First tropospheric δD data observed by ground- and space-based remote sensing and surface in-situ measurement techniques at MUSICA’s principle reference station (Izaña Observatory, Spain)

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The main goal of the project MUSICA (Multiplatform remote Sensing of Isotopologues for investigating the Cycle of Atmospheric water) is the generation of a quasi global tropospheric water vapour isotopologue dataset of a good and well-documented quality. Therefore, ground- and space-based remote sensing observations (NDACC-FTIR and IASI/METOP) are combined with in-situ measurements (Picarro L2120-i). Here we trace back the remote sensing data to the continuously calibrated in-situ data.

1. Location and instrumentation.


- FTIR validation is carried out by comparing the FTIR at 2.400 m a.s.l. with the in-situ (Picarro) data. Figures A1 and A2 show the H₂O-vs.-δD relationship for FTIR and Picarro interpolated average data set.

\[ \delta D = 1000 \times \left( \frac{H_2O}{H_2} \right) - 1 \] SMOW=3.152·10⁻⁴ (standard mean ocean water)

- Assuming that each system measures the same air mass under FT and MBL conditions, in the case of mixing δDFTIR and δDPic follow the next equation. The error on δDFTIR and δDPic is depicted in Figure B and the inter-comparison in Figure C.

\[ \delta D_{Pic} = \delta D_{FTIR} \cdot \left( \frac{H_2O_{Pic}}{H_2O_{FTIR}} \right) \]

3. The added value of isotopologue observations.

- H₂O-vs.-δD plots of the 3 sensing instruments from extratropical and tropical air mass origins are shown below.
- The data set were binned in increments of 500 ppmv.
- Mean values and 98% of confidence interval are shown.

Conclusions:

- The first comparison between δD MUSICA observations at the Izaña Observatory shows a good agreement (R=0.75).
- The instruments observe similar systematic differences between the isotopic fingerprints of tropical and extratropical middle/upper tropospheric water vapour (confidence level of 98%). Tropical middle/upper tropospheric water vapour is significantly more enriched in HD+O than extra-tropical middle/upper tropospheric water vapour.

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