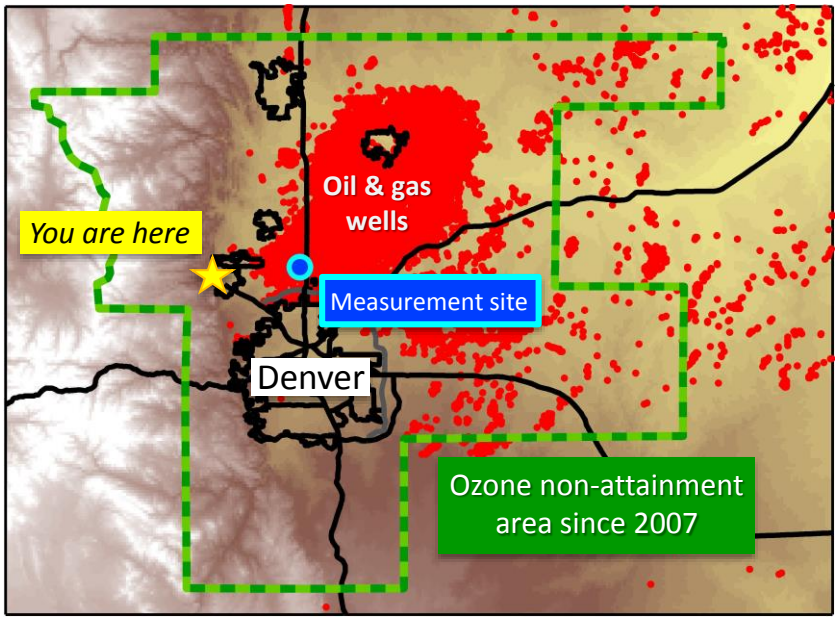
Oil and gas VOC emissions and chemistry

Jessica B. Gilman

Emissions:

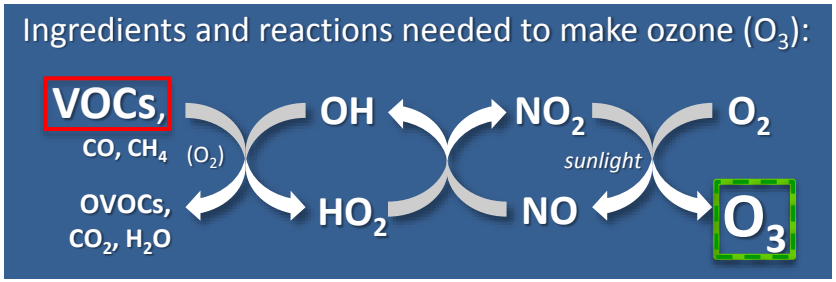
Raw oil and natural gas are complex mixtures of methane and volatile organic compounds (VOCs)



Oil and gas emissions have a unique "source signature" that is distinguishable from other fossil fuel sources

Chemistry:

VOCs may react in the atmosphere to form tropospheric ozone (O_3) and organic aerosol



VOC emissions from oil and gas in Uintah and Denver Basins are an important source of O_3 precursors

CSD's Role: Characterize the chemical composition of volatile organic compound (VOC) emissions from oil and gas operations in order to assess potential air quality impacts

Oil and gas VOC emissions and chemistry

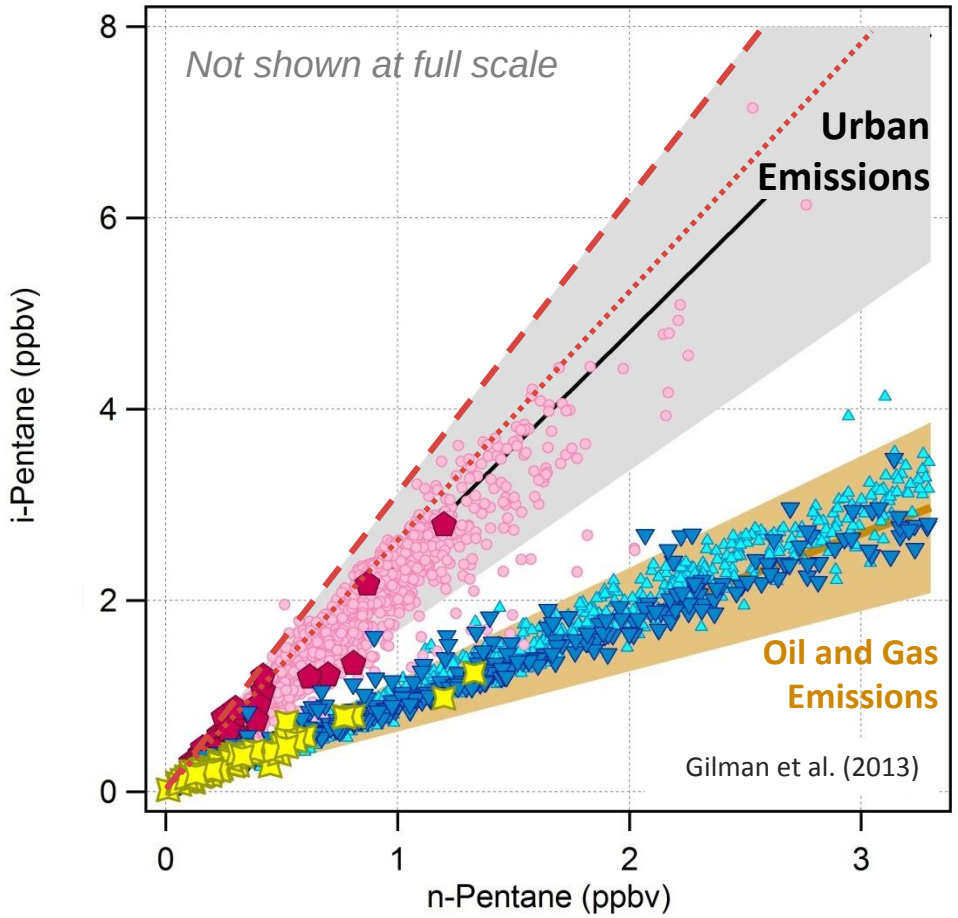
Emissions from oil and gas have a unique "source signature"

Urban Ratio = 2.4 ± 20%
- Pasadena, CA 2010
- 28 U.S. Cities *(Baker, 2008)*
- Gasoline *(Schauer, 2002)*
- Vehicle Exhaust *(Gentner, 2009)*

Urban emissions of VOCs are dominated by gasoline related sources (Warneke, 2013)

- i-Pentane is the most abundant hydrocarbon in gasoline

Natural Gas Ratio = 0.88 ± 20%
- Uintah Basin, UT 2012
- Denver Basin, CO 2011
- Raw Natural Gas Composition
  from Colo. Oil and Gas Conservation Comm. Report



Emissions of volatile organic compounds (VOCs) from oil and gas can be clearly distinguished from other fossil fuel sources allowing for accurate source apportionment

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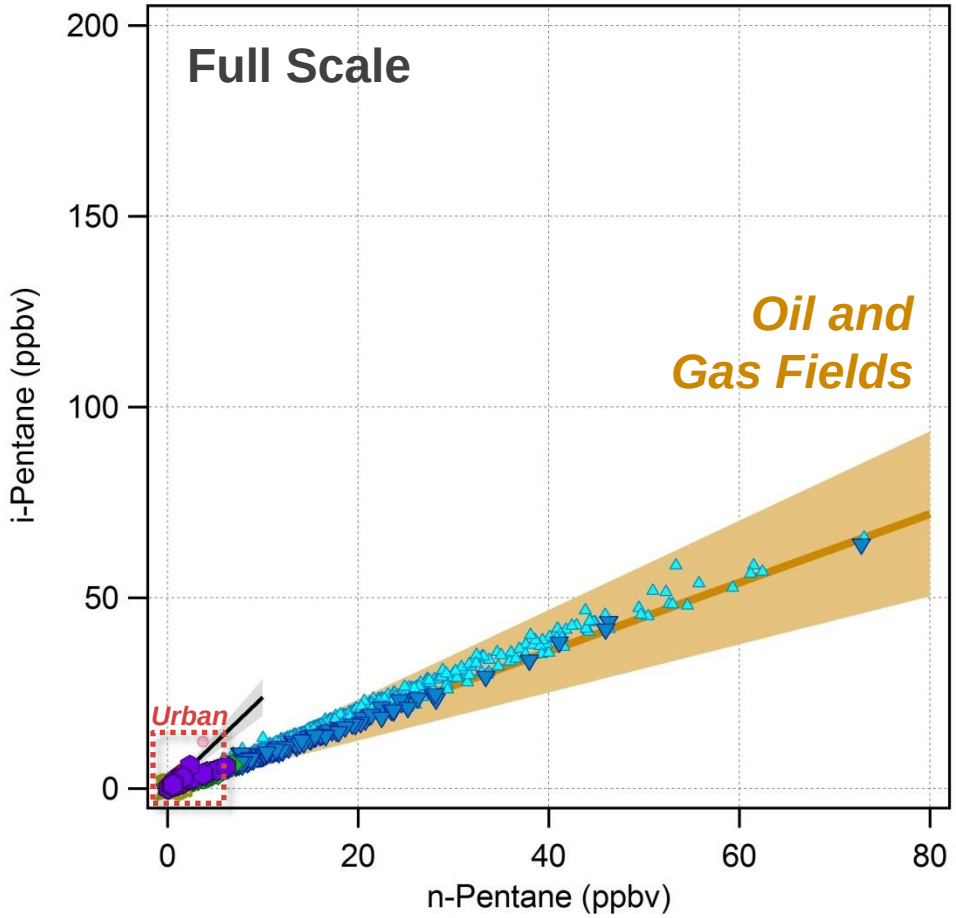
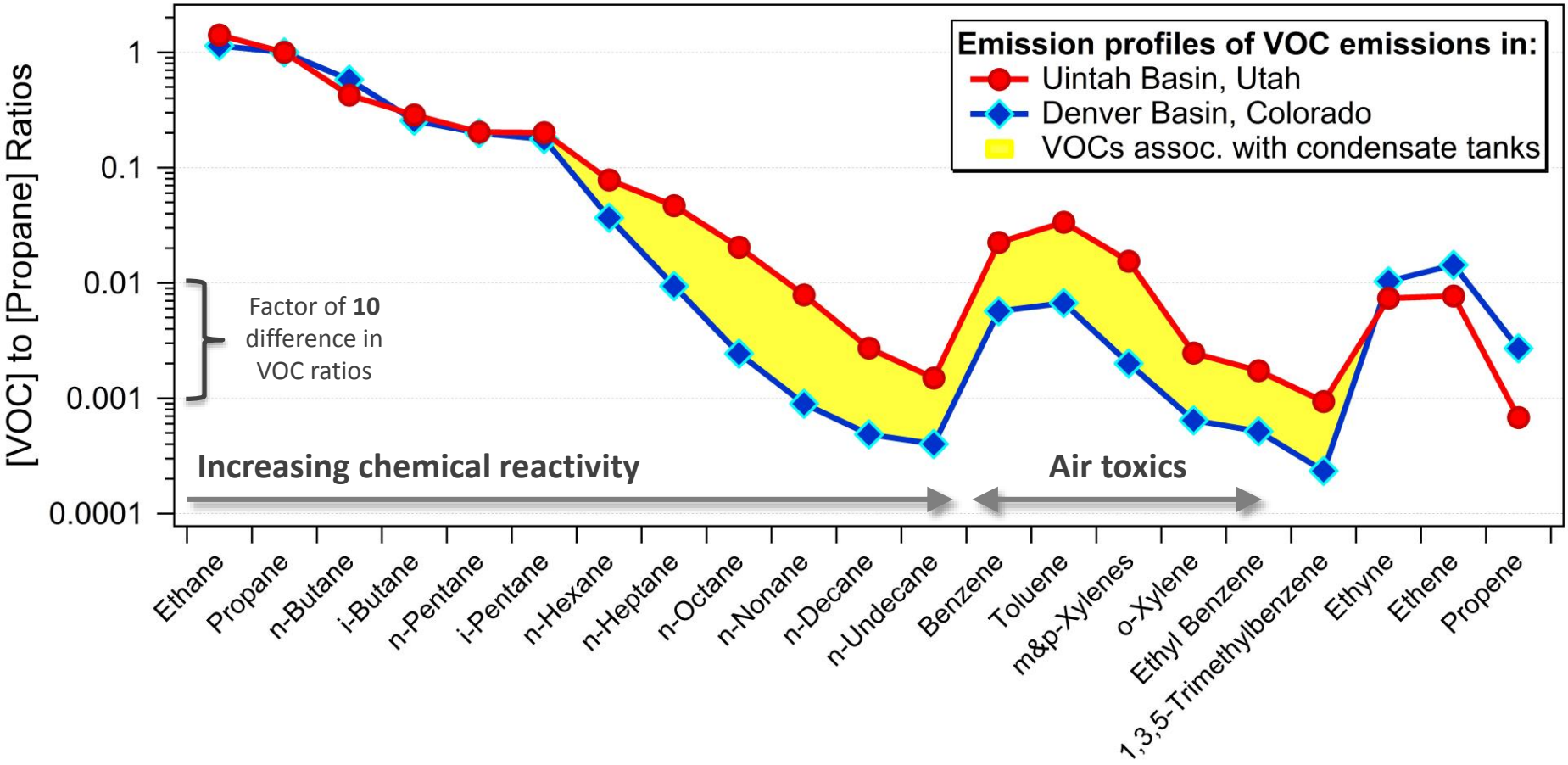
We have observed **high levels of VOCs** near oil and gas operations in the Denver and Uintah Basins (Petron, 2012; Gilman, 2013; Edwards, 2013)



Emissions of volatile organic compounds (VOCs) from oil and gas can be clearly distinguished from other fossil fuel sources allowing for accurate source apportionment

Oil and gas VOC emissions and chemistry

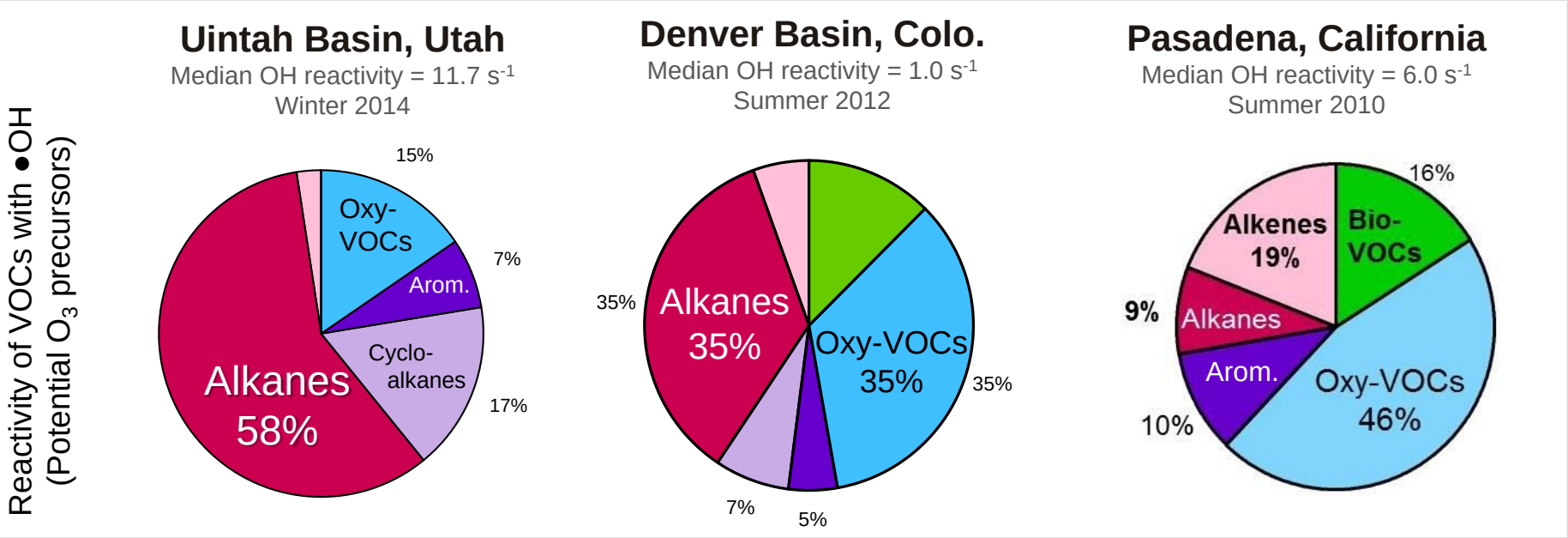
Each shale basin has a unique "chemical fingerprint"



The chemical composition of each basin is critical input to chemical inventories, atmospheric models, and the regulatory community. "One profile does not fit all."

Oil and gas VOC emissions and chemistry

VOCs may react in the atmosphere to form ozone (O_3)



- Composition of O_3 precursors emitted from oil and gas sources is dominated by alkanes
- **On average, 55 ± 18% of the VOC-OH reactivity was attributable to emissions from oil and gas operations in the Denver Basin in winter 2011 indicating that these emissions are a significant source of ozone precursors (Gilman et al., 2013)**

Characterizing the chemical composition of volatile organic compound (VOC) emissions from oil and gas operations is critical to assessing potential air quality impacts

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Stakeholders:

Two CSD co-authored studies [**Petron et al. (2011) and Gilman et al. (2013)**] were used as **"State Exhibits A &B" out of 143 total exhibits** by the **Colorado Department of Public Health and Environment (CDPHE) in 2014** as part of a regulatory hearing aimed at reducing methane and VOC emissions from oil and gas sources in Colorado

https://www.colorado.gov/pacific/cdphe/aqcc-meeting-materials-february-19-23-2014

Key Points:

- VOC emissions from oil and gas has a distinct "source signature" allowing for accurate attribution of VOC sources
- Each basin has a unique VOC composition related to oil and gas operations
- VOCs from oil and gas are a significant source of O_3 precursors in Denver and Uintah Basins

Characterizing the emissions of methane and VOCs from oil and gas operations is critical to assessing future climate and air quality impacts