

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
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Comment on hess-2022-313

Anonymous Referee #2

Referee comment on "Technical note: A stochastic framework for identification and evaluation of flash drought" by Yuxin Li et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-313-RC2>, 2022

General comment

This study used a stochastic water balance framework to examine the nonlinear relationship between the timing of drought and various hydrometeorological factors and identify possible flash drought events caused by lack of rainfall, high evapotranspiration, low soil water storage capacity, or a combination thereof. Indeed, there are a variety of definitions for flash drought, which has been merged as a critical sub-seasonal phenomenon with great impacts on agriculture, the economy, and society. Providing new metrics for flash drought from a stochastic perspective is certainly of great importance to our understanding of the rapid intensification of drought events. The stochastic theory is sound and straightforward, and the authors also found that flash drought also exists in humid regions such as southern China and the northeastern United States, calling for particular attention to flash drought monitoring and mitigation. And the manuscript is well-written and well structured, with potential publication in HESS. Below I list some points and the authors are wished to address before published.

Major concerns

- As illustrated in the text, the proposed framework measures the effect of deforestation on flash drought, but the description on this content is unclear. Soil water storage capacity does have a strong link with vegetation distribution, for example, drylands, with low NDVI, correspondingly show weak soil water storage capacity. In addition, deforestation can change hydrological and energy cycle processes, such as altering surface albedo and soil infiltration rate, which have an impact on flash drought. What is the relationship between deforestation and soil water storage capacity? Please add some specific statements. Further explaining is also needed, from my viewpoint, on how the framework measures the effect of deforestation on flash drought.
- Existing model simulations or satellite observations can provide daily-scale soil moisture as well, although these data are not free from biases. In comparison to

traditional droughts, flash droughts are characterized by rapid development, while the rapid development of flash droughts usually occurs within days or weeks, so pentad-scale hydrometeorological variables are commonly used and few studies analyzed flash droughts based on daily-scale data. The necessity to study the timing of flash drought based on the minimalist hydrological model should be further explained and discussed.

- One more point I concern is that the framework can measure the effect of evapotranspiration (E) on flash drought, yet there is difference between potential evapotranspiration (PET) and E, for example for moisture-limited drylands. I don't know did the authors measure the difference between E and PET on the results in Figure 3? In addition, the change in E is related to heatwave, while other factors (such as change in leaf area index and solar radiation) can also impact E. I suggest adding some discussion, in particular, on the difference between E and PET.

Minor concerns

- Aside from soil moisture, evaporation deficit (PET-ET) or evaporative stress ratio (ET/PET) is often closely monitored to quantify the intensification of flash drought. It would be useful also to provide a more general framework to consider these variables (or at least these variables should be acknowledged).
- Line 75: the example given in Fig. 2c clearly shows an exponential tail. Can we still have exponential distribution for parameters with different values? This should be explored.
- abstract should also emphasize the probabilistic structure of the first passage time, which is the benefit of the stochastic framework.
- Line 13: period is missed after the citation.
- I think there should be minus sign in front of Eq. (4).
- Line 74: The atom probability of no rainfall is not trivial. Please provide references or details of its derivation.
- How to calculate the rainfall frequency and average depth. Please clarify.
- The information provided by each picture is seemingly not enough. Can you add more information, please?
- Discussion chapters should be added to enrich the content
- I think the explanation of "timing of drought" in the text is slightly vague, which may further affect the readers' understanding of the drought risk mentioned in the study. Please add some explanations for this concept.
- Could you point out the numerical interval of timing of drought with high risk of flash drought?