What can isotopes tell us about the atmospheric H_2 cycle?

MARIA ELENA POPA[1], DIPAYAN PAUL[2], CHRISTOF JANSSEN[3], FREDERIK FELIUS[4], FABIAN EDUARDO TAPIA RODRIGUEZ[5], THOMAS RÖCKMANN[6]

[1] Utrecht University, Institute for Marine and Atmospheric Research Utrecht (IMAU), m.e.popa@uu.nl
[2] University of Groningen, Centre for Isotope Research (CIO), d.paul@rug.nl
[3] Sorbonne Université, Observatoire de Paris, Université PSL, CNRS, LERMA-IPSL, Laboratoire d'Etudes du Rayonnement et de la Matière en Astrophysique et Atmosphères, christof.janssen@upmc.fr
[4]Utrecht University, Institute for Marine and Atmospheric Research Utrecht (IMAU), frederikfelius@gmail.com
[5]Utrecht University, Institute for Marine and Atmospheric Research Utrecht (IMAU), f.e.tapiarodriguez@uu.nl
[6]Utrecht University, Institute for Marine and Atmospheric Research Utrecht (IMAU), T.Roeckmann@uu.nl

At a mole fraction of about 500 ppb, molecular hydrogen (H_2) is the second most abundant reduced gas in the atmosphere after methane. It is important for atmospheric chemistry, and an indirect greenhouse gas due to its reaction with OH, which increases the lifetime of methane. Atmospheric H_2 is produced by incomplete combustion processes, together with CO, and from atmospheric oxidation of CH_4 and non-methane hydrocarbons. H_2 is also emitted into the atmosphere by microbial sources (fermentation, N_2 fixation) and by geologic sources (seeps, volcanoes). The main sinks for atmospheric H_2 are uptake by soil microbes and reaction with OH radicals.

The isotopic composition of H_2 (δD) has been used to investigate its atmospheric budget, based on the fact that main sources, sinks and chemical processes of H_2 have specific isotopic signatures. Partially due to these studies, the atmospheric H_2 cycle is currently relatively well understood.

We will present an overview on the current knowledge on the atmospheric H_2 isotopic budget, and on the remaining questions, information gaps, and potential for future studies. We will also introduce the newly developed clumped isotope measurements (ΔDD), and will discuss their potential for studying atmospheric, (micro)biologic and geologic processes.