

Wyoming Department of Environmental Quality
(WYDEQ)
Visibility & Air Quality Monitoring Network

Durango, Colorado
September 6, 2007

John V. Molenaar
Air Resource Specialists, Inc.

http://www.wyvisnet.com/

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Wyoming Visibility Monitoring Network



Live Sites

Boulder
Carnegie County
Cloud Peak
Daniel South
Jordan
Murphy Ridge
North Pass
Thunder Basin
Wamsutter
All Sites

Image Gallery

Bridger Wilderness
Cloud Peak Wilderness
Teton Wilderness
Yellowstone National Park

Boulder
Carnegie County
Cloud Peak
Daniel South
Green River Basin
Jordan
Thunder Basin

Welcome to the Wyoming Visibility Monitoring Network

The Wyoming Department of Environmental Quality - Air Quality Division (AQD) brings you live air quality data and images from our Visibility Monitoring Network.

WYVISNET.com also provides tools to better understand air quality and visibility in Wyoming. Image galleries from state and federal sites show examples of good and poor visibility and unique events. The Air Quality info page provides more detailed information about various air quality topics. Links guide you to other web cams, air quality sites and agencies around the state.

The Air Quality Division is involved in many programs to protect and improve visibility in Wyoming and Class I areas. Please visit the Air Quality info page to find out more about the Wyoming Visibility Monitoring Network, including the Green River Basin Visibility Study, Northeast Wyoming Visibility Study, and the IMPROVE Visibility Monitoring Program.



Access live or gallery images data by selecting a site of interest from the map or the list in the left-hand frame.

WYDEQ Monitoring Sites



Jonah Basin Aerial Shot

Proposed Jonah Infill Drilling Project:

Up to 3100 new gas wells would be drilled and developed, with associated ancillary facilities, on up to 16,200 acres of new surface disturbance.

Well spacing is expected to range from the current 16 wells per 640-acre section (40-acre spacing) to 128 wells per section (5-acre well spacing).



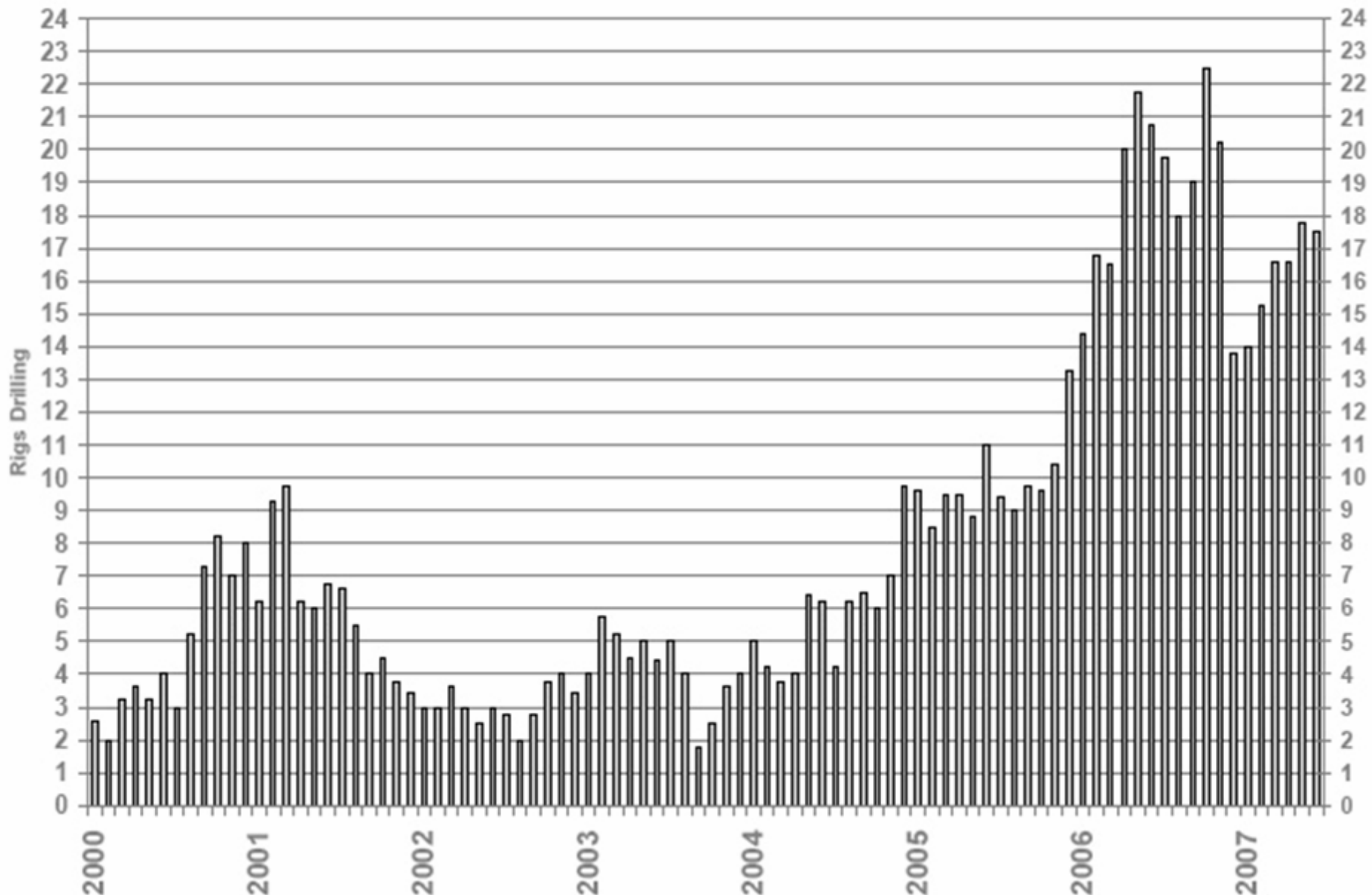
Wind River Mts. & Drill Rig



Rigs Drilling in the Jonah Field by Month 1/1/00 - 7/1/07

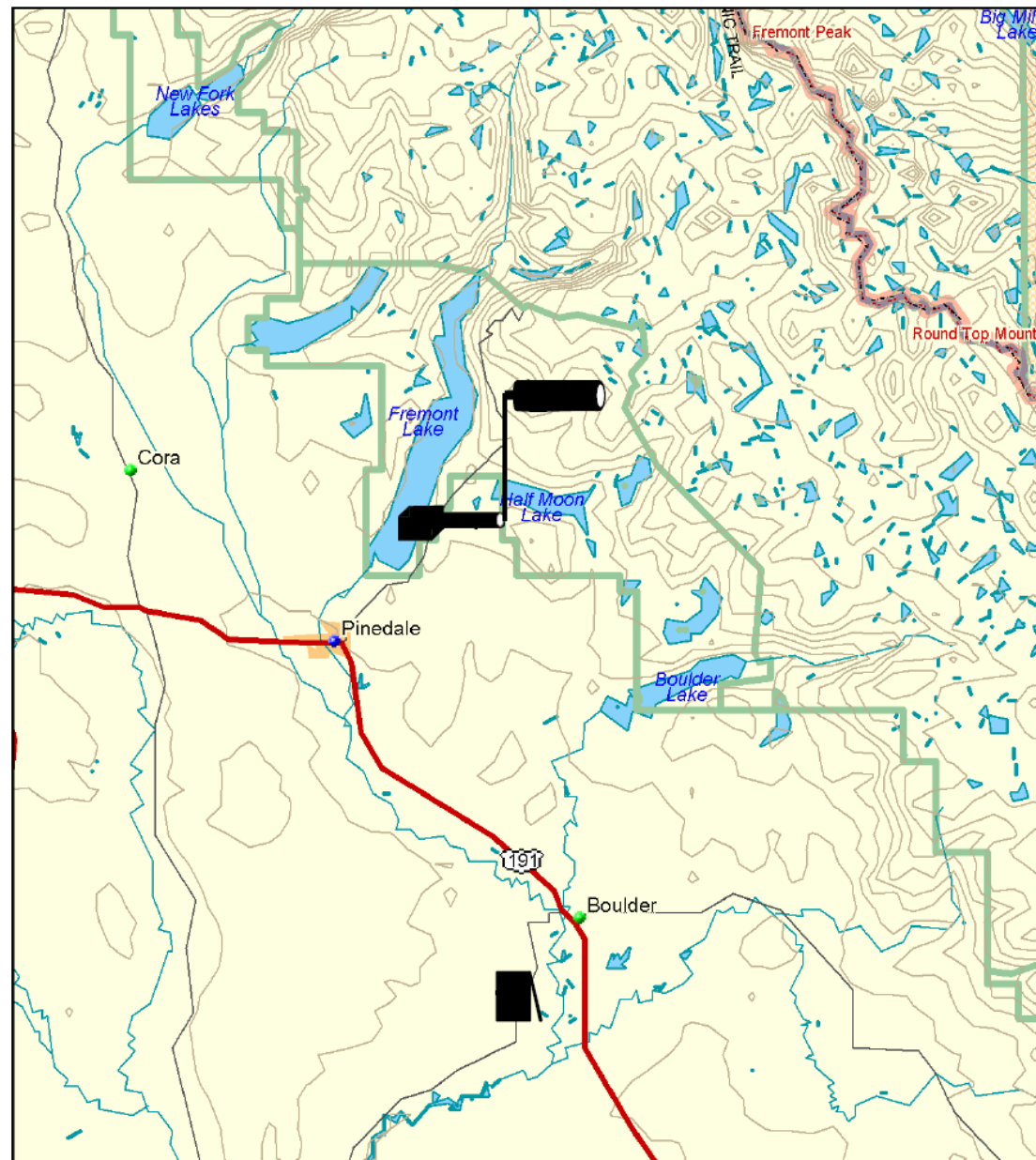
Source: Divestco Inc.

Compiled By: Jeffrey Jacquet | www.sublette-se.org



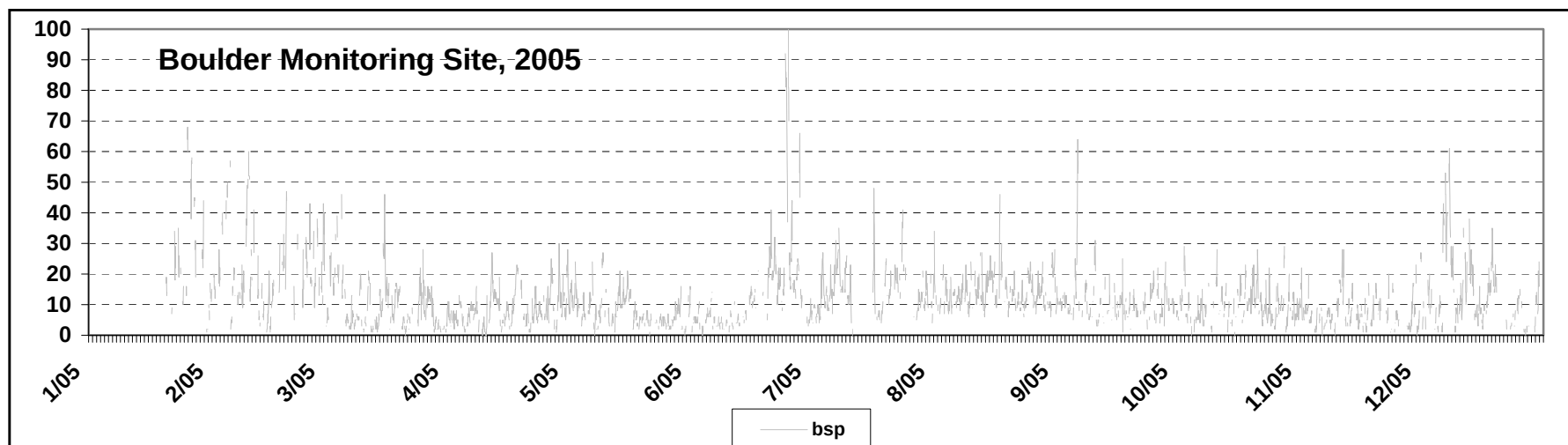
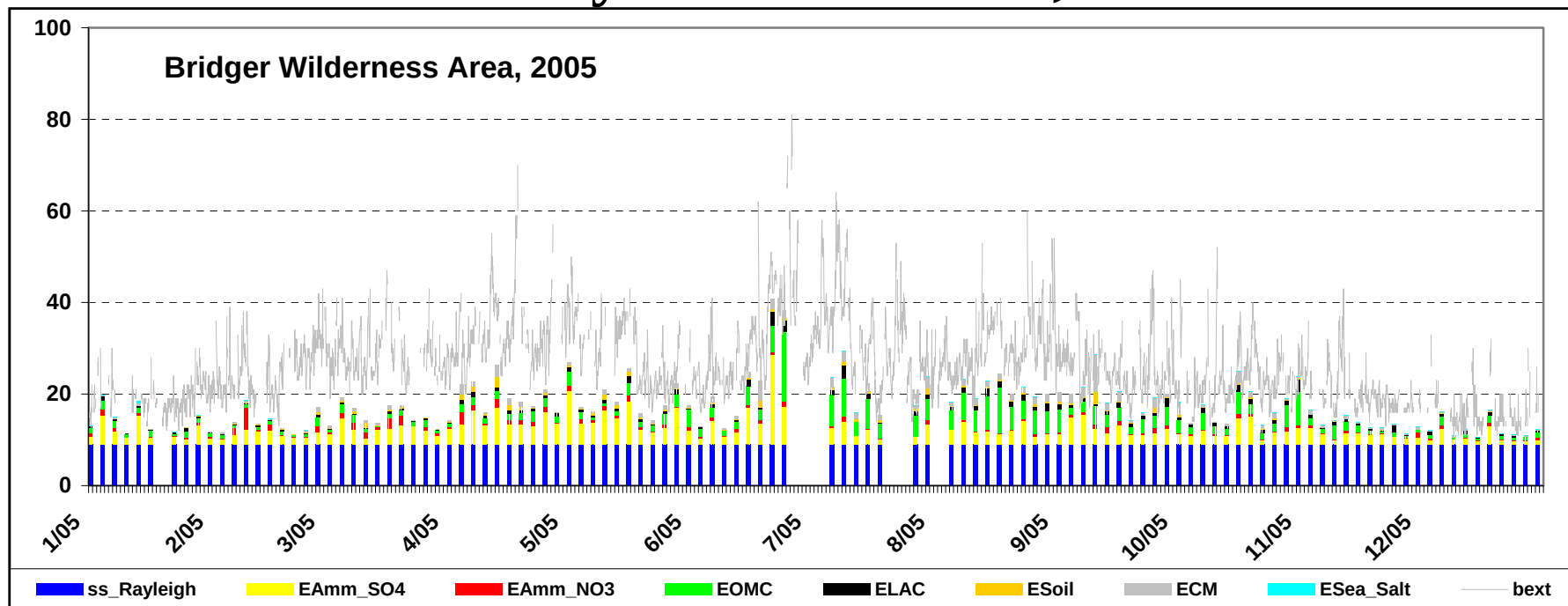
Western WY Visibility Measurements:

- **Bridger Transmissometer (continuous)**
- **Bridger IMPROVE Monitor (every third day)**
- **Boulder Nephelometer (continuous)**

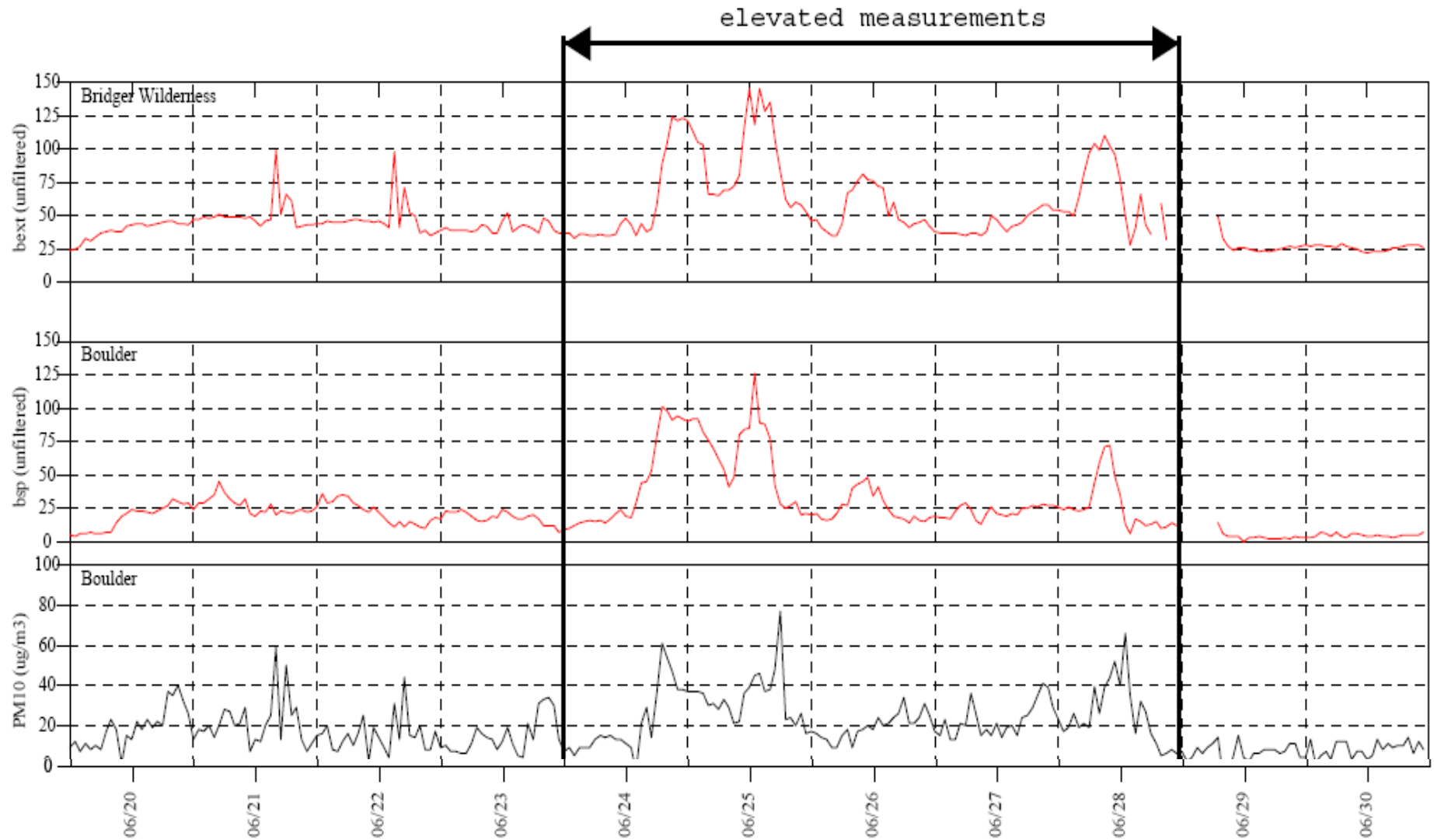


■ = Nephelometer
┌─┐ = Transmissometer Receiver
└─┘ = Transmissometer Transmitter

Visibility Measurements, 2005



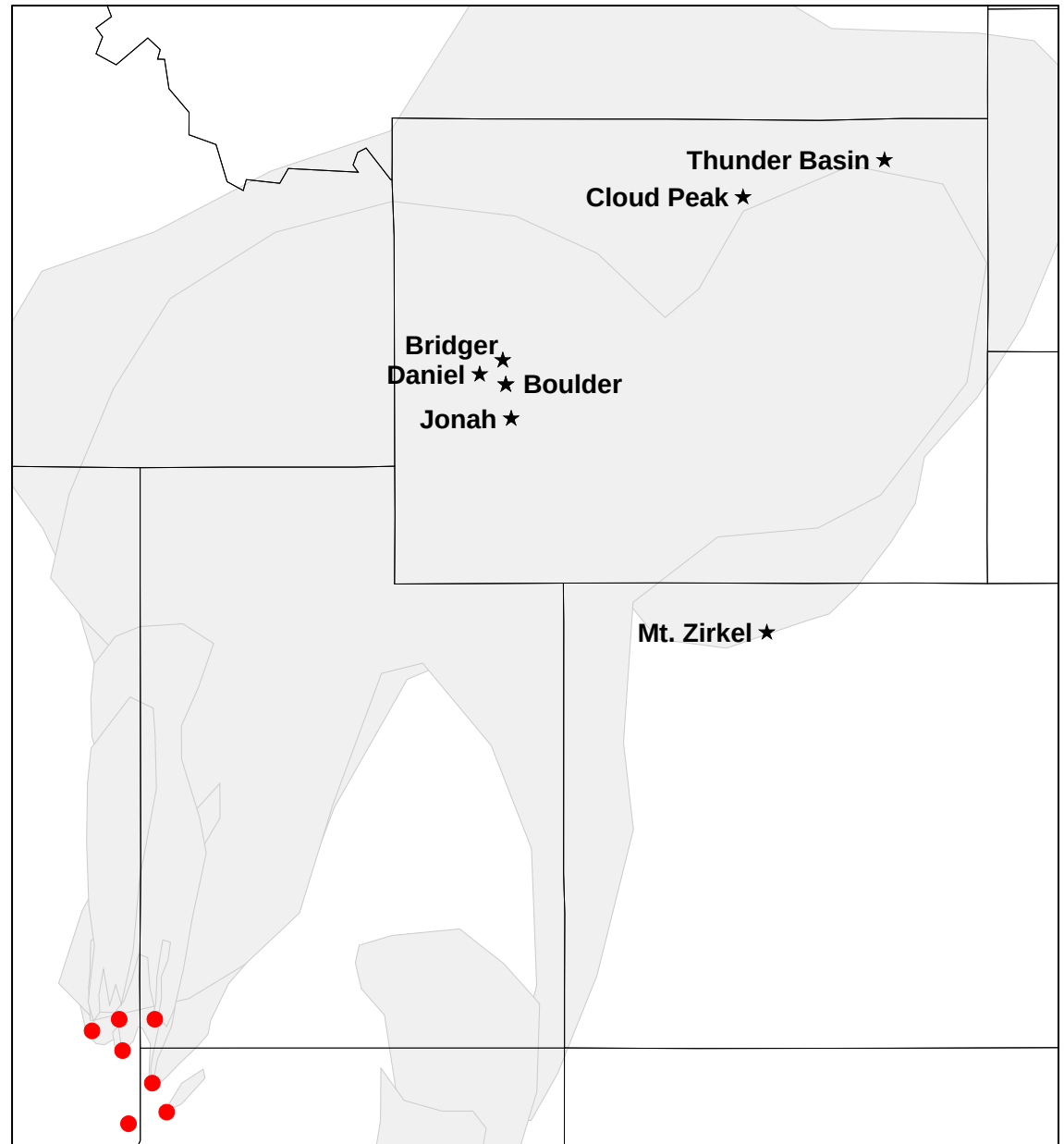
Visibility Measurements, 2005



HMS Analyzed Smoke on June 25, 2005

- Red dots indicate HMS detected hotspots

- Grey masses indicate analyzed smoke.

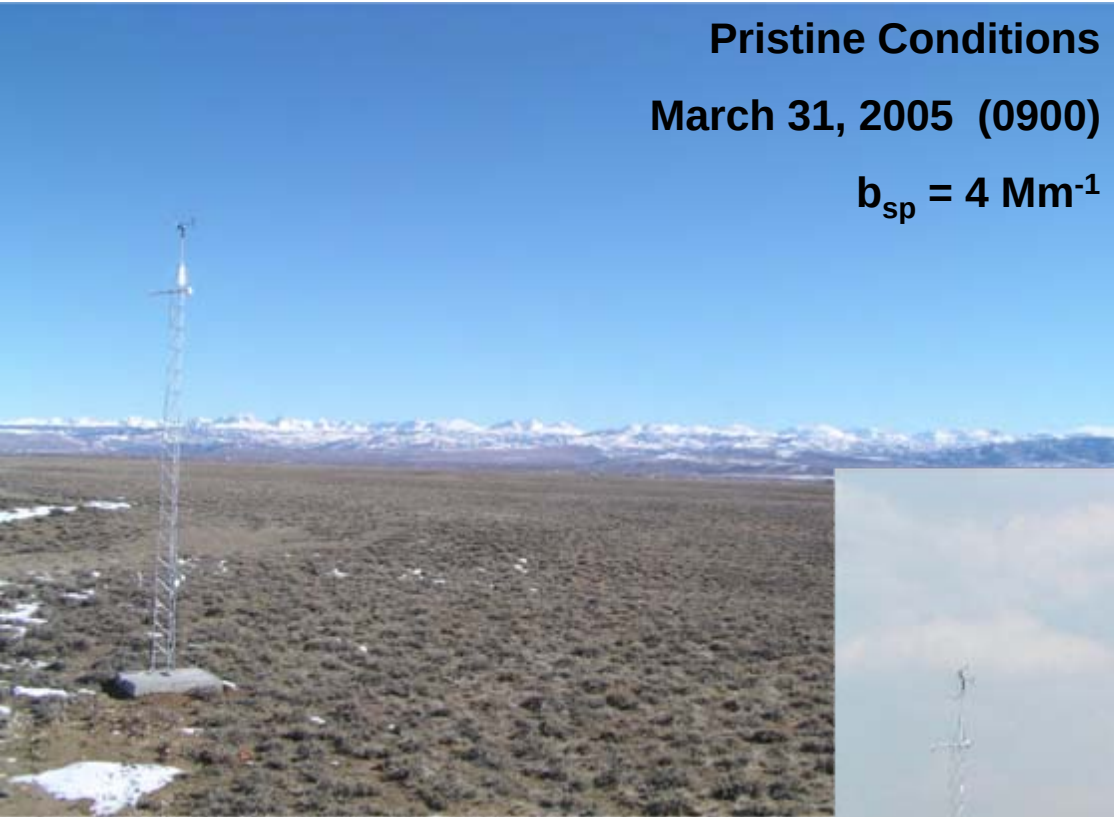


Boulder Monitoring Site

Pristine Conditions

March 31, 2005 (0900)

$$b_{sp} = 4 \text{ Mm}^{-1}$$



Hazy Conditions

June 25, 2005 (1300)

$$b_{sp} = 125 \text{ Mm}^{-1}$$



Boulder Monitoring Site
September 20, 2005 (1630)



Camera Images, Summer 2006

Jonah

July 25, 2006 (0900)

Smoke visible between 0900 and 1000



Ammonia Monitoring at Boulder Site

Funded by Shell Oil and Gas

Why is Shell interested in Ammonia?

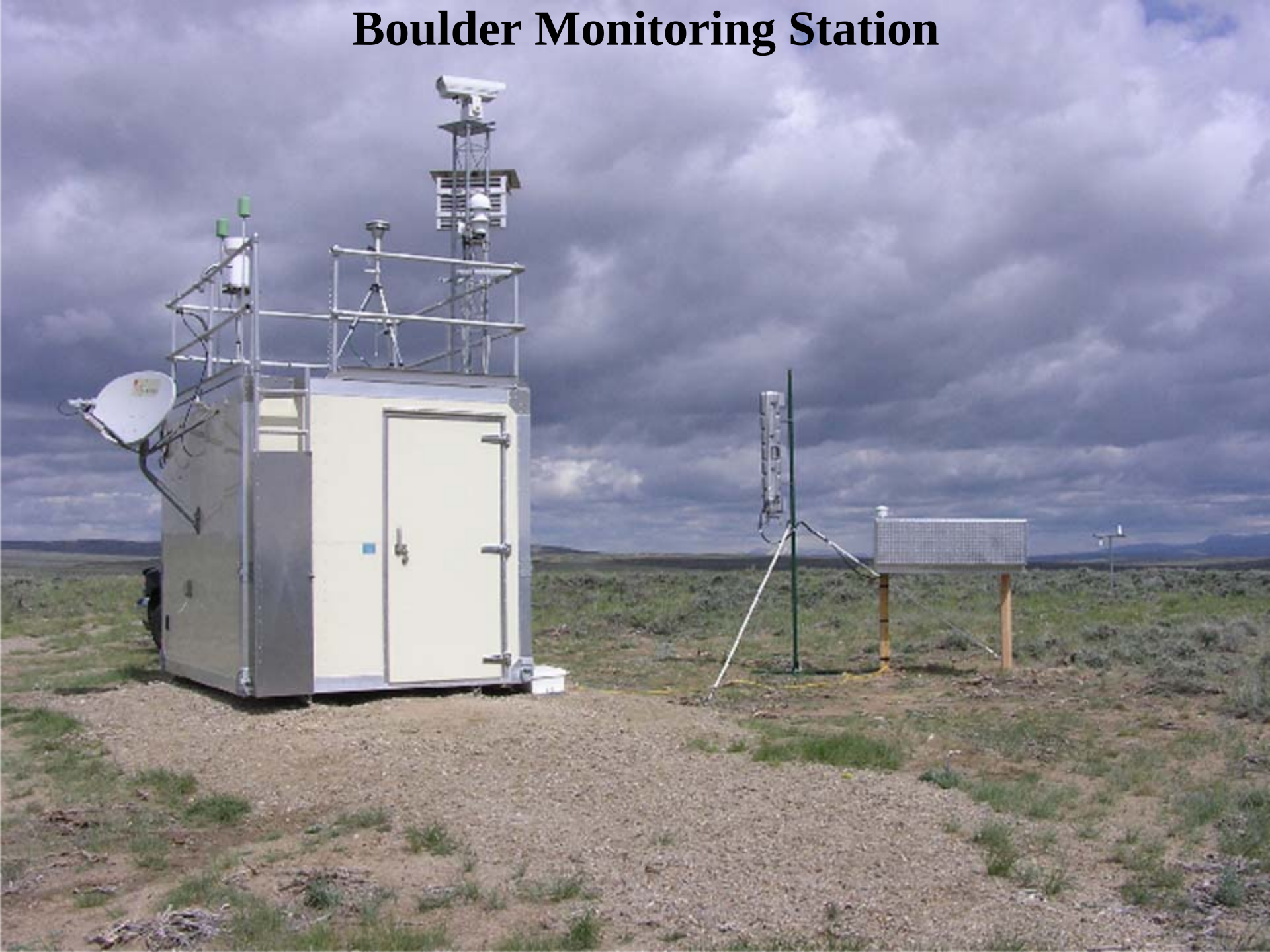
- Initial CalPuff modeling of NO_x emissions from Shell drilling rigs indicated visibility impacts in Bridger Wilderness from Nitrates
- Default background value in CalPuff is 1.0 ppb
- Shell wants to use actual NH_3 concentrations in future CalPuff modeling
- Pilot study 12/2006 – 3/2007
- Funded full year of monitoring April, 2007 – March, 2008

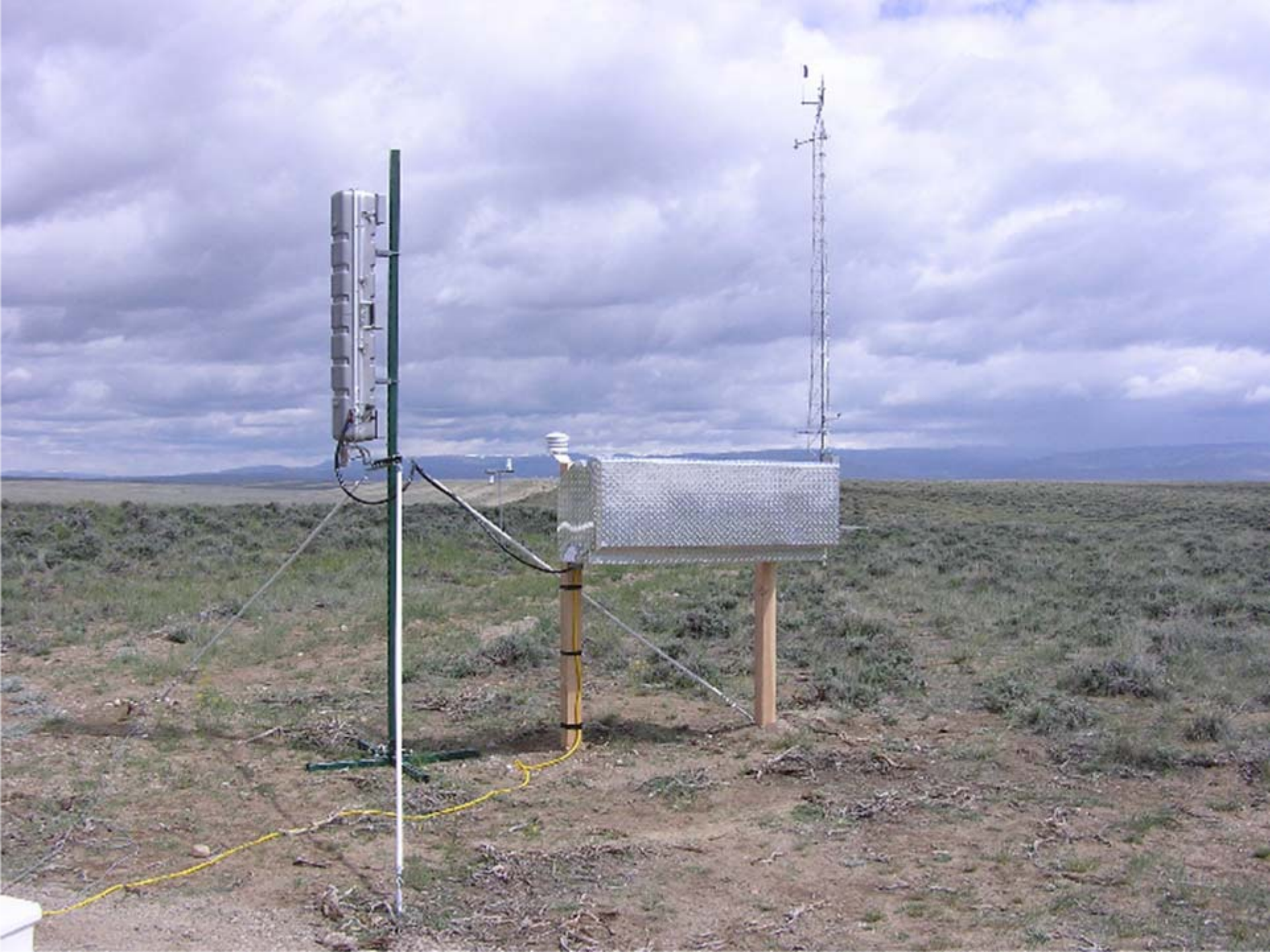
A dual channel URG denuder/filter-pack sampler is used to collect twice weekly samples (3 day & 4 day) of ambient trace gas (NH_3 and HNO_3) and $\text{PM}_{2.5}$ aerosol species (NH_4^+ , NO_3^- , SO_4^{2-}) concentrations.

Sampler installation was coordinated by Air Resource Specialists (ARS) and Colorado State University (CSU). Sample train preparation, extraction, and analysis is performed by CSU. Sampler operation is performed by a local site operator, with supervision from CSU and ARS.

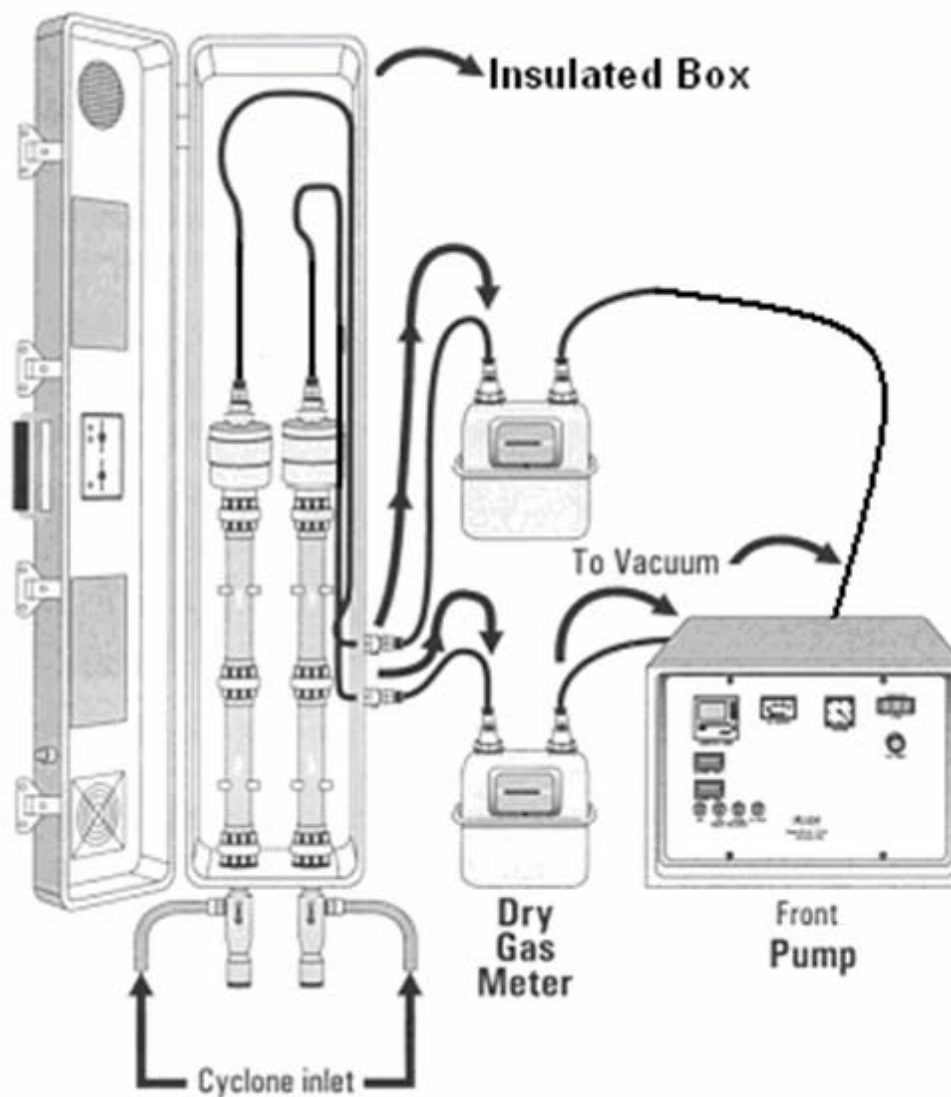
Sampling began 12/15/2006 and will continue until March 31, 2008

Boulder Monitoring Station

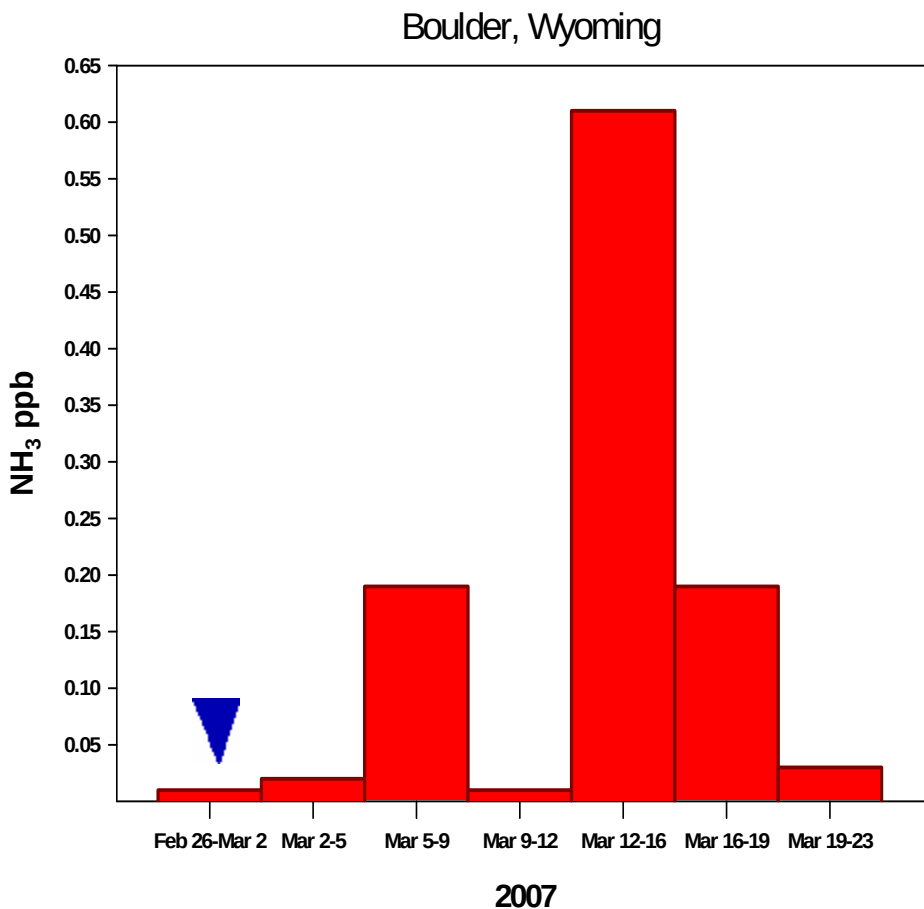




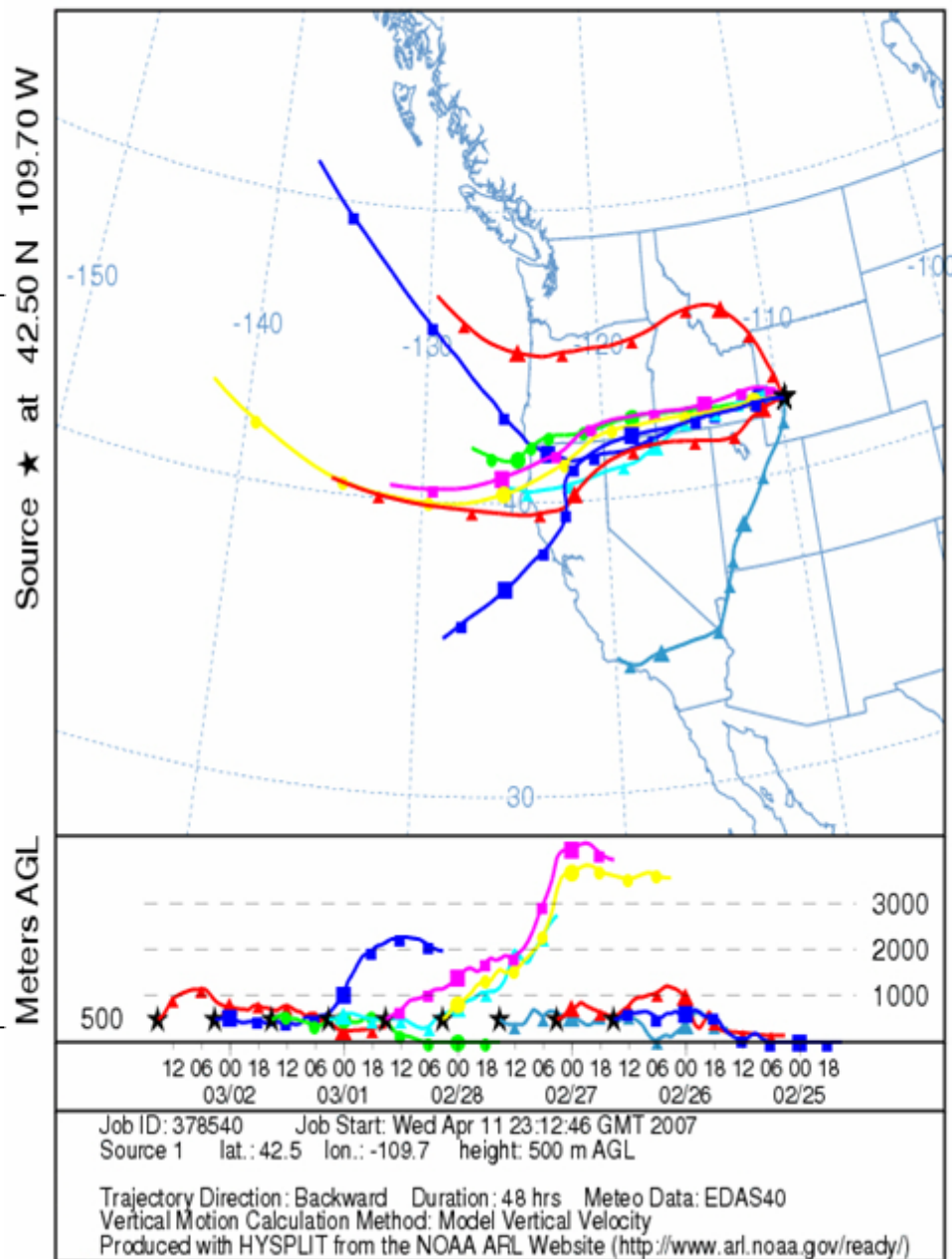
Schematic of a dual channel URG annular denuder/filter pack system



Feb 26- Mar 5, 2007

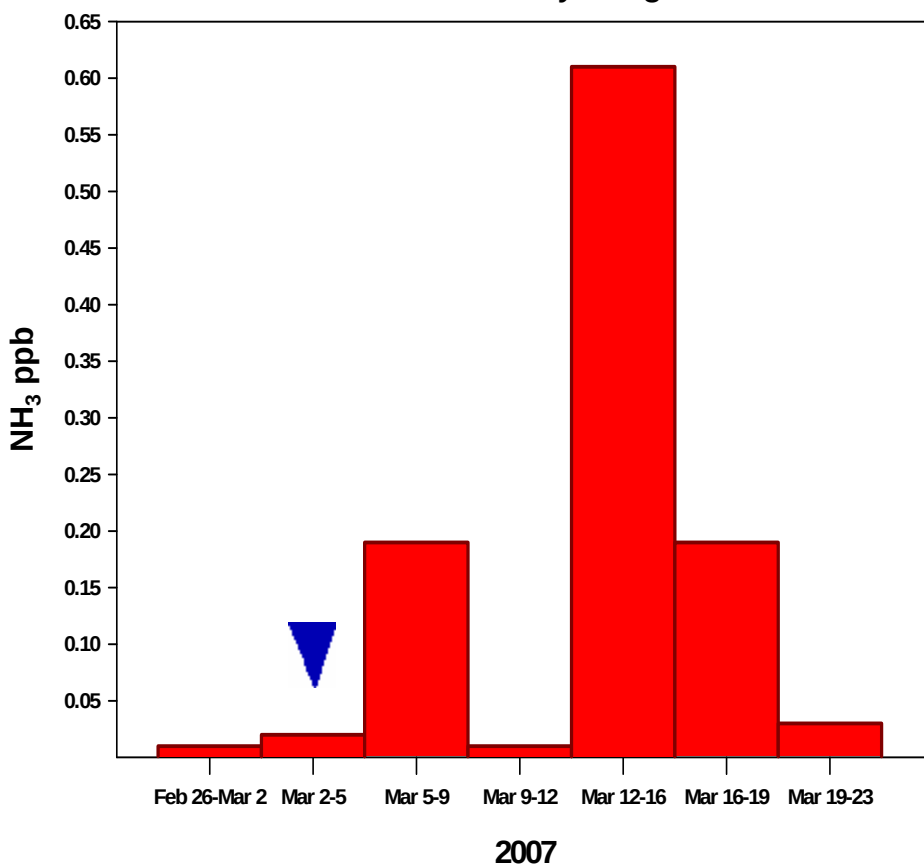


NOAA HYSPLIT MODEL
Backward trajectories ending at 15 UTC 02 Mar 07
EDAS Meteorological Data

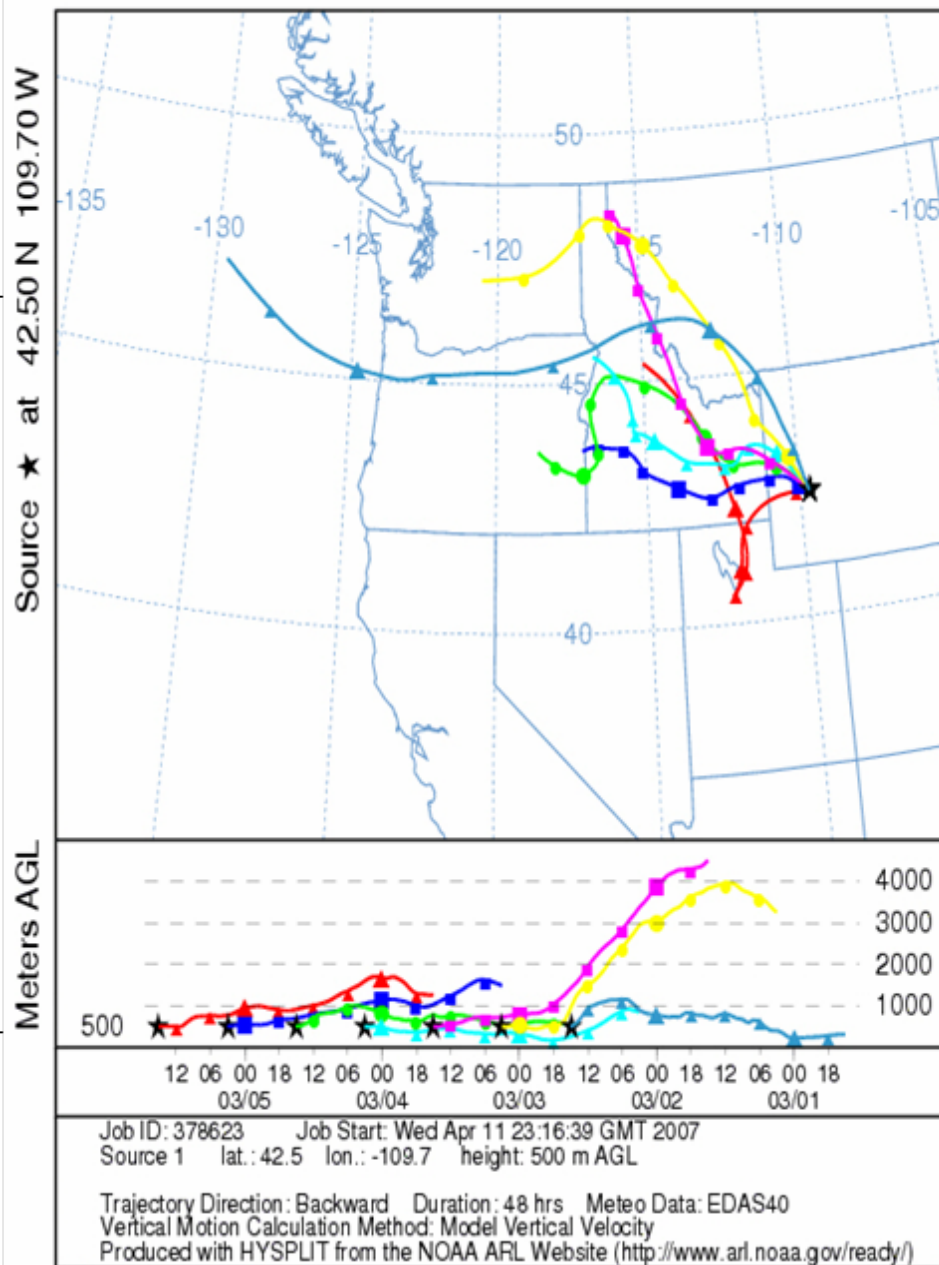


March 2-5, 2007

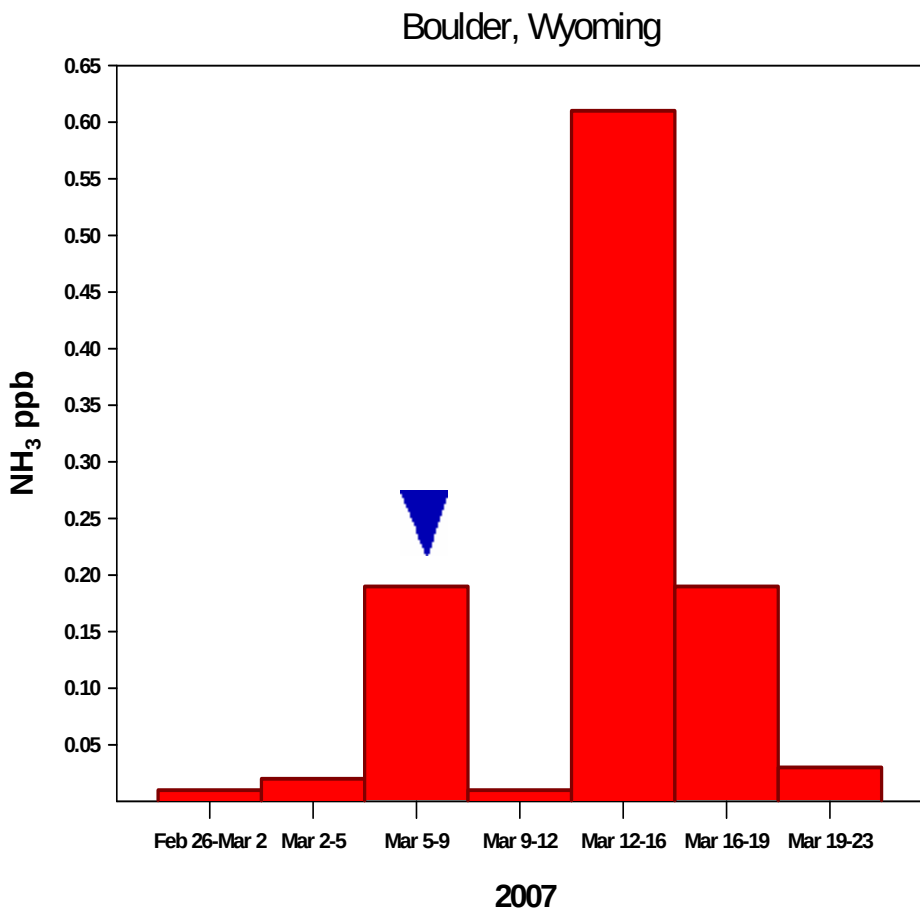
Boulder, Wyoming



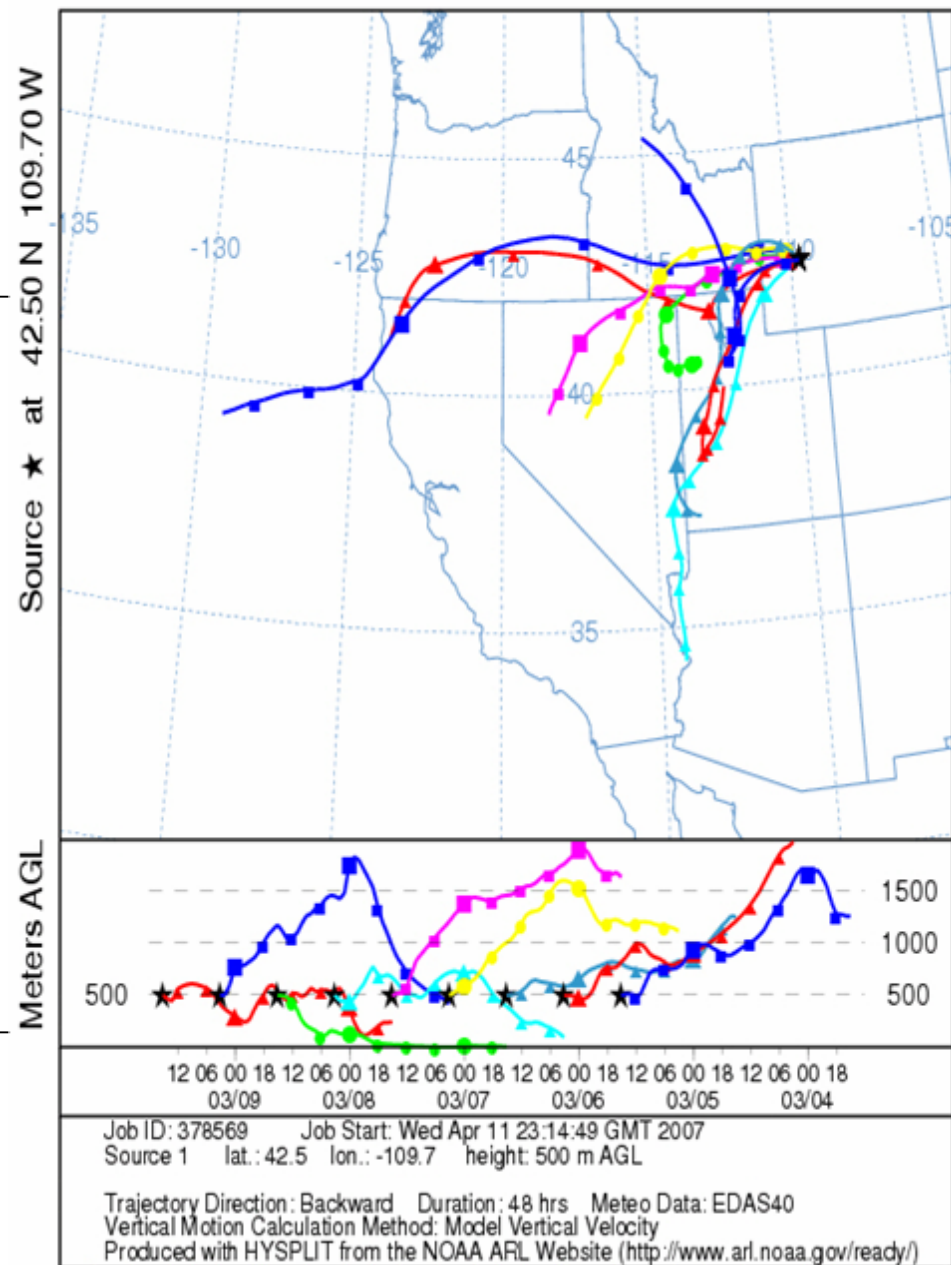
NOAA HYSPLIT MODEL
Backward trajectories ending at 15 UTC 05 Mar 07
EDAS Meteorological Data



March 5-9, 2007

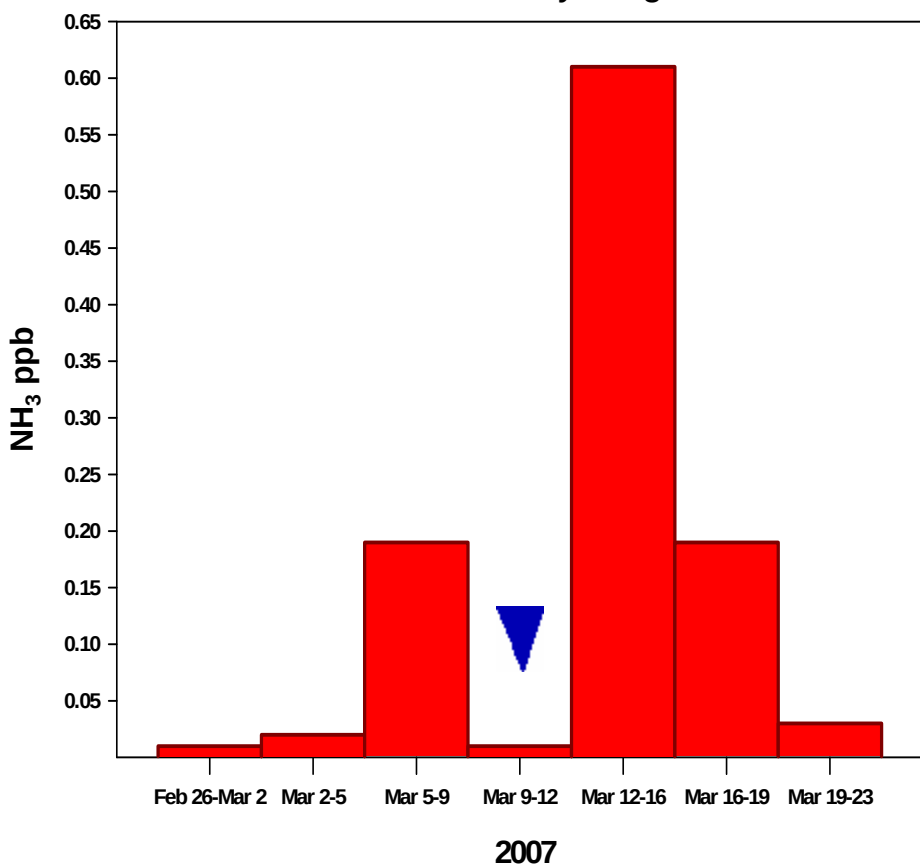


NOAA HYSPLIT MODEL
Backward trajectories ending at 15 UTC 09 Mar 07
EDAS Meteorological Data

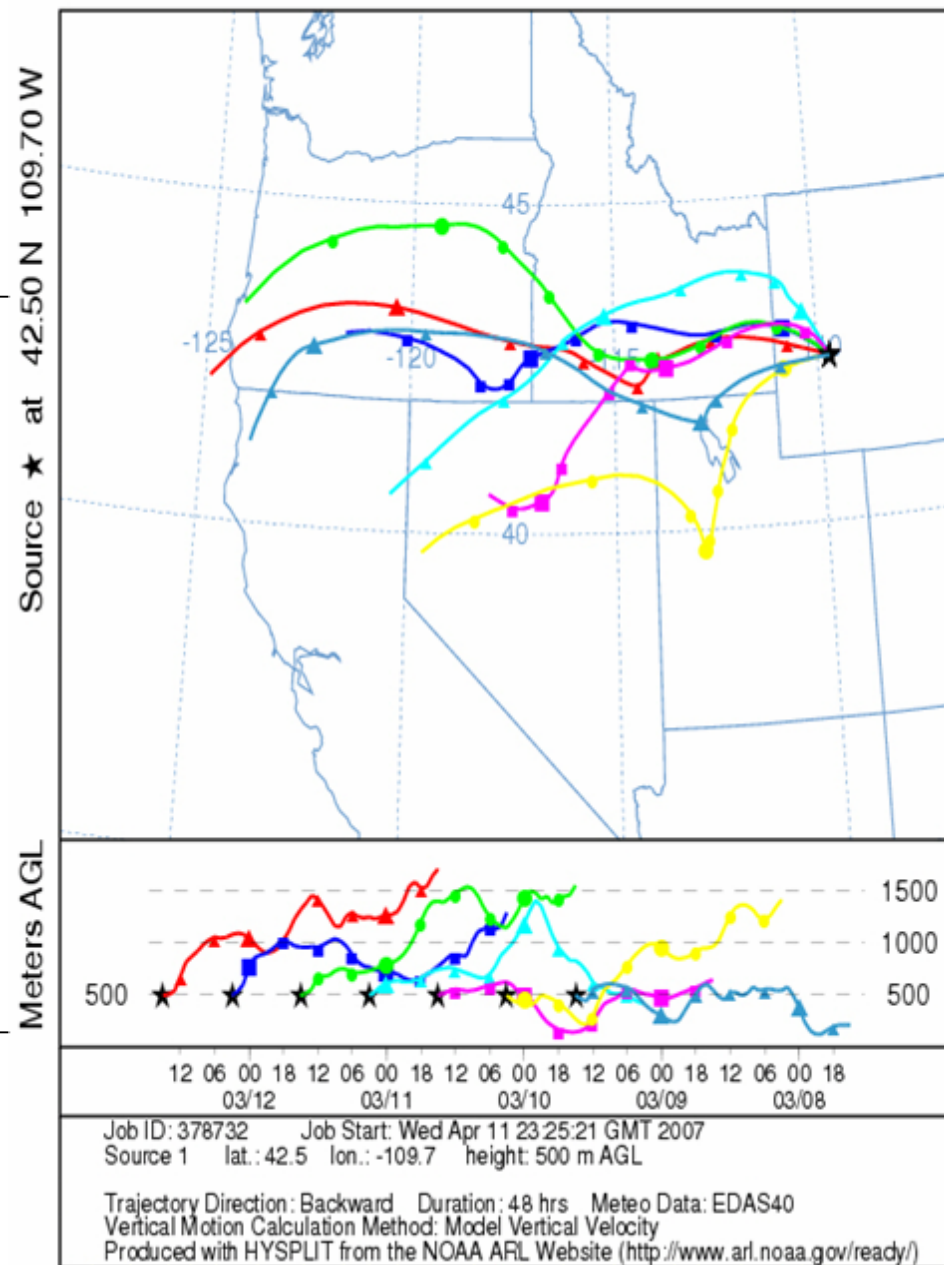


March 9-12, 2007

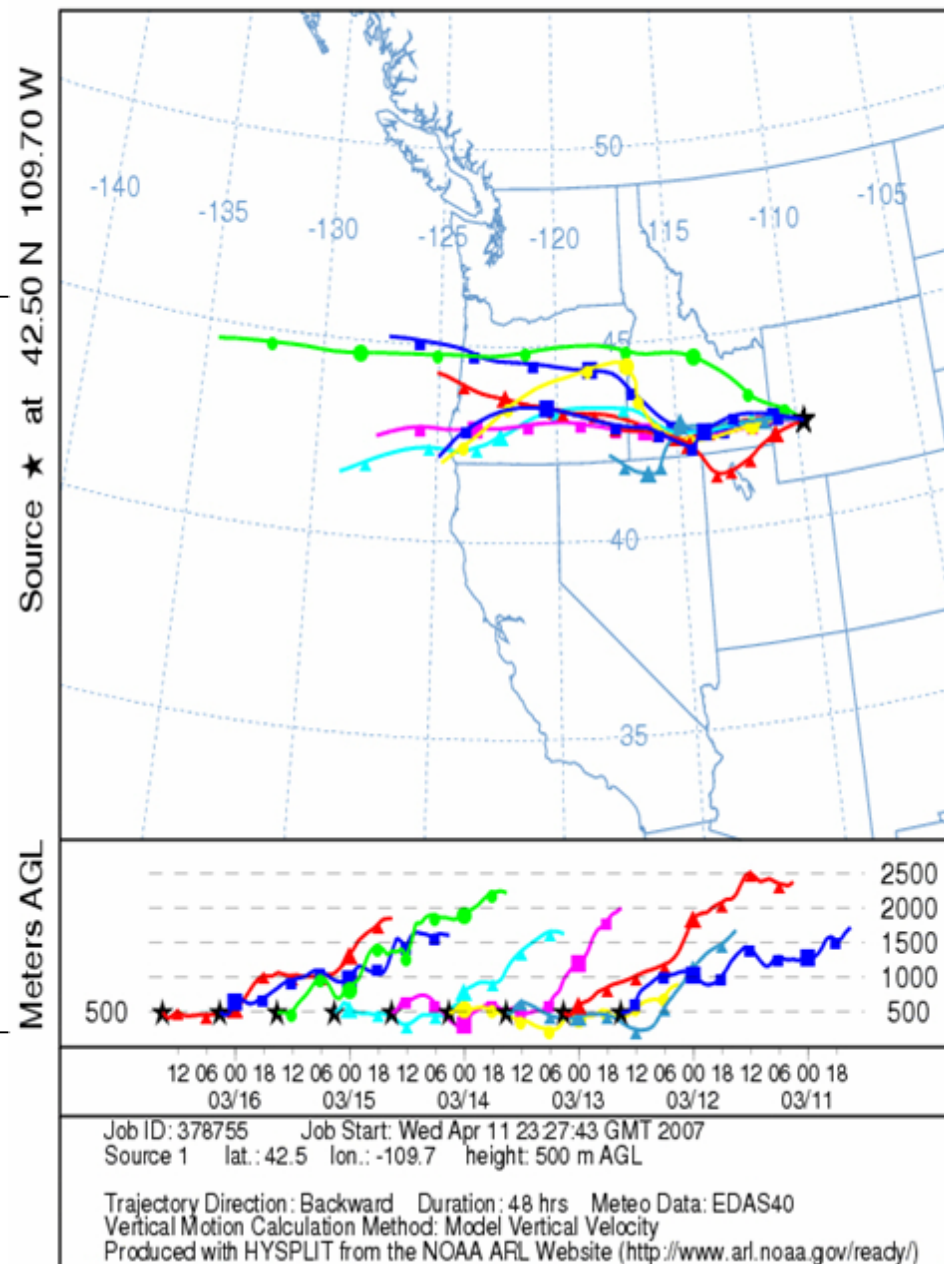
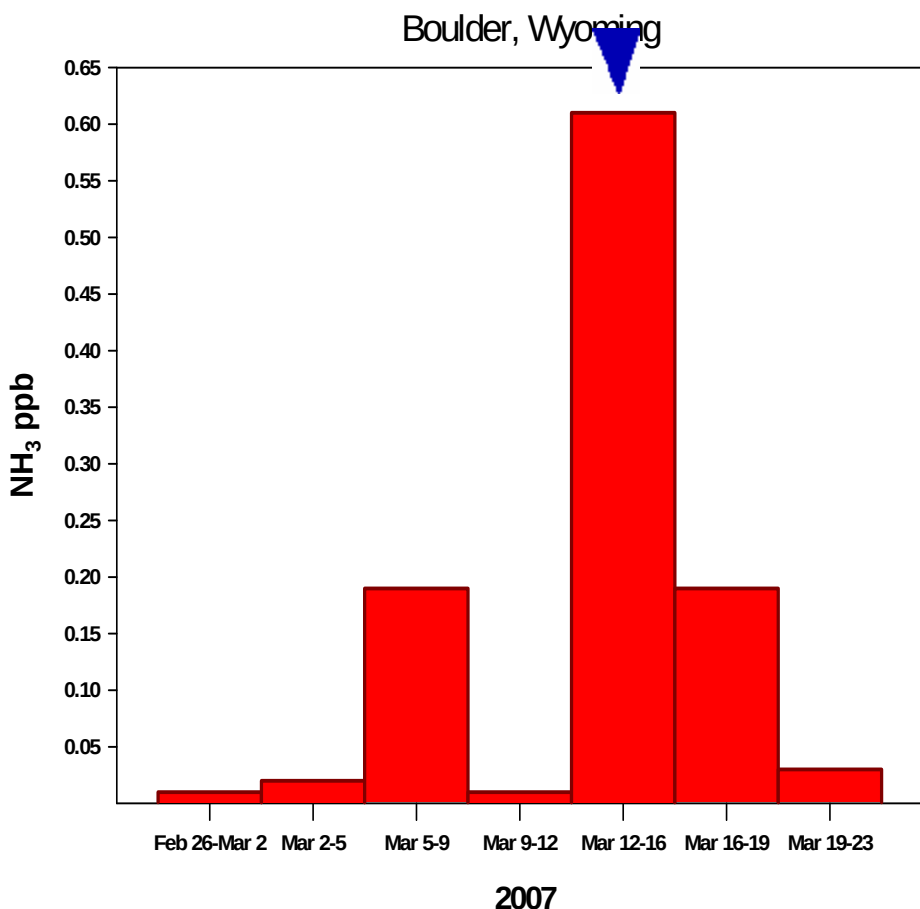
Boulder, Wyoming



NOAA HYSPLIT MODEL
Backward trajectories ending at 15 UTC 12 Mar 07
EDAS Meteorological Data

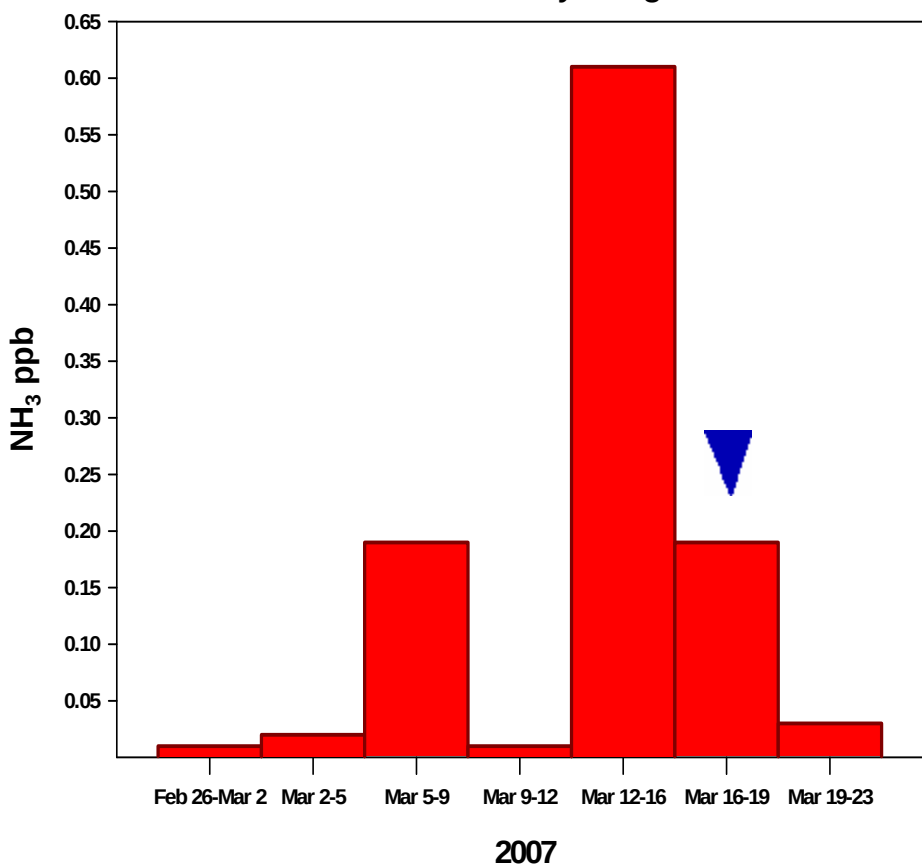


March 12-16, 2007

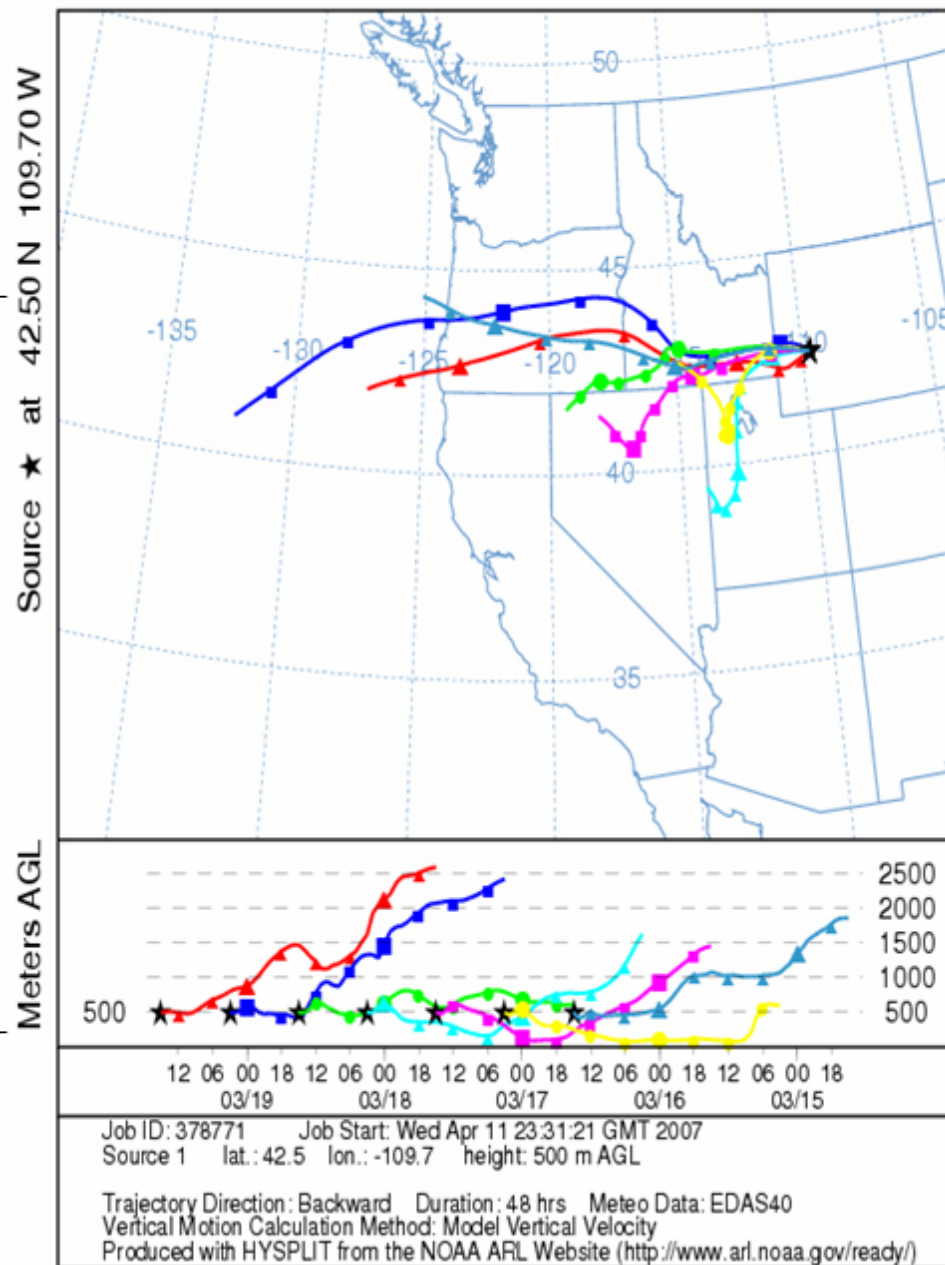


March 16-19, 2007

Boulder, Wyoming

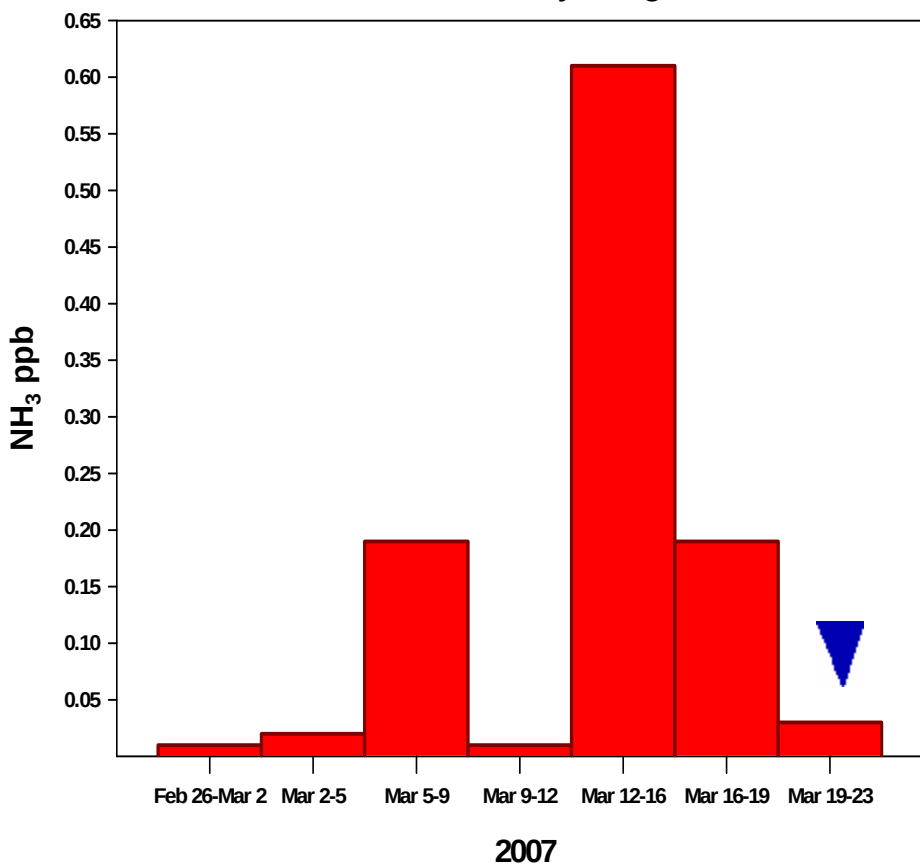


NOAA HYSPLIT MODEL
Backward trajectories ending at 15 UTC 19 Mar 07
EDAS Meteorological Data

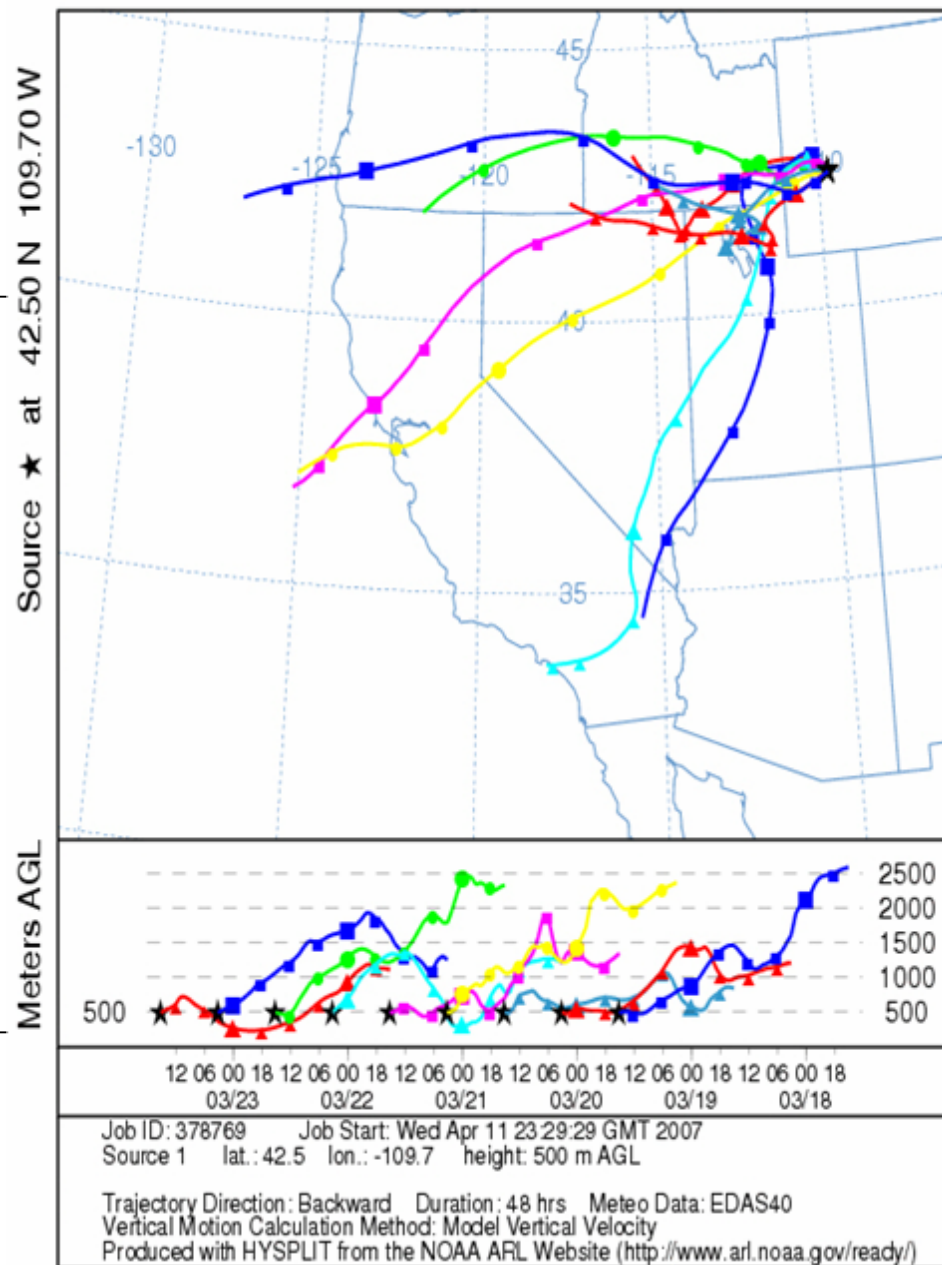


March 19-23, 2007

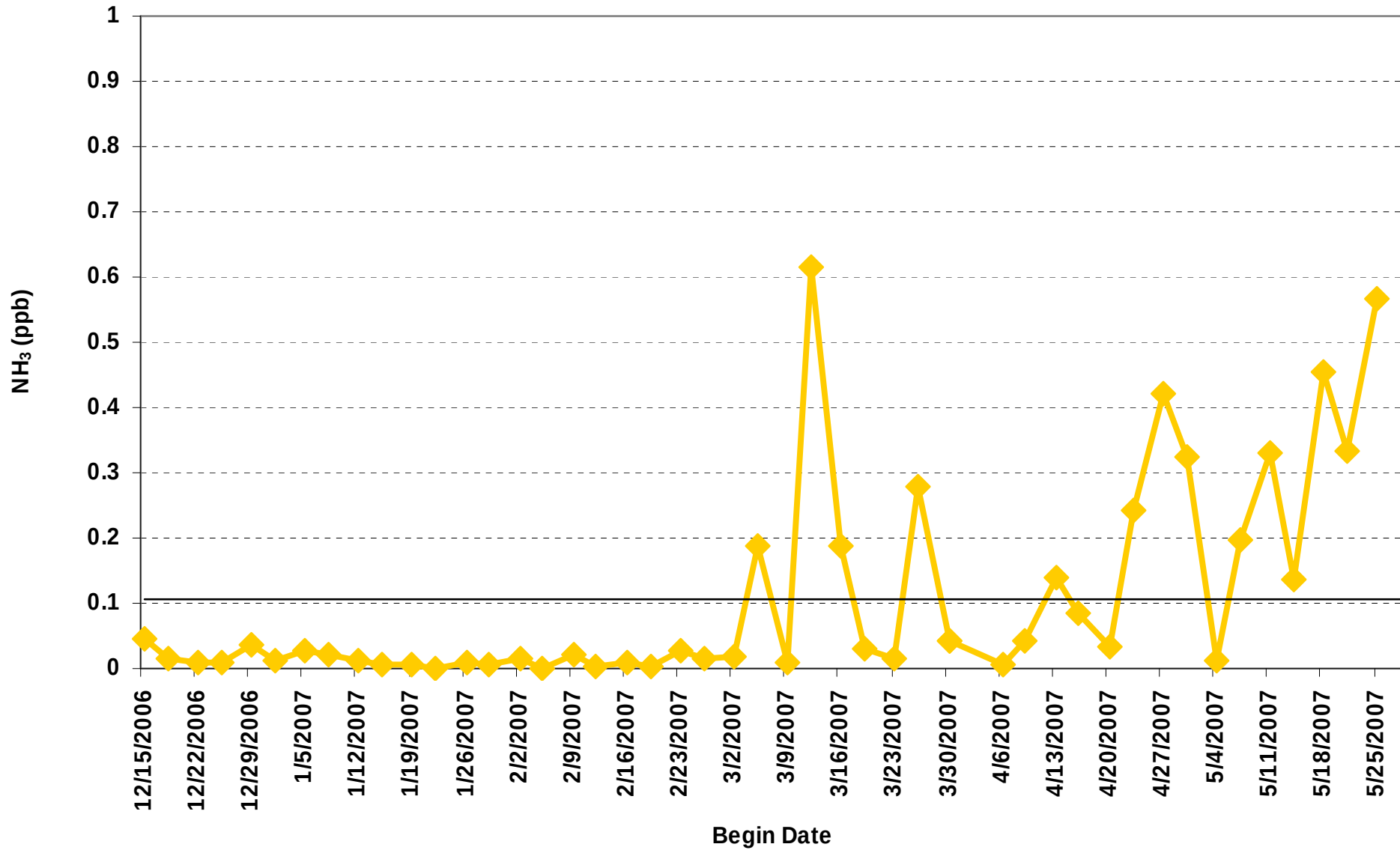
Boulder, Wyoming



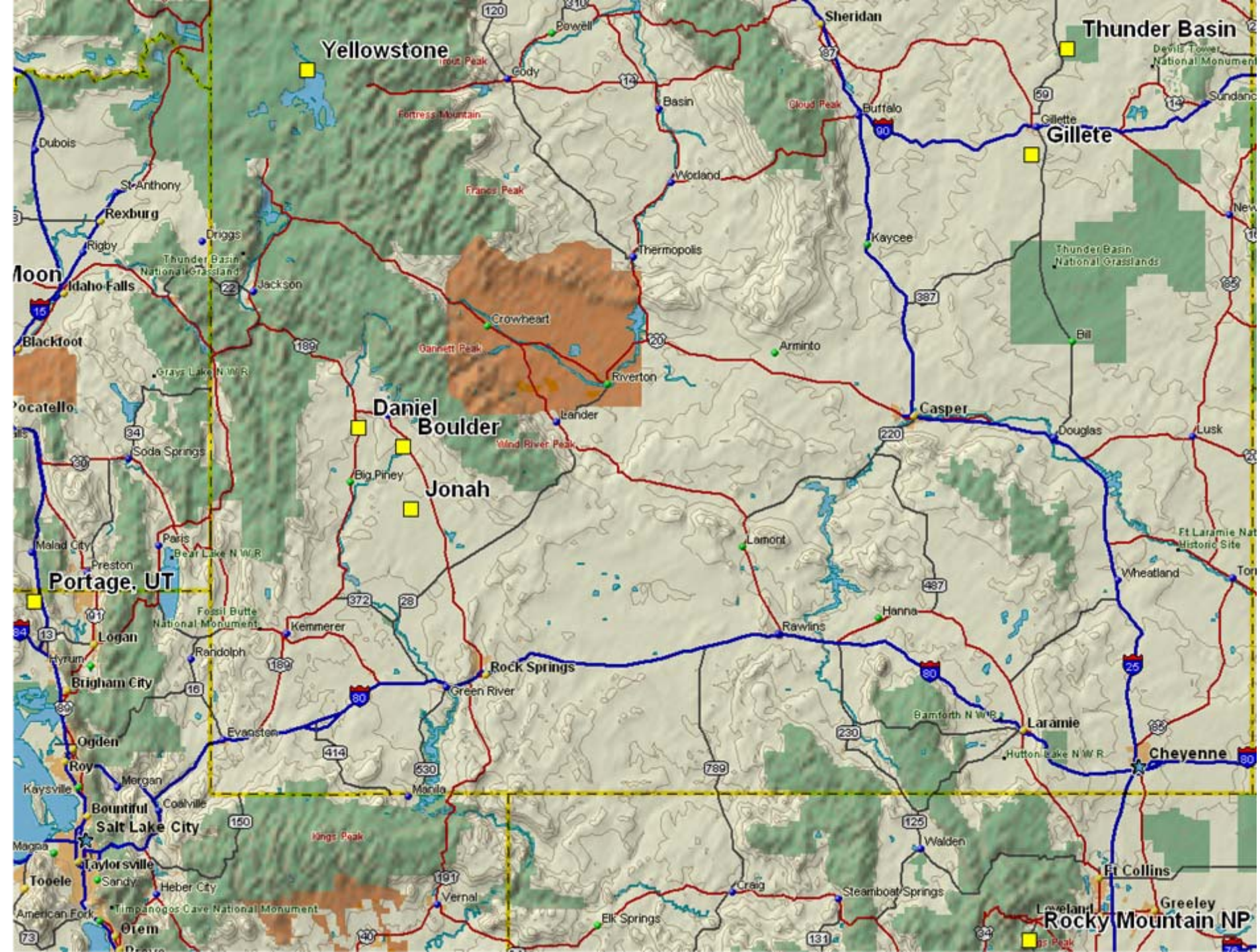
NOAA HYSPLIT MODEL
Backward trajectories ending at 15 UTC 23 Mar 07
EDAS Meteorological Data



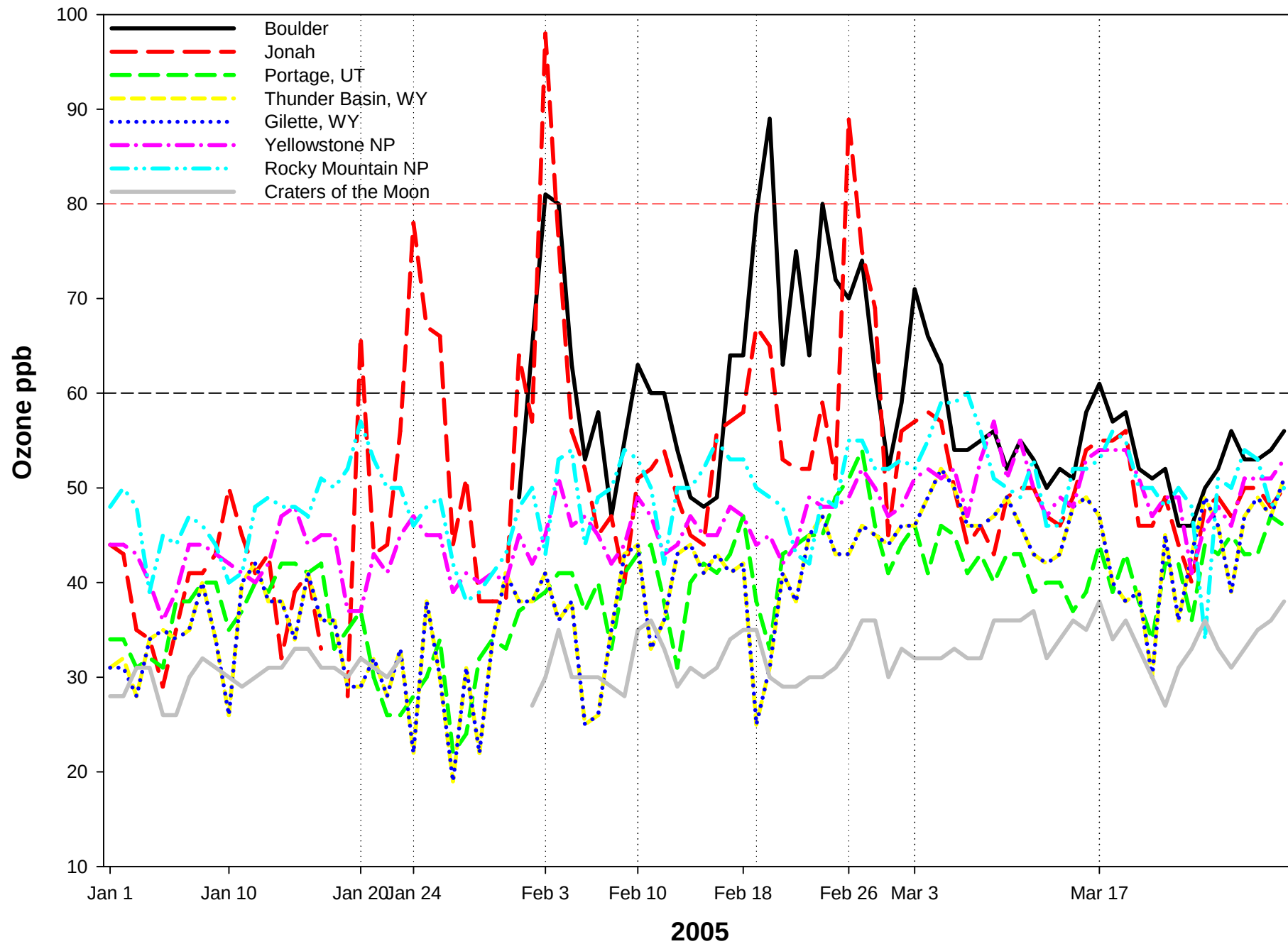
Boulder, WY Ammonia Study



Investigation of Elevated Ozone Events During Late Winter – Early Spring in the Jonah-Pinedale Anticline Area

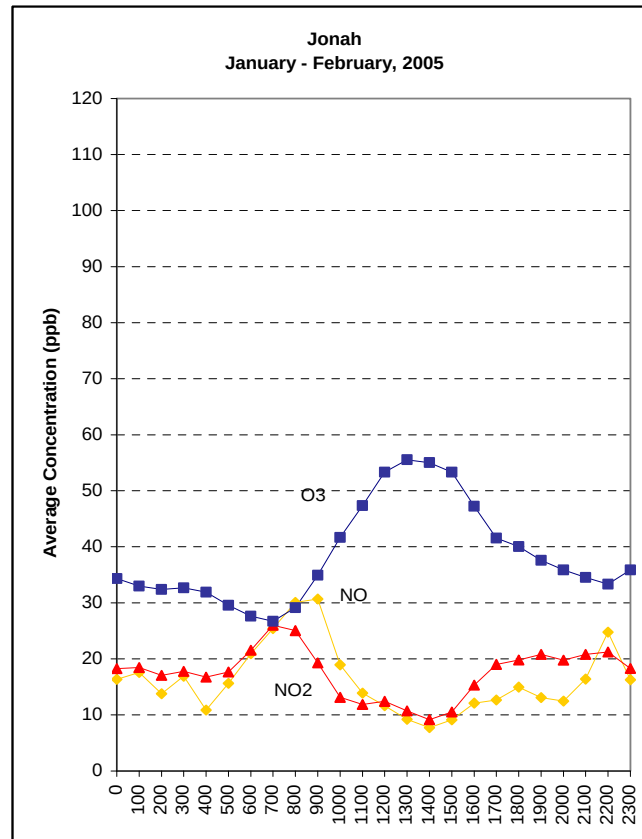
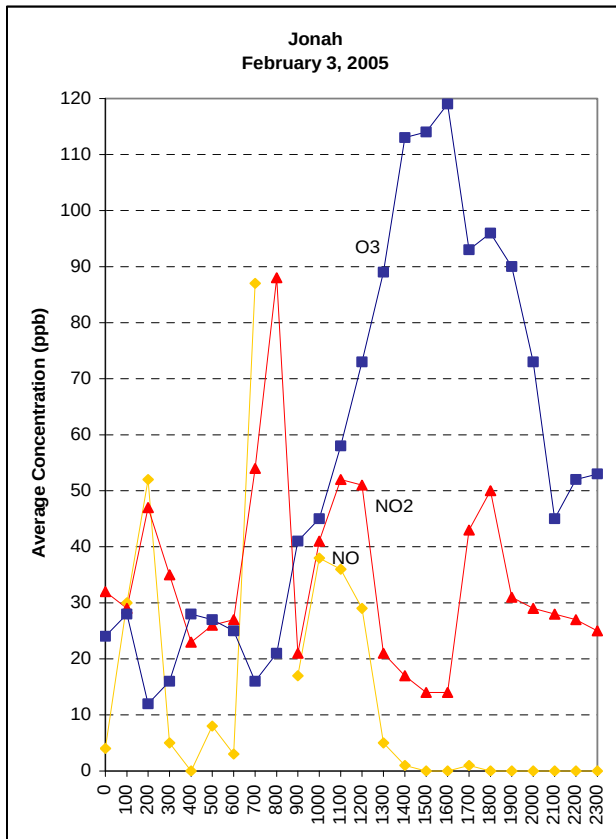


Max 8hr Ozone Concentration



February 3, 2005

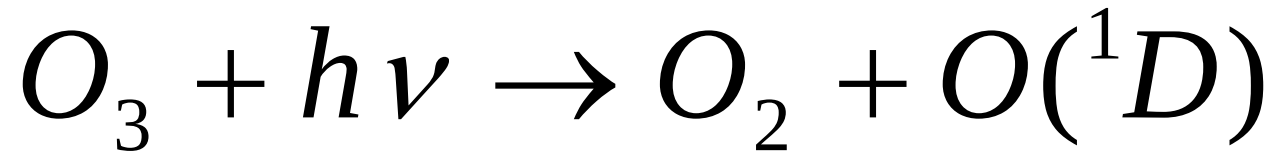
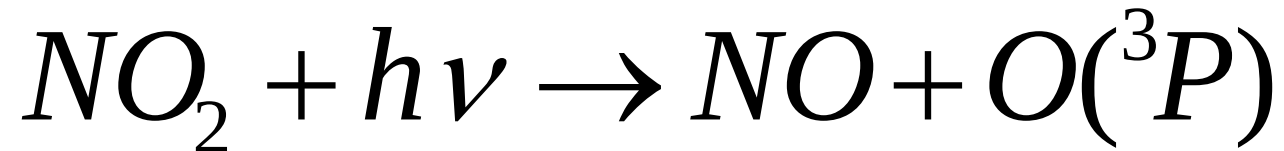
NO-NO₂-O₃ Hourly Data



Possible Explanations

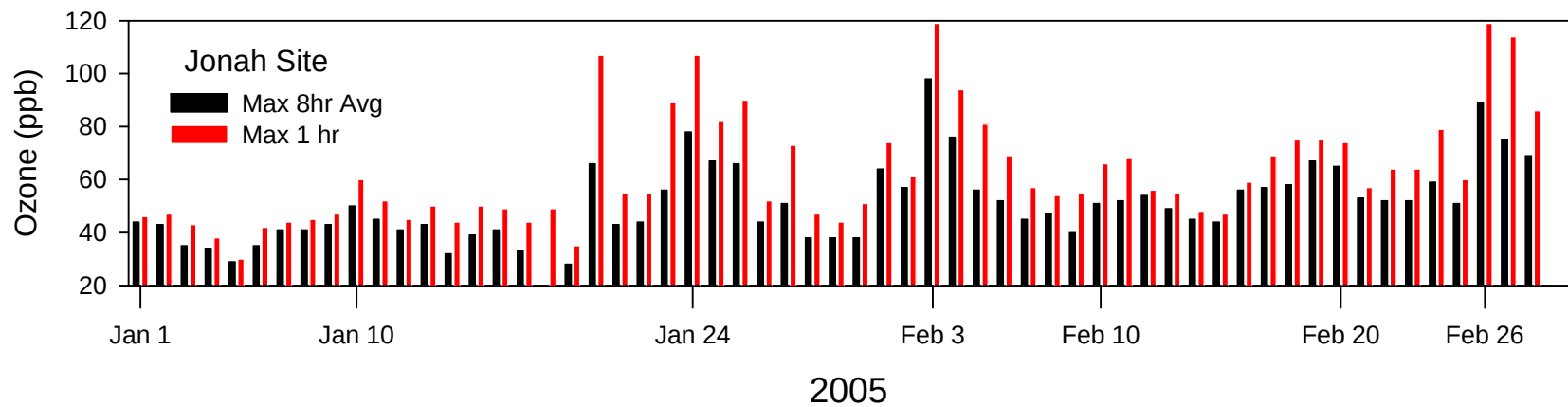
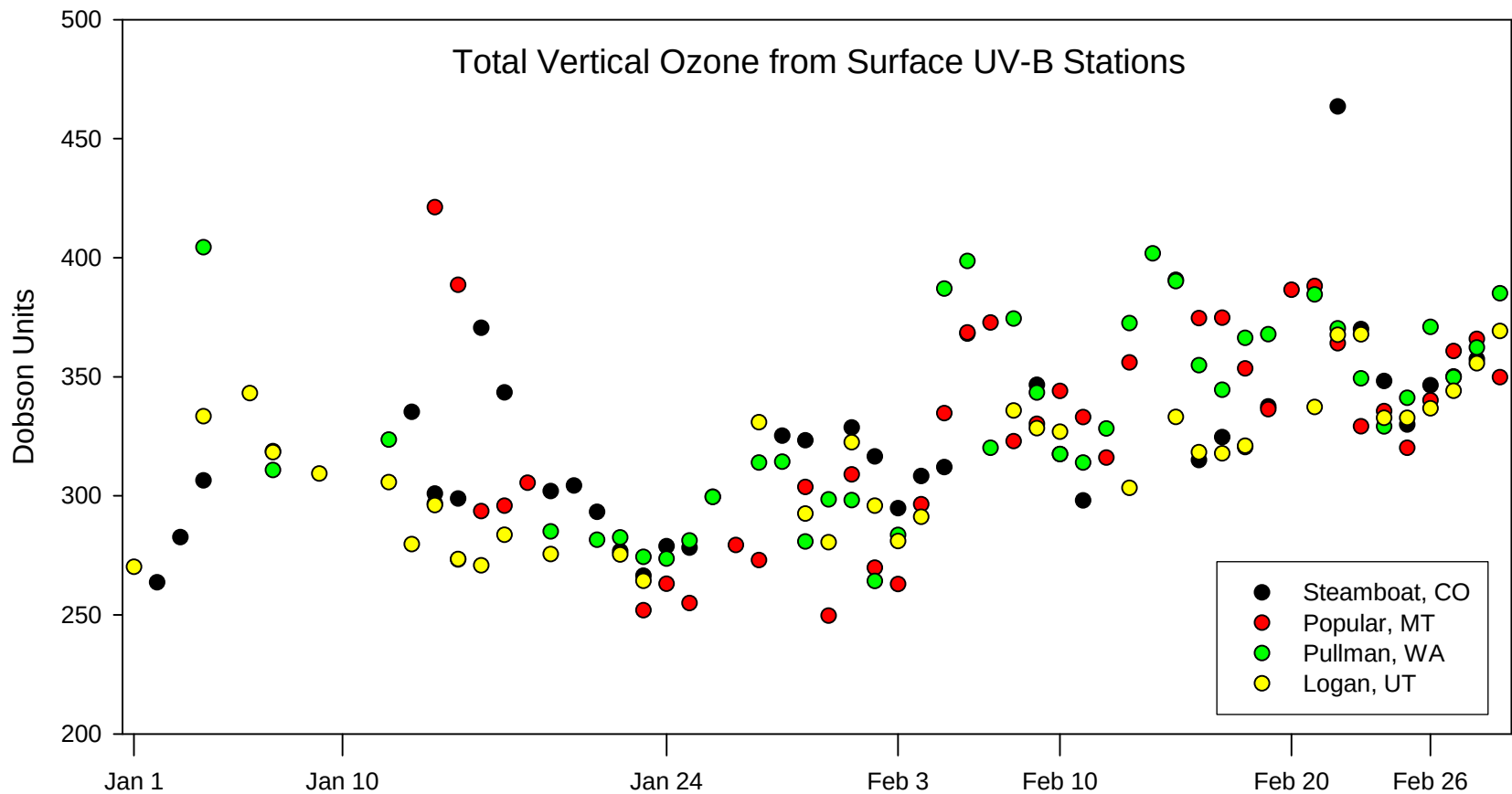
- Malfunctioning ozone analyzers
- Interference from some other atmospheric species
- Long range transport
- Stratospheric-Troposphere Exchange (STE)
 - ozone injection
- Enhanced O_3 - NO_x -VOC Photochemistry

Primary Photolytic Reactions

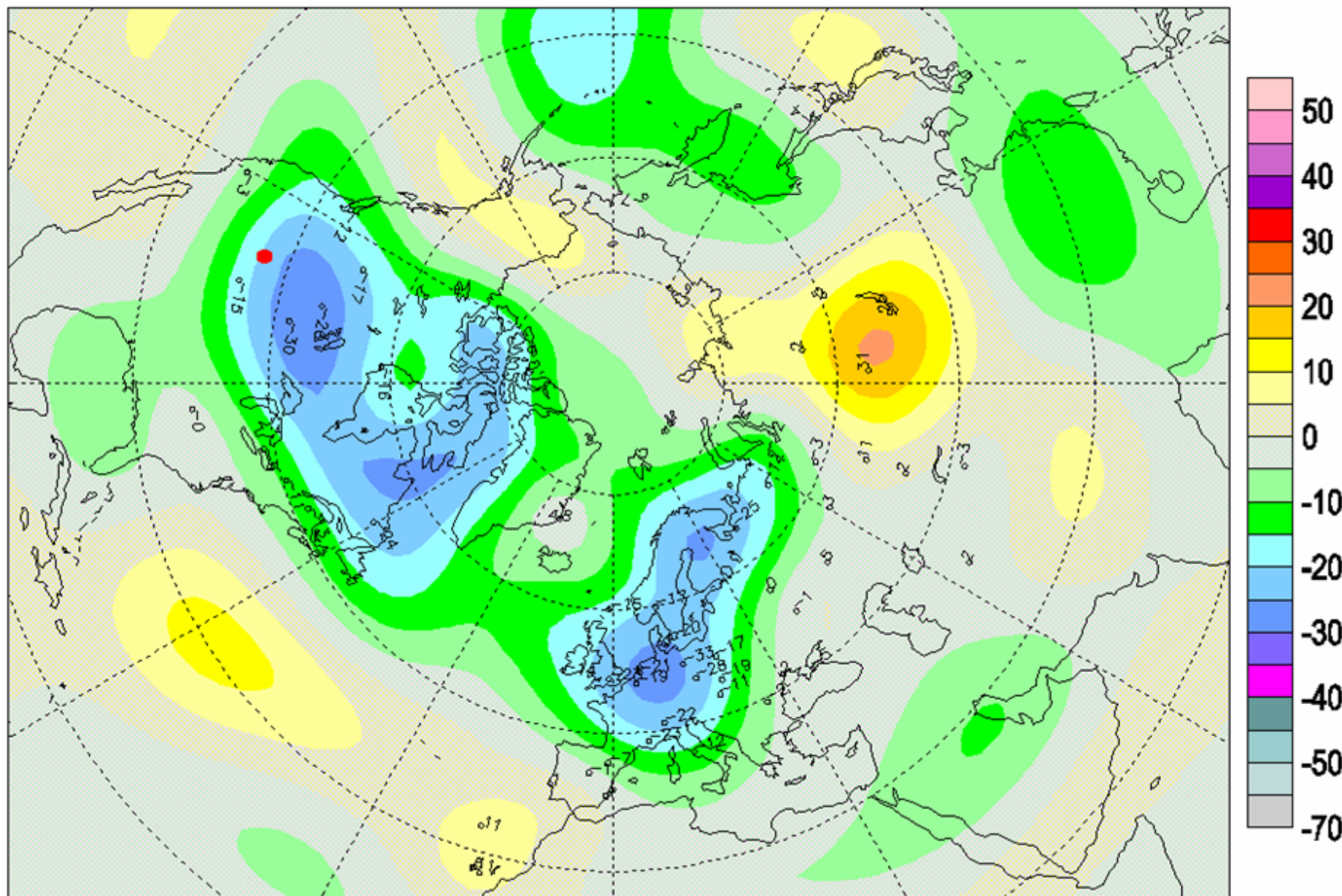


Hypothesis

- Low total vertical ozone results in increased UV-B radiation reaching surface
- High albedo surface reflects radiation back enhancing UV-B flux
- High NO_x and VOC in shallow inversion layer with enhanced UV-B results in increased photochemical production of Ozone even during late Winter early Spring periods

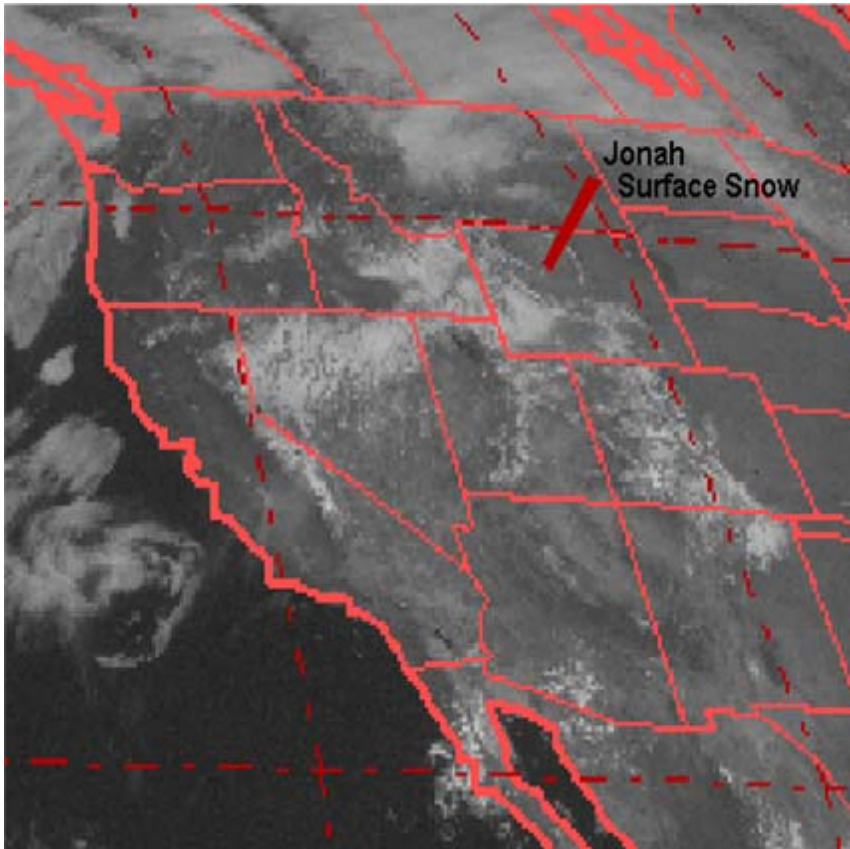


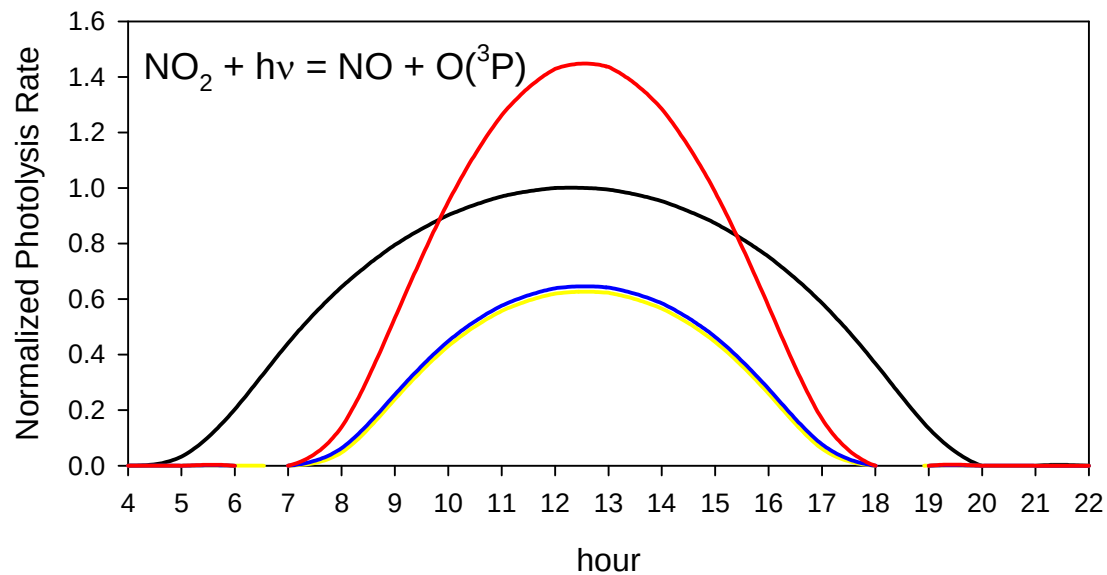
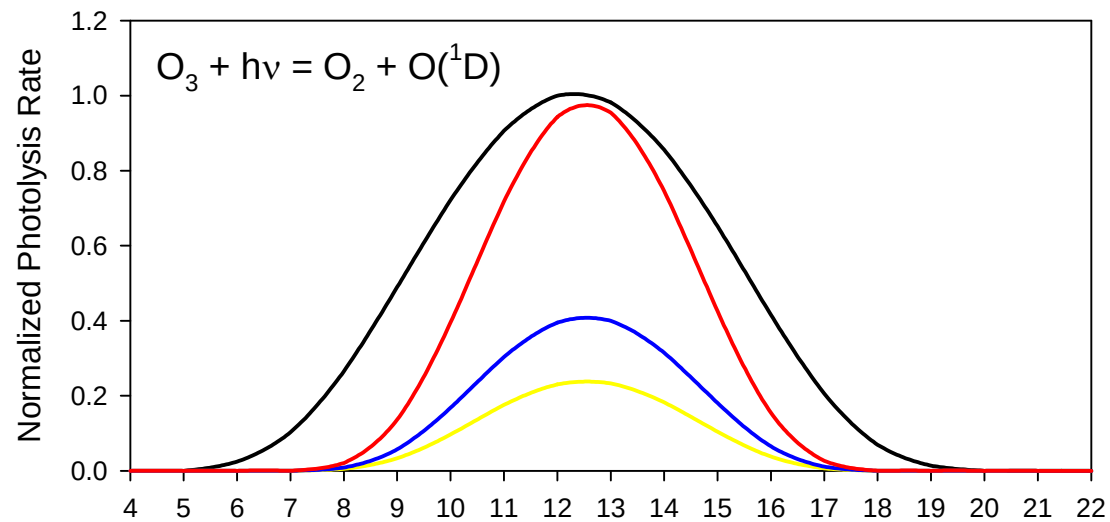
Deviations (%) / Ecart (%) , 2005/02/03



February 3, 2005

Visible Satellite and Surface Images

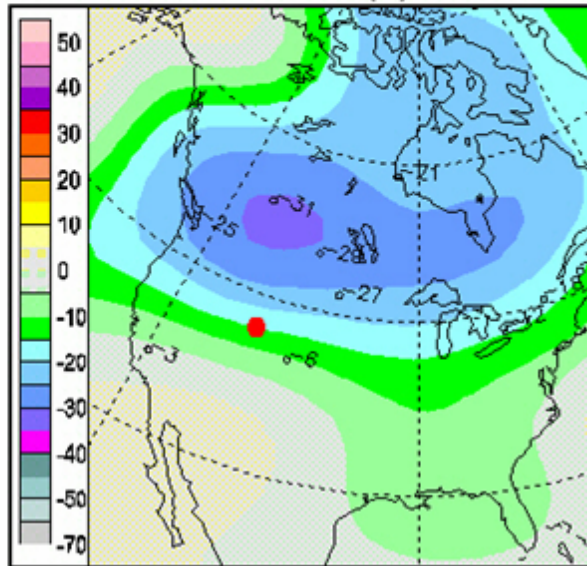




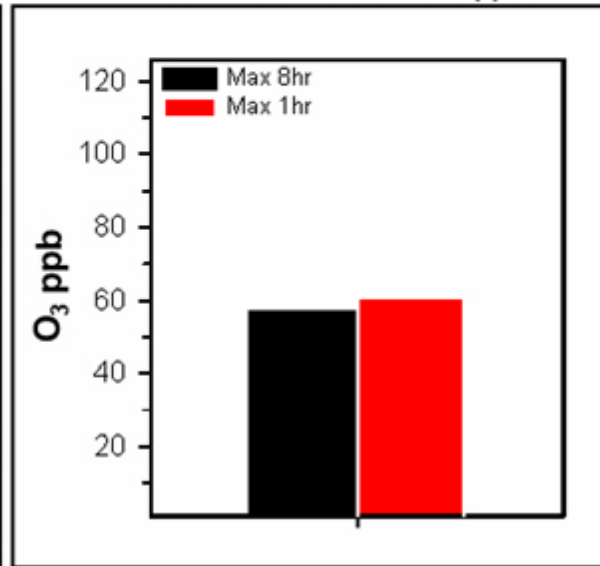
- June 21, 2005 Surface albedo = 0.1 Vertical O_3 = 350 Dobson units
- February 3, 2005 Surface albedo = 0.1 Vertical O_3 = 350 Dobson units
- February 3, 2005 Surface albedo = 0.1 Vertical O_3 = 250 Dobson units
- February 3, 2005 Surface albedo = 0.9 Vertical O_3 = 250 Dobson units

February 02, 2005

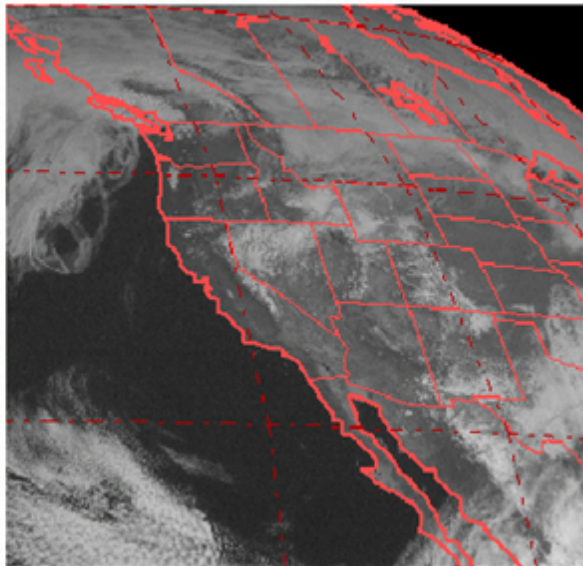
Vertical Ozone Deviation (%) from Normal



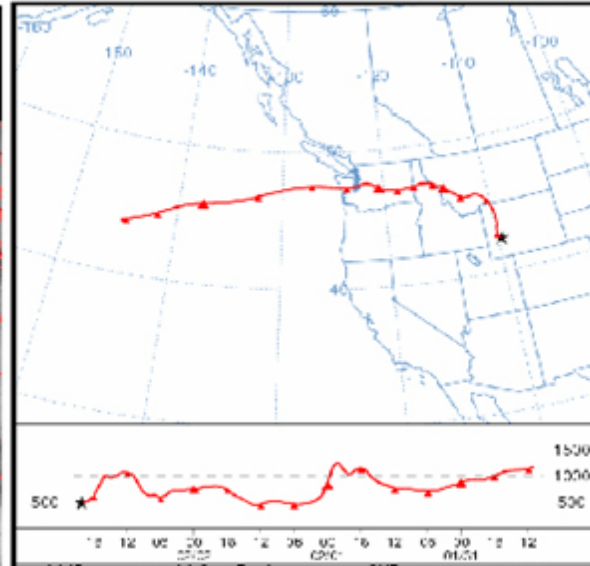
Jonah Surface Ozone ppb



GOES 20Z Visible Image

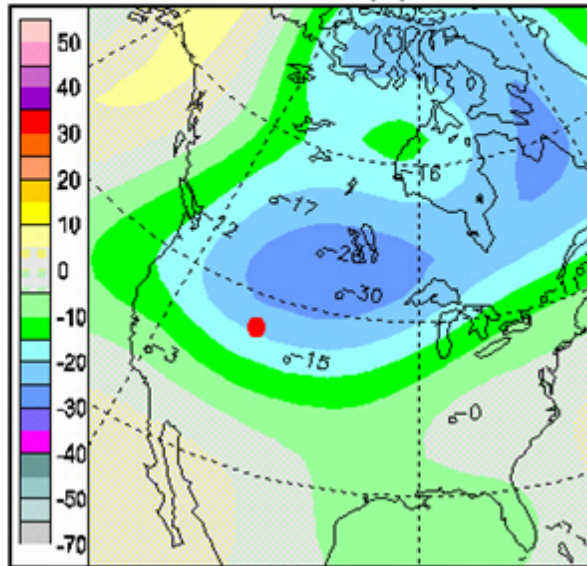


Hysplit 20Z - 5 Day Back Trajectory

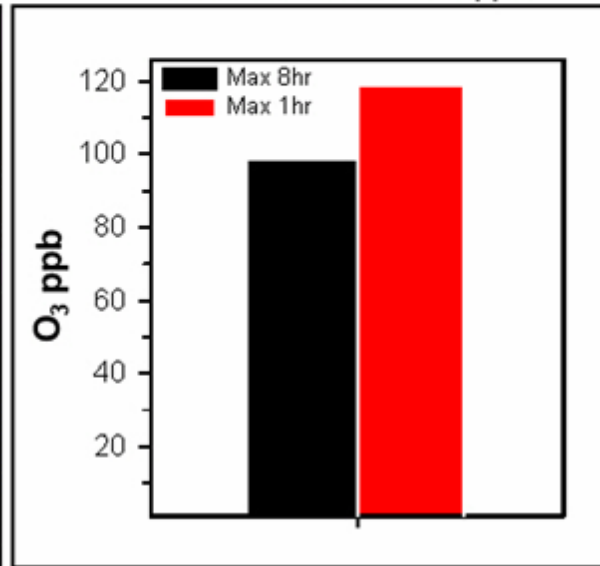


February 03, 2005

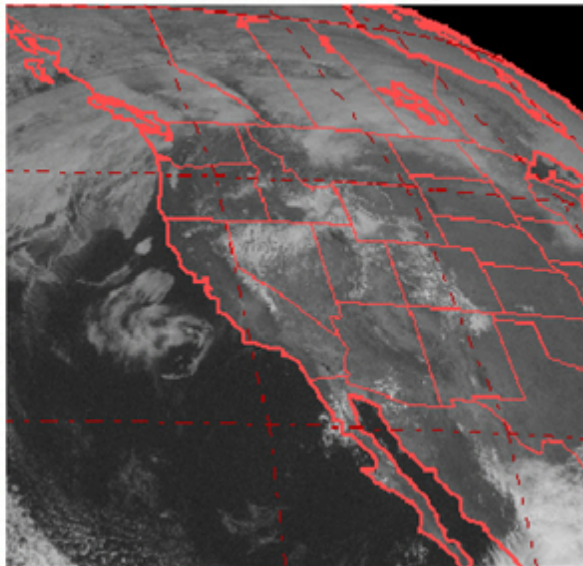
Vertical Ozone Deviation (%) from Normal



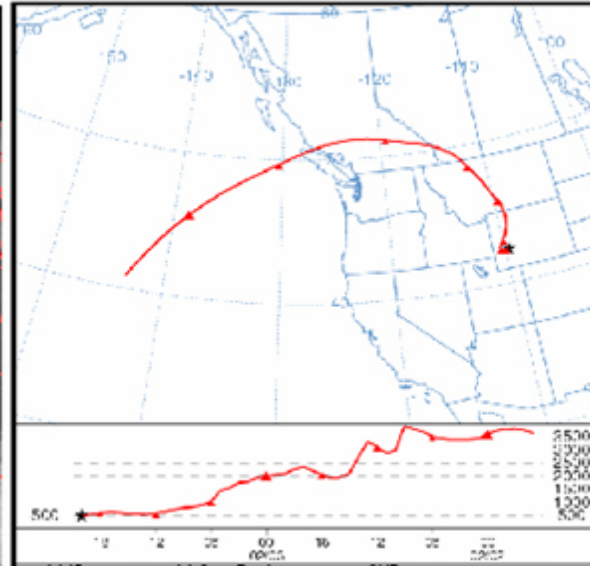
Jonah Surface Ozone ppb



GOES 20Z Visible Image

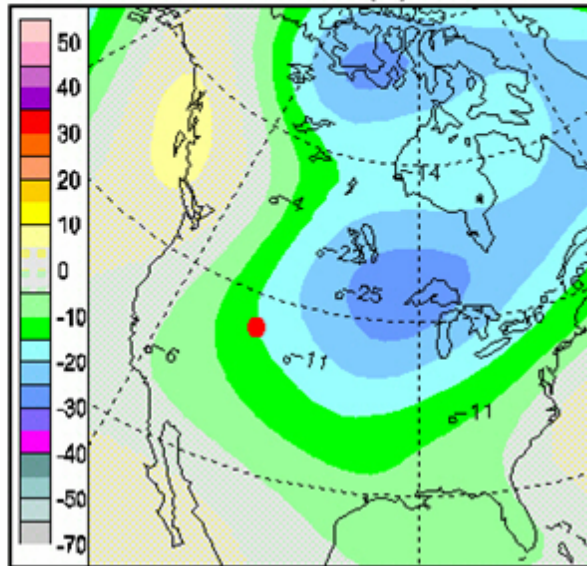


Hysplit 20Z - 5 Day Back Trajectory

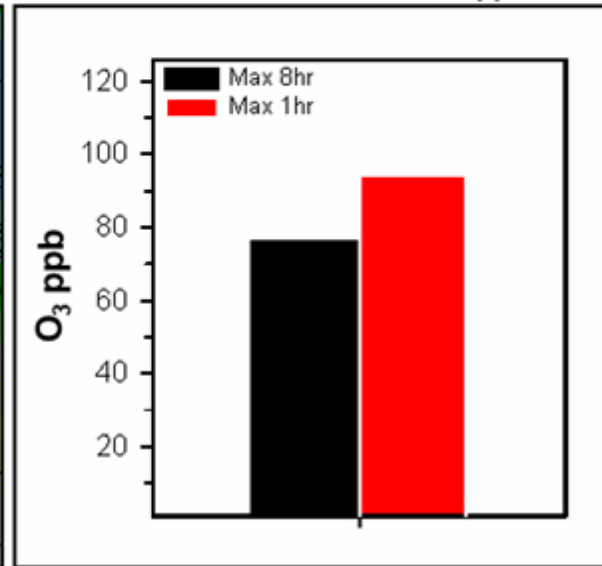


February 04, 2005

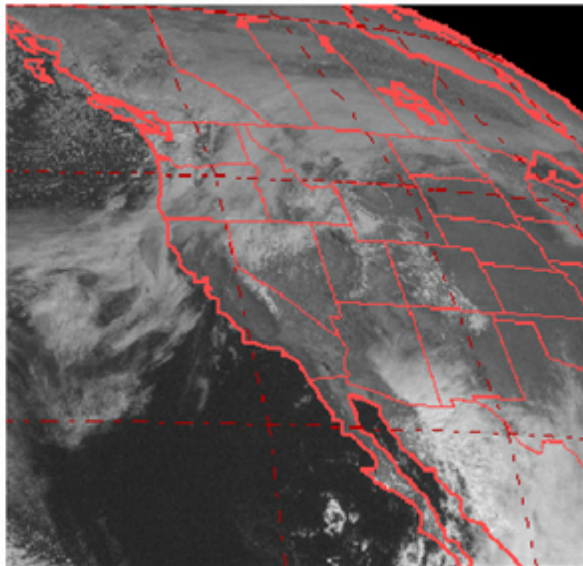
Vertical Ozone Deviation (%) from Normal



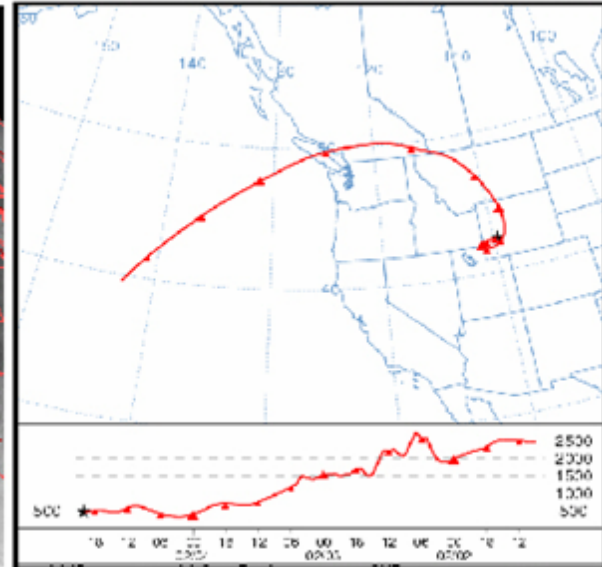
Jonah Surface Ozone ppb



GOES 20Z Visible Image

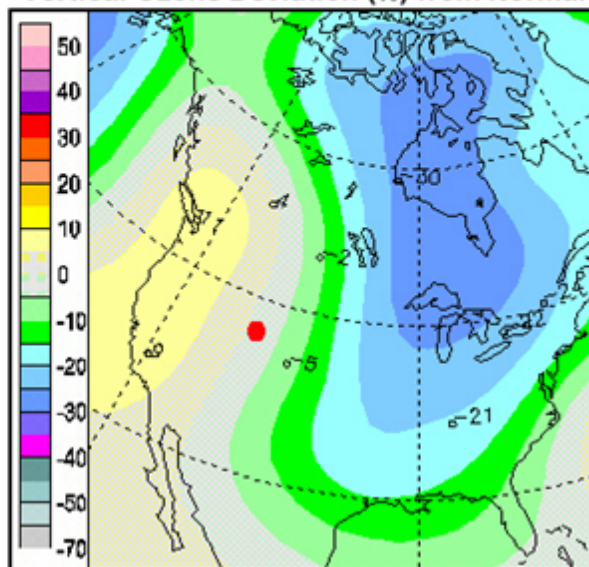


Hysplit 20Z - 5 Day Back Trajectory

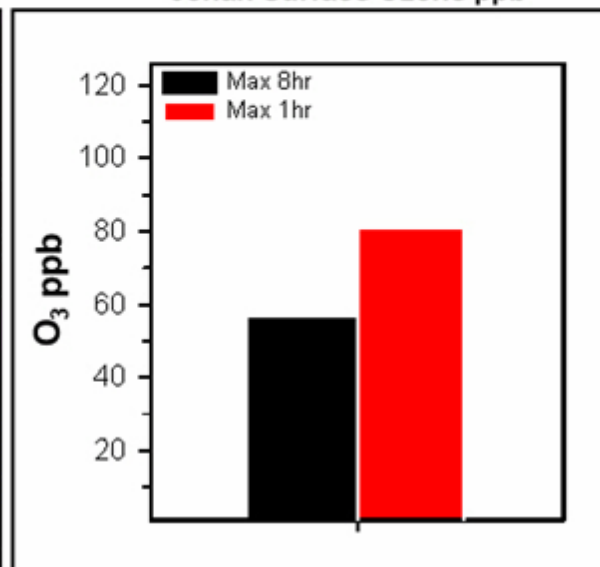


February 05, 2005

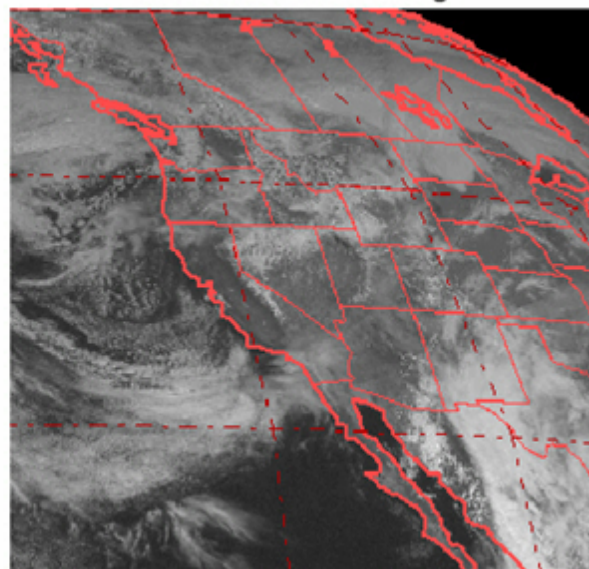
Vertical Ozone Deviation (%) from Normal



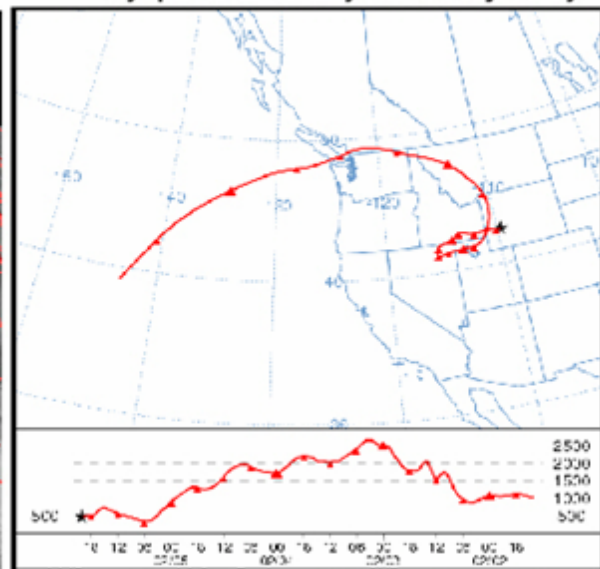
Jonah Surface Ozone ppb



GOES 20Z Visible Image



Hysplit 20Z - 5 Day Back Trajectory



WYDEQ Monitoring Sites

