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The Water Isotope Signal from the upper Troposphere: a Model/Data Comparison.

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The concentration of water vapour in the high troposphere and in the low stratosphere is an important parameter in global climate evolution. Due to the very dry conditions at high altitudes, small shifts in water vapour concentration are extremely effective in shielding the infrared radiation of the Earth's surface and in affecting the Earth's energy budget. The key question therefore is what processes control the water vapour concentration at high altitudes. Various approaches have been made to obtain better constraints of the different processes involved. Here we focus on the analysis of the isotopic composition of water vapour and of other components of the water cycle such as cloud ice. Water vapour at the tropopause level is isotopically strongly depleted, however significantly less than a pure "non-mixing" Rayleigh process suggest. Several in-cloud mechanisms (lofted ice within convective systems, convective overshooting etc.) have been suggested to explain this relatively weak depletion. In a former study we have shown that in fact such isotope values can be explained by a GCM (GISS atmospheric model) which was fitted with isotope diagnostics. Since this GCM has not a detailed parameterisation of the in-cloud processes in question this study pointed to the importance of mixing of different air masses with varying isotopic signatures. Here we present a comparison of our former results with results obtained by the isotope version of the ECHAM atmospheric model. We mainly focus on the robustness of our former conclusions. Both models have a quite distinct parameterisation of in-cloud processes and transport within convective systems. This difference in model physics allows us to better estimate the essential factors controlling the vertical isotope gra-

dient of atmospheric water vapour. Moreover, new data sets are now available from the "terrestrial emission spectrometer" giving a considerably more complete picture of the Deuterium concentration, in particular over the Pacific. In fact, the combination of remote sounding of the water isotopes and the modelling of the corresponding signals within atmospheric GCMs becomes a more and more powerful diagnostic of the hydrological cycle.