LIFE Project Number

LIFE12 ENV/FIN/000409

2nd progress report of Action B5: Retrieving climate change indicators by models

Reporting Date

31/03/2016

LIFE+ PROJECT NAME or Acronym

Climate change indicators and vulnerability of boreal zone applying innovative observation and modelling techniques

Data Project

Project location	Helsinki
Project start date:	02/09/2013
Project end date:	01/09/2017
Total budget:	2755288 €
EC contribution:	1366952 €
(%) of eligible costs	49.61

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1 Summary

This report describes last implementation steps prior to application of the impact models for retrieving climate change indicators thought the current century as well as the status of ongoing scenario simulations and retrieval of the indicators.

2 Introduction

The impact models of the project are land ecosystem models JSBACH (FMI) and PRELES (Luke and UHel). This action produces hindcast land ecosystem model runs that represent the current climate (1980-2010) and scenario runs that extend until year 2100. The land ecosystem models are run in relatively high spatial resolution of approximately 10km and the models operate with daily or subdaily climatic drivers – here we run the scenarios with daily driving data. The target climate change indicators are duration of vegetation active season (VAP), vegetation carbon uptake rate, forest and soil respiration rates, methane emission rate, evapotranspiration (sum of surface evaporation and plant transpiration), soil moisture, length of soil frost period, snow cover and surface albedo.

3 Models and their driving data

The two land ecosystem models we use are: JSBACH that is a land surface model (LSM) of an earth system model of Max Planck institute for meteorology (MPI-MET) implemented and operated in FMI, and a semi-empirical stand flux model PRELES, that is developed and used in University of Helsinki and LUKE. JSBACH can be operated either in daily or subdaily timestep and climatic driving data can be adopted for example from a climate model. In addition to our regional domain covering Finland, a domain may consist of a single point representing an ecosystem site as the model has been operated in Action 4. A site run can be alternatively forced with locally measured meteorological data. PRELES domain covers Finland and is run in 10km spatial resolution and driven with daily data. PRELES can be run also with single point meteorological data. For current day simulations data is adopted from FMI gridded harmonized weather data and from pre-existing regional model runs. For future scenarios, data from seven CMIP5 models are adopted (http://cmip-pcmdi.llnl.gov/cmip5/docs/standard_output.pdf). See the "1st report on climate data processing" for more details on model requirements and driving data.

We have implemented and run JSBACH in FMI high performance computing facilities including state-of-art Cray XT5m computing system as well as in desk top computers. PRELES we have operated in desk top computers.

Results of various hindcast runs performed so far in the context of model calibration are reported in the *1st* and *2dn progress report*s *of Action B4: Methodologies developed, implemented and tested*.

4 Scenario run set-up

Since the *1st progress report of Action B5: Retrieving climate change indicators by models* JSBACH model domain as well as model version were upgraded and the driving data fields were processed into the new domain. Reasons for updating the model domain are manifold: First, formerly our regional JSBACH domain was set to accord with a regional climate model providing the climatic drivers for JSBACH but as in this project down-scaled and bias-corrected global scenarios are used as driving data, conformance with a climate model domain is not practicable. Consequently, it is possible to reduce the lateral extension of the domain and limit it to Finnish territory thus diminishing the fraction of unnecessary land area in the model runs.

Secondly, since the beginning of the project, a new Finnish CORINE land cover data CLC2012 was released (Corine 2012 Final Report). Finnish CLC2012 is of higher resolution and more detailed nomenclature than its European counterparts priorly used. It contains also information about soil type providing thus a soil information consistent with the vegetation cover information, while earlier these data was collected from separate data base. Furthermore it has been developed for Finland with local expert knowledge.

Finally, FMI has lately adopted a new standard for gridded meteorological data product that is produced into a approximately 10 km grid (Aalto et al 2013). In order to maximize consistence between the new domain and gridded data available for down-scaling purposes, we decided to adopt the same grid for our regional modeling. The grid resolution is also somewhat improved in the revision being now 0.1°x0.1°.

Simultaneously with a new domain and up to date boundary data a new model version was adopted. The updated version has 5-layer soil moisture description (Hageman and Stacke, 2013) and Yasso soil carbon modules (Goll et al., 2014) implemented. Additionally for our scenario simulations we adopt the state of acclimation (S) formulation, whose performance is

demonstrated in the *2dn progress report*s *of Action B4: Methodologies developed, implemented and tested.* Furthermore, a condition that reduces stomatal conductance under supersaturation – that is under very high air humidity – is removed because it falsely prohibits photosynthesis at all under such situations that are not infrequent in such an off-line coupling set-up that we're running the model.

Because of the changes in the JSBACH modeling setup, starting the scenario production runs was delayed for half a year. The benefit of the delay was that the model calibrations and tests performed in the action B4 could be used in designing the production run set-ups.

All new climate scenarios for PRELES have been implemented to simulation platform at Luke. PRELES has been combined with two other models, a carbon-blance based stand growth model CROBAS and the soil model Yasso also included in JSBACH. These provide additional new outputs for the climate change indicators, including forest volume growth and forest ecosystem NEE. The model combination can be run for all the new climate scenarios.

5 Scenario forcing data production

The production of the driving data for JSBACH model was started after having the new domain implemented. Other driving variables but long-wave radiation are bias corrected with gridded FMI meteorological data. See the *Report on climatic data processing* of this action for more details on extraction of driving data from CMIP5 runs and its preparation for driving the land ecosystem models.

6 Extracting climate change indicators

The climate change indicators were described in the *1st progress report of Action B5: Retrieving climate change indicators by models.* Meanwhile the postprocessing routines for extracting the indicators have been further improved, implemented and tested (see reports of the actions B4 and C1 for the demonstration) for JSBACH applications.

Annual results of PRELES output have been generated for the first selected variables (GPP, ET, Soil moisture) for the forthcoming century and with one of the climate models.
Procedures have been developed to extract indicators related to forest growth and carbon balance from the models now combined with PRELES.

References

Aalto, J., Pirinen, P., Heikkinen, J. et al., 2013, Theor Appl Climatol, 112: 99. doi:10.1007/s00704-012-0716-9

Corine 2012 Final Report Finland GIO Land Monitoring 2011 – 2013 in the framework of regulation (EU) No 911/2010 - Pan-EU Component - Grant Agreement 3541/B2012/R0-GIO/EEA.55037

Hagemann, S., and T. Stacke, 2015, Impact of the soil hydrology scheme on simulated soil moisture memory. Clim. Dyn., 44: 1731-1750, doi:10.1007/s00382-014-2221-6