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Interactive Comment

Interactive comment on "Intraseasonal variations of upper tropospheric water vapor in Asian monsoon region" *by* R. Zhan et al.

R. Zhan et al.

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Response to comments of reviewer ♯2

1. This paper presents some interesting patterns related to upper tropospheric water vapor in the Asian monsoon region. While some of the correlations shown are quite interesting (for instance the similarity of the OLR and water vapor lag correlations shown in Fig. 5 and 6), the paper very much gives the impression of forcing certain results. Beginning with Fig. 3, it is very difficult to see why the authors would pick 10–20 and 30–60 day modes from this data. The power spectra is above the level of white noise almost everywhere from 10–60 days in both plots.

Response: We agree that the power spectra is above the level of white noise almost everywhere from 10–60 days in Fig. 3 of the manuscript, however, this paper focused on two preferred bands, 10–20 and 30–60 day mode. The reasons are as follows: 1) Figure 3 shows that there are two peak powers in UTWV around 50 days and 13 days, respectively. These two peaks are basically located over the upper limit (the 95% confidence levels). Many researches on Asian summer monsoon have suggested that the intraseasonal oscillations (ISOs) of the Asian summer monsoon represent a broad-band spectrum with periods between 10 and 90 days but have two preferred bands of periods (Krishnamurti and Bhalme, 1976; Krishnamurti and Ardunay, 1980; Yasunari, 1980), one between 10 and 20 days and the other between 30 and 60 days. The two peaks in UTWV are just located in these two bands. 2) The meridional propagations of the 10–20 and 30–60-day modes in the Asian monsoon region are known to be different (Yasunari, 1979, 1980; Krishnamurti and Ardanuy, 1980; Chen and Chen, 1993; Zhou et. al., 2005). They are linked to regional characteristics, such as monsoon onsets and breaks. In Fig. 4, two propagating patterns in the 30–60 day mode are seen, while the 10–20-day mode exhibits a uniform westward direction of propagation, suggesting that the meridional propagations of UTWV in these two bands are also different. Therefore, if the relationship between monsoon and UTWV is studied on 10–60 day band, its uncertainty and complexity would be augmented.

2. Before discussing Figure 2 the authors need to explicitly define what they mean by East Asia and South Asia. Having done so, they should stick to this geographic description unless they explicitly state a good reason for changing them. The continually changing geographic regions chosen for the plots give the impression that the authors are trying to force a publishable result out of the data.

Response: This is an important point, but the results prove not to be very sensitive to the region chosen after we carefully checked different regions. We concretized the

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comment as follows. All of the following figures can be found at http://web.lasg.ac.cn/staff/ljp/download/Fig-reviewer%232.pdf.

Figure 1 here is similar to Fig. 2 in the manuscript but averaged over 0°–20° N and 0°–40° N. There is good agreement among these three plots, all suggesting that UTWV variations in East Asia are as variable as those in South Asia on intraseasonal time scales. Figure 2 shows Hovmöller plots of 30–60-day 200 hPa WV averaged over 0°–20° N and 0°–40° N latitude from May to September in 2004 based on AIRS. Like Fig. 4 in the manuscript, two patterns in the 30–60 day oscillation are clear: a South Asian pattern that originates on the western side of the Arabian Sea and moves eastward, and an East Asian pattern that develops over West Pacific and moves westward. Give another instance of the lag correlations between OLR and AIRS WV shown in Fig. 3. Comparison between Fig. 3 here and Fig. 8 in the manuscript suggests that the relationship between OLR and UTWV over the Asian summer monsoon regions is consistent in different sub-region. All above instances suggest that the results are not very sensitive to the region chosen.

We agree that a good reason should be explicitly stated for changing the geographic regions chosen. Next, we further state the reasons.

The definition of South Asia and East Asia mainly is based on the work of Li and Zeng (2002). South Asia is defined as the region (35°–97.5° E, 0°–22.5° N) and East Asia as the region (110°–140° E, 0°–40° N). However, according to the UTWV seasonal variations over these two domains (Fig. 4), in South Asia, the regions with the significant seasonal changes of UTWV can arrive at around 30° N, and over 15°–25° N latitude upper troposphere is wetter all through boreal summer in two monsoon regions. Therefore, we modified the above definition a little. The 15°–25° N latitude is selected as the preferred region where main information in both South Asia and East Asia can be included in a plot with longitude.

The 20°–30° N latitude in Fig. 2 of the manuscript is chosen only because of the more missing in daily data at the 0°–20° N latitude, which can seen from Fig. 1a. In addition, it is known that it is likely not appropriate that the OLR data are used as a proxy for monsoon activity in the extratropics, which leads to the latitudinal selection in Fig. 8 of the manuscript.

3. The authors need to give an explicit description of whether there is any a priori dependence in the AIRS retrievals that could be affecting the results. Presumably there is some climatology used in the retrievals. Could this in any way be affecting the results observed here? Also, I assume that AIRS water vapor is not being assimilated by ECMWF, but an explicit statement of this is required.

Response: There is no a priori dependence in the AIRS retrievals that would affect the results. We focus here on spatial and temporal patterns, and there is no spatial or temporal variability to the airs retrieval methodology (which uses a trained regression which is static).

Some AIRS radiances are being used for temperature in the analysis, but not the geophysical retrieval of humidity. Thus, AIRS water vapor is not assimilated by ECMWF, and the corresponding statement has been noted in the revised manuscript as reviewer $\sharp 2$ suggested.

Altogether, the difference between Figures 7 and 11 is surprising. I certainly would expect that the ECMWF results would be smoother, but I would have expected that the higher horizontal resolution of the AIRS data would lead to smaller variations, not larger variations as the authors find. The authors need to search further to find a more plausible explanation for this.

Response: We wrote in the manuscript that “UTWV disturbances in ECMWF seem to be larger than AIRS." (p8080/L13). This is consistent with the reviewer’s expectation

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that the higher horizontal resolution of the AIRS data would lead to smaller variations.

4. A last very minor point related to Fig. 4 and 10. Presumably the negative contours in the 10–20 day mode have been dropped, but if so then this should be explicitly stated since they are shown in the 30–60 day mode plots. If there are no negative contours then I have really misunderstood this plot, and they definitely need further explanation.

Response: Apologies for the confusion. Indeed, the negative contours in the 10–20 day mode are existent (shown in Fig. 5) but dropped in Figs. 4 and 10 of the manuscript just in order to make the plots more explicit and compact. The explicit statement has been added in the revised manuscript.

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