11 April 2021

RESPONSES TO REVIEWER #2

RC2: 'Comment on gmd-2020-371', Anonymous Referee #2, 22 Mar 2021

GENERAL COMMENT

The authors analyze the performance of four land surface models (LSMs) in reproducing the sensible and latent heat fluxes. The model performance is assessed using sensible and latent heat fluxes from the second intensive observational period of the BLLAST campaign. The fluxes consist in area averaged values calculated using observations at five different land covers and a high resolution LC classification, CESBIO, derived from Landsat-5 data. Although the derivation of the fluxes may be subjected to considerable uncertainties, the study goes beyond the more traditional comparison against fluxes at one location. The manuscript is well written and provides a clear description of the results with a detailed characterization of the LSMs performance. The evaluation should be useful to refine the LSMs formulation in order to improve the representation of the surface fluxes. The manuscript could be accepted as it is. I provide below a few specific comments, all of the of minor character, that the author should consider to further increase the value of the manuscript.

The authors would like to thank Reviewer #2 for her/his interesting suggestions that have served to better achieve the objectives of the manuscript. Please, find below (in blue) detailed answers to your suggestions.

SPECIFIC COMMENTS

1. In order to isolate the effects of the LSMs the authors can inspect the sensitivity to the initial and boundary conditions. The authors used the NCEP-FNL data to create the initial and boundary conditions and one wonders about the sensitivity of the results to this choice. This is particularly relevant for the initialization of the soil temperature and moisture in WRF. Inspecting the impact of other sources of initial and boundary conditions (e.g. ERA-5) would be a valuable addition.

This is a quite interesting suggestion that we have included in the new version of the manuscript. Besides an additional experiment checking the impact of the spin up in the initial soil moisture values (as suggested by reviewer 1), we have also checked the impact of using a different database for the initial and boundary conditions (ERA-INTERIM, which resolution is more similar to NCEP-FNL than ERA-5). The description of this experiment has been included in the new Section 2.3.5 and the results are included in Section 3.5.

As expected, the results changed, but only slightly. In any case, more experiments in this line (analysing the impact of other data, different horizontal and vertical resolution, etc.) are very interesting to be analysed in a different study.

2. Do the authors have any hypothesis for the different performance of CLM4 in reproducing urban fluxes (Fig. 7)?

Indeed, this LSM showed very large Le values and very low SH, contrary as expected (in Noah the urban class produces almost no evaporation). We do not have a hypothesis for this behaviour and contacting the model developers can help. However, we have decided to remove this LSM in the new version of the manuscript due to some issues found with the simulation of the radiative components.

As commented in the reviewer #1 response, this has been done due to a strange and unrealistic radiative effect found in the inner domain of WRF: after the second analysed day, there is a delay in the morning increase of SWDOWN, showing values equal to 0 W/m^2 until some hours after sunrise. This error also appears in subsequent analysed days, but with a delay that lasts 3 hours more every day. This possible bug leads to an unrealistic surface energy budget, affecting the fluxes.

In our case the issue only affected some hours in the morning of day 19th since we only analysed the second simulated day (19th June) from 09 to 15 UTC, but the simulation is not correct. We have tried to solve it and ask the WRF scientific community (https://wrfforum.com/viewtopic.php?f=43&t=11824), but we do not have a solution at the current date. Therefore, we have decided to remove CLM4 from the paper (all the manuscript lines discussing CLM4 and its figures have been removed). Figure R1 shows this issue for a period used in the SPIN-UP simulations:

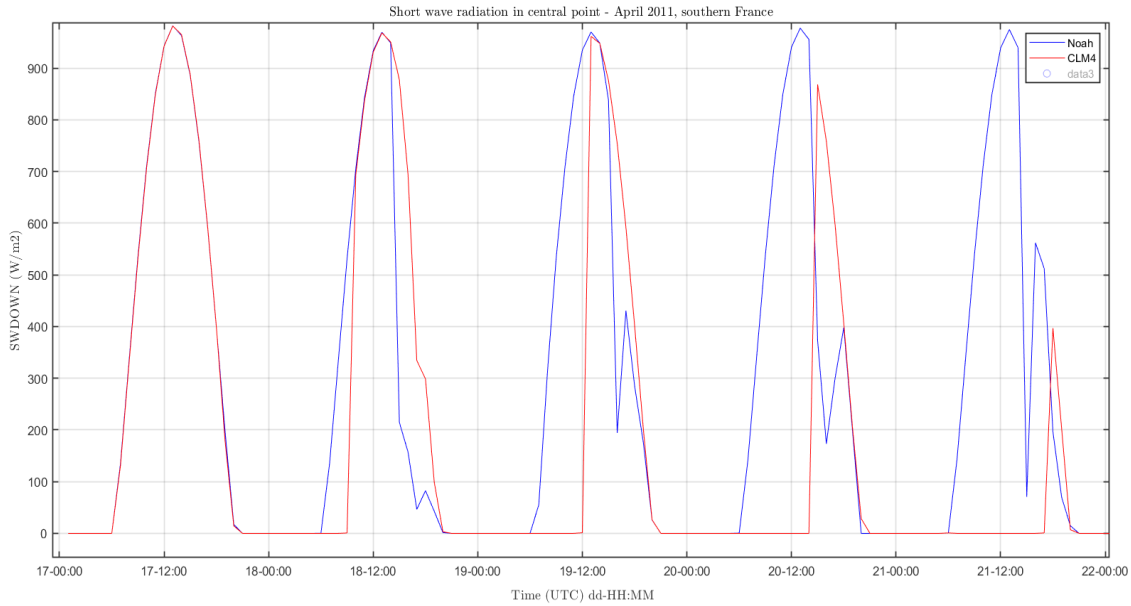

Figure R1. Short wave radiation simulated by Noah and CLM from 17 April 2011 to 22 April 2011 in the central pixel of the simulations for Noah and CLM4, illustrating the issue found in CLM4 (not solved at the present day) and affecting the total radiation available at the surface when several days are simulated. Note how this is observed only in the inner domain (4th domain of 1 km of resolution) and in land pixels (in lake pixels the radiation seems normal). We have tried to change different options in the WRF namelist.input file without success.

3. In order to generalize LSMs performance for the present region, other days should be analyzed to see if results are consistent. This may be well beyond the objectives of the present study, but some discussion in this direction could be added to Section 5.

We do agree completely. We have tried to evidence this even more in lines 676-683 of the new version of the manuscript, being quite interesting for other research focused on analysing different conditions over the same area. In any case, the analysed day (intensive observation period) is representative of the general conditions of the rest of the IOPs, as indicated in lines 114 to 116.