



The Science of Fracking and Health July 2018 Webinar

Ambient Nonmethane Hydrocarbon
Levels Along Colorado’s Northern Front
Range: Acute and Chronic Health Risks

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Acknowledgements:

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72-96 hour samples: Boulder County Public Health.

1-minute samples: Colorado Department of Public Health and Environment provided to the National Center for Atmospheric Research and NSF Front Range Air Pollution and Photochemistry Experiment (FRAPPÉ) campaign which took place in conjunction with the NASA DISCOVER-AQ project.

Continuous air measurements: NASA DISCOVER-AQ project

Ambient Nonmethane Hydrocarbon Levels Along Colorado's Northern Front Range: Acute and Chronic Health Risks

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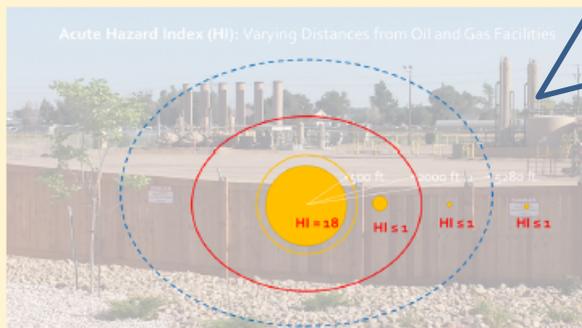
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S Supporting Information

ABSTRACT: Oil and gas (O&G) facilities emit air pollutants that are potentially a major health risk for nearby populations. We characterized prenatal through adult health risks for acute (1 h) and chronic (30 year) residential inhalation exposure scenarios to nonmethane hydrocarbons (NMHCs) for these populations. We used ambient air sample results to estimate and compare risks for four residential scenarios. We found that air pollutant concentrations increased with proximity to an O&G facility, as did health risks. Acute hazard indices for neurological (18), hematological (15), and developmental (15) health effects indicate that populations living within 152 m of an O&G facility could experience these health effects from inhalation exposures to benzene and alkanes. Lifetime excess cancer risks exceeded 1 in a million for all scenarios. The cancer risk estimate of 8.3 per 10 000 for populations living within 152 m of an O&G facility exceeded the United States Environmental Protection Agency's 1 in 10 000 upper threshold. These findings indicate that state and federal regulatory policies may not be protective of health for populations residing near O&G facilities. Health risk assessment results can be used for informing policies and studies aimed at reducing and understanding health effects associated with air pollutants emitted from O&G facilities.



Gabrielle Pétron
Anne Thompson,
Simone Meinardi,
Jason Schroeder,
Daniel Bon, Amy
Townsend-Small,
Bianca Baier

Concentrations of hazardous air pollutants increase with density of oil and gas wells

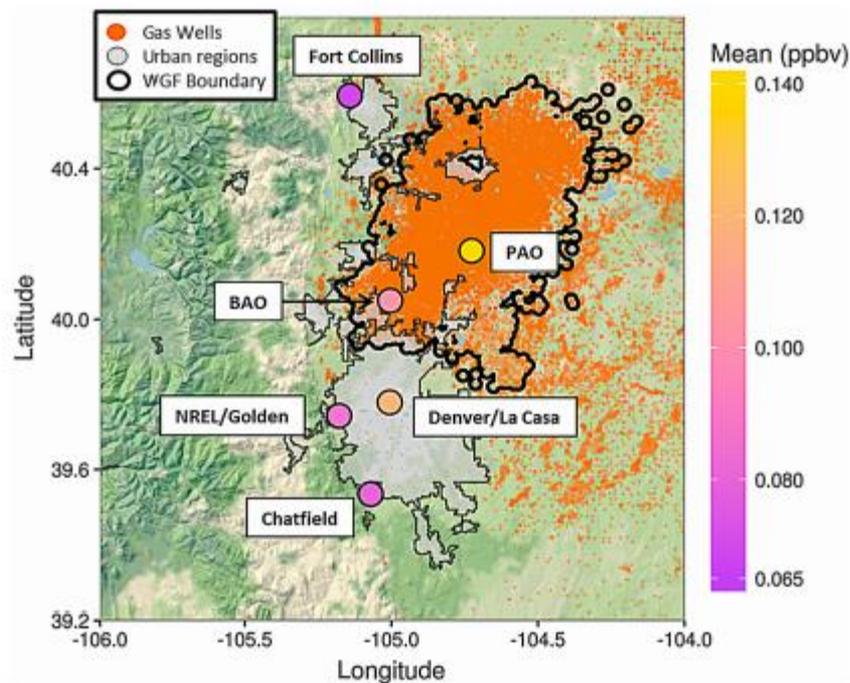
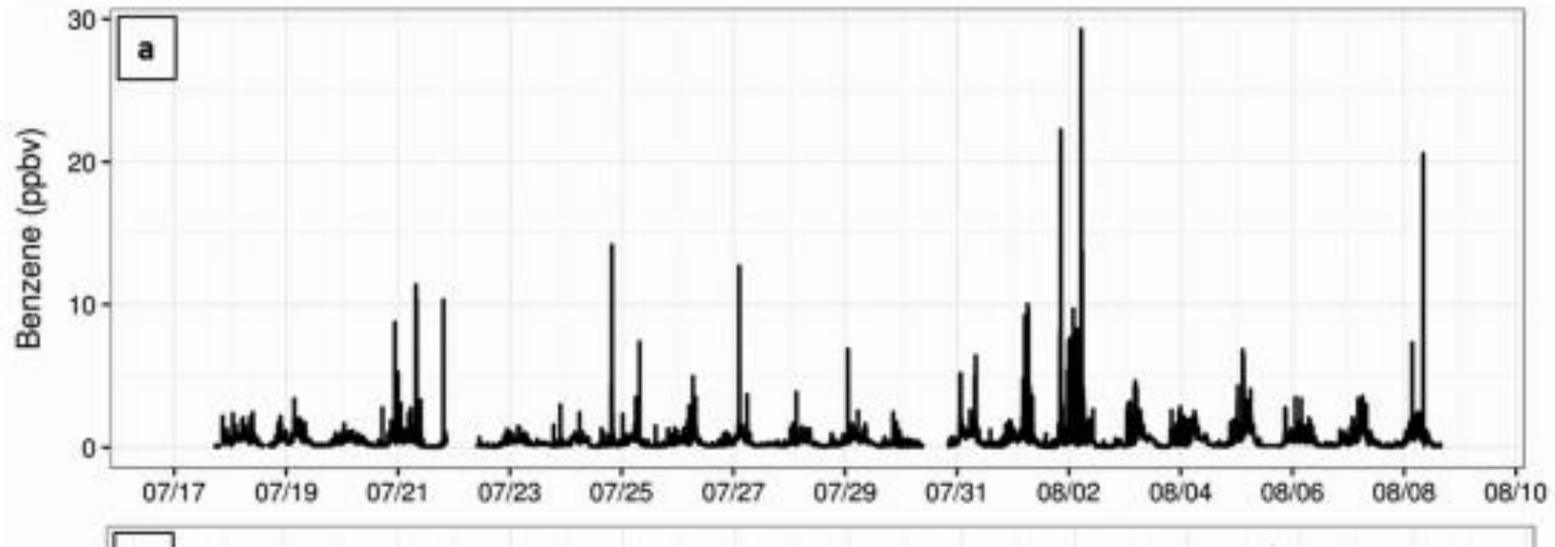
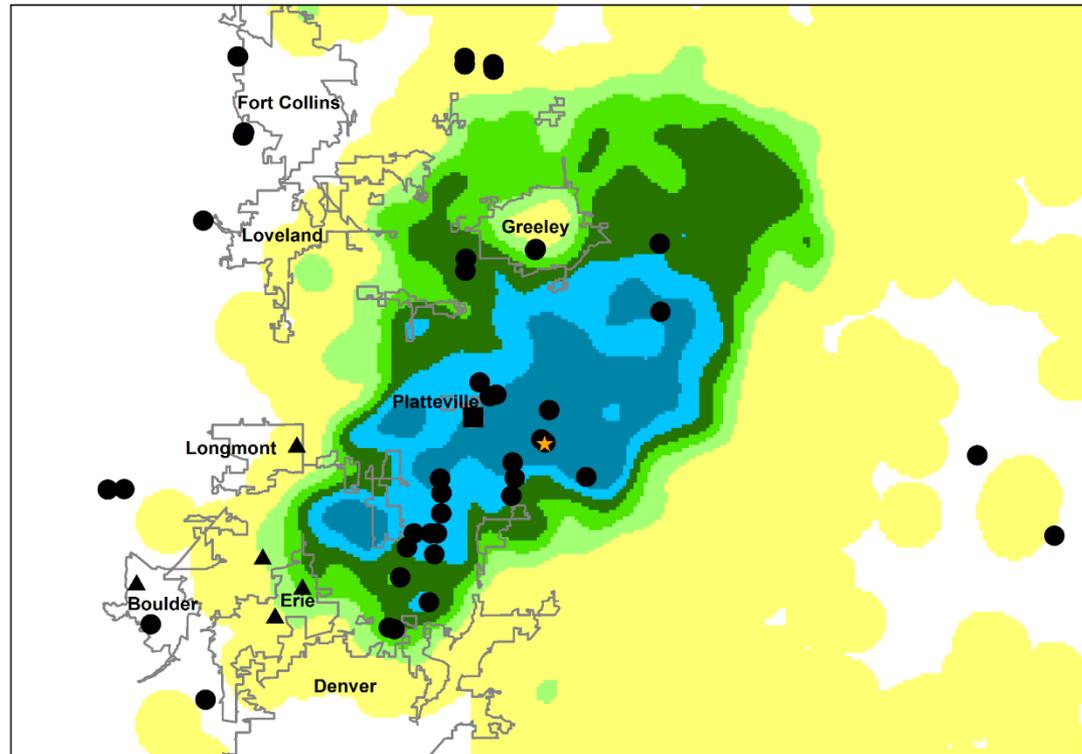


Figure 1. Map of the 2014 DISCOVER-AQ study area. The urban areas are shown in grey (data courtesy of the United States Census Bureau, <http://www.census.gov/geo/maps-data/data/tiger.html>). The boundary of the WGF is shown in black along with the gas wells (brown points) (data courtesy of the Colorado Oil and Gas Conservation Commission, <http://cogc.state.co.us/>). The DISCOVER-AQ ground sites are plotted and colored using the mean benzene volume mixing ratio measured during the aircraft spirals over each site. Benzene statistics were calculated using data from the bottom 1 km agl for each site.

Repeated peak exposure potentials at night, before sunrise

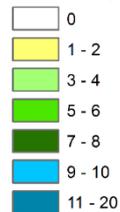


Locations where air was sampled at ground level in the summer of 2014.

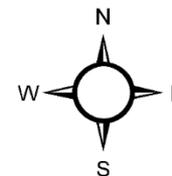


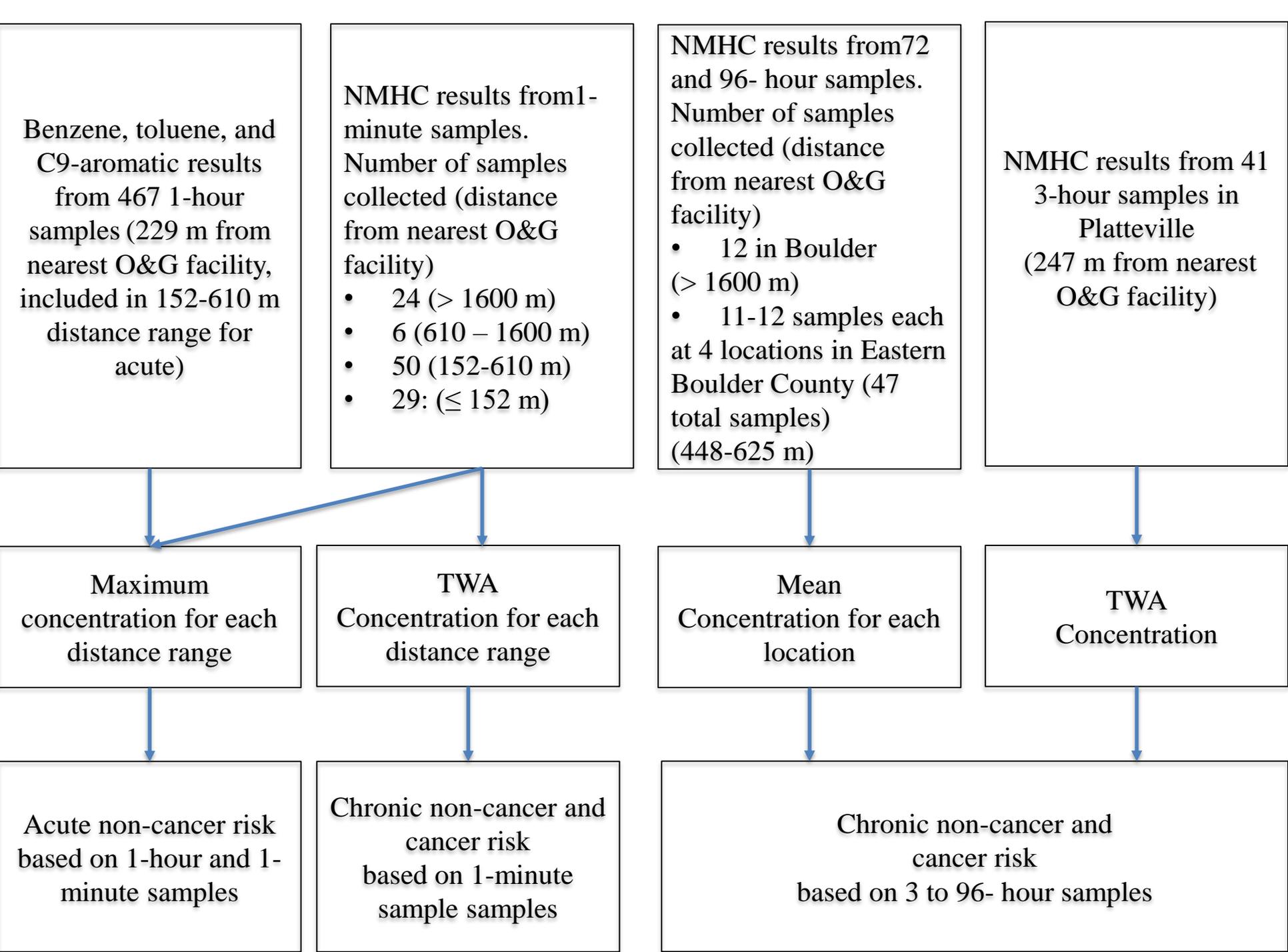
Legend

Wells / Sq Km



- ★ Continuous Monitoring
- ▲ 72-96 Hour Integrated Canisters
- 3 Hour Integrated Canisters
- 1 Minute Grab Canisters
- Cities / Towns





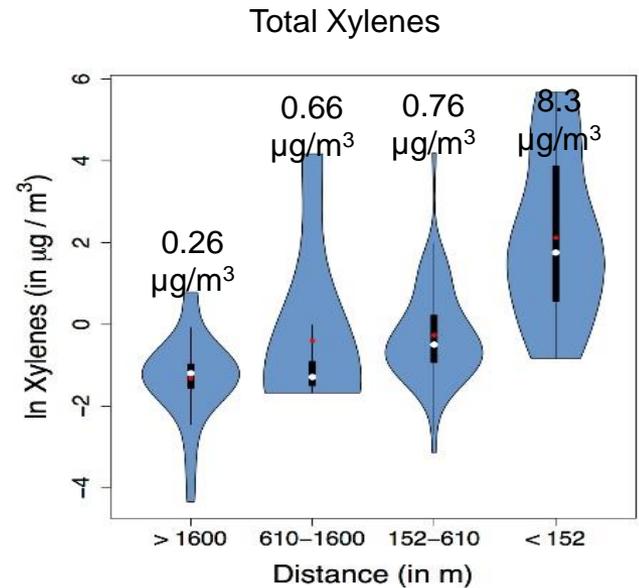
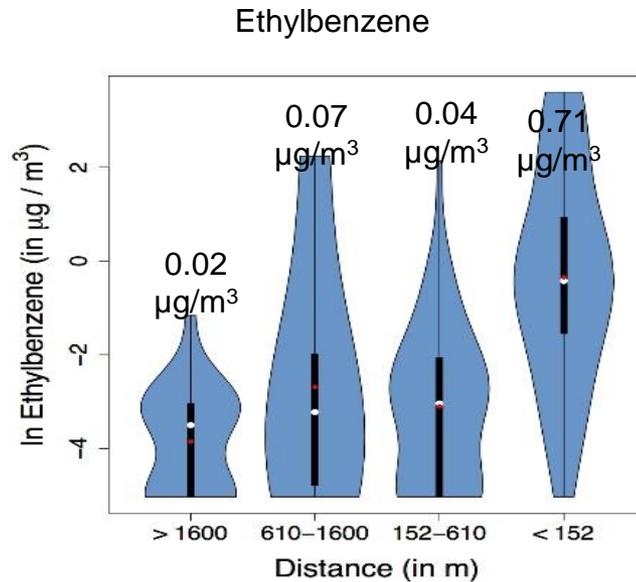
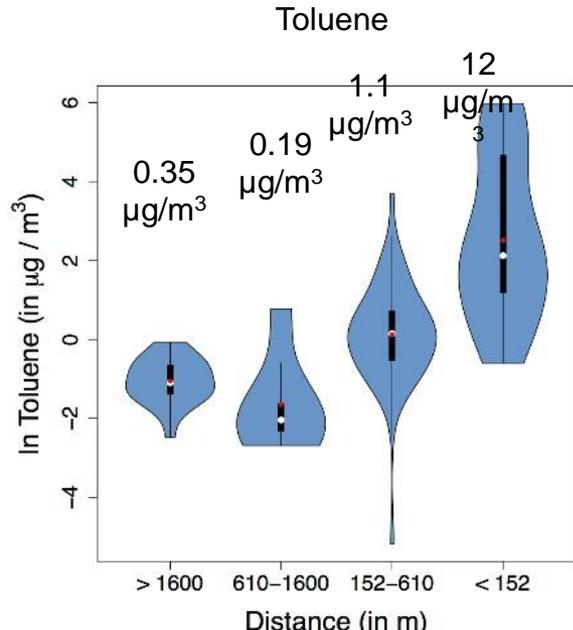
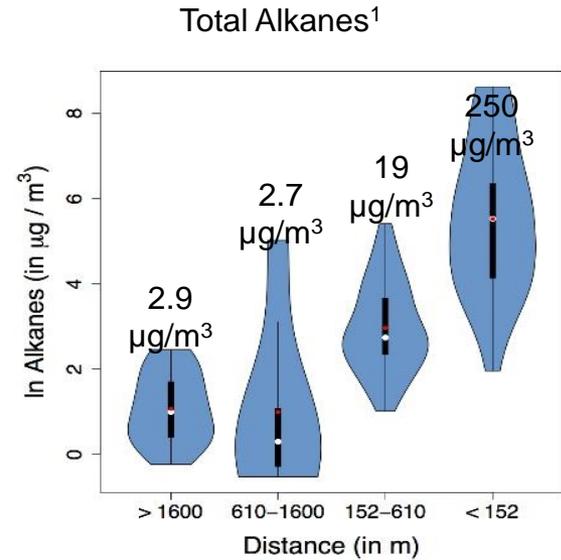
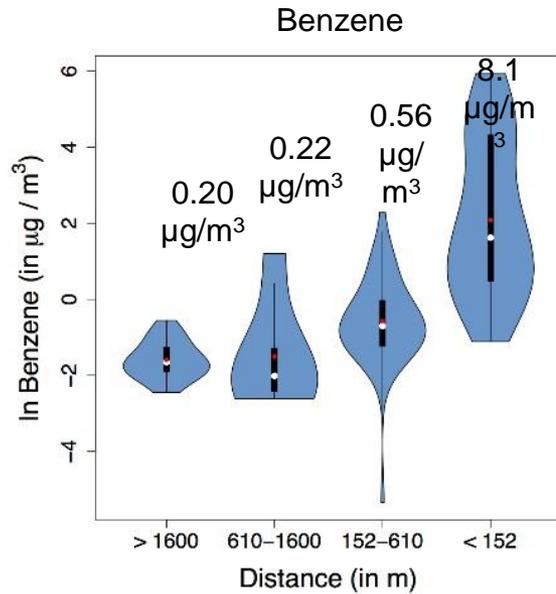
Methods

- Human Health Risk Assessment Guidance from California Office of Environmental Health Hazard Assessment (OEHHA).
 - ✓ Current toxicity information for benzene
 - ✓ Consideration of lifelong effects resulting from exposures beginning in gestation.
- Accounted for higher night-time levels of hazardous air pollutants
- Assessed health effects for exposure to hydrocarbons associated with petroleum.
 - ✓ Did not assess ozone, particulate matter, or carbonyls

Methods Continued

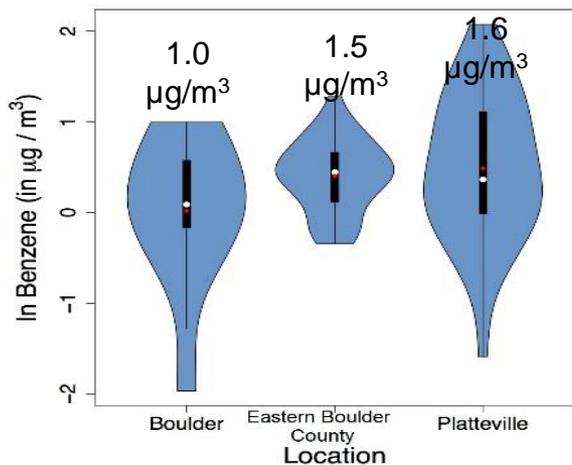
- Used maximum concentration to estimate health hazards from exposure for 1 hour (acute)
- Used time weighted averages for long term chronic and cancer exposures which considered higher nighttime exposures
- For non-cancer health effects: assumed chronic exposures for 24 hours per day, 350 to 365 days per year for more than 7 years.
- For cancer health effects assumed that people spend 72 to 85 percent of their time at home over a 30 year period.

Concentrations of hazardous air pollutants in 1-minute samples collected by University of California, Irvine

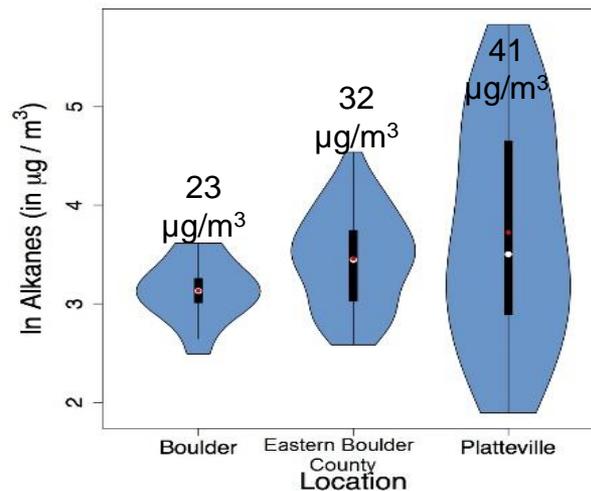


Concentrations of hazardous air pollutants in 3-96 hour damples collected by Boulder County Study (INSTAR) and Halliday

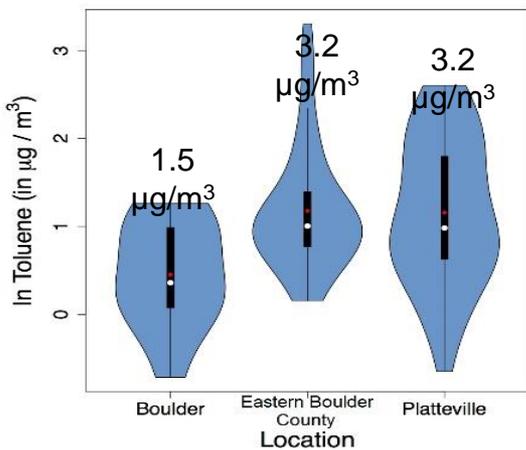
Benzene



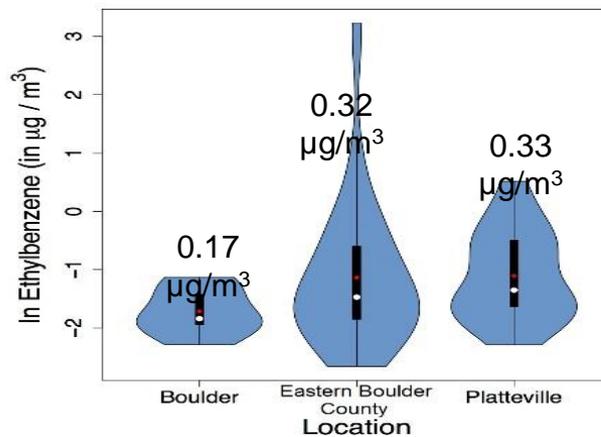
Total Alkanes¹



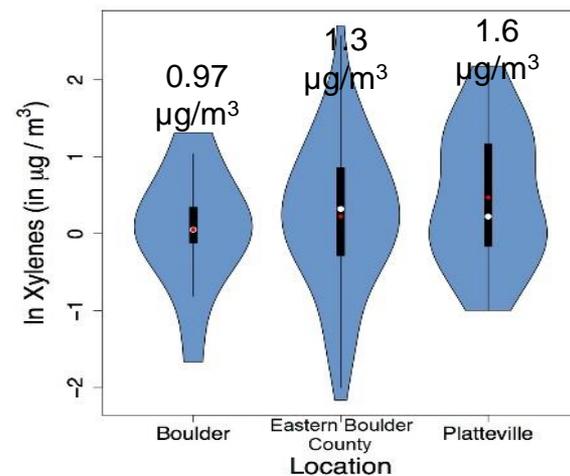
Toluene



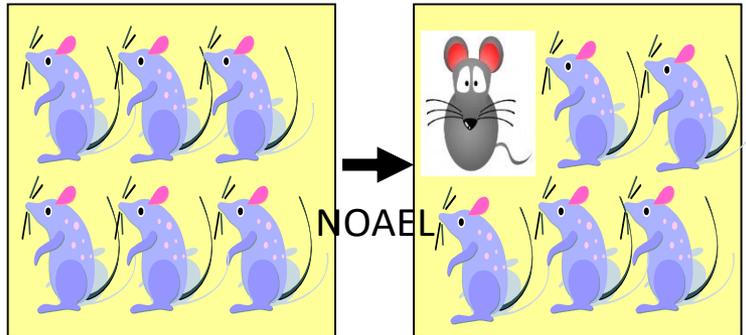
Ethylbenzene



Total Xylenes



Risk Characterization: Non-cancer Hazard Quotient



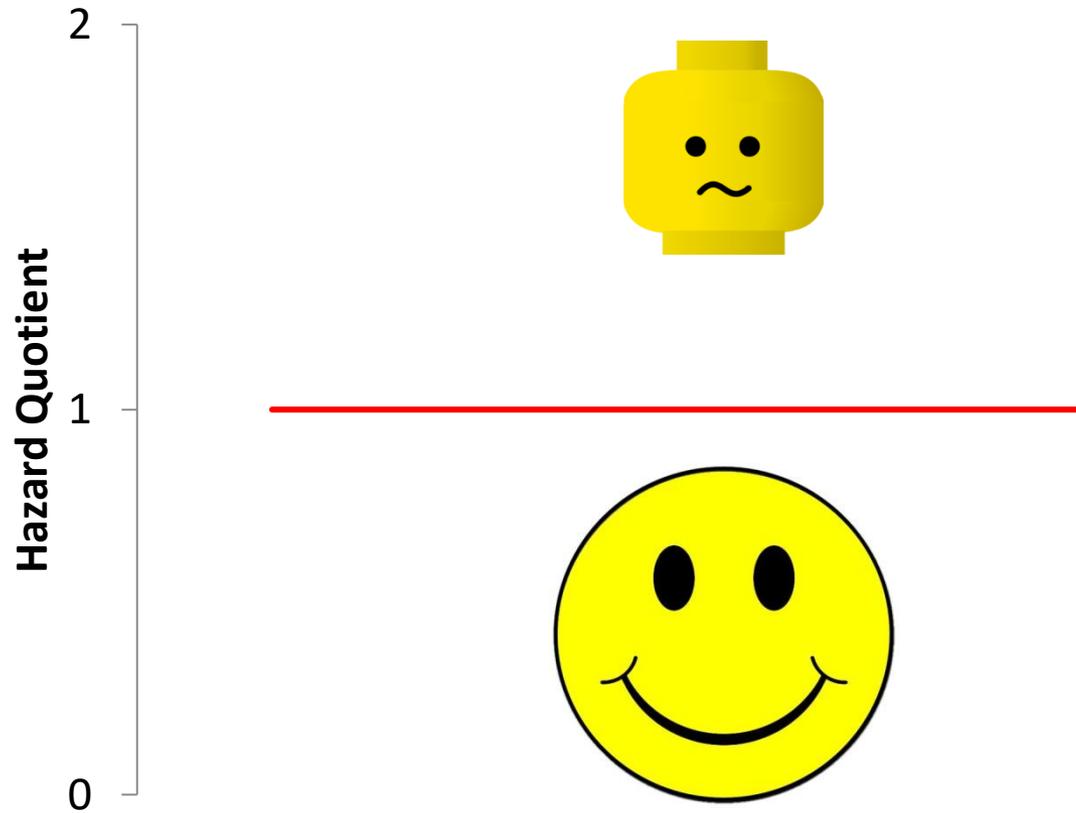
**Uncertainty
Factors**



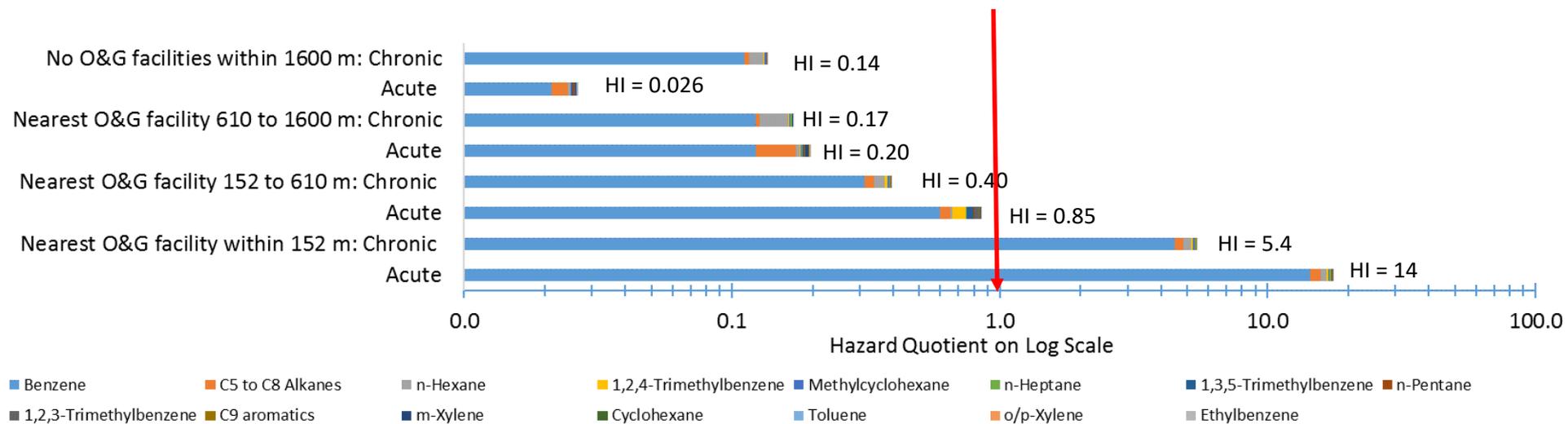
**Reference
Dose
(RfD or RfC)**

Risk Characterization:

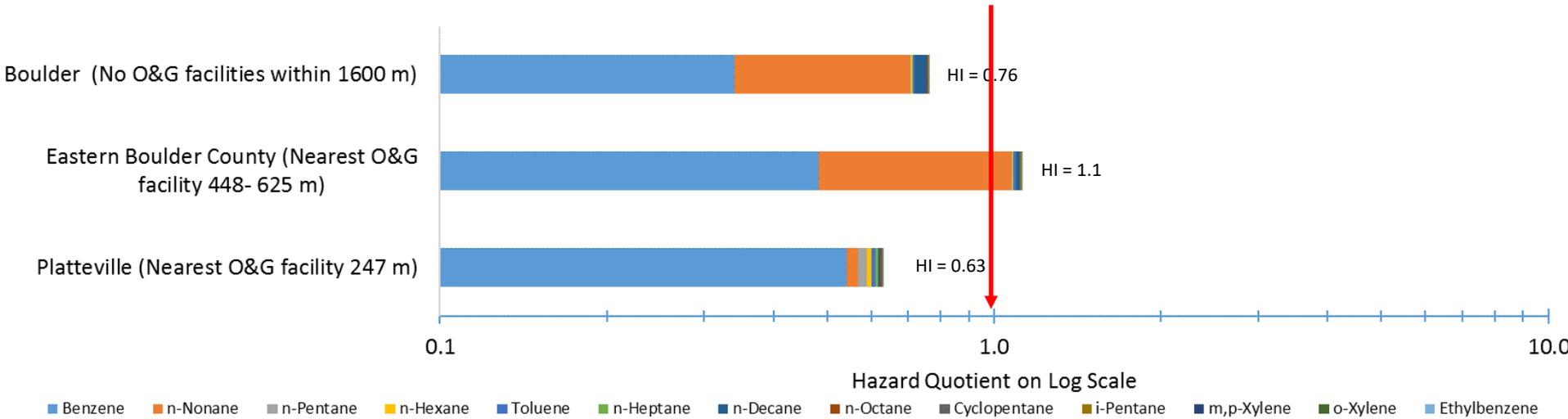
Hazard Quotient = reference dose/exposure



Chronic and acute hazard quotients and hazard indices based on 1-minute and 1-hour sample results



Chronic hazard quotients and hazard indices for residents living in Boulder, Eastern Boulder County, and Platteville based on 3, 72, and 96-hour sample results



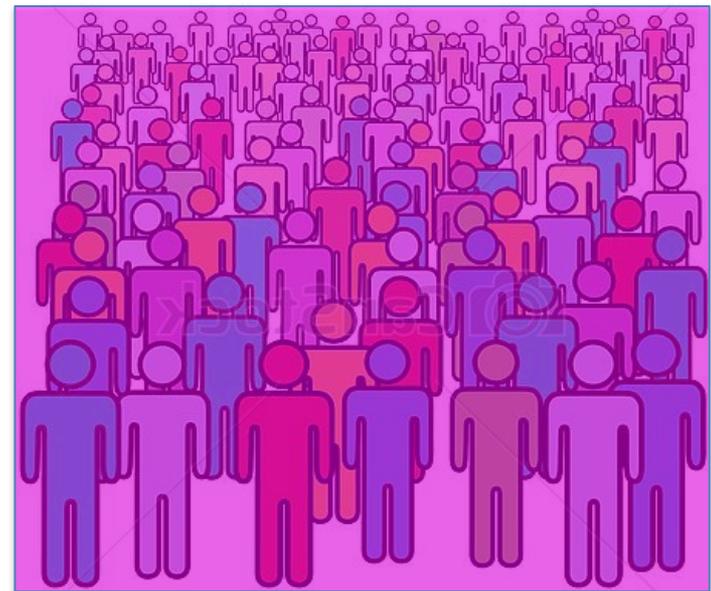
Total Lifetime risk of being diagnosed with Cancer



Excess Lifetime risk of being diagnosed with Cancer because of exposure from a site



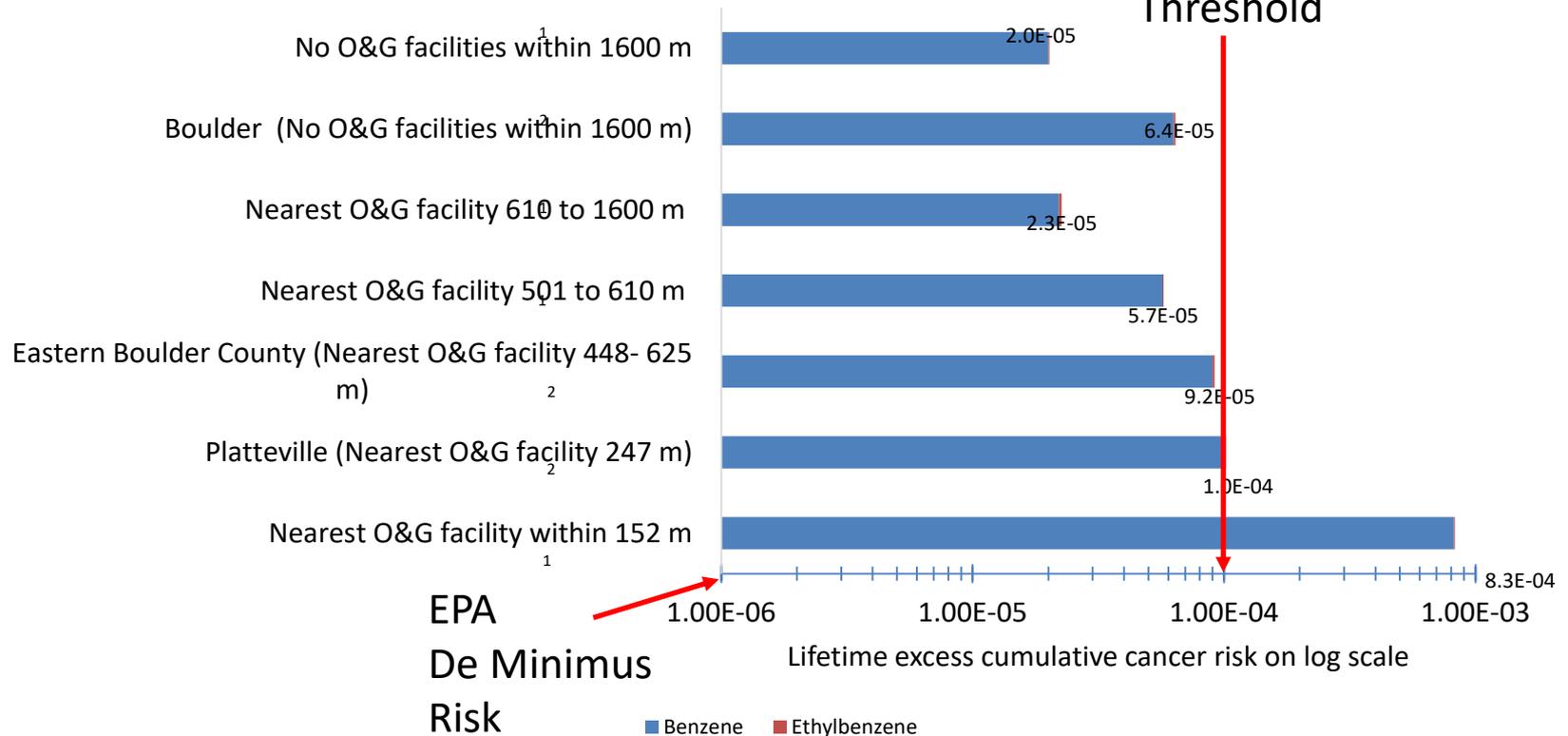
De Minimus Risk = 1 in a million



Upper Threshold = 100 in a million

Lifetime excess cancer risks (30 year exposure duration)

EPA Upper
Threshold



Strengths

- Realistic residential exposure scenarios
- Incorporated spatial and temporal variability
- Evaluated risks resulting from short exposures to high levels of hazardous air pollutants
- Reference sites (> mile for an O&G site) included those with traffic influences
- Findings consistent with published epidemiological studies and risk assessments.

Limitations

- Limited Information on the toxicity at the levels of hazardous air pollutants used in the risk assessment
- Did not assess all of the air pollutants associated with oil and gas development
- Most samples were collected in the daytime – which limits our ability to assess nighttime exposures.
- Only one season – summer

Policy Implications

- Tens of thousands of people in Colorado live within 500 feet of an oil and gas well site.
- Cancer burden in this population is estimated at 14 additional cancers.
- The population living within 500 feet of an oil and gas well site is growing faster than the general population.

Policy Implications

- State regulatory setback distances and municipal building codes
 - ✓ Historical setbacks: 150 and 300 feet
 - ✓ Reverse Setbacks
 - ✓ Setbacks for all types of O&G facilities
- Existing wells
 - ✓ Older and smaller facilities may have leaks and equipment malfunctions
 - ✓ 65% of 145 O&G sites in Boulder had gas leaks – most leaks were from storage tanks, thief hatches, separators, and wellheads
 - ✓ Audio, visual, and olfactory inspections miss most leaks.

Conclusions

This study provides further evidence that populations living nearest to O&G facilities bear the greatest risk of acute and chronic health effects from exposures to NMHC air pollutants emitted from upstream O&G facilities. Therefore, this analysis supports and highlights the importance of policies aimed at reducing or eliminating air emissions from O&G equipment and facilities, particularly those near homes, and effective monitoring of emissions from these facilities.



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Continuous air measurements: NASA DISCOVER-AQ project

AirWaterGas



Sustainability
Research
Network



Colorado School of
PUBLIC HEALTH

