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The Data Gap: Can a Lack of Monitors Obscure Loss of Clean Air Act Benefits in Fracking Areas?

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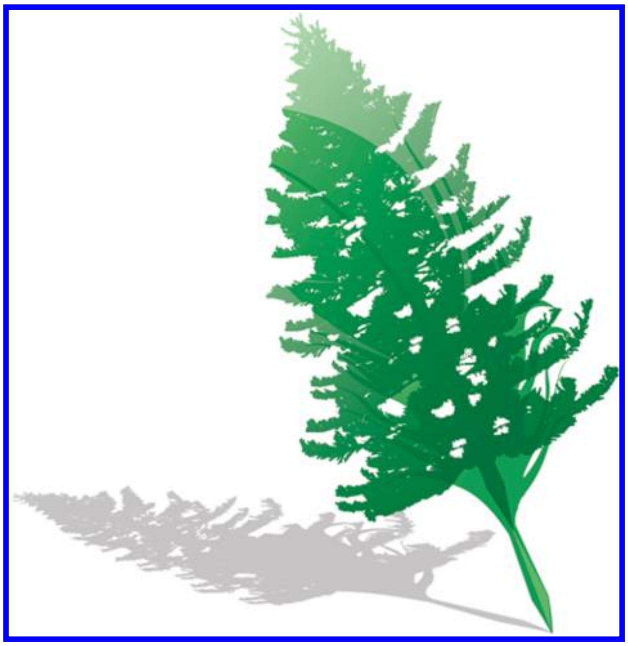

The U.S. is shifting to a greater reliance on natural gas to meet its energy needs, and a large part of this demand is being met by the development of shale gas formations. The increased utilization of natural gas is driven by the supply and thus lower cost, which largely results from new advances in engineering techniques. Primarily, gas production from horizontal drilling and high-volume hydraulic fracturing of shale and other low-porosity rock drives the favorable economics. Discussion of the environmental impacts of these operations has largely focused on water quality issues, but air pollution is also an important potential impact due to emissions associated with drilling, extraction, and associated transportation activities. Recently, air quality impacts have been measured in active oil and gas well areas.[1] The extent to which these increased emissions impact air quality, especially in highly developed shale gas regions where there are no air monitors represents a substantial data gap and hinders effective air quality management.

Throughout the United States, ambient concentrations of criteria pollutants have been decreasing in response to the implementation of the Clean Air Act. For example, Russell et al. (2012) find the rate of decrease in ambient NO_2 concentrations in the mid 2000s to be, on average, about 4.5% yr^{-1} for U.S. cities.[2] Using data from the Environmental Protection Agency's Technology Transfer Network (TTN) (http://www.epa.gov/ttn/airs/airsaqs/detaildata/downloadaqsdata.htm; data downloaded on September 23, 2013 and processed with R statistical software[3]), we find overall similar decreasing trends in New York, Ohio, Pennsylvania, and West Virginia for SO_2, CO, NO_2, NO_x, and $PM_{2.5}$. This improvement in air quality through reduction in ambient concentrations of a variety of criteria air pollutants represents a tremendous success of the Clean Air Act. However, there can be local differences. An example is the Marcellus Shale Region of Western Pennsylvania where the amount of gas development activities has recently exploded (e.g., >6000 active wells in Pennsylvania alone). Ambient NO_x ($NO+NO_2$) concentrations generally were decreasing since the mid 2000s in most Eastern U.S. locations. However, in some areas a clear decrease is not evident and at a few locations the pollutant concentrations have been increasing in recent years. TTN air quality data indicates that at a monitor in Beaver County in western Pennsylvania, near several active wells in the Marcellus Shale region, monthly mean ambient NO_x concentrations have been steadily increasing since 2010. In fact, some recent wintertime monthly average NO_x concentrations have reached levels not observed since the implementation of the "Clean Air Interstate Rule" (CAIR) in 2009 (Figure 1). We find a similar trend in Steuben County, New York in a forested area downwind of shale gas activities in PA, where ambient NO_2 concentrations have been increasing since 2008. The increase in pollutant concentrations and potential onset of losses in Clean Air Act benefits started in the latter part of the 2000s, coincident with the onset of shale gas activities in the surrounding areas. In addition to these findings, we observe that the individual counties with the highest number of active wells by State in the Marcellus Shale region, that is, Carroll, OH; Marshall, WV, and Bradford, PA have no routine air quality monitors. As a consequence, current trends in criteria air pollutants such as NO_2, SO_2, CO, Pb, $PM_{2.5}$ cannot be effectively evaluated with observational data in those locations. This represents a data gap that may be obscuring negative air quality effects from shale gas activities.

NO_x emissions from electric generating units (EGUs) in Pennsylvania have been decreasing and are unlikely to explain the increases in ambient NO_x concentrations measured at these sites. Continuous emissions monitoring (CEM) data from EPA clean air markets division (www.epa.gov/airmarket downloaded November 9, 2013) indicates that statewide NO_x emissions from EGUs in Pennsylvania peaked in 2008. The CEM data suggest year-to-year variability in NO_x emissions exists, possibly as a combination of meteorology and NO_x credit trading price,

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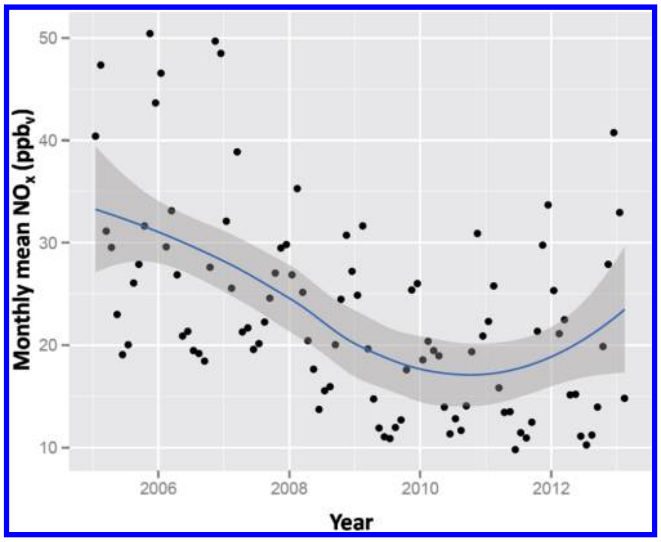

Figure 1. NO_x trends at a monitor located at Beaver Falls within Beaver County, Pennsylvania in a residential development along the Beaver River. The site coordinates are Latitude: +40.747796 Longitude: − 80.316442. The black dots are monthly mean of the measurement values, the blue line is the trendline, and the dark gray area represents the 95% confidence interval of the mean.

but 2008 EGU sector NO_x emissions in Pennsylvania are at least 30% higher than any subsequent year. Further, nationwide personal motor vehicle miles traveled (VMT) peaked in 2007,[4] suggesting national trends in light duty vehicle use is not responsible for recent increases in ambient NO_x concentrations. However, local trends in motor vehicle use could be different than the national average. For example, increased diesel truck transportation of liquid fuel products, and water and wastewater associated with hydraulic fracturing could impact local ambient NO_x and volatile organic compound (VOC) concentrations and potentially cause increases.

A question then for Southwestern Pennsylvania and other shale gas regions is the degree to which shale gas development may impact ozone and particulate matter air quality management strategies. Local air quality impacts are likely occurring as a result of emissions of VOCs and NO_x from operations. VOC-emitting operations include operation of diesel engines on well pads as well as transportation activities, for example, of liquid fuel products, water, and wastewater.[5] Similarly, NO_x-emitting operations likely include flaring, diesel engine operations, and increased diesel truck traffic related to production and new drilling sites.[5]

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Notes

The authors declare no competing financial interest.

■ REFERENCES

(1) Petron, G.; Frost, G.; Miller, B. R.; Hirsch, A.; Montzka, S. A.; Karion, A.; Trainer, M.; Sweeney, C.; Andrews, A. E.; Miller, L. Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study. *J. Geophys. Res.* **2012**, *117*, D04304 DOI: 10.1029/2011JD016360.

(2) Russell, A. R.; Valin, L. C.; Cohen, R. C. Trends in OMI NO_2 observations over the United States: Effects of emission control technology and the economic recession. *Atmos. Chem. Phys.* **2012**, *12* (24), 12197−12209.

(3) R Core Team, R: A language and environment for statistical computing. R Foundation for Statistical Computing, 2013, Vienna, Austria. ISBN 3-900051-07-0; http://www.R-project.org/.

(4) Annual Energy Outlook: with Projections to 2040; DOE/EIA-0383; U.S. Energy Information Administration: Washington, DC, 2013; www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf.

(5) Jiang, M.; Griffin, W. M.; Hendrickson, C.; Jaramillo, P.; VanBriesen, J.; Venkatesh, A. Life cycle greenhouse gas emissions of Marcellus shale gas. *Environ. Res. Lett.* **2011**, *6*, 1−9.