3.006 Top-down estimates of methane and nitrogen oxide emissions from the Haynesville and Fayetteville shale gas production regions.

Early Career Scientist

Presenting Author:
Yuyan Cui, NOAA/ESRL/CIRES, yuyan.cui@noaa.gov

Co-Authors:
Jerome Brioude, NOAA/ESRL/CIRES
Stuart McKeen, NOAA/ESRL/CIRES
Wayne Angevine, NOAA/ESRL/CIRES
Daven Henze, University of Colorado, Boulder
Zhen Liu, Ramboll Environ US Corporation
Nicolas Bousserez, University of Colorado, Boulder
Jeff Peischl, NOAA/ESRL/CIRES
Thomas Ryerson, NOAA/ESRL
Gregory Frost, NOAA/ESRL
Michael Trainer, NOAA/ESRL

Abstract:

Production of unconventional natural gas grows rapidly during the past ten years in the US. This increase most likely led to an increase in emissions of methane (CH_4) and nitrogen oxides (NOx). In terms of radiative forcing, CH_4 is the second most important greenhouse gas after CO_2. NOx is a precursor to ozone (O_3) in the troposphere and nitrate particles, both of which are regulated by the US Clean Air Act. However, the emission inventories of CH_4 and NOx from the shale regions are highly uncertain. To improve the inventories, we use data collected during the Southeast Nexus of Climate Change and Air Quality (SENEX) aircraft campaign (June-July, 2013) to drive inversion calculations and estimate CH_4 and NOx emissions in the Haynesville and Fayetteville shale production regions. We use three transport models and EPA's 2011 National Emission Inventory as prior information to optimize CH_4 and NOx emissions, taking advantage of a Bayesian inversion technique. The posterior CH_4 emissions are then used to constrain NOx emission estimates as well using a flux ratio inversion technique. Compared with the ground-based in-situ observations, the optimized CH_4 and NOx inventories improve the ground level CH_4 and O_3 concentrations simulated with the Weather Research and Forecasting model coupled with chemistry (WRF-Chem).