The "Boulder Record": 30 Years of Water Vapor Vertical Profiles Over Boulder, Colorado

D. Hurst[1], E. Hall[1], A. Jordan[1], S. Davis[1], K. Rosenlof[2] and S. Oltmans[2]

[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309; 303-497-7003, E-mail: dale.hurst@noaa.gov
[2]NOAA Earth System Research Laboratory, Boulder, CO 80305

The balloon-borne NOAA frost point hygrometer (FPH) has been providing *in situ* measurements of water vapor from the surface to 30 km above Boulder (40°N, 105°W) since April 1980. The resultant "Boulder record" is now comprised of 330 vertical profiles of water vapor mixing ratios that span 30 years. Though the FPH has undergone numerous improvements since its inception, the long-term measurement record has remained self-consistent because the fundamental measurement technique and its calibration have not changed. Stringent assessments of data quality, including evaluations of frost point temperature stability and ascent-descent differences for each stratospheric water vapor profile, have recently been performed to provide statistical weights for use in trend analyses. The newly calculated trends for stratospheric water vapor during 1980-2000 are only 75-90% of those originally published [Oltmans et al., 2000]. It will be shown that 20-40% of the 1980-2000 increase in water vapor above 20 km is attributable to the growth of atmospheric methane.

The 30-year time series can be divided into four distinct periods based on multi-year trends in stratospheric water vapor abundance: a period of mixed increases and decreases (1980-1988), a net increase (1989-2000), a rapid decline (2001-2005) and a short but significant increase in recent years (2005-present). The "Boulder record" is unique and has proven useful in connecting changes in mid-latitude stratospheric water vapor abundance to changes in climate. The rapid and significant decline in stratospheric water vapor during 2001-2005 has been linked to a reduction in tropical tropopause temperatures thought to be driven by increased tropical upwelling [Randel et al., 2006], and to a change in the Earth's radiation budget that slowed the rate of increase in global surface temperatures during the last decade [Solomon et al, 2010].

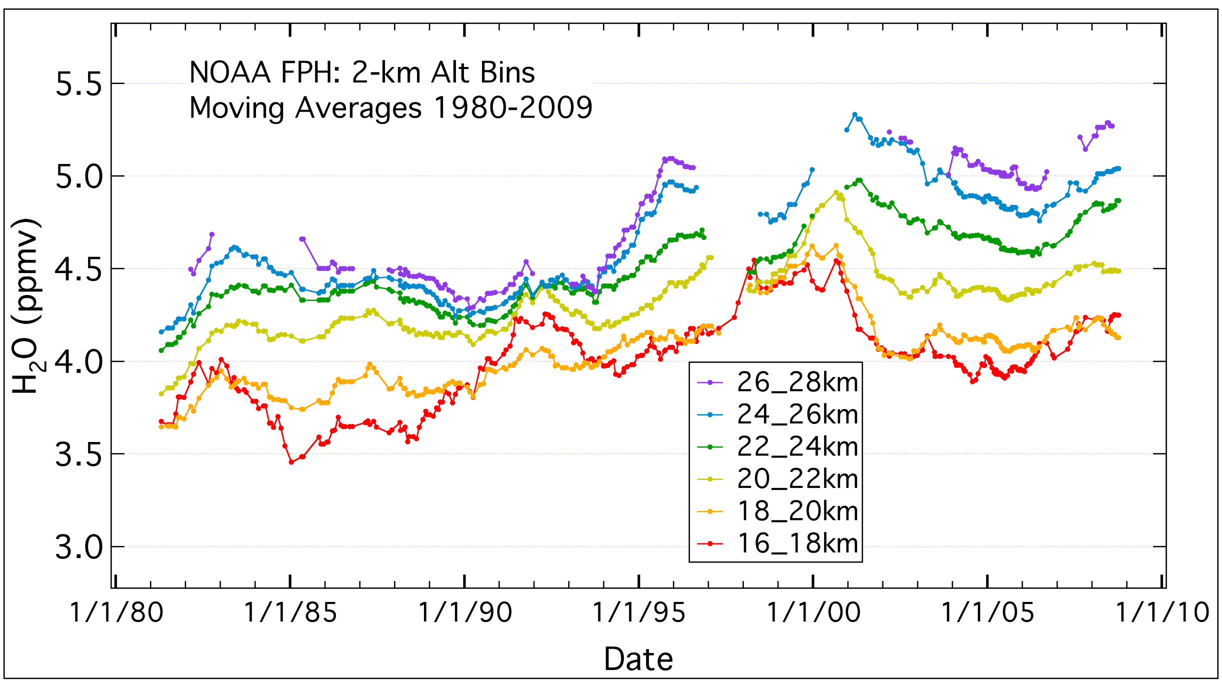

Figure 1. Moving averages of mean water vapor mixing ratios in 2-km altitude bins as measured during 330 flights of the NOAA FPH. Stratospheric water vapor gradually increased during 1980-2000, rapidly declined during 2001-2005, and is now increasing again.