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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Comparing soil moisture anomalies from multiple independent sources over different regions across the globe" *by* Carmelo Cammalleri et al.

Anonymous Referee #1

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General

This study investigates the potential of one model-based and two remotely sensed datasets for their use in an established global drought monitoring system. The study uses soil moisture from the Lisflood model, surface soil moitsure from the microwave-based ESA CCI soil moisture dataset and land Surface temperature from MODIS. Random errors of these datasets are characterised with the triple collocation analysis (TCA), a firmly established method in soil moisture analysis. As such, apart from applying the TCA to a different triple of datasets, the study is not very innovative. However, since the datasets are expected to be used in an operational drought monitoring sys-

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tem, the results of this study are expected to have a large practical impact. This study is performed in a scientifically sound and clearly structured way and provide some interesting insights in the skill of the datasets considered. I therefore recommend its publication after addressing the following issues.

Major comments

1. The analyses in this study are based on monthly anomalies. Although theoretically it is feasible to do so, I wonder what the practical relevance of these results are. All datasets used are also available at a daily time step and already now the European Drought Observatory works with ten-day periods (dekades). Hence, also the error structures should be known at these time scales .

2. I was expecting a more thorough analysis on the consequences of using three datasets that represent very different layer depths, i.e.:

* ESA CCI soil moisture represents the upper $\sim$2 cm, * LST represents the skin temperature, which is driven both by surface soil moisture (influencing bare soil temperature) and root zone soil moisture (impacting vegetation canopy temperature) * LIS represents root zone soil moisture (but layer depth is not provided in the manuscript).

Typically, deeper and thicker layers have lower random errors than observations of the surface layer, but this also depends on the time scale you're looking at (e.g. daily observations typically have larger random errors than monthly averages). Is there a way you can test the impact of using such different layer depths, e.g. by using the surface layer of LISFLOOD?

3. Some important information is missing (or not clearly provided) which is needed for a correct interpretation of the results: in which units are the TCA results expressed? Is it the fractional RMSE? If not, are the errors of each dataset expressed in its own data space or in a common data space provided by one of the models?

Minor comments

Line 16: why do you use the word proxy here? Only LST can be considered a proxy of soil moisture, while both LIS and ESA CCI are real estimates of soil moisture.

Line 20: The official name is ESA CCI Soil Moisture or ESA CCI SM

line 43: When agricultural droughts start affecting human welfare, people commonly use the term socioeconomic drought

Lines 47/48: include references or URLs to these drought monitoring systems

Lines 51/52: these citations refer to the formulation of drought indices rather than soil moisture

Lines 83-97: please provide references to the various datasets discussed here (MODIS LST, ESA CCI SM, LISFLOOD)

Regarding the skill of LST-based soil moisture versus ESA CCI SM the authors should also refer to the ALEXI-based work of Fang et al. 2016 (http://www.sciencedirect.com/science/article/pii/S0303243415300404)

Line 93: ESA CCI SM will soon be updated in NRT in the framework of Copernicus Climate Change Services (http://www.sciencedirect.com/science/article/pii/S0303243415300404)

Line 97: The use of the term "models" is confusing ans only applies to Lisflood. Replace "models" with "datasets" or "products", also throughout the rest of the manuscript.

Line 120: No definition is given of the root zone soil moisture simulated with Lisflood. What soil column is sampled?

line 128: I don't see how Pearson R would give information about the slope and biases between two datasets. Do you confuse it with the "regression function" between the datasets?

Line 130: to my knowledge the correct name for this test is Student's t-test

Line 148: spelling error: where -> were

Line 168: it is unclear why you don't use the surface layer, which is much closer to the other two data sets. I suggest to repeat the TCA with the surface layer as well to see what impact is on the estimated errors of all datasets.

Line 204: It may be worth checking whether using Microwave-based LSTs would lead to similar results (See Holmes et al., 2009; http://onlinelibrary.wiley.com/doi/10.1029/2008JD010257)

Line 225: provide version number of "current" version.

Line 233: Please check Terms and Conditions (http://www.esa-soilmoisture-cci.org/dataregistration/terms-and-conditions) for a correct citation of the data.

Line 236-237: Only for the integration of SSM/I into the merged products the soil moisture signal is decomposed into seasonality and anomalies (Liu et al. (2012))

Line 253: it is not clear whether the linear correlation is computed from the original signal or from the anomalies. Since your TCA implementation is based on the anomalies, also the correlation computation should be based on these.

Line 282-283: Is the stronger correlation between CCI and LST not expected, as they represent more closely related soil layers? This is something you could test by including also the surface layer of Lisflood in your analysis.

Line 307: On one hand -> On the one hand

Line 331: the results of this manuscript cannot be directly compared to those of Pierdicca et al., since the latter applies the TCA to daily observations.

Line 397: For what is skin soil moisture more reliable? Do you mean the estimates themselves? The estimation of soil moisture from microwave remote sensing may have large uncertainties over dry areas (e.g. Hahn et al., 2017: http://ieeexplore.ieee.org/document/7815274/)

Line 406: There are several studies that combine various datasets with different error characteristics, e.g. Liu et al., 2011 (http://www.hydrol-earth-syst-sci.net/15/425/2011/hess-15-425-2011.html); Beck et al., 2017 (http://www.hydrol-earth-syst-sci.net/21/589/2017/hess-21-589-2017.html); Yilmaz et al; 2012 (http://onlinelibrary.wiley.com/doi/10.1029/2011WR011682/full). Is there something that you can learn from these studies for your application?

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