4.227 The effect of El Nino Southern Oscillation on global CH4 concentrations..

Early Career Scientist

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Abstract:

The growth rate of global methane (CH_4) concentrations has a strong interannual variability driven largely by fluctuations in CH_4 emissions from wetlands and wildfires, as well as changes to the atmospheric sink. The El Niño Southern Oscillation (ENSO) is known to have a strong influence on these drivers; however, there are still uncertainties associated with the exact mechanism and magnitude of this influence. Here we use a modelling approach to investigate how ENSO events affect global CH_4 concentrations via changes to wildfire emissions and dynamical transport.

Wildfire emissions have large interannual variability and enhanced fire events are known to occur during El Niño (positive ENSO phase), leading to larger CH_4 emissions. Wildfires also emit large amounts of carbon monoxide (CO), which may indirectly increase CH_4 concentrations by supressing the hydroxyl radical (OH^-) - the primary sink for both species. ENSO events also affect meteorology and atmospheric circulation which influence CH_4 variability by changing the CH_4 sink efficiency and lifetime.

Using a three-dimensional chemical transport model (TOMCAT) coupled to a sophisticated aerosol microphysics model (GLOMAP) we simulate the 1997-2014 period, capturing several El Niño and La Niña (negative ENSO phase) events. The model has been recently developed to include ECMWF clouds and extensive evaluation against observations demonstrate very good skill at capturing global CH_4 and oxidant species. Using

experiments with the fixed year 2013 (‘ENSO-neutral’ control year) fire emissions and/or meteorology we examine the simulated ENSO impacts on CH_4 and OH concentrations, analysing their relative importance. A series of sensitivity experiments for fire emissions is then used to investigate the importance of the chemical effect induced by CO emissions relative to the direct impact of increased CH_4 emissions from fires.
Finally, we present a comprehensive analysis of the dominant mechanisms responsible for the connection between ENSO and CH_4 concentration growth rates.