

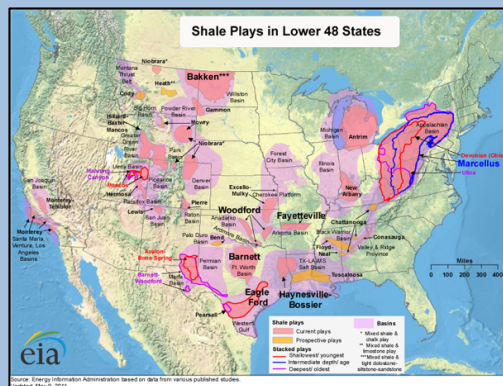
# Energy Development Impacts on Climate, Air Quality, and Health

A research focus in the Chemical Sciences Division

NOAA Earth System Research Laboratory

## ***The nation is striving to increase its energy independence:***

- Oil and natural gas (O&NG) development in the nation has been proceeding at a rapid rate; the United States has now become a net exporter of liquified natural gas (LNG).
- Production of natural gas from shale is expected to increase (U.S. Energy Information Administration - EIA).
- Oil and natural gas development is occurring throughout the United States (Figure: U.S. EIA), resulting in significant local, regional, and national issues of environmental concern, including health, air quality, and climate effects.

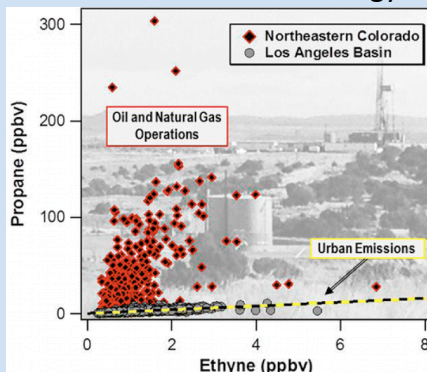


## **What are the impacts? Why conduct this research?**

- O&NG emissions into the atmosphere raise environmental issues:
  - Climate change: methane is a potent greenhouse gas
  - Air quality degradation: O&NG emissions of hydrocarbons produce ozone and particulate material (PM)
  - Health effects: benzene and hydrogen sulfide are toxics
- Sound science will **inform industry** on how to determine best-practices to reduce adverse environmental consequences of energy development.
- Sound science will **inform regulatory agencies** so that their emissions control strategies are scientifically sound and effective.

## **What is needed?**

- Improved and verified emission inventories for O&NG energy development activities throughout the nation.
- Better scientific process-based understanding of chemistry and transport of emissions from regions of energy development, enabling assessments of local, regional, and national impacts.



## **Why ESRL/CSD?**

- CSD has the unique capability to combine field observations, modeling, fundamental laboratory studies, and instrument development skills that are critical to success in advancing the understanding of these impacts.
- CSD has a proven track record in communicating science and providing actionable information to both industry and regulatory communities.

## **Recent Accomplishments**

- CSD measurements at the Boulder Atmospheric Observatory north of Denver, CO, showed the influence of energy development on air quality (see figure at left).
- CSD has led three field studies, requested by the State of Utah and funded by energy industry, in the Uintah Basin of Utah to decipher the unusual chemistry associated with very high wintertime ozone levels.
- CSD led an extensive 2015 study of emissions from shale basins across the west-central United States, the SONGNEX mission (see back page).

## **Expected Payoffs**

- Improved characterization of emissions associated with energy development
- Better scientific process-based understanding of complex atmospheric chemistry of emissions
- Improved predictive capability
- Scientific information for industry & decision makers on best practices and win-win solutions

# SONGNEX 2015

## Shale Oil and Natural Gas Nexus

*Studying the Atmospheric Effects of Changing Energy Use in the U.S.  
at the Nexus of Air Quality and Climate Change*

**What:** An aircraft-based field study throughout the west-central United States

**When:** March - May 2015

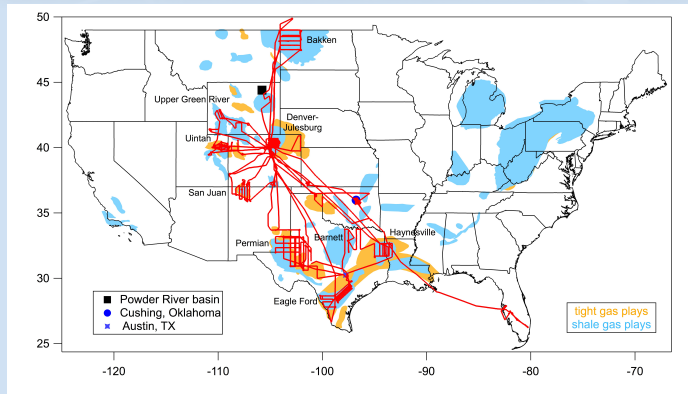
**Goals:** The primary goal of NOAA's SONGNEX field study is to quantify the emissions of trace gases and fine particles from several different tight oil and shale gas basins in the western United States, and to study the chemical transformation of these emissions. The study focused on basins that represent a mixture of oil and gas production regions at various stages of development.

**Who:** Investigators in this project include researchers from several universities, industries, and governmental agencies, led by the Chemical Sciences Division of NOAA's Earth System Research Laboratory.



Over a dozen instruments flew aboard the NOAA WP-3D research aircraft to measure methane and other volatile organic compounds (VOCs), nitrogen oxides, ozone, and other trace gases in the air above oil & gas fields ranging from Texas to North Dakota.

NOAA research has shown that many different VOCs are emitted in the production fields, and that the amounts emitted depend greatly on the composition of the oil & gas mixture, as well as the equipment and production practices in use.



### Preliminary Findings

- Leak rates of western O&NG fields are generally larger than fields in the eastern United States.
- Drilling activity declined in early 2015 but methane emissions were relatively unchanged.
- Emissions of VOCs from these oil & gas basins are large and potentially globally important.