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Supplement of

The effect of assimilating satellite-derived soil moisture data in SiBCASA on simulated carbon fluxes in Boreal Eurasia

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Supplement

Supplement S1: Temporal correlation coefficients for the months July and September

In the paper only the temporal correlation coefficient for the month August is shown (Fig. 4). The temporal correlation coefficients for the months July (Fig. S1) and September (Fig. S2) are shown to support our statement that the patterns are similar in other months (section 3.1).

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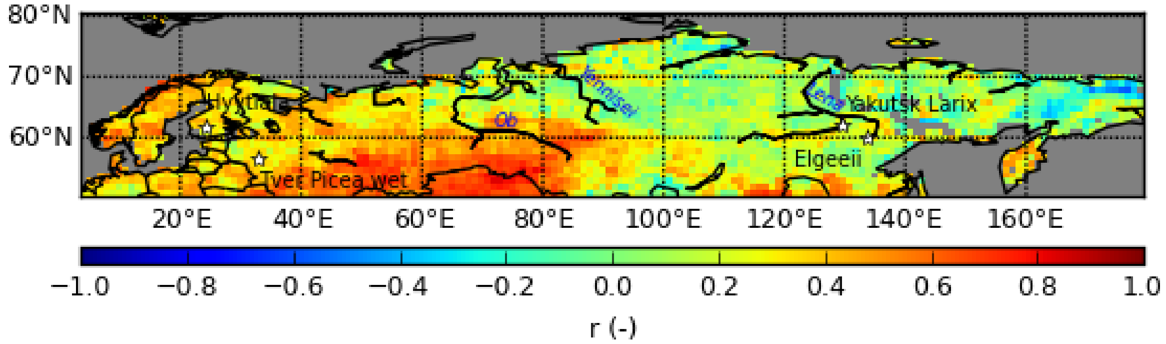

Figure S1. The temporal correlation coefficient of SiBCASA and ASCAT soil moisture for all July months in the period 2007–2013 (7 years × 31 days).

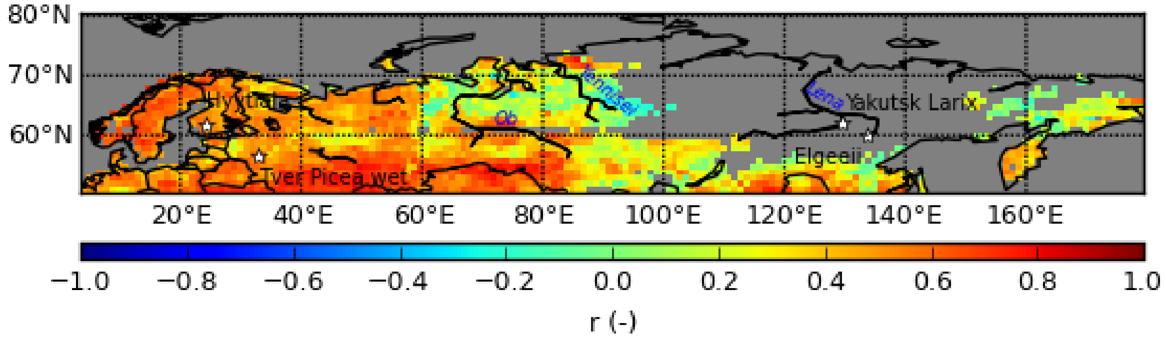

Figure S2. The temporal correlation coefficient of SiBCASA and ASCAT soil moisture for all September months in the period 2007–2013 (7 years × 30 days).

Supplement S2: The July 2012 drought

In the discussion of Fig. 9 of the August 2010 drought , we mention the spatial drought pattern in July 2012, which is shown in Fig. S3.

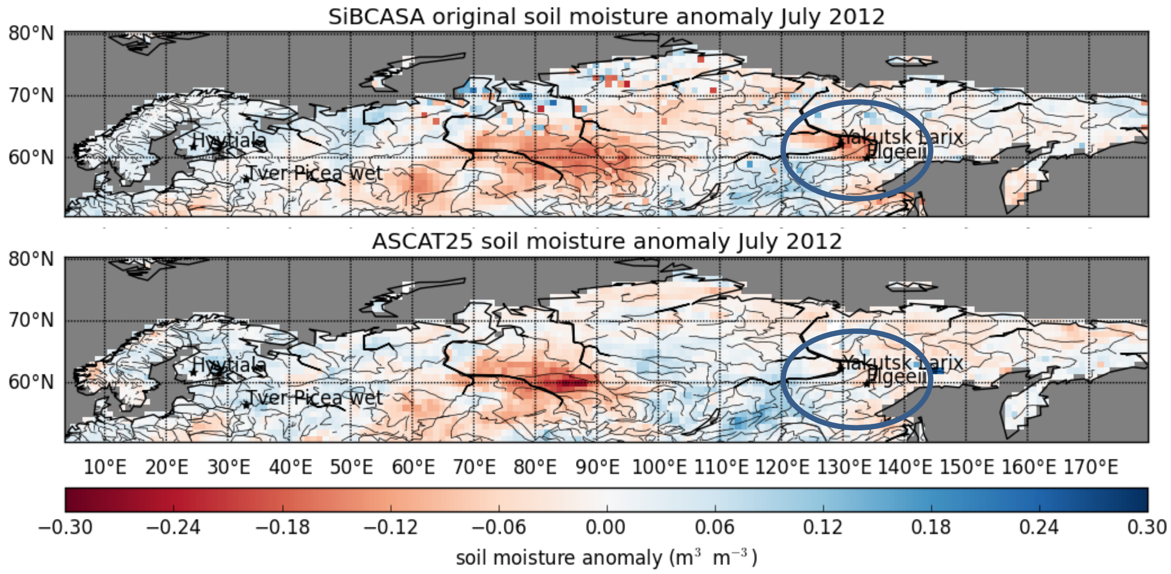

Figure S3. Monthly mean soil moisture in (a) SiBCASA and (b) ASCAT in July 2012. The ellipse shows the extent of the 2012 drought according to SiBCASA.

Supplement S3: Comparison of observed and simulated NEE

Fig. S4. shows an example of a comparison of observed NEE and SiBCASA NEE without and with soil moisture assimilation. This figure may be compared with Fig. 7 in the paper, which shows the associated in-situ observed and SiBCASA soil moisture time series. Fig. S4 shows that even though the change in soil moisture due to assimilation of ASCAT soil moisture may be substantial, particularly in the spring and in drought periods, the associated changes in NEE are usually small. The physics behind this is explained in terms of GPP and TER in section 3.2 of the paper.

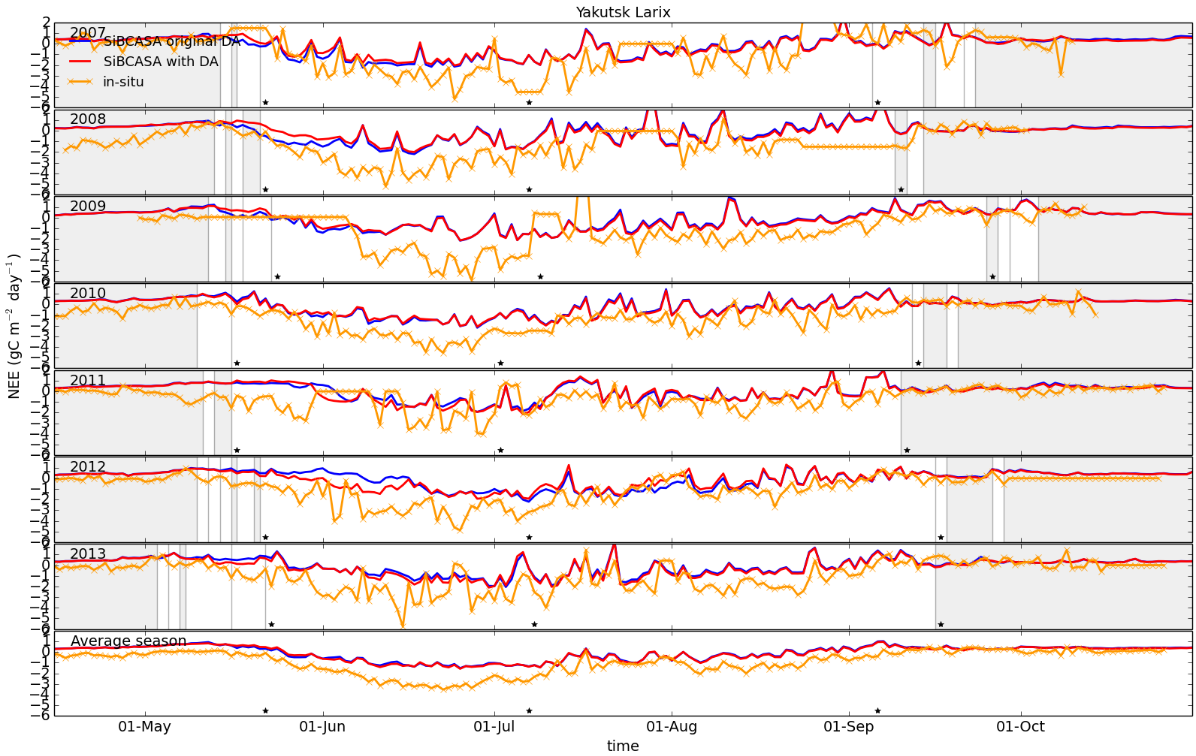

Figure S4. Time series of daily NEE in SiBCASA original (without assimilation) (blue), and with assimilation (red), in situ soil moisture (orange),at the Yakutsk Larix site, Russia. Each panel shows one year of soil moisture. Grey-shades indicate periods when the top soil is frozen. The three asterisks indicate the date when the top soil is last frozen in the spring, 46 days after that, and the date when the top soil is first frozen again in the fall. The bottom panel shows the average seasonal cycle of the each NEE type.

Considering the question if soil moisture assimilation improves the NEE in SiBCASA, Figure S4 shows that the change in NEE is usually small compared to the difference with the eddy covariance observations. The eddy covariance observations of NEE have a larger short-term variability due to micro- and meso-scale atmospheric processes which are not represented in the 1x1 ° lat/lon input weather data to SiBCASA (e.g. how the forest characteristics in the fetch change with wind direction). This may cause the sign of the difference to change from day to day. Additionally, SiBCASA underestimates NEE in the spring (the simulated NEE is less negative than the observations). This suggests that there is room for improvement of the phenology or allocation scheme.

The paper shows that unfortunately the four observation sites are not located in regions where ASCAT has the largest skill, and this is reflected in the uncertainty associated with the satellite observations (see also Fig. 12). Therefore the change in soil moisture with assimilation is small at those sites (see Eq. 2). However in other regions across Boreal Eurasia

(e.g. steppe) the uncertainty is smaller, resulting in a stronger effect of assimilation of soil moisture. There the effect of assimilation on the carbon fluxes may be larger, depending on the expression of the soil moisture response functions (Fig. 1).
Concluding, this analysis shows that the NEE in SiBCASA may be subject to improvement, and that assimilation of satellite observed soil moisture is one of the target variables, along with scale issues, phenology and carbon allocation and probably others.