Reactive Organics From Oil and Gas Combustion Sources

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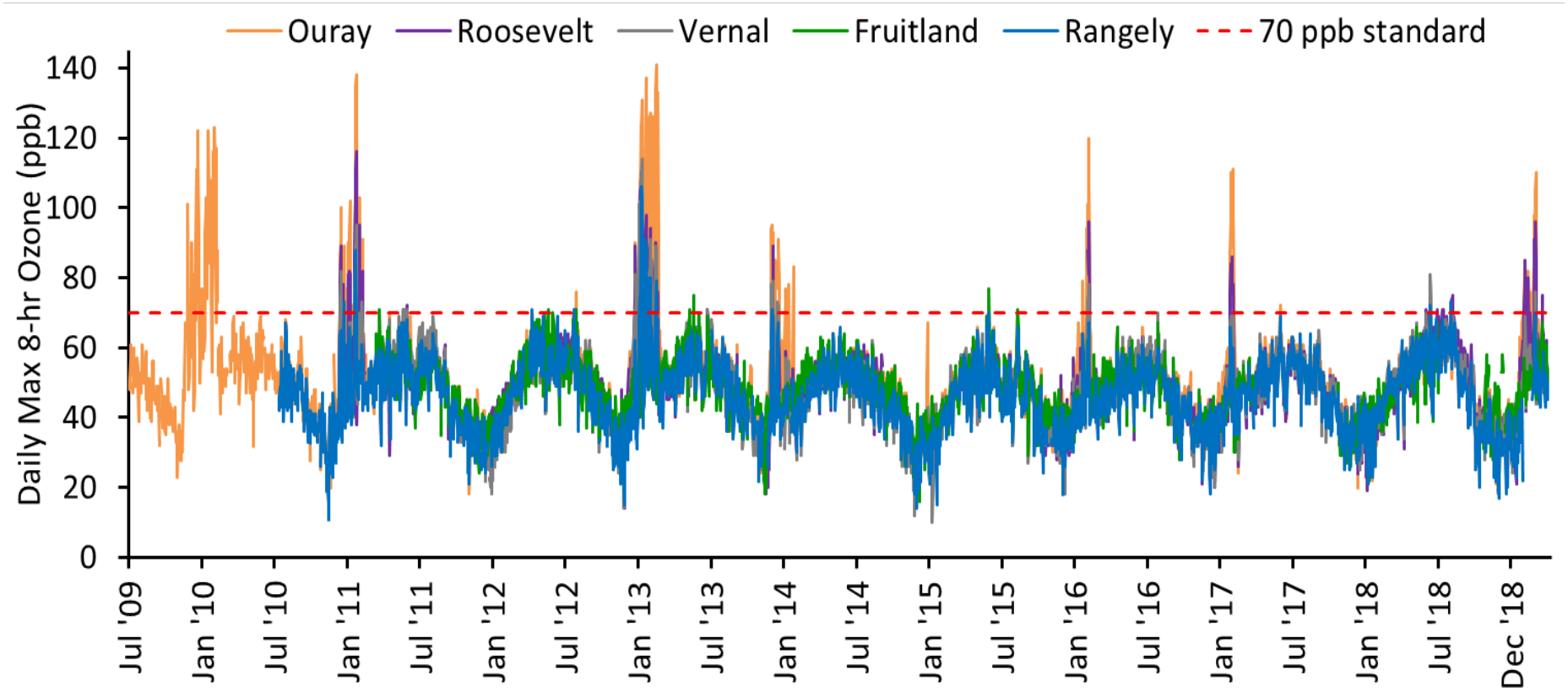
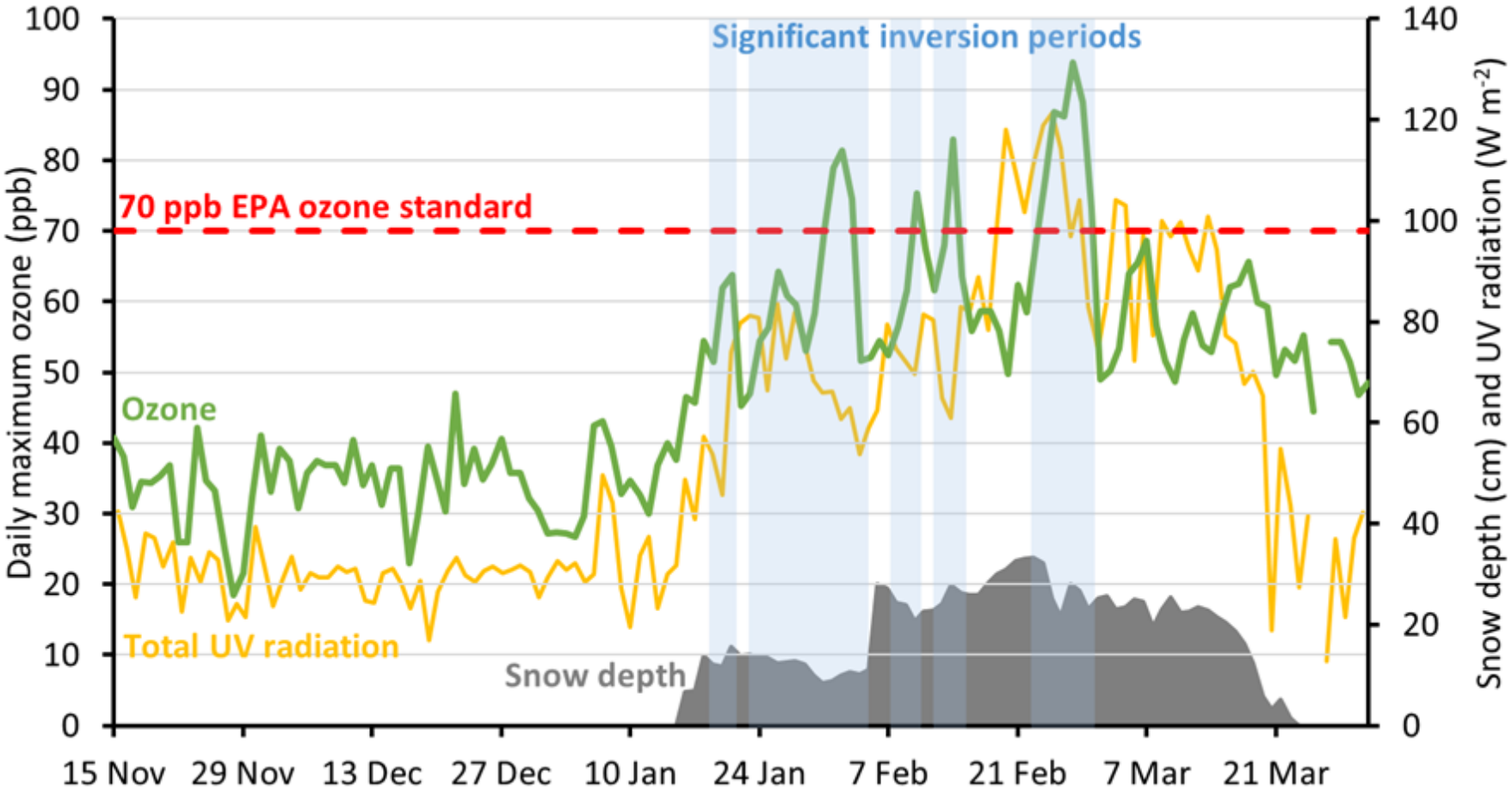
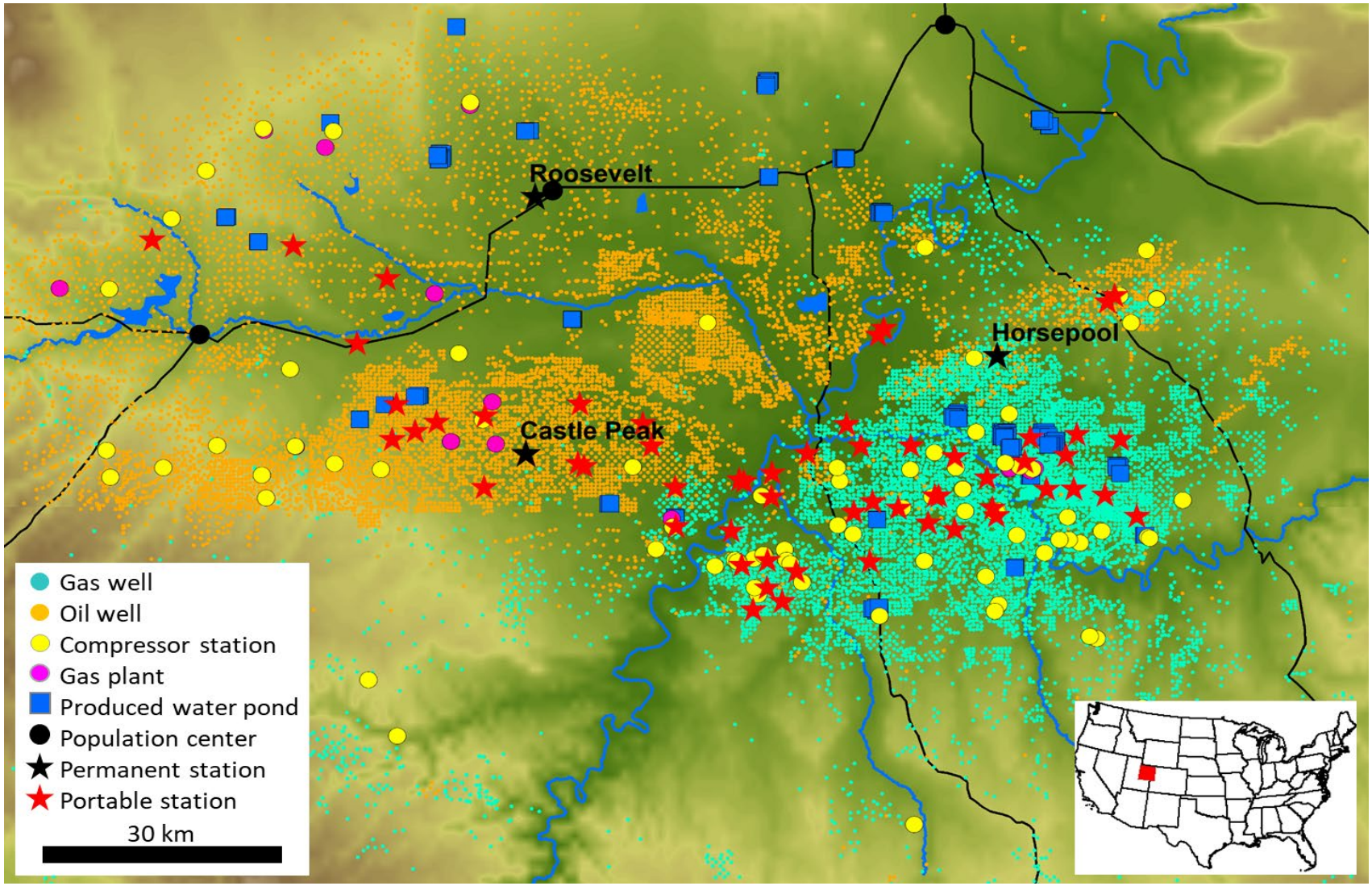
Winter Ozone is a Frequent Problem In the Uinta Basin



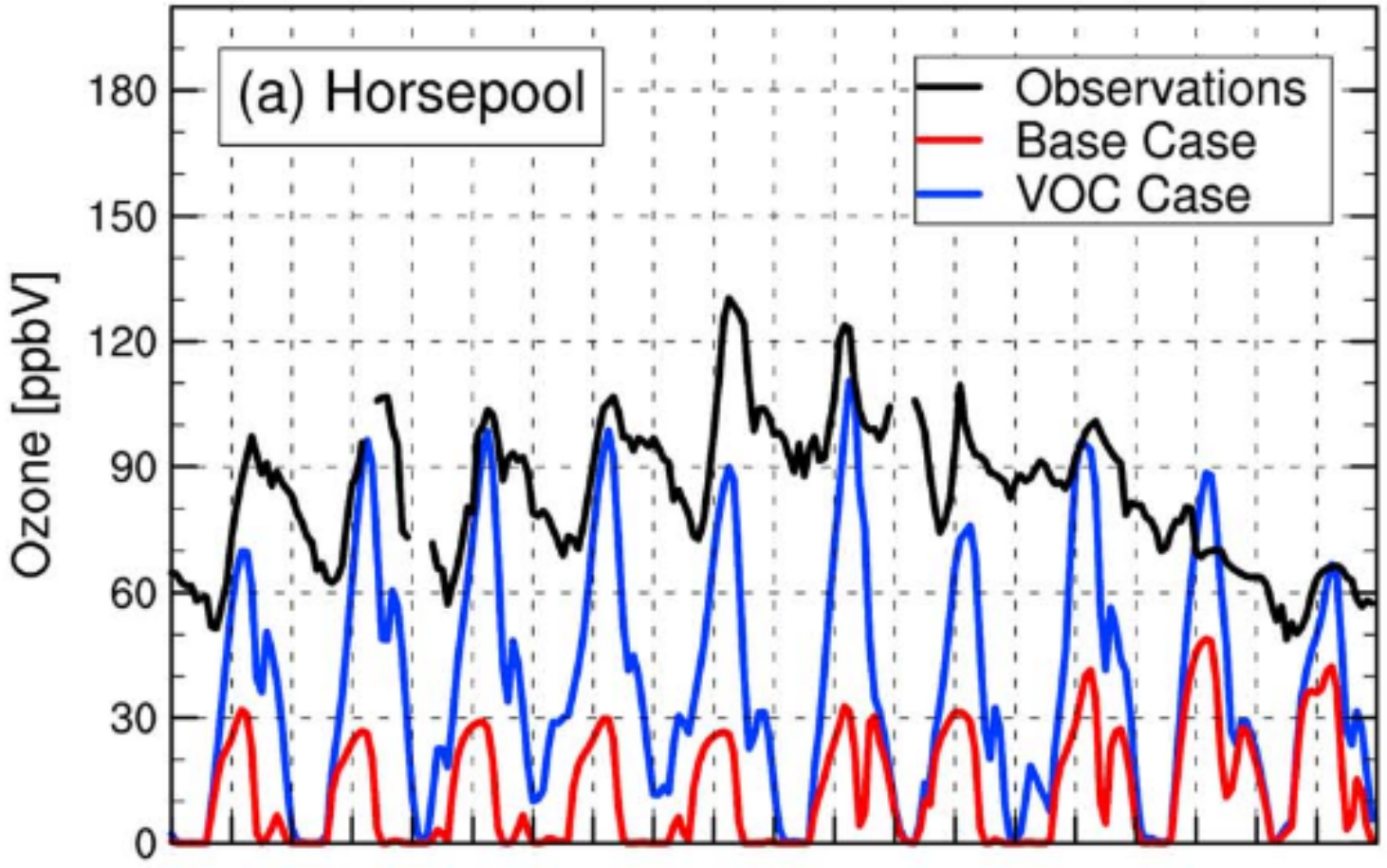
Winter Ozone Occurs When Snow Cover Facilitates Temperature Inversions



Oil and Gas Development is the Primary Source Of Ozone-forming Emissions

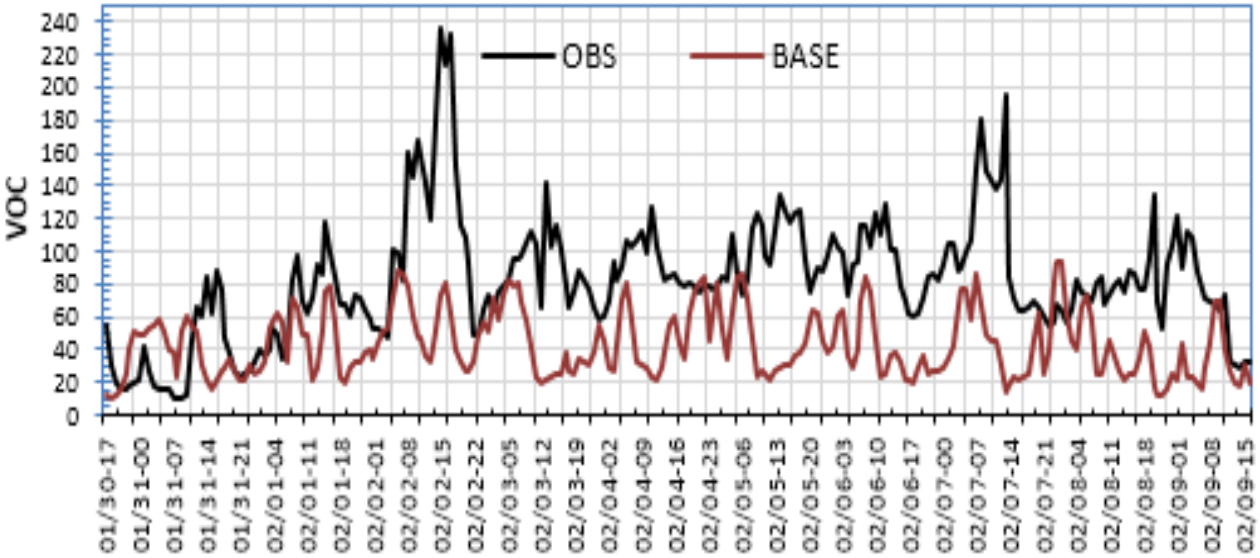


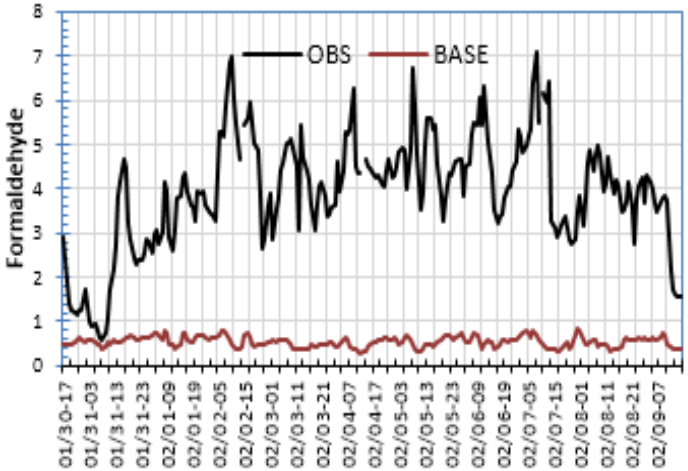
Out-of-the-box Emissions Inventories Fail to Simulate Enough Winter Ozone in Photochemical Models

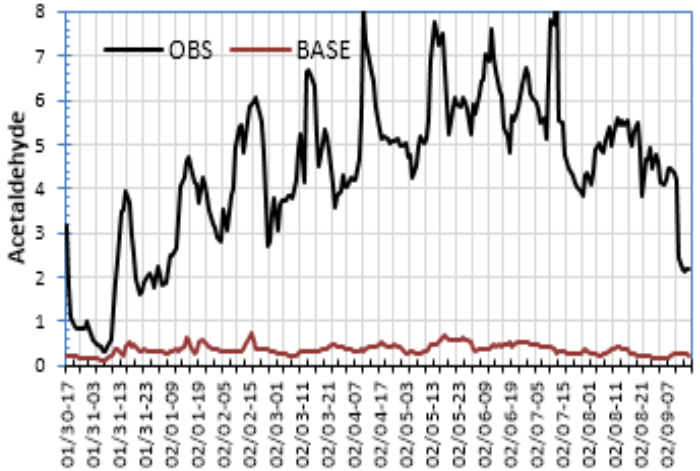


Matichuk et al. (2017) produced high ozone in their model only by dramatically increasing organic compound emissions

Emissions Inventories Simulate Total VOC in the Right Ballpark, but Reactive VOC are Much Too Low

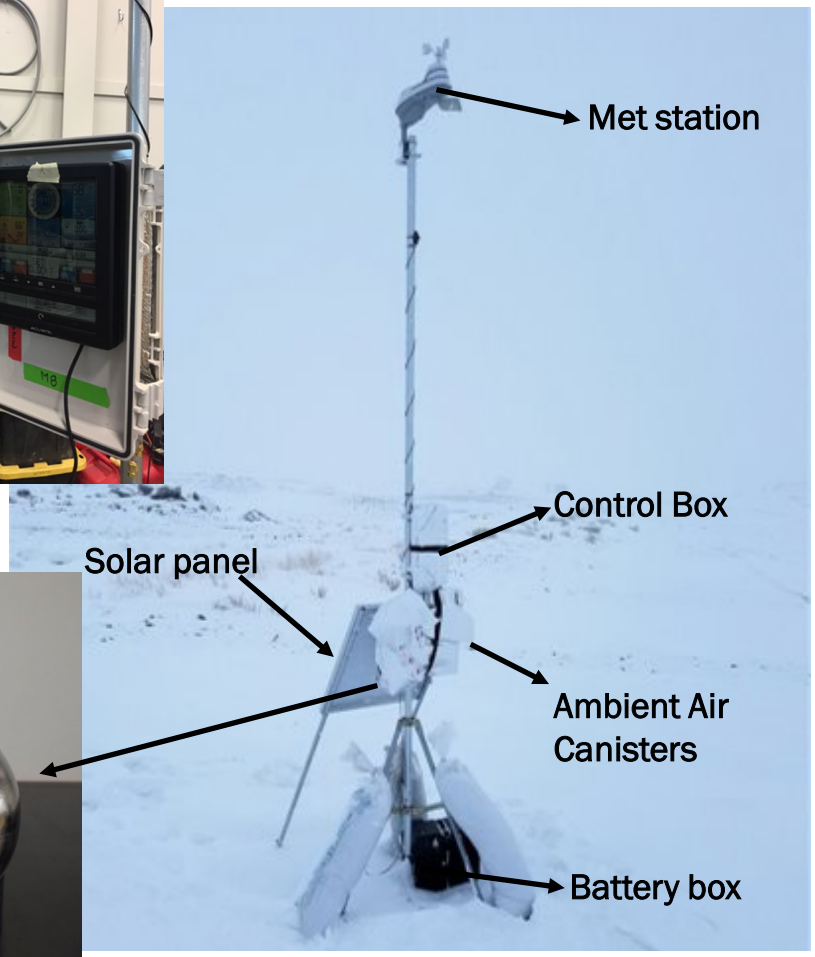




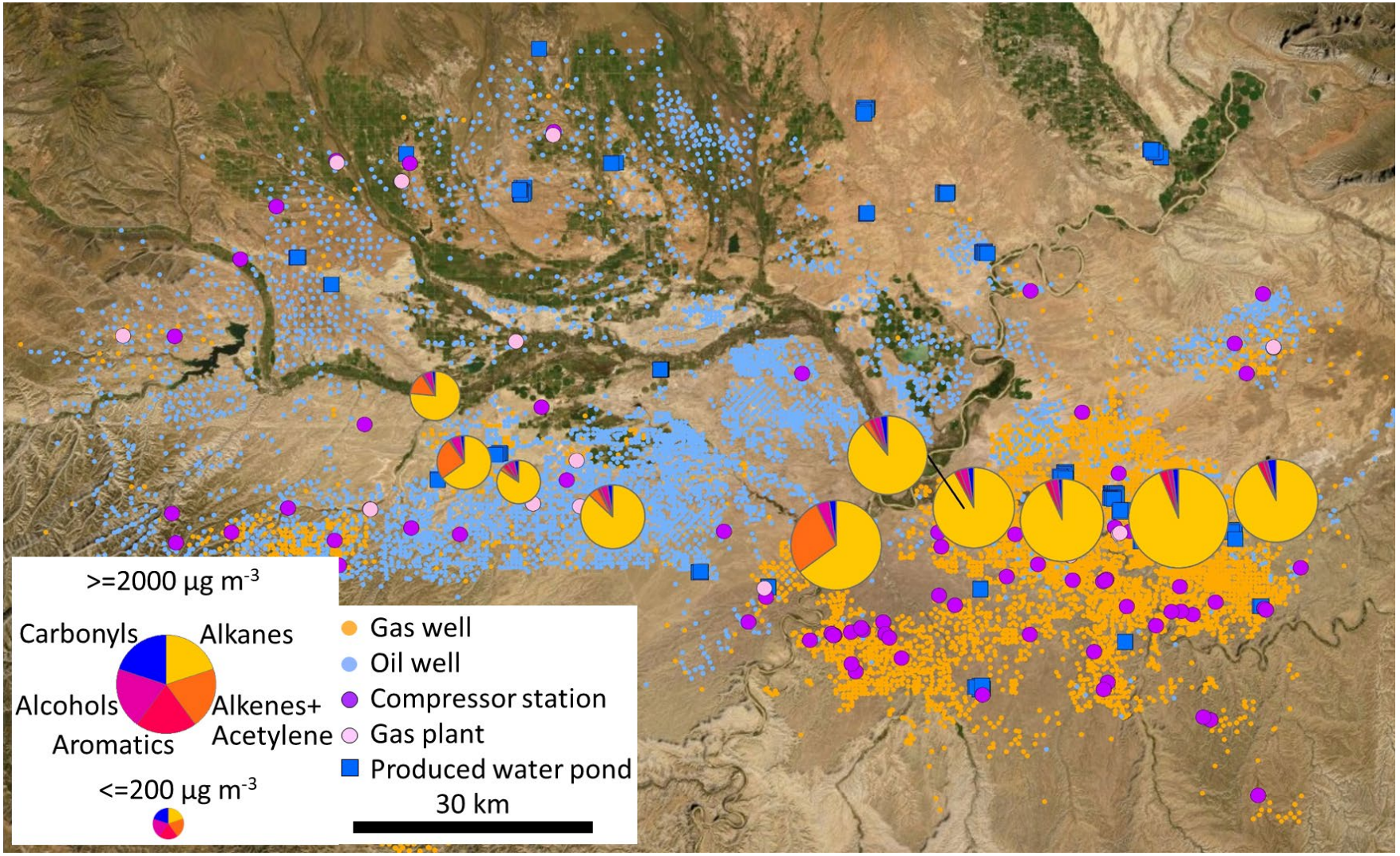


Portable Sampling Stations Allow for Snapshot of VOC Composition, Distribution

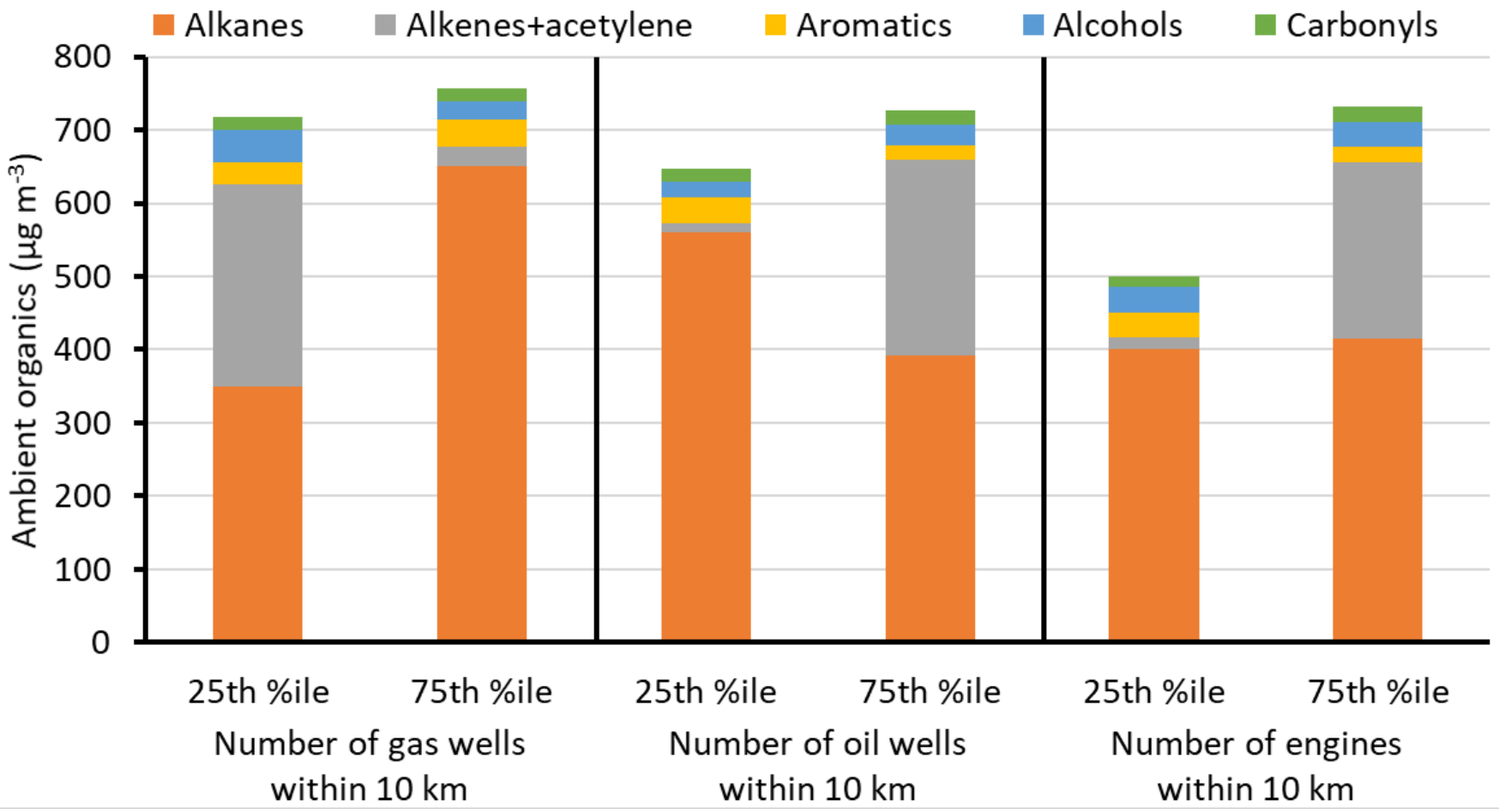
- Collection of silonite-coated canister samples for C2-C10 hydrocarbons and light alcohols
- Collection of DNPH cartridges for carbonyls
- Samples were analyzed to identify 73 separate organic compounds
- Air samples collected over 6 hr periods in the day or night
- Sampling, data collection controlled by a Rasbery Pi



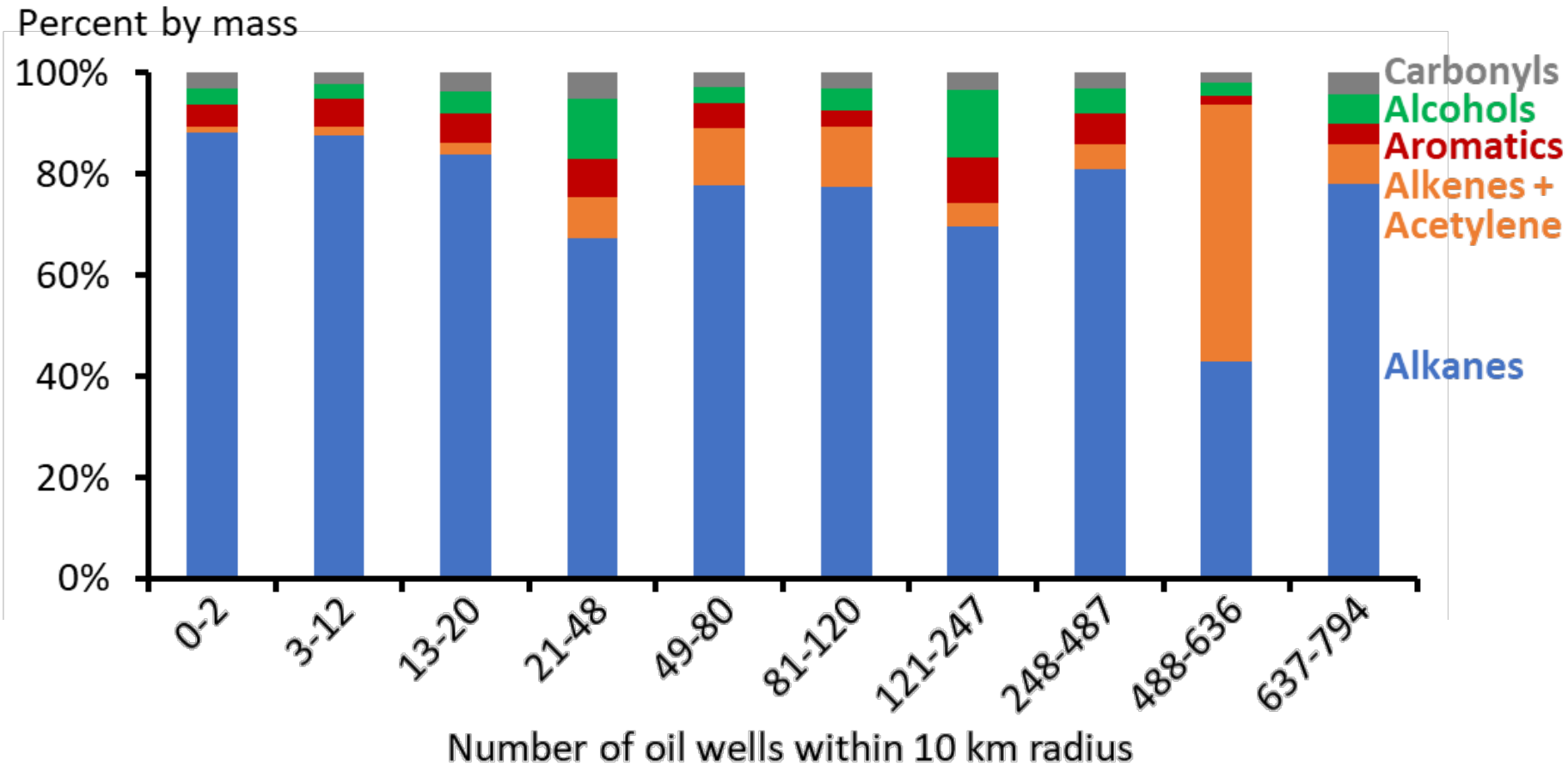
Sampling Station Deployments Show Distribution Of Organics Across the Uinta Basin



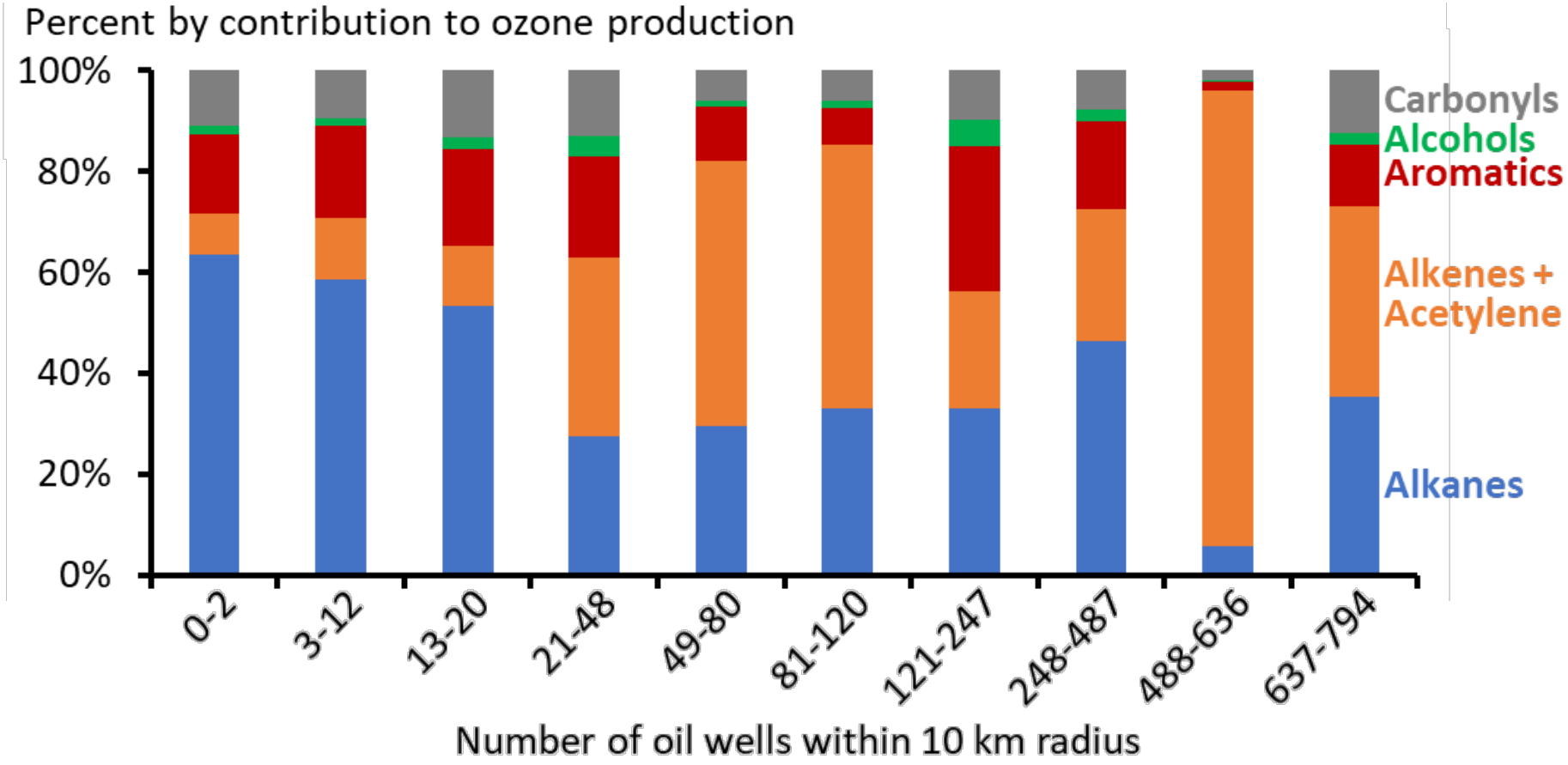
Several Distinct Patterns Emerged Across 13 Deployments in 2019 and 2020



Samples Collected in Areas with More Oil Wells Had a Higher Percentage of Alkenes+Acetylene



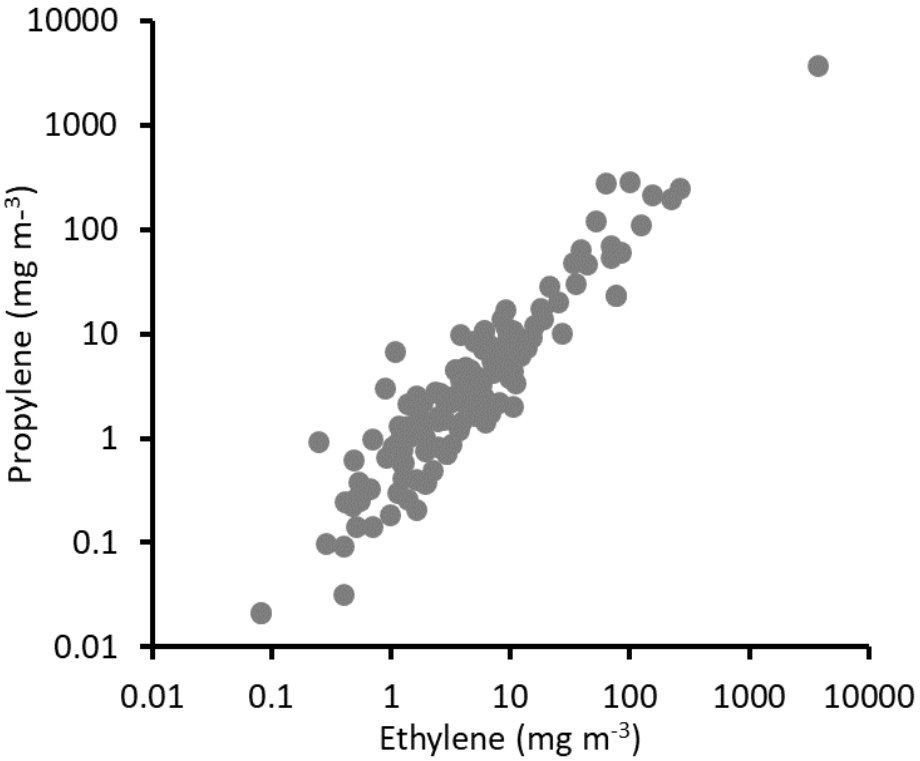
Alkenes+acetylene Responsible for Large Portion of Ozone Reactivity in Oil-Producing Areas



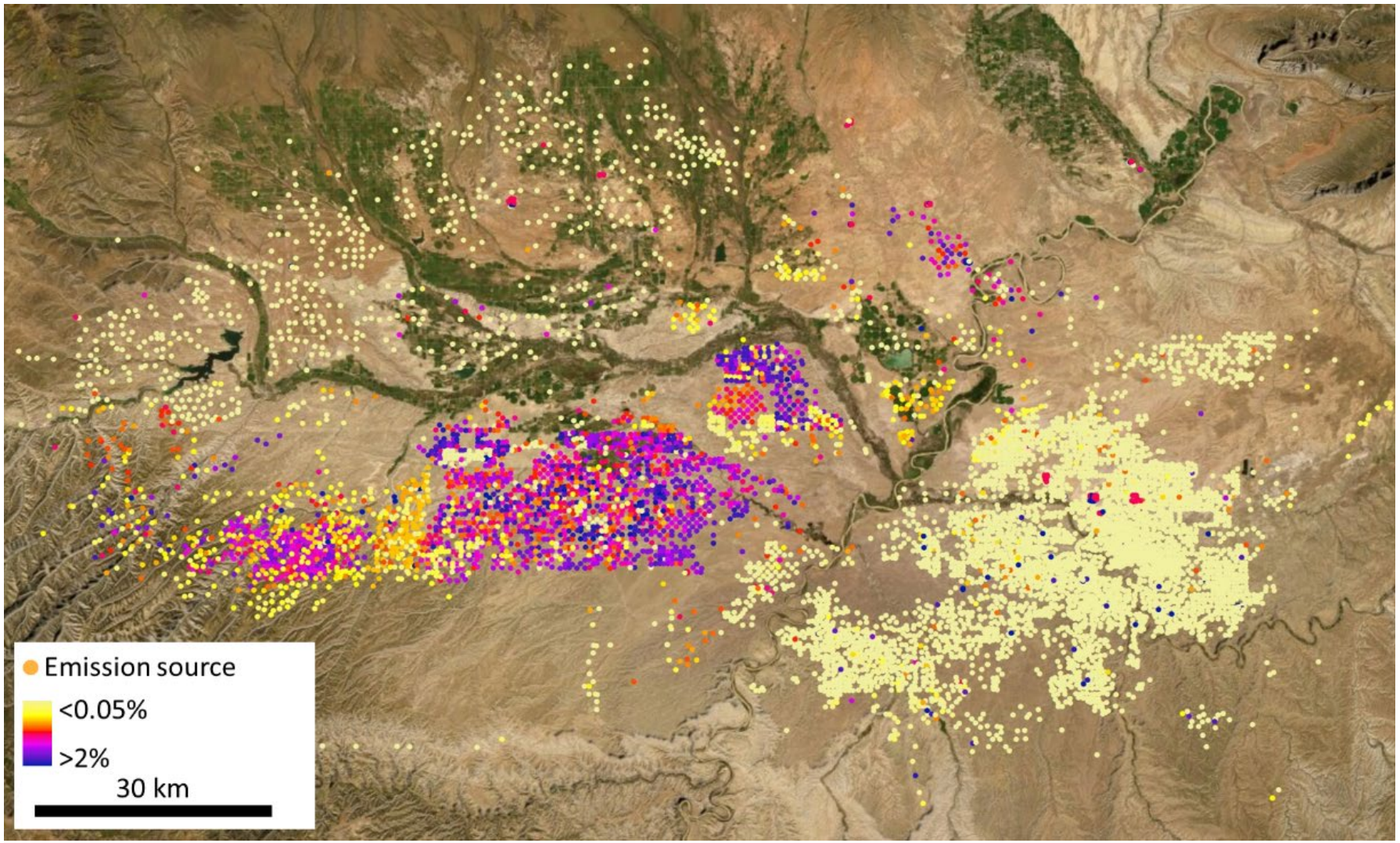
Compound Ratios Indicate Lean-burn Natural Gas Engines as Most Important Source of Alkenes+acetylene

- Previous studies show very low emissions from non-combustion sources

- Observed very high propylene:ethylene and ethylene:acetylene ratios indicate:
  - Raw natural gas, rather than gasoline or diesel, as the fuel source
  - Cool, lean-burn combustion conditions

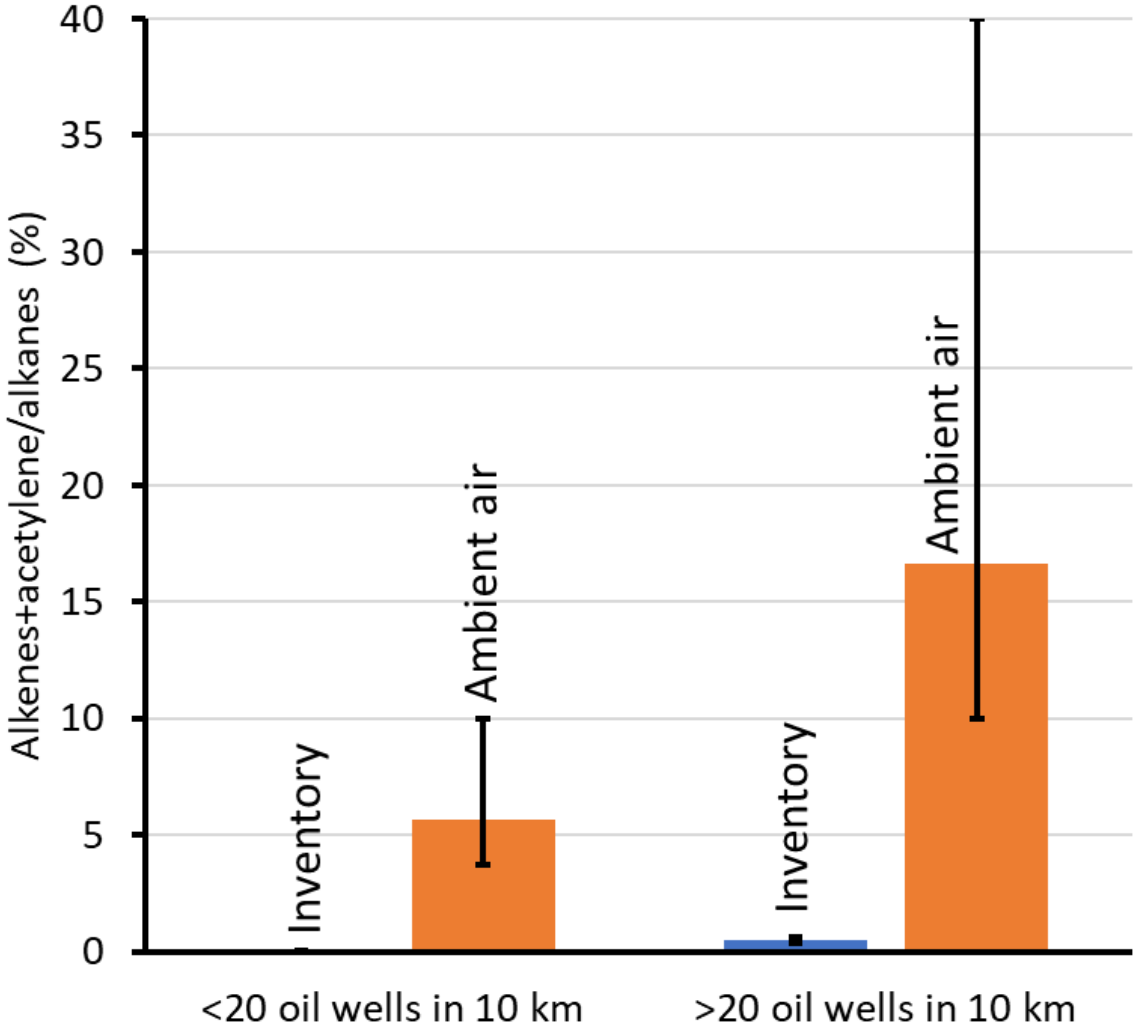


Official Emissions Inventory Also Shows Higher Percentage of Alkenes from Facilities with Engines



Facility locations colored by percentage of emissions comprised of alkenes+acetylene

Inventoried Alkene Emissions are Much Lower Than Ambient Air Measurements

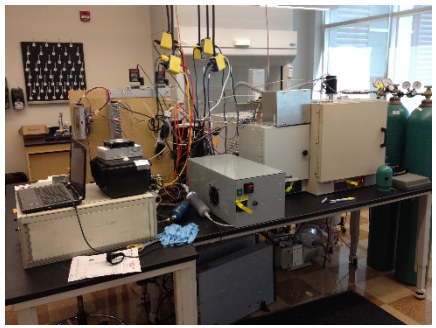


Conclusions

1. Alkenes are an important contributor to ozone reactivity of organics in an oil producing area
2. Most important source of alkenes appears to be raw gas-fueled lean-burn engines
3. Official inventory appears to vastly underestimate alkene emissions.

Lean-burn creates less NO_x and more reactive organics, while rich-burn creates more NO_x and fewer reactive organics. Which mode is best for the airshed?

Thank You



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