3.145 The Mysterious Global Methane Budget.

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Abstract:

Atmospheric methane (CH_4) contributes 0.5 W m^{-2} to global radiative forcing, making it the second most important anthropogenic greenhouse gas after carbon dioxide. Over half of global CH_4 emissions is related to human activities that range from food and energy production to waste disposal. The largest natural source of atmospheric methane is microbial production in wetlands, which is difficult to quantify and potentially sensitive to changing climate and land use. Understanding the global CH_4 budget is essential due to the large human influence on the global CH_4 budget and possible climate feedbacks. CH_4 plays an important role in global atmospheric chemistry because it is an ozone precursor and an important sink of the hydroxyl radical (OH).

The OH sink of CH_4 approximately balances emissions globally. Until 2006 when observed CH_4 abundance started to increase again, atmospheric CH_4 had nearly reached equilibrium after rising from pre-industrial levels of ~800 ppb to ~1850 ppb. The reason for the recent increase is not currently well understood, and there remains considerable controversy about the causes of the period of stability in the late 1990s and early 2000s, and the recent growth. Some studies have argued that significant decadal trends in OH are behind the recent trends in global CH_4, or that emissions from fossil fuel production have increased. Unfortunately, current data assimilation/inversion systems have difficulty attributing changes in atmospheric CH_4 to individual sources and results can be significantly biased by prior emissions, both natural and anthropogenic. We show that source attribution can be significantly improved if more observational constraints are introduced, namely methane isotopes that allow partitioning of sources between microbial and thermogenic processes, and that the recent CH_4 increase is mostly likely due to changes in low latitude microbial sources, especially wetlands.