# 5.019 Improving constraints on the oxidative capacity of the atmosphere.

Early Career Scientist


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Abstract:

The hydroxyl radical (OH), dubbed the cleansing agent of the atmosphere, is a gas at the centre of atmospheric chemistry. It is involved in the oxidation and removal of a wide variety of pollutants, which contribute to global warming ($CH_4$), stratospheric ozone depletion (H-CFCs) and air quality issues (NOx, CO). However, due to its short lifetime of seconds, combined with a low atmospheric abundance (< 1 pptv), it is difficult to obtain reliable constraints on metrics such as abundance, global trends and interannual variability. Currently, the most stringent constraints are derived indirectly from the effect OH has on methyl chloroform (MCF): a gas rapidly disappearing from the atmosphere due to restrictions placed on production through the Montreal Protocol.

However, interpretation of the MCF record is tricky, and recent studies using two-box models have found even these most stringent constraints lacking, when derived OH is propagated to the $CH_4$ budget. Currently, limited constraints on OH are one of the key uncertainties in many pollutant budgets: without better constraints on pollutant sinks, it is difficult to get to improved emission estimates.

Here, we present a parametrization of a two-box model, using output of full 3D simulations of MCF, $CH_4$ and $SF_6$. The parametrization reveals how the loss of information from a 3D to a two-box model can affect the outcome of a two-box inversion. Due to varying 3D distributions of sources and sinks, complicated species-dependent corrections to the parameters of the two-box models are required. Thus, though two-box models seem deceptively simple, correct usage actually requires a complex 3D model analysis for each species involved. Incorrect usage can bias the results and can contribute to the already significant uncertainties on derived OH.