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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Estimating Sahelian and East African soil moisture using the Normalized Difference Vegetation Index" *by* A. McNally et al.

Anonymous Referee #2

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The manuscript "Estimating Sahelian and East African soil moisture using normalized difference vegetation index" by McNally et al. presents a methodology to estimate soil moisture from NDVI data. Employing available in-situ data relative to different locations and satellite data, the proposed approach is applied to Sahelian Africa. While the manuscript is of potential interest for the HESS readership, I have several major concerns regarding the employed methodology, its presentation and applicability, and the discussion of results, as detailed below.

Methodology: Soil moisture is estimated as a linear regression of current and antecedent NDVI, with coefficient obtained by linear fitting of NDVI and in-situ soil moisture 6-year averages for a single site. It is well known that soil moisture impacts and is impacted by vegetation activity, but the linear model somehow implies that NDVI is

the explanatory variable for soil moisture. This would be appropriate when trying to capture, e.g., the effect of leaf flushing and shedding on soil moisture within a drought-deciduous ecosystem or crop emergence and harvest in an agricultural system. While clearly any variable can be regressed against any other, I wonder how the proposed approach is superior to others, maybe still based on regressions, but with a more solid physical motivation. An example is the antecedent precipitation index (rainfall drives but is not driven by soil moisture, unless a significant evapotranspiration recycling occurs in the area), which is used by the authors as a term of comparison. Given this potential flaw in the mechanistic interpretation of their approach, the authors should make a stronger case on why the proposed approach is superior to existing others. In this respect, the currently presented comparison of the soil moisture estimates obtained with API and NDVI does not clarify if and under which circumstances the NDVI estimate works better that the API one. The only clear conclusion is that the NDVI estimate (and the API one) are not expected to "match with the point soil moisture observations" (p. 7977), nor they capture the interannual variability (p. 7981). Moreover, while clearly the available time series are short and the on-point observations refer to few locations, I wonder why the data have not been used in a different fashion, dividing the available years in two subsets (and exploring different partitioning) and using the first one for calibration, the second one for validation, and repeating the same exercise for each location. This would allow better assessing the robustness of the obtained coefficient against year, soil and vegetation types, and local climate.

Motivation and applicability of results The motivation provided by the authors (establish methodologies for early warning of water shortages for food security purposes) is definitely an important one, but I wonder if the proposed tool may be helpful in that direction. First, its inability to capture the interannual variability and the effect of different rainfall patterns significantly hampers the effectiveness of such a tool as an early warning index. Second, if soil water availability for agricultural purposes is the goal, then more attention should be devoted to i) the model performances during the main growing season, ii) the applicability of the approach to crops (at least as a discussion

on the expected differences between savanna and the staple crops in the region).

Presentation of material The presentation of available data, employed methods, and results is rather confusing. A table listing the various sites for which point data are available, listing succinctly the site features and the use of the data (calibration/validation), would be really helpful. Also, a more clear division of the material in methods, available data, and results would enhance clarity.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 7963, 2013.