

Fugitive Emissions from Unconventional Wells in Northeastern Pennsylvania: Tower Network Design

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A network of tower-based methane measurements will be put in place across northeastern Pennsylvania (PA) over a two year period to estimate methane (CH_4) emissions from unconventional natural gas wells in the Marcellus shale region. To accurately calculate methane emissions from the unconventional wells, it is essential to have a tower network set up that measures both background CH_4 concentrations and enhancements from leaks in the natural gas system. A first-guess inventory of CH_4 emissions was created for various sources, including industry, enteric fermentation, unconventional wells, and conventional wells. The emissions were entered into WRF-Chem and concentration fields were generated. These concentration fields were then compared with field observations to find optimal locations for the tower network design. Results show that background conditions for the region vary greatly depending on wind conditions. Days with winds predominantly from the northwest produce a large area with little to no CH_4 enhancement upwind of the conventional well sites. However, days with winds from the southwest produce upwind concentrations that are polluted with enhancements from coal mines, conventional wells, and other industries in southwestern PA. These enhancements remain incompletely dispersed when they reach our study region, resulting in concentrations in the west of our domain that may not be representative of the true background. Such a case can be seen in aircraft data collected by the NOAA/ESRL Chemistry Science Division on July 6th, 2013, where some observations west of the unconventional wells were of a higher concentration than those at the well sites themselves (Figure 1). To counter this effect, background tower sites will be located directly north and south of the well sites rather than to the west to provide cleaner background conditions.

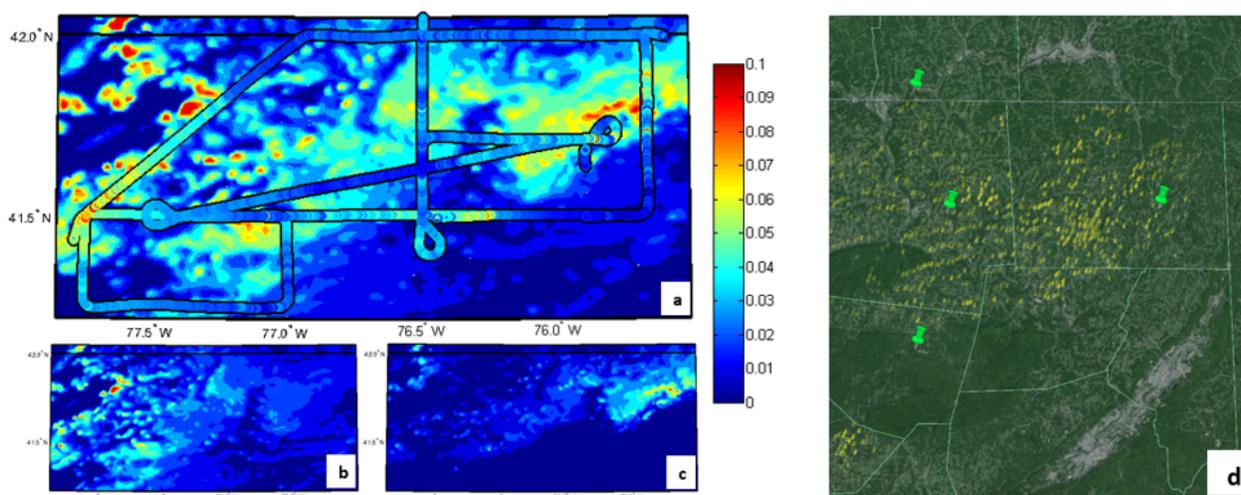


Figure 1. (a) Methane enhancements projected by WRF at 19:00 UTC on July 6, 2013 at 1100m height compared to aircraft data from NOAA outlined in black. Methane enhancement from observations was calculated by taking measured values and subtracting off 1.85ppm. (b) Methane enhancements projected from both point sources found in EPA GHG Report 2013 and conventional wells compared to (c) enhancements projected from unconventional wells assuming a leakage rate of 2% of production for conventional wells and 0.4% of production for unconventional wells. (d) Current tower network design in northeast PA. Green icons are selected towers to be used for measurements while yellow markers represent locations of unconventional wells.