“Unconventional” gas production - a new CSD focus since our last review in 2008:
Advent of horizontal drilling and high-pressure hydraulic fracturing has led to major changes in the U.S. energy portfolio, with poorly known impacts on air quality & climate

CSD research results

- Decreasing power plant CO₂ emissions... de Gouw et al., 2014
- ...from an increasing supply of natural gas
  Peischl et al., 2015

AQ impacts: Increased CH₄ emissions. Summer and winter(!) O₃ formation.

CSD response:
- apply expertise in field measurements and atmospheric chemical modeling
- provide timely scientific information to industry, policymakers, and the public
Unconventional gas production has led multiple field studies quantifying CH$_4$ emissions from oil & gas production regions.

- **2010**: California Research at the Nexus of Air Quality and Climate Change (CalNex)
- **2011**: Nitrogen, Aerosol Composition, and Halogens on a Tall Tower (NACHTT)
- **2012–14**: Uintah Basin Winter Ozone Studies (UBWOS) - co-led with GMD
- **2013**: Southeast Nexus (SENEX)
- **2014**: Twin Otter Projects Defining Oil/gas Well emissions (TOPDOWN) - co-led with GMD
- **2015**: Shale Oil and Natural Gas Nexus (SONGNEX) ← currently active

Our work quantifies CH$_4$ emissions from regions accounting for 65% of unconventional shale gas production in the U.S.

Leaks from U.S. energy sector natural gas production...

... are a fraction of U.S. total CH$_4$ emissions (CO$_2$, NOx, VOCs, PM, etc.)

Keeping an eye on the big picture

CSD field projects have provided constraints on all major CH$_4$ source types in the U.S.

We collaborate with other agencies, academic researchers, and industry to better understand the total U.S. CH$_4$ emissions budget.

This work addresses the President’s Climate Action Plan goals for “improved understanding to reduce emissions”
O$_3$ formation from energy development

CSD has led multiple field studies assessing $O_3$ formation from oil & gas emissions

2011: Nitrogen, Aerosol Composition, and Halogens on a Tall Tower (NACHTT)
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CSD research results

Summer: Oil & gas contributes about half of the initial VOC reactivity leading to $O_3$ formation in the Denver non-attainment area

Winter: Remarkably high $O_3$ values observed in oil & gas production regions in the rural western U.S.

See talks by
Jessica Gilman, 4-2
Jim Roberts, 4-3
Christoph Senff, 4-4
Ravan Ahmadov, 4-5

CSD research has quantified oil and gas emissions’ impacts on both summer and winter $O_3$