Review

Analysis of SMOS brightness temperature and vegetation optical depth data with coupled land surface and radiative transfer models in Southern Germany

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Summary

The study compares SMOS Level 1c brightness temperatures and Level 2 vegetation optical depth to modeled data in the Vils test site in the Upper Danube catchment, Southern Germany, for the year 2011. Data recorded by the airborne L-band radiometer EMIRAD 2 at the SMOS Validation Campaign in 2010 are used for validation of the coupled models PROMET and L-MEB.

A small dataset size induces that no conclusions are drawn from the direct comparison of SMOS and airborne brightness temperatures. The comparison of SMOS Level 1c data and time series of modeled brightness temperatures shows a positive bias. The expected seasonal behaviour could not be observed. Showing lower correlation coefficients than correlation coefficients of Level 2 soil moisture data and modeled soil moisture it is concluded that most of the observed problems of the SMOS data are due to RFI. The analysis of SMOS Level 2 optical depth showed high values in comparison to modeled data and not the expected seasonal behaviour, which leads the authors to the conclusion that the data set is not a reliable source of information about vegetation characteristics. Exhibiting a strong correlation between SMOS optical depth and soil moisture this problem is assigned to a retrieval problem.

General statement

The paper is an interesting contribution to the validation activities of the SMOS mission and presents new data for the Upper Danube Catchment. The language is fluent, the methods are explained clearly and the results are discussed thoroughly. However, the structure of the paper is sometimes confusing. In some parts of the text it is difficult to distinguish between the results presented in this paper and results of prior studies. In the Introduction and in the Material and Methods part it is sometimes difficult to get the point of the argumentation because reasoning tends to jump from one issue to another.

Agreed. The Introduction as well as chapters 2, 3 and 4 have been completely restructured. The argumentation is clearer and more concise now. New and old results are clearly indicated now.

Specific comments

1 Introduction

This part should be restructured, because the literature review is somehow confusing and seems to be mixed up with the objectives of the study. *The second part of the Introduction has been completely restructured to make it clearer and more concise.*

2.3 SMOS data

P. 5399, L. 22: Please give the source. *Done*

2.4.1 Land surface model PROMET

P. 5401, L. 26: Why did you not do a simulation with a layer depth of 0-5 cm? This would

have been more straightforward than the averaging. *Agreed. It is a good idea for future work to work with different model layer depths. In the current manuscript however it was not possible because the whole model validation was done with the 2cm layer depth.*
P. 5402, L. 21-24: You write about local and regional scale. Are the soil moisture measuring stations as well as the handheld probes of the validation campaign 2010 both point measurements? *This is much clearer now in the manuscript. Both measurements are point measurements. But the handheld measurements are averaged per focus area and are the considered to represent the regional scale.*
P. 5402, L. 18 - P. 5403, L. 15: In the description of the uncertainties of soil moisture estimation from Schlenz et al. (2012a) it is hard to follow the explanation, which RMSE and R^2 belong to local / regional scale or to a specific soil type. Maybe this can be structured differently or shortened. *The section has been restructured. This is clearer now.*
2.4.2 Radiative transfer model L-MEB
Please restructure. You jump from the parameterization of the model and the new rape parameterization to the validation of the models and then back to the rape parameterization. *This section has been restructured and is more clear now.*
2.5 SMOS L1c data analysis and **2.6 SMOS optical depth analysis**
Maybe it would be better to shorten these parts and leave out the subheadings or to combine it with the prior section 2.3. *This section has been restructured and is more clear now. Both sections have been combined.*
3.1 Model validation and L-MEB parameterization under local conditions
P. 5408, L. 20: Please give the citation. *Done*
P. 5408, L. 11: Provide values of RMSE of modeled and airborne brightness temperature here, rather than in section 2.4, because these are the new results. *Done*
3.2.1 Comparison with airborne brightness temperatures during the SMOS Validation Campaign 2010
Why did you do the comparison of SMOS Level 1c data to airborne data, as nothing can be concluded from this due to the small sample size? Maybe make this clearer and give your reasons for doing that. *This has been done because it is a common practice to do so. Other authors have done comparable things (e.g. Bircher et al. 2012). It is the most straightforward comparison avoiding model uncertainties. In addition to that this makes clear what the benefit of the models is in this analysis.*
3.3 Analysis of SMOS optical depth Tau
P. 5414, L. 11: What does "some peaks are constant in time" mean? *I changed this. It was not clearly understandable.*
P. 5414, L. 20: ORNL-DAAC, 2012 is not in the references *Yes it is. But the citation formatting was wrong I changed it.*
4 Conclusion and outlook
You conclude that the problems of SMOS brightness temperatures and through that the soil moisture product is mainly due to RFI, while the SMOS vegetation optical depth data suffers mainly from a retrieval problem. However, could RFI that effects the soil moisture retrieval influence the optical depth data in the same way? And could a retrieval problem also influence the soil moisture retrieval? Maybe you can explain that clearer, it sounds a bit contradictory. *This is explained much clearer now. Of course RFI that effects the soil moisture retrieval has also an influence on the optical depth retrieval (as it is the same retrieval). The definition of a retrieval problem is that it influences the (soil moisture) retrieval.*
Tables and Figures
Table 1: Please give explanations of the parameters. *Done. (in the text)*

Table 2: Again, please give explanations of the parameters. In the text you mention the bias, while the table says "offset". How is the gain calculated? *Done The gain is "m" in following equation: y= m*x+t which describes the regression line*
Fig. 10: Please replace R^2 by R, because you use that in the text. *Done*

Technical corrections

P. 5396, L. 18-19: Please rephrase the sentence. *Done*
P. 5397, L. 27: Give only 2 decimal points. *Done*
P. 5395, L. 4, P. 5397, L. 21 and 25, P.5401, L. 19 and 21, P. 5402, L. 16, P. 5416, L. 4, 19 and 22: Please change citation to make all citations uniform. *Done*
P. 5410, L. 23: "brightness temperature" should be plural. *Done*