3.007 Emissions of volatile organic compounds (VOCs) from oil and natural gas activities in 13 major U.S. shale basins.

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Abstract:

The recent and unprecedented increase in oil and natural gas production from shale formations is associated with a rise in the production of methane (CH_4) and non-methane volatile organic compounds (VOCs) including natural gas plant liquids (e.g., ethane, propane, and butanes) and liquid lease condensate (e.g., pentanes, hexanes, aromatics and cycloalkanes). Methane is an important greenhouse gas and the emission of VOCs may affect local and regional air quality due to the potential to form tropospheric ozone and organic particles as well as from the release of toxic species such as benzene and toluene. Since 2010, the production of natural gas liquids and the amount of natural gas vented/flared has increased by factors of approximately 1.3 and 1.6, respectively (U.S. Energy and Information Administration), indicating an increasingly large potential source of hydrocarbons to the atmosphere.

Here we present measurements of a full suite of carbon-containing gases emitted from oil and gas activities in 13 U.S. shale basins in order to better understand their potential air quality and climate impacts. These measurements were made between 2011-2015 aboard the NOAA WP-3D research aircraft or at various ground sites. Aircraft measurements of non-methane hydrocarbons were measured using a whole air sampler (WAS) with post-flight analysis via gas chromatography-mass spectrometry (GC-MS). The discrete whole air samples are complimented by near-continuous measurements of

methane (Picarro spectrometer), ethane (Aerodyne spectrometer), and VOCs (H_3O^+ chemical ionization mass spectrometer). We will (i) compare the composition of methane and VOC emissions for each basin in order to show that each shale basin has a unique VOC source signature, and (ii) quantify emission fluxes of VOCs for a subset of these basins. This information is critical for accurate emission inventories and input for air quality models.