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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 #1

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The ESP method is applied to approximate the probability of droughts in the future with rather short lead time. Standardized Soil moisture Index (SSI) is used as agricultural drought indicator. Persistence analysis is conducted on SPI and SSI with 6-month accumulation window. The forecast method is sound; however, it is overrated by a few questionable comparisons. My major concerns are as follow:

1) Author emphasized on the higher auto-correlation in SSI timeseries vs SPI and concluded accordingly that SSI is a better indicator for drought forecasting (Page 1954,

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lines 3-5). Higher persistence is not a basis to choose among drought indicators. In fact, drought type determines the indicator; i.e. SPI for meteorological droughts and SSI or any other soil moisture-based index for agricultural droughts. Thus, this point should be cleared in the manuscript for potential future readers. According to specific attributions of SSI and SPI, they give different information about droughts. For example, flash storms as an important cause in producing flash floods (especially in wet regions with saturated/near-saturated soil) are reflected in SPI. The smooth variation in SSI cannot address sudden storms; and then, it is not appropriate in prediction of hydrological droughts where streamflow (or runoff) is used as drought variable. Flash floods can mitigate ongoing hydrological droughts to some extent. In general, persistency is not always an ideal attribution for a drought indicator. It depends on the application.

2) One-month lead time is very short for decision making in agricultural applications. For 6-month SSI with a lead-time of one month, the soil moisture of 5 months is available and the soil moisture of only one month is produced by ESP approach. In a 6-month window, the impact of one month is not as much to affect the total summation (and consequently SSI value). Moreover, the variable (soil moisture) itself is highly persistent as approved by Fig. 1. Hence, the agreement of observed and predicted SSI with 1 or 2 months lead-time cannot confirm the quality of forecast model. Instead, the performance of method can be illustrated in greater lead times (3 or 4 months) as shown in Fig. 5. Comparing Fig. 2 and 5, the forecast results are not encouraging. Majority of droughts are captured with low probabilities (Probability=0.1-0.5). Who might plan for droughts with low probabilities? Moreover, this analysis is conducted for July and August droughts (Fig. 5) when soil moisture is usually at its lowest amount and agricultural droughts are intense. Since the forecast model cannot capture summer droughts well, how it would perform in detecting mild droughts of other seasons. It seems that for a better picture of the performance of proposed model, it needs to be examined for a) greater lead times and b) other seasons with less severe droughts.

3) In “conclusion”, there is a statement saying: “While dynamic models did not predict

HESSD
11, C423–C425, 2014

the 2012 summer drought well in advance, . . .". How much were the models weak in predicting 2012 droughts? According to the points in my previous comments, the proposed model could not predict those droughts well either, especially with lead times greater than 2 months. I should mention once again that model performance cannot be revealed by 1 or 2 months lead time in a 6-month accumulation window where the soil moisture of 4 or 5 months are already observed.

4) In Fig. 1, please make it clear that what time windows are used for auto-correlation analysis. The boxplots are provided for 4 initial conditions with accumulation window of 6 months. On the other hand, the lag time varies from 1 to 6 months. To my understanding, for example, for SSI with initial condition of March (i.e. accumulation window: Mar, Apr, May, Jun, Jul, Aug), the autocorrelation with 1-month lag time refers the SSI with accumulation window of Apr to Sep. Is this correct? If so, please clarify that "initial condition" refers to the start month in the accumulation window for only one variable. The other variable starts with a lag-time whose initial condition is not the same as the first variable.

5) It is recommended that Fig. 3 and 5a be updated for SSI<-0.5 (instead of SSI<-0.8). Comparing these figures with "any" observed droughts (SSI<-0.5) is not very reliable (Fig. 2a).

6) It seems that "(Fig. 2b)" in Page 1954-line 28 should be replaced by "Fig. 2a".

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