Effect of Oil and Gas Development on Atmospheric Levels of Hydrocarbons and Tropospheric Ozone

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Unconventional oil and natural gas have been an increasingly significant source of energy in the United States due to modern technology such as hydraulic fracturing. The consequences of the production and processing of oil and gas development to climate and air quality are imperative to understand, especially in prevalent oil and gas sites like Colorado, Wyoming, and Utah. In this study, the data from a tower observatory in Colorado from 2008 to 2012 are utilized to characterize chemical composition of oil and gas emissions and investigate the impact of these emissions on tropospheric ozone. Alkane and benzene are significantly enhanced in the air originated from oil and gas development region in Denver-Julesburg Basin, which confirms the results in previous researches for different time periods. This study is the first to examine direct relationship between hydrocarbons and concurrently measured ozone in summer in Colorado. Under the conditions of high hydrocarbons concentrations, ozone concentration is high and tends to increase as hydrocarbon accumulates. Chemical analysis suggests large contribution of propane and butane from oil and gas development to ozone. Additional studies on a national level are beneficial to fully understand the relationship between hydrocarbons from oil and gas explorations and tropospheric ozone.

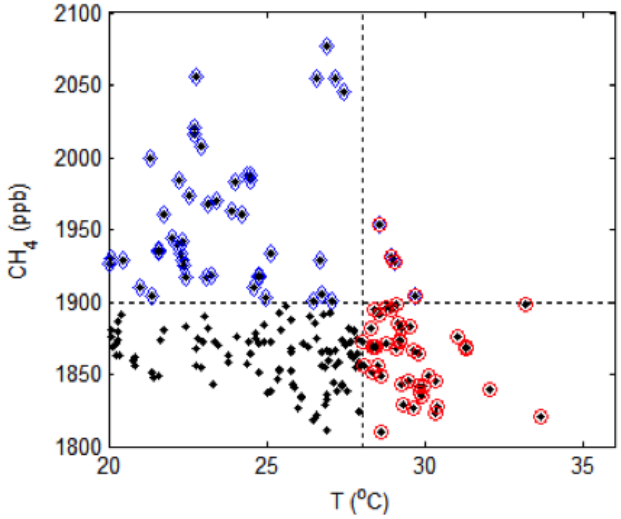

Figure 1. A graph comparing methane to temperature for the Boulder Atmospheric Observatory NE wind over summer 2008-2012. The data is highlighted for two conditions: high methane (blue, above 1900 ppb of methane) and high temperature (red, above, 28oC)

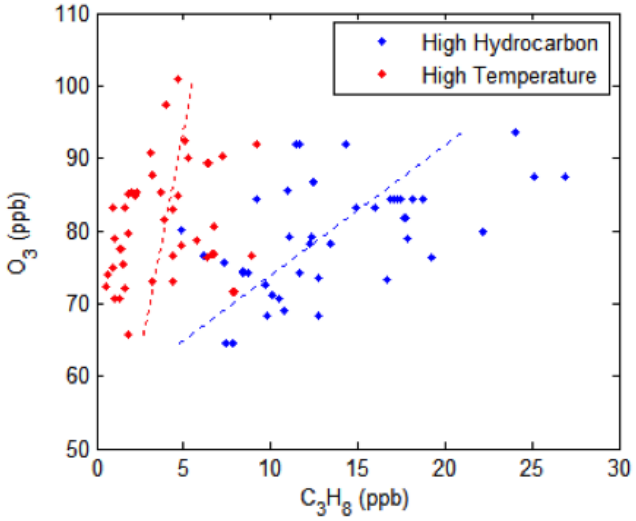

Figure 2. This graph is segregated into the same two conditions high temperature (red) and high methane/hydrocarbon (blue). Dashed lines denote orthogonal fit.