Parallel estimates of gross primary production of Finnish forests – comparison of two process models

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What we did

We simulated Gross Primary Production (GPP) of Finnish forests using a land-surface model JSBACH4, and a semi-empirical stand flux model PRELES5. We compared model’s GPP predictions to MODIS GPP product1,4,5.

The objective of this study was to screen the total annual production of forests and its temporal and spatial distribution in the approaches, so as to analyse the causes of possible discrepancies between the models. Especially, we aim to assess to what degree the possible differences are related to either forest structure or to the response of GPP to climate in the models.

Models predicting GPP

**JSBACH**

1. Photosynthesis of trees, is described with Farquhar et al. (1980) model, which has two PFT-specific parameters in JSBACH.

2. JSBACH used information about plant functional type fractions in 0.167 degree pixels, based on the European Corine Landcover

3. A new five-layer soil moisture scheme (Hagemann and Sucke, 2013) where the soil information is not merely PFT specific but partly based on soil texture data.

**PRELES**

1. Semi-empirical model of GPP, evapotranspiration, and water balance of stand. GPP-prediction is based on light-use efficiency based model, and evapotranspiration is predicted based on water use efficiency.

2. PRELES applied forest inventory-scaled information about forest structure at 100 m resolution

3. PRELES applied a simple soil water model with one pool for root-available water and one pool for surfacial water.

Results

Modelled spatial patterns of annual GPP with JSBACH and PRELES were close to each other, and MODIS showed higher GPP (Fig 1).

Annual total GPP (Fig 2), and the latitudinal gradient of the mean GPP predictions (Fig 3) of JSBACH and PRELES agreed.

Models predicted coinciding patterns of GPP at sites for conifers (Fig 4). Further improvement of models for deciduous species and their seasonality is needed.

Discussion

The consistency between PRELES and JSBACH largely stems from the fact that their respective predictions for conifers coincided well with each other (and with data), as this group of species dominates the forest area in Finland.

Remaining differences in GPP predictions between JSBACH and PRELES can be reconciled with differences in LAI data used (Fig. 5, Fig. 6), and their different sensitivity to soil water. Differences to MODIS GPP can be partially reconciled by the fact that we simulated here only the GPP of trees.

Agreement of the modelled GPP is remarkable as all these estimates are based on different approaches, and calibration data sets, PRELES currently calibrated with eddy-covariance data from only two sites. JSBACH parameters, on the other hand, draw from generic PFT-parameters that originate outside the study region.

References:


