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Geoscientific Model Development Discussions

Interactive comment on "Suitability of modelled and remotely sensed essential climate variables for monitoring Euro-Mediterranean droughts" *by* C. Szczypta et al.

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Response to Reviewer #2

2.1 [First of all, the originality and/or advantage of this study are not clear. I know that two models have been assessed their accuracies on LAI and SSM (only for ISBA), individually so far. I'd like to know more precisely about the originality and/or advantage for this model validation when compared to previous model validation papers on both models.]

RESPONSE 2.1

This study complements the joint evaluation of the ORCHIDEE and ISBA-A-gs land surface model performed by Lafont et al. (2012) over France using satellite-derived LAI, as it is expanded to the Euro-Mediterranean domain. A 18 yr time period is considered against a 8 yr period (2000-2007) in Lafont et al. (2012). The capacity of the two models to represent the interannual variability of the vegetation growth and the impact of extreme events such as the 2003 heat wave is assessed. Finally, the synergy between SSM and LAI is investigated using the satellite products and the ISBA-A-gs model.

2.2 [Although the satellites data of this study are newly prepared long-term record of LAI and SSM, it does not guarantee their higher accuracies compared to previously organized other data sources.]

RESPONSE 2.2

The direct validation of the GEOV1 LAI product performed by Camacho et al. (2013) is based on an ensemble of ground observations at 30 sites but it does not completely address the seasonality of LAI as for a given site, LAI observations are available at only one or very few dates. Based on these observations, Camacho et al. (2013) show that the GEOV1 LAI scores are better than those obtained by other products such as MODIS c5, CYCLOPES v3.1, and GLOBCARBON v2.

Regarding SSM, as far as we know, the ESA-CCI SSM product is today the only multi-decadal SSM dataset derived from satellite observations. Loew et al. (2013) have assessed this product and showed that the agreement with other soil moisture datasets from modeling studies as well as with rainfall data is generally good.

REFERENCE:

Loew, A., Stacke, T., Dorigo, W., de Jeu, R., and Hagemann, S.: Potential and limitations of multidecadal satellite soil moisture observations for selected climate model evaluation studies, Hydrol. Earth Syst. Sci., 17, 3523–3542, 2013.

2.3 [Especially, no validation of SSM for ORCHIDEE reduces the value of this paper. I think that ORCHIDEE also has soil moisture outputs, which could be converted into similar soil moisture variable to be compared to satellite SSM. So I hope that you can show us the SSM analyses with ORCHIDEE's estimation. If it's impossible, you have to mention more precisely the reason why ORCHIDEE could not produce the SSM value.]

RESPONSE 2.3

An attempt was made by Rebel et al. (2012) to compare the soil moisture simulated by ORCHIDEE with the AMSR-E SSM product. They concluded that the shallow soil moisture estimates they derived from the ORCHIDEE simulations were not an explicit representation of SSM and could not be compared with the AMSR-E SSM product. Instead, they compared the AMSR-E SSM with the root-zone soil moisture simulated by ORCHIDEE, and they observed that the satellite-derived SSM had a much faster reaction time and a much shorter characteristic lag-time than the simulations. This can be explained by the shallow penetration depth (<5 cm) of the C-band microwave signal measured by AMSR-E, which is not representative of deep soil layers.

REFERENCE:

Rebel, K. T., de Jeu, R. A. M., Ciais P., Viovy, N., Piao, S. L., Kiely, G., and Dolman, A. J.: A global analysis of soil moisture derived from satellite observations and a land surface model, Hydrol. Earth Syst. Sci., 16, 833–847, doi:10.5194/hess-16-833-2012, 2012.

2.4 [The comparability of satellite-derived SSM data has not been that much discussed. The satellites detect the SSM only for first several centimeters, which does not necessarily match with the depth for which the plants will take up the water for growth and the models take into account. So it will invoke the incomparability between model and satellite. This issue is mainly from insufficient explanation on which soil layer with how large depth of ISBA-A-gs the authors took up for comparison.]

RESPONSE 2.4

In the Introduction section, we made clear that the sensing depth of microwave remote sensing observations is limited to the first centimetres of the soil surface. The definition of SSM in ISBA-A-gs is given in Table 1. We acknowledge that this could be better emphasized/discussed in the text.

2.5 [Minor thing is that the authors change the order of explanation on two variables: SSM and LAI. In Introduction you explained firstly about LAI and secondarily about SSM. But, in Result and Discussion section, you did it firstly about SSM and secondarily about LAI.]

RESPONSE 2.5

Yes. The LAI paragraph in the Introduction could be moved after the SSM paragraph.

2.6 [Also you put the figures in the panel from Fig 6 to Fig 11 in the order of ISBA, ORC, GEOV1 or ORC, ISBA, GEOV1, or GEOV1, ISBA, ORC, separately. It is not intuitively easy to understand. You have to unify them.]

RESPONSE 2.6

Yes. The figures could be harmonized using the GEOV1, ISBA-A-gs, ORCHIDEE sequence.

2.7 [Page 5554, Line 1-5: I do not think that the authors have investigated deeply the drought effect on vegetation this time. You rather did the validation between model and satellite products, meaning that you explored how nicely the models represent the seasonal and interannual changes in LAI associated with SSM (though only for ISBA).]

RESPONSE 2.7

Yes. This part of the first sentence of the Abstract ("to investigate how recent droughts affected vegetation over the Euro-Mediterranean area") could be reworded and/or moved to another part of the Abstract.

2.8 [Page 5556, Line 23-24: Is it right? I think that ORCHIDEE also has several soil layers, which definitely can produce the variables concerning soil moisture. You have to explain the reason why you excluded ORCHIDEE in that analysis more precisely.]

RESPONSE 2.8

Again, part of the explanation is given in Table 1. We acknowledge that this could be better emphasized/discussed in the text.

2.9 [Page 5557, Line 6-8: I have no objection on this projection of climate forcings onto half degrees although the spatial and temporal variabilities of climate data should be more or less smoothed when projected onto finer resolutions. But, I like to know why you had to do it. I guess that it is because ORCHIDEE and/or ISBA have other ancillary data only on half degrees. Anyway write the reason.]

RESPONSE 2.9

In fact, we mean that the ERA-Interim atmospheric variables used to run the LSMs are available on a $0.5^\circ \times 0.5^\circ$ grid (Szczypta et al., 2012).

2.10 [Page 5557, 2.1.1 and 2.1.2: I think that it is easier for readers to understand when you explain the models from ISBA but from ORCHIDEE because hereafter you address the result and make the figures in the order of ISBA, ORCHIDEE normally.]

RESPONSE 2.10

Yes, the sequence of model description in Sect. 2.1 could be revised.

2.11 [Page 5557, Line 21-: What's the temporal resolution? Write it.]

RESPONSE 2.11

The two models are driven by the 3 hourly atmospheric variables from the bias-corrected ERA-Interim and perform half-hourly simulations of the surface fluxes, of soil moisture and of surface temperature. LAI is produced at a daily time step for each Plant

Functional Type (PFT) present in the grid-cell. Daily mean SSM values are produced for each PFT. The grid-cell simulated LAI (SSM) is the average of the PFT-dependent LAI (SSM) multiplied by the fractional area of each PFT.

2.12 [Page 5558, Line 20, Did you compare the soil moisture of this 'thin surface layer' to the SSM by ESA-CCI? Clarify it.]

RESPONSE 2.12

In this study, only the surface atmospheric variables of ERA-Interim are used.

2.13 [Page 5559, Line 6-8: ISBA has been already assessed its accuracy on LAI estimation, and ORCHIDEE also has been checked that several times previously. So what is the point of this research?]

RESPONSE 2.13

This study complements the joint evaluation of the ORCHIDEE and ISBA-A-gs land surface model performed by Lafont et al. (2012) over France using satellite-derived LAI, as it is expanded to the Euro-Mediterranean domain. A 18 yr time period is considered against a 8 yr period (2000-2007) in Lafont et al. (2012). The capacity of the two models to represent the interannual variability of the vegetation growth and the impact of extreme events such as the 2003 heat wave is assessed. Finally, the synergy between SSM and LAI is investigated using the satellite products and the ISBA-A-gs model.

2.14 [Page 5560, Sec. 2.2: I like to know the accuracy of this SSM dataset and how deeply in the soil it can detect soil moisture. Explain it. Also I like to know the original temporal resolution of satellite detection of SSM.]

RESPONSE 2.14

Yes, we could recall here that the sensing depth of microwave remote sensing observations is limited to the first centimetres of the soil surface. Loew et al. (2013)

have assessed this product and showed that the agreement with other soil moisture datasets from modeling studies as well as with rainfall data is generally good. The ESA-CCI SSM temporal and spatial coverage is much better after 1990 than before but is limited at high latitudes due to snow cover and frozen soil conditions (Loew et al. 2013).

2.15 [Page 5563, Line 25-Page 5564, Line 1: It also shows that 2003 year does not affect that much on consistency in correlation between ESA-CCI and ISBA. More than that, it also shows that AMSR-E has quite lower correlations with ISBA, which suggests that AMSR-E SSM are quite different with other SSM satellite data sources, and that ISBA may provide the reduced accuracy on SSM estimation when AMSR-E products are assumed to be more accurate than other SSM sources due to its latest technic for detection. Another thing is that this part should be in Discussion.]

RESPONSE 2.15

Yes, Fig. 3 and the top sub-figures of Fig. 4 are similar over western Europe, although the extreme 2003 year has more weight in the time series considered in Fig. 4. In Sect. 4.4, it could be mentioned that SSM simulations could be used to improve the blending of the active and passive microwave products.

2.16 [Page 5564, Line 17-19: How do you count the values in terms of month? Because the days of month are different for each month, I feel that it is strange to use the unit of months to count the LGP. I think that 'days' is good unit enough for expressing the LGP.]

RESPONSE 2.16

Yes, this sentence could be rewritten as:

"On average, ORCHIDEE gives relatively high LGP values (180 $\pm$ 28 day), compared to ISBA-A-gs and GEOV1 (138 $\pm$ 41 day and 124 $\pm$ 44 day, respectively). "

2.17 [Page 5564, Line 26: I am not so sure that there is a 1 month lag in leaf onset.

ISBA appears 1 month lag in max LAI to GEOV1, but the timing of taking-off the bottom line is not that so clearly delayed to GEOV1 in my view. Along with the definition of leaf onset, it could be possible to have small or no delay when you describe the map of Fig 6.]

RESPONSE 2.17

Yes, a new figure showing leaf onset and LGP differences in days could be added.

2.18 [Page 5568, Line 12: improving?]

RESPONSE 2.18

Yes, "improve" should be replaced by "improving".

2.19 [Page 5588, Figure 6: I think that the interval of colors would better be shorter than 1 month. Also I recommend you to put another Diff (ORC - GEOV1 and ISBA - GEOV1) figures. The order of panels of Fig6&7 are different to that of Fig. 8&9, and that of Fig 10&11. I prefer the order of ISBA, ORC, GEOV1 or GEOV1, ISBA, ORC for every figure as same order as you explained in the text.]

RESPONSE 2.19

Yes, a new figure showing leaf onset and LGP differences in days could be added. The figures could be harmonized using the GEOV1, ISBA-A-gs, ORCHIDEE sequence.

2.20 [Page 5589, Figure 7: The interval of colors should be shorter than 1 month to know the gradual change in value. Could be 2 weeks or 1 week.]

RESPONSE 2.20

Yes, a new figure showing leaf onset and LGP differences in days could be added.

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