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Geoscientific Model Development Discussions

Interactive comment on "Variational Assimilation of Land Surface Temperature within the ORCHIDEE Land Surface Model Version 1.2.6" *by* H. S. Benavides Pinjosovsky et al.

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Dear Rihab,

Thank you for your review and for the interest in our work. I make list of answers regarding all your comments and questions Minor corrections âĂć Abstract 1. The sentence corresponding to page 1, lines 16 to 18 is too long and should be shortened or divided in two sentences. Remark taken into account. The phrase will be replaced from the manuscript to the following sentence: SECHIBA-YAO allows the control of the eleven most influent internal parameters or initial conditions of the soil water content, by observing the land surface temperature or remote sensing data as brightness temperature.

âĂć Section 2 : Models and Data 1. Page 3, line 16 change "22th" to "22nd". Modification taken into account 2. Page 4, line 10 the unit is not clear for the spectral band "um". It is the spectral band μm. Modification taken into account

âĂć Section 3 : The Methodology –Subsection 3.1: Variational Assimilation 1. Page 6, line 3 : you should replace the "f" at the end of equation (5) by "J" Modification taken into account 2. In the page 6, lines 6 and 7 you explained that y is described by equation 2. I can't see the relationship between equation 2 describing the empirical formulation of the brightness temperature and the surface radiation and the description of the observation term "y". Are you making reference to the equation described in page 5 at line 23 ? Eq (2) makes reference to the calculation of brithness temperature in SECHIBA based on the Radiation, term that can be later used as observation if needed. The reference to equation 2 is misplaced, it will be erased from the manuscript –Subsection 3.4: Development of SECHIBA-YAO 1. Page 8, line 11 : change "ANNEX A" to "Appendix A" Modification taken into account

âĂć Data assimilation experiments –Subsection 4.3: Experiment Definition 1. Page 11, line 27 : change as follows : "sensible (H) and latent (LE) heat Modification taken into account –Subsection 4.4: Experiment Definition 1. Page 12, line 25 : correct 'retrieved' to 'retrieve'. Modification taken into account Questions and Comments Regarding the questions, I make a point by point answer to all your different comments.

1. In the variational assimilation can you please specify what do you exactly mean by observations and first guess : what are you exactly assimilating Pnoise (referred as 'first guess' and 'perturbed' in figures 5 and 6 (a and b)) or Ptrue (referred as 'observations' and 'initial value' in figures 5 and 6 (a and b)) ? Since we are performing twin experiments, an initial set of parameters (Ptrue) is used to produce synthetic observations. The idea is to perturbate Ptrue (to obtained Pnoise,meaning my first guess). The idea is to used the synthetic observations produced with Ptrue in order to go from Pnoise to Ptrue by the asismilation process. (a) In the case you are assimilating observations then how could you perform your validation using the same observations?

Since the assimilation process estimates control parameters, its final values will affect the final model state, thus a comparison between observations and the final estimated temperature allows to validate the assimilation (b) In the case you are assimilation your Pnoise then can you explain more how did you perturbed the 'Truth' using your uniform random noise (precise the respective variation ranges of the different assimilated variables so that we can see how much 50% of the nominal value is consistent) ? The perturbation was a random noise produce by the machine, limited up to 50% the true parameter value, equal to one, so the perturbed value is constrained between [0.5 , 1.5]

2. In the experiment 3 the goal was to show how could the number of variables included in the assimilation affects the performances of the method. In this case Experiment 3 must have the same conditions than Experiment 2 except the number of assimilated variables. Surprisingly you have changed the assimilation period starting the 8th of August 1996 rather than the 3rd of March. My questions are the following : (a) Why did you change the starting date of the assimilation? I want to test different conditions in the assimilation capabilities. The scope of this work was only to prove the assimilation potential. More experiments have been done and give similar results. For further informations and tests, readers can consult my thesis (Benavides, 2014). (b) How could you know that the decrease in the performances is only related to the number of parameters knowing that you have taken a different assimilation period and knowing the fact that the sensitivity of parameters toward LST is - as you have already mentioned- dependent on the seasons, period of the day etc. ? The decrease in performance is related to the complexity of the cost function used during the assimilation process: the more the number of parameters the more complex the cost function is. A decrease during the assimilation can be expected, regardless the season, period of the day, etc. In my thesis (Benavides, 2014) I performed other experiments that corroborates this statement. I have added a sentence in the manuscript explaining the general validity of the result

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