE within the European Space Agency programs GSE (GMES Services Element) PolarView and GSE Land by refining the products for the purposes of this project.



Land ecosystem CO₂ balance is modeled by combining ecosystem processes to their climatic drivers and transport processes in the atmosphere.

Summary of the SnowCarbo main objectives:

1. *To provide accurate map information on net carbon balance in boreal forest zone in order to assess the real levels of carbon sinks and sources for future climate controlling treaties and policy making,*
2. *To provide and demonstrate methodologies to extract anthropogenic influence from natural background CO₂ sources in order to enable the development new legislative means for CO₂ regulation,*
3. *To provide information for the future needs of required in situ, model, Earth observation and land cover data needs of continental scale carbon balance mapping/monitoring (focusing on northern areas).*

The most important environmental benefits obtained by the project are the more precise knowledge of the green house gas concentrations and their future trends in northern latitudes. Project also aims at developing suitable monitoring tools for these purposes. This allows more accurate separation of anthropogenic sources from the natural background. The monitoring information yielded by the system implemented in SnowCarbo can be used in political decision making as it provides information on carbon sinks and sources that has not been available earlier. This may also enable

the development of tools to estimate carbon balance in the scale of forest holdings, which would have a major significance for forestry.

The accurate information and services on spatial and temporal distribution of snow cover produced in the framework of this project serve numerical weather prediction, hydrological and environmental applications.

The validation of the SnowCarbo products will be performed by using test areas in northern Finland. The Sodankylä-Pallas test site developed by FMI is especially aimed for calibration and validation of present and future space-borne environment and climate monitoring instruments.

CONTRIBUTION TO THE ACHIEVEMENT OF EUROPEAN ENVIRONMENTAL OBJECTIVES

The SnowCarbo project develops and demonstrates CO₂ balance monitoring systems and methodologies that are applicable to support a wide variety of EU activities including:

- DG ENV: Action on Climate Change Post 2012. Consistent and accurate monitoring of the full carbon balance of Europe and realistic modelling of future scenarios are needed to prepare for the implementation of future climate change actions. Consistent snow cover data are needed for accurate carbon accounting, because snow controls ecosystem net carbon exchange in northern landscapes through the timing of carbon uptake by vegetation and soil. This information is also relevant for establishing future versions of the EU Emission Trading Scheme (ETS).
- DG ENV: European Climate Change Programme (ECCP). Supporting the initiative of the European Commission for a policy strategy to adapt to the impacts of climate change that is aimed at assisting local, regional and national efforts. Pan-European, spatially detailed data on northern latitudes and improved models on it's changes for future climate scenarios are very relevant for these efforts.

Additionally, the project has relevance e.g. to European Strategic Energy Technology Plan - SET (DG TREN), Integration of climate change into the EU's Rural Development Policy (DG AGRI) and Water Information System for Europe, WISE (DG ENV).

1. *Global Monitoring for Environment and Security (GMES) is a program that has been established under the leadership of the European Commission (EC) to fulfill the growing need amongst European policy-makers to access accurate and timely information services to better manage the environment, understand and mitigate the effects of climate change and ensure civil security.*

PROJECT PARTICIPANTS

Coordinating beneficiary:

FINNISH METEOROLOGICAL INSTITUTE (FMI)

www.fmi.fi

The Finnish Meteorological Institute (FMI) is a service and research organisation under the purview of the Ministry of Transport and Communications. Its special fields of competence include weather, climate, air quality and geophysics. The FMI is responsible for the production of reliable information on the state of the atmosphere, its characteristics and phenomena with the aim of enhancing overall safety as well as serving the needs of the general public, industry and commerce, and other branches of science.

Associated beneficiaries:

FINNISH ENVIRONMENT INSTITUTE (SYKE)

www.ymparisto.fi

The Finnish Environment Institute (SYKE) with a staff of about 600 is a national research and development centre under the Ministry of the Environment, Finland. The institute provides environmental information, publishes assessments on the state of the environment, and conducts research on the environment and environmental effects of activities and analyses approaches and methods for the prevention and mitigation of harmful effects.

COMMISSARIAT A L'ENERGIE ATOMIQUE, LE LABORATOIRE DES SCIENCES DU CLIMAT ET L'ENVIRONNEMENT (CEA-LSCE/IPSL)

<http://www.lsce.ipsl.fr/>

The Laboratoire des Sciences du Climat et de l'Environnement (CEA LSCE/IPSL) is a joint research unit of the Centre National de la Recherche Scientifique (CNRS) and the Commissariat à l'Energie Atomique (CEA), two major research agencies in France. The LSCE is also part of IPSL, l'Institut Pierre Simon Laplace, a federative institute based in Paris, France. The Institute is composed of 6 laboratories working on global environmental and climate studies. LSCE employs currently 240 people, in the fields of biogeochemical cycles modelling and observation, past and future climate studies and isotopic markers in the environment. LSCE has a world class expertise on carbon cycle modelling and analysis, with particular focus on modelling land atmosphere CO₂ fluxes and their interactions with the climate system.

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Photos by Timo Lindholm and Anna Kontu



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