

Interactive comment on “Modeling of severe persistent droughts over eastern China during the last millennium” by Y. Peng et al.

Anonymous Referee #1

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General comments: As described in the manuscript, the factors causing droughts are diverse. Therefore, the idea is very correct to study the causes of each specific drought events, respectively. e.g. the stronger volcanic activity may lead a specific drought, and another may be induced by the weakened monsoon. However, both cannot lead all drought events. The other factors have similar problem. Thus, this article is very important to improve understanding of the formation reasons of droughts in eastern China. Moreover, the comparison of proxy reconstruction and simulation is a potentially practical way to understand the spatial and temporal characteristics of drought events in the past and reveal the internal mechanism of their occurrence. However, the conclusion is too hasty. Firstly, the proxy data and simulation data all were averaged by a 10yr-running mean. Thus, the drought persistent should be more than 10 years, and the drought periods should be redefined. Secondly, the simulations from other models

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in CMIP5 are available. I suggest you need check more model simulations to verify the conclusion. Thirdly, uncertainty of proxy data reconstruction should be considered? In spite of the historical documents that are more accurate than the current simulation, you should mention the uncertainty. e.g. the Dry-wet indices have some missing values, especially in the early years. Thus, this manuscript needs a minor revision before publish. Specific Comments: 1. P6346, line 5. ‘many aspects’ is not precise. Here, the results just indicate the model can depict several persistent drought events in decadal scale. The averaged index in the study region is only an aspect. In fact, for all I know, many climate models in CMIP5 cannot accurately capture the spatial characteristics of precipitation in China. 2. P6346, line 21-23. Another possibility may be the proxy data reconstruction underestimates the decreasing trends. 3. P6347, line 2. ‘great recurring’ should be changed with ‘main’. Since the droughts may have no stationary periodicities. 4. P6347, line 2-5. There is a little problem in logic expression. The sentence should be that ‘Since the frequency and intensity of droughts has increased globally in recent years and its significant impacts on economy, society, and environment (Easterling et al., 2000; Changnon et al., 2001; IPCC, 2002), droughts have been received increasing attention.’ 5. P6347, line 4. It is better to cite the new IPCC report. 6. P6347, line 6-10. The death toll about the 1960s drought is incorrect. One million deaths of two 2-year major droughts in 1928-1929 and 1965-1966 include China and India (Shen et al., 2007). The information at the website is that two years of severe droughts in 1941-1942 in China leave 3 million dead by starvation. Please check it. 7. P6347, line 13. Some references should be added to support the considerable effort. 8. P6348, line 15. A sentence should be added to summarize the status of these studies, for example, A great deal of literature works has been carried out in drought events, but the possible mechanism remains unclear because of the complex climate system in eastern China. 9. P6349. Line 14. The May-September should be rainy season not summer. 10. P6350, line 15. There are many indices to depict the EASM variability. Please illustrate the reason that the index (Sun et al. 2000) was chosen in this study in detail. Moreover, this index is not first developed in this paper, and you

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just use it. Thus, the title '3 defining ...' is not rigorous. 11. P6351, line 4. How much is the sample window? I suggest that an odd number (9 or 11) of datum points as the sample window for the central running mean. 12. P6351, line 25. Please explain how to define the threshold. I guess that the value '-0.43' is equal to the 1.28 times the standard deviation. If I am right, the order of these sentences is not appropriate. The principle should be firstly introduced, and then the threshold is calculated according to the principle. 13. P6353, line 8-10. The result of comparison of proxy and model is not good. The drought centers and the periods are both different. Thus, it is difficult to get a conclusion 'in terms of drought intensity, duration, and spatial coverage, these six droughts over eastern China revealed by our model are consistent with the results of proxy data'. I suggest you compare them on a longer time scale. 14. P6354, line 4-5. From Figure 4, the first three droughts (1133-1140, 1204-1210 and 1356-1360) occurred in the periods following weaker indices (ILSTD), however, the other three droughts are not the same case. Thus, the conclusion that the weak summer monsoon during these droughts may be driven by the changes of land-sea thermal contrast is too rough. If you want to get this conclusion, you need check all weaker index periods and explain why the droughts do not occur in some weakened monsoon periods. 15. P6455, line 1-3. From Figure 5 and 6, the similar quasi-periodicities were found by the spectral analysis. It is better to try to explain how to the dynamics mechanism about the solar activity and the internal variability of the climate system in detail. 16. P6357, line 23-27. I suggest this conclusion should indicate which drought was caused by the reduced monsoon, since a single factor can not explain all drought events. 17. P6358, line 13. There is a high-resolution ENSO developed by Li et al. (2013), which can be used to assess the relationship between the drought and ENSO. 18. Please calculate the correlation coefficient and the effective number of degrees of freedom to assess the significance of the correlation in Fig. 1. 19. Please indicate the six well-captured severe droughts from the model simulation in Figures.4, 5 and 7. 20. What's the 10yr smoothed response in Fig.8?

Reference: Li, J., Xie, S.-P., Cook, E.R., Morales, M.S., Christie, D.A., Johnson, N.C.,
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Chen, F., D'Arrigo, R., Fowler, A.M., Gou, X., Fang, K., 2013. El Nino modulations over the past seven centuries. *Nature Clim. Change*, 3(9), 822-826. Shen, C., Wang, W.C., Hao, Z., Gong, W., 2007. Exceptional drought events over eastern China during the last five centuries. *Climatic Change*, 85(3), 453-471.

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