Water vapor continuum absorption in near-infrared from CAVIAR laboratory measurements

The files present cross-sections of the water vapour continuum absorption, retrieved from the high-resolution spectra. The spectra were recorded using a Bruker IFS-125 High-Resolution FTS at the Rutherford Appleton Laboratory (RAL) Molecular Spectroscopy Facility (http://www.msf.rl.ac.uk).

The optical depth τ_m of the measured spectra was derived in a standard way as:

$$\tau_m(\nu) = -\ln\{I(\nu)/I_o(\nu)\},$$

where I is the measured intensity of a sample measurement, I_o is the intensity of a background measurement, and ν is wavenumber in cm^{-1}.

The continuum optical depth τ_c in each microwindow was then derived using a procedure similar to that of CKD [1], i.e. the local line contribution was excluded from the experimental spectra:

$$\tau_c(\nu) = \tau_m(\nu) - \Sigma\tau_{line,i}(\nu-\nu_i),$$

where $\tau_{line,i}(\nu-\nu_i)$ is local Lorentzian[1] contribution from i^{th} H_2O spectral line, centered at ν_i, within 25 cm^{-1} from every line centre. Following the CKD approach the Lorentzian contribution of monomer lines is calculated without the 25 cm^{-1} 'CKD-plinth' [1]. The local line contribution was calculated using line-by-line code and HITRAN-2008 [2] spectral line database.

The self-continuum cross-sections [$cm^2 molec^{-1} atm^{-1}$] was derived from pure water vapour measurements and defined as:

$$C_s(\nu,T) = \frac{\tau_c(\nu)}{\rho_s P_s L} \equiv \tau_c(\nu)\frac{kT}{P_s^2 L};$$

where ρ_s and P_s are water vapor gas number density and pressure respectively; k is Boltzmann constant, T is the temperature, and L is the absorbing optical path length.

The foreign continuum cross-section was derived from measurements with relatively high pressure P_f of an artificial air (Air Products Zero Air, 79.1% N_2 and 20.9% O_2), with the self-continuum contribution subtracted according to the values obtained from pure water vapour measurements, and N_2 and O_2 binary absorption contribution excluded by the experimental scheme (by background measurements).

$$C_f(\nu,T) = \frac{\tau_c(\nu)}{\rho_s P_f L} \equiv \tau_c(\nu)\frac{kT}{P_s P_f L}$$

In the MT_CKD software the continuum cross-section [$cm^{-1}(molec/cm^3)^{-1} \equiv cm^2/molec$] at any temperature is normalized to the number density at standard conditions (1 atm, 296 K). Therefore, the presented here values should be multiplied by the factor T/296 to be compared with MT_CKD values.

[1] Clough, S. A., F. X. Kneizys, and R. W. Davies (1989), Line shape and the water vapor continuum, *Atmos. Res, 23,* 229–241.

[2] Rothman L.S., et al. (2009), The HITRAN 2008 molecular spectroscopic database, *J. Quant. Spectrosc. Radiat. Transfer*, *110*, 533-572, doi:10.1016/j.jqsrt.2009.02.013.

All other details of the experiments and continuum retrieval can be found in the references below.
The references to cite with regards to the data

[1] At the wavenumbers of interest here, the Lorentzian line shape is equivalent, to high accuracy, to the Van Vleck and Huber lineshape used by *Clough et al.* [1989].

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Self-continuum:

Paynter DJ, Ptashnik IV, Shine KP, Smith KM, McPheat R, Williams RG. "Laboratory measurements of the water vapour continuum in the 1200-8000 cm-1 region between 293 K and 351 K". *J. Geophys. Res*., 114, D21301 (2009).

Ptashnik IV, McPheat RA, Shine KP, Smith KM and Williams RG. "Water vapor self-continuum absorption in near-infrared windows derived from laboratory measurements". *J. Geophys. Res*., 116, D16305 (2011).

Ptashnik IV, Shine KP and Vigasin AA. "Water vapour self-continuum and water dimers. 1. Analysis of recent work". *JQSRT*, 112, 1286-1303 (2011).

Foreign continuum:

Ptashnik IV, McPheat RA, Shine KP, Smith KM and Williams RG. "Water vapour foreign continuum absorption in near-infrared windows from laboratory measurements". *Phil. Trans. R. Soc*. (A), 370, 2557-2577 (2012).

Newman SM, Green PD, Ptashnik IV, Gardiner TD, Coleman MD, McPheat RA and Smith KM. Airborne and satellite remote sensing of the mid-infrared water vapour continuum, *Phil. Trans. R. Soc*. (A), 370, 2611-2636 (2012).