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Heavy hydrogen in the stratosphere

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Abstract. We report measurements of the deuterium content of molecular hydrogen (H_2) obtained from a suite of air samples that were collected during a stratospheric balloon flight between 12 and 33 km at 40° N in October 2002. Strong deuterium enrichments of up to 400 permil versus Vienna Standard Mean Ocean Water (VSMOW) are observed, while the H_2 mixing ratio remains virtually constant. Thus, as hydrogen is processed through the H_2 reservoir in the stratosphere, deuterium is accumulated in H_2 . Using box model calculations we investigated the effects of H_2 sources and sinks on the stratospheric enrichments. Results show that considerable isotope enrichments in the production of H_2 from CH_4 must take place, i.e., deuterium is transferred preferentially to H_2 during the CH_4 oxidation sequence. This supports recent conclusions from tropospheric H_2 isotope measurements which show that H_2 produced photochemically from CH_4 and non-methane hydrocarbons must be enriched in deuterium to balance the tropospheric hydrogen isotope budget. In the absence of further data on isotope fractionations in the individual reaction steps of the CH_4 oxidation sequence, this effect cannot be investigated further at present. Our measurements imply that molecular hydrogen has to be taken into account when the hydrogen isotope budget in the stratosphere is investigated.

[Final Revised Paper](#) (PDF, 460 KB) [Discussion Paper](#) (ACPD)

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