

Reviewer #3: Based on experiment data, in this paper, the authors aim to identify drought occurrence, development and intensity in pasture and alpine areas, Qinghai China. Tens of thousands drought indicators have been developed in previous studies, such as the most widely used PDSI, SPI and SPEI, etc. Yet, few of them are focused on pasture and alpine areas, Qinghai China, which maybe the authors' motivations. The authors may want to well introduce their experiment design, how to quality control observational data, and how occurrence, duration and intensity of the so-called soil drought impact pasture and alpine growth and yield. Unfortunately, the related works are not well done in this study. In current version, there are many uncertainties to define soil-drought. Specifically, the exponent "a" is very sensitive and flexible, and thus it is very hard to be identified and applied in larger areas. In this case, readers are not able to build their confidences in this paper.

Response to comments: The reviewer is thanked for noting that the reader could get confused in this paragraph. The text in this paragraph in the revised manuscript further clarifies that the purpose to research are soil drought not the meteorological drought. we also rewrote those parts of the introduction in the revised manuscript where drought indicators were mentioned.

Comment 1: I would like to suggest the authors to inter-compare currently widely used drought indicators such as: PDSI (Dai, 2013), SPEI (Vicente-Serrano et al., 2010), VHI (Kogan, 1997), and current CMA operational drought monitoring product using the observational data. Dai A, increasing drought under global warming in observations and models, *Nature Climate Change*, 2013(3): 52-58, Kogan F., 1997, Global drought watch from space. *Bull. Am. Meteorol. Soc.*, 78:621–636 ,Vicente-Serrano S M., S Beguería, and J I. López-Moreno. 2010, A Multiscalar Drought Index Sensitive to Global Warming: The Standardized Precipitation Evapotranspiration Index. *Journal of Climate*, 23: 1696-1718 Minors:

Response to comment 1: A good suggestion by the reviewer. The reviewer is thanked for directing us to this reference, which we have cited in the revised manuscript at the location recommended by the reviewer (we additionally added several citation). But this area is an irrigated area, the main purpose of this paper is to study the effect of soil drought on pasture, so soil relative humidity was used in paper. We have also added a recommendation to the future work section to further examine the link between drought indicators with observational data in **discussion sections**. The reviewer is thanked for noting that the manuscript is stronger if it notes the inter-compare with the different drought indicators.

Reference:

Dai, A. G.: increasing drought under global warming in observations and models., Nature Climate Change, 1,52-58,2013.

Kogan, F. N.:Global drought watch from space,Bull. Am. Meteorol. Soc., 78:621–636,1997.

Vicente-Serrano, S. M., Begueria, S., Lopez-Moreno, J. I.: A Multiscalar Drought Index Sensitive to Global Warming: The Standardized Precipitation Evapotranspiration Index. Journal of Climate, 23: 1696-1718, 2010.

Comment 2: The authors may want to read the manuscript couple more times to fix the grammar and typo issues.

Response to comment 2: We like the reviewer's suggested language and have adopted it verbatim in the revised manuscript. We have had the entire manuscript professionally edited by International Science Editing (a language editing company).

Comment 3: Soil drought: generally, this is called agricultural drought, due to soil moisture deficits may lead to a reduction in crop yields, plant biomass and ecologic productivity (Wilhite and Glantz 1985; Yin et al., 2018). Wilhite, D. A., and M. H. Glantz, 1985: Understanding the drought phenomenon: The role of definitions. Water Int., 10: 111–120. Yin, J., Zhan, X., Hain, C. R., Liu, J., & Anderson, M. C. (2018). A method for objectively integrating soil moisture satellite observations and model simulations toward a blended drought index. Water Resources Research, 54. <https://doi.org/10.1029/2017WR021959>

Response to comment 3: The reviewer is correct that the original manuscript needed to go into additional detail on these aspects of the droughts definitions. We have added a new paragraph at the **very front of the introduction section** in the revised manuscript that goes into more detail as to the droughts definitions. The reviewer is thanked for noting that the original manuscript should have filled in details, which has now been done in **Line39-48**.

Comment 4: Line 18-19: have demonstrated »» demonstrate; Line 20: 0-20 cm layer »> 0-20cm soil layer.

Response to comment 4: The reviewer again notes our casual language. In the revised manuscript, we have used more rigorous language, in addition to providing more details as to characterization soil drought. The reviewer is thanked for noting the need for clarification in the manuscript on this point. the **abstract section** has been rewritten, see in **Line12-27**.

Comment 5: Please remove the first and fifth highlights.

Response to comment 5: Agree. we modify the highlights section in **Line29-36**.

Comment 6: Line 54: be become» »become

Comment 7: Line 55: high temperatures»»»> extreme temperature

Comment 8: Line 59, Meteorological drought »» Agricultural drought

Comment 9: Line 62-85, there are many drought indices introduced in previous studies, why only the couple indicators that are not the most popular ones are listed here? And the authors' motivations are not clearly described here.

Response to comment 6-9: The reviewer again notes our casual language. In the revised manuscript, we have used more rigorous language. According to your suggestion, the **introduction section** has been rewritten, see in **Line39-48**.

Comment 10: Section 2.1, experiment details are missed.

Response to comment 10: The reviewer notes that additional clarification is needed here. The research area and experimental design area (2.1) were further improved in **Line78-104**. Add Table 2 to introduce the sample plot distribution map of precipitation

control experiment.

Comment 11: Equ (1): so f (soil moisture changes) = e^{1+a} ? Is there any physical explanation?

Response to comment 11: The reviewer notes that additional clarification is needed here. Order to explanation the $f(w)$, we make reinterpretation in **Line103-125**. The reviewer is thanked for noting the need for clarification in the manuscript on this point.

Comment 12: Line 134: lower than 20»» lower than 20%?

Response to comment 12: The reviewer again notes our casual language. The threshold section was modified in **Line232-244**.

Comment 13: Section 3.2: so the technique is developed here? Otherwise, please add the related references.

Response to comment 13: According to your suggestion, add the reference. In order to describe this problem clearly, **the structure of the paper has been adjusted**, see section2.2.1.

Reference:

Chen, J. Z., Li, L. R., S., LÜ, G. A.: An index of soil drought intensity and degree: An application on corn and a comparison with CWSI, Agr. Water. Manag., 97, 865–871, 2010.

Comment 14: Discussion parts are not new. Basically, all the discussions have been investigated in previous studies.

Response to comment 14: According to your suggestion, the **discussion section** has been rewritten, see in **Line264-290**.

Comment 15: A table focused on Groups' (Group 1-5) descriptions is missed.

Response to comment 15: A good suggestion by the reviewer. Since there are more than 6 figures in the paper, so the groups' (Group 1-5) descriptions is arranged using written words in Line 81-89.

Comment 16: Figure 2, the unit should be m^3/m^3 for volumetric soil moisture.

Response to comment 16:According to experiment design, The variable is the volumetric soil water content, its units is % in Figure 2.

*In summary, **the yellow part of the paper is the modified sections**. There were significant changes made to the manuscript as regards multiple strike years. The reviewer is thanked for mentioning this suggestion, which has definitely strengthened the manuscript.

Thank you for your valuable comments.

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