

## **Response to comments of Anonymous Referee #1**

This paper by Wu et al. (2011) uses observed precipitation and temperature time series to drive the Variable Infiltration Capacity (VIC) hydrologic model to reconstruct soil moisture values across China from 1951-2009. In turn, an assessment is undertaken of drought occurrence in nine drought study regions. The paper is a valuable contribution to the identification of drought events in China, and the reliable VIC simulations could be useful for future drought monitoring and prediction. However, there are general and some specific points which I believe need to be addressed. Here are the general comments followed by some specific and technical comments:

### **General comments:**

1. Most importantly and critically the clarity of English throughout the paper needs some attention. I have not listed an exhaustive list of changes to the English (see specific comments), and what is mentioned is only meant as a constructive critique.
2. On occasions I think it would be best to put parentheses around the drought regions when you mention them e.g. Page 1862 line 19, and p1877 lines 12-13. Currently they do not sit well in the sentences.
3. It would be useful to have some physical reasoning behind the occurrence of extreme drought events in China, and in particular the worsening drought in eastern China (e.g. p1876 lines 6-10). Is it to do with increased water consumption because of industrial and population growth in these areas, or is it due to changing climate patterns (or perhaps a mixture of both)?
4. In the text there are a few times where it says “in the recent fifty nine years”. On occasions for brevity and clarity, it would be better to say “from 1951-2009” (e.g. P1875 line 3, P1878 lines 10-11).

### **Response to General comments:**

*We appreciate the valuable and fruitful comments. We have addressed the four general comments as follows.*

1. *As you will see from the improved manuscript, significant efforts have been made on the suggestion of clarity of English throughout the original manuscript.*
2. *As suggested, we have put parentheses around all names of drought study regions when they are mentioned. For example, in the **Abstract**, the original sentence – “Regionally, an upward trend in drought-affected areas has been detected in three regions Inner Mongolia, Northeast and North during the recent fifty nine years.” (P1862 lines 18-20) has been rephrased to “Regionally, an upward trend in drought-affected areas has been detected in three regions (Inner Mongolia, Northeast and North) from 1951-2009.” in the revised manuscript.*
3. *We have added a new paragraph including a new reference at the end of the subsection **3.3** in the revised manuscript. The new paragraph discusses some physical reasoning behind the occurrence of extreme drought events in China. The new paragraph is quoted here, “Since most parts of China is located in the East Asian Monsoon area. The monsoon variability is affected by both tropical and mid-latitude circulation systems. The variability is likely to be responsible for the frequent occurrence of extreme drought events in China. In the background of global warming, the climatic characteristics of regional atmospheric water and energy have changed in both time and space, which can result in frequently occurred abnormal circulations and can bring weather extremes such as high temperature and less precipitation. Ma and Fu (2006) found that the increase of extreme drought events in North China since 1990 mainly due to precipitation decrease and temperature increase. The increasing water consumption from human activities like population growth, industry and agriculture development, as well as changes of land use and land cover have interfered the water circulation system in China. All of these factors would increase the vulnerability to drought, and thus exacerbating the effects of drought. ”*
4. *The suggestion has been well taken in the revised manuscript. For example, in the subsection **3.3**, the original sentence – “Figure 5 shows the geographic distribution of drought occurrences over China in the recent fifty-nine years.” (P1875 line 3) has been rephrased to “Figure 5 shows the geographic distribution of drought occurrences over China from 1951-2009.” in the revised manuscript.*

### **Response to Specific and technical comments:**

*We address below each point raised by the reviewer, with our response shown in italics.*

1. P 1862 line 10: “As the result” should be “As a result”. This is repeated in other parts of the text too.

*The suggestion has been well taken in the revised manuscript.*

2. P1862 line 15: “progressing” should be “progression”. This is also repeated on P1878 line 21.

*As suggested, we have replaced “progressing” with “progression” in the **Abstract** and **Conclusions**, and other places.*

3. P1862 line 20: “week” should be “weak”. This is repeated elsewhere.

*We have corrected the typo in the **Abstract** and **Conclusions**.*

4. P1862 line 21: “wetting” should be rephrased to include the word “wetter”. This is also repeated elsewhere (e.g. p1877 line 29).

*As suggested, the original sentence – “Xinjiang has even been wetting steadily since the 1950s.” has been rephrased to “Xinjiang has even been showing steadily wetter since the 1950s.” in the revised manuscript.*

5. P1863 line 6: “agriculture productions” should be “agricultural productivity”.

*We have made changes according the suggestion.*

6. P1863 lines 17-20: Is there a reference?

*As suggested, a new reference published by the Chinese Ministry of Water Resources in 1997 has been added in the revised manuscript.*

7. P1863 line 22: does the 60% refer to China or the World? Just a little clarification is needed.

*The original sentence – “The annual average of drought-affected areas has reached 22.5 million hectares, which can account for up to 60% of the total area suffered from natural disasters.” has been rephrased to “The annual average of drought-affected areas has reached to 22.5 million hectares, which can account for up to 60% of the total areas that suffered from natural disasters in China.” in the revised manuscript.*

8. P1864: “indexes” should be “indices”

*As suggested, we have replaced “indexes” with “indices” when the word is used in the revised manuscript.*

9. P1867 lines 11-12: Is there a reference for the temperature and precipitation data?

*Unfortunately, we cannot find any official publications on the temperature and precipitation data, but only internal documents. To clarify the data source, the original sentence – “... and the observed time average near-surface air temperatures and precipitation.” has been rephrased to “and the observed time average near-surface air temperatures and precipitation archived at the China Meteorological Administration.” in the revised manuscript.*

10. P1868 lines 1-3: Is it possible to say what the calibration and validation periods are?

*As suggested, we have added a new “The calibration period varies from 5 to 6 years, while the model validation is done using 2- to 7-year observed hydrographs outside the calibration period.” in the subsection 2.1 to reporting on the VIC calibration and validation periods.*

11. P1870 line 9: “minima” should be “minimum”.

*We have corrected the typo.*

12. Fig.3: For consistency, perhaps the y-axis should have the same values for all nine plots. I realise that it may make the top three panels harder to read, but the current plots are slightly misleading to the eye.

*The suggestion has been well taken in the revised manuscript. Fig. 3 has been re-plotted; the main y-axis varies from 0 to 11 mm/d in all nine panels. We set the scale of the second y-axis varying from 12% to 36%. The new Fig. 3 is attached at the end of this reply.*

13. Fig. 4: It may be useful to include (in the figure caption) the name of the region that has the most severe drought during each of these four periods.

*As suggested, the caption of Fig. 4 has been rephrased to “Four reconstructed most severe drought events together with other drought-affected areas for the same events during the period 1951-2009. (a) South; (b) East; (c) Inner Mongolia; (d) Southwest” in the revised manuscript.*

14. Fig. 5: Should the figure title “1951-1959” be “1951-2009”?

*We have corrected the typo in Fig.5*

15. P1873 line 17: I think “gain loss” should be “grain loss”. I believe this happened in another place too.

*We have corrected the typo in the revised manuscript.*

16. P1873 line 28: “life” should be “lives”.

*The typo has been corrected as suggested.*

17. P1874 line 4-5: “Spatial extension” should be “Spatial extent”.

*We have corrected the typo in the revised manuscript.*

18. P1876 line 7: “social-economical” should be “socio-economic”.

*The suggestion has been well taken.*

19. P1878 line 26: It may be best to replace “less occurring” with “low frequency” or something similar.

*Corrections are made in the revised manuscript.*

20. P1879 lines 8-11: These lines read exactly the same as P1875 lines 9-13. This is a very minor point, but perhaps one of them should be rephrased slightly.

*As suggested, the original sentence – “The first center is located in the area partial covered by two drought study regions North and Northwest, which extends to the southeastern portion of Inner Mongolia and the southwest part of Northeast.” (P1875 lines 9-13) has been rephrased to “As shown in Figure 5, the first centre is located in the area partial covered by two drought study regions (North and Northwest), which extends to the southeastern portion of Inner Mongolia and the southwest part of Northeast.” in the revised manuscript.*

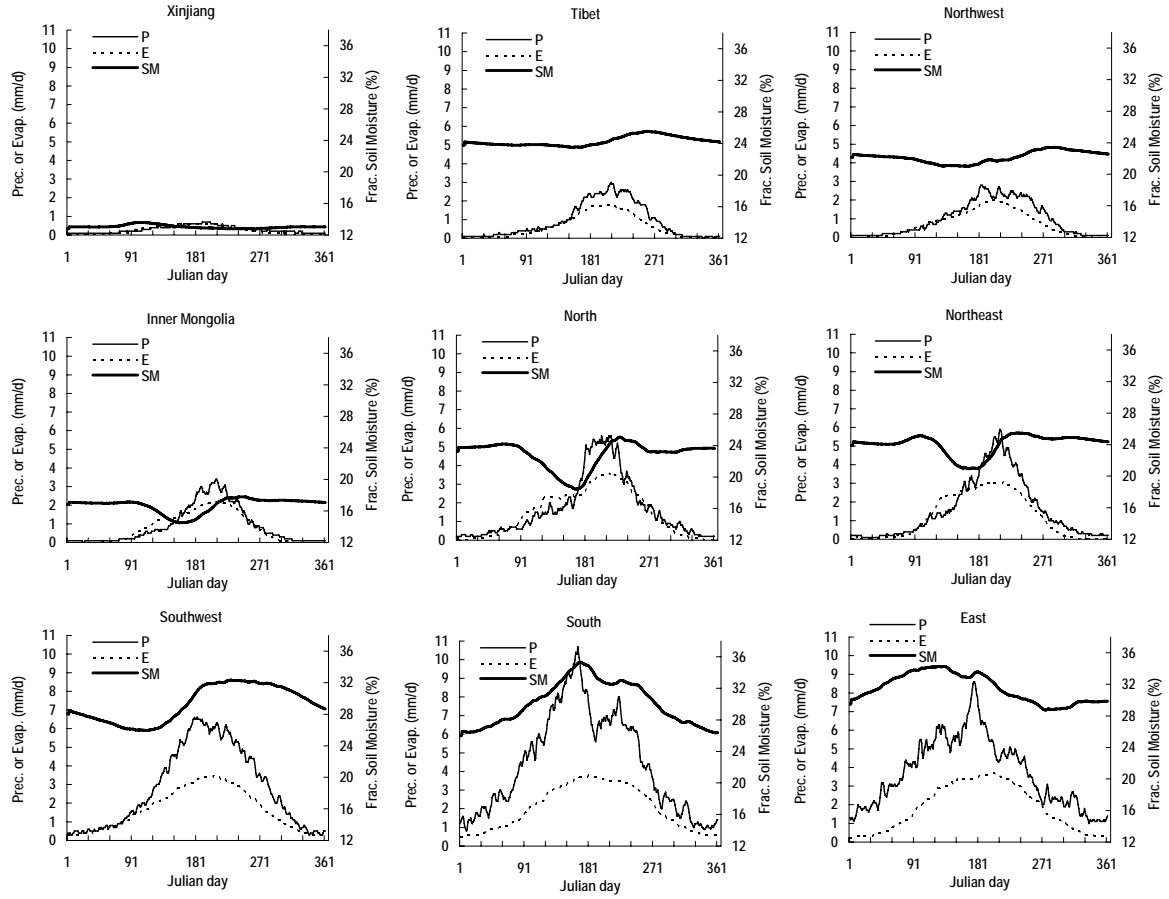
#### References:

Office of State Flood Control and Drought Relief Headquarters and Nanjing Institute of Hydrology and Water Resources, Ministry of Water Resources, China (Eds.): China flood and drought disaster, China WaterPower Press, Beijing, 569 pp., 1997.

Wu, Z. Y., Lu, G. H., Wen, L., Lin, C. A., Zhang, J. Y., and Yang, Y.: Thirty-five year (1971–2005) simulation of daily soil moisture using the variable infiltration capacity model over China, *Atmos. Ocean*, 45, 37–45, 2007.

Ma, Z. G. and Fu C. B.: Some evidence of drying trend over northern China from 1951 to 2004, *Chinese Science Bulletin*, 51, 2913–2925, 2006.

**Re-plotted Fig. 3**



**Fig. 3.** The annual cycle of VIC soil moisture (SM: thick solid line) for the period 1951–2009 over China’s nine drought study regions, as well as the observed precipitation (P: thin solid line) and the simulated evapotranspiration (E: dashed line).