

## 2 Reviewer #2

We greatly appreciate the reviewer's effort to review the manuscript and make recommendations to improve the paper. The reviewer's points were well taken and we have adopted all the reviewer's comments in the revised version. The main concern of the reviewer is that we have not properly cited the previous publications. We agree that we should have either cited the previous publications conducted using infrared measurements or should have provided an explicit justifications for not doing so. Nevertheless, we are providing very comprehensive answers to the comments, hoping to fully address the reviewer's concerns. In order to adopt the reviewer's comments, we have particularly revised the introduction to better explain the novelty of our work. In addition to citing several new relevant papers in the introduction and elsewhere, we have also considered analyses and results provided in the previous publications for the interpretation of our results.

General comments: The paper addresses an interesting topic, it attempts to analyse the diurnal cycle of humidity in tropical regions in a more coherent manner with a multi-channel microwave instrument in a drifting orbit. I agree with the authors that there is still scope for better analyses of the diurnal cycle of tropospheric humidity, and the measurements used in this paper provide a good basis for such an analysis.

We thank the reviewer for the encouragement.

The authors state: Despite the importance of water vapor especially in the tropical region, the diurnal variations of water vapor have not been investigated in the past due to the lack of observations. - This not true. - Let me give you a few examples of papers that analyse the diurnal cycle of upper tropospheric moisture, the first one goes back more than 20 years.

We agree that there has been several previous efforts to evaluate the diurnal cycle of relative humidity mainly using infrared measurements. We have now cited these publications in the introduction and have also benefited from the discussions provided in some of these publications that try to connect the RH distribution with the physics and dynamics of the atmosphere. In addition to citing publications introduced by the reviewer, we have also included several recent publications to diversify our references. That being said, we would like to emphasize that for the reasons explained below, the IR and MW measurements are expected to yield different results, therefore the disagreement between the results should be considered as the instrumental differences.

- the cloud screening removes a large portion of the IR measurements

especially over convective regions. The rejected observations normally represent moist conditions, therefore the IR results only represent dry conditions. For instance, John et al. (2011) indicated that the IR cloud screening introduces on average around 10% systematic error in the upper tropospheric humidity values. It is clearly shown in John et al. (2011) that the cloud screening especially removes most of the data over the convective regions causing a large systematic bias in the RH analysis for the convective regions. It should be noted that among the channels, the upper tropospheric channels are less sensitive to clouds than the lower channels, because the weighting functions for the upper channels normally peak above the clouds, therefore it is expected that the dry bias due to cloud screening is even larger for the middle and lower tropospheric channels.

- it should be noted that the cloud screening not only impacts the RH amplitude by removing the moist conditions, but also impacts the diurnal peak time. For instance, Figure 1 shows an example of the impact of applying different cloud thresholds on the diurnal cycle of relative humidity. As shown the diurnal peak time significantly changes with the threshold used to filter the clouds.

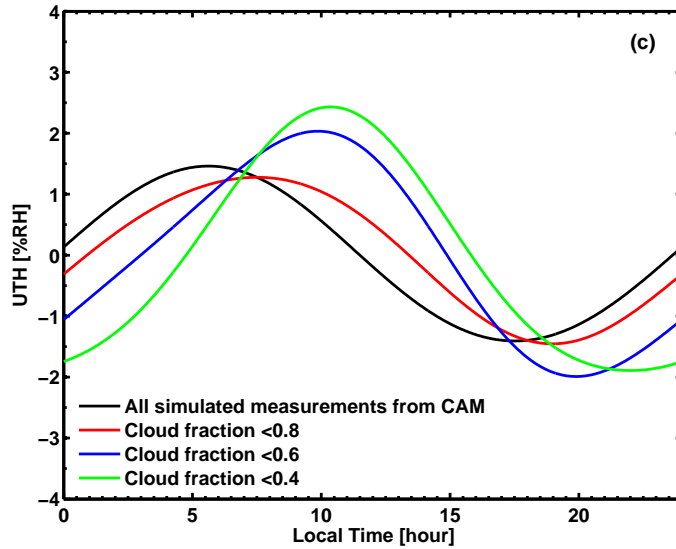


Figure 1: Impact of cloud screening on the diurnal peak time of upper tropospheric humidity. Image contributed by Ajil Kottayil, Cochin University of Science and Technology, India

My second major concern is that the analysis is too descriptive with little attempts to explain the observations in terms of meteorology/physics.

We have now provided more information and explanation for the physical mechanisms behind the results. Besides, we have also provided details regarding how the results are connected with mesoscale features of the atmosphere. However, we need to emphasize that the goal of the current study was to provide an observational analysis as well as a clear picture of the diurnal cycle of RH in the tropical region using unbiased observations. We agree with the reviewer that there is still a need to conduct work on the impact of meteorology/physics on the diurnal cycle of RH. However, this cannot be accomplished using the data provide by SAPHIR instrument nor was the goal of the current study. This would require combining data from models/reanalyses and measurements but as it has been shown in previous publications (e.g., Chung et al. 2013), the diurnal cycle in most models/reanalyses is not expected to be accurate.