Geophysical Research Abstracts
Vol. 18, EGU2016-11209, 2016
EGU General Assembly 2016

Investigation of natural gas plume dispersion using mobile observations and large eddy simulations

Dana R. Caulton, Qi Li, Levi Golston, Da Pan, Elie Bou-Zeid, Jeff Fitts, Haley Lane, Jessica Lu, and Mark A. Zondlo

Princeton University, Princeton, NJ, USA (dcaulton@princeton.edu)

Recent work suggests the distribution of methane emissions from fracking operations is skewed with a small percentage of emitters contributing a large proportion of the total emissions. These sites are known as 'super-emitters.' The Marcellus shale, the most productive natural gas shale field in the United States, has received less intense focus for well-level emissions and is here used as a test site for targeted analysis between current standard trace-gas advection practices and possible improvements via advanced modeling techniques. The Marcellus shale is topographically complex, making traditional techniques difficult to implement and evaluate.

For many ground based mobile studies, the inverse Gaussian plume method (IGM) is used to produce emission rates. This method is best applied to well-mixed plumes from strong point sources and may not currently be well-suited for use with disperse weak sources, short-time frame measurements or data collected in complex terrain. To assess the quality of IGM results and to improve source-strength estimations, a robust study that combines observational data with a hierarchy of models of increasing complexity will be presented. The field test sites were sampled with multiple passes using a mobile lab as well as a stationary tower. This mobile lab includes a Garmin GPS unit, Vaisala weather station (WTX520), LICOR 7700 CH_4 open path sensor and LICOR 7500 CO_2/H_2O open path sensor. The sampling tower was constructed consisting of a Metek uSonic-3 Class A sonic anemometer, and an additional LICOR 7700 and 7500. Data were recorded for at least one hour at these sites. The modeling will focus on large eddy simulations (LES) of the wind and CH_4 concentration fields for these test sites. The LES model used 2 m horizontal and 1 m vertical resolution and was integrated in time for 45 min for various test sites under stable, neutral and unstable conditions. It is here considered as the reference to which various IGM approaches can be compared.

Preliminary results show large variability in this region which, under the observed meteorological conditions, is determined to be a factor of 2 for IGM results. While this level of uncertainty appears adequate to identify super-emitters under most circumstances, there is large uncertainty on individual measurements. LES can provide insights into the expected variability and its sources and into sampling patterns that will allow more robust error estimates.