

We thank Anonymous Reviewer #3 for taking the time to review our manuscript, engaging in collegial discussion, and providing constructive comments and suggestions. These have been helpful in improving the manuscript. The manuscript is revised as described below. For clarity, reviewer's original comments are included in black, our responses are written in blue, and the revision in the updated manuscript is marked with green.

Author response to Anonymous Reviewer #3

Reviewer's comments on "Assessing the consistency of satellite derived upper tropospheric humidity measurements" by Shi et al.

General comments:

This article describes an assessment of four UTH datasets: one using IR measurements and the other three using microwave (MW) measurements. The main purpose is to evaluate the consistency among these UTH datasets. Focus is placed on the tropics. Comparisons show that the four datasets are consistent in tropical-mean, interannual variability. For spatial patterns, they show broad consistency in ENSO-related action centers (e.g., Nino 4 region). Spatially, the IR-based UTH shows smaller variability than the MW-based UTH. The authors also re-examined a previous finding that was based on IR data (Shi et al. 2018), namely, upper tropospheric moistening during the El Nino events where convection is concentrated, but overall upper tropospheric drying when averaged over the whole tropics. They found that this conclusion is supported by the other three MW datasets. Finally, they analyzed the long-term changes as depicted in the four datasets by focusing on consistency among them.

Overall, I believe results from this assessment study should be useful to researchers in climate community who wish to use these datasets for diagnostic studies or model evaluations. It will contribute to the literature. As such, the paper is publishable. This kind of technical analysis fits the scope of AMT. Therefore, I'd recommend the paper be published after minor revisions.

We thank Reviewer #3 for the helpful comments and suggestions. We revised the manuscript as suggested. The following details the revision.

Specific comments:

L223-224: While UTH anomalies in the IR measurements are weaker than those in the MW in the Hovmoller diagram, the tropical-averaged UTH anomalies in the IR seem to be larger than those in the MW, as seen in Fig. 1(b). I see deeper dips in the IR data during the 1997-1998, and 2015-2016 ENSO events.

The Hovmöller diagram is averaged over 5°S-5°N, while the plots in Fig. 1b are averaged over 20°S-20°N. The deeper dips in the IR data during the 1997-1998, and 2015-2016 ENSO events mainly come from larger ratio of dry areas in the subtropics as shown in the new Fig. 4b in the revision. The following is edited and added to the paragraph discussing UTH spatial features during El Niño:

In the NCEI HIRS UTH panel, the magnitudes of both positive anomalies along the central-eastern equatorial Pacific and the negative anomalies in the western Pacific appear smaller than those in the other three microwave UTH panels, consistent with what is seen in the Hovmöller analysis discussed earlier. However, over the tropical domain, the HIRS data have larger proportions of dry areas in the subtropics during El Niño events (resulting in larger overall dry area ratios shown in Figure 4b), leading to deeper dips of UTH during El Niño events displayed in Figure 1b.

L224 – 225: “Differences in the definition and computation of UTH, the sensitivity of different sounder, and clear-sky process may all contribute to the different strengths of derived anomalies”. More details should be given to each of these causes as to how they affect the magnitude of the anomalies. This is a technical paper. The readers will likely care about such details.

This statement was referring to the observation of the weaker HIRS anomalies described in the previous sentence. We believe that the smaller magnitude of the anomalies compared to microwave data is primarily due to the definition used to compute UTH. The sentences are edited to:

In general, the equatorial UTH anomalies in the infrared measurements are relatively weaker than those in the microwave measurements. The definition used to compute the HIRS UTH may be the primary factor for the smaller magnitudes. The averaging of pixel-level brightness temperatures to the grids first before the UTH is computed may further smooth out the largest anomalies (both positive and negative).

L300: Since Nino 4 region has been mentioned and used for comparison in quite a few places, it makes sense to mark it up on the maps using rectangles.

The Nino 4 region is added using a rectangle to all the El Niño and La Niña maps.

L315 Conclusion: for a technical paper, I’d recommend the main findings be organized in bullet points to facilitate reading.

The main findings in the conclusion are organized in bullet form in the revision.