Reply to Reviewer （Dr. Anmin Duan） of acpd-14-C5708-2014

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 78-103^{o}E; 28- 38^{o}N 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 1-3^{o}C warmer than surrounding rural environments (Voogt and Oke, 2003;Zhao et al., 2014), while air temperatures over the TP is 4~6^{o}C and even up to 6^{o}C 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.

Reply to Reviewer 2 of acpd-14-C5708-2014

We are grateful to the reviewer for the 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.

*[**General comments***

This paper uses NCEP/NCAR reanalysis datasets to understand the hydrological cycle over the Tibetan Plateau. The authors show that plateau's thermal structure leads to the formation of two CISK type systems, characterized by lower level convergence and upper level divergence, which ladders the moist air up to the plateau. The analysis is sound and the results are well presented. I only have few minor concerns. Overall, I recommend the paper for publication in ACP after the authors address following comments.]

Reply 1: The encouraging comments are great appreciated.

[Specific comments

Page 18259, Line 8: What are the longitude bounds for the region you considered for regional mean?]

Reply 2: The longitude bounds are between 93°E and 94°E. Accordingly, we have clarified the description the in the revised text and caption of Fig. 2.

[Page 18260, Lines 14-18: You say that frequency of occurrence of cumulonimbus clouds is 2.5 times the regional mean. Can you clarify which region are you referring to? Figure 6 shows that cloud fraction is much higher over southern slopes of Tibetan plateau. Given this, why should cloud fraction be higher over the Tibetan plateau?]

Reply 3: We have clarified these with "the annual occurrences of convective clouds (cumulonimbus) over the TP are observed with 2.5 times of the regional mean over the other areas of China" in the revised manuscript. Also, we have modified some sentence in Sect. 3.3 with "Figure 6 presents the spatial distribution of total cloud cover over the TP and its surrounding area in July 2008. During the Asian summer monsoon period, the dense cloud covers existed over the regions from the Bay of Bengal, South Asian monsoon region to the southern TP." High cloud fraction in Fig.6 are also located in the South Asian (Indian) summer monsoon region but excluding the other areas of China, which is caused by the two ladders of CISK system presented in this manuscript.

[Page 18260, Line 17: You mention Fig. 6 before Figs. 3-5. I would recommend rearranging figures based on the flow of text.]

Reply 4: Following the reviewer's suggestion, we have mentioned the "see Section 3.3" instead of the "Fig. 6" in that sentence to keep the structure of manuscript.

[Page 18260, Line 26-28: Can you please elaborate how elevated wet island prevents mixing of tropical air with the extra-tropical air?]

Yes, it is elaborated with "the large TP topography prevents dry and cool extratropical air from ''ventilating'' the moist and warm tropics and subtropics" in the revised manuscript.

[Page 18261, Line 11-16: This is a very long sentence. Please consider breaking the sentence into smaller sentences. It is also not clear what you mean here by saying "correlation of Q1 with divergence in contours". The caption of Figure 3 mentions "daily correlation". Do you average daily correlations to construct middle panel of Figure 3?]

Reply 5: Thanks for the careful revision of reviewer.

We have broken this sentence into the short sentences in the revised manuscript as follows: " The middle panel of Figure 3 presents the correlation vectors of the TP heat source column strength Q1 over the TP to the W- and V-wind components at the vertical sections around the TP averaged in July of 2000-2009. In this study, zonal, meridional and a vertical components of the correlation vector are derived through the correlation coefficients of Q1 to U- ,V- and W- wind (or transport flux) components, respectively, where the arrow length denotes the combined correlation with a longer arrow implying a better correlation, and the arrow direction means the direction of anomalous wind (or transport flux) induced by the TP-thermal effect. Therefore, the middle panel of Figure 3 indicates that the air ascent motions induced by the TP heating are profound over the TP during the summer monsoon period."

We don't average daily correlations to construct middle panel of Figure 3. The caption of Figure 3 (middle panel) is changed into "Vertical sections of the correlations of the daily TP heat source column Q1 to the divergences (filled contours) and the correction vectors of daily Q1 to V- and W-wind components in July of 2000-2009…." in the revised version.

[Page 18261, Line 20: Change "and also" to "but also"]

Reply 6: It is changed.

[Page 18264, Line 6: Change "Bengal Bay" to "Bay of Bengal".]

Reply 7: It is corrected.

Figure 2: You say that zonal means are calculated along 93°-94° E. However, NCEP/NCAR reanalysis datasets are available at 2.5° resolution? How do you go from 2.5° to 1° for constructing zonal means?

Reply 8: The NCEP/NCAR reanalysis datasets are available at 1° resolution after 2000. In this study, we used the NCEP/NCAR data of 2000-2009.

[Figure 3: What do you mean by "correction vectors"?]

Reply 9: In the revised manuscript, we have added the following description of "correction vectors" (also see the reply 5):

In this study, zonal, meridional and a vertical components of the correlation vector are derived through the correlation coefficients of Q1 to U- ,V- and W- wind (or transport flux) components, respectively, where the arrow length denotes the combined correlation with a longer arrow implying a better correlation, and the arrow direction means the direction of anomalous wind (or transport flux) induced by the TP-thermal effect.