Possible Influences of Stratospheric Transport Variability on Emission Estimates of Long-lived Trace Gases

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We use surface measurements of a number of long-lived trace gases, including chlorofluorocarbons (CFC-11, CFC-12) and nitrous oxide (N_2O), and a 3-box model to estimate the influences of interannual variability in bulk stratospheric transport characteristics on emission estimates of these trace gases. The results suggest that stratospheric transport variability such as due to the Quasi-Biennial Oscillation, decadal scale trends, anomalous shifts in stratospheric circulation strength such as around the years 2000 and 2014, and shifts in Southern Hemisphere versus Northern Hemisphere stratospheric circulation can all affect emission estimates of long-lived trace gases. We compare the 3-box model derived bulk stratospheric transport characteristics to the variability in stratospheric satellite measurements, residual circulation estimates and global model simulations to check for consistency. The implications of fully accounting for stratospheric variability in emission estimates of long-lived trace gases can be significant, including for those gases monitored by the Montreal Protocol and/or of climatic importance.

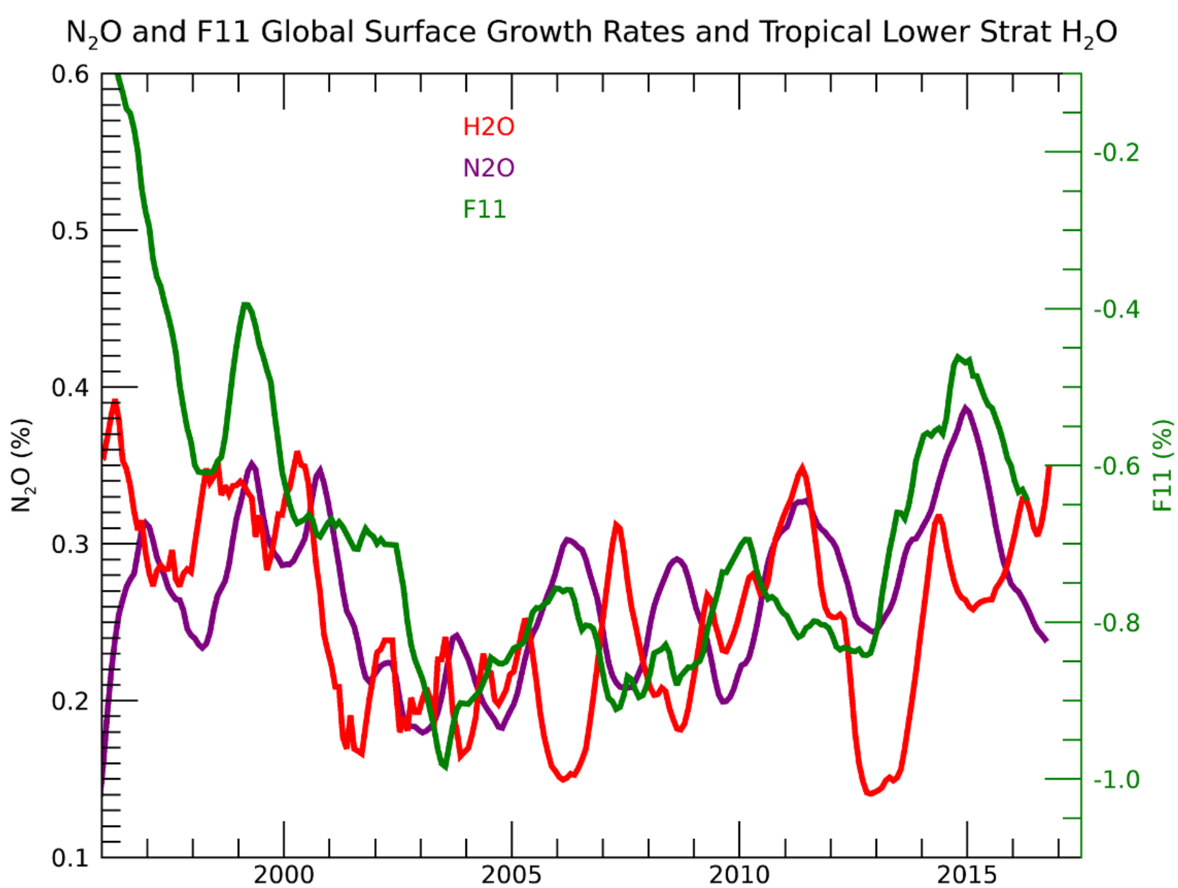

Figure 1. Time series of the global surface growth rates of CFC-11 (green) and N_2O (purple) based on NOAA/GMD measurements, and the anomaly of tropical lower stratospheric water vapor (red) from the SWOOSH data set.