Area-wide emission flux measurements from aircraft

Michael Trainer

Methane Emission Flux Measurement over the Uinta Basin

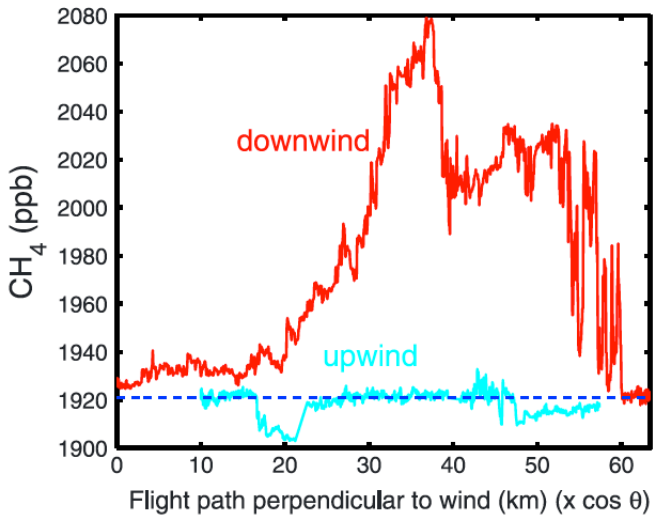
The airborne mass balance technique gives an accurate **"top-down" observation-based emission flux estimate** used by CSD in field campaigns since 1992

Mass balance for the Uinta Basin on 3 February 2012:

CH_4 emission flux = (55 ± 15) metric tons per hour

→ **9% of CH_4 production** leaked to the atmosphere

Karion *et al.*, 2013



$$flux = v\cos(\alpha)\int_{z_0}^{z_1}\int_{-y}^{y}\left(X - X_{bg}\right)dy\,dz$$

Local Economic, Climate & Health Perspective:

Leaked CH_4 could generate 85% of the electricity of the 500 MW Bonanza coal-fired power plant

- *electricity for 400,000 households*
- *with less than half of the CO_2 emissions*
- *with much reduced NO_x and SO_2 emissions*

Application to CSD modeling:

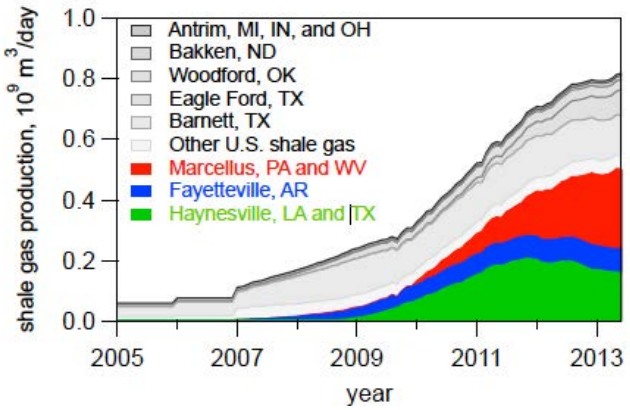
This CH_4 emission flux, coupled with observed VOC-to-CH_4 ratios (*Jessica Gilman, talk 4-3*), provided key input for CSD regional chemical modeling (*Ravan Ahmadov, talk 4-5*)

Collaborations within ESRL:

Airborne CH_4 data: **G**lobal **M**onitoring **D**ivision
Lidar wind data: **C**hemical **S**ciences **D**ivision
Turbulence data: **P**hysical **S**ciences **D**ivision

Comparison of CH_4 emissions from different oil & gas basins

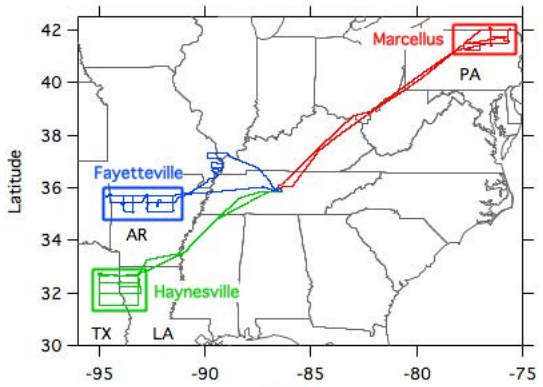
Results from the CSD-led SENEX airborne field study



The Haynesville, Fayetteville and Marcellus regions contribute about 50% of U.S. shale gas production

NOAA P-3

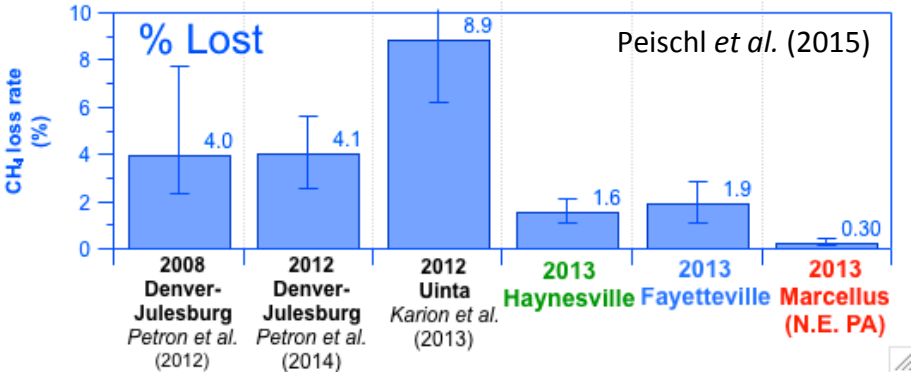
Southeast Nexus (SENEX) study Summer 2013



CSD used the P-3 aircraft in 2013 to assess CH_4 and VOC emissions from these 3 regions

Average CH_4 emissions in these 3 regions **equaled about 1% of production**, roughly consistent with US EPA estimates

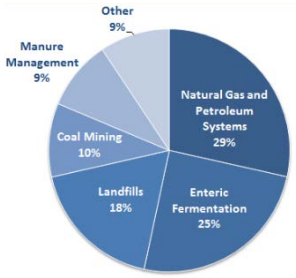
But across the U.S., one size does not fit all



CSD studies have helped quantify the large regional variability in oil & gas CH_4 emissions

Comparison of CH_4 emissions from different U.S. source types

Our research provides critical context for oil & gas CH_4 emissions



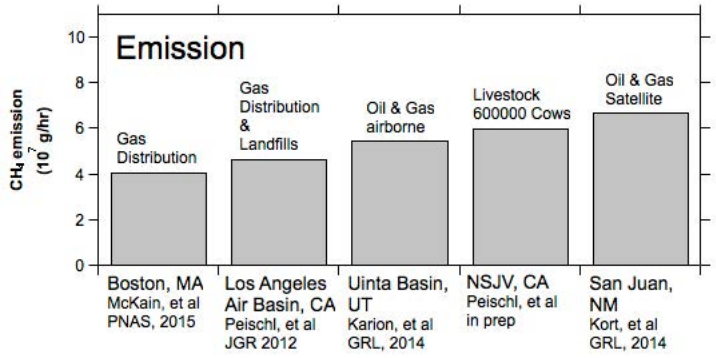
CH_4 sources in the U.S. EPA

CSD quantifies CH_4 from oil & gas, coal, livestock, landfills, & urban sources

Ongoing modeling work: reconcile findings from different top-down approaches

CSD uses top-down emissions data and the WRF-Chem 3-D model to provide a "transfer standard" for meaningful validation of satellite CH_4 column data

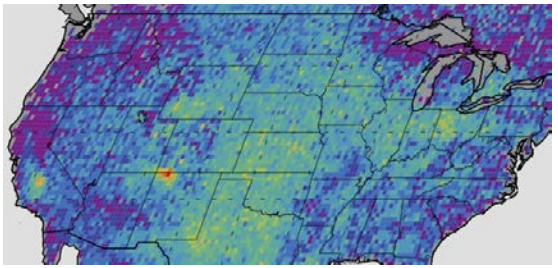
Top-down emissions data



CSD modeling

NOAA High Performance Computing System

Satellite column data



CH_4 columns from the SCIAMACHY sensor

Kort *et al.*, (2014)

Addresses Presidential Climate Action Plan goal for improved knowledge of CH_4 sources