Validation of Aura Microwave Limb Sounder Stratospheric Water Vapor Measurements by the NOAA Frost Point Hygrometer

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Differences between stratospheric water vapor measurements by NOAA Frost Point Hygrometers (FPH) and the Aura Microwave Limb Sounder (MLS) are evaluated for the period August 2004 through December 2012 at Boulder, Colorado, Hilo, Hawaii, and Lauder, New Zealand. Two groups of MLS profiles coincident with the FPH soundings at each site are identified using unique sets of spatiotemporal criteria. Before evaluating the differences between coincident FPH and MLS profiles, each FPH profile is convolved with the MLS averaging kernels for eight pressure levels from 100 to 26 hPa (~16 to 25 km) to reduce its vertical resolution to that of the MLS water vapor retrievals. The mean FPH–MLS differences at every pressure level (100 to 26 hPa) are well within the combined measurement uncertainties of the two instruments. However, the mean differences at 100 and 83 hPa are statistically significant and negative, ranging from -0.46 ± 0.22 ppmv (-10.3 ± 4.8%) to -0.10 ± 0.05 ppmv (-2.2 ± 1.2%). Mean differences at the six pressure levels from 68 to 26 hPa are on average 0.8% (0.04 ppmv), and only a few are statistically significant. The FPH–MLS differences at each site are examined for temporal trends using weighted linear regression analyses. The vast majority of trends determined here are not statistically significant, and most are smaller than the minimum trends detectable in this analysis. Except at 100 and 83 hPa, the average agreement between MLS retrievals and FPH measurements of stratospheric water vapor is better than 1%.

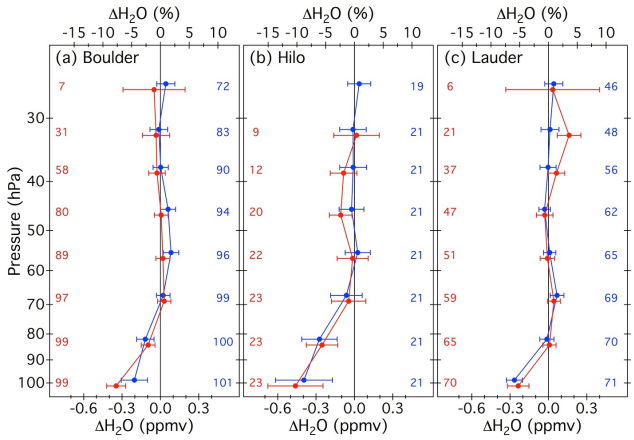

Figure 1. Mean FPH–MLS differences for profile groups B1 (red) and A2 (blue) at eight pressures from 100 to 26 hPa over (a) Boulder, (b) Hilo and (c) Lauder. Error bars span the 95% confidence intervals of the mean differences. The numbers of FPH–MLS differences in profile groups B1 (red) and A2 (blue) that determine the mean values at each pressure level are listed.

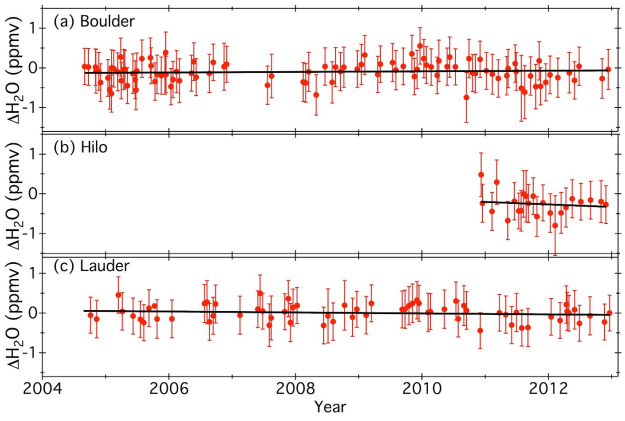

Figure 2. Linear trends in the FPH–MLS differences of profile group B1 at 83 hPa, as determined by weighted regression fits. Error bars depict the uncertainties of the FPH–MLS differences that provide statistical weights for the fits.