

Towards an Understanding of Inter-Annual Variations in Tropospheric OH Since 1998 from Observations of Reduced Trace Gases

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Can the oxidizing capacity of the atmosphere, as controlled by the hydroxyl radical (OH), change by 10 to 20% from year to year? Or is the global OH abundance buffered against large interannual variations in emissions by biomass burning, industrial pollution, solar radiation, water vapor, and other OH sources and sinks? Past work suggests a wide range of potential sensitivities and, therefore, accurate projections of future atmospheric changes are problematic. Studies of methyl chloroform observations made in the 1980s and 1990s suggest OH could be highly sensitive to interannual variations in the atmospheric environment. Such variations are difficult to reconcile with the rather low variability observed for atmospheric methane. Furthermore, model studies suggest a much lower sensitivity for OH to such changes in precursors and sinks because of balancing effects by chemical and transport processes.

We have argued recently that methyl chloroform (CH_3CCl_3) observations since 1998 should provide a more precise estimate of OH interannual variability because errors associated with large atmospheric gradients and emissions have become small. Our analysis shows, for example, that OH variations inferred from CH_3CCl_3 since 1998 are much smaller than during earlier decades. But has the precision of the analysis improved to the point that OH variability over the past decade can be accurately discerned? Do results from different trace gases provide a consistent picture regarding the magnitude and phase of OH variations? What do model calculations suggest? How consistent are inferences regarding OH variability when one considers results for CH_3CCl_3 from different laboratories, different emissions histories, or model analyses of varying sophistication, especially given that atmospheric mixing ratios of CH_3CCl_3 are now quite small (10 ppt)? This presentation will focus on addressing these questions and improving our understanding of the stability of the atmosphere's oxidation capacity.

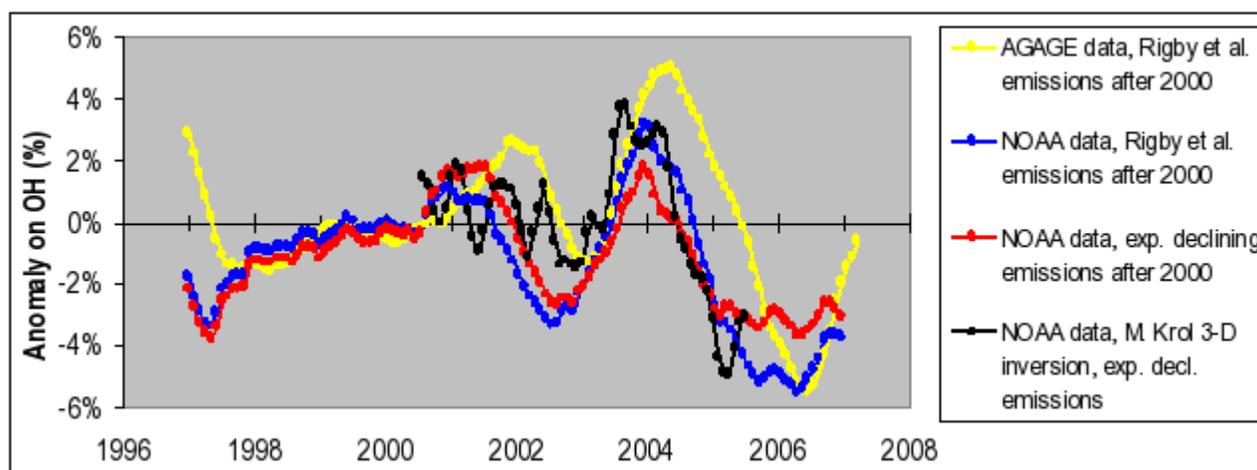


Figure 1. Estimates of anomalies on OH derived from independent global surface measurements of CH_3CCl_3 (yellow line: AGAGE from Prinn et al., 2005; and blue line: NOAA); two different emission histories for CH_3CCl_3 since 2000: exponentially declining at 20%/yr or from Rigby et al. (2008) (yellow and blue lines); and two different modeling approaches: a simple 1-box analysis (Montzka et al., 2000) and a 3-D inversion with inter-annually varying meteorology (Krol et al. 2003) (black line).