

A Monitoring Network for Winter Ozone in Utah's Uintah Basin



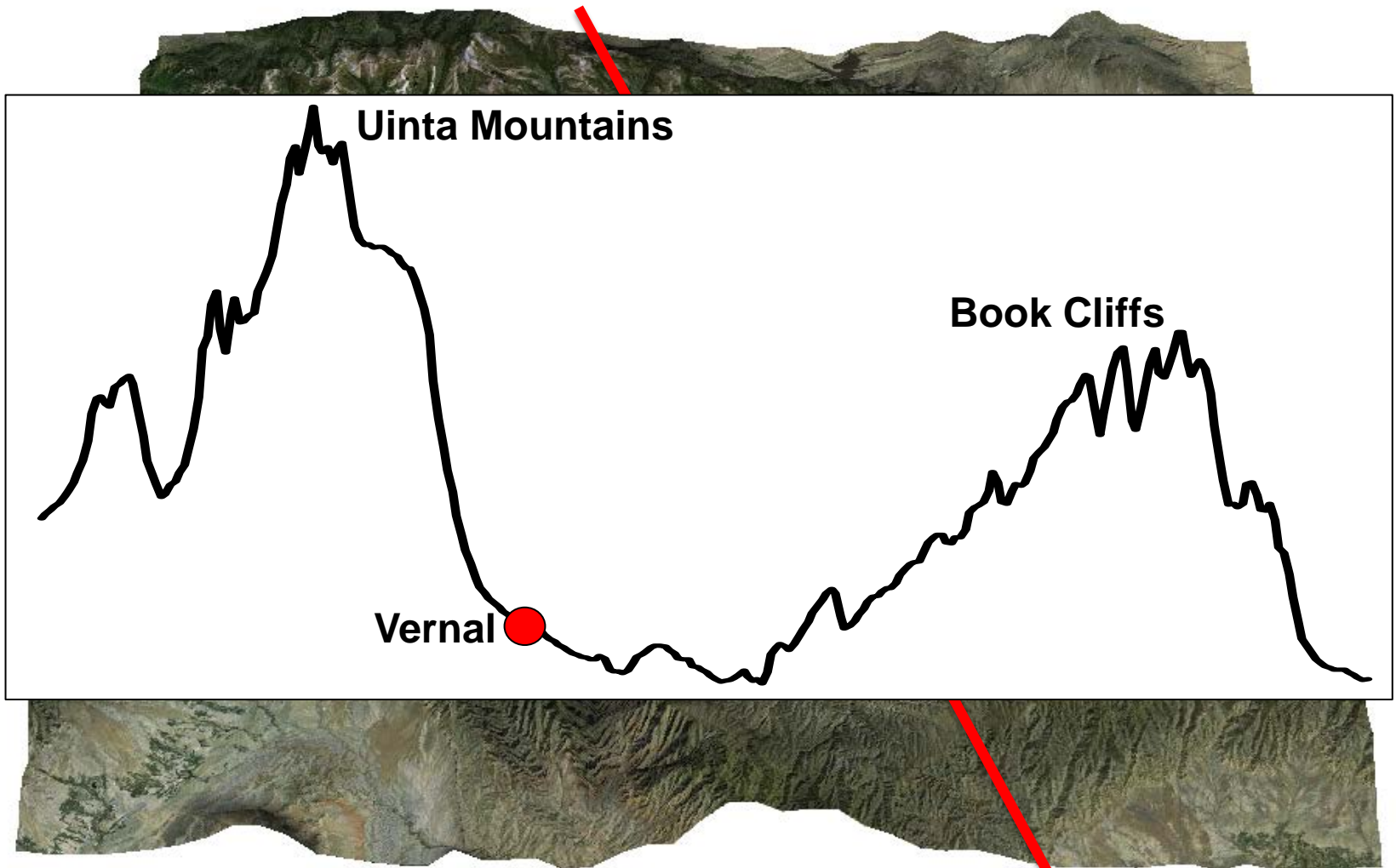
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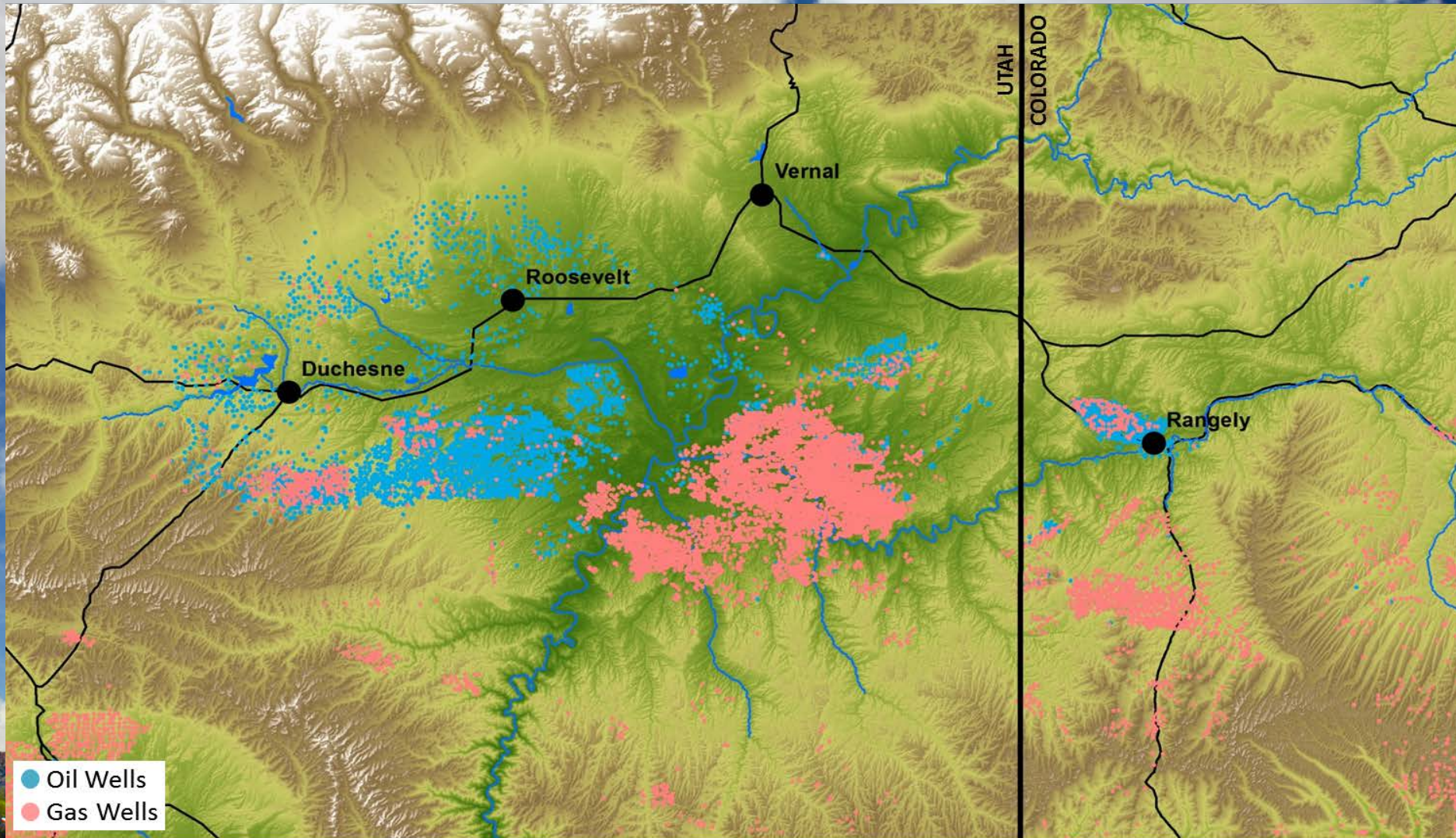
Seth Lyman

Utah State University

Uintah Basin Is Uniquely Suited for Winter Inversions



The Uintah Basin Is Home to Extensive Oil and Gas Development



Meteorology + Precursors = Winter Ozone

Warm air aloft stops atmospheric mixing

NO_x and VOC are trapped near the cooler surface, react to produce ozone

Snow reflects sunlight

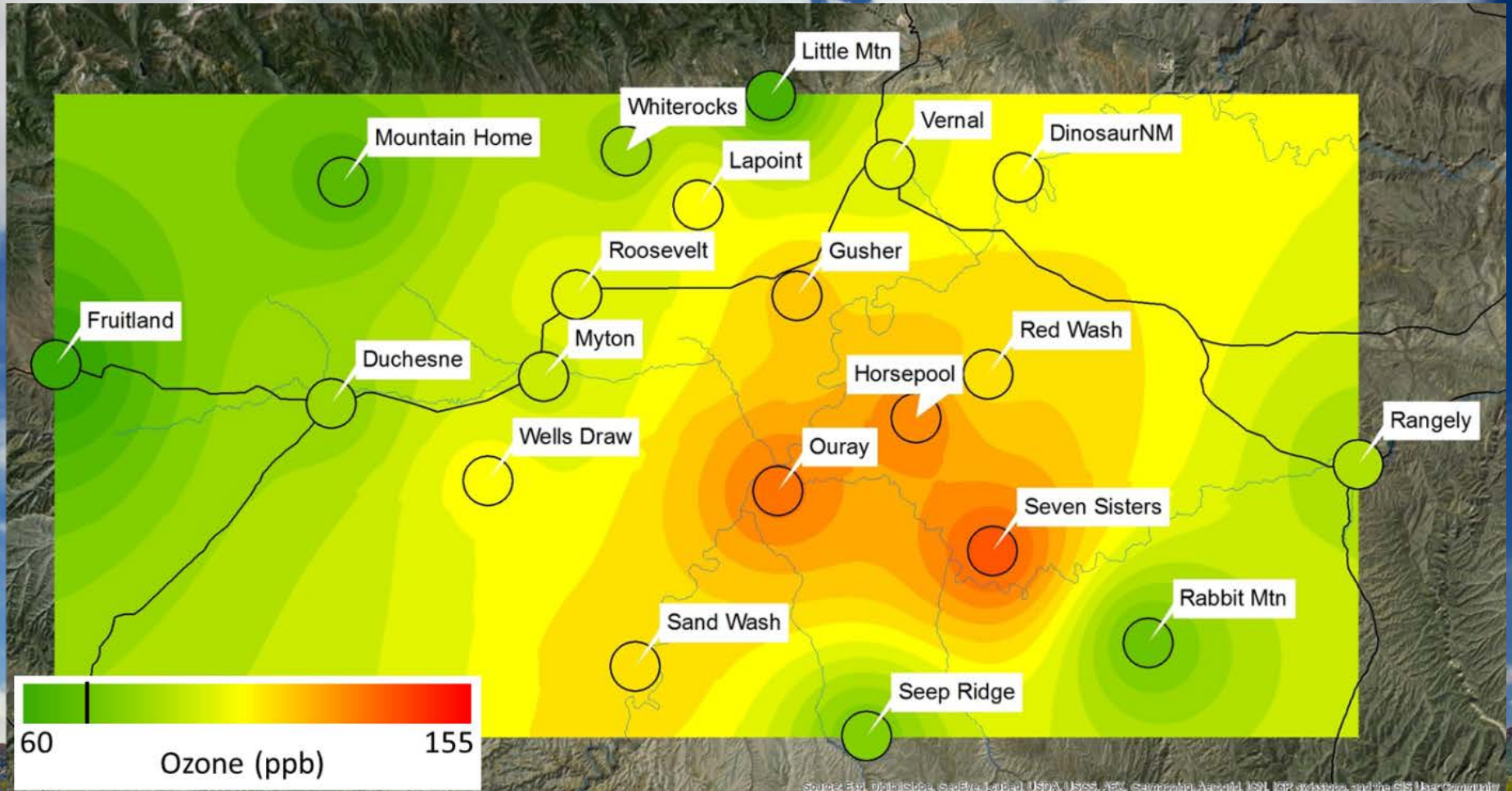
Several Networks Operate In Concert to Characterize Winter Air Quality

- 20-30 monitoring sites for ozone.
- 10-15 monitoring sites for NO_x .
- 2 monitoring sites for speciated VOC.
- 5-10 episodic monitoring stations for VOC.
- 40-60 monitoring sites for meteorology.

Multiple Strategic Air Quality Measurement Platforms Are Deployed

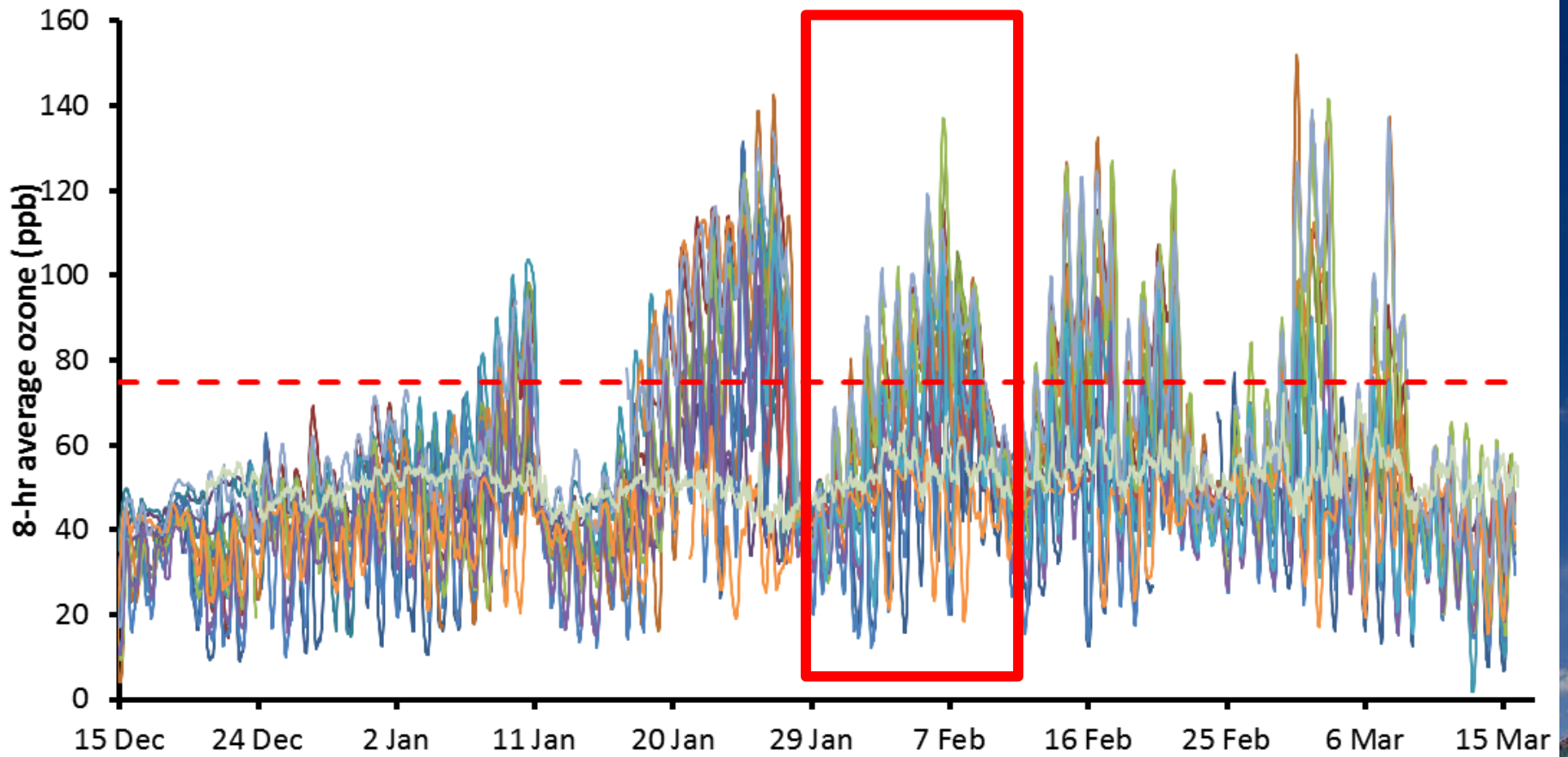


Ozone Exceeded EPA Standards During Winter 2012-13

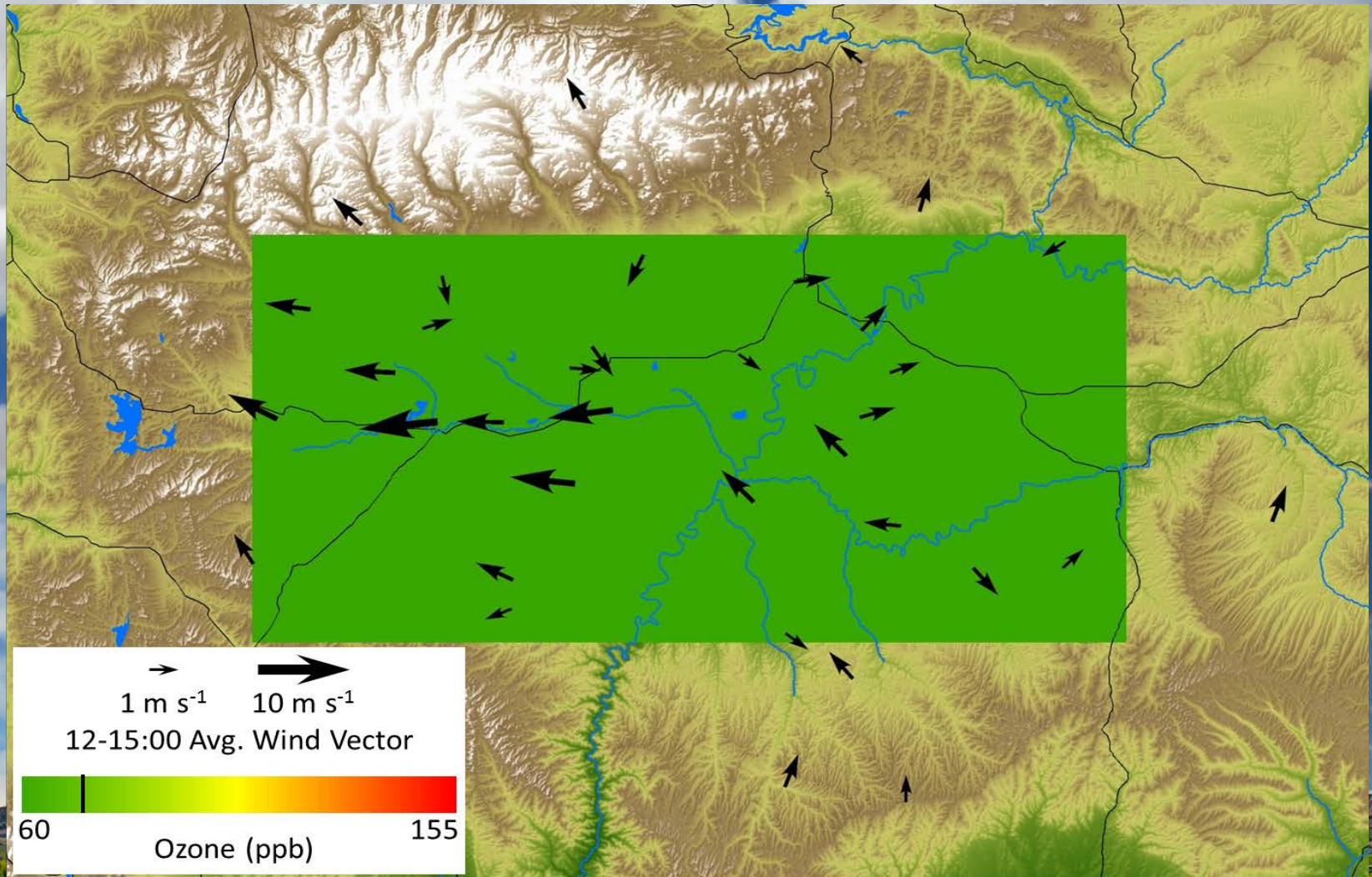


Source: EPA, DigitalGlobe, Google, JPL/Caltech, USGS, AEM, Geomapping, Aerial, USN, IAP, exosite, and the GIS User Community

A Closer Look at One Inversion Episode

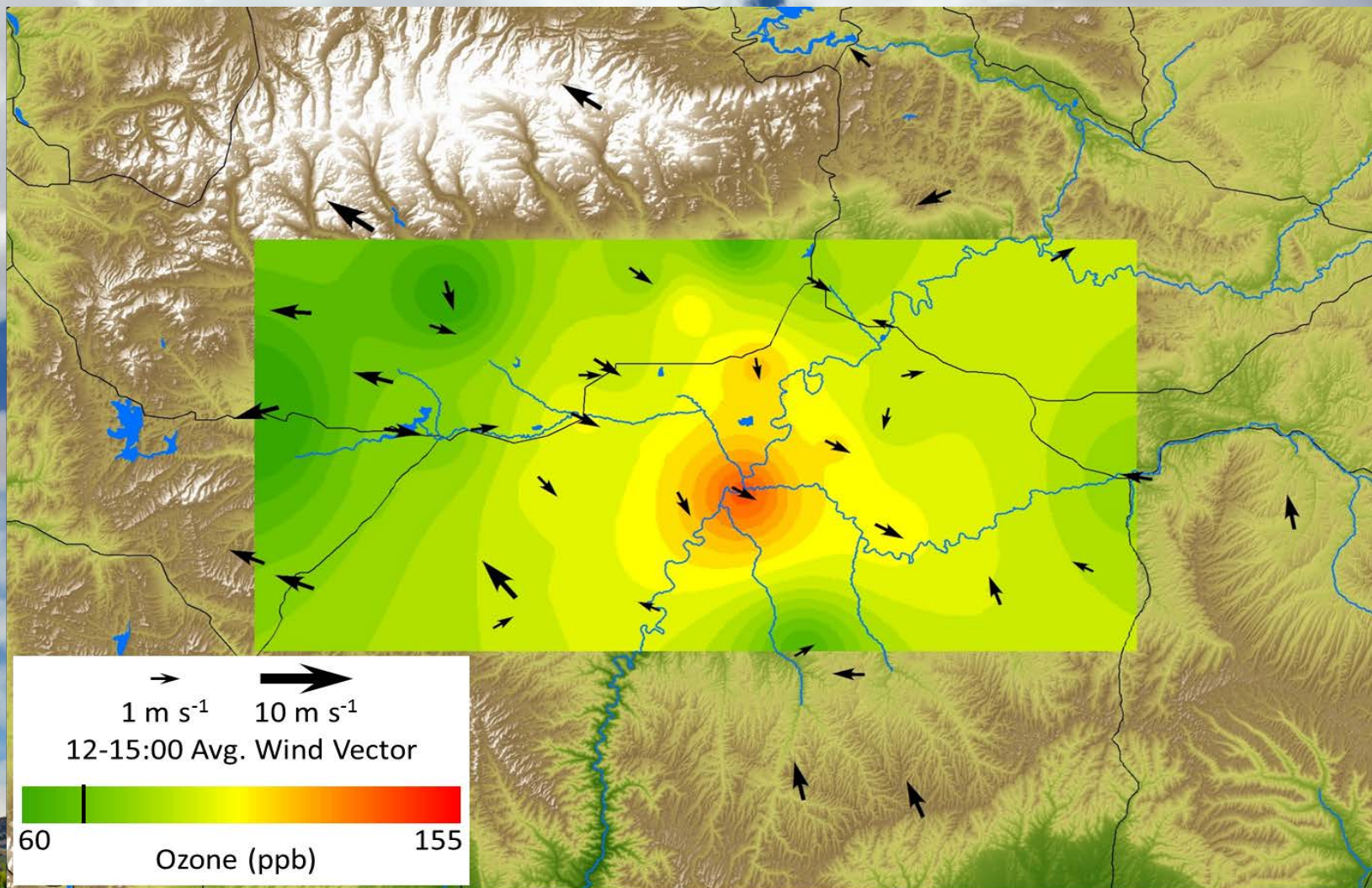


Ozone Concentration and Wind Vectors 28 January 2013

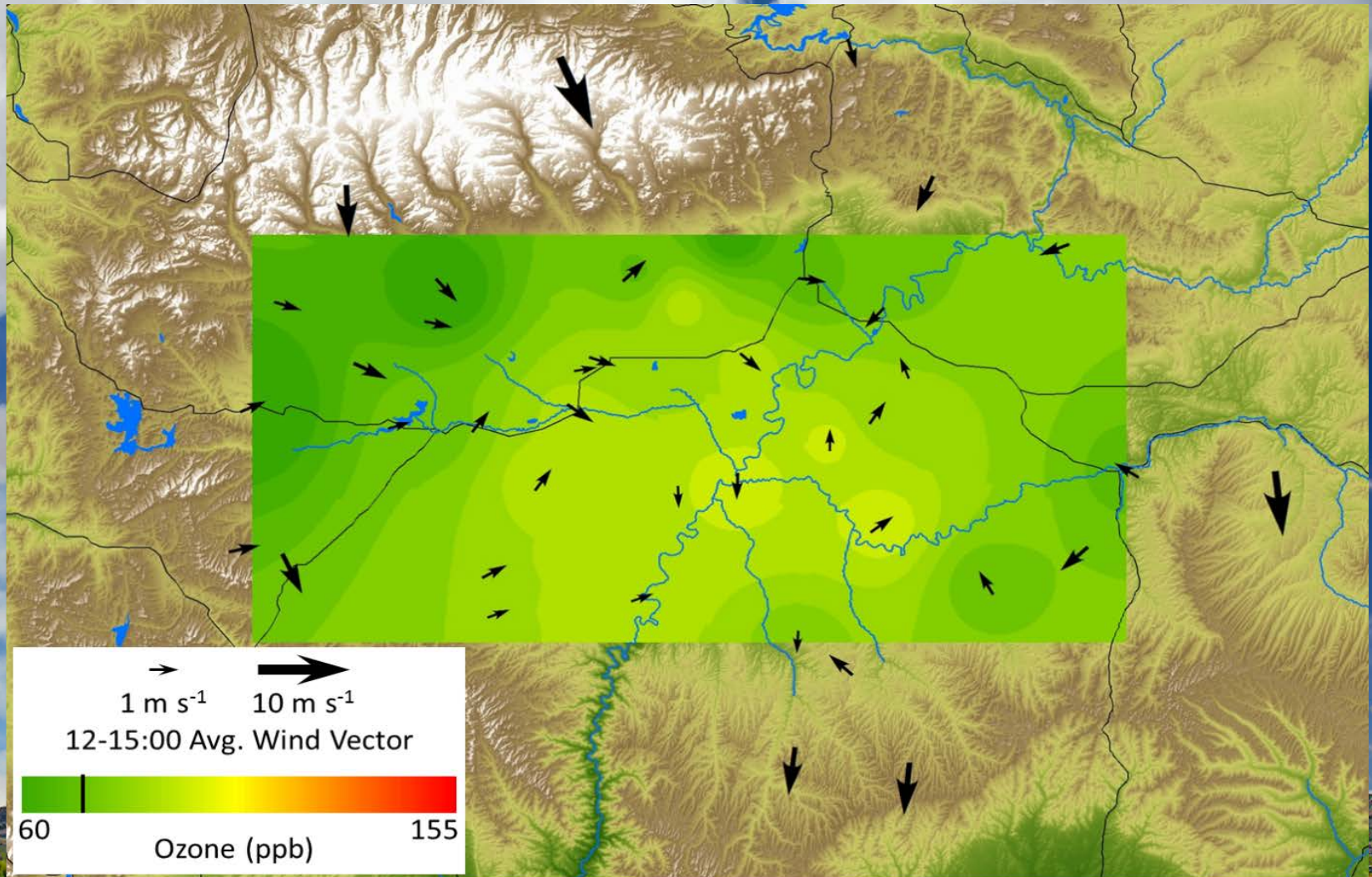


Ozone Concentration and Wind Vectors

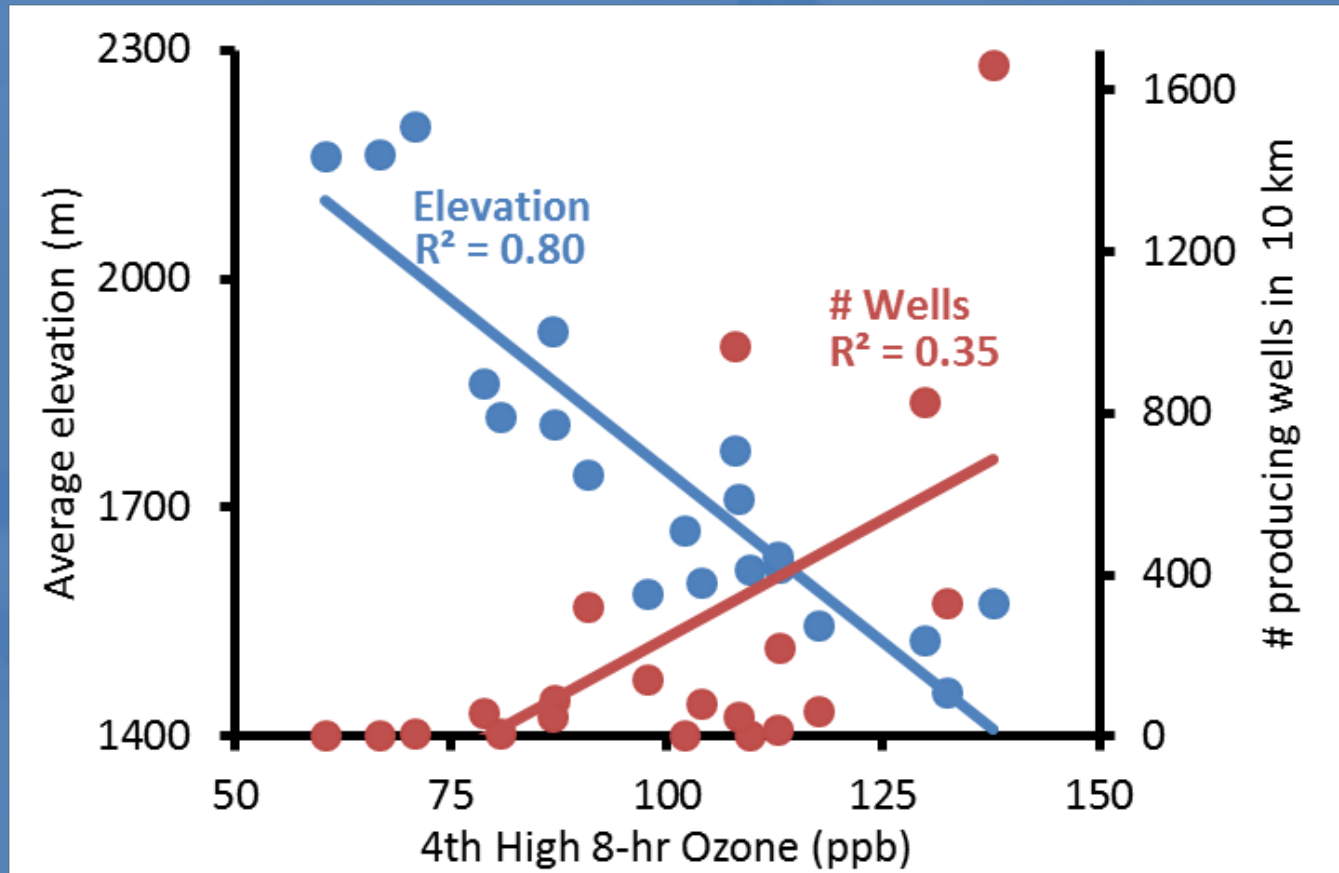
06 February 2013



Ozone Concentration and Wind Vectors 08 February 2013

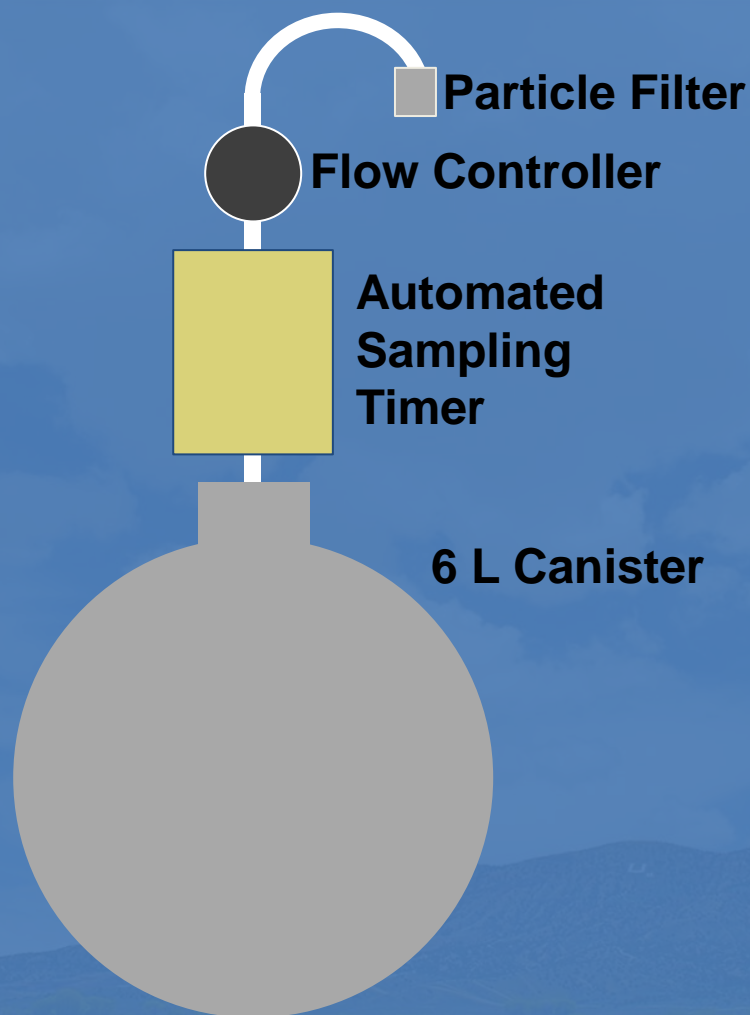


Ozone Is Correlated with Elevation and Proximity to Oil and Gas Extraction



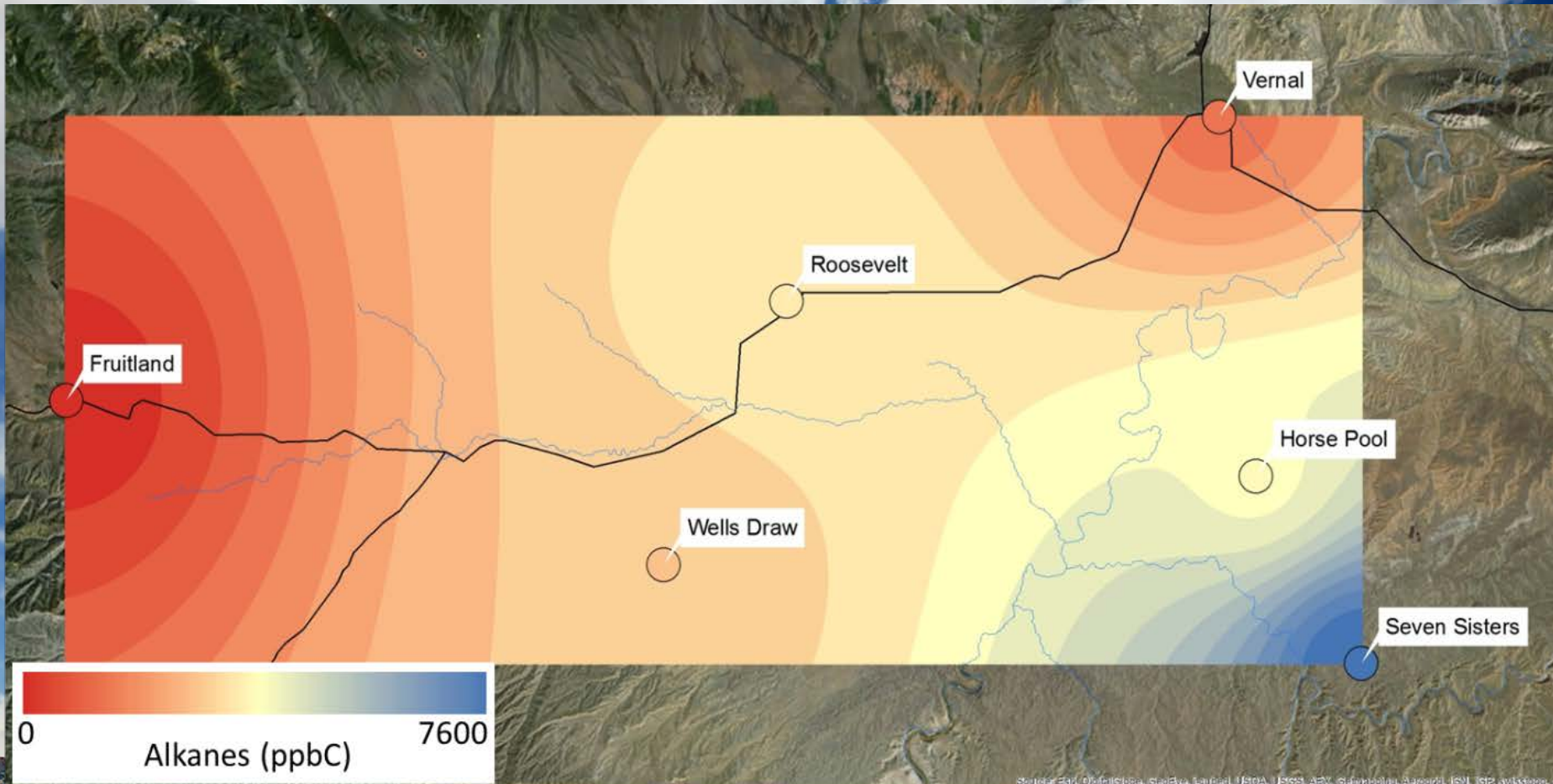
R^2 for both variables in multiple regression is 0.90

Speciated VOC Measured at Multiple Sites

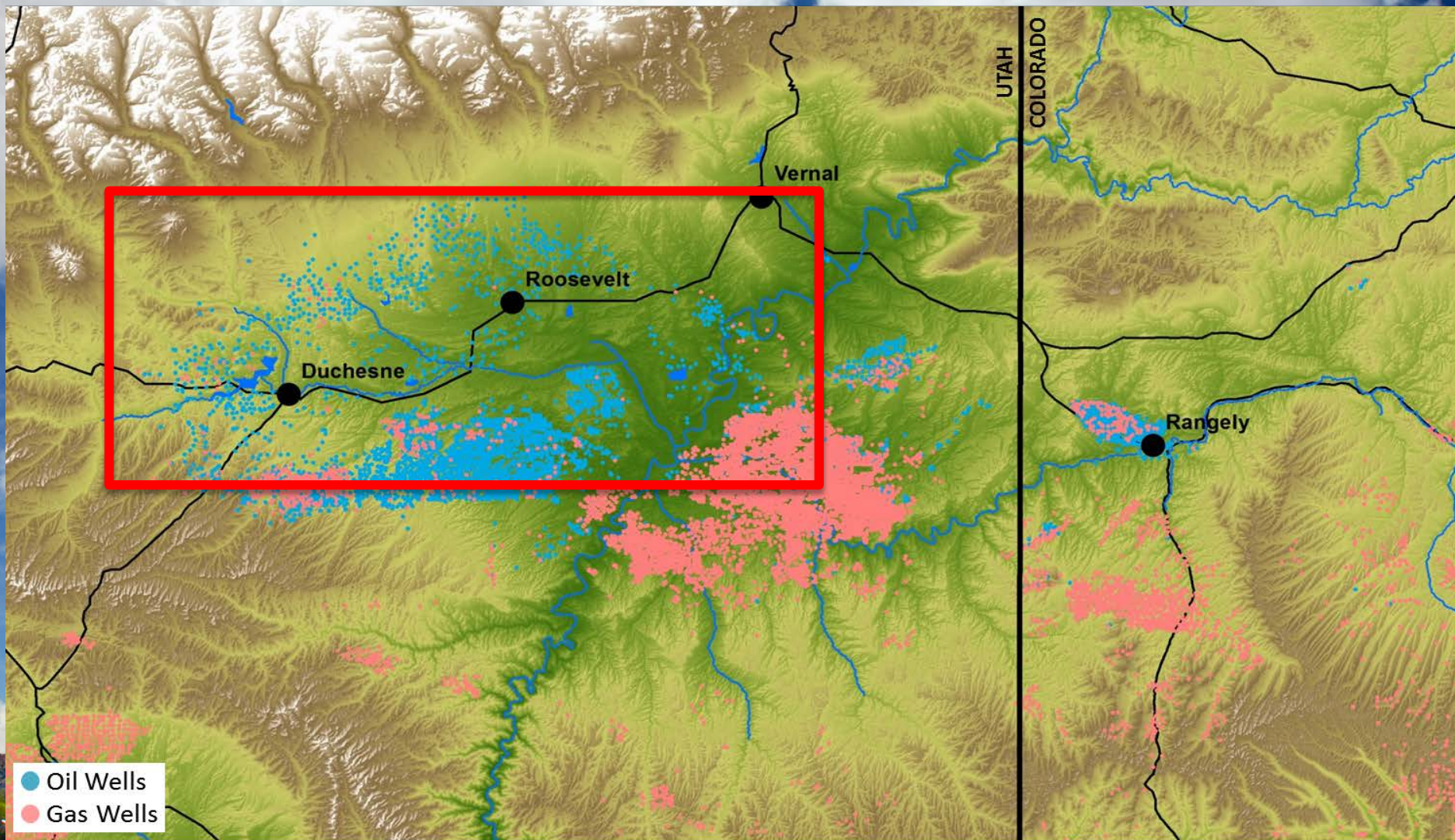


- 2-hr samples (7-9 am)
- VOC analysis (GC-FID)
- Methanol analysis (GC-MS)
- All wetted parts cleaned with humidified and heated N_2 before each use.

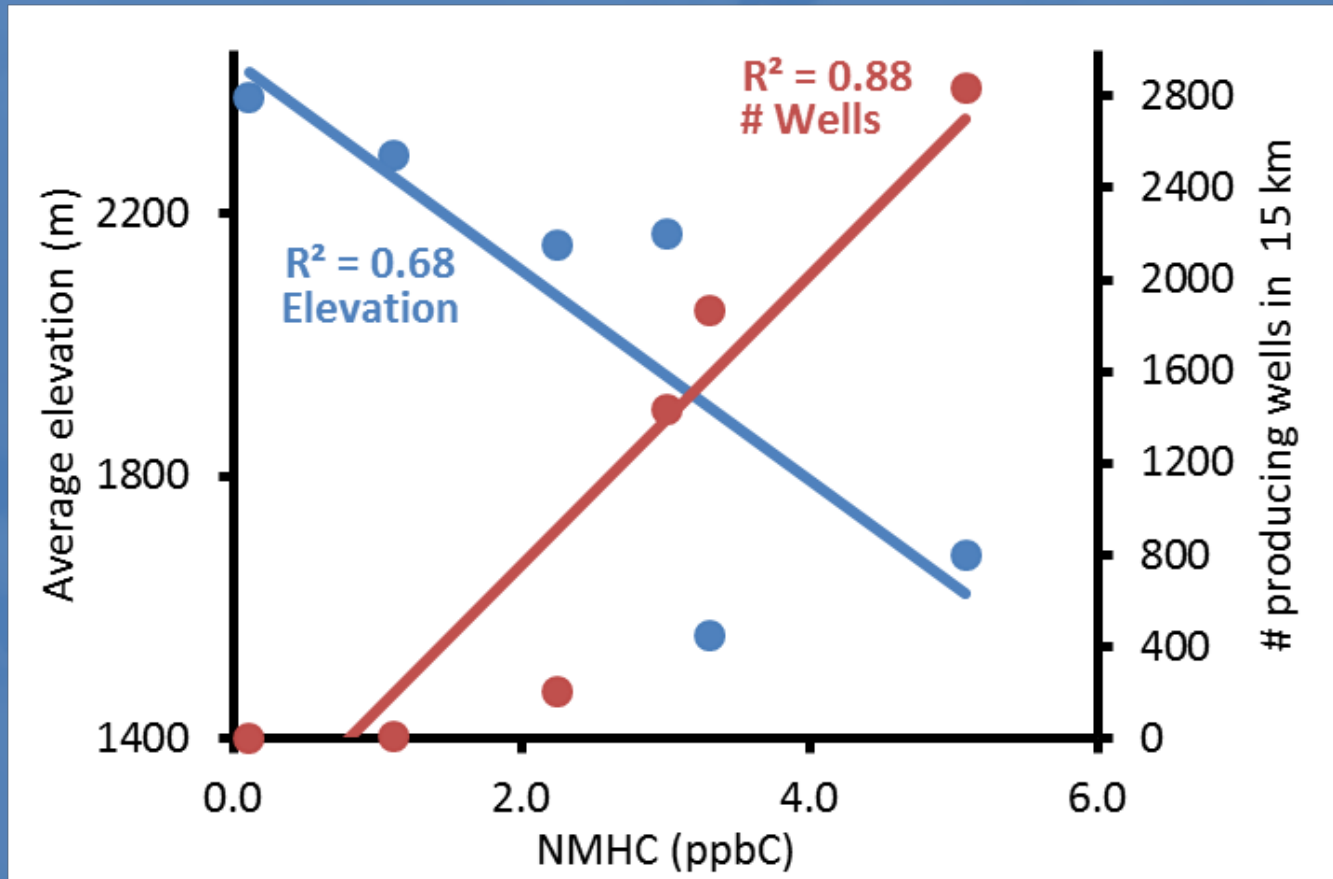
Distribution of Alkanes in the Uintah Basin



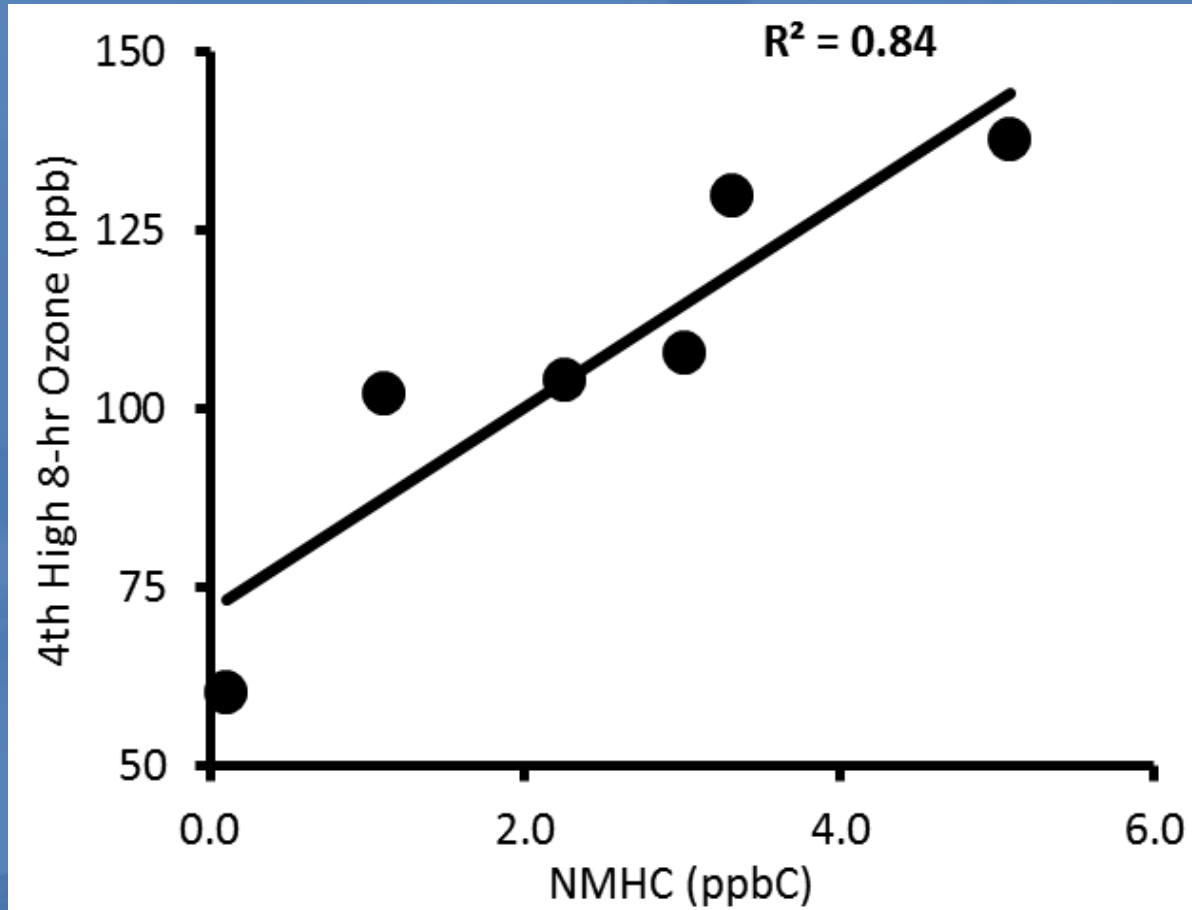
Higher Alkanes Were Observed in Gas-Producing Areas



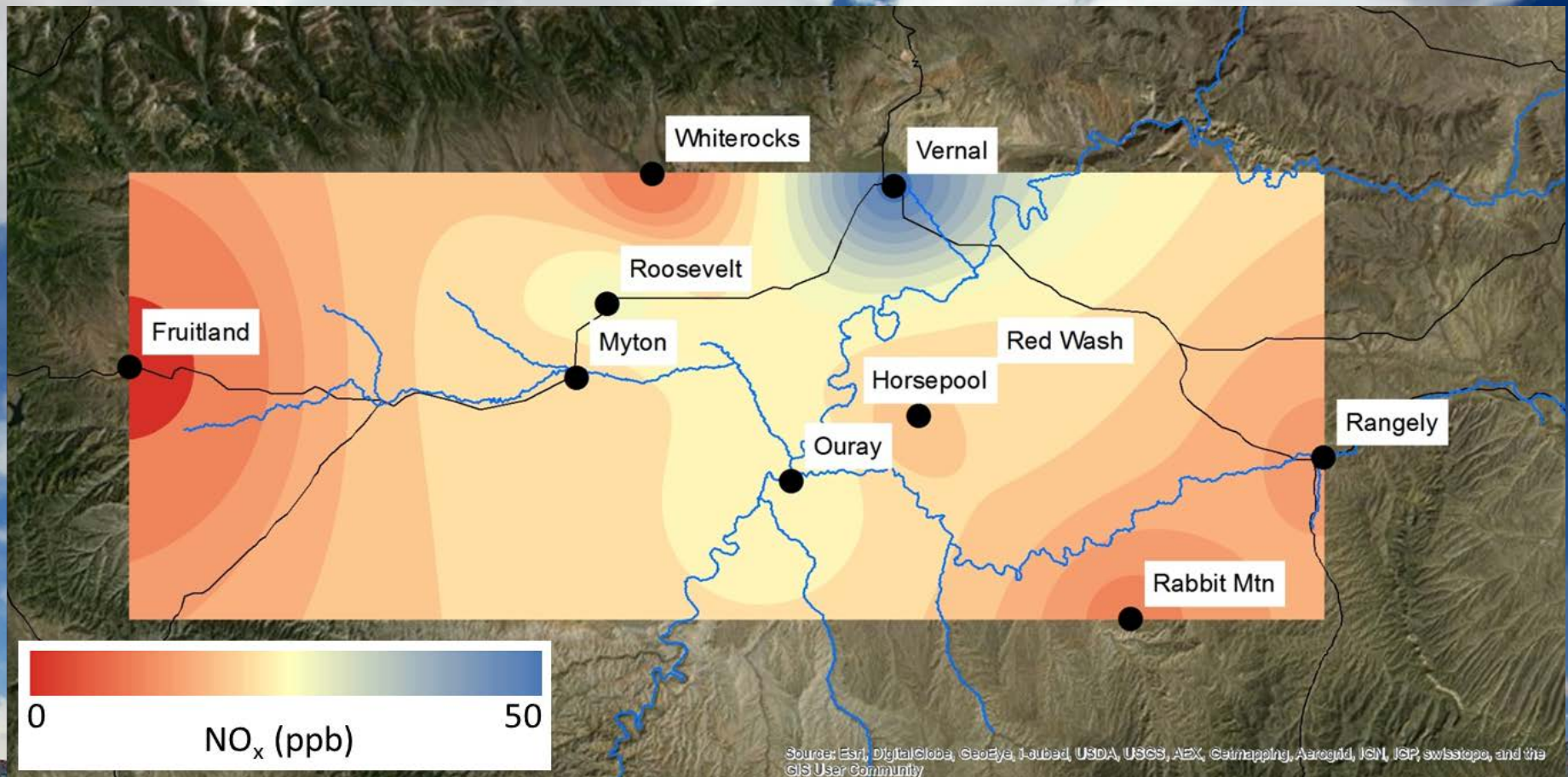
Like Ozone, VOC Are Correlated with Elevation and Proximity to Oil and Gas Extraction



Ozone and Hydrocarbon Concentrations Are Strongly Correlated



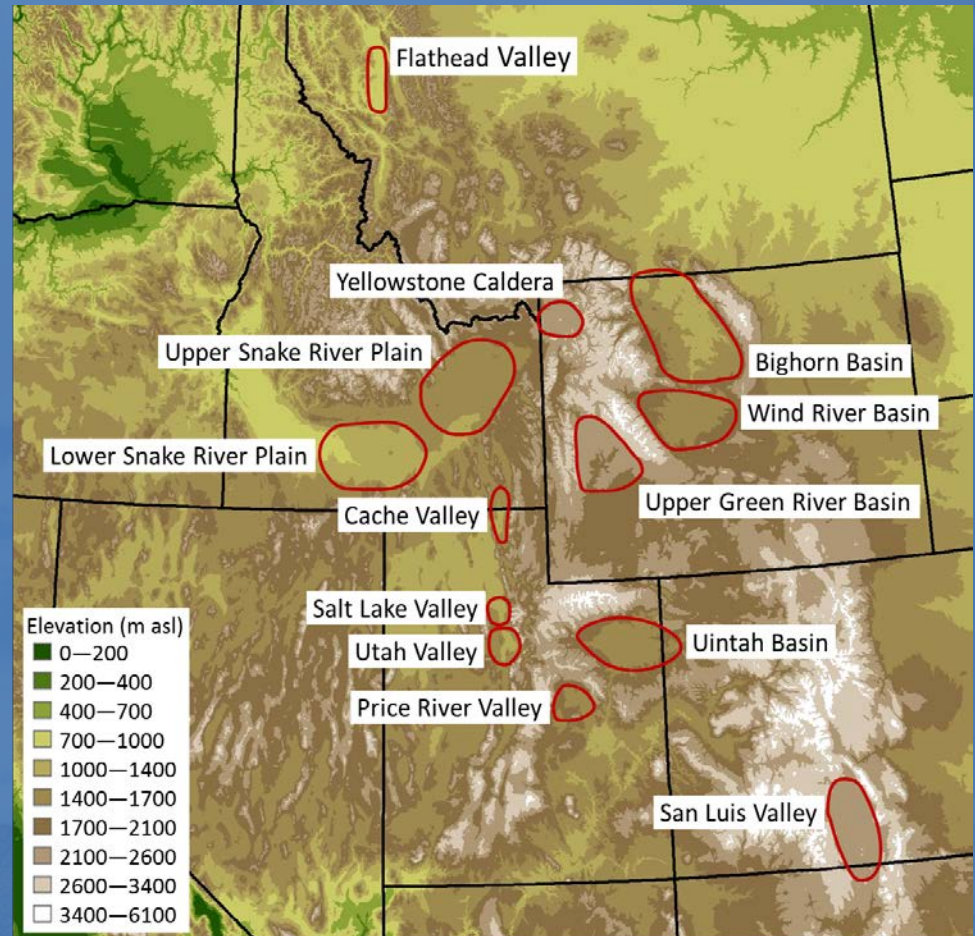
NO_x Distribution Does Not Follow Ozone and VOC Distribution



VOC Are Thought To Be Key for Winter Ozone Production

VOC limited conditions found to be predominant in box model studies of winter ozone:

- Nopmongcol et al., 2010
- Carter and Seinfeld, 2012
- Edwards et al., 2013



Special Thanks To:

- Uintah Impact Mitigation Special Service District; Uintah and Duchesne Counties; Utah Science, Technology and Research Initiative; and U.S. Department of Energy.
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