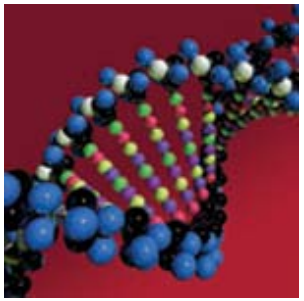
Use of Photochemical Grid Models for NEPA: New Oil and Gas Wells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EPA's 9th Conference on Air Quality Modeling
Non-Guideline Applications

October 9, 2008

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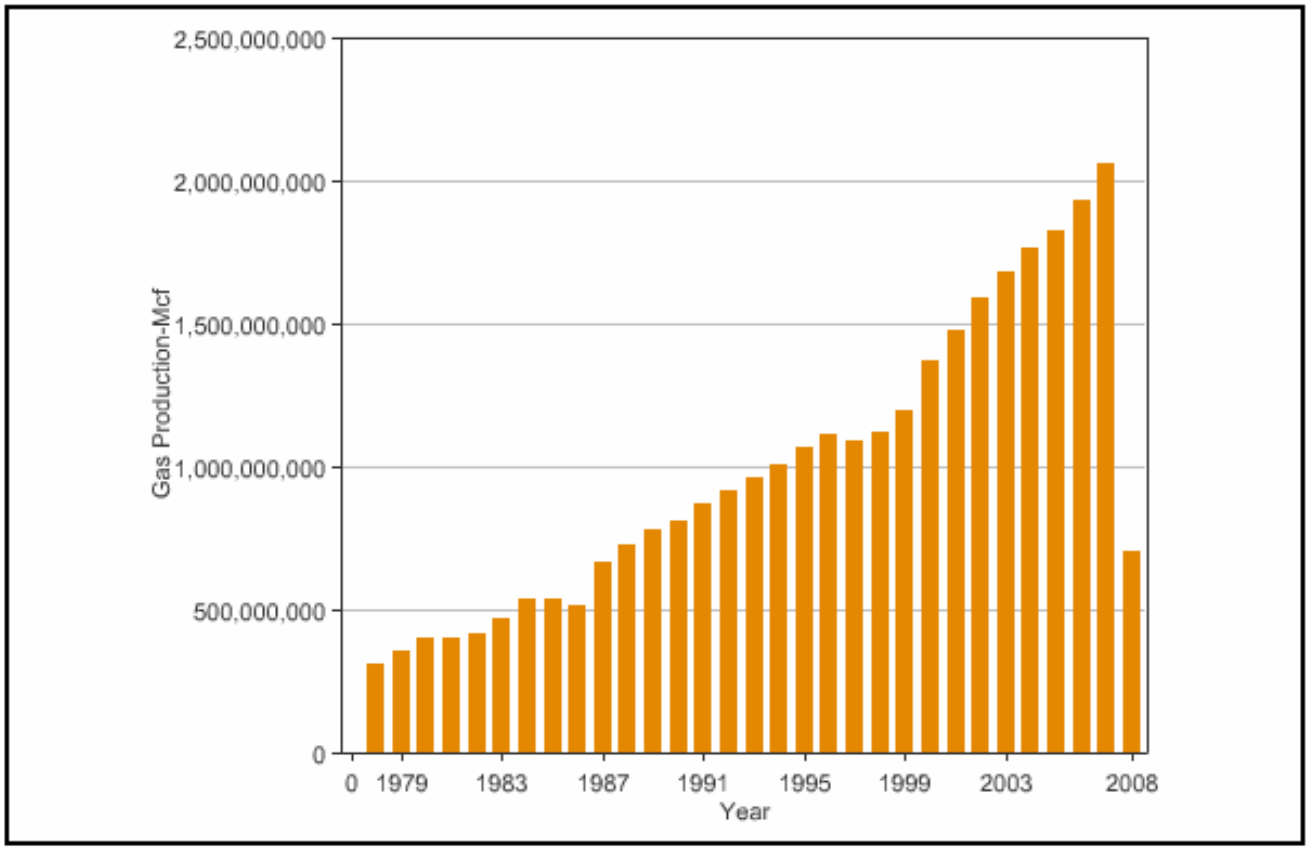
National Environmental Policy Act (NEPA)

- Legislation enacted in 1969
- Requires agencies to fully analyze and disclose impacts of new projects
  - Guided by Council on Environmental Quality (CEQ)
  - Consultation with public and private parties
  - Disclosure provided through Environmental Assessments (EAs) and Environmental Impact Statements (EISs)
  - Use **"Best Science"** available
- Potential environmental impacts of Oil and Gas developments in the western states disclosed under NEPA
  - The FLM is responsible for preparing EISs/EAs for O&G development projects on federal land. The Bureau of Land Management (BLM) has been most active in this area, although U.S. Forest Service, Tribes and other agencies are also are active in this area

NEPA Oil and Gas Example

- Wyoming natural gas production increasing
- Efforts to increase domestic production of oil and gas



Source: Wyoming Oil and Gas Conservation Commission

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Background SWWY O&G

Drill Rig

Natural Gas Processing Plant

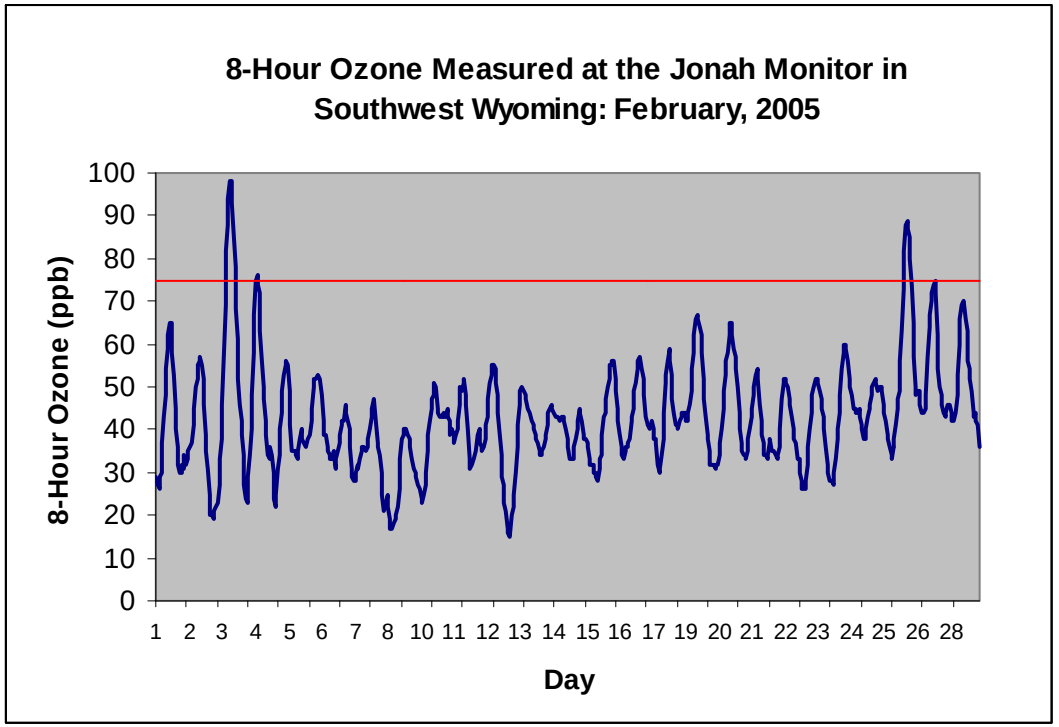
Images from Wikipedia

- The development of an oil and gas production project on federal land usually involves the preparation of an EIS or EA under NEPA that discloses the potential environment effects of the project
- EIS/EA includes air quality modeling to show project impacts on criteria pollutant concentrations, visibility, and deposition

Background: SWWY O&G Air Quality Assessments

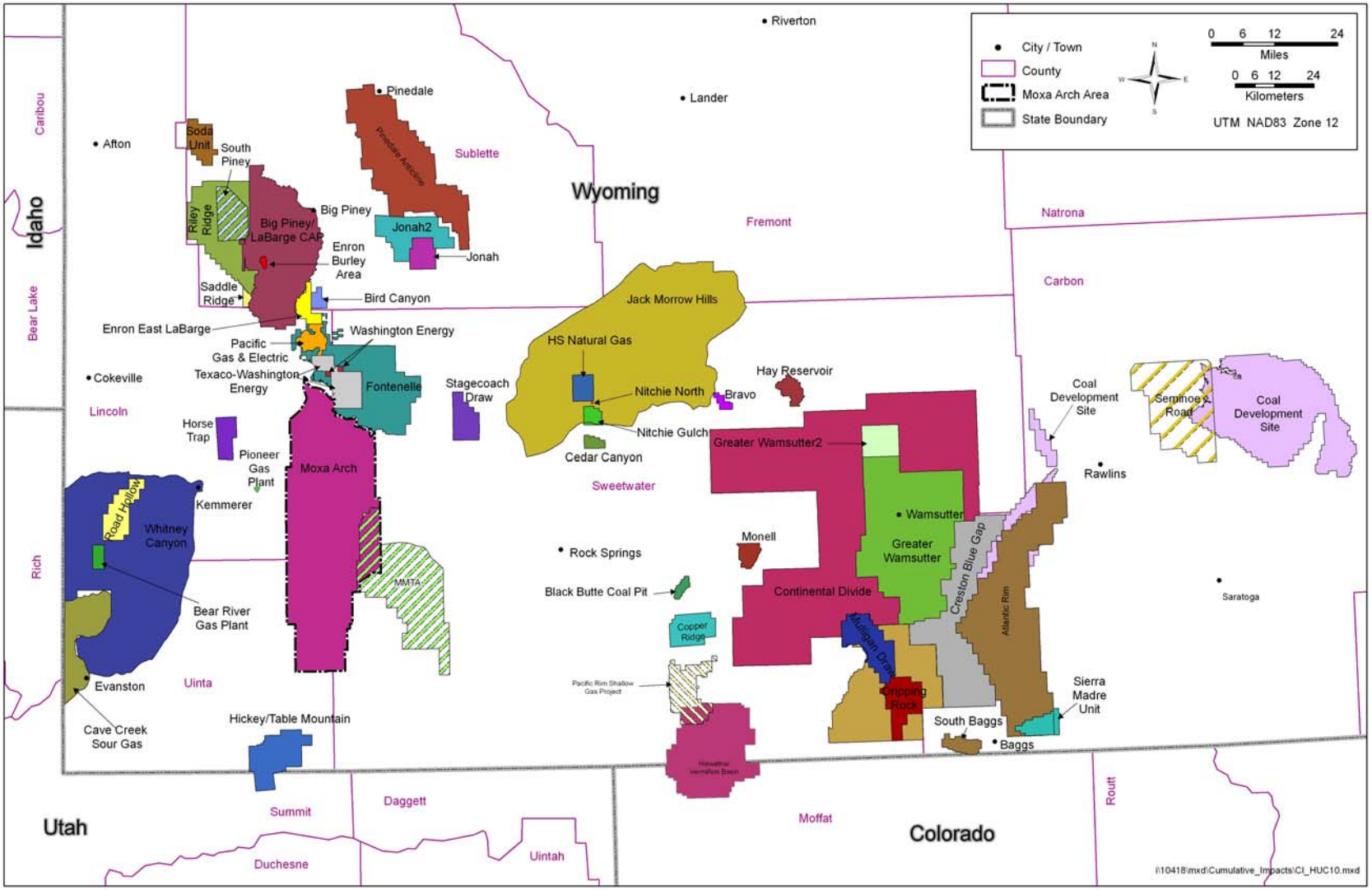
- Pre-History <1996: Qualitative
- 1996 – Moxa Arch: Set Many Precedents
- 1997 – 1st Jonah & Pinedale Anticline EIS
  - Pinedale Anticline mitigates visibility impacts through purchase of low NOx burner for Bridger coal-fired generating station
- 1997 – 1999 – SWWYTAF
  - Develop CALPUFF Database for SWWY
- 1999 Continental Divide & SUIT
  - First to Use CALPUFF for Cumulative Analysis
- 2000: FLAG guidance Issued
- 2004 – 2006 Jonah Infill EIS
- 2005 Ozone exceedances recorded in Pinedale area
- 2007 Pinedale Supplemental EIS
  - First to address ozone using PGM
- 2007-2008 – 4-Corners Interagency AQ Task Force Analysis
- 2008 – 2009 Planned: Continental Divide-Creston EIS
  - Use PGM for air quality, visibility and deposition (No CALPUFF)

EIS Air Quality Modeling



- Until recently, EIS AQ impact assessments used AERMOD for near-field impacts and CALPUFF for far-field AQ and AQRV impacts.
- High ozone concentrations have been observed in southwest Wyoming
- AERMOD/CALPUFF do not simulate ozone formation

Southwest Wyoming O&G Areas



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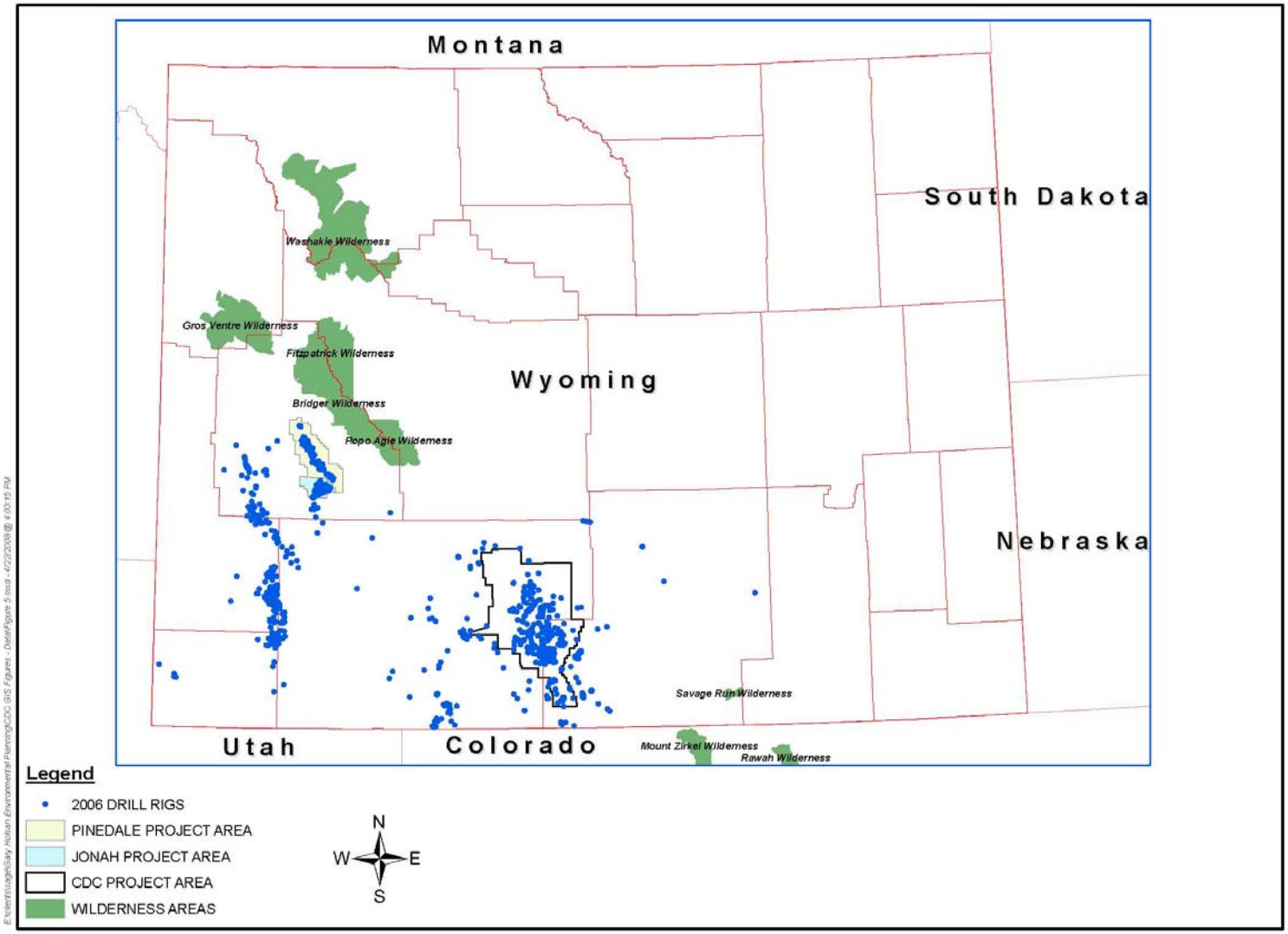
2006+ SWWY O&G Developments

- 2006 Moxa Arch and Hiawatha (MA&H) O&G Infill Projects
  - Use AERMOD for near-source AQ and CALPUFF for far-field AQ and AQRV
- 2005-2006 ozone exceedances recorded in SWWY
- 2007 ozone analysis added to MA&H using PGM
  - Leverage off of WRAP 2002 PGM database
- 2007+ proposed Continental Divide-Creston O&G
  - First EIS to proposed using PGM for ozone and all far-field AQ and AQRV (still use AERMOD for near-source AQ)
- 2008 MA&H also adopt PGM approach for ozone and far-field AQ and AQRV
  - Need to redo ozone/AQ/AQRV analysis due to emission changes and lack of adequate cumulative inventory to address ozone
  - CD-C PGM and emissions database development available

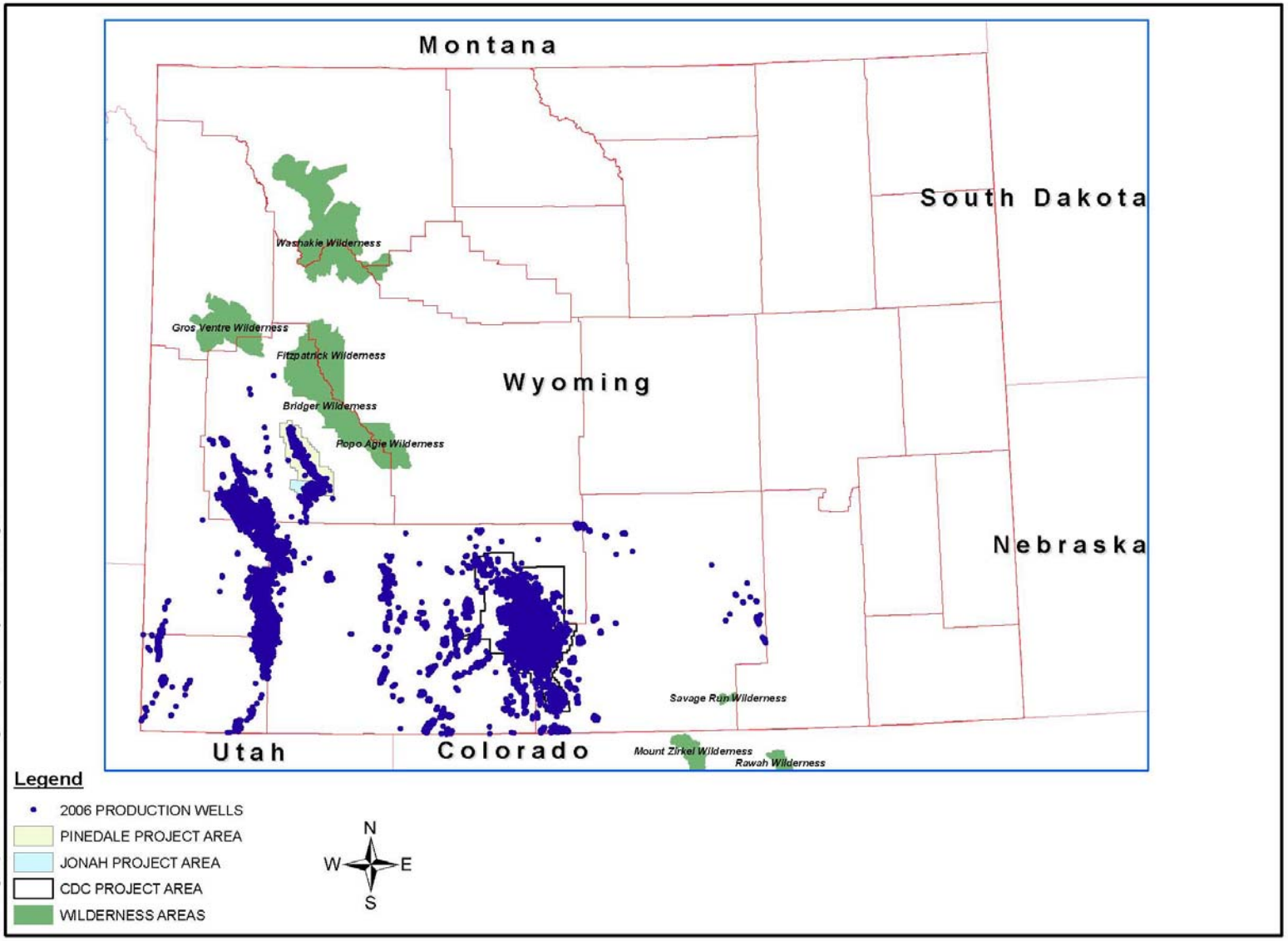
Continental Divide-Creston EIS

- Proposed natural gas project in southern Wyoming: 8,950 new wells
- First EIS to propose to use photochemical grid model to perform both ozone and AQ/AQRV impact analysis
- Comprehensive emission inventory for oil and gas production sources in southwest Wyoming using field-specific information supplied by the producers
- 2005 & 2006 36/12/4 MM5 meteorological modeling

2006 Drill Rig Locations: 5 County SWWY



2006 Producing Wells: 5 County SWWY



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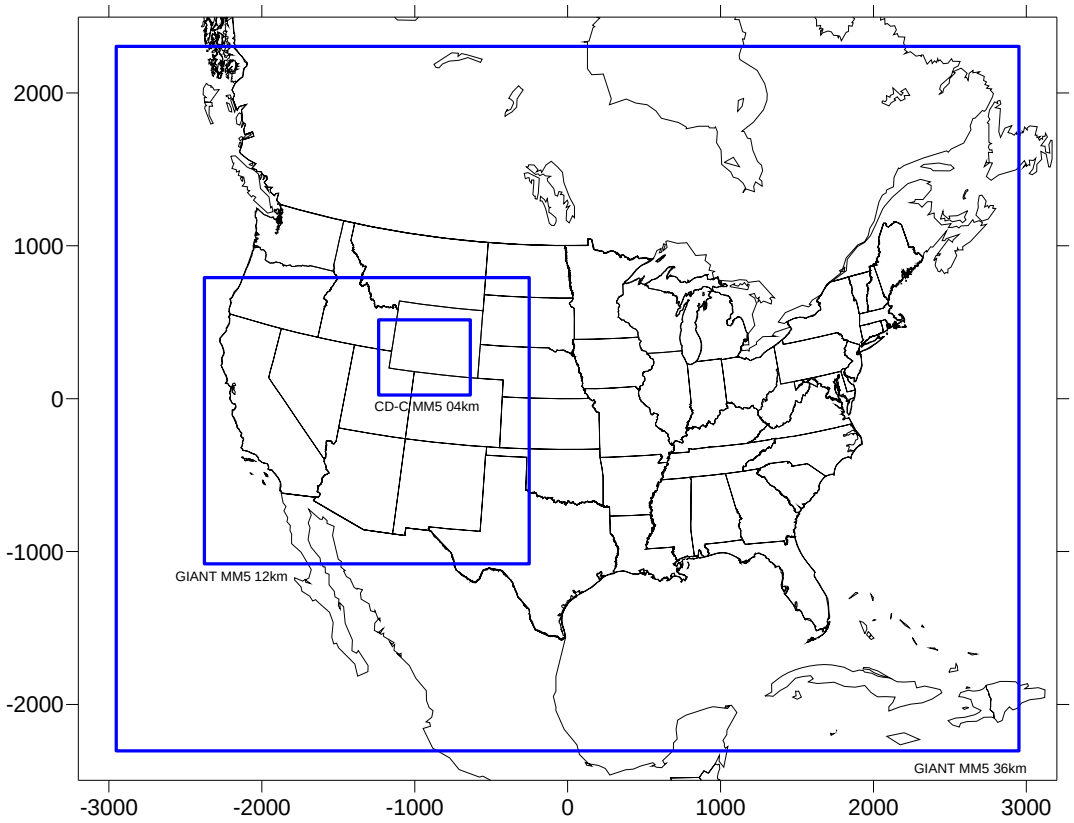
MM5 Modeling Domains



2005 and 2006 Calendar Years

- 3 nested grids
- 36 km grid is the RPO national grid
- 12 km domain large enough to encompass CD-C 4 km domain as well as those of other O&G Basins
- 4 km domain focused on SWWY

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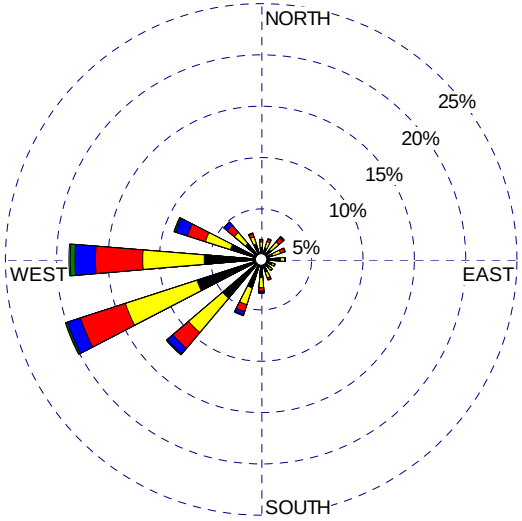
MM5 Evaluation

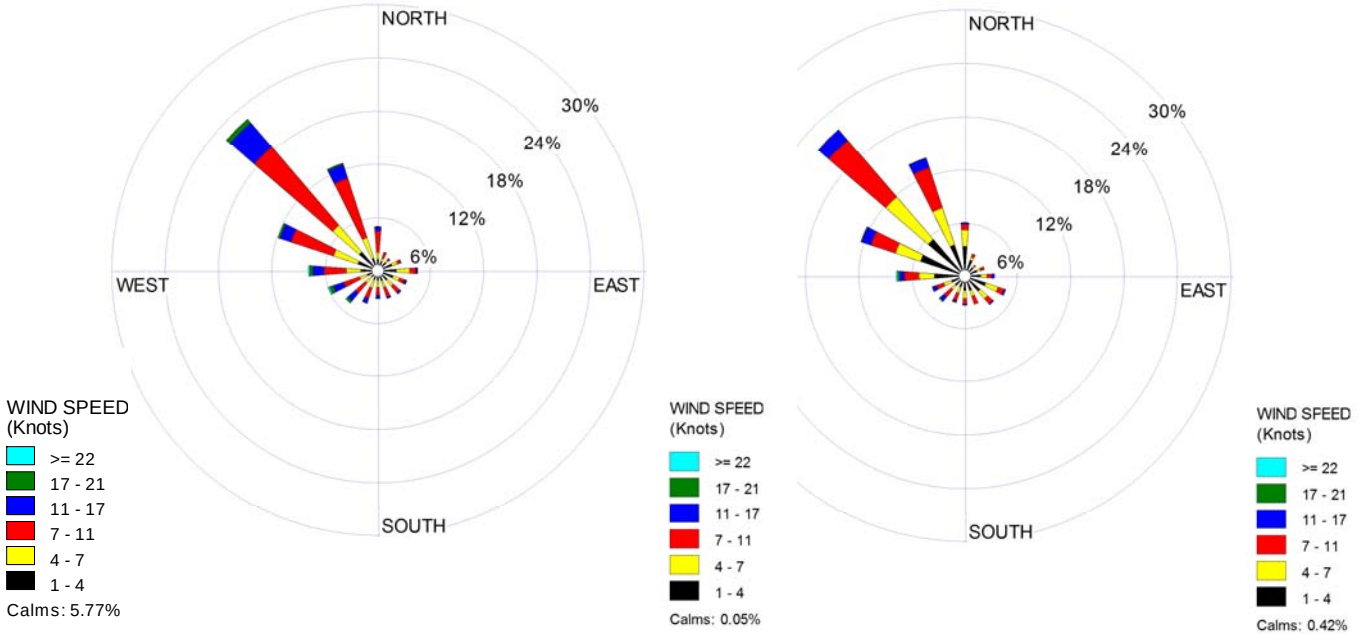
Compare annual wind roses from CALMET and 4 km MM5 simulations against observed values – example for Jonah follows

- Recent review of CALMET/CALPUFF modeling of SWWY noted that CALMET w/ 12 km MM5 and standard observations fails to “see” Wind River Range
- MM5 evaluation includes evaluation against surface and upper-air meteorological observations and precipitation analysis fields

Winds at Jonah: 4 km Grid

CALMET
4 km





Observed

MM5
4 km

- MM5 4km run shows good direction performance, but low wind speed bias for peak wind speeds
- Improvement over 4 km CALMET runs using 12 km MM5 data

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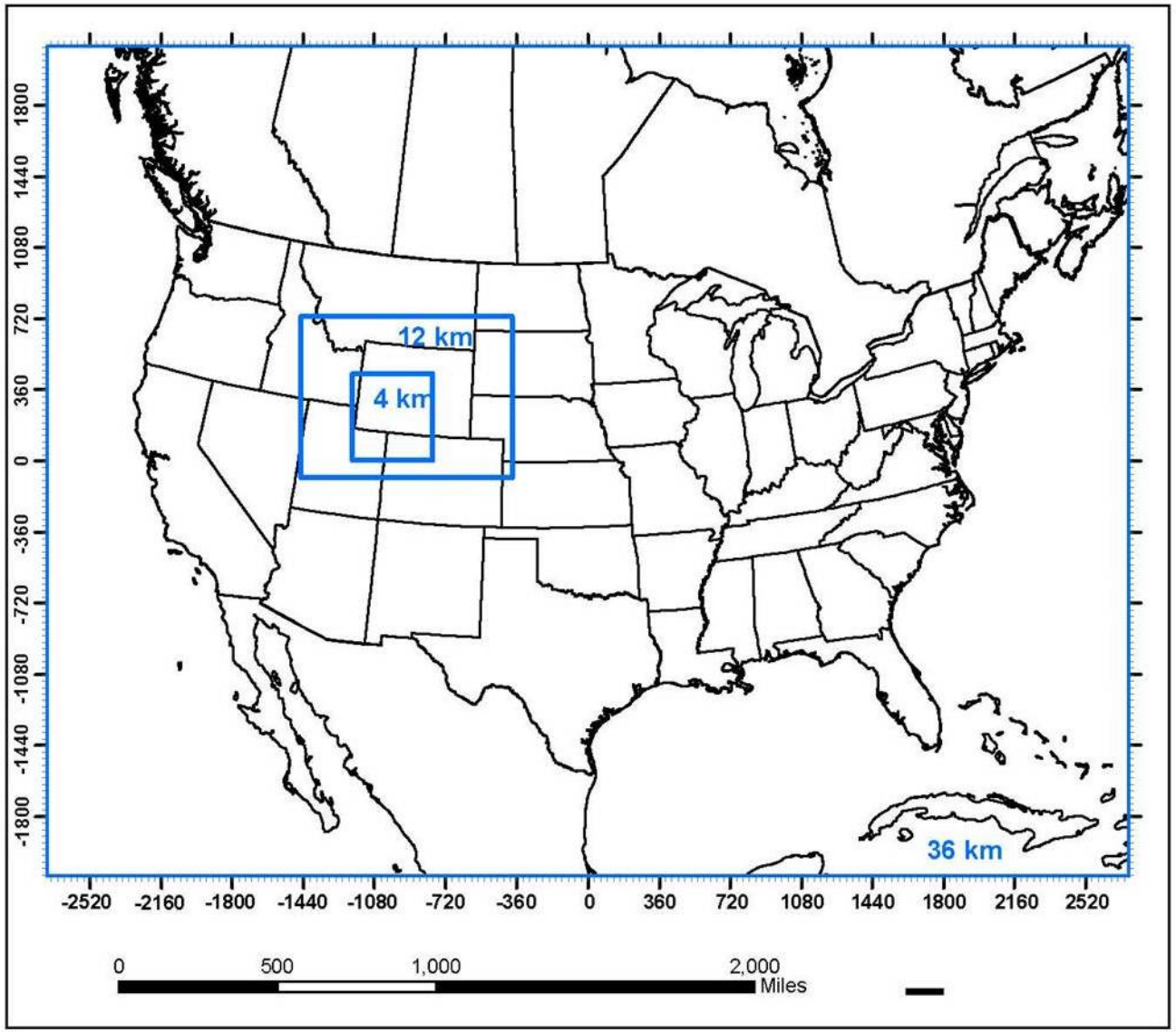
36/12/4 km CD-C PGM Domains



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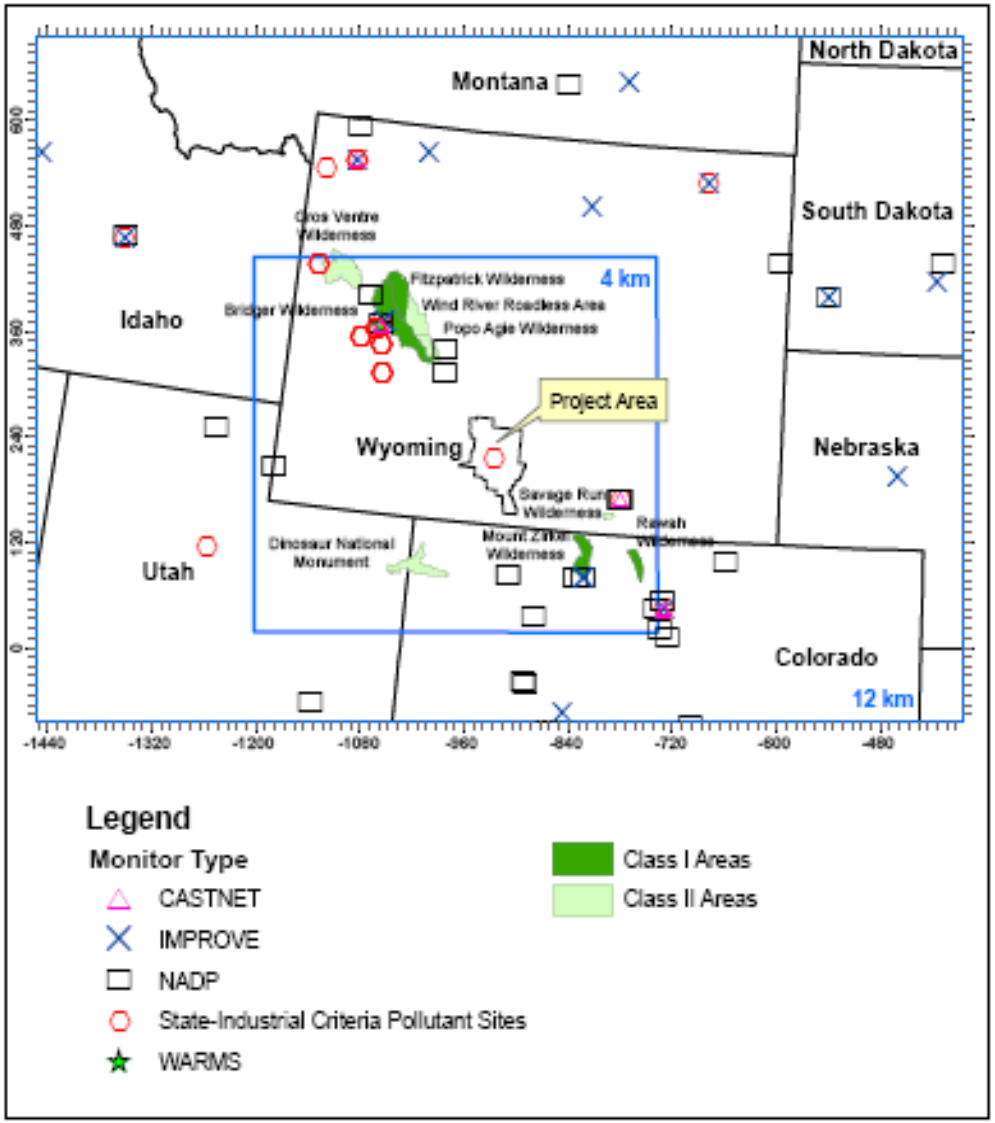
CD-C 12/4 km PGM Domain



- Impact assessment will focus on ozone everywhere and AQ/AQRV impacts at Class I and sensitive Class II areas
  - AERMOD still used for near-source impacts
- 12/4 km domains defined so that the inputs developed for the CD-C project can be used for other EISs
  - Moxa Arch
  - Hiawatha
  - Other?
- Consistency among EIS assessments
- Using best science available

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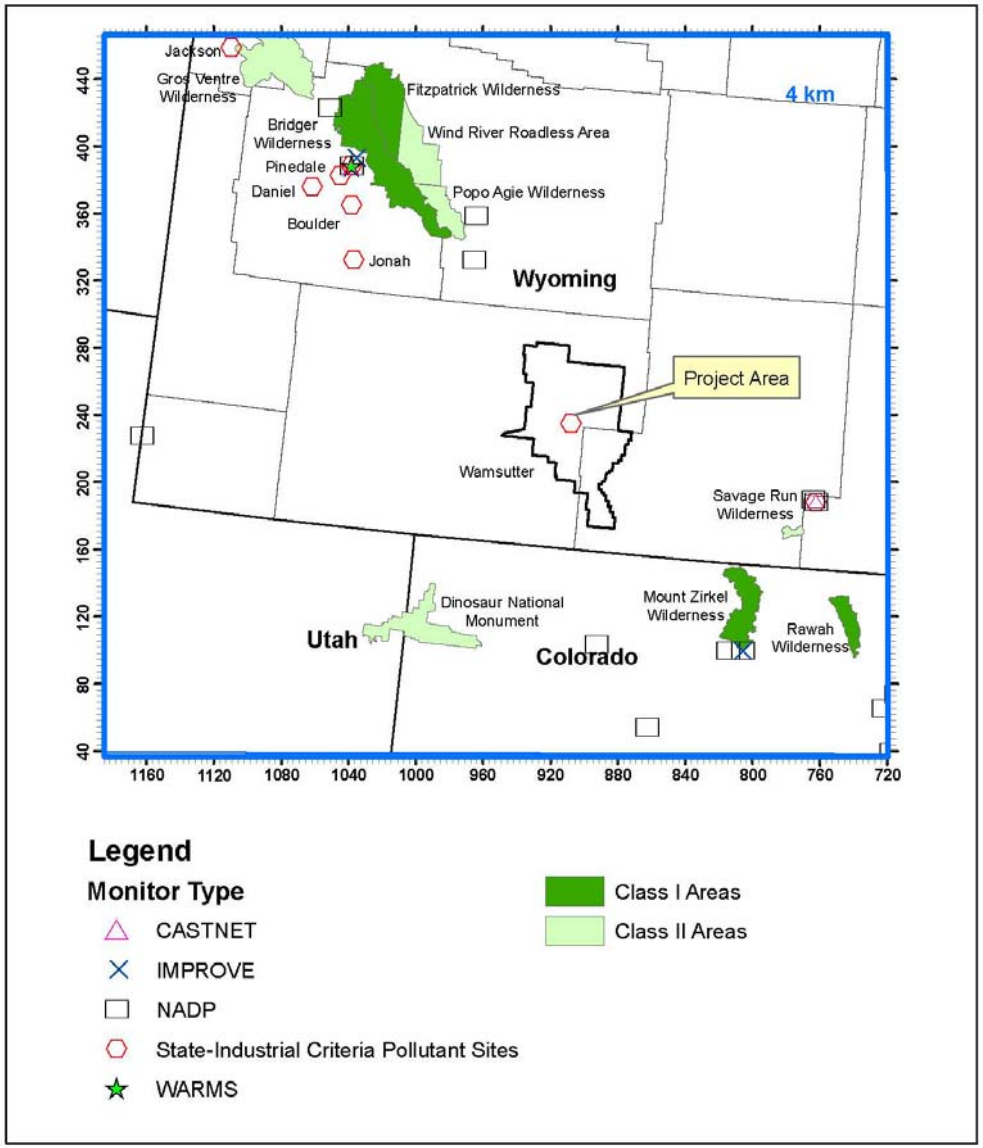
PGM Configuration

- MM5 36/12/4 km meteorology (2005 & 2006)
- CB05 gas-phase and RADM aqueous-phase chemical mechanisms and ISORROPIA aerosol thermodynamics
- Boundary conditions on 36 km grid from global chemistry model
- How to simulate winter high ozone events in SWWY?
  - Clear Skies
  - Snow on ground
  - Strong surface inversion
  - High VOC and NOx concentrations

SWWY EIS Modeling Challenges



- Monitoring network not as dense as is typical for urban areas
  - How to use EPA-guidance projection approach using relative modeling results?
  - How to perform model evaluation?
- How to obtain project-specific and cumulative impacts?
  - Use ozone and PM source apportionment to obtain incremental contributions
- How to address ozone given that current measurements violate new (75 ppb) ozone NAAQS?
  - Need Projects that reduce emissions (existing decline plus controls on new wells)
  - Ozone source apportionment to assess Project's contribution to ozone exceedances

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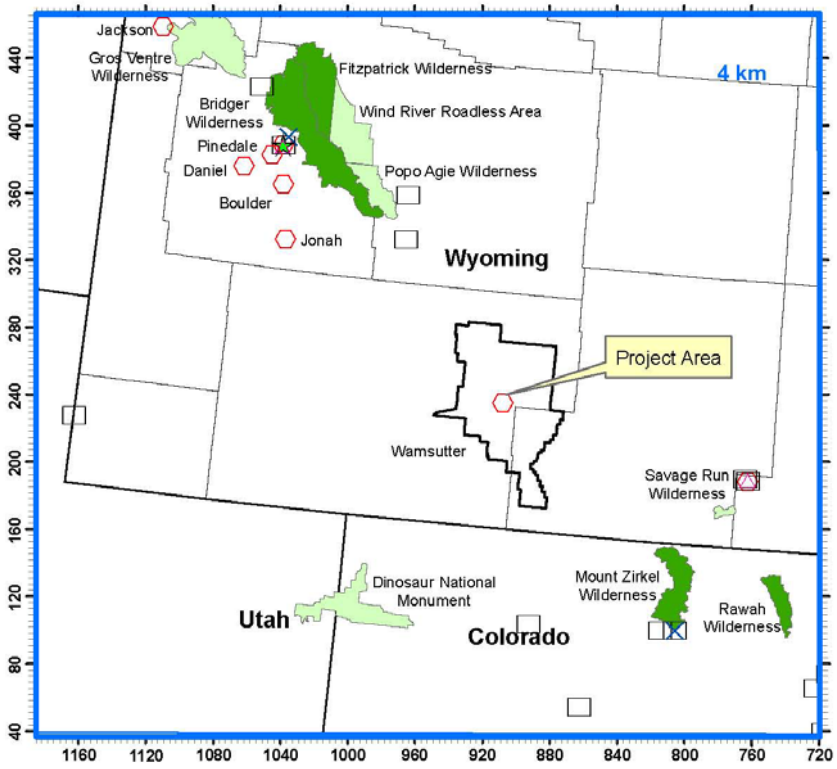
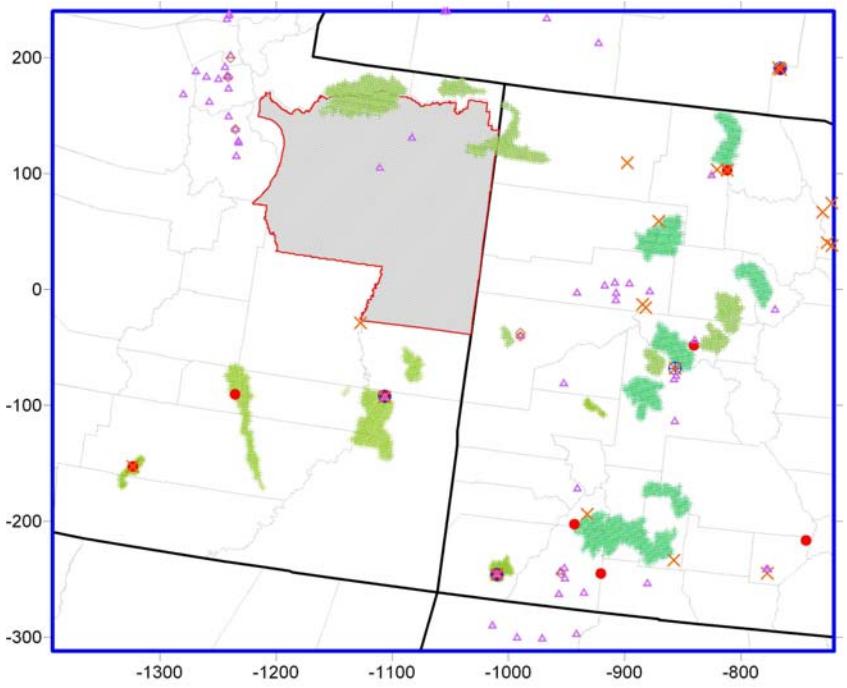
PGMs in NEPA-Related Studies

- Comprehensive Air-quality Model with extensions (CAMx; www.camx.com) for SWWY and Four Corners region



- Community Multiscale Air Quality (CMAQ) model for Uinta Basin Air Quality Study (www.cmasceneter.org)



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Conclusions

- Recent advances allows for the more routine use of PGMs for NEPA EIS/EA air quality assessments
  - Represents best science
  - Advances in PGM modeling features
    - Two-way grid nesting
    - Flexi-nesting
    - Plume-in-Grid
    - Ozone and PM source apportionment
  - Advances in database availability and expertise
    - RPO databases (e.g., WRAP)
  - Advances in computing
    - Doubling computing speed every 18 months
  - Advances in PGM software
    - MM5/WRF meteorological; SMOKE/CONCEPT emissions; post-processing tools
- Current NEPA-related studies demonstrate utility of PGMs
  - BLM Moxa Arch and Hiawatha EISs in SWWY
  - Uinta Basin Air Quality Study (UBAQS) Utah
  - Four Corners Air Quality Task Force NM/CO
  - BLM/WDEQ Continental Divide Creston EIS SWWY

Acknowledgements

- We acknowledge the assistance of numerous groups to make the use of PGMs routine for EISs/EAs
  - Bureau of Land Management (BLM)
  - U.S. Environmental Protection Agency (EPA)
  - Wyoming Department of Environmental Quality (WDEQ)
  - Colorado Department of Health and Environment (CDPHE)
  - New Mexico Environmental Department (NMED)
  - BP and other Operators
  - Sage Environmental Consulting
  - SWCA Environmental Consultants