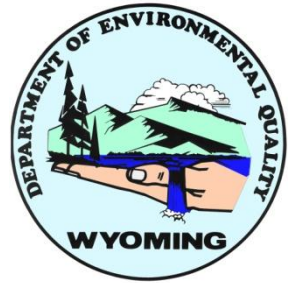


DEQ Ozone Response EQC Meeting, Rock Springs

June 3, 2009



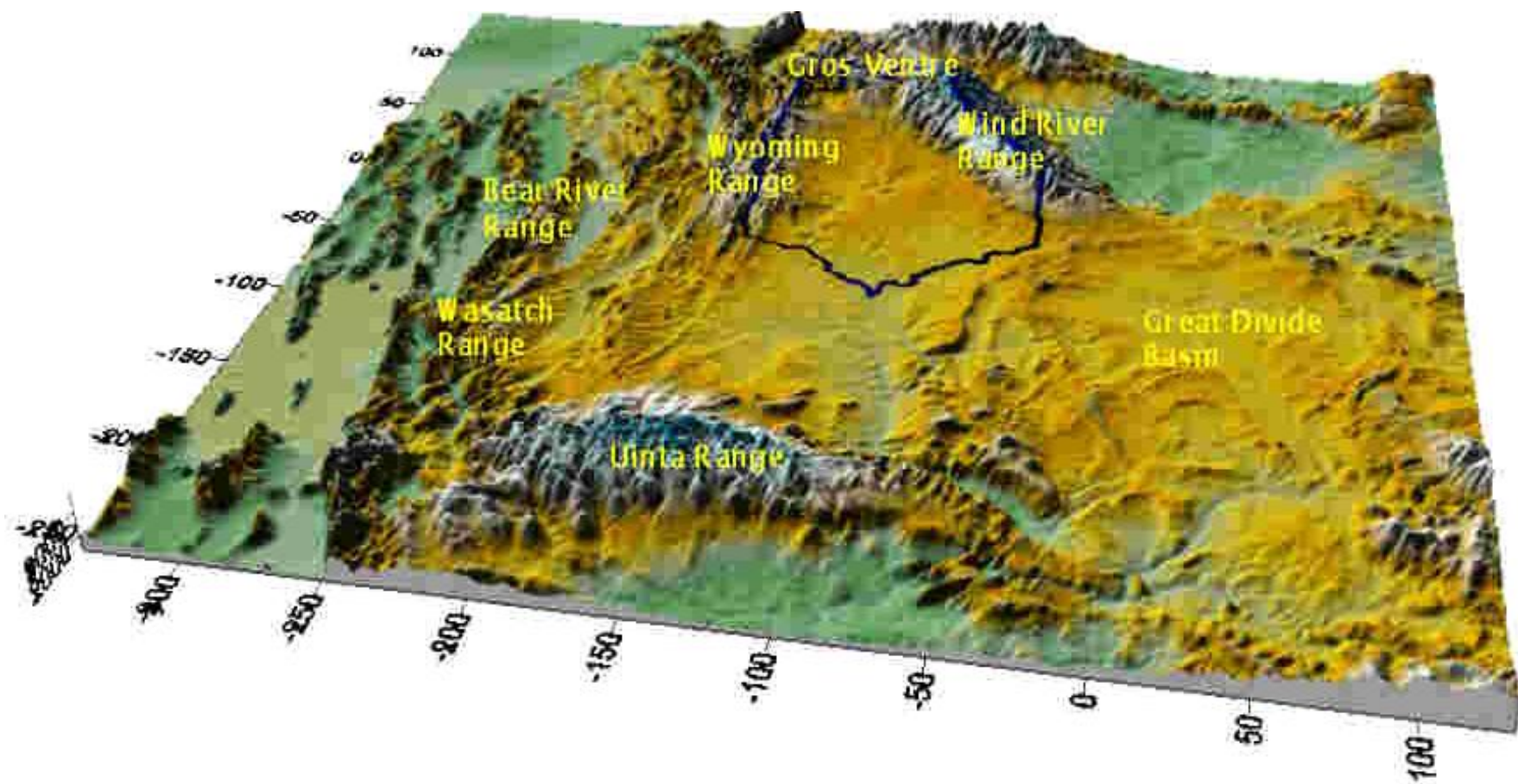
Discovery

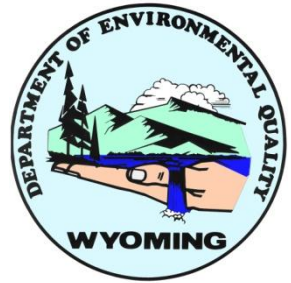


- ◆ Concerns about impacts of rapid oil & gas development led to establishment of 5 monitoring stations
- ◆ Elevated ozone discovered in February 2005 & 2006 at Boulder & Jonah



Jonah 2/27/06
8-hour max 93 ppb





Identify Cause

- ◆ Speculation:
 - Stratospheric Intrusion
 - Transport from far away urban areas
 - Monitoring equipment malfunction
 - Impossibilities
- ◆ Needed to find true cause so we could act



Ozone: Chemistry

Nitrogen Cycle



M- body with mass, absorbs energy from reaction as heat

uv – ultraviolet portion of solar radiation

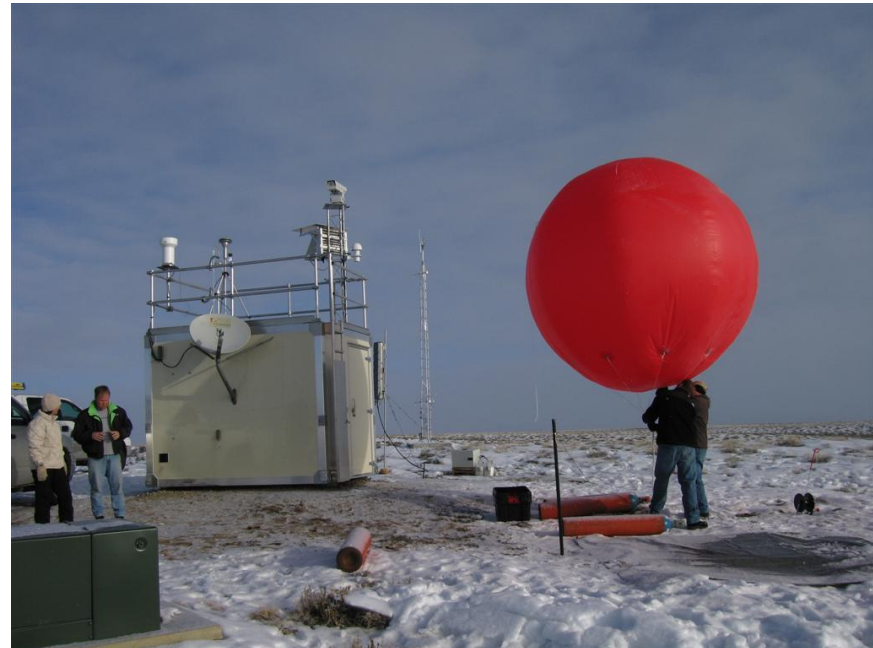
VOC Cycle

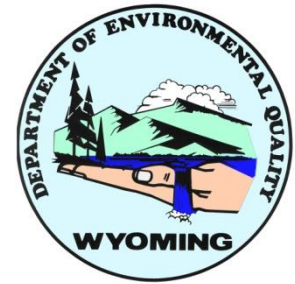


R – organic fragment

Winter Studies

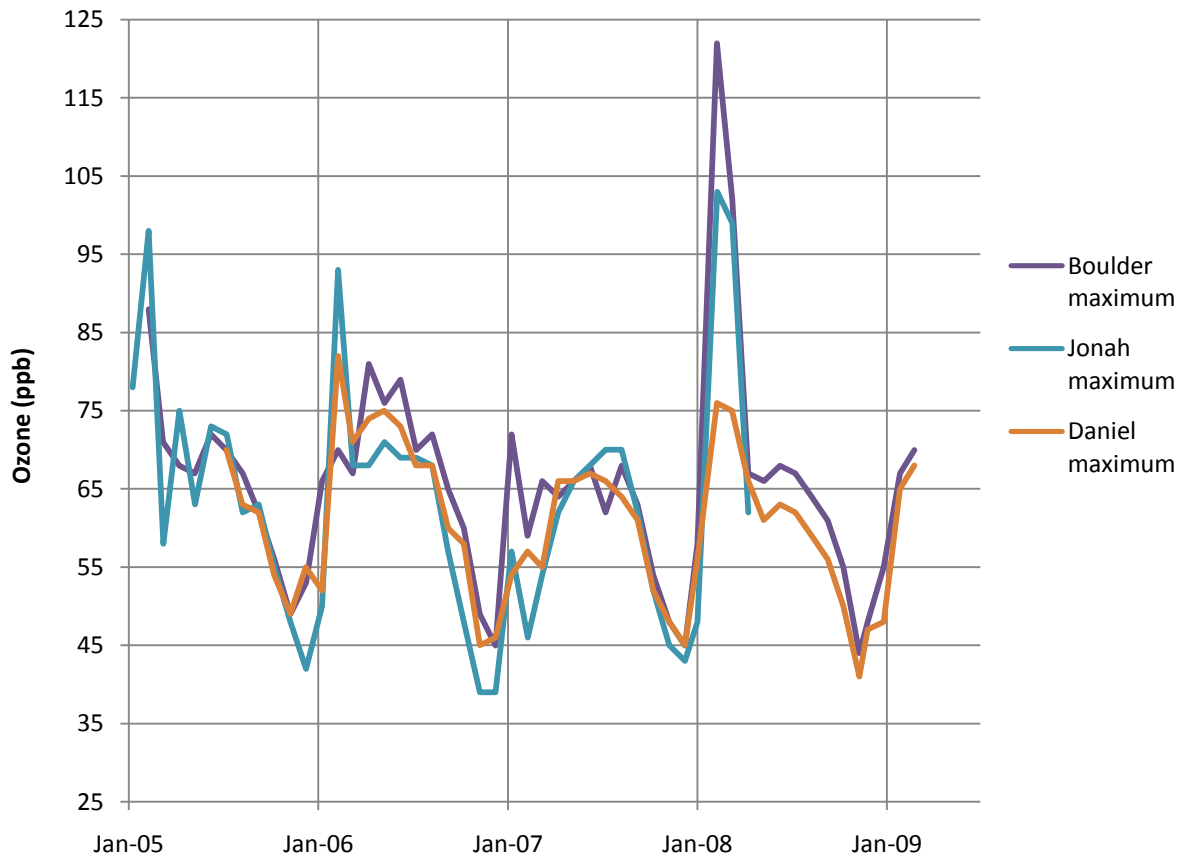
- ◆ February & March 2006, 2007, 2008, 2009
- ◆ Expanded continuous monitoring
- ◆ Intensive sampling periods when elevated ozone expected





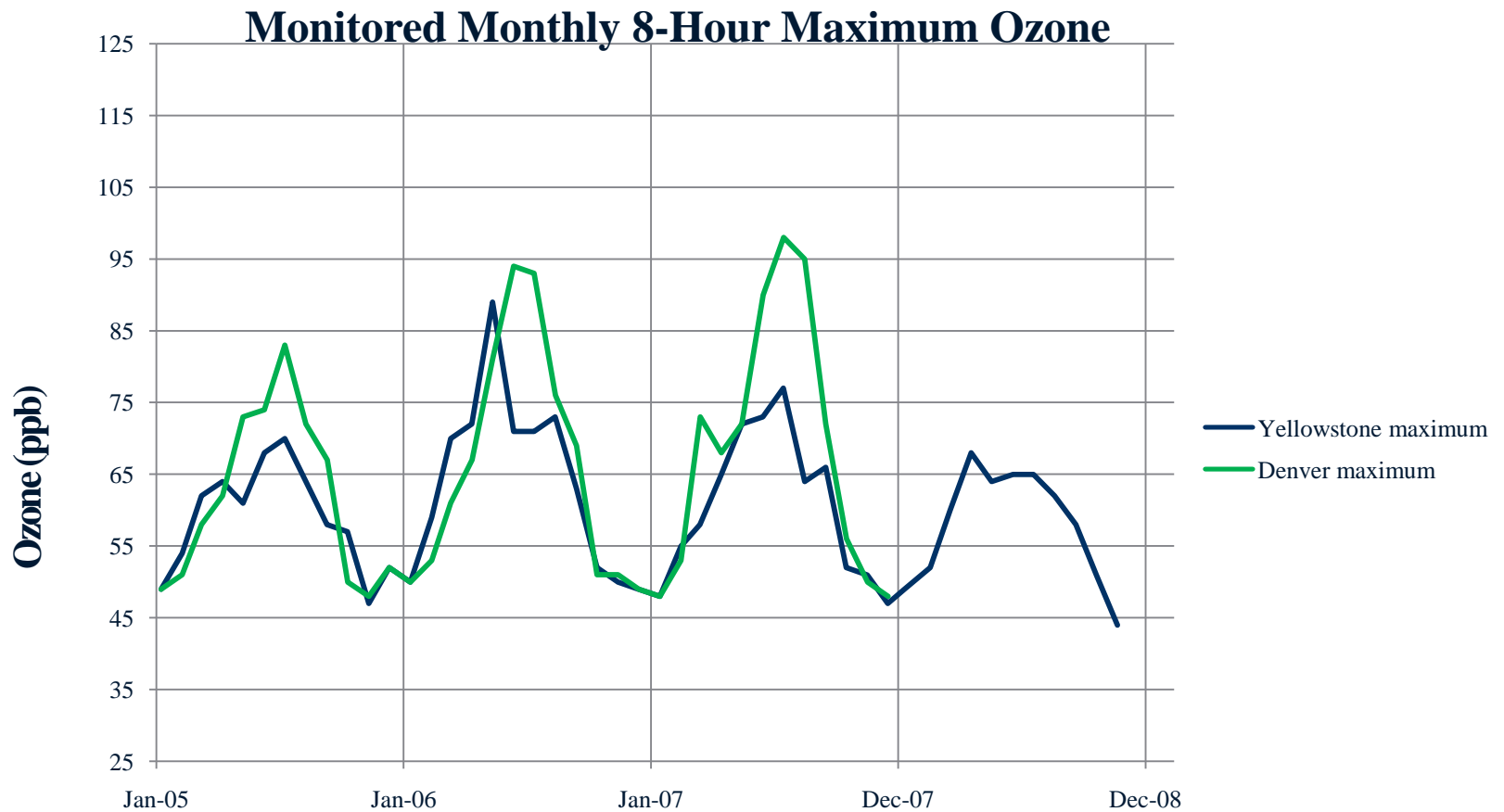
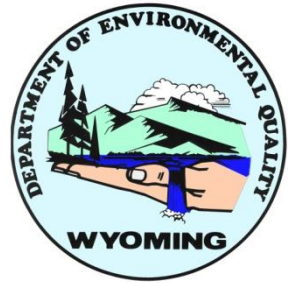
Results

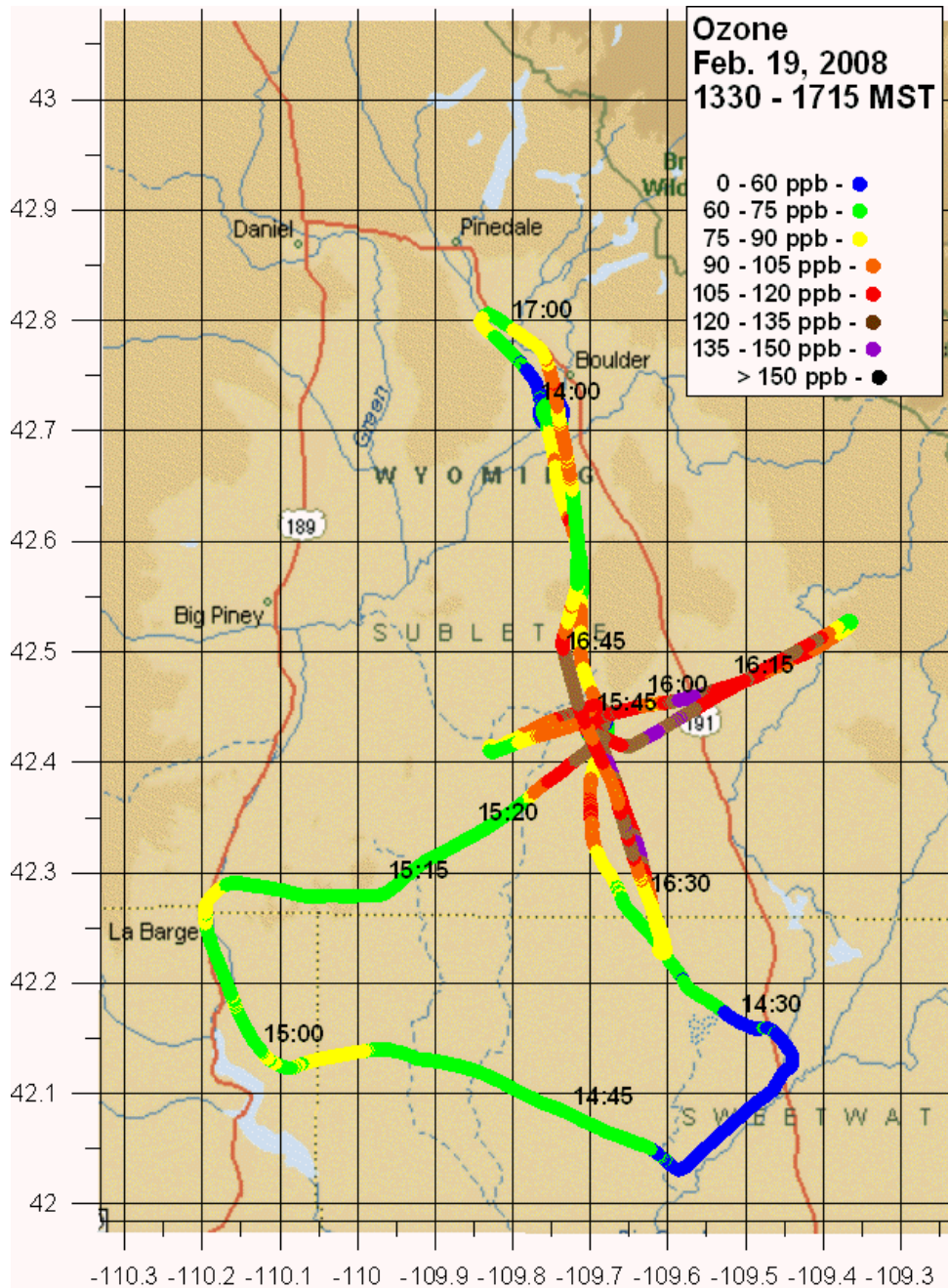
Monitored Monthly 8-Hour Maximum Ozone



- ◆ 2005 & 2006 – Wintertime peaks
- ◆ 2007 – No snow; no ozone
- ◆ 2008 – All factors lined up; plenty of ozone
- ◆ 2009 (preliminary) – Limited snow, lower emissions; limited ozone

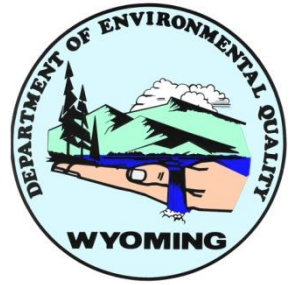
Comparative Ozone levels





Aircraft data – Feb 19th

- ◆ 8-hr high 79 at Boulder, 80 at Jonah
- ◆ Note “patchy” non-uniform ozone concentrations

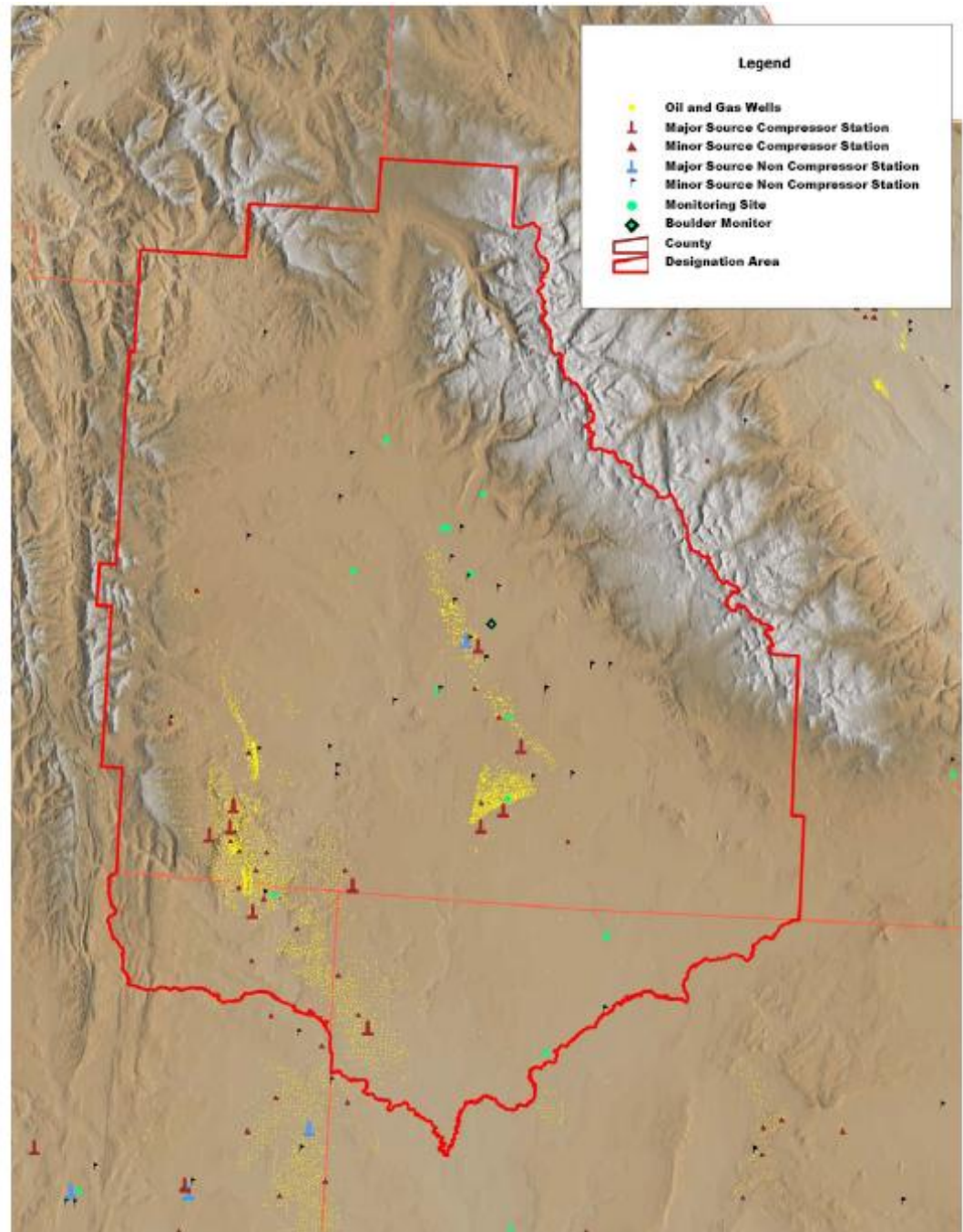


Ingredients for Ozone Formation in the Upper Green

- ◆ Snow
- ◆ Low winds
- ◆ Sun
- ◆ Low level inversion
- ◆ Local precursor sources



Utilized detailed
wind fields to
determine
appropriate
nonattainment
area boundary



Backward Trajectories

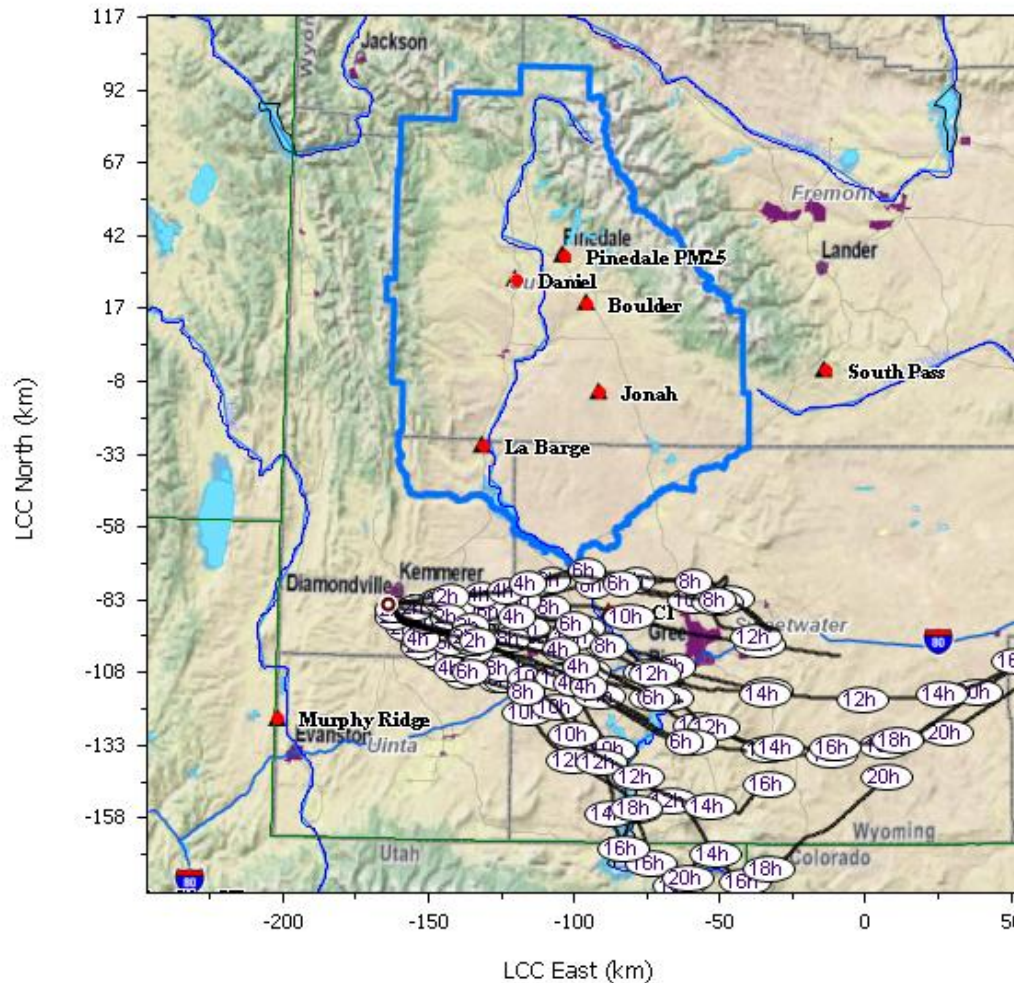
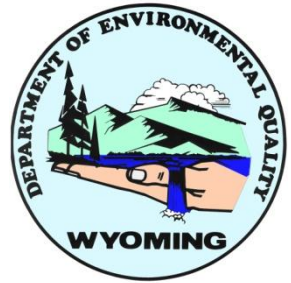


- 20 Feb 2008
- Start from 14:00 (O3 max hour at Boulder), go back 12 hrs

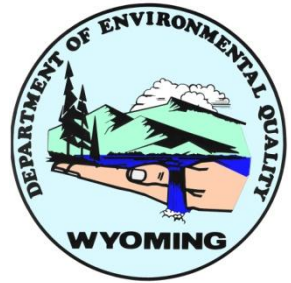
83 ppb

Forward Trajectories

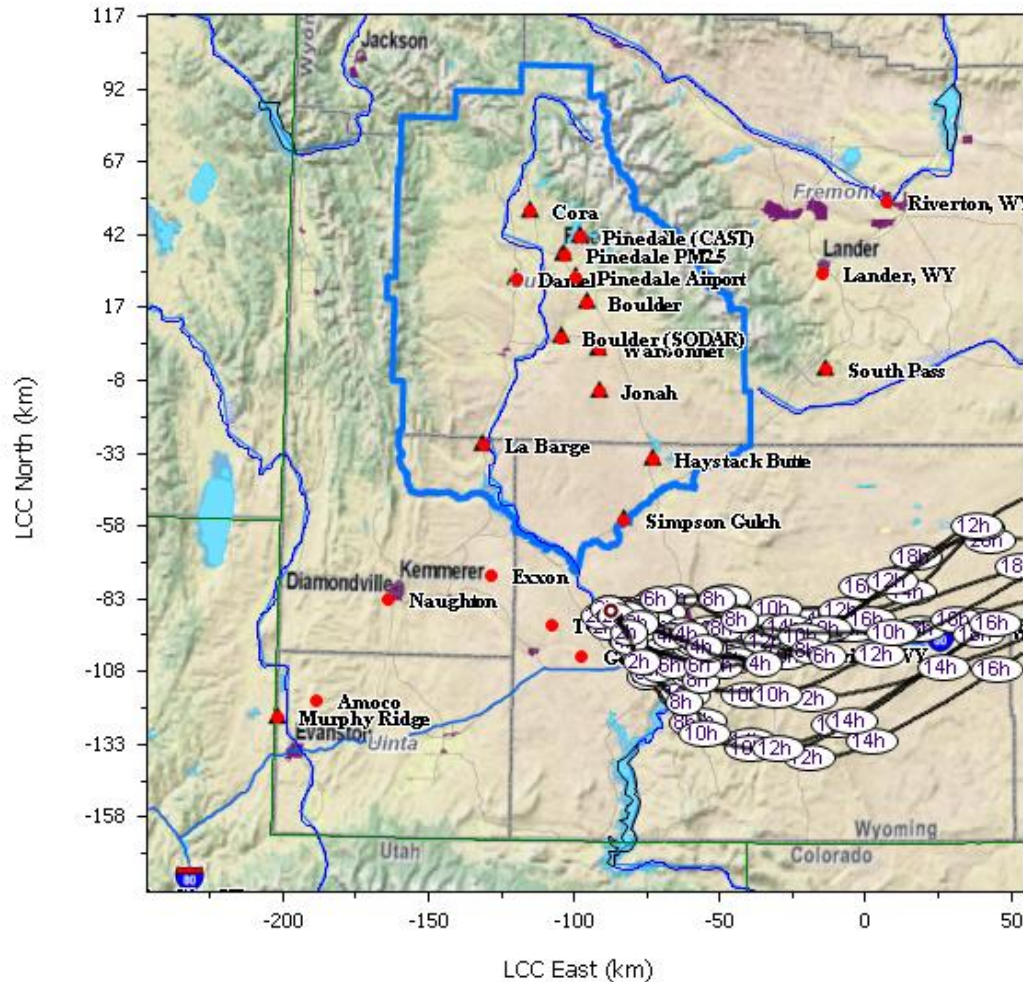
Feb 21_24 hr_FTA_Naughton 10 m



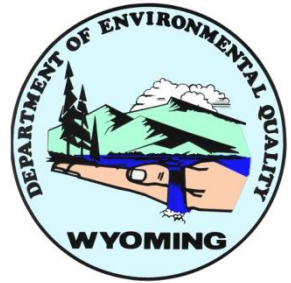
Trajectory Analysis



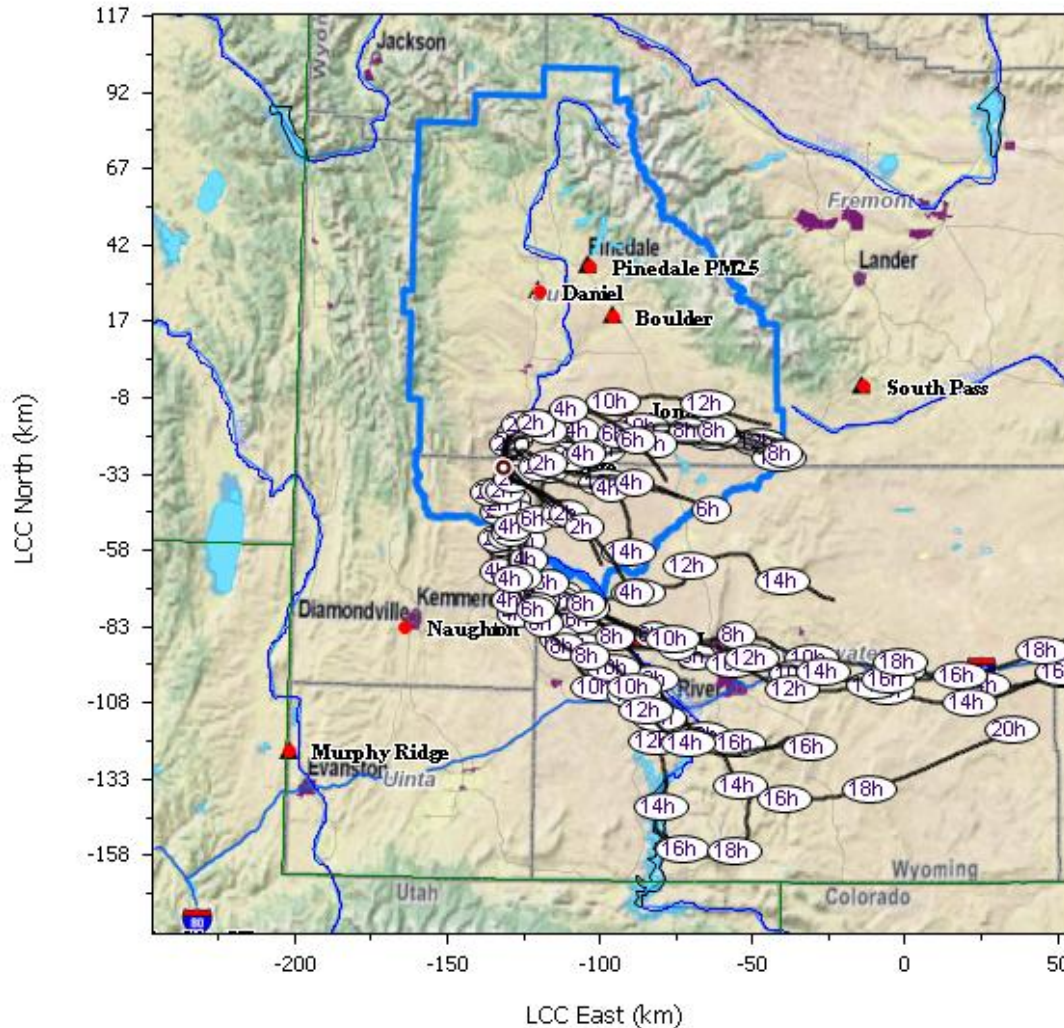
Feb 21_24 hr_FTA_OCI 10 m



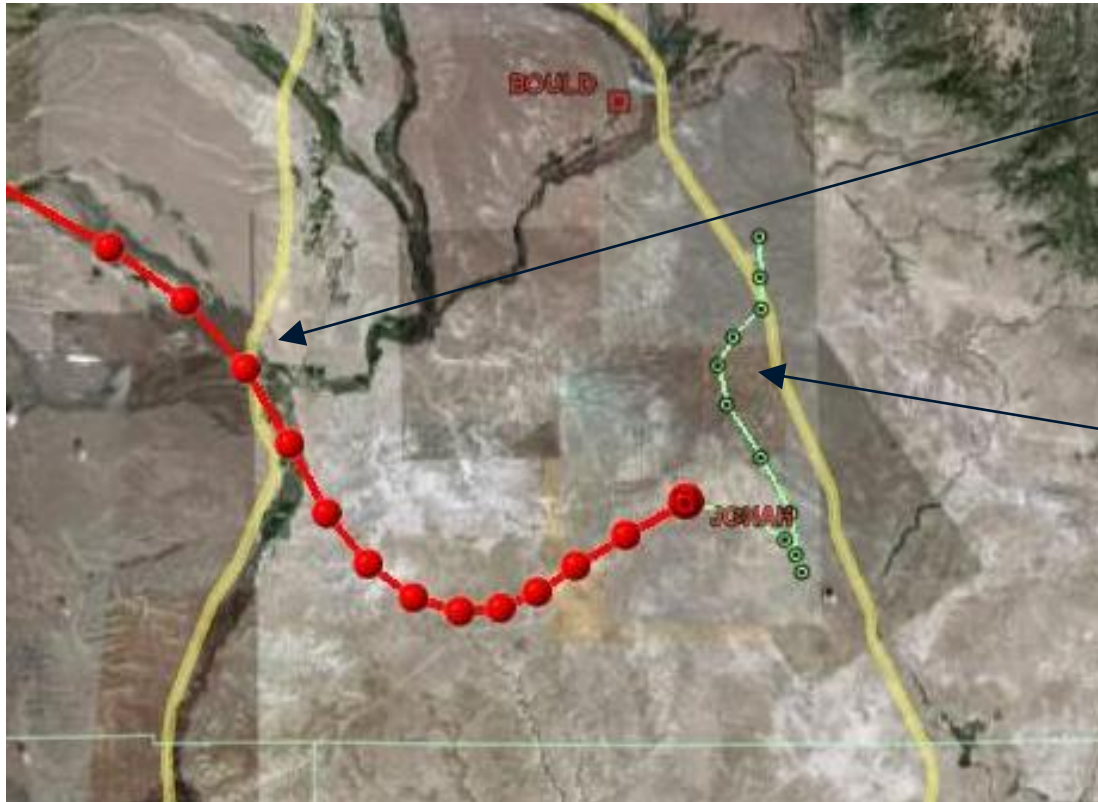
Forward Trajectories



Feb 21_24 hr_FTA_LaBarge 10 m



Trajectories: Regional Scale Versus Local Scale



Regional-scale model: HY-SPLIT back trajectories using 40 km resolution

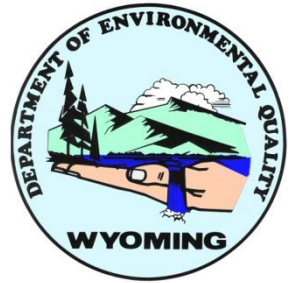
Local scale: UGWOS '08 surface wind data (markers at 1-hour intervals)

- 20 February 2008: 14:00 MST surface back trajectory from Jonah
- Markers at 1-hour intervals; 12 hours total



Response Actions

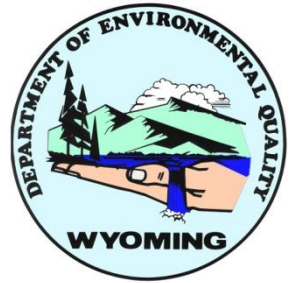
- ◆ Public ozone alerts
 - Initiated after elevated ozone episode of February 21st 2008; based on anticipated weather conditions
- ◆ Voluntary reductions
 - Industry commitments to change out equipment and modify operating/maintenance practices
- ◆ Increase inspection presence & use of technology (FLIR)
- ◆ More stringent permit requirements for oil and gas production – BACT revised August 2007



Response Actions (con't)

- ◆ Interim permitting policy
 - Offset option
- ◆ Contingency plans
 - Defer/reduce operations; delay fueling
- ◆ Quarterly public meetings
- ◆ Permanent monitor established in Pinedale
- ◆ Mitigation requirements in Jonah & Pinedale Anticline RODs

NEPA – Mitigation Efforts

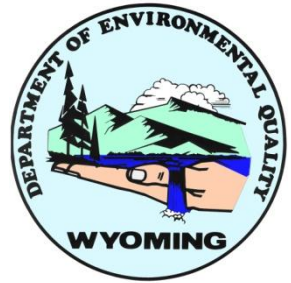


Jonah Infill

- ◆ ROD March 2006
- ◆ Authorized 3100 wells in addition to ~800 existing wells in 2006
- ◆ Approximately 1500 producing wells to date
- ◆ Mitigation
 - NOx reductions
 - Technology Demonstrations
 - Consolidation to Centralized Facilities
 - Funding for AQD staff

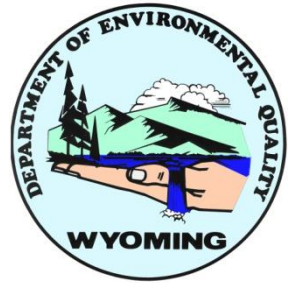
Pinedale Anticline

- ◆ ROD September 2008
- ◆ Authorized 4400 new wells in addition to ~1200 existing wells
- ◆ Mitigation
 - Liquids gathering systems
 - NOx reductions
 - Contingency plans
 - Future ozone modeling
 - Funding for AQD staff and monitoring



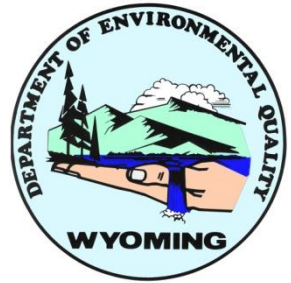
Legislative Support

- ◆ Additional positions and funding approved to address statewide energy development impacts and Upper Green ozone
 - Uncertainty due to declining revenue forecasts
 - 6 new positions
 - \$3.2 M for setup and operation of monitoring
 - \$1.3 M for development of statewide planning & analysis system, boundary conditions, & model data
 - \$0.6 M for development of Upper Green model, inventory, and meteorological data



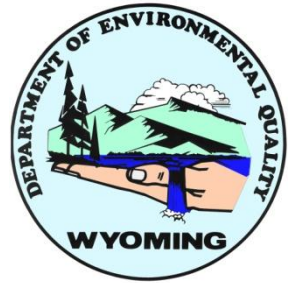
Funding Support

- ◆ Partnerships
 - SWWY Agreement
 - \$7.894 million; 50/50 industry/DEQ sharing
 - PAW Support of Winter 2009 Ozone Study: \$497,000
 - UW Upper Green Ozone Studies
 - \$302,000; 64% DEQ/36% University Grant
 - Jonah Infill Office Support
 - \$442,000 for Winter 2007/08 Ozone Studies
- ◆ 2009/10 Exception Budget Approval for Winter Ozone Model Development: \$387,200



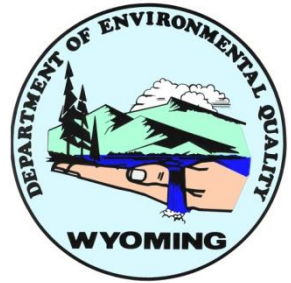
Ongoing efforts

- ◆ Continuing field presence through inspections
- ◆ Collaborative study with UW
- ◆ In-house forecasting during ozone “season”
- ◆ Investigating options for continuous VOC speciation
- ◆ Drill rig permitting
- ◆ Air toxics study
- ◆ Tracking air quality ROD commitments
- ◆ BACT revisions (summer 2009)



Ongoing monitoring

- ◆ Confirm our conclusion that elevated ozone events are
 - Limited in extent
 - Correlated with snow, sun, low wind, temperature inversion
 - Almost entirely a consequence of local emission sources
- ◆ Development of a working model
 - Need for several reasons



Model development

- ◆ Conventional models haven't been shown to reproduce the elevated ozone concentrations observed in the winter
 - Very low, meandering wind
 - Account for reflected UV from snow
 - Dominant terrain features
- ◆ Anticipate a working model by end of 2009