Geophysical Research Abstracts
Vol. 16, EGU2014-14360, 2014
EGU General Assembly 2014
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Local and large-scale MBL to FT mixing of water vapour at Tenerife as observed by water vapour isotopologues

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This work shows the first time series of δD in-situ measurements recorded at Izaña Observatory, located at the lower free troposphere (FT) of the Subtropical North Atlantic region. These measurements have been complemented with the first water vapour isotopologue (H_2O and δD) profiles (200–6800 m asl) taken in-flight in this region using the homemade ISOWAT instrument, together with atmospheric aerosols measurements. The combination of this data set allows us to distinguish between the effect of local and regional moisture transport.

At local scale, under the NNW typical wind blowing at Izaña station, the highest concentrations of new particles, prompted by the thermally buoyant upslope flow, are well correlated with the highest δD values registering during daylight. This suggests that these δD concentrations are resulting from local mixing between the MBL and the FT. Such mixing is also in agreement with the respective H_2O-vs.-δD curves.

At regional scale there are two main frequent origins of air masses reaching Izaña station: (1) subsidence from higher latitudes, and (2) horizontal transport of African air masses. For the same water vapour concentrations, δD values related to an African origin are clearly less depleted than those related to the subsiding North Atlantic transport. For situation (1) the H_2O-vs.-δD curves can be reasonably explained by Rayleigh distillation processes. For situation (2) the H_2O-vs.-δD curves can be well explained by mixing from the MBL to the FT.

In summary, this work includes new information about the importance of the African continent for the humidity of the FT of the Subtropical North East Atlantic region.