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# *Interactive comment on* "Understanding and seasonal forecasting of hydrological drought in the anthropocene" *by* Xing Yuan et al.

**Anonymous Referee #2**

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Overall Remarks

The paper presents a fairly interesting study on an important topic with substantial results and insights. The research therein is a good fit for HESS. The main focus is on the impact of human water use/regulation activities on drought. The authors also carried out a number of seasonal meteorological/hydrological forecast experiments and I find them very carefully designed and carried out. The results/discussions are clearly presented too. My major concerns are on the analysis methodology and the adequacy of supporting information. The study area is one large river basin in China while a quite minimum level of specific information on the local water management is provided. Usually, more information on the surface water use practices will be very useful in helping readers understand the findings and their implications across similar areas in other parts of the world. I recommend its publication in HESS with improvements on



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Discussion paper

the analysis method and additional discussion on local water management and how that leads to what is seen in the results.

Specific Remarks

The paper (circa P. 5, L. 3-18) interprets the peak correlation time scale as the "optimal response time of streamflow to sub-basin averaged precipitation", while offering no supporting evidence (e.g. citation of previous research, data results). The 6-12 months (and later 8-16 months) "response time" seems incredibly long and beyond what a hydrologist can reasonably expect. Given the size of the Yellow River basin, it shouldn't take more than a month or two for water to travel from rain-falling hillslopes down to river gauging stations. And the local soil water stores or snowpack won't be able to defer the release of precipitated water for that long either. SPI/SSI does time averaging to the underlying parameters and this essentially smooths out noises at shorter time scales. A true "response time" is usually calculated from time lagged correlation analysis, e.g., between SPI-1 and SSI-1. Either the "response time" needs to be calculated differently or the same calculations need to be interpreted differently. Note that the change in the relationship between meteorology and hydrology is one of the major points in the paper as summarized in the abstract.

Further, the notion of "nonlinear response" of hydrological drought to meteorological drought is a bit vague in the discussions. The rainfall-runoff process is by itself "non-linear" and lagged in time, at least at short time scales. If the word "response" refers to the rainfall-runoff process (at any time scale), the research here should try to find out what exactly human interventions did to that process. Reduction in streamflow volume (i.e. significant amount of consumptive use)? Longer lag times (delayed release for flood control)? If the lag times become longer, should this be considered in the fore-cast post-processing procedure? (For example, a time series based procedure that looks at a prior history instead of just the current month.) For the same reasons, more information on the water regulation practices in the study area is needed for a (much) better understanding of the impacts and differences found in the results. For exam-

ple, reservoirs may store rain water from wet season and distribute it in the remaining time of the year according to the need. How much of the streamflow water is being regulated in the Yellow River basin (e.g. reservoir capacity relative to the annual total inflow) and for what purposes? How much of the streamflow is being modified (in both absolute and relative senses)? Fig. 4 helps to understand the scenario but direct comparisons between observations and naturalized values (in seasonal cycles and annual totals) can help explain what happened in Fig. 4 in a much better way. I guess the observed SSI in Fig. 4 is calculated against observed flow climatology and naturalized SSI against naturalized flow, right? (Please clarify.) If so, the comparisons between the two do not reveal the difference between the observed and naturalized climatologies, e.g. reduced total flow volumes or lagged peak times. Specific information on the local water management and water use practices is always helpful in understanding the findings and their implications across similar areas in other parts of the world (Wada et al., 2014). The study could be significantly stronger if more specific water management information is provided and related to the research findings.

P. 5, L. 13: nonlinearly -> nonlinear Fig. 1: The map needs to show at least the Yellow River and its main tributaries (thicker lines for the main stream) under this study. Replace the political boundaries with sub-basin boundaries (keep the coast lines). Fig. 4: SSI at what time scale? 1-month? Subplots are too small and better if they are rearranged into multiple columns.

References

Wada, Y., Wisser, D., and Bierkens, M. F. P.: Global modeling of withdrawal, allocation and consumptive use of surface water and groundwater resources, Earth Syst. Dynam., 5, 15-40, doi:10.5194/esd-5-15-2014, 2014.

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