Routes to Sustainability for Natural Gas Development and Water and Air Resources in the Rocky Mountain Region:
Sensitivity Analysis

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The AirWaterGas project is an NSF Sustainability Research Network (http://airwatergas.org) which endeavors to elucidate pathways to preserve air and water quality in the midst of significant natural gas and oil extraction in the Rocky Mountain region. The effort is being led by investigators at the University of Colorado Boulder with academic and national laboratory partners across the state and country. To highlight the breadth of the project, it encompasses the development and implementation of a social-ecological system model, the evaluation of impacts of natural gas development on air and water resources, and the communication of these findings to a wide variety of stakeholders.

Comparing and contrasting the effects of oil and gas production nationally on air quality in adjacent urban areas will provide context for a more detailed study of the Rocky Mountain region. The investigation will center around four regional conglomerations of Census-based combined statistical areas (Fig. 1). The CSAs in the Northeast, Texas, and Colorado have been selected because of recent growth of production nearby. Southern California provides an opportunity to compare these recent developments to an area with more steady, long-term production.

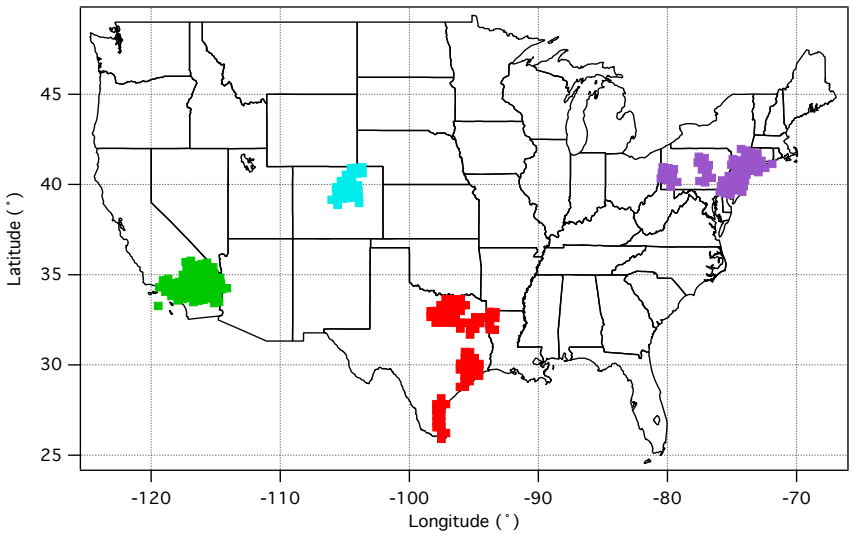

Figure 1. Select urban areas adjacent to oil and gas production activity.

For each of these regions, we will use the gas-phase adjoint of CMAQ to elucidate the relative influence of ozone precursor emissions from specific locations on a regulatory ozone metric in the CSAs. The CMAQ adjoint calculates ozone concentration fields from which a concentration-based metric is evaluated; we intend to assess a measure of exceeedance of the maximum daily average eight-hour ozone (MDA8) because of the policy-relevance of this metric. The adjoint determines the relative influence of all emissions parameters, including NOx and modeled volatile organic compounds (VOCs) on this metric.

Specifically, we will use 2007 emissions and meteorological inputs to drive CMAQ. Because emissions from oil and gas activities have changed over the time and are likely different than the 2008v2 National Emissions Inventory in this sector, we intend to use alternate emissions estimates and in situ observations to approximate how revised emissions may alter ozone concentrations or the relative importance of a source. To this end, we seek the opportunity to use 2008 emissions developed for the Three State Air Quality Study (3SAQS). Additionally, we are requesting access to the concentration fields from the 2008 3SAQS modeling platform as a point of comparison for the CMAQ adjoint-based concentrations. The emissions data for the region will be used alongside measurements of ambient air from the Denver-Julesburg basin to establish the relevant perturbations of emissions and concentrations with which the sensitivities from the adjoint can be meaningfully combined for the Colorado CSA.

We anticipate disseminating the sensitivity analysis results in a scientific journal article as well as through the WAQDW for aspects focused on the western US. As prioritized by the AirWaterGas project, we will aim throughout the process to communicate clearly with the states as key stakeholders in the outcomes.

Timeline of Executing Modeling Work

Time (months)	***Anticipated output***
Jan 2015	Adjoint model set up
6	Modeling sensitivities for 2007 episode with CMAQ adjoint
9	Evaluation of relative influence of ozone precursor changes on selected regions
15	Publication of results of national sensitivity analysis investigation