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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A baseline probabilistic drought forecasting framework using Standardized Soil Moisture Index: application to the 2012 United States drought" *by* A. AghaKouchak

Anonymous Referee #3

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The article discuss about 'probabilistic drought forecasting framework using SSI and to evaluate the model for 2012 US drought'. During recent years, a large number of articles reported improved drought forecasting techniques using multiple as well as improved drought indices. Based on those previous articles, this article did not seem to be either improving drought indices or forecasting technique, whereas by applying to the continental US, it draws several shortcomings.

Drought indices: There are numerous articles highlighting the application of SPI for

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quantifying the drought events, which is valid as precipitation is a natural input to water resource system. However, using the concept of SPI, the standardized soil moisture index (SSI) is not useful as it should be, for example, the agricultural water sources is highly variable for USA due to precipitation pattern. The eastern USA is supplemented by rainfall, whereas western USA is irrigated by artificial means (i.e., canal and reservoir operated). Therefore by realizing this fact, the application of SSI for continental USA is a major drawback of the study. The PDSI is a more robust index based on a scientific reasoning for monitoring agricultural drought in comparison to SSI (which is based on cumulative values). Several articles developed soil moisture deficit index at a shorter temporal scale, which can be more useful for agricultural droughts monitoring and forecasting. The SSI lacks in quantifying soil moisture supply for crop growth, for example, one day extreme precipitation event within a month will provide higher soil moisture, where as it will have negative impact on crop growth.

Methodology: There is a shortcoming in drought forecasting, when applying a persistence based model to a moving sum drought index (i.e., SSI based on six month accumulated values) for 1 to 2 month lead time. Similar concern was also raised by reviewer 1 (second comment). For example, taking an m period moving sum of the time-series, it will completely destroy the evidence for an m period periodicity. The persistence method works well when weather variables change very little and features on the weather maps move very slowly. However, if weather conditions change significantly from month to month, the persistence method usually breaks down and is not the best forecasting method to use. Therefore, the application of proposed methodology has two drawbacks: (a) application of persistence based model to a moving sum time series, (b) the constant selection of 6 month moving sum for all climatic regions of US do not seems to be true as there is a wide variation of climatic patterns across USA, for example variation of precipitation from east to west and temperature north to south, which are major drivers for soil moisture availability. The probability of drought definition (line 18, page 1952) seems to be based on number of events using a threshold level, however more damage will occur at higher severity level. The methodology

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section is not clearly written, a flow chart might be helpful for linking the components.

Results: It is highlighted that 'using accumulated soil moisture would significantly improve persistence based forecasting model'. This cannot be a stressed as a major finding, as all moving sum time series will have higher persistence level. How do the box plot is created for Texas and California? Is it collection of all the gridded soil moisture ACF values? The higher ACF values of soil moisture with respect to precipitation will not hold true for across USA. This is due to the fact that higher uncertainty involved in soil moisture predictability in comparison to the precipitation as reported by several articles. The author also highlighted similar concerns in page1950, line 5: 'The uncertainty of dynamic soil moisture forecasts is even higher than the climate forcings (precipitation and temperature) because in addition to input uncertainty, model errors. . ..(Wood, 2008). Overrated statements like line 6-10 (page 1956), should be avoided. Use of persistence based model on a moving sum time series has several limitations in comparison to the dynamic models.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 1947, 2014.