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Hydrology and Earth System Sciences
Discussions

Interactive comment on "SMOS brightness temperature assimilation into the Community Land Model" *by* Dominik Rains et al.

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GENERAL COMMENTS

The paper explores a very interesting idea of assimilating brightness temperature observations, as opposed to derived soil moisture products, into a land surface model. However, no compelling argument is provide as to why this might be 'better' than assimilating the derived soil moisture product. Nor is there any real examination to the improvements, or otherwise, to the model performance. Most troubling however is the lack of evaluation against local information about the continental water balance to see if the patterns the authors have identified may be corroborated with either independent data or research. Why choose Australia as a case study but ignore the very many articles about data assimilation for water balance over the country? More detail critique is

provided in the following.

I recommend major revision and another review.

MAJOR ITEMS: * Most concerning is that there appears to be no interest in gaining new insight about Australian hydrology or indeed assessing the validity of the model estimates beyond soil moisture. No papers referencing Australian sources on the continent's hydrology or water cycle, so how do you know if the results are any good. There are clearly patterns in the results that may or may not be known to Australian research community. A simple first check is to see if the results accord with those from http://www.bom.gov.au/water/landscape/. The limited evaluation against in situ data in the Murrumbidgee catchment is weak, including no mention of the sites locations, the depth measured, nor what is measured (e.g. volumetric water content or wetness, neutron count etc).

* Should mention in the introduction that while L-band on SMOS may be the first 'dedicated' mission for soil moisture, there has been a long history of data assimilation development in C-band soil moisture retrievals (AMSR-E,-2 and ASCAT for example) and SMAP is yet another L-band mission that is providing global coverage. Moreover you would be wise to cite work from research who have performed assimilation with an Australian focus (you are not the first) and you cannot ignore the rich legacy of work conducted in understanding Australian hydrology.

* Simulations appear to be made for layers 0-9 cm, however the L-band sees emissions from at (at best) 0-5cm. Comment on this disparity and the impact, if any, on simulated brightness temperatures.

SPECIFIC ITEMS: P1,L17: Change to ' . . . sensitive to 1.4 GHz electromagnetic emissions, measures . . . multi angular top-of-atmosphere . . .'

P1,L18: Delete 'influenced by, among others, surface soil moisture.' Sentence is too long and 'among others' doesn't make sense. Among other what?

P1,L22: I suggest including the key reference by Kumar et al. 2009 in the list which describes the mechanisms how top layer soil moisture assimilation can improve root-zone estimates in LSM's. [Kumar, S. V., Reichle, R. H., Koster, R. D., Crow, W. T., & Peters-Lidard, C. D. (2009). Role of Subsurface Physics in the Assimilation of Surface Soil Moisture Observations. Journal of Hydrometeorology, 10(6), 1534–1547. https://doi.org/10.1175/2009JHM1134.1]

P2,L11: Suggest rewording the sentence to: ". . . retrievals represent the optimum fits between simulated brightness temperatures and the . . . "

P2,L19: Modify: "Sources of uncertainty include atmospheric forcing, . . ."

P2,L32-33: Not clear what is meant here. Elaborate on the link between brightness temperature and 'qualitative' models. Why would this even be a consideration?

P3,L2: "Within this" should be the start of a new paragraph.

P3,L2-35: Very lengthy introduction to what this paper is about. Strongly suggest restructuring to be more clear in the lead up to Section 2 about what the objectives of this paper are. The paragraph should start: "In this paper we . . " and itemise the objectives. This will help the reader link the findings with the objective of the work.

P3,L19: Why Australia? This needs to be clearly articulated.

P3,L26-28: If the results will be evaluated over Australia then you should cite "Smith et al. (2012)". Yes, these data are part of ISMN, but should cite the official source. [Smith, A. B., Walker, J. P., Western, A. W., Young, R. I., Ellett, K. M., Pipunic, R. C., . . . Richter, H. (2012). The Murrumbidgee soil moisture monitoring network data set. Water Resources Research, 48(7), 1–6. https://doi.org/10.1029/2012WR011976]

P3,L33: Change "avoiding to large" to "minimising the impact of potential large".

P4,L6: So did you use coupled or uncoupled mode? Why mention these if you're not going to specify here why.

P4,L9: What are these more recent higher resolution data sets? Explain that these will be described in Section 2.1 and 2.2. Why 0.25 degree? What is CLM normally run at? 0.25 degrees is quite coarse for continental studies, makes me think why not extend to the whole world. That way t=you can use the whole ISMN and not just the tiny little southeast corner of Australia?

P4,L13-32: How do you know if the derived surface information is accurate for Australia? What local information/expertise have you consulted? There is A LOT of research work (none of which are cite here) that shows these MODIS products are not representative of truth in Australia, (let alone the soils information). I would accept that a global study may use inferior information because it is the only data available with global coverage, but because this investigation focuses on Australia, it must be addressed! If accuracy is not an issue for this investigation (because assimilation compensates for the model deficiencies, including parameterisation) than you should state it explicitly here.

P5,L26: Change to '. . . allows the coupling of different . . .'

P6,L15: Is that "K ensembles" or "K ensemble members"? Clarify.

P6,L22: I recommend "mapped" instead of "propagated". Propagated is only relevant to mapping through time (or space).

P7,L29: The UTC to local time conversion may work for eastern Australia but not central or western Australia. How big an impact do you think a 2 hour error in timing will make on simulations?

P8,L16-17: Modelled brightness temperature can be extremely sensitive to choices in h, the roughness parameter. How have you dealt with this? Perhaps through the bias correction? Explain.

P8,L24: Is RFI an issue over Australia? If so, where will it be most likely. If not, then say so.

P10,L2-3: You need to be more specific. These are the OzNet network in the southeast of Australian in a catchment called the Murrumbidgee, I presume. If so, confirm and cite the relevant work (Smith et al, 2012). If not, then you need to explaining where the in situ data are located, how deep they measure, etc.

P10,L18-19: I would have thought the innovations would be close to zero on average (in fact that is one of the tests to see if your filter is operating optimally). Do you mean innovation or increment? Clarify. Also, what are the units on the increment? They appear to highlight dryland agricultural areas, e.g. western Australian wheat belt. Can you comment on the patterns and their connection to the surface parameterisation?

P11,L19: Please comment on the strong positive features in Fig. 6 in the 0.8 - 2.3 m layers. They are clearly linked to features in the landscape. What can you say about them?

P11,L34-P12,L1: A more relevant way to "place these findings in the context of" hydrological monitoring systems is to compare with actual modelling system output. A simple web search shows you can gain a lot of information about water balance in Australia from http://www.bom.gov.au/water/landscape/ I strongly urge you to consider locally relevant information to assess your results.

P12,L10-13: How do you know it was a drought event? What other independent corroborating evidence supports this?

P12,L23-24: You should mention the coupling to CMEM, as CLM does not estimate brightness temperatures.

P13,L5-7: Agree with revisiting the use of LAI climatology. Recommend further than you examine the usefulness in Australia.

Figure 1: Why cant the two panels be compared? They should be able to be compared. The point need to be identified, otherwise why have them a s separate shapes and colours?

Figure2 2-8,10: Why no label on the colour bar? Insert units. ('Unitless' is acceptable)

Figure 10: Where are we looking. Consider a location diagram/inset or mention: "central coast of New South Wales." for example.

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