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Hydrology and Earth System Sciences Discussions

Interactive comment on "The AACES field experiments: SMOS calibration and validation across the Murrumbidgee River catchment" *by* S. Peischl et al.

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We thank the reviewer for the critical comments and suggestions to our manuscript. We have revised the structure of our paper to be more consistent in the description of study area/sampling strategy data and in the presentation of results and analysis by modifying section 5 (Towards SMOS data validation) to include two subsections: i) Evaluation of L-Band brightness temperature patterns, and ii) Analysis of L-MEB performance. Please see our response to later comments for more details.

Comment: P2765.L20: It shall be mentioned that apart from the dedicated campaigns

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and validation sites also the International Soil Moisture Network (Dorigo et al., 2011a,b) is part of ESA's official platform for SMOS validation.

Response: We have included the information about the ISMN in the introduction as suggested by the reviewer:

"Moreover, permanent soil moisture measurements obtained from long-term monitoring stations provide an additional basis for world-wide validation activities. The International Soil Moisture Network (ISMN) has been established to serve as a platform making station data available (Dorigo et al., 2011)."

Comment: P2766.L22-25 (. . .analyses): These two sentences are redundant and can be removed.

Response: We agree with the reviewer and removed both sentences.

Comment: P2767.L26ff: the description of observed soil moisture goes already into the interpretation of what has been encountered during the campaign. See my first comment to summarize the main observations in a separate section.

Response: We have moved this description into chapter 5 as proposed by the reviewer.

Comment: P2769.L11: Explain why these three incidence angles were used.

Response: The PLMR design of six parallel beams allows a maximum coverage during a single swath, with the benefit of collecting multi-incidence data. Without increasing the beam-width, which is undesirable, the only alternative is to have a mechanically scanning instrument, which results in a very large and heavy instrument, thus making deployment problematic.

We have rephrased this text section to clarify this aspect:

"The PLMR instrument consists of a flat-array antenna resulting in six beams which allow the land surface to be observed at three incidence angles ($\pm 7^{\circ}$, $\pm 21.5^{\circ}$, and $\pm 38.5^{\circ}$). During each campaign the radiometer was mounted in the across-track or

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push-broom configuration, thus scanning the earth surface at three angles to each side of the aircraft. The resulting 3dB beam width of each beam corresponds to about 14°, producing a 6km wide swath from a 3000m (a.g.l.) flying height”

Comment: P2771.L4-21: This part could be moved to a “preliminary results” section.

Response: As suggested, we have moved this part to section 5.1.

Comment: P2772.L2-11: This part could be moved to a “preliminary results” section.

Response: As suggested, we have moved this part to section 5.1.

Comment: P2774.L15: What is the average time span temporary monitoring stations were installed at a specific location?

Response: The temporary monitoring stations were generally installed two days before the actual airborne/ground soil moisture sampling took place. The schedule of setting up and removing these stations was closely linked to the SMOS overpasses which usually occurred every 3 days. The following text passage describes the working time frame:

“The temporary monitoring stations were ideally installed at least two days before the scheduled airborne sampling and spatial soil moisture measurements took place, as part of the focus farm reconnaissance activities. This ensured sufficient time for the soil temperature and soil moisture sensors to equilibrate within the partly disturbed soil column.”

Comment: P2774.L21: How was skin T measured (which instrument, manufacturer, etc.)?

Response: We added some additional information about the TIR sensor to the text:

“Furthermore, one station per farm made thermal infrared measurements using a Raytek Thermalert TX (LT/LTP) to record the skin temperature of the (i) soil surface in the case of bare soil or (ii) canopy layer in the presence of vegetation. The TIR sen-

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sor used has a temperature range of -18°C to 500°C and a spectral range from 8μm to 14μm."

Comment: P2776.L15ff: this section needs some more detail and references, e.g: LICOR LAI-2000 (reference, number of repetitions, etc.), destructive measurements (how did you determine biomass / VWC (I reckon by oven drying for 24h?)), ASD (how many repetitions, using a white reference?), surface roughness (how was this measured (laser, pin board)?)

Response: We have revised this text passage and included the suggested information.

"The actual vegetation data recorded at each focus farm included (i) leaf area index (LAI) using a LI-COR LAI-2000, (ii) hyper-spectral properties of the vegetation using a Fieldspec 3 instrument developed by ASD Inc., and (iii) destructive biomass samples from sampling locations previously observed with the LI-COR and ASD instruments. At each of the five sampling locations 3-5 individual LAI measurements were conducted within an approximate 10m radius. Each LAI measurement consisted of five individual LAI readings: one above the canopy as a clear sky reference and four beneath the canopy (where possible half-way and near-soil). The final LAI reading recorded was the average calculated from the combination of those measurements. The reflectance data were collected across a 5x5m2 area with a minimum of 25 ASD measurements on a regular grid of 1m spacing, with a white reference measurement each 3-4 ASD measurements. In the case of rapid changing sky conditions white reference measurements were conducted before each individual ASD reading. The 0.5x0.5m2 destructive sampling area was always located at the centre point of the grid. To assist with the data analysis, supplementary information including vegetation type and height, row spacing and direction, and photographs of the sky/cloud conditions as well as of the actual sample were taken for each sampling point. To ensure optimal spectral sampling conditions, the ASD vegetation measurements were made between 10:00a.m.–02:00p.m. LST. The LAI data were collected earlier at about 07:00–09:30a.m. to reduce the effect of direct sunlight on the sensor. The destructive vegetation sampling took place by removing all organic matter within sampling area and subsequently monitoring the weight loss through oven drying at 40°C until a constant weight was achieved. In addition to the vegetation sampling, the ground teams recorded at least three surface roughness profiles of 2m length in North-South and East-West direction across each focus farm (Table 2). At each location a pin-profiler was positioned and levelled, and subsequently the height of each pin recorded manually as well as in a photograph."

Comment: Fig 4: For the interpretation it would be helpful to include the catchment boundaries (like in Fig 3).

Response: We believe that the catchment boundaries as shown on Fig. 3 would distract from the data and have therefore left it out.

Comment: Fig 5: This figure shows an example of SMOS L1C brightness temperature data which on itself are not very relevant for this manuscript but gain importance when directly compared with airborne data (like presented in Fig.4). I would therefore recommend integrating Fig 4. and 5 to enable a direct comparison between airborne and satellite data. Also this comparison can be presented in a "preliminary results" section.

Response: Displaying the data together is difficult, as the PLMR data were collected on individual days. It would therefore be required to display each PLMR day (one flight patch) with the catchment-wide SMOS overpass. This would be somewhat counterproductive, as the intention of Fig. 4 is to also highlight the spatial coherence between the individual days and the similarity of patterns between the two campaigns. This would not be possible otherwise.

We have moved the discussion of both plots to section 5.1.

Comment: Fig. 8: This plot is not really needed, as it just shows one example out of many. Besides, it raises some questions, i.e. why does the soil moisture content of the deeper layers in AACES-2 rise before precipitation takes place, and earlier than for the surface layers? I would therefore suggest removing this figure.

Response: We agree with reviewer and removed the station data plot and corresponding text from the manuscript.

Comment: Fig 10: For which dates and location were the brightness temperatures calculated? Is it possible to add a similar plot for comparing simulated brightness temperatures with observed SMOS L1C brightness temperatures?

Response: The calculation of brightness temperature response was based on the data available from the temporary monitoring stations installed in both campaigns. The results were subsequently compared to the angular PLMR observations corresponding to the particular location of each station and time of overpass. We are hesitant to do a similar comparison between the modelled TB and the SMOS TB due to the significant difference in scale of each. Moreover, a detailed analysis of both radiometric sensors is the focus of a separate paper by Rüdiger et al. (in preparation).

Comment: Type setting P2764.L3: please state that it concerns SMOS product validation over land

Response: We have modified the text to specify that it corresponds to the soil moisture product of SMOS.

"Following the launch of the European Space Agency's Soil Moisture and Ocean Salinity (SMOS) mission on 2 November 2009, SMOS soil moisture products need to be rigorously validated at the satellite's approximately 45km scale, and disaggregation techniques for maps with finer resolutions tested."

Comment: P2764.L1: Add http:// to URL. The same applies to P2778.L23

Response: We have updated the website reference according to the referee's suggestion.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 2763, 2012.