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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "An important mechanism sustaining the atmospheric "water tower" over the Tibetan Plateau" *by* X. Xu et al.

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We are grateful to Dr. Anmin Duan for his encouraging comments and careful revisions which helped to improve the quality of our paper. In the following we quoted each review question in the square brackets and added our response after each paragraph.

[Specific comments: Section 1 Introduction Second paragraph When the authors explain why the abundant water resources appear in southeastern China in summer season; Duan and Wu (2005; Climate Dynamics) should be cited'; in which they found that the lower southwesterly related to warm and wet air transportation from tropical oceans is induced mainly by the conjunction of TP thermal forcing and Eurasia thermal forcing because the TP topographical defection effect exists also in winter]

We have cited the paper of Duan and Wu and accordingly added the discussion in the Section 1 as follows: The lower southwesterly driving warm and wet air transport from tropical oceans to these areas of southeastern China in summer season could also induced by the conjunction of the TP and Eurasia continental thermal forcing (Duan and Wu, 2005).

Reference

Duan, A. M., and Wu, G. X.: Role of the Tibetan Plateau thermal forcing in the summer climate patterns over subtropical Asia, Climate Dynamics, 24, 793-807, 2005.

[Section 2 Data and method A reference for NCEP/NCAR reanalysis should be given. Quality of NCEP/NCAR reanalysis over and around the TP is usually worse than some other reanalysis datasets such as JRA-25, ERA-Interim, or MERRA. A comparison between NCEP/NCAR and of the others is necessary.]

We have accepted the comment. A reference for NCEP/NCAR reanalysis has been given in the Section 2 with the sentence "In this study, we used the reanalysis data data of years 2000-2009 in the Research Data Archive at the US NCEP (National Center for Atmospheric Research), Computational and Information Systems Laboratory (http://dx.doi.org/10.5065/D6M043C6)" in the revised manuscript. We also agree on the comment about the quality of NCEP/NCAR reanalysis data over and around the TP. As an important issue for our future study, a comparison between NCEP/NCAR and some other reanalysis datasets such as JRA-25, ERA-Interim, or MERRA is necessary in further work. The corresponding discussion has been emphasized in the Section 4. "Conculsions and discussions" of revised manuscript.

[Q1 and Q2 is defined firstly by Yanai (1961); please cite: Yanai, M., 1961: A detailed analysis of typhoon formation. J. Meteor. Soc. Japan, 39, 187–214.]

In the revised manuscript, the paper of Yanai (1961) has been cited.

[Different authors gave different domain of the TP; is there any particular reason for the authors to choose it as (78-103E; 26-38N)?]

We have selected the TP-domain of 78-103oE; 28- 38oN covering the most region with the altitude of higher than 3000m (please see the revised upper panel of Fig.4).

[Lower panel of Fig. 1. The center of column vapor content over is located over the central TP rather than the southeastern TP, why? Is this result data dependent?]

In the Lower panel of Fig. 1, the column vapor contents over 500hPa and then averaged in summer over 2000-2009. There are two centers of high column vapor contents respectively over 1) the central TP and 2) the region from the Bay of Bengal to the southeastern TP . Two reasons for the center of column vapor contents over the central TP could be 1) the column vapor contents integrated over 500hPa and 2) the NCEP/NCAR data dependence. Comparing to the reanalysis data of NCEP/NCAR, the other reanalysis datasets such as JRA-25, ERA-Interim, or MERRA will be used in the further study.

[Section 3.1; "This heat island over the massive TP exceeds that of any urban agglomerations in the world in both intensity and area"; A reference is needed here;]

In the revised version, we have cited two reference papers about the urban heat island intensity. On average, the urban temperature is 1-3oC warmer than surrounding rural environments (Voogt and Oke, 2003;Zhao et al., 2014), while air temperatures over the TP is 4$\sim$6oC and even up to 6oC higher than its surrounding atmosphere at the same altitude in summer (upper panel of Fig. 2). This heat island over the massive TP exceeds that of any urban agglomerations in the world in both intensity and area.

References

Voogt, J. A., and Oke, T. R.: Thermal remote sensing of urban climates, Remote Sens. Environ. , 86, 370-384, 2003.

Zhao, L., Lee, X., Smith, R. B., and Oleson, K.: Strong contributions of local background climate to urban heat islands, Nature 511, 216-219, doi:10.1038/nature13462,

2014.

[Lower panel of Fig.2. Why not use sensible heat directly to calculate its correlation with vertical velocity?]

Air temperature is a measure of the sensible heat content of the air. Therefore, the sensible heat is not directly used to calculate its correlation with vertical velocity in this study. In the lower panel of Fig. 2, a good positive correlation between surface air temperature and vertical velocity at 500hPa over the TP could reflect an important role of the surface sensible heating and its vertical transfer in building the heat and wet islands over the TP.

We have emphasized the relation in the revised manuscript.

[Fig.6. Only the cloud cover fraction in July 2008 is shown here, how about the JJA climate mean?]

The data derived from the Chinese meteorological satellite FY-2F in July 2008 are only currently available to present the spatial distribution of cloud cover fraction over the TP and its surrounding areas, which could be used to further clarify the atmospheric "water tower" over the TP in the Asian water cycles.

We will characterize the seasonal and annual varaitions in TP-cloud cover with the long time series satellite data in future work, if they are available.

[Interaction region marked in Fig.7 should be explained clearer in the context.]

In the revised manuscript, the interaction region marked in Fig.7 has been clarified as follows: These dynamic and thermodynamic processes depict a coupling of two CISK type systems, both with convergence at low levels and divergence at upper levels, but the systems are horizontally contiguous as well as vertically staggered. The two systems display a mutually supportive mechanism with the mechanical and thermal TP-impact between the southern slopes and the platform of the TP in the interaction region marked in Figure 7.

[Technical corrections: Caption of upper panel of Fig.1. Rivers are marked by green rather than light blue.]

It is corrected.

[Right upper panel of Fig.3, contours of 500 hPa divergence are too much to easily read..] Following the suggestion, the right upper panel of Fig.3 has been revised. [Upper panel of Fig.4. The topography of the TP should be clearly outlined.]

The TP region has been outlined with the yellow- shaded contour of higher than 3000m in the revised upper panel of Fig.4.

[Line 6 in the first paragraph of Section 4, Conclusion, "water storage" should be "atmospheric water storage".]

It is changed to "water storage in the atmosphere".

[Fig.5 and its caption. Q1/Q2 should be Q1&Q2.]

Following the comment, they are revised in Fig. 5 and its caption.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 18255, 2014.