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Can We Account for Observed Trends In Atmospheric Methane over the Past Decades?

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Atmospheric methane abundance is determined by the balance between surface emissions and losses due to consumption in aerobic soils and reaction with the hydroxyl radical. By the 1980s, atmospheric methane concentrations more than doubled from the preindustrial level of approximately 800 ppb. Fairly rapid growth in atmospheric concentrations observed in the 1980s was followed by substantially slower increases in the 1990s though the present, including some years with zero growth; global atmospheric methane appears to have equilibrated to around 1780 ppb. Atmospheric observations exhibit considerable interannual variability in growth rate, mostly associated with year-to-year variability in emissions from natural wetlands and biomass burning; anthropogenic sources change relatively slowly and determine the trend in concentrations. In this study we test our understanding of the methane budget over the last two decades against a global network of observations of atmospheric methane. Can we explain the observed trend atmospheric methane from 1980 to 2003? Can we explain the decrease in growth rate during the 1990's? Are we able to simulate the observed interannual variability in the observations?

We will show results from a multi-decade simulation using analyzed meteorology from the ERA-40 reanalysis and the TM5 model over this period. A new times series of methane emissions for 1980 through the early 2000's is used as input to the simulation. Anthropogenic sources include fossil fuels including a suite of fuel-process emission combinations associated with mining, processing, transport and distribution of coal, natural gas and oil; ruminant animals and manure based on regionally-representative profiles of bovine populations; landfills including the impact of on-site

methane capture; and irrigated rice cultivation based on seasonal rice-cropping calendars and water management. Natural methane sources included in the study are biomass burning from the Global Fire Emission Dataset (GFED) and the Reanalysis of the Tropospheric Chemical Composition over the past 40 years (RETRO) data bases, natural wetlands estimated from a multiple-regression model derived from a process-based model, and smaller sources including oceans and termites. By running each source as a tracer, we quantify how much of the spatial and temporal variability, and the secular trend, in the network observations may be accounted for by this suite of natural and anthropogenic source histories.