Recent Stratospheric Water Vapor Variability as Revealed by SWOOSH, a New Merged Satellite Data Set

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Vertical profiles of ozone and humidity from the upper troposphere to stratosphere have been retrieved from a number of limb sounding and solar occultation satellite instruments since the 1980's. In particular, measurements from the Stratospheric Aerosol and Gas Experiment (SAGE) instruments, Upper Atmosphere Research Satellite (UARS) Microwave Limb Sounder (MLS), UARS Halogen Occultation Experiment (HALOE), and most recently Atmospheric Chemistry Experiment - Fourier Transform Spectrometer (ACE-FTS) and Aura MLS, have provided overlapping data since 1984. In order to quantify interannual- to decadal-scale variability in water vapor and ozone, it is necessary to have a uniform and homogenous record over the period of interest. With this in mind, we merged and gridded the aforementioned satellite measurements to create the Stratospheric Water and Ozone Satellite Homogenized (SWOOSH) data set. The primary SWOOSH product is a monthly-mean zonal-mean (2.5°) dataset that can be used for quantifying variability and long-term changes in water vapor and ozone, and can be used for assessing the radiative impact of these changes.

Here, we describe the process of merging the individual satellite data sets using offsets calculated from coincident observations taken during instrument overlap periods. The homogenized data are provided on a variety of grids for different applications, including both geographic and equivalent latitude in the horizontal, and pressure and isentropic coordinates in the vertical. We also discuss recent lower stratospheric water vapor variability within the context of tropical tropopause layer (TTL) variability and variability seen in balloon-borne frostpoint hygrometer measurements, as presented in the forthcoming State of the Climate in 2014 report. Finally, we highlight the utility of the long-term merged record provided by SWOOSH for studying interannual to decadal-scale water vapor variability and testing the stratospheric water vapor feedback found in some climate models.

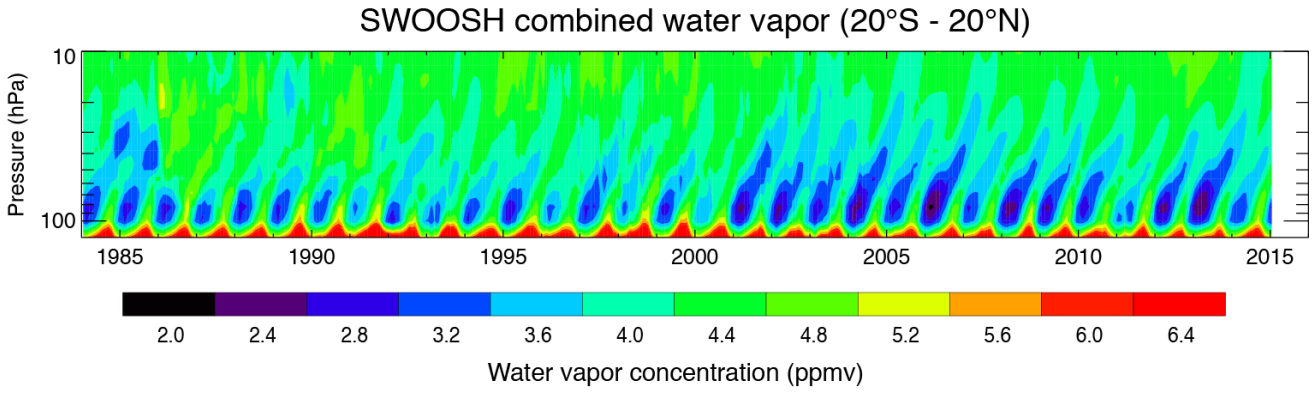

Figure 1. The 20°S-20°N average water vapor from the combined and filled SWOOSH data set.