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Global distributions of water vapour isotopologues retrieved from IMG/ADEOS data

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Abstract. The isotopologic composition of water vapour in the atmosphere provides valuable information on many climate, chemical and dynamical processes. The accurate measurements of the water isotopologues by remote-sensing techniques remains a challenge, due to the large spatial and temporal variations. Simultaneous profile retrievals of the main water isotopologues (i.e. $H_2{}^{16}O$, $H_2{}^{18}O$ and HDO) and their ratios are presented here for the first time, along their retrieved global distributions. The results are obtained by exploiting the high resolution infrared spectra recorded by the Interferometric Monitor for Greenhouse gases (IMG) instrument, which has operated in the nadir geometry onboard the ADEOS satellite between 1996 and 1997. The retrievals are performed on cloud-free radiances, measured during ten days of April 1997, considering two atmospheric windows (1205–1228 cm^{-1}; 2004–2032 cm^{-1}) and using a line-by-line radiative transfer model and an inversion procedure based on the Optimal Estimation Method (OEM). Characterizations in terms of vertical sensitivity and error budget are provided. We show that a relatively high vertical resolution is achieved for $H_2{}^{16}O$ (~4–5 km), and that the retrieved profiles are in fair agreement with local sonde measurements, at different latitudes. The retrieved global distributions of $H_2{}^{16}O$, $H_2{}^{18}O$, HDO and their ratios are presented and found to be consistent with previous experimental studies and models. The Ocean-Continent difference, the latitudinal and vertical dependence of the water vapour amount and the isotopologic depletion are notably well reproduced. Others trends, possibly related to small-scale variations in the vertical profiles are also discussed. Despite the difficulties encountered for computing accurately the isotopologic ratios, our results demonstrate the ability of infrared nadir sounding for monitoring atmospheric isotopologic water vapour distributions on a global scale.

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