Atmos. Meas. Tech. Discuss., 7, C3490–C3492, 2014
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Atmospheric Measurement Techniques Discussions

Interactive comment on "Upper-troposphere and lower-stratosphere water vapor retrievals from the 1400 and 1900 nm water vapor bands" *by* B. C. Kindel et al.

Anonymous Referee #1

Received and published: 3 November 2014

The present paper reports on water vapor retrieval in the upper troposphere and lower stratosphere from aboard the Global Hawk during the NASA-ATTREX missions using a solar spectral flux radiometer. A validation of the measurements with the NOAA water vapor instrument is given and a convincingly good agreement is found between the two measurements. The manuscript is well written and it may deserve publication after some revisions are made, as they are detailed out below.

Major comments:

1. The measurements made during dive 2 of SF2-2013 were certainly affected by the

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presence of cirrus clouds (e.g., see the NASA ATTREX CPL data, and the data from other spectrometric measurements aboard) and in fact you are seeing traces of an ice absorption between 1450 to 1600 nm. Accordingly, ice absorption needs to be included in your retrieval, and mentioned in the manuscript.

2. Unlike mentioned in the final paragraph, the O2 ($1\Delta g(0)$ $3\Sigma g\text{-}(0)$) absorption at 1270 nm and the CO2 (21o2, 00o0) absorption band (at 1580 to 1620 nm) could be used to validate the assumptions made in RT calculations. This might be relevant for example to check for the assumptions made regarding the extra-terrestrial solar irradiance and the aerosol concentration and their type in the air column between the aircraft and TOA. This issue needs to be more carefully addressed.

3. The manuscript lacks some crucial information on the assumption on the aerosol type and profiles used in the RT model. To provide such information appears rather necessary, since in the near-R spectral range, Mie scattering – though small in stratosphere – becomes more important as compared to Rayleigh scattering.

Minor comments:

1. Abstract, third line: correct to 'Solar Spectral Flux Radiometer' (SSFR)

2. Section 2, third paragraph: Here, a sentence needs to be included in the manuscript for which spectral resolution the calculations were made.

3. Section 7, equations (2) and (3): Since at large water vapor columns, the water vapor bands starts to become saturated, you need to mention an upper limit of the validity of the linear equations (2) and (3) of the water column as a function of water vapor absorbance.

4. Section 7, last paragraph: An absolute calibration of the radiometer would not be necessary if you were to inspect ratio of measured spectra, for example a ratio of a spectrum taken at the upper levels vs a spectrum taken at the lower levels of the Global Hawk cruise, because then you could use a differential approach to interpret

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the measurements. In this case, you would also not need to refer your measurements to the 'Kurucz' TOA solar irradiance spectrum (which in fact is not a TOA solar irradiance spectrum, but a spectrum taken the Kitt Peak observatory, from which residual atmospheric absorption have been a more or less well removed).

5. Section 'results', last but one paragraph: Since in section 3 you mention that the absolute radiometric uncertainty of the instrument is 5%, please demonstrate how the radiometric precision of the instrument can be 0.1%, as stated in the section results. Arguments need to be developed via inspecting the spectrometer straylight, the detector noise as a function of the number co-added spectra, detector well-depth, et cetera,

6. Section 'summary', last paragraph: You write that the instrument zenith looking, what is field of view. If the field of view is $2{\cdot}\pi$, then it would be more appropriate to use the notation 'upper hemisphere'.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 10221, 2014.