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Hydrology and Earth System Sciences Discussions

Interactive comment on "Improving evapotranspiration in land surface models by using biophysical parameters derived from MSG/SEVIRI satellite" *by* N. Ghilain et al.

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We would like to aknowledge the anononymous Referee#1, who has found the paper very interesting and appreciates the method as innovative. As well, we would like to thank Referee#1 for his/her comments that help improving the paper, both on the general structure and on information to add/clarify. As suggested, the structure of the paper will be revised in a more classical presentation, and English will be improved. As well, the discussion will be re-written and we will put efforts to reduce the length of the paper. Each specific comment raised is answered below.

-P.9113, title: "biophysical parameters" will be replaced by "biophysical variables" in the title and text.

-P.9122, L.1 (and p.9121, L.27-28): LSA-SAF products are generated over 4 regions defined inside the MSG field of view: Euro (covering Europe), NAfr and SAfr (covering Northern and Southern Africa, respectively), and SAme (South America). The names will be defined in the revised version of the manuscript.

-P.9122, L.8: Thanks for this interesting comment, and the reference to Szczypta et al. paper. The meteo forcing of the model does of course impact the estimation of the surface fluxes, which shows that land surface models are sensitive to input variables, as expected. For example, in Zhao et al. (2011, BGD), the authors have compared at 6 measurements sites in France simulations of the ORCHIDEE model forced by different datasets (SAFRAN, ERA-I, etc and local observations), and they have shown the impact of using those set of meteo forcing. More specifically on ERA-I, Szczypta et al., 2011 (HESS) have shown that precipitation from ERA-I is underestimated over France (as you pointed out), and they have presented a useful method to correct ERA-I precipitation with GPCC monthly values.

In our paper, we can make a difference between two kinds of simulations: 1) point-scale simulations for verifications at measurements sites, 2) a simulation over a latitudinal transect in West Africa to show the impact of the new veg dataset on the simulations.

For the verification simulations at measurement sites, ERA-I forcing is used for all the meteo fields, except for the radiation (observation), and precipitation (local in-situ observation) in most cases (all stations, except for Agoufou and Vielsalm). It is expected that for Agoufou the lack of accuracy of the precipitation forcing dataset can have a large impact on the evapotranspiration simulation, and that could probably explain the poor statistical scores obtained. However, given that the same forcing is used for both simulations (with ECOCLIMAP-I or LSA-SAF LAI), it is informative to see the scores improvement with LSA-SAF LAI.

For the second simulation type, forcings are ERA-I raw output, and LSA-SAF radiative terms. The comparison presented in the manuscript still shows the relative impact of the new veg data in the land surface model output, even with imperfect precipitation input. This is in agreement with the focus of the paper on the method development and the impact of the new dataset in the land surface model simulations. If the purpose of the paper had been to analyze in detail quantitative aspects related to hydrology or climatology or to set up an operational method with no real-time constraint, it would certainly have been an added-value to correct the precipitation estimates, as it was also done in Boone et al. (2009) or Szsczypta et al. (2011). But this is a bit beyond the scope of the present study.

However, the precise forcing sources will be clarified in the text and in Table 3.

Zhao et al. (2011): How errors on meteorological variables impact simulated ecosystem fluxes: a case study for six French sites, Biogeosciences Discuss., 8, 2467-2522, 2011.

-P.9123, L.5: "ecoystems" changed to "ecosystems".

-P.9124, L.18: The pixelwise LAI climatology is based on 4 years of LSA-SAF LAI estimates, which means that in most regions LAIc will have a small error bar compared to the daily LSA-SAF LAI error bar. An example is given in Fig.2. If the factor had been 1, given the difference of magnitude between both error bars, the climatology of LAI would have damped completely the signal, and no inter-annual variability would have been seen anymore. If the factor had been increased, some instabilities in LSA-SAF LAI daily product would have induced instable LAI time series, which is not desirable. The 2.5 value used has been tuned on a selection of MSG pixels, to make a compromise between the stability of the time series, and the possibility to capture the inter-annual variability. This will be clearly written in the text.

As LSA-SAF LAI estimates are based on geostationary satellite data with a high repetition rate from the same viewpoint, the daily estimates (based on a weighted contri-

bution of the 5 previous days) are more stable than the product derived from MODIS. Given that stability, we can give more weight on the daily product contribution for LSA-SAF LAI. However, no direct comparison of those errors are shown here, though interesting, as it is beyond the scope of the paper.

-P.9125, L.6: Most of the time the correction on large temporal gaps in winter has to be applied over Scandinavia (particularly, ENF) and some other ENF forests of Northern Europe. Other types are less affected: 1) either they are located where those problems do not occur, 2) or LAI has already dropped because of wintertime (e.g. deciduous forests, crops), and the linear interpolation is not crucial.

-P.9126, L.14: the weighting factors are the inverse of the standard deviation of LSA-SAF LAI. The sentence was unclear and will be clarified.

-P. 9129, L.11: We opted for a random selection of the points, but an alternative could have been to use a regular grid. A random number generator has been used to select the 120 locations over Europe, and most of the points are not specifically located on the edges of the image. The use of LSA-SAF LAI can be done also at high incidence angles, therefore the conclusions must be representative of the total area, and edges pixels have also to be taken into account in the analysis.

-P. 9129, L.12, L.15: "land covers" changed to "land cover maps".

-P. 9129, L.16: The neighbourhood size (3x3) will be added in the caption of figure 5, as suggested, and in line with caption of Fig.6.

-P. 9131, L.15-16: "Option 1" means that the reference for the correction is the LAI of the pixel, as explained p.9131 L.15-16, and p.9132 L.21. In equation 17, LAIHg , valid for "Option 2", is replaced by LAIpixel for Option 1. This will be clearly written in the text, and particularly in Eq 17.

-P.9131, L.20: "Hg pixel" will also be defined in the caption.

-P.9136, L.11: Those sites have been chosen because 1) they represent a large panel of climate conditions and biomes to scan different simulation conditions, 2) most of the selected sites have a large homogeneous fetch suitable for MSG scale, 3) we have used data we already acquired and analyzed in the past to maximize the confidence we have in the measurements. The simulations are not always improved, as for 2 sites the correlation decreases.

-P. 9138, L.1-22: As there is no ET observation dataset to validate/verify the improvements at large scale over West Africa, other remote sensing products are of interest for output verification. As mentioned in the manuscript, the modeled skin temperature can be compared to the land surface temperature derived from IR sensors. LSA-SAF provides a LST product that is suitable for comparison as it is provided with the same spatial resolution. The LST product is indeed not described in the paper, but it is properly referenced to Trigo et al. (2008) and Ghent et al. (2011). Other studies make use of LST retrieval from satellite to verify model output (e.g. Jimenez et al. (2008)), and in particular the surface fluxes (e.g. Edwards (2011)), so it seems relevant to make such comparison.

A particular interest of LST is its link found with soil moisture. For example, during AMMA campaign in Western Africa, LST was linked to the soil moisture retrieved with passive microwave sensors (as pointed out by Kergoat et al. (2011)). As well, LST from METEOSAT has been used to derive evaporative fraction (Stisen et al. (2008)), which should likely be mainly driven by soil moisture in that region. It makes LST a good alternative dataset to compare the model with, in view to verify the simulations.

To avoid the effect of short-term fluctuation of the temperature, we have computed daily heating rates, so the result is expected to be less affected by bad cloud screening, or other short-term fluctuations.

The comparison is done over a long transect (∼1000 km), and over 275 consecutive days in 2007, based on roughly 12 to 14 skin temperature estimates per day, and 24-28 LST retrievals per day, which seems to be a fair sample to draw conclusions. The

impact on skin temperature is seen on the graphs, and the results do suggest the skin temperature modeled when using LSA-SAF LAI is closer to the remote sensing measurements. That latter conclusion adds credits to the improvement of the simulations of ET over West Africa.

We will reformulate in the manuscript the way the comparison is envisaged, by adding references and explaining a bit more the motivations. As well, we will comment more the results obtained.

[1]Jimenez et al. (2008) : Verification of a clear-sky mesoscale simulation using satellite-derived surface temperature, Monthly Weather Review, Volume 136, p. 5148-5161. [2]Edwards, J. M. (2011): Simulation of land surface temperatures: comparison of two climate models and satellite retrievals, Geosci. Model Dev., 2, 123-136. [3]Kergoat et al. (2011): Remote sensing of the land surface during the African Monsoon Multidisciplinary Analysis (AMMA), Atmospheric Science Letters, Special Issue: African Monsoon Multidisciplinary Analysis (AMMA): an integrated project for understanding of the West African climate system and its human dimension, Volume 12, Issue 1, pages 129–134, January/March 2011.

-P.9138, Section 7: As suggested, we will revise the structure of the paper, and the discussion section will be re-written.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 9113, 2011.