

Anomalous dehydration of the TTL during January 2013: evidence from balloon, aircraft and satellite observations

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The goal of this study is to comprehensively document an anomalous dehydration of the Tropical Tropopause Layer (TTL) related to a major Sudden Stratospheric Warming in early January 2013. The analysis involves the data of balloon soundings of water vapour at various tropical locations using FLASH-B, Pico-SDLA and CFH hygrometers as well as NOAA Water instrument flown onboard high-altitude Global Hawk aircraft. Simultaneous water vapour and backscatter measurements by FLASH-B and COBALD sondes provide information on tropopause clouds formation process. Satellite observations of water vapour by Aura MLS are used to derive the deviation from climatological values. Trajectory modeling is applied for locating the dehydration source spots. Spatiotemporal evolution of dehydration at different scales is characterized after combining the consistent in situ and satellite water vapour observations. All data sets provide evidence of rapid and severe dehydration of the TTL throughout the tropical belt shortly after the onset of SSW. In situ measurements around the Cold Point Tropopause (CPT) show up to 2 ppmv of negative deviation from Aura MLS 10-year climatology with record-low water mixing ratios below 1 ppmv in the Western Pacific region.

The TTL dehydration case of 2013 is compared with previous similar occurrences and the role of extra-tropical dynamics in setting the global stratospheric water budget through thermal response in the TTL is pointed out.