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Isotopic constraints on methane's global sources and ENSO-dependence

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Atmospheric levels of the potent greenhouse gas methane (CH4) have been rising since the industrial revolution, except for a plateau during the early 2000s. Stable carbon isotopes in methane (delta-13CH4) provide constraints on the budget changes associated with the plateau's onset and its end. We present a reconstruction of annual global delta-13CH4 averages based on a global network of stations, whose trends are indicative of global methane source and sink activity. A box model analysis shows that from the mid-1990s methane emissions with the characteristic thermogenic delta-13CH4 signature reduced, implying persistently lower emissions from fossil fuel productions as the cause of the plateau. However, variations in hydroxyl, the main CH4 sink, provide an equably plausible explanation for the plateau onset that may also account for strong variability in emission-vs-removal rates during the plateau period. In contrast, the renewed CH4 rise since 2006 can only be explained by increasing emissions with a biogenic isotope signature, i.e. agriculture or wetlands. We present correlation studies that test whether ENSO activity controls atmospheric delta-13CH4, and by extension methane levels, through tropical wetland emissions.