

Water vapour isotopologue observations from space and their scientific potential

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Tropospheric water vapour isotopologue ratios (expressed as δD) give unique insight into moisture sources and cloud processes, in particular if analysed together with the water vapour concentration.

In this presentation we briefly introduce the theoretical framework of generating $\{H_2O, \delta D\}$ -pair distributions and we present the MUSICA IASI $\{H_2O, \delta D\}$ -pair data set (1.5 billion individual data points, offering twice daily global coverage for 10/2014 to 12/2020, [1]). We present results from recent studies that document the potential of the MUSICA isotopologue data for validating the representation of cloud processes in atmospheric models [2-4].

Furthermore, we discuss the promising opportunities of the upcoming Metop-SG-A missions for generating tropospheric water vapour isotopologue profile data by combining the two sensors IASI-NG and Sentinel-5.

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[2] Galewsky, J., Schneider, M., Diekmann, C., Semie, A., Bony, S., Risi, C., et al. (2023). The influence of convective aggregation on the stable isotopic composition of water vapor. *AGU Advances*, 4, e2023AV000877. <https://doi.org/10.1029/2023AV000877>

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[4] Diekmann, C. J., Schneider, M., Knippertz, P., Trent, T., Boesch, H., Roehling, A. J., Worden, J., Ertl, B., Khosrawi, F., and Hase, F.: Water vapour isotopes over West Africa as observed from space: which processes control tropospheric H_2O/HDO pair distributions?, submitted to *Atmos. Chem. Phys.*, May 2024.