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Atmospheric composition last 17 years – recent emission driven trends and variability due to meteorology.

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Understanding the drivers of past climate change is crucial for understanding future warming. The recent temporal development in the atmospheric concentration of methane, the second largest greenhouse gas forcer, is not fully understood. The concentration leveled off at the beginning of the millennium with a renewed growth since 2007. In this study, we investigate two of the suspected causes: changes in OH-concentration and hence changes in methane lifetime, and changes in natural emissions from wetlands. To study the atmospheric composition and changes in methane lifetime, two sets of simulations using a chemistry transport model (Oslo CTM3), with the Community Emissions Data System (CEDS) historical emission inventories and prescribed methane concentrations, are performed. The first set is time slice simulations for selected years between 1850 and 2017 with fixed meteorology. The second set of simulations is year 2000 to 2017 using emissions and meteorology for the year simulated. Alternative emission inventories to CEDS are used to capture the recent rapid decline in aerosol precursor emissions in China. We find that methane lifetime decreased by ∼0.3 year between 2001 and 2007 contributing to the leveling off and increased by ∼0.1 year from 2007 to 2014 due to variability in meteorology and emission changes. Due to emissions changes alone, the changes in methane lifetime is much weaker, it decreased by ∼0.1 year from 2000 to 2010 and increased by ∼0.025 year from 2010 to 2014 using CEDS emissions. The increase from 2010 to 2014 was twice as large if the recent emission trends in China are considered. In addition to changes in OH and methane lifetime, we also study the year to year variability and long-term anthropogenic emission driven changes in tropospheric and stratospheric ozone and aerosol components. The second suspect for changes in methane concentration, changes in natural emissions from wetlands, are studied using the Community Land Model (CLM5.0). In the tropics, there is large year to year variability, with larger emissions in La Nina years. The meteorological variability and anthropogenic influence on OH as well as natural emissions during 2000 to 2015 have trends contributing to the recent methane evolution, but likely insufficient in magnitude to fully explain the trend.