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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Improved meteorology and surface energy fluxes in mesoscale modelling using adjusted initial vertical soil moisture profiles" *by* Igor Gómez et al.

Anonymous Referee #1

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<Overall comments>

This manuscript discusses the sensitivity of soil moisture profile to the estimation of heat fluxes, and their error propagation to latent heat through lower boundary layer. Authors also clearly demonstrated the importance of RAMS atmospheric model initialization.

However, novelty is uncelar. Although RAMS model is very interesting to look at, it is already known that soil moisture initialization is important for and and sensitive to atmospheric and land surface model performance. Despite of signifiance, it is our challenge that our models still can't reasonably simulate both surface and subsurface

soil moisture (this paper didn't resolve such an issue or improve a model formulation of soil moisture vertical profile, or provide a better parameterization of soil properties). Some mechanism is obviously missing from current model structures. For this reason, ESA and NASA launched soil moisture satellite to provide soil moisture 'observations'. However, the data are still not perfect so that most of weather prediction centers have satellite data assimilation procedures to improve soil moisture initialization. That's where we are, although there are still several challenges remaning even in their works. Considering our current status, it is unsure how much the message of this paper will help people who are struggling in this field. Please clarify in abstract the novelty of your findings.

Other issues may include:

- Validation methods of RAMS model performance:

I realized that there are no field measurements on soil moisture, and surface fuxes, although these are the key parameters or variables that this manuscript tried to discuss, ultimately. Rather, they borrowed GLDAS data or SEVIRI data as reference. However, there is a huge difference in scale between point-scale flux station, and foot-print scale satellite data at 0.25 degree. 0.25 degree is a quite coarse scale as authors are also aware of at L230. In this case, intercomparisons, consistency or agreements between datasets only provide limited interpretation. Rather than true values or robustness or correctness, it may be argued that it informs of spatial homogeneity. At L230, Authors also admitted that due to a coarse resolution of GLDAS, it is not possible to capture the features at local sites. Please discuss whether flux station data can spatially represent the meso-scale circulations, or synoptic advection in Figure 1, and whether reduced MBE, RMSEs can say a better representation, despite of a large difference in scale or just spatial homogeneity. Agreements with GLDAS data can really prove the correctness or integrity of models. Although GLDAS is one of the best data sets, they are not perfect, as well. You may use:

Chen, B., Black, T.A., Coops, N.C. et al. Boundary-Layer Meteorol (2009) 130: 137. https://doi.org/10.1007/s10546-008-9339-1

Lee, J.H.; Zhao, C.; Kerr, Y. Stochastic Bias Correction and Uncertainty Estimation of Satellite-Retrieved Soil Moisture Products. Remote Sens. 2017, 9, 847

- information on RAMS model structures

Please try to provide the explanation in terms of model structures for each overestimation or underestimation. Although it is sometimes nicely explained about synoptic advection case at L270, it is not fully explained. For example, at L204, differences reached 100 W/mˆ-2. However, there is no speculation for the reasons in terms of RAMS model structures.

<Detail comments>

L25: As SEVIRI and LSM GLDAS have a coarse resolution, and still contain errors, they are nether “ground” nor ‘truth’. It is just reference data.

L32: Please discuss whether a better agreement between model and simulation can guarantee the robustness of models? What if both of data sets do not play a role of ‘ground truth’? in fact, both data sets contain unknown errors. You also said that GLDAS makes an overstimation at L189, and L230.

L33: Please highlight in abstract what the novel finding of your works is.

L100-105: Figures only show a week of study period. Does it exclude a warm-up period?

L111: reference run mean control run?

L115: Please inform a spatial resolution of spatial soil moisture to compare RAMS output with GLDAS or station data.

L125: It may be helpful to illustrate RAMS or LEAF model structure for soil moisture

profile to show their current limitations, because your message is that proper representation or simulation of soil moisture profile is important. Equation (1) and (2) do not inform how LE is influenced by soil moisture.

L145: Please provide foot-print scale coverage of your flux stations, as they were compared with GLDAS or satellite or model data. You did that for satellite at L161. Please provide difference in land cover or soil heterogenity between BRX and BON, as you said at L379. Are they upscaled enough so that we can compare it with GLDAS?

Please see Crow, W.T.; Berg, A.A.; Cosh, M.H.; Loew, A.; Mohanty, B.P.; Panciera, R.; de Rosnay, P.; Ryu, D.; Walker, J.P. Upscaling sparse ground-based soil moisture observations for the validation of coarse-resolution satellite soil moisture products. Rev. Geophys. 2012, 50, RG2002

L149: Please provide STSEB model error structure, as you used that as ‘ground truth’.

L190: Do you want to discuss possible reasons for such differences?

L228: extend -> extent

L232: Instead of temperature, please specify that like 2m air temperasture. There are so many types of temperatures, e.g. soil temperature, capony temperature, land surface temperature. Instead of ‘moisture’, please specify that like (subsurface or surface) soil moisture. Atmosphere also has moisture.

L247: differences in maximum temperature.

L258: global mean bias means a spatial and time average?

L271: Please provide references for the speculation of reasons on differences.

L331: same as above at L232.

L336: is that because meso-scale mixing caused spatial homogenity? High RMSE or MBE may be affected by spatial heterogeniety in case of large discrepancy in scales.

L341: Again, please discuss the scale difference between RAMS and GLDAS.

L345: uppermost 4 layers

L349: 'clear' is unclear to readers. Do you mean larger or higher than uppermost? You may provide more references in relation to deeper soil vertical profile. Examples are:

Juglea, S. Juglea, Y. Kerr, A. Mialon, J.-P. Wigneron, E. Lopez-Baeza, A. Cano, A. Albitar, C. Millan-Scheiding, M. Carmen Antolin, S. Delwart Modelling soil moisture at SMOS scale by use of a SVAT model over the Valencia Anchor Station, Hydrology and Earth System Sciences, 14 (2010), pp. 831-846, 10.5194/hess-14-831-2010

Lee, J.H., Pellarin, T., Kerr, Y. (2014). Inversion of soil hydraulic properties from EnKF analysis of SMOS soil moisture over West Africa. Agri. Forestry. Meteo. 05/2014; 188, 76–88, doi: 10.1016/j.agrformet.2013.12.009

Lee et al., 2012, J. Timmermans, Z. Su, M. Mancini, Calibration of aerodynamic roughness over the Tibetan Plateau with Ensemble Kalman Filter analysed heat flux, Hydrology and Earth System Sciences, 16 (2012), pp. 4291-4302, 10.5194/hess-16-4291-2012

Montaldo and Albertson, 2001 N. Montaldo, J.D. Albertson, On the use of the force-restore SVAT model formulation for stratified soils, Journal of Hydrometeorology, 2 (2001), pp. 571-578

Norman et al., 1995. J.M. Norman, W.P. Kustas, K.S. Humes A two-source approach for estimating soil and vegetation energy fluxes in observations of directional radiometric surface temperature, Agricultural and Forest Meteorology, 77 (1995), pp. 263-293

Pollacco and Mohanty, 2012, Uncertainties of water fluxes in soil-vegetation-atmosphere transfer models: Inverting surface soil moisture and evapotranspiration retrieved from remote sensing, Vadose Zone Journal (2012), 10.2136/vzj2011.0167

<Figures>

Figure 1. why there is no BON? Please comment it if there is no advection there?

Figure 6. Did you compare it with EXP 3 simulation, instead of EXP 1 or 2, because GLDAS covers 0-10 cm? Does RAMS read the soil layer specifically at 5 cm or integrate the whole profile ranging from 0 to 10cm?

Figure 8. It is not absolute that LST is inversely proportional with Soil moisture. However, it is commonly found. It's quite interesting that BON site has no relationship between LST and SM. BRX seems to have a positive correlation between LST and SM. . .? Would you explain that a little bit by using appropriate references?

Figure 9. deeper layer is important, but it is not covered by satellite observation. I wish to pursue authors' suggestion to improve the representatin of deeper layer? That may make a productive discussion. There are uncertainty in subsurface soil properties, as illustrated in the references suggested above.

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