Increased Propane Emissions from the United States over the Last Decade

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Propane (C_3H_8) is the second most abundant non-methane hydrocarbon in the atmosphere. It contributes to photochemical air pollution, including ozone and aerosol formation in the troposphere. It is also commonly used as a tracer for distinguishing thermogenic from natural emissions of methane. Global atmospheric observations indicate increases of atmospheric C_3H_8 after mid-2009 that is largely due to U.S. oil and natural gas production (Helmig et al. 2016). We analyzed atmospheric C_3H_8 measurements from the continental U.S. as well as those from the remote atmosphere. Measured C_3H_8 mole fractions over the continental U.S. are up to three orders of magnitude larger than those measured in the remote Northern hemisphere, and they show a clear increasing trend, especially near oil and gas production regions. We then performed inverse modeling analyses of C_3H_8 with and without consideration of the photochemical losses of C_3H_8 to reaction with OH. Inverse-modeled emissions of C_3H_8 show most U.S. C_3H_8 emissions came from oil and gas production regions and the emission magnitude was a few times larger than reported by bottom-up emission inventories for 2008 - 2014. Derived emissions display seasonal variation that is consistent with C_3H_8 demand in the U.S. for all years between 2008 and 2014. Furthermore, derived emissions from atmospheric observations confirm an increase of U.S. C_3H_8 emissions over the 2008 to 2014 period, likely associated with increased C_3H_8 production (Figure 1).

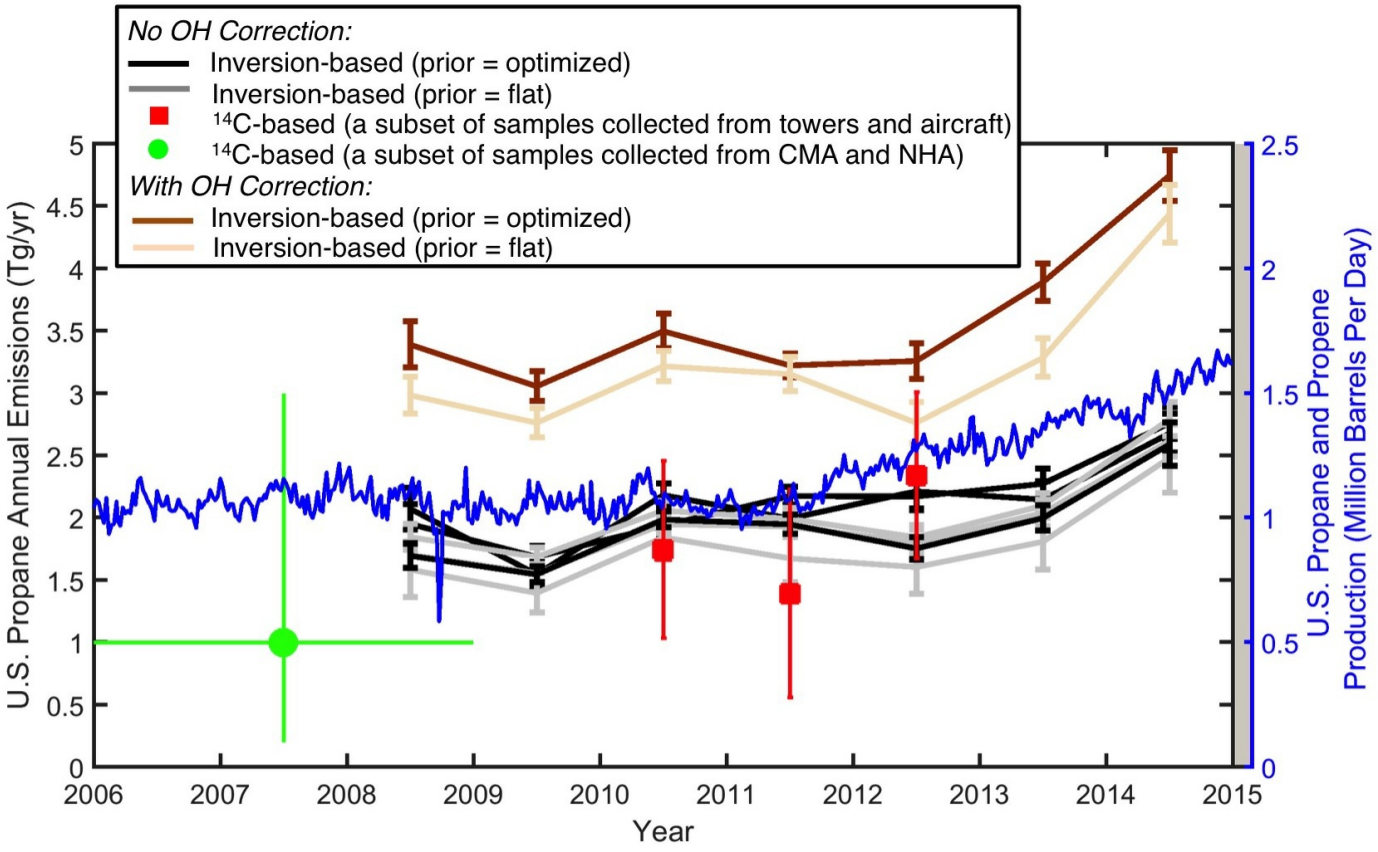

Figure 1. U.S. annual emissions of propane (the left y-axis) derived from atmospheric observations with and without considering OH chemistry. U.S. C_3H_8 and propene production is also shown in the right y-axis.