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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.

Anonymous Referee #2

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This is a review of ACP manuscript acp-2010-233 ("Diurnal variations of humidity and ice water content in the tropical upper troposphere") by Eriksson et al.

This is an interesting paper that investigates the diurnal variations of water vapor and ice water content in the tropical upper troposphere through a synergistic use of multiple polar-orbiting satellite measurements. Although approximately 6-hourly measurements are not definitely sufficient to fully decompose the diurnal variations, since microwave measurements are less affected by clouds compared to infrared measurements, the results shown in this paper will help to supplement and improve the previous findings on the diurnal variation of upper tropospheric humidity. Furthermore, this paper presents the diurnal variation of ice water content for the first time. Thus, this paper is suitable for publication after the following issues are addressed.

Major comments:

1. Due to the temporal sampling issues of polar-orbiting satellites in comparison to geostationary satellites, the authors combined measurements of Odin-SMR, AURA-MLS, and CloudSat in order to determine the amplitude and phase of diurnal variations of water vapor and ice water content in the tropical upper troposphere. However, it should be noted that any bias between satellite measurements and possible orbital drift of satellites may distort both amplitude and phase of the diurnal variations. Therefore, it is required to confirm the consistency between these satellite measurements using a vicarious calibration method (e.g., Breon et al., 2000; Gunshor et al., 2008).

Breon, F.-M., D. Jackson, and J. Bates, 2000: Calibration of the METEOSAT water vapor channel using collocated NOAA/HIRS-12 measurements. J. Geophys. Res., 105, 11,925–11,933.

Gunshor, M. M., T. J. Schmit, and W. P. Menzel, 2004: Intercalibration of the infrared window and water vapor channels on operational geostationary environmental satellites using a single polar-orbit satellite. J. Atmos. Ocean. Technol., 21, 61-68.

2. The authors addressed that AURA-MLS produces ice water content in addition to profiles of humidity and temperature. Thus, the AURA-MLS ice water content should be employed to supplement the poor spatial coverage of CloudSat. In addition, it appears more reasonable to include results of comparison between the CloudSat ice water content derived by the authors with the standard product.

Minor comments:

P11712, Line 10: 'in the order of 6%' to '$\sim$7%'

P11712, Line 20: also show

P11713, Lines 22-29: More detailed analyses are given in Horvath and Soden (2008) and Sohn et al. (2008).

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Horvath, A., and B. J. Soden, 2008: Lagrangian diagnostics of tropical deep convection and its effect upon upper tropospheric humidity. J. Climate, 21, 1013-1028.

Sohn, B.-J., J. Schmetz, and E.-S. Chung, 2008: Moistening processes in the tropical upper troposphere observed from Meteosat measurements. J. Geophys. Res., 113, D13109, doi:101029/2007JD009527.

P11714, Lines 6-7: It is true that infrared measurements have sampling problems in the presence of clouds. However, the infrared measurements from geostationary satellites provide a superior temporal sampling compared to polar-orbiting satellites. Thus, this point should be addressed.

P11714, Line 27: Please delete 'within'.

P11715, Line 7: the tropical upper troposphere

P11716, Lines 20-23: The observational time difference ($\sim$6 hours) between CloudSat and Odin and the poor spatial coverage of CloudSat may induce uncertainties in the construction of retrieval database.

P11716, Line 22: Please clarify 'weather information'.

P11717, Line 4: It seems that 'the horizontal footprint size' is a more accurate expression than 'the horizontal resolution'.

P11717, Lines 5-6: Please provide references on the accuracy of retrieved RHi and ice water content.

P11717, Lines 16-17: What does 'a 6 dB footprint resolution' mean?

P11718, Line 13: a 13:40 h local time ascending node

P11719, Line 6: a 3-month spin-up

P11721, Line 14: member states

P11722, Line 6: were then

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P11723, Line 23: the humidity distribution

P11724, Lines 16-17: Needed to be rephrased.

P11725, Line 10: the datasets

P11725, Line 11: noisier

P11725, Line 15: It is not clear what 'relatively local convection' means.

P11725, Line 20: show

P11725, Line 20: noisier

P11725, Line 21: show

P11726, Line 11: observes

P11726, Line 20: typo ('tho')

P11726, Line 21: show

P11726, Lines 21-22: How about 'previous observational studies' instead of 'what can be expected from previous observations'?

P11727, Lines 3-4: amplitude and phase of the diurnal variations

P11727, Line 11: meaningful

P11727, Line 23: respective

P11728, Line 4: accurately

P11728, Line 18: combinations

P11729, second and third paragraphs: The vertical phase distributions of high cloud diurnal variations are presented in more detail in Tian et al. (2004) and Chung et al. (2009).

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Tian, B., B. J. Soden, and X. Wu, 2004: Diurnal cycle of convection, clouds, and water vapor in the tropical upper troposphere: Satellites versus a general circulation model. J. Geophys. Res., 109, D10101, doi:10.1029/2003JD004117.

Chung, E. S., B. J. Sohn, and J. Schmetz, 2009: Diurnal variation of outgoing longwave radiation associated with high cloud and UTH changes from Meteosat-5 measurements. Meteorol. Atmos. Phys., 105, 109-119, doi: 101007/s00703-009-0041-8.

P11730, Line 1: relatively

P11730, Line 1: double maxima

P11730, Line 19: provide

P11731, Line 6: captures

P11731, Line 15: the IFS is

P11732, Line 13: also show

P11732, Line 22: Please clarify ‘the measured’.

P11733, Line 1: the diurnal variation

P11733, Lines 12-15: Needed to be rephrased.

P11733, Line 19: occurs

P11733, Line 22: 05:00 h

P11734, Line 4: How about ‘atmospheric layer’ instead of ‘region’?

P11734, Line 18: maximum or peak

P11734, Line 19: an early morning maximum

P11735, Lines 14-15: The RHi variations in ERA data were found to be excellent agreement with the observations.

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P11735, Line 22: a little difference

Table 1: The diurnal amplitude over the tropical Indian Ocean is smaller than that over the northern Pacific Ocean. In addition, the diurnal amplitude is significant in spite of the small mean value over the northern Pacific Ocean. Is there any reason?

Table 2: Is there any reason that the northern Pacific Ocean has a significantly large diurnal amplitude?

Figure 1: It will be better to superimpose the geographical distribution of wind vectors.

Figure 1: (Caption) The red and cyan

Figures 2 and 3: It would be more reasonable to change the order of two figures.

Figure 4: (Caption) CloudSat.

Figure 5: (Caption) Fig. 4 instead of Fig. 1

Figure 7: It is difficult to identify the satellite-estimated IWC of the northern Pacific region due to the legend box.

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