Geophysical Research Abstracts
Vol. 15, EGU2013-6721, 2013
EGU General Assembly 2013

Modelling carbon fluxes in northern boreal forests at site level

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Coniferous forests play a fundamental role in the northern region's carbon cycle. The carbon cycle of the northern coniferous forests can be studied using a large scale biosphere model. We have studied carbon and water cycle of the northern region, covering Fenno-Scandinavia and the Baltic countries, by the JSBACH biosphere model using meteorological data from the regional climate model REMO.

In this work we assessed the performance of the JSBACH model at three forest sites located in Finland. The sites are Scots pine forests Sodankylä and Hyytiälä and the Norway Spruce forest Kenttärova. Sodankylä and Kenttärova are located in the northern Finland and Hyytiälä is in the central Finland. All the three sites have a long time series of micrometeorological measurements as well as a wide range of other observations.

The JSBACH model was run at the three sites using both locally observed meteorology and the meteorology from the closest grid point calculated by REMO. Comparison to the site level measurements revealed that the annual amplitude of the simulated total ecosystem respiration was too small. This was caused by too large wintertime respiration and too small respiration levels in summer. Magnitude of Gross Primary Production (GPP) was underestimated at Hyytiälä. This was partly caused by a small model LAI, but also the magnitude of photosynthesis parameters was a significant factor. The commencement of modelled photosynthesis in spring was too early at all the three sites.

The snow dynamics differed between observations and simulations. The model run using the REMO meteorological forcing showed larger amount of snow fall than the run using the local weather observation. The simulated snow melt occurred too early compared to the measurements. This is one of the reasons for the too early start of modelled photosynthesis in spring.

In addition, a soil carbon model Yasso07 was implemented to JSBACH, replacing the old soil carbon model CBALANCE. The Yasso07 model has soil carbon pools that are chemically different and it has been parameterized using a wide range of different observations worldwide. The soil carbon contents estimated by Yasso07 were closer to observations than by CBALANCE that showed large overestimations. Yasso07 and CBALANCE showed differing responses to environmental conditions.