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Simulation of the isotopic composition of molecular hydrogen in the stratosphere

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Molecular hydrogen has both source and sink in the stratosphere yielding an approximately constant mixing ratio of about 0.5 ppmv. The stratospheric source and sink processes of H_2 can therefore be investigated using the isotopic composition. Stratospheric observations of isotopic composition of molecular hydrogen showed deuterium enrichment of H_2 with a tight correlation with CH_4 decrease that is rather independent of latitude (Röckmann et al., 2003).

We present simulations of the hydrogen isotope ratios of H_2 and CH_4 in the stratosphere. A consistent hydrogen isotope chemistry scheme for the whole CH_4 oxidation chain was incorporated into the chemistry module of the Chemical Lagrangian Model of the Stratosphere (CLaMS). The simulations are performed using a simplified representative box model approach. The results are compared with simultaneous observations of the isotopic composition of CH_4 and H_2. We also show the sensitivity with respect to uncertainties in the individual branching ratios and fractionation constants. As many isotope fractionation factors and branching ratios of the CH_4 oxidation chain are not known with high accuracy, the simultaneous comparison of the deuterium enrichment of both CH_4 and H_2 and their correlation with CH_4 is important for the evaluation of the different sensitivities.