



NE Colorado Oil and Gas Hydrocarbon Emissions

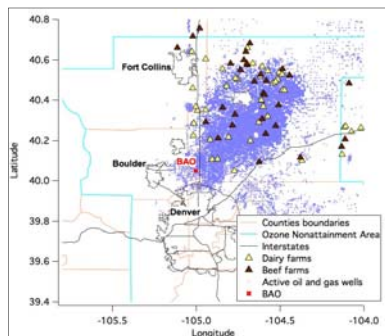
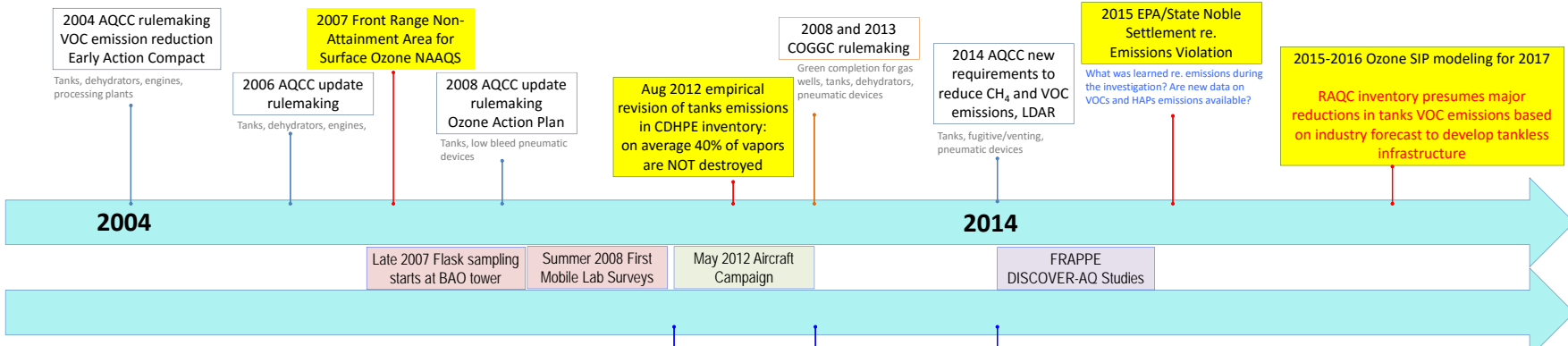
A long & iterative path

towards understanding and mitigating air impacts

Gabrielle Pétron^{1,2}, Benjamin R. Miller^{1,2}, Eryka Thorley^{1,2}, Ingrid Mielke-Maday^{1,2}, Jonathan Kofler^{1,2}, Owen Sherwood³, Bruce Vaughn³, Stefan Schwietzke^{1,2}, Stephen A. Montzka², Colm Sweeney², Anna Karion³, Pieter Tans², Arlyn Andrews², Ed Dlugokencky², Patricia Lang², Tim Newberger^{1,2}, Sonja Wolter^{1,2}, Bradley Hall², Paul Novelli², Duane Kitzis^{1,2}, Stephen Conley⁵, Dan Wolfe¹ and Russell Schnell



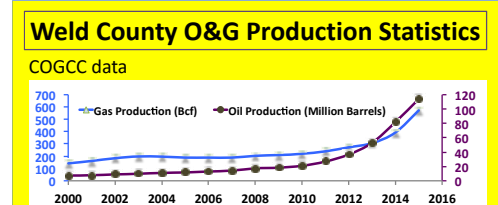
Background: Large portion of NE Colorado has been non-attainment for ozone since 2007



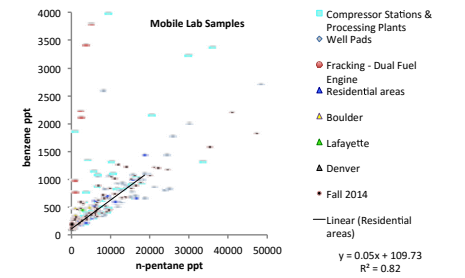
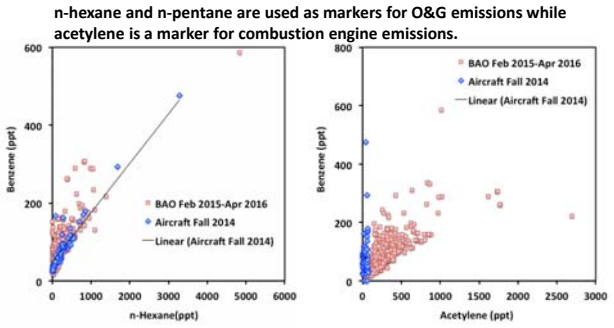
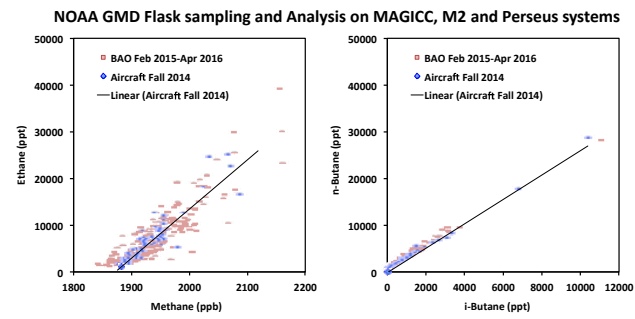
Facts:

- The Colorado northeast airshed is a non-attainment area for surface ozone.
- It is home to close to 4 million people, a large cattle industry as well as a booming oil and gas industry.

- Methane and VOC emissions from O&G major source for regional ozone [Pétron et al., 2012]
- VOC emissions from O&G underestimated [Gilman et al., 2013]
- Methane, VOC and benzene emissions from O&G underestimated by factors of 3, 2 and 7 [Pétron et al., 2014]



NOAA GMD Mobile Lab samples are collected in the field from public access roads. Data below covers 2008-2014



Atmospheric Measurements:

- Recent data from the BAO 100 ft tall tower and aircraft flights in the area continue to show elevated hydrocarbons, markers of O&G emissions in the region.

- Air samples from tower, aircraft and ground surveys show benzene is emitted by O&G operations in the area. Pétron et al. [2014] found state O&G benzene emission estimates are underestimated by a factor of 7.

Independent studies are needed to investigate O&G HAPs emissions and assess the effectiveness of mitigation.

Authors Affiliation

- Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO
- NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO
- Institute for Arctic and Alpine Research, University of Colorado, Boulder, CO
- National Institute of Standards and Technology, Gaithersburg, MD, USA
- University of California Davis, Davis, CA 95616