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Discussions

Interactive comment on "Estimating root zone soil moisture using near-surface observations from SMOS" *by* T. W. Ford et al.

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The paper describes the capacity of an exponential filter to retrieve root zone soil moisture from surface measurements. After successfully applying the method to in situ measurements, authors applied it to soil moisture retrieval from the SMOS spatial mission. The paper is well written and clear. It relates a topic that is of interest for HESS readers. However the title does not reflect the main topic of the paper. While reading it I was expecting a more in depth analysis of the application of the Exponential filter to the SMOS data, section 4 (Estimating root zone soil moisture using SMOS) is rather short compared to the applications to in-situ measurements of soil moisture. Also I am missing a strong literature background

on the use of the Exponential filter and on the coupling between surface and root zone soil moisture. For example, the exponential filter (and its recursive formulation) has already been applied to many satellites products of soil moisture; (i) Wagner et al. (1999) applied it to ERS-1&2 (ii) Albergel et al. (2009) applied it to ASCAT (Brocca et al. 2010 also) and a SWI (Soil Water Index) is operationally produced in the framework of the GEOLAND-2 project using ASCAT measurements of soil moisture (more information: http://www.gmes-geoland.info/project-background/project-tasks/core-mapping-services/biophysical-parameters.html), (iii) Hain et al. (2011) applied it to AMSR-E. Albergel et al. (2010) compared the ability of both the Exponential filter and a Land Data Assimilation System (LDAS) to reproduce the root zone soil moisture from surface measurements, Barbu et al., (2011) assimilated the resulting SWI from an Exponential filter using an Extended Kalman Filter (EKF).

Despite the mentioned shortcomings, I consider that the article deserves publication in HESS subject to major revisions. Particularly I recommend that the authors improve the literature (state of the arts) and develop section 4 (Estimating root zone soil moisture using SMOS) to make the manuscript in better accordance with the title.

Specific comments

Abstract

P.8326, L.2, you could add that for many applications the variable of interest is however the root zone soil moisture that e.g. controls evapotranspiration. Introduction

P.8328, L.14, for SMOS please refer to Kerr et al. (2010, 2012).

P.8328, L.16, please update Kerr et al. (2001), see above. Data and Methods

P.8329, L.21, please introduce the SMAP mission (including acronym).

P.8330, are soil temperatures also available? It would help to remove measurements potentially affected by thaw, freezing conditions. What is the period considered by this study?

P.8330, L.13, nothing seems to be available directly from the website yet (?). Are there any connections with the International Soil Moisture network (Dorigo et al., 2011, http://www.ipf.tuwien.ac.at/insitu/)? Which period is considered, what is the frequency of the measurements?

P.8331, L.9-10, please rephrase sentence.

P.8332, general statement: this discussion could be extended and presented in the introduction for a better readability of the manuscript. It is difficult to compare the exponential filter and data assimilation systems as they do not have the same objectives. The simple exponential filter produces a proxy of the root-zone soil moisture, but has not the LDAS capacity of monitoring e.g. the surface fluxes and the vegetation biomass. The two techniques may be complementary however as both surface soil moisture and SWI (from an exponential filter) are operationally available. The assimilation of SWI by the LDAS, instead of SSM, has been investigated (e.g. Barbu et al., 2011). In applications focussing on SWI only, this very simple method might be a good alternative to a LDAS, especially in areas where the availability of in situ observations of atmospheric variables (especially precipitation) or on soil characteristics (required to run the LDAS) are poor. Albergel et al. (2010) found that even if LDAS and the exponential ïňĄlter concern different applications, this simple technique is helpful to retrieve the root-zone soil moisture variations in areas where surface soil moisture (e.g. estimated from remote sensing) is the only data available.

P.8332, L.22, SMOS-derived

P.8332, L.24-26, what is the meaning of this sentence? Do you mean that the result of an exponential filter should not be assimilated -or directly inserted- into a land surface model?

P.8332, last paragraph, questions (1) and (2) have been largely investigated by many studies and as it is mentioned above your study is new in that the exponential filter is applied to SMOS, only. Therefore question (3) should be enhanced in the manuscript.

Results

P.8335, L.5-12, the use of surface soil moisture measurements to retrieve root zone soil moisture has been highlighted by many studies already, amongst them; Entekhabi et al., 1994; Houser et al., 1998; Calvet and Noilhan, 2000; Walker et al., 2001a,b. . .

P.8336, General statement; how did you obtain the 5cm SWI? Did you normalise each 5cm time series using their own min and max values? Or did you use the mean values described in table 2? Which period did you consider? I guess it is a full year so you can capture the dynamic of a full water cycle. NS score is used to determine the optimal T parameter, is there a big difference if you use the coefficient of determination? As NS includes some notion of bias that is artificially removed using the SWI conversion it could be interesting to investigate R2, also.

P.8336, frequency of the observations; did you apply the filter to one, two, [. . .] data every day, at what time? Or maybe you have tried to mimic SMOS over time passes? Please clarify.

P.8336, L.27-28, could the drop in NS be due to some frozen conditions?

P.8338, extreme conditions that could lead to a decoupling between the surface and the deeper layer are likely to affect the retrieval. Estimating root zone soil moisture using SMOS P.8339, more details and results should be presented in this section; comparison between SMOS surface retrievals and surface observations at 5cm, comparison between SMOS (SWI) and observations at a depth of 25 cm. . .Also this section could be part of the results section.

P.8339, L.6, L.5, first time in the manuscript that you mention anomalies (?), please clarify.

P.8339, L.9, is the whole study is based on 2009? Also, how did you normalise the SMOS data? It is not clear how you used them as inputs of the exponential filter.

P.8339, L.11, a T value of 8 days is consistent with the results that use 5 cm observations. SMOS data are likely to be representative of the first 2 cm of soil, did you try to test a higher T value (e.g. 10) even if I am not expecting a big difference, testing it could be of interest. It is not clear if you used the same frequency of data with the in situ measurements and with SMOS (I guess it is not the case?), please clarify.

P.8340, L.7-8, as it was mentioned earlier, the fact that the exponential filter method has applicability for estimating root zone soil moisture from satellite surface soil moisture is something that has been thoroughly investigated already (ERS-1&2, ASCAT, AMSR-E). It should be acknowledged. The novelty of your paper is that it applied it to SMOS for the first time. Any idea on how it compare with the SMOS root-zone soil moisture product from CESBIO (http://www.cesbio.ups-tlse.fr/us/indexsmos.html)?

Table 1; ERS 1&2 SCAT and MetOp ASCAT revisit time is daily, please correct. Also SMAP is (not yet) a recent satellite soil moisture mission, you could add; 'to be launched in XX'.

Tables 2-6, which period is considered? Also Table 2 could be replaced by time-series for a better readability.

List of references you might want to consider:

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