

## ***Interactive comment on “Anthropogenic forcing of shift in precipitation in Eastern China in late 1970s” by T. Wang et al.***

### **Anonymous Referee #3**

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Review's comments for the paper (acp-2013-48) "Anthropogenic forcing of shift in precipitation in Eastern China in late 1970s"

General comments By using coupled ocean-atmosphere general circulation model ensemble simulations with different external forcing, this paper attempts to attribute the anomalous precipitation pattern experienced over East Asia during the second half of the 20th century which is characterized by a dipole pattern with increased rainfall in the middle and lower reaches of the Yangtze River Valley and decreased rainfall in northern China. The manuscript concludes that this dipole structure of precipitation anomalies is mainly caused by the combined effect of increasing global greenhouse gases and regional aerosol emissions over China. The paper further argues that the increasing greenhouse gases induce tropical warming and a westward shift of the western Pacific

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subtropical high, leading to more precipitation in southern China. At the same time the aerosol cooling effect over land contributes to a reduced summer land–sea thermal contrast and therefore to a weakened East Asian summer monsoon and to drought in northern China. Consequently, an anomalous precipitation pattern starts to emerge in eastern China. The results are interesting and worth of publication after addressing the following questions.

Specific comments 1. The model simulation in response to all forcing (ALL150) shows a dipole pattern of precipitation anomalies over East Asia, similar to that based on observations occurred during the second half of the 20th century. However, the sum of the response to natural forcing (NAT150) and that to anthropogenic forcing (ANT150) does not reproduce the precipitation pattern seen in all forcing experiment. The reviewer likes to see more understanding and comments on this nonlinear behavior in the model. 2. The paper argues that the increasing greenhouse gases induce tropical warming and a westward shift of the western Pacific subtropical high, leading to more precipitation in southern China. At the same time the aerosol cooling effect over land contributes to a reduced summer land–sea thermal contrast and therefore to a weakened East Asian summer monsoon and to drought in northern China. However, there are not enough evidences in the paper to support these statements since there are no experiments performed to assess the separate roles of increasing greenhouse gases and of increasing aerosols. 3. The paper claimed that ANT150 simulated the weakened EASM and associated the anomalous precipitation pattern. But various figures shown in the paper do not support this conclusion. Therefore, the conclusion that anthropogenic forcing is responsible for the observed precipitation changes experienced during the second half of the 20th century is not justified. 4. Lines 4-7 on page 7. “the negative-positive-negative precipitation anomalies do appear in ANT150, implying linkages between the anthropogenic forcing agents and the change in the observed precipitation”. The pattern shown in figure 5d is very different from either Figure 5a or Figure 5c, and therefore does not support that observed pattern is anthropogenic related. Meanwhile, it seems that the sum of figure 5d and figure 5e is very different

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from figure 5c. The reviewer likes authors to make comments on this nonlinearity and clarify their attribution statements. 5. On page 7. Figure 6 shows negative trend in both the NC and YRV regions in ANT150 experiment. Correlation with observations in the YRV is also negative. The running trends in the NC and YRV shown in figure 7b in the last 50 years show a similarity to those in figure 7a, but figure 7c does not. Therefore, figures 5, 6, and 7 do not support your attribution statement that the IVSP in late 1970s is likely controlled by anthropogenic factors. 6. Line 24-26 on page 8. The pattern of circulation anomalies over East Asia and Northwestern Pacific shown in Figure 9d is not similar to either figure 9a or figure 9c, and therefore does not support your statement that the observed climatic features were partly captured by ANT150. 7. Lines 3-6 on page 9. This statement is very confusing. The tripole structure of observed SAT anomalies with cooling in the middle might indicate that the cooling is the response of land surface to enhanced convection since it is expected that enhanced convection reflects more shortwave radiation. Meanwhile enhanced precipitation enhances surface evaporative cooling. Both processes might be responsible for the cooling. It is not convincing that this anomalous temperature distribution causes a weakened EASM. 8. Lines 20-22 on page 9. The lack of cooling in ANT150 shown in Figure 10d does not support your comments that the slight cooling in ALL150 over eastern China is most likely attributed to the cooling effect of increased anthropogenic sulphate aerosols there. 9. Lines 24-28 on page 9. There are no evidences to support these statements. 10. Unless you can justify your attribution statement about the role of the anthropogenic forcing in observed precipitation changes, further analysis about the changes in the subtropical high does not help much. 11. Lines 12-19 on page 11. These conclusions are not justified.

Technical corrections

Figure 2 caption. Shall the unit of aerosol burden being  $\text{mg m}^{-2}$

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