

**THE TROPICAL AND SUB-TROPICAL UT/LS: PROBING
ITS CHARACTER USING IN SITU MEASUREMENTS OF
HDO, H₂¹⁶O, H₂¹⁸O, AND H₂¹⁷O**

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The isotopic composition of gas, liquid and frozen water in the upper troposphere and lower stratosphere (UT/LS) is determined by physical processes accompanying phase changes during the transport and mixing of air parcels. For the first time, simultaneous in situ measurements of HDO, H₂¹⁶O, H₂¹⁸O, and H₂¹⁷O have been made in the UT/LS in and out of clouds, including the region of the Tropical Tropopause Layer (TTL). These measurements, made by the Aircraft Laser Infrared Absorption Spectrometer (ALIAS) in July 2002 as part of the CRYSTAL-FACE Mission, are compared with a model of water isotopes that includes ice lofting and overshooting convection to probe the character of the TTL and the sub-tropical UT/LS.