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36 Years of Stratospheric Water Vapor Measurements over Boulder, Colorado: Lessons Learned for the Future

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The Frost Point Hygrometer (FPH) record of vertical profile measurements of water vapor over Boulder will surpass 36 years in length in April 2016. The 1980 inception of this record pre-dates stratospheric water vapor (SWV) measurement records of substantive quality and duration from satellite- or ground-based remote sensors, so only models are able to provide records of comparable length. Models that simulate SWV abundance unfortunately require records of tropical tropopause temperatures that are notoriously poor in quality, especially as far back as 1980. Recently we have compared the Boulder FPH record to 1979-2014 output from the Chemical Lagrangian Model of the Stratosphere and found good agreement between the measured and modeled SWV mixing ratios and anomalies.

The quality of future SWV measurements by satellite sensors will depend strongly on their continued validation by FPHs and other ground-based instrumentation. Current validation efforts are sparse, both geographically and temporally, and are financially under-supported by the satellite communities. Nevertheless, efforts by several FPH sounding sites have produced data sets that can be compared to the 10 to 15-year SWV records of several different satellite sensors. These comparisons have shown agreement ranging from poor to excellent depending on the satellite sensor, retrieval levels and time periods examined.

A recent comparison of FPH profiles and SWV retrievals by the Aura Microwave Limb Sounder (MLS, 2004-present) for the period 2004-2012 reported excellent agreement (within $\pm 1\%$) from 68 to 26 hPa, but also exposed statistically significant biases of 2 to 10% at 83 and 100 hPa. The analysis revealed no significant long-term trends in FPH-MLS differences. A more recent FPH-MLS comparison through mid-2015 has discovered divergences in their SWV mixing ratios that began in 2010 and have since increased. To date the root cause(s) of these differences has (have) not been identified.