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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diurnal variations of humidity and ice water content in the tropical upper troposphere" *by* P. Eriksson et al.

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We appreciate that our and the referee's viewpoint on the main advantages on the manuscript coincide. The late reply from our side depends vacation for the first author.

Major comments:

1. Any bias between the instruments is clearly a critical point. We have studied the bias between MLS and SMR RHi in Ekström et al. (2008) and Rydberg et al. (2009), and the bias between CloudSat and SMR IWC in Eriksson et al. (2008) and Rydberg et al. (2009). The question is not totally resolved by these studies, but we do not see how the suggested references can be applied here. To our best understanding,

the calibration of geostationary instruments discussed in the references can make use of the fact that polar orbiting and geostationary instruments observe occasionally the same atmospheric volume, and this at the same wavelengths. Let us use Odin-SMR as example for our case. SMR observes the atmosphere around 500 GHz and there is no other sensor operating in this frequency region (MLS and SMILES have channels at 640 GHz). Anyhow, the basic calibration (in terms of brightness temperature) is only secondary in this context. This calibration is discussed for SMR in Ekström et al. (2007).

The biases are dominated by retrieval issues, and for SMR RHi the main uncertainty is cloud interference. To what extent we handle the cloud interference and other retrieval uncertainties can only be assessed by comparison with other measurement data. In fact, this manuscript is a step in this process. However, we have failed to make this clear in the manuscript. This is in line with a comment by Referee 1 and in that reply we suggested adding a new section (3.4 Discussion), where instrument biases will be discussed. This will include some quantitative study to show how a bias between, e.g., MLS and SMR RHi will affect the derived diurnal cycle.

2. The spatial coverage of MLS IWC retrievals is only marginally higher than the one for CloudSat. Both instruments observe only along the orbital plane (though MLS has a higher across-track footprint size). CloudSat provides a better accuracy than MLS, especially for the high IWC values that dominate the average IWC we study here. Accordingly, we see no reason to include MLS IWC. In addition, this would make the error estimation for derived diurnal cycles much more complex and the overall interpretation of the comparison much harder.

Why we perform alternative CloudSat IWC retrievals is commented in Section 2.2.2, but just very briefly. This section will be extended (see reply to Referee 1) and we will then also justify the alternative retrievals more in detail. In short, the official retrievals make different assumptions on the particle size distribution (PSD). In Eriksson et al. (2008) we showed that those assumptions gave significantly higher average IWC. It

is not clear what assumptions are the best, an unlucky fact, as the PSD is the main retrieval uncertainty for IWC. We can not mimic the CloudSat assumptions in the SMR retrievals. Accordingly, by making alternative CloudSat retrievals, we decrease strongly the impact of the unknown PSD, that otherwise would have masked the diurnal cycle.

Minor comments:

P11716, L 20-23: A single retrieval database is used for the complete tropical region, and both 06.00 and 18.00 data. The difference in local time between CloudSat and SMR observations has thus no impact, as long as CloudSat encounters at some location and time atmospheric scenarios similar to the ones SMR observe. See further Rydberg et al. (2009).

Table 1: The table includes the one standard deviation error. The significance is normally judged with respect to two standard deviations and Figure 6 shows that a zero amplitude is inside those error margins.

Table 2: It should be remembered that the N. Pacific Ocean amplitude is only large in relative terms. We will investigate more in detail, and try to better understand, this result.

Figure 1: We have practical experience from presentations that the contour lines are needed for a good visualization of the data. Adding wind vectors would hide the basic measurement information, the figure would be too crowded.

Figure 7: Is not the problem here that the values are small? Referee 1 thought the data were missing. The satellite-estimate is among the model points, quite far away from the legend box.

All other comments: We thankful for these well-observed suggestions and needed grammatical corrections.

Patrick Eriksson for the author team

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 11711, 2010.