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Assessing seasonal cycle of photosynthesis by solar induced fluorescence in Fenno-Scandinavia

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INTRODUCTION

Satellite observed sun-induced fluorescence (SIF) is thought to provide a new proxy for photosynthesis. In this work we implemented a SIF module to a land surface model JSBACH and evaluated its performance at site scale and Fenno-Scandinavian region.

Models

- SIF model from Magnani et al.
- Land surface model JSBACH

Regional simulation done for 2007-2011in the Fenno-Scandinavian region.

Data for evaluation

Abbrev.	Name	Location	Ecosystem
FI-Kns	Kalevansuo	60°39'N, 24°21'E	Scots pine forest
FI-Hyy	Hyytiälä	61°51'N, 24°18'E	Scots pine forest
FI-Ken	Kenttärova	67°59'N, 24°15'E	Norway spruce forest
FI-Sod	Sodankylä	67°21'N, 26°38'E	Scots pine forest

Table 1. Eddy covariance sites.

For regional GPP estimate we used data from MPI-BGC (Jung et al., 2009). The remotely sensed SIF was from GOME-2 (Köhler et al., 2015).

RESULTS

The model captured the seasonal cycle of the GPP and SIF at four coniferous forest sites in Finland (Fig. 1). Decoupling of SIF and GPP at FI-Ken in 2009 is connected to dry period, which causes decrease in GPP level but due to the current photosynthesis formulation in JSBACH, the SIF signal is not affected.

The spatial variation of observed and simulated SIF signal are quite similar, with some differences seen in the Lapland region, which might be connected to the model's land cover classification (Fig. 2).

The seasonal cycle of the observed SIF signal in the northernmost region had seasonal maximum later than simulated SIF and GPP and the upscaled GPP product (Fig. 3).

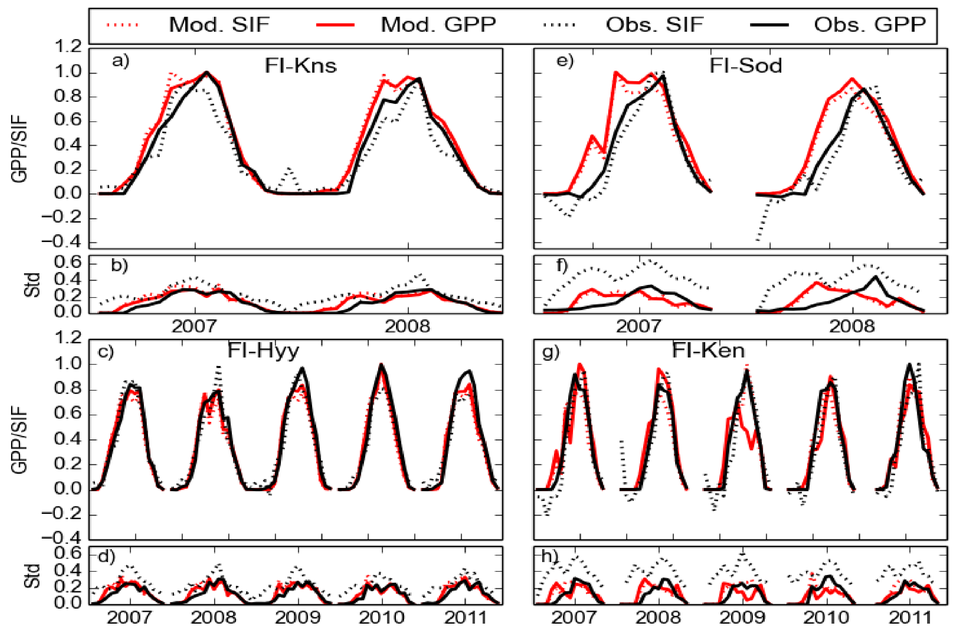

Fig. 1. Seasonal cycle of simulated and observed GPP and remotely sensed SIF at four sites in Finland.

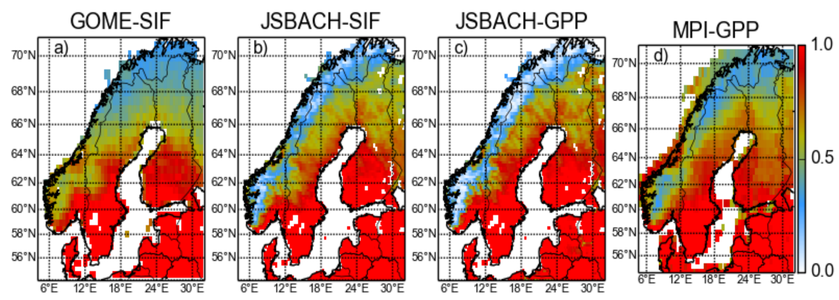

Fig. 2. The averaged SIF from GOME-2 and simulations and simulated GPP and observation-based GPP estimate, MPI-GPP for years 2007-2011. The values are scaled to unity, which is 90th percentile value.

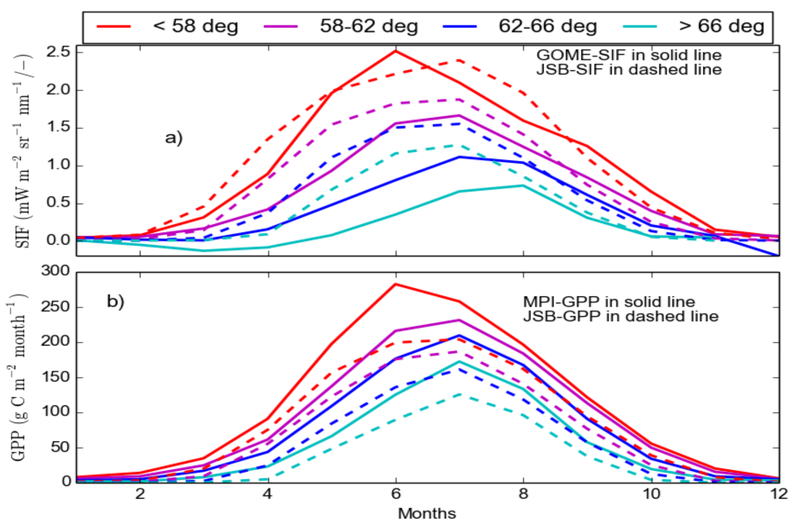

Fig. 3. Seasonal cycle averaged for 2007-2011 in different latitudinal regions for simulated and observed SIF (a) and GPP (b).

CONCLUSIONS

Observed and modelled SIF gave good estimates for the seasonal cycle of the gross primary production (GPP), but the inter-annual variation on the level of GPP was not captured. The seasonal cycle of observed SIF in high latitudes might reflect difficulties in remote observations in those regions.

References: Jung et al., 2009. Biogeosciences, doi:10.5194/bg-6-2001-2009.Köhler et al., 2015. Atmos. Meas. Tech., doi:10.5194/amt-8-2589-2015. Thum et al., 2017. Biogeosciences, doi: 10.5194/bg-14-1969-2017.

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