Author comment on Anonymous Referee #1

Interactive comment on "The effect of assimilating satellite derived soil moisture in SiBCASA on simulated carbon fluxes in Boreal Eurasia" by M.K. van der Molen et al.

Anonymous Referee #1
Received and published: 20 October 2015

Authors make an attempt to apply the remotely sensed soil moisture product ASCAT for observation–based adjustment of the soil moisture simulation in terrestrial biosphere model SiBCASA and compare the large scale anomalies in the observed soil moisture (METOP ASCAT) to one simulated by SiBCASA over Boreal Eurasia. The conclusion is not entirely positive. The ASCAT soil moisture product appears to agree with model simulation in the southern band, while showing less correlation in the tree-covered areas and tundra. Authors attribute the problems outside of the arid zone to the presence of snow and standing water. The study presents useful assessment of the current capability of the remotely sensed soil moisture product ASCAT for applications in the ecohydrological modeling, thus has value for use in further developments amid hopes for practical applications of the soil moisture products. The manuscript is well written, and can be published after minor revision addressing the comments below.
Response: This is a proper summary of the main message of the paper. We are glad that the referee recognises the need to also publish studies not only positive results.

General comments.
1. Authors rely heavily on SiBCASA simulation for large-scale comparison but did not mention any other model-simulated soil moisture products usable for comparison with ASCAT over Boreal Eurasia such as GLDAS (http://ldas.gsfc.nasa.gov/GLDAS/)
Response: The referee remarks that SiBCASA soil moisture is one of many available simulated soil moisture products. ASCAT soil moisture could also be assimilated into other ecosystem models. We agree with this remark. In line 22-24 of page 9006 we refer to a number of earlier studies, using ISBA, GLEAM, the NASA Catchment land surface model, WOFOST, C-Fix and the USDA modified Palmer soil moisture model. Our interest in using SiBCASA in this study is twofold: 1) we wanted to test the effect of assimilation on simulated carbon fluxes in a coupled hydrology – carbon assimilation model and 2) SiBCASA is used intensively in our department (e.g. van der Laan-Luijkx et al., 2015, van der Velde et al., 2013, 2014) for carbon exchange studies and as part of CarbonTracker (Peters et al., 2010). As such, SiBCASA is a logical choice. It would of course be interesting to test the performance of the assimilation scheme in other models as well, although the current paper shows that the limitations are mostly associated with the ASCAT data and less with the land surface model.

2. (page 9020 line 19) Authors effectively point at deficiency of the SiBCASA soil hydrology module during drought spells in Eastern Siberia. In dry Yakutsk Larix site, ample proportion of the water supply in spring and summer is provided by downward propagation of the active layer, and water is released from ice in the melting front, so water availability should be a function of the melting front propagation rather than active layer depth.
Response: When the melting front propagates downward, a larger depth of soil becomes available to the roots for water uptake. However, this does not automatically mean that more water is available, because the frozen soil is often quite dry, as it froze at the end of the summer. In the spring, melt water cannot penetrate into the top soil, because the top soil is still frozen. It depends on the local topography if the melt water logs the soil or runs off (see line 5-10 on page 9006). So in principle, as the referee comments, melting front propagation could make more water available to the plants if the thawed soil contained water when it froze. This process is however correctly simulated in SiBCASA by defining the water stress

as a function a function of the relative amount of water that is available for uptake by roots, where frozen water is not available for uptake, but liquid water is.

3. (page 9028 line 13) Higher correlation between SiBCASA and ASCAT is found in sparsely vegetated and steppe areas. However, there are two exceptions that deserve to be commented. As can be seen on Fig.4, correlation in August over steppe regions is good in Europe, West Siberian and deteriorates to the East. Poor correlation over Larix forest region, which is relatively sparse, also doesn't fit to the statement.
Response: The statement "The match between SiBCASA and ASCAT soil moisture is best in the steppe zone, and in the forest zone where LAI is low, soil temperature is high, and soil moisture is low." (line 13, page 9028) is based on Fig. 12. This figure clearly shows that the temporal correlation coefficient is generally large for steppe regions, and for a selection of forests, e.g. those forests where LAI is small, soil temperature large, and soil moisture is low. For tundra regions the match is smaller than for steppes and for the selection of forests mentioned above, while it is better than the remainder of the forest regions. The figure also shows that the correlation coefficients for a given LAI, soil temperature and soil moisture are subject to variation, which is what the referee hints at. We will improve the formulation of the statement:

"The temporal correlation between SiBCASA and ASCAT soil moisture is best in the steppe zone, and ***in a selection of forest locations*** *where LAI is low, soil temperature is high, and soil moisture is low* ***(Fig. 12).*** *" (Bold words indicate the ones that have been changed.)*

Minor corrections
p 9005 line 15. Abbreviation TER introduced without reference
Response: The abbreviations NEE, GPP and TER are defined at their first occurrence in the main text (on page 9010, line 15-17). In the abstract we used them without explanation to keep the abstract as short as possible and because we assume they are sufficiently familiar to most readers.

p 9019 line 22. Could be "extent" in place of "extend".
Response: 'extend' will be replaced with 'extent' in the final manuscript