Design and airborne application of a tunable diode laser spectrometer for in-situ measurements of water isotope ratios

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The measurement of isotope ratios in water vapor (H_2O) can significantly enhance our understanding of many crucial processes in which atmospheric water is involved. The H_2O-isotope ratios collect and conserve the H_2O evaporation and condensation history prior to sampling. They thus contain supplementary information on the hydrological atmospheric cycle which H_2O-concentration measurements cannot provide. Furthermore, due to the considerable temperature-dependent isotope fractionation, H_2O-isotope ratios of cloud particles are a measure of the supersaturation present during cloud formation.

While a number of satellite measurements have recently been realized [1, 2, 3, 4], they only provide a global picture. Airborne in-situ measurements providing the often necessary high spatial resolution have very scarcely been performed, and only about four instruments exist worldwide, one of which is the tunable diode-laser spectrometer ISOWAT [5].

In this presentation we will discuss the design and performance characteristics of our compact and fully autonomous airborne spectrometer. ISOWAT will regularly (once per month) be deployed aboard the CARIBIC passenger aircraft (Lufthansa A340-600) [6] as of spring 2010, and we will examine the importance and potential of our measurements based on the first in-flight data. Finally we will give an outlook to further developments, which will even improve the performance of this instrument.

Keywords: Water; Isotope Ratio; Laser Spectroscopy; Airborne Instrumentation

References

[1] A. E. Dessler, T. F. Hanisco, and S. Fueglistaler. tropopause layer. *J. Geophys. Res.*, **112**:D18309, 2007.

[2] J. Steinwagner, M. Milz, T. von Clarmann, N. Glatthor, U. Grabowski, M. Höpfner, G. P. Stiller, and T. Röckmann. *Atmos. Chem. Phys.*, **7**:2601–2615, 2007.

[3] V. H. Payne, D. Noone, A. Dudhia, C. Piccolo, and R. G. Grainger. for understanding the transport of water vapour into the stratosphere. *Q. J. R. Meteorol. Soc.*, **133**:1459–1471, 2007.

[4] D. Brown, J. Worden, and D. Noone. regions using water vapor isotope measurements from space. *J. Geophys. Res.*, **113**:D15124, 2008.

[5] C. Dyroff, D. Fütterer, and A. Zahn. airborne measurements of water-isotope ratios. *Applied Physics B*, **98**:537–548, 2010.

[6] C. A. M. Brenninkmeijer, P. Crutzen, et al. atmosphere based on an instrumented container: The new CARIBIC system. *Atmos. Chem. Phys.*, **7**:4953–4976, 2007.