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Interactive Comment

Interactive comment on “Evaluation of balloon and satellite water vapour measurements in theSouthern tropical UTLS during the HIBISCUS campaign” *by* N. Montoux et al.

N. Montoux et al.

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General comments:

The major comment of the reviewer was the lack of conclusions regarding the performances of each of the balloon and satellite instruments, which could help understanding better which data could provide the best water vapour measurements. In addition a question was the advantage of including measurements such as those of GOMOS, SAOZ or even MIPAS ESA operational processor never validated before.

Following those comments and those of the other reviewers, the paper has been deeply revised in the aim of providing clear information on the performances of each of the water vapour instruments available in the tropics during the HIBISCUS campaign, including measurements never evaluated before (unfortunately not MLS because of the delay of its launch). Since it is recognised that the performances of each vary greatly with altitude for a number of reasons, conclusions have been derived separately for the stratosphere, the TTL and the upper troposphere, which we hope could be useful for potential users of the data.

A major change in the comparison is the use of the ECMWF / Reprobus model water vapour profiles as reference instead of AIRS products little reliable above 100 hPa. Though the model has known limitations (eg dry bias in the stratosphere, no supersaturation), the advantage of this use is to provide an indication of H2O variability in the upper troposphere between the location of the measurements of two platforms never fully collocated.

Specific issues:

- Differences between in situ and remote measurements:

As shown in Fig. 1 and 2, the use of ECMWF / Reprobus, allows better separating the possible contribution of instrument biases and atmospheric variability.

- Instrumental component SDLA in situ measurements in the stratosphere :

The instrument is 40 m below the balloon and descent measurements only are considered. But contamination by outgassing cannot be totally excluded at the upper levels, particularly at the very beginning of the descent at slow velocity, which is the likely explanation of the 10 ppmv H2O at the top of the SF2 profile above 19.5 km and perhaps above 18.5 km in SF4 since this balloon descended slower than SF2 at the beginning. However, outgassing is not an explanation for the relatively large H2O mixing ratio variations between the tropopause and 18 km since the variations can also be seen, but anti-correlated in CH4 (see Durry et al., 2006), which is the basis of the attribution of these variations to an overshooting of tropospheric air, including hydration by ice particles (Nielsen et al., 2007). Note that the mesoscale model of Marecal et al. (2007)

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having no overshoot process cannot capture such event, which requires a cloud resolving model (Grosvenor et al., Atmos. Chem. Phys. Discuss., 7, 7277–7346, 2007).

- SAGE II:

Indeed, SAGE II and HALOE cannot be seen as independent, since the retrievals of the first have been modified to match those of HALOE. There are now several references to this in the description of SAGE II as well as in the discussion of the comparisons.

- HALOE:

We have contacted the PI. This correction refers to a retrieval shown in the SPARC water vapour report (section 2.3.1) which uses a modified O2 continuum in the water vapour forward model and reduced retrieval constraints. It indeed decreases the dry bias seen around the tropopause with the V19 but gives also noise in the profiles. A new v20 version of the algorithm should be available sometimes which we are ready to use in the comparisons (as for ozone see Borchi and Pommereau, 2006). However, in addition to the already identified altitude registration error, there is also a possible contribution of spectral lines saturation in the UT, providing a potential explanation for the strange extremely small variability of HALOE H2O (2.8 ppm at 12 km) compared to ECMWF (21.9 ppm). This point, not identified in the first version of the paper, has been added in the discussion. Since the correction is still unpublished and not applied in the recent publications of HALOE water vapour data (eg, Scherer et al., 2007; Grooß and Russell, 2005), we feel difficult and probably confuse to apply it here.

- AIRS:

We have contacted the PI. There is indeed no validation of AIRS above 100 hPa. The referee is right, these data have likely little meaning in the stratosphere since the profiles are strongly weighted by the a priori. This is the main reason for replacing the AIRS reference by ECMWF / Reprobus in the paper as suggested by other

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reviewers. However, a new retrieval version v5 was made available after our first submission, which we are using now. The new version has only 14 pressure layers only between the surface and 50 hPa, and has also more stringent quality criteria (less data with Qual H2O=0 or 1 in v5 than in v4) and improved error estimates as explained in the “AIRS/AMSU/HSB Version 5 Level 2 Performance and Test Report” http://daac.gsfc.nasa.gov/AIRS/documentation.shtml The individual profiles studied in the UT are wetter by 20% compared to v4 (consistent with the above report), showing better agreement with SDLA in the UT, as explained in the paper.

- MIPAS:

The list of validation papers has been updated. Indeed MIPAS has been compared to the MIAWARA ground-based microwave radiometer displaying a small wet bias compared to the last, but these measurements are little relevant here since our comparisons extend to 25 km only. It is true that HALOE, SAGE II and MIPAS validations are in some way all tied to the CFH. But since the difference between them is smaller than the systematic error of 25-40% of MIPAS estimated by Raspollini et al (2006), all we can do is to conclude that there is no significant bias between them in the tropics. However, a difference as shown by the statistics of collocated profiles as well as zonal means is the relatively lower precision of MIPAS ESA operational processor in the stratosphere (10%, consistent with Raspollini estimates) and its fast degradation below 20 km.

- GOMOS:

This is the first validation exercise of the H2O profiles of this instrument, concluding at a 25% random error in the stratosphere, which has nothing to do with the errors provided in the data files. The reason for that was given to us by the GOMOS team who is working on it.

- General:

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The present study applies to retrieval versions currently available, sometimes after 20 years efforts, sometimes very recently only. We are aware of the work in progress on GOMOS, MIPAS, AIRS, SCIAMACHY and HALOE and look forward to evaluate the progress with the above data and technique.

-Zonal means. HALOE minimum at 17-19 km:

The HALOE minimum in the TTL is a feature, which can be seen also, though less pronounced on SAGE II, but not on other data or model. Since the minimum mixing ratio is 4 times smaller than that of saturation (SF2, Fig.1), it cannot be attributed to local condensation as in the case of very low tropopause temperature (Kelly et al., 1993 in Northern Australia and SCOUT-O3 at the same place in 2005). A similar problem is also observed on ozone (see Borchi and Pommereau, 2006), recognised by the HALOE PI to come from a growing altitude registration error below 20-21 km. It is expected that it should be corrected in the new line-by-line calculation of the V20 HALOE version. Given the importance of the minimum in the discussion of the dehydration process, we think useful underlying this point.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 6037, 2007.

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