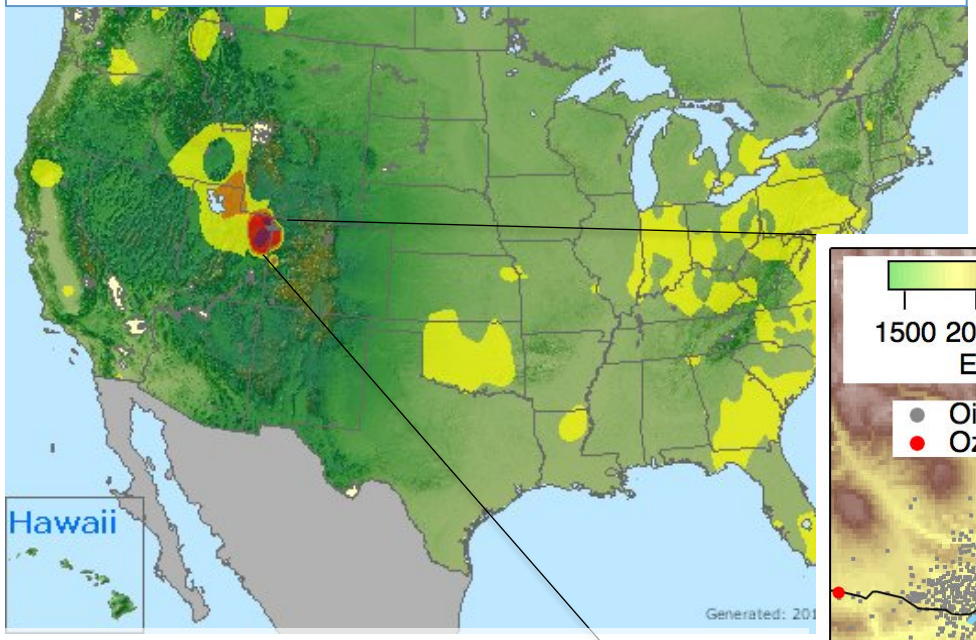
Wintertime high ozone in an oil and gas development basin

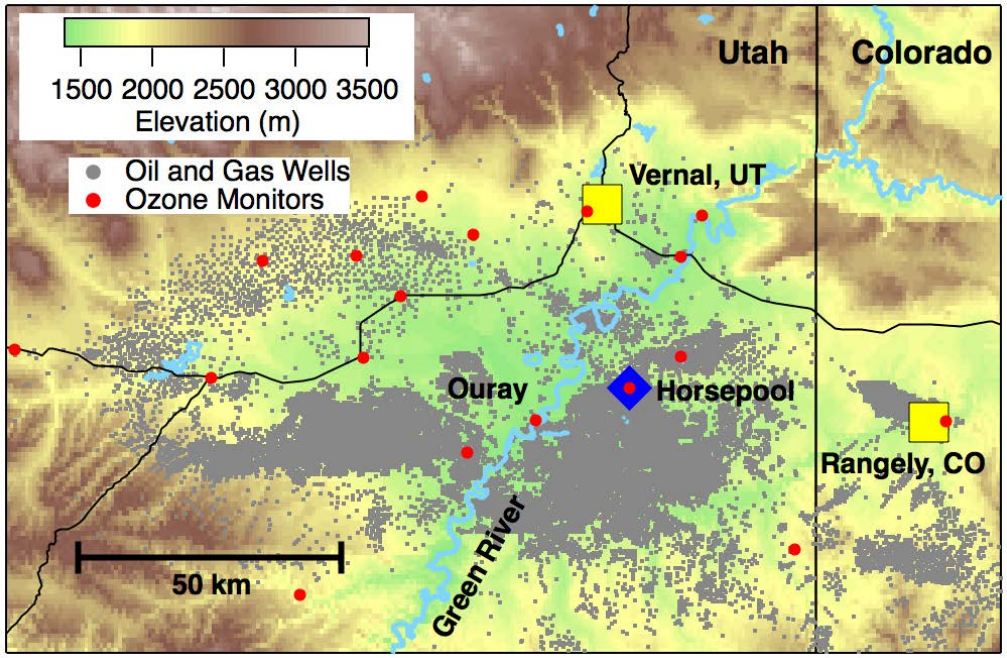
James Roberts

Daily Peak Air Quality Index (Combined $PM_{2.5}$ and O_3)
Winter, 2013



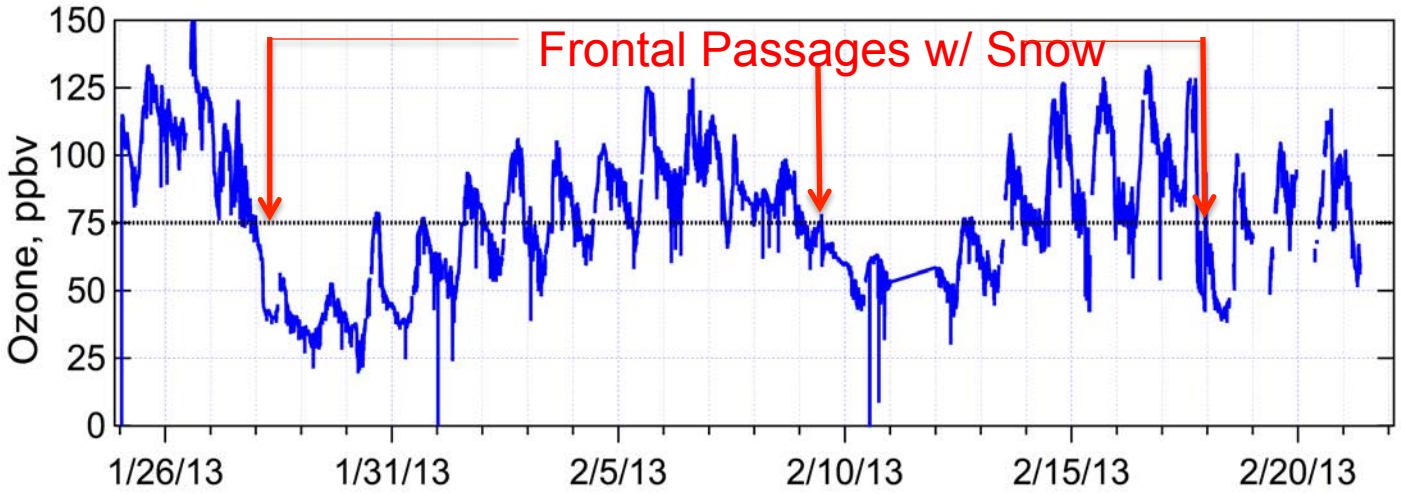
High photochemical ozone remains a critical Air Quality problem in the U.S.

Over the last 4 years some of the highest ground level ozone in the U.S. has been found in a rural basin in Utah, in the middle of Winter



- CSD has a long-standing mission to understand the causes of high ground-level O_3

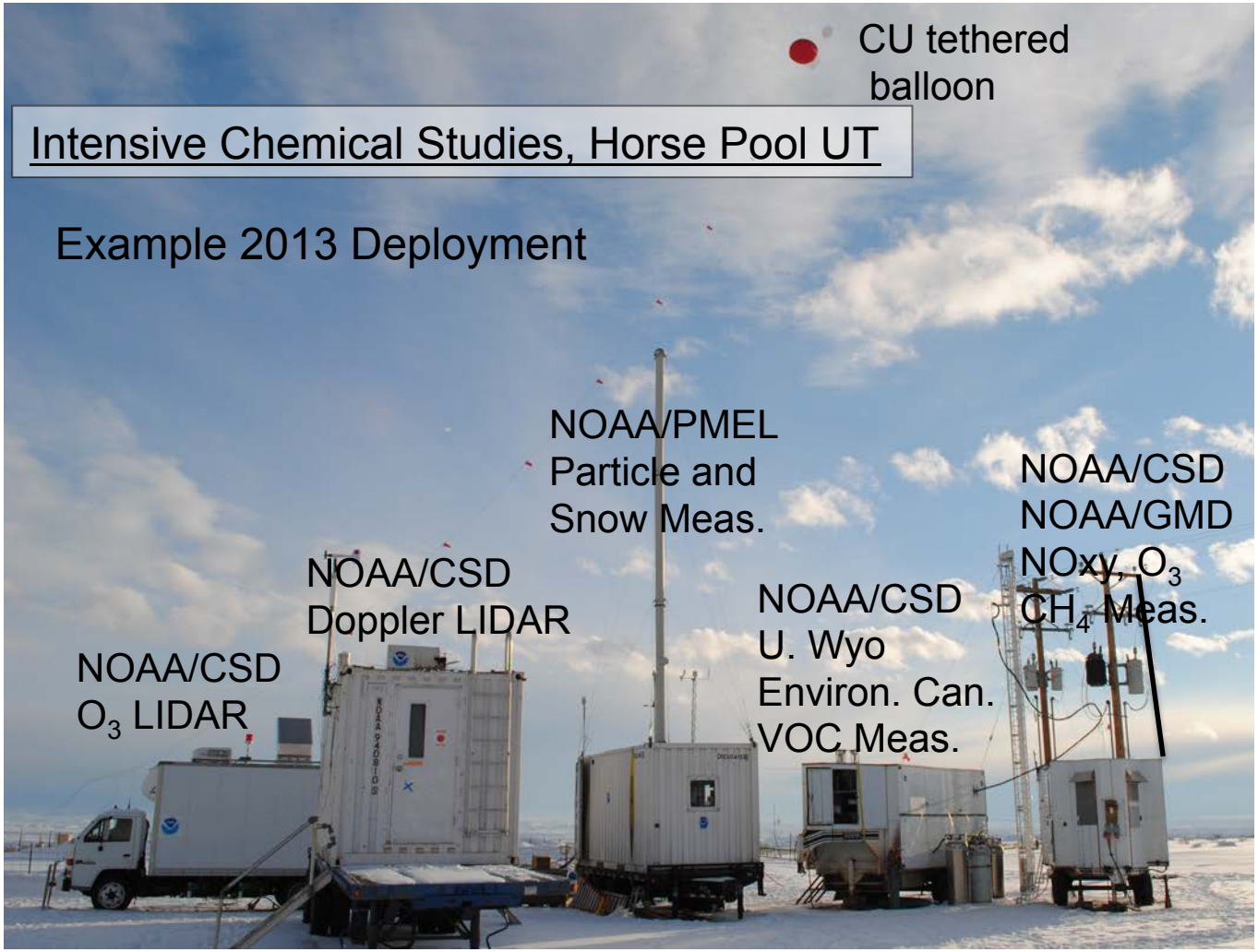
Winter Ozone Episodes in the Uintah Basin – the role of snow



Snow Cover has the following effects:

- Creates shallow boundary layers
- Increases UV radiation ~50%
- Decreases O_3 deposition rates
- Does it promote other Chemistry?

- CSD undertook extensive *in situ* measurements to determine how the photochemistry makes O_3 in this environment



Collaborators

NOAA PMEL, NOAA/ESRL GMD, NOAA/ESRL PSD Utah DEQ, EPA, Environ. Canada, HARC U. Colorado, UCLA, U. Washington, UC Berkeley, Hiram College, U. Houston, U. Wyoming, U. of Toronto, York U., CAN., U. of Calgary, Utah State U., U. Utah, ENVIRON, Alpine Geophysics

Supporters

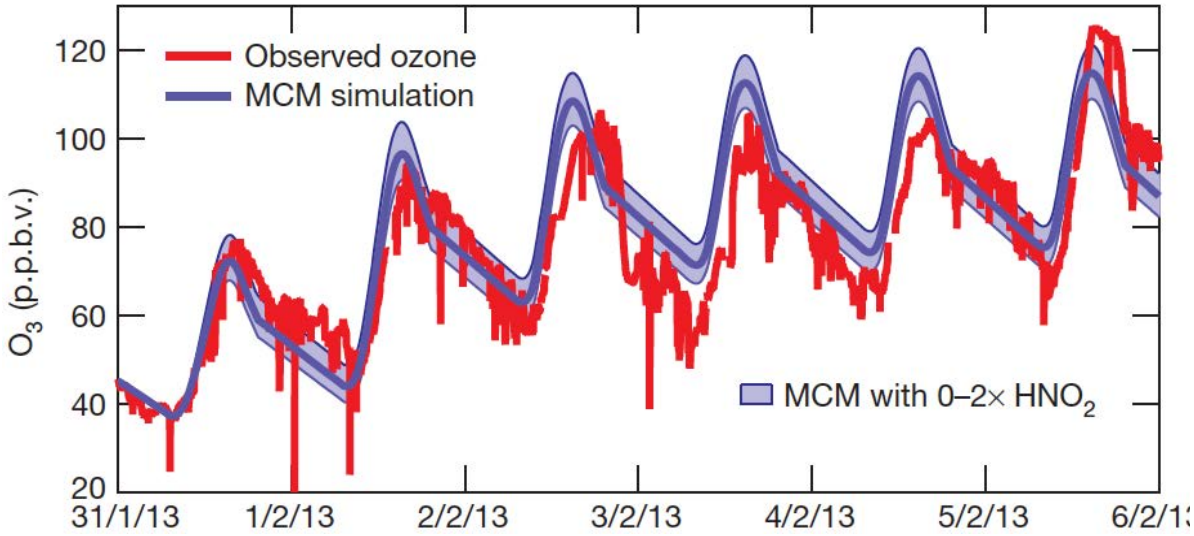
Western Energy Alliance, Questar Energy Products, State of Utah, Uintah Impact Mitigation Special Services Dist., BLM, EPA, NSF, Environ. Canada

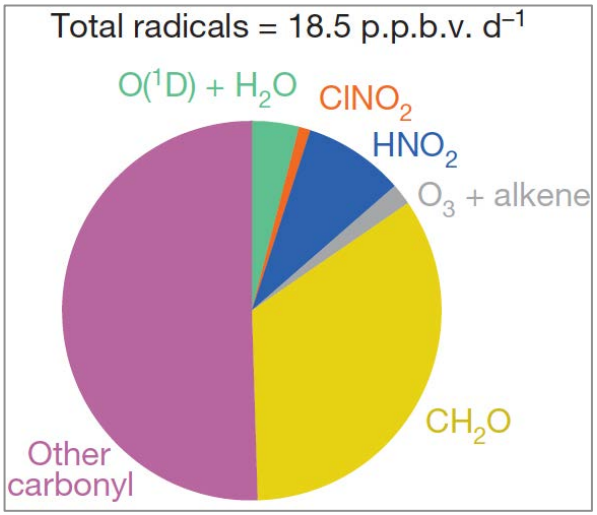
- CSD led the effort to make extensive NOx, NOy, VOC, Particle and Snow Chemistry Measurements
- The Co-products of NOx and VOC chemistry tell us what happened.
- A valid model needs to simulate these Co-products along with Ozone

CSD Implemented the Master Chemical Mechanism Box Model for Utah wintertime conditions [Edwards et al., *Nature,* 2014]

Constrained to observations (inventory independent)
Uses only simple first-order mixing (meteorology independent)

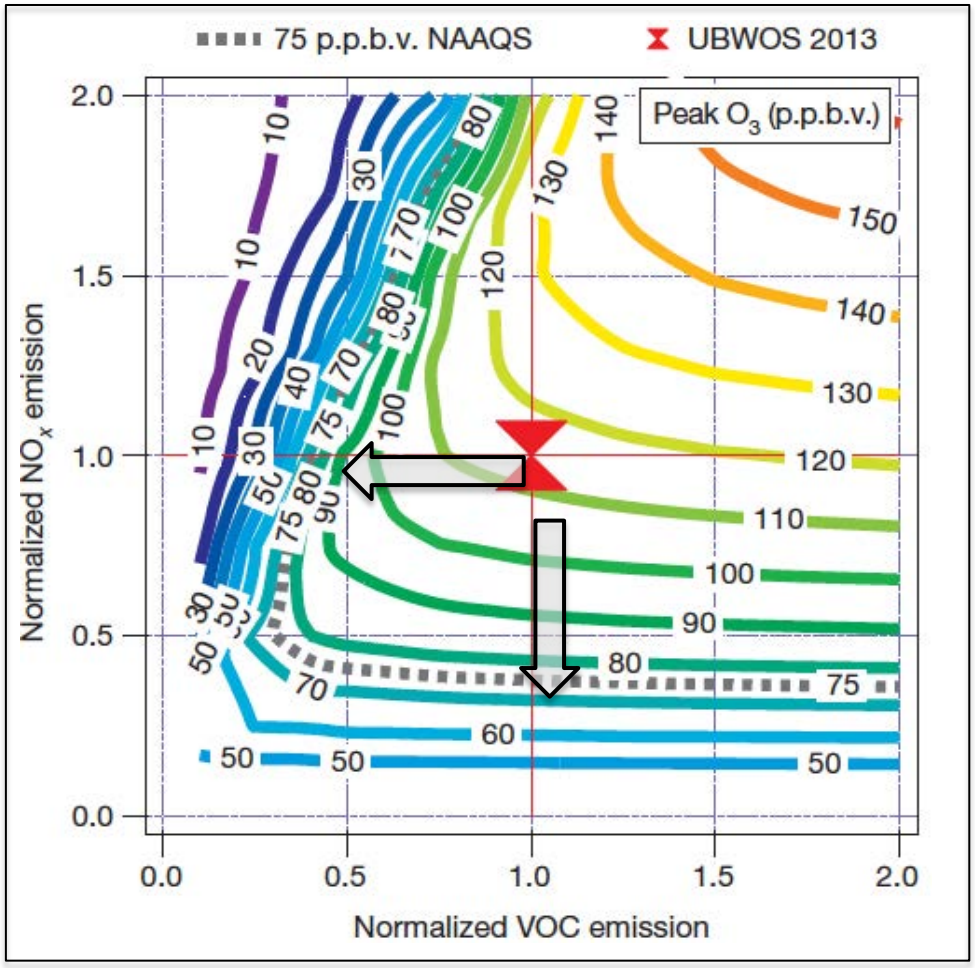
- The MCM Box Model simulates O_3 accurately





- Formaldehyde and other carbonyls are the major radical sources

CSD results provide the policy-relevant science to inform the regulatory process



- O_3 Isopleth from MCM Box Model by CSD, [Edwards et al., *Nature,* 2014]
- Indicates the Uintah Basin is NOx and to some extent VOC sensitive

- Utah DEQ has used these results to enact new rules governing oil and gas activities.
- These results provide a means to predict where and when other Wintertime Ozone problems might occur.