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Radiative impact of the water vapour continuum in near-infrared windows and possible consequences for cloud remote sensing

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Water vapour plays an important role in the Earth's energy budget. In addition to the spectral lines, it has long been recognized that water vapour possesses a continuum absorption which varies relatively slowly with wavelength and pervades the entire infra-red and microwave spectral region. It has a marked impact on the Earth's radiation balance with consequences for understanding present day weather and climate and predicting climate change. It is also important for remote sensing of the Earth and its atmosphere.

The UK-based consortium CAVIAR (Continuum Absorption at Visible and Infrared wavelengths and its Atmospheric Relevance) aims to improve both the characterisation and understanding of the water vapour continuum. It uses state-of-the-art theory and co-ordinated, intercalibrated laboratory and field measurements in order to quantify the strength of the water vapour continuum in a consistent manner across the wavelength range 0.5-125 microns.

We present calculations of the radiative impact of the water vapour continuum comparing results from different continuum descriptions, in particular the commonly used CKD and MTCKD models with the new description developed within CAVIAR. CAVIAR laboratory measurements show that e.g. the MTCKD-2.5 model underestimates the strength of the water vapour continuum by up to an order of magnitude in near-infrared windows.

Single-column calculations of the impact of the revised continuum absorption have been performed using a line-by-line code (Mitsel et al., 1995) based on the HITRAN 2008 database as well as the Edwards-Slingo radiation code (Edwards et al., 1996), an offline version of the two-stream radiation code used in the UK Met Office Unified Model. The latter model has also been used to calculate the global radiative impact of the continuum.

Remote sensing of cloud parameters is heavily dependent on near-infrared window channels, where absorption from atmospheric gases is small; hence revisions to the water vapour continuum absorption used in retrievals have the potential to distort retrieved cloud properties. We will illustrate and quantify the possible effect on retrieved cloud liquid water content for channels in the near-infrared as used e.g. by the MODIS instruments on the AUQA/TERRA satellites.

References:

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