

## ***Interactive comment on “Frequently used drought indices reflect different drought conditions on global scale” by Niko Wanders et al.***

### **Anonymous Referee #3**

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This paper makes a comparison of drought indices to assess how information they provide is redundant through correlation analysis. The authors conclude that it is not possible to summarize the different facets of droughts by a single index. The conclusion is partly consistent with WMO recommendations (P2L25).

This paper is an original scientific contribution that should be published in HESS. The paper is well presented. The objectives are also clearly presented.

However, results are based on the outputs of a conceptual hydrological model applied with the same parameter set all over the globe. The choice of fixed parameters is based on a previous study (Van Lanen et al., 2013). In addition, a (too) brief sensitivity analysis was carried out, but:

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- the sensitivity analysis was performed under a temperate climate (P3L31),
- the sensitivity analysis was based on the alteration of the parameters leading to the change of the response time (between -10% and 10%). I am not convinced that the obtained parameters are representative of the possible values across the world. The range seems too restrictive to draw reliable conclusions. We need objective reasons that explain the range [-10;+10]%,
- I suspect also that the changes are too slight to be noticeable at the monthly time scale (time step of the calculations of the drought indices),
- there is no graph, no table to support the statement,
- the sentence “The sensitivity analysis [...] parametrization” (P3L28-29) may contradict the following sentence “The responsiveness of groundwater systems to groundwater recharge has strong control on the development of hydrological drought” found in the conclusion of (Van Lanen et al., 2013).

This assumption is the main weakness of the paper. The authors have to better justify or to reconsider their choice.

Results are valid for elementary catchments (= 0.5° grid cell). I am wondering whether correlations remain the same for large basins encompassing a large range of climate and river flow regime of the tributaries. I do not find any discussion on a possible scale effect (the droughts propagate along the river network and are governed by both local end upstream conditions; there may be a smoothing effect that moderate/strengthen the relation between meteorological and hydrological drought indices).

Abstract: “Possible drought impacts are crop losses, famine, fatalities, power blackouts and degraded ecosystems” => The article points out the drought impact in terms of economic losses. The aspects related to famine and fatalities are not developed and should be discarded from the abstract.

Additional information is required on the time step of the hydrological model, on the

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definition of the response time (P11L26-27), on the link between the values of the parameters and the characteristics of the soil, etc.

Appendix A is not very informative (see the section on SPEI, it is more or less the information given in Table 1). I would expect more details on the calculation of each index, highlighting the reasons of their strong or weak dependence.

P1L20: United states => United States P6L30: were we => where we Figures: I suggest reorganizing the graphs to make the comparisons easier:

MAP EDI SPI-1 SPI-3 SPI-6 SPI-12 SPI-24 MAS PDSI SPEI-1 SPEI-3 SPEI-6 SPEI-12  
SPEI-24 MAQ TSDI SRI-1 SRI-3 SRI-6 SRI-12 GRI

Column 1= threshold method Column 3-7 = same time scale

P14L8-9: Standardized Precipitation Evaporation => Standardized Precipitation Evapotranspiration

P19L37: Wanders, N. and Wada, Y.: Human and climate impacts on the 21st century hydrological drought, *Journal of Hydrology*, pp. 1–13, => Wanders, N. and Wada, Y.: Human and climate impacts on the 21st century hydrological drought, *Journal of Hydrology*, 526, 208-220,

P20L13-14: Appropriate application of the standardized precipitation index in arid locations and dry seasons., *International Journal of Climatology*, 27, 65 – 79, 2006. => Appropriate application of the standardized precipitation index in arid locations and dry seasons, *International Journal of Climatology*, 27, 65 – 79, 2006.

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