Identifying Transport Pathways Using the HYSPLIT Model

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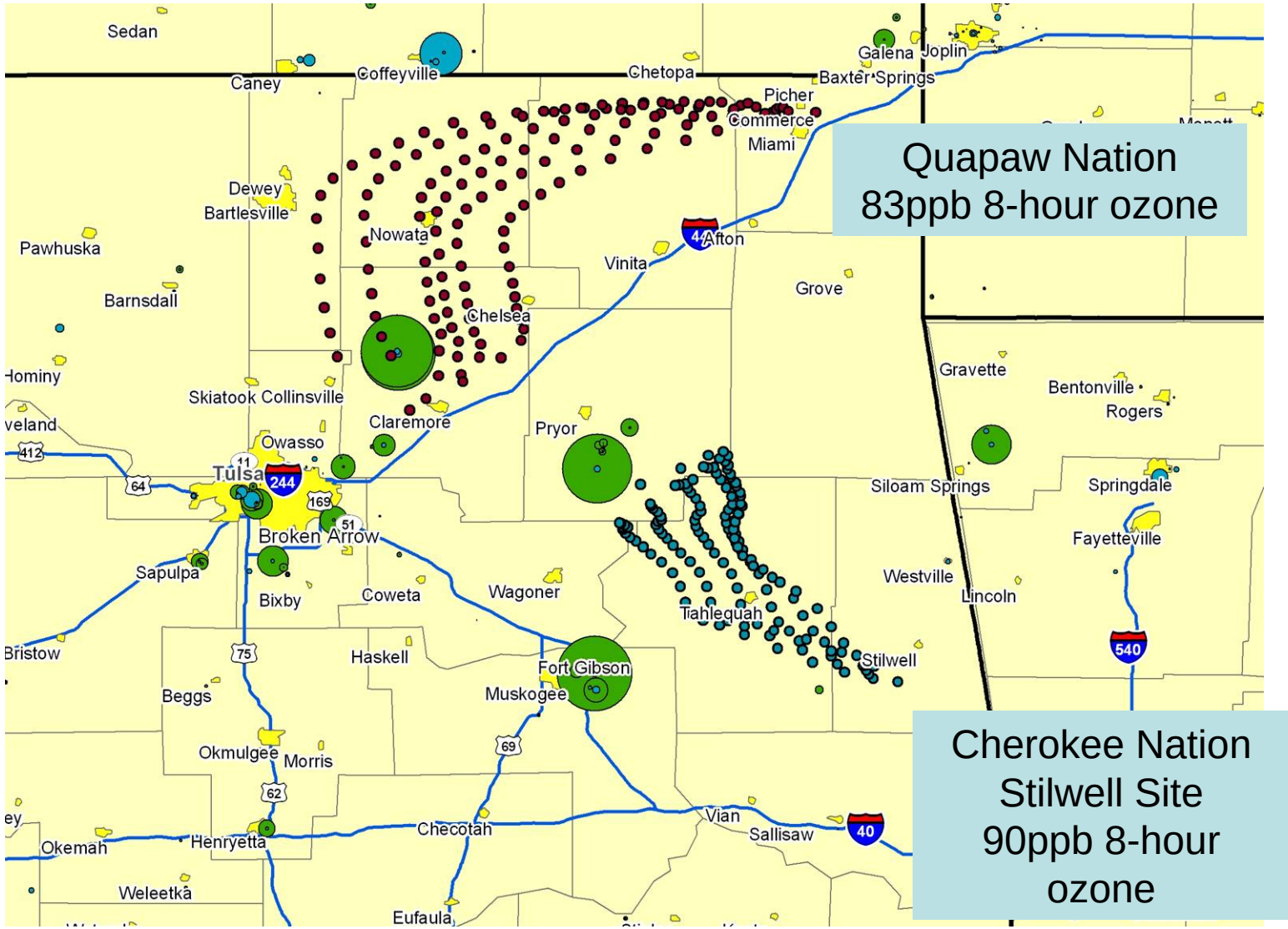
This presentation will include:

- Brief introduction to ozone precursors
- Demonstrated uses of the HYSPLIT model
- Ozone data interlude
- NOAA’s HYSPLIT online modeling tool

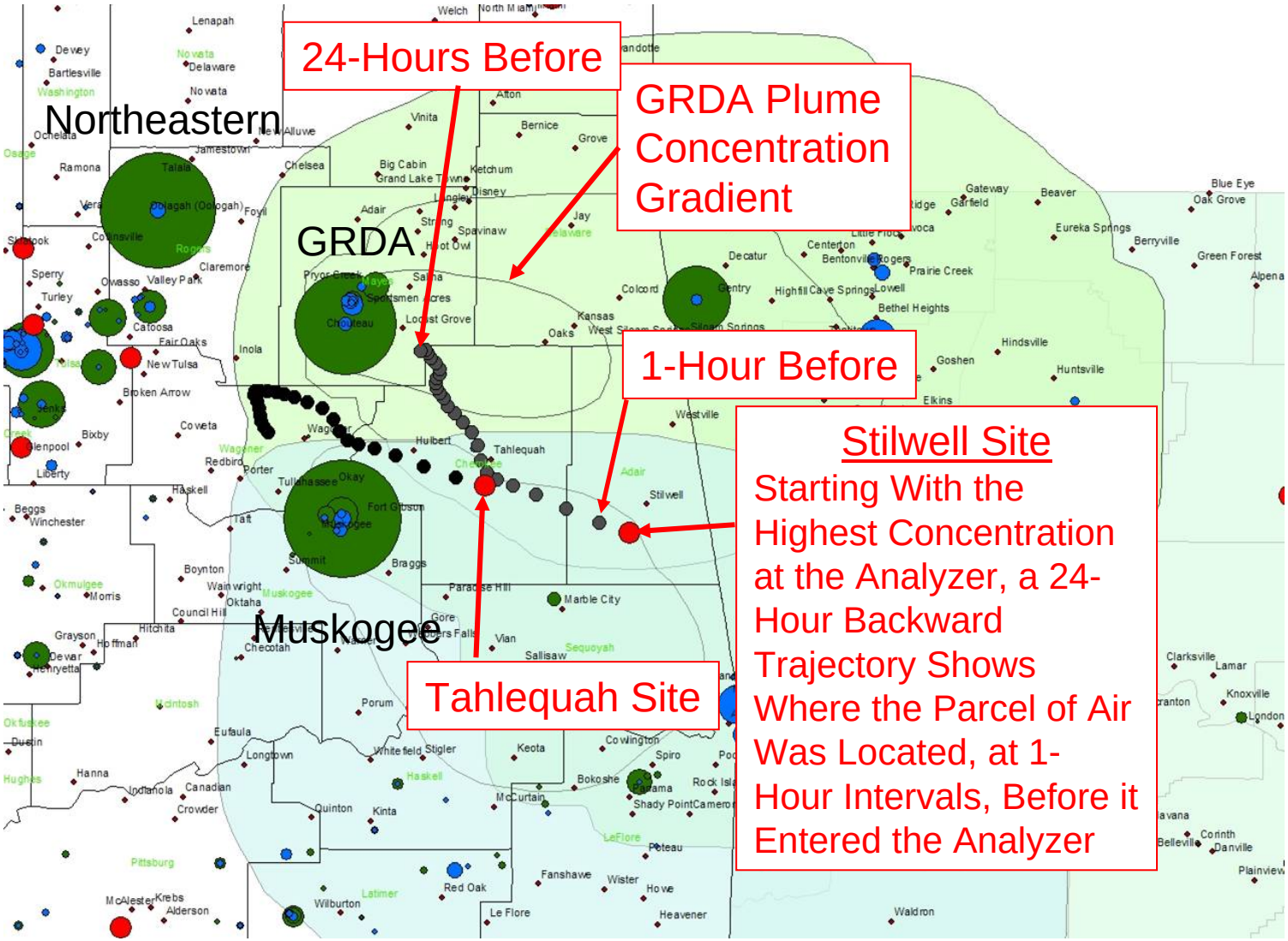
Ozone Precursors

- NOx
- VOC
- Need sunlight
- Power plants emit considerable NOx, but emissions are typically low in VOC – VOC limited
- Forests can emit considerable VOC
- Location matters

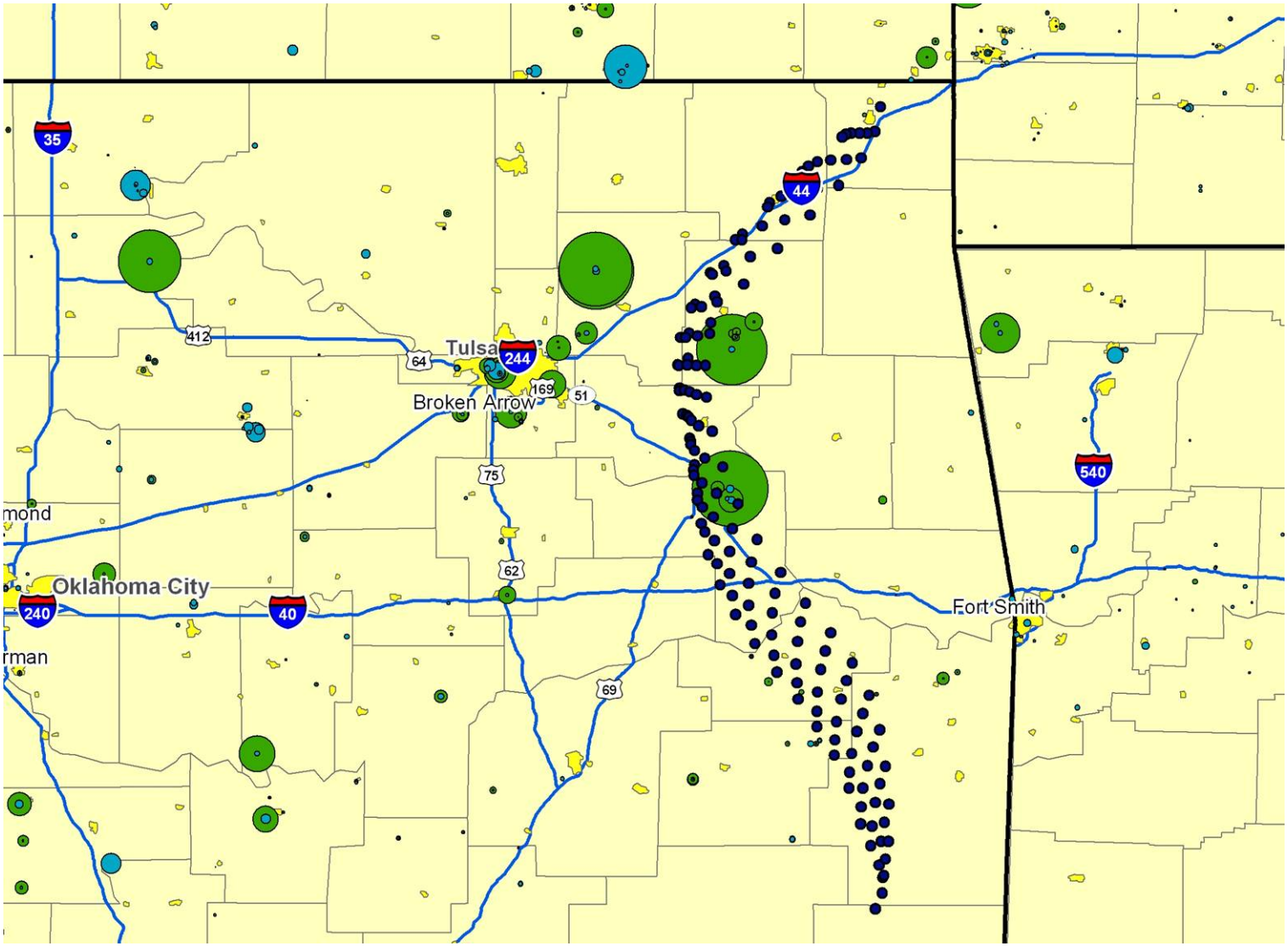
Two ozone sites on 4/12/2003



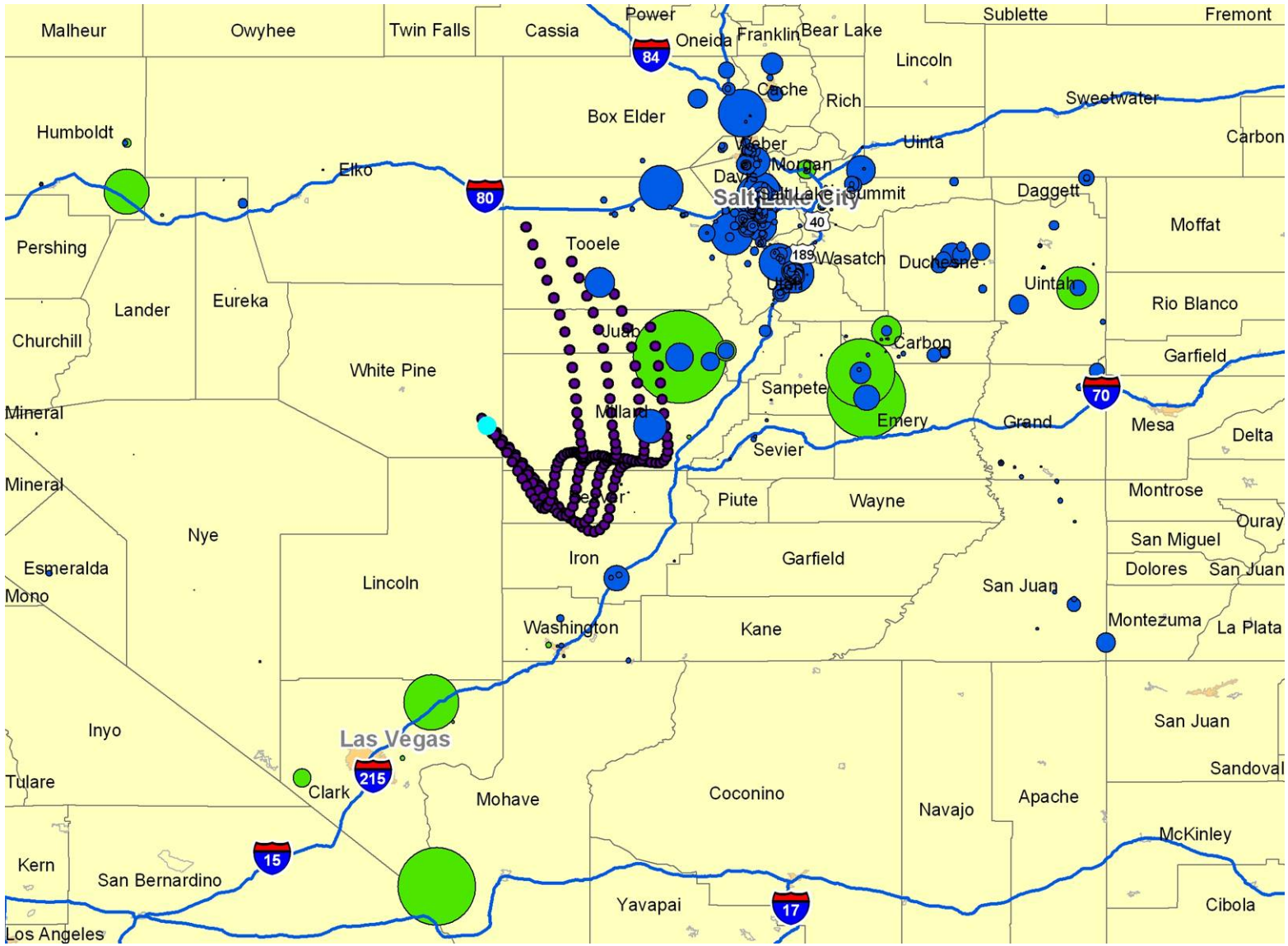
24-Hr. Forward Plume Starting 4/11/03
Back Trajectory Starting 2 PM 4/12/03
Stillwell 8-hour Ozone - 0.090 PPM



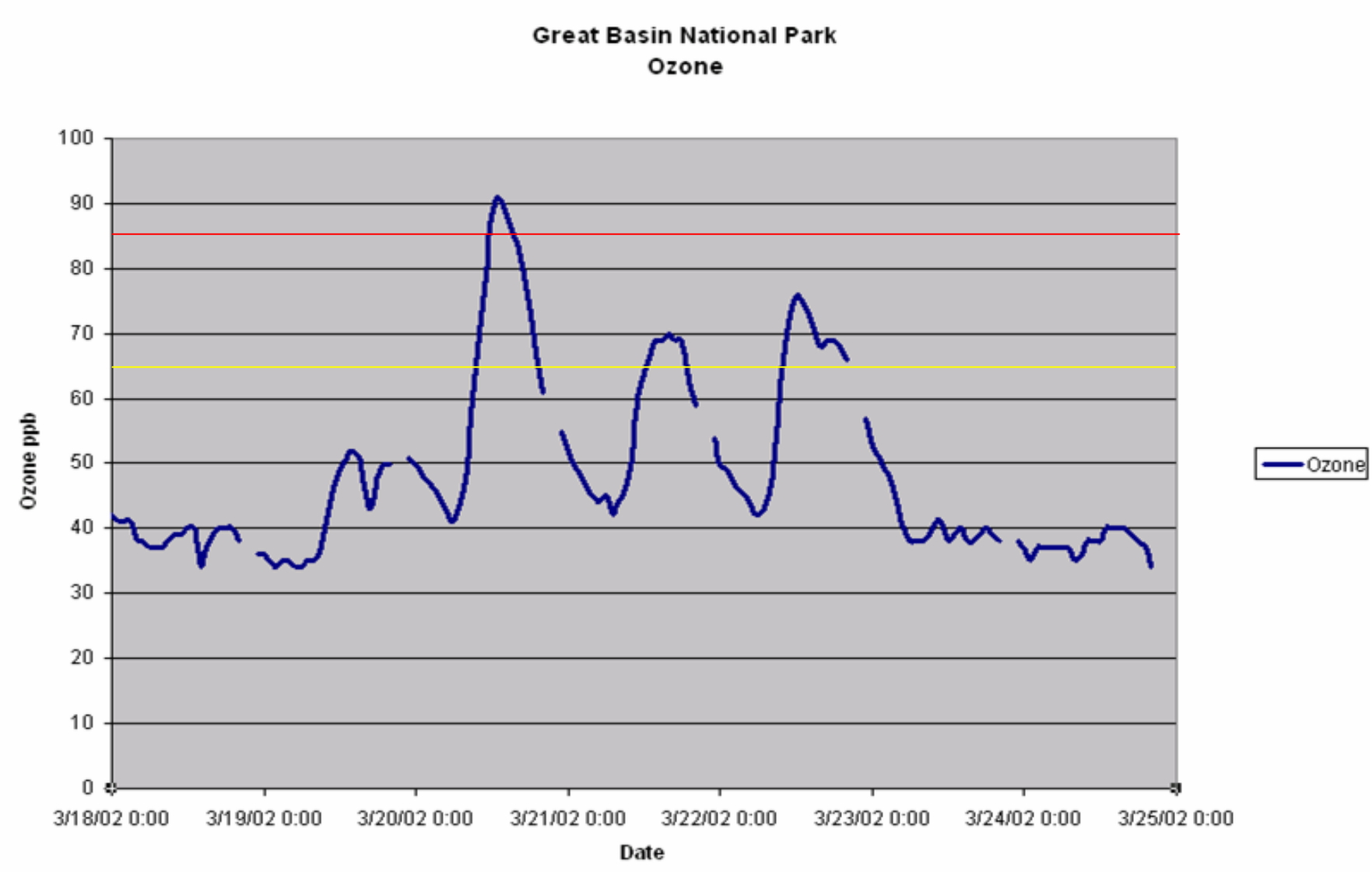
Highest Quapaw Concentration – 93 ppb



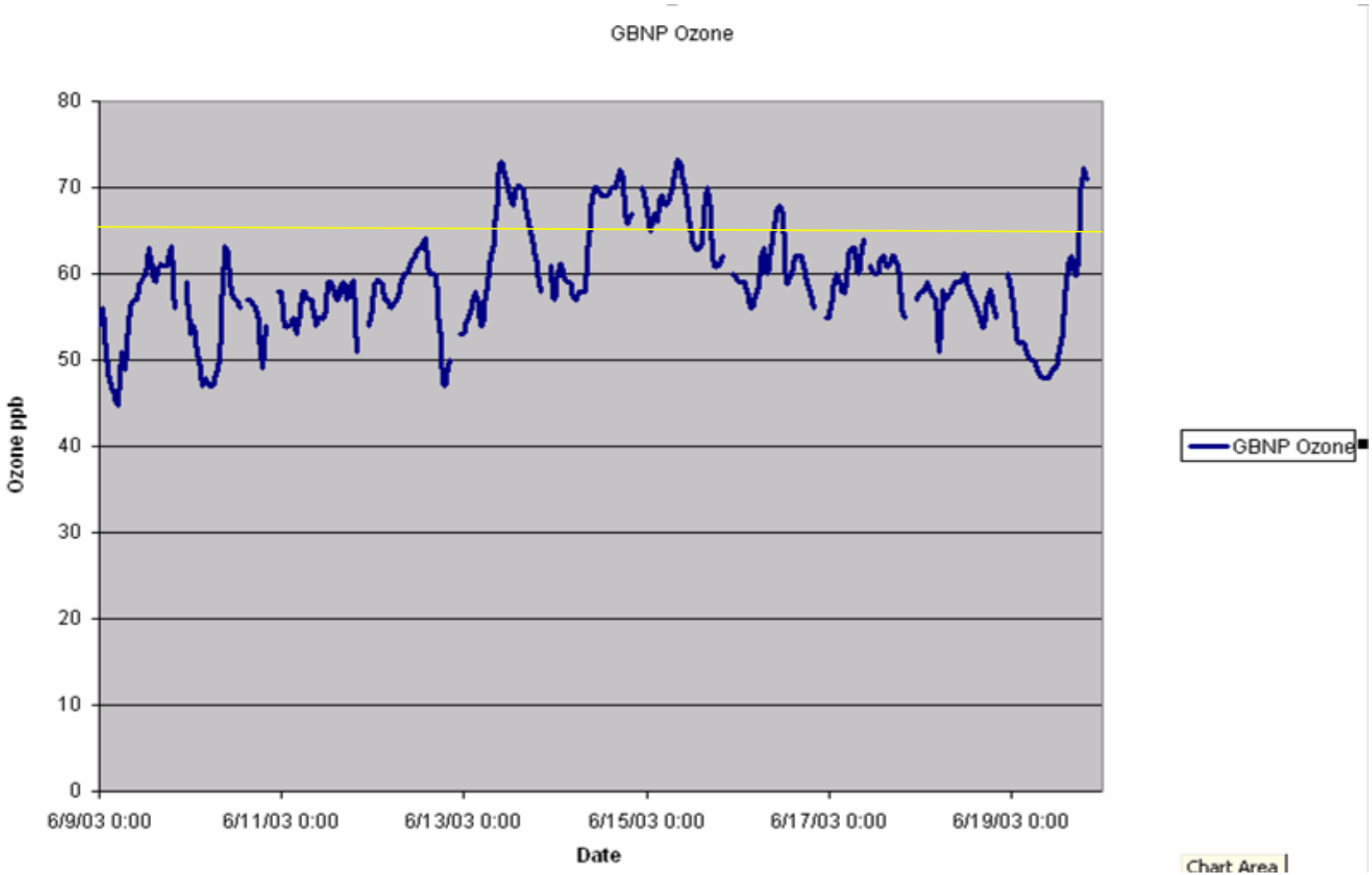
3/20/2002 Great Basin National Park



Ozone Interlude

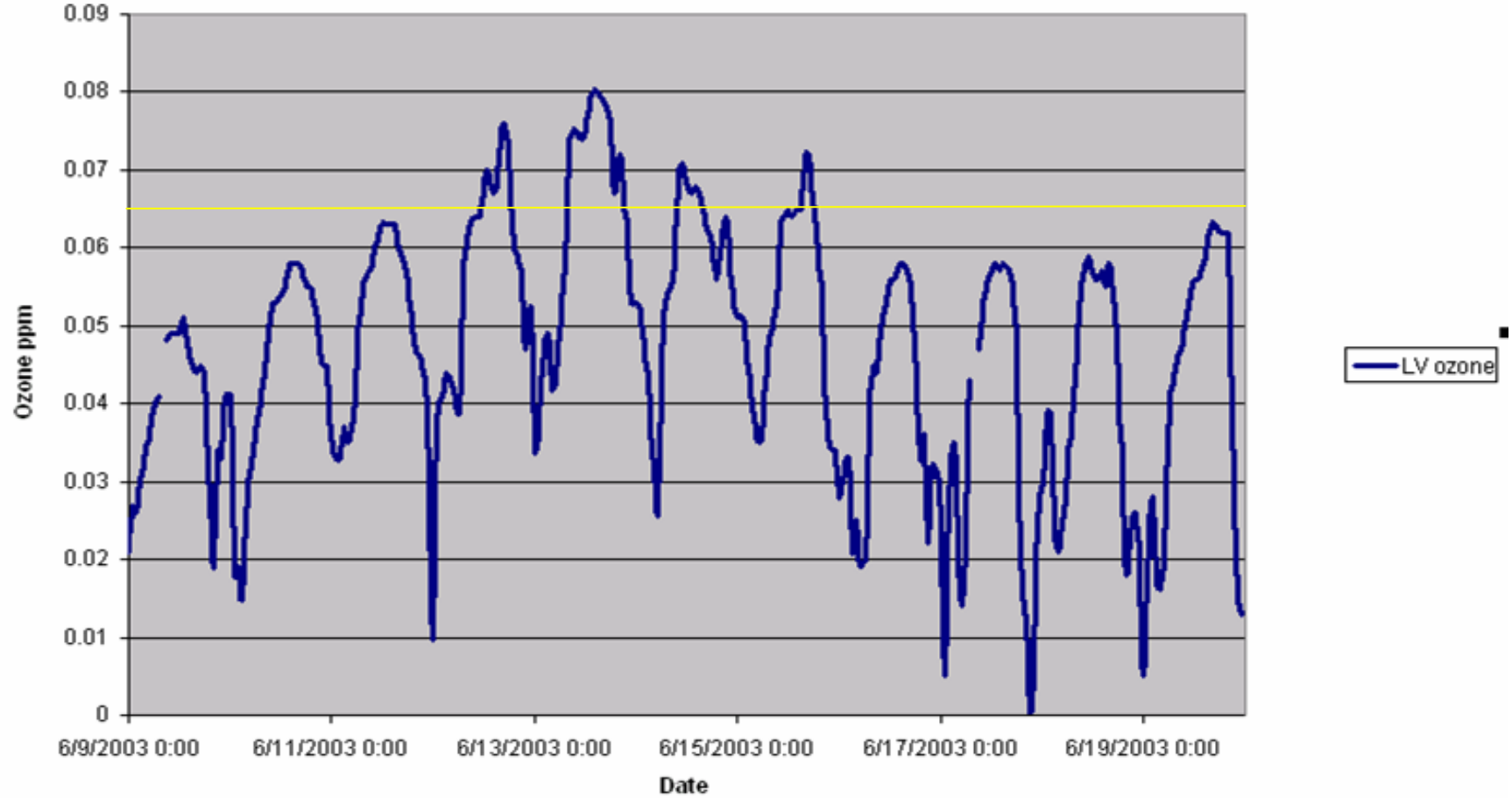

Great Basin National Park
Ozone
Ozone ppb
100
90
80
70
60
50
40
30
20
10
0
3/18/02 0:00
3/19/02 0:00
3/20/02 0:00
3/21/02 0:00
3/22/02 0:00
3/23/02 0:00
3/24/02 0:00
3/25/02 0:00
Date
Ozone

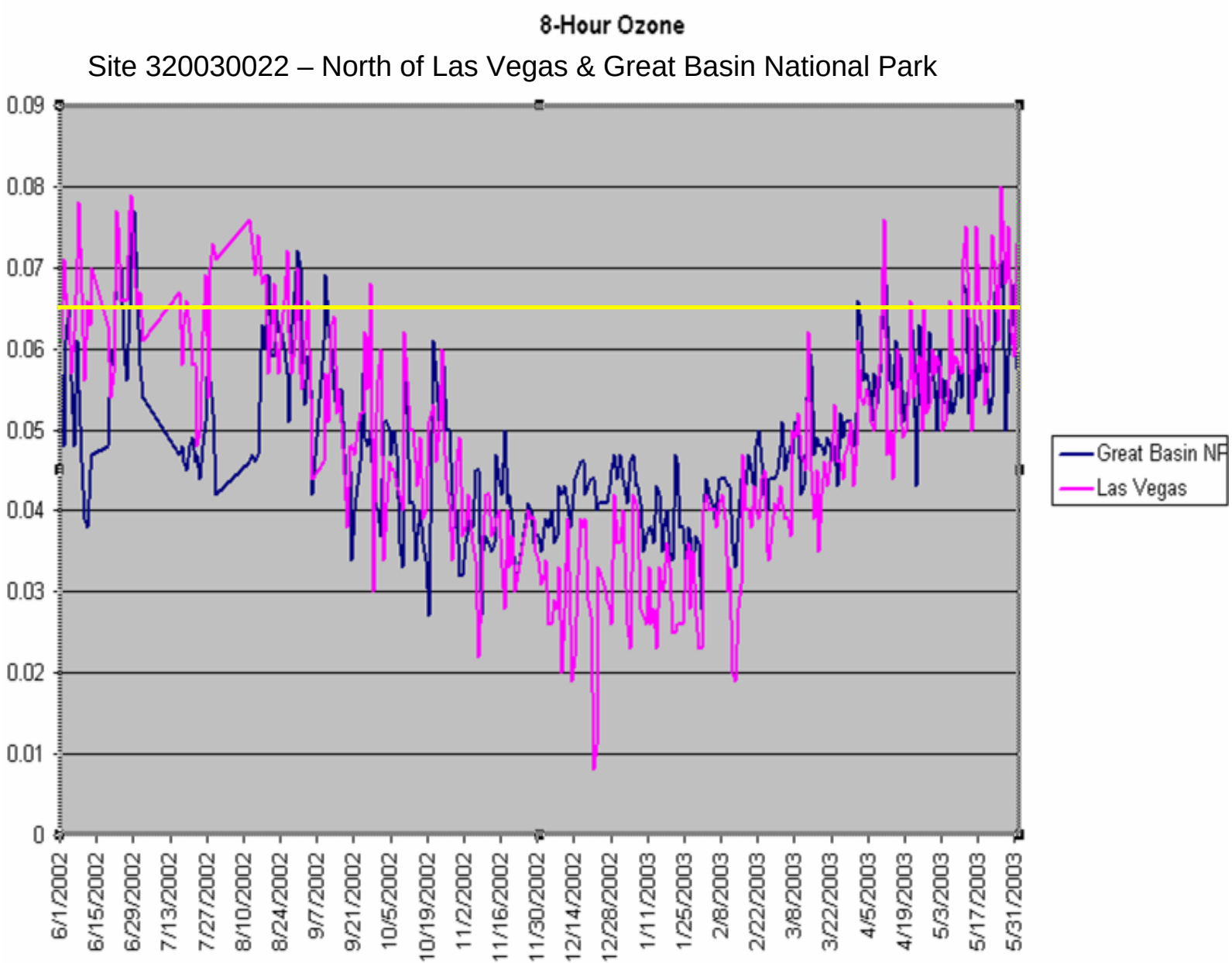
Great Basin National Park Ozone

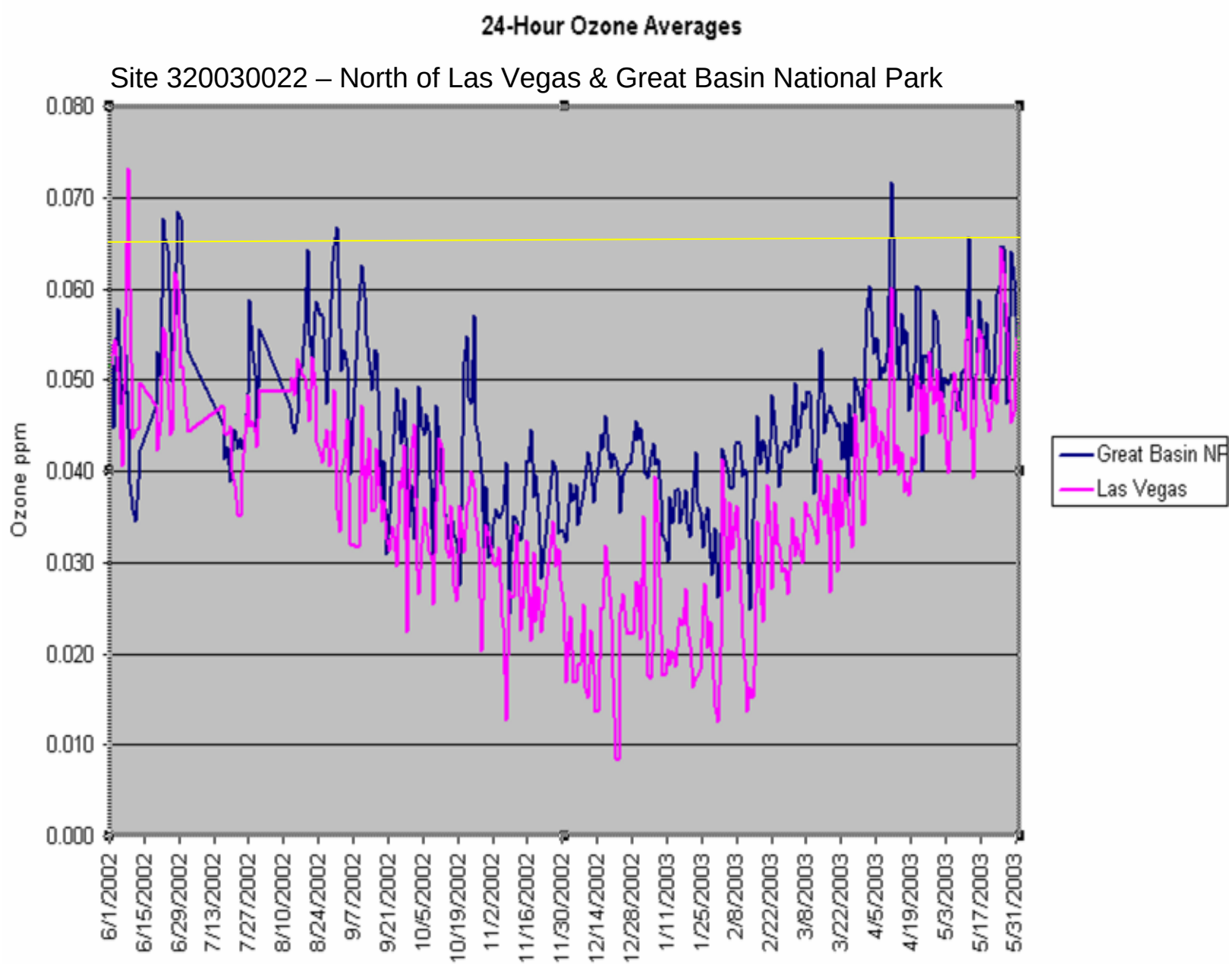


LV ozone

(Site 32 003 0022 – North of Las Vegas)



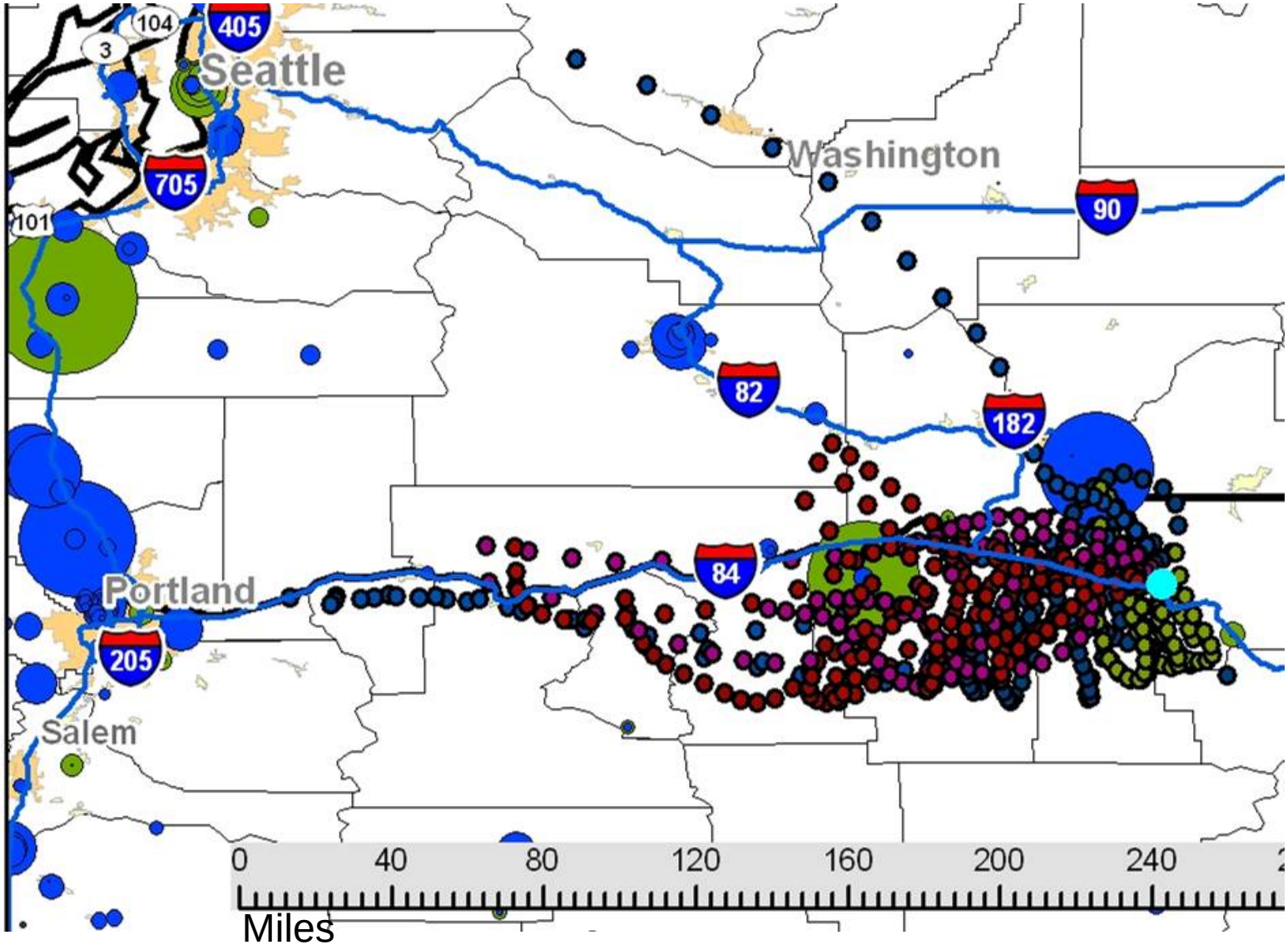

8-Hour Ozone
Site 320030022 – North of Las Vegas & Great Basin National Park
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
6/1/2002
6/15/2002
6/29/2002
7/13/2002
7/27/2002
8/10/2002
8/24/2002
9/7/2002
9/21/2002
10/5/2002
10/19/2002
11/2/2002
11/16/2002
11/30/2002
12/14/2002
12/28/2002
1/11/2003
1/25/2003
2/8/2003
2/22/2003
3/8/2003
3/22/2003
4/5/2003
4/19/2003
5/3/2003
5/17/2003
5/31/2003
Great Basin NP
Las Vegas


24-Hour Ozone Averages
Site 320030022 – North of Las Vegas & Great Basin National Park
Ozone ppm
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
6/1/2002
6/15/2002
6/29/2002
7/13/2002
7/27/2002
8/10/2002
8/24/2002
9/7/2002
9/21/2002
10/5/2002
10/19/2002
11/2/2002
11/16/2002
11/30/2002
12/14/2002
12/28/2002
1/11/2003
1/25/2003
2/8/2003
2/22/2003
3/8/2003
3/22/2003
4/5/2003
4/19/2003
5/3/2003
5/17/2003
5/31/2003
Great Basin NP
Las Vegas

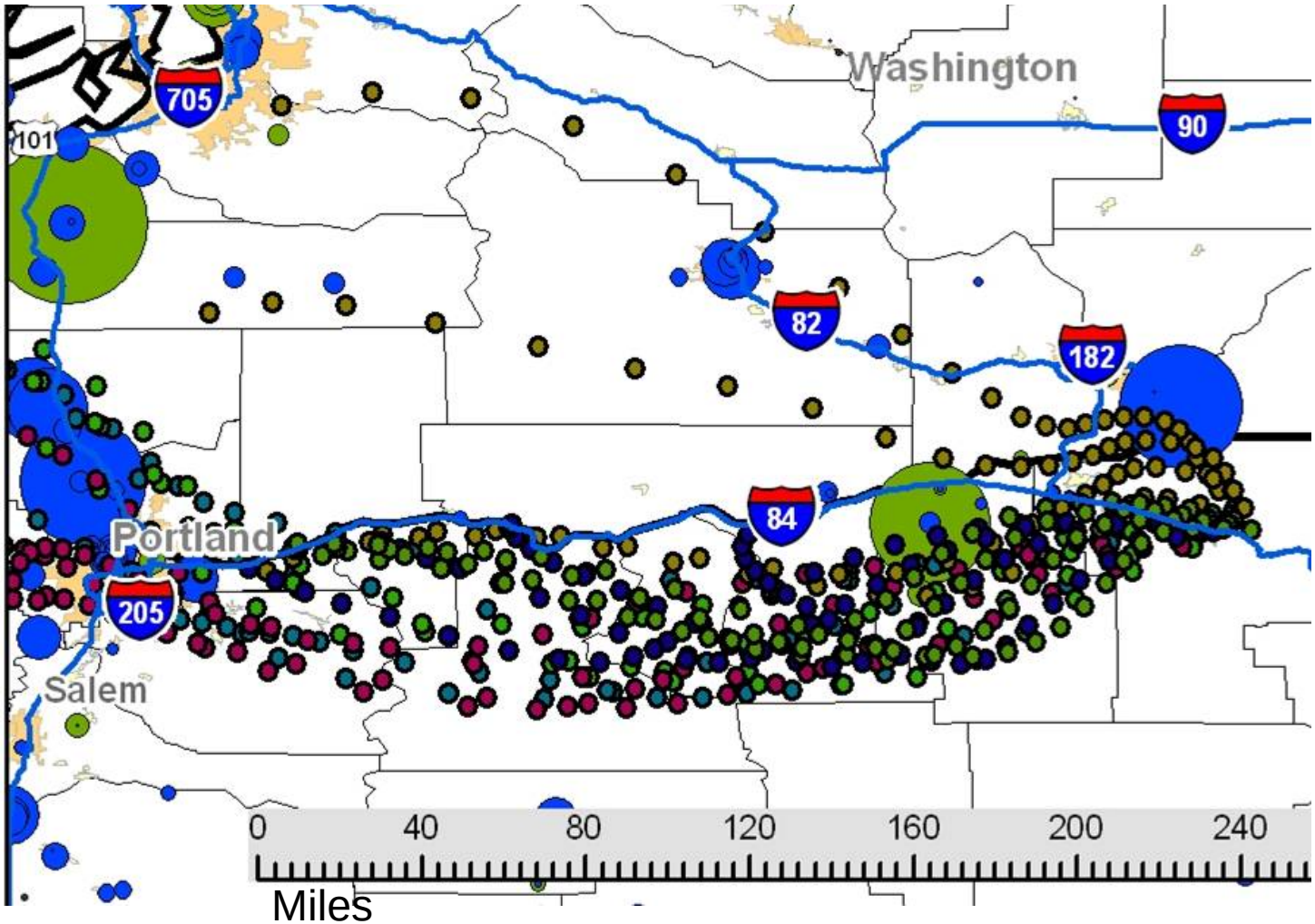
Back to Trajectories

A view toward the Umatilla Reservation

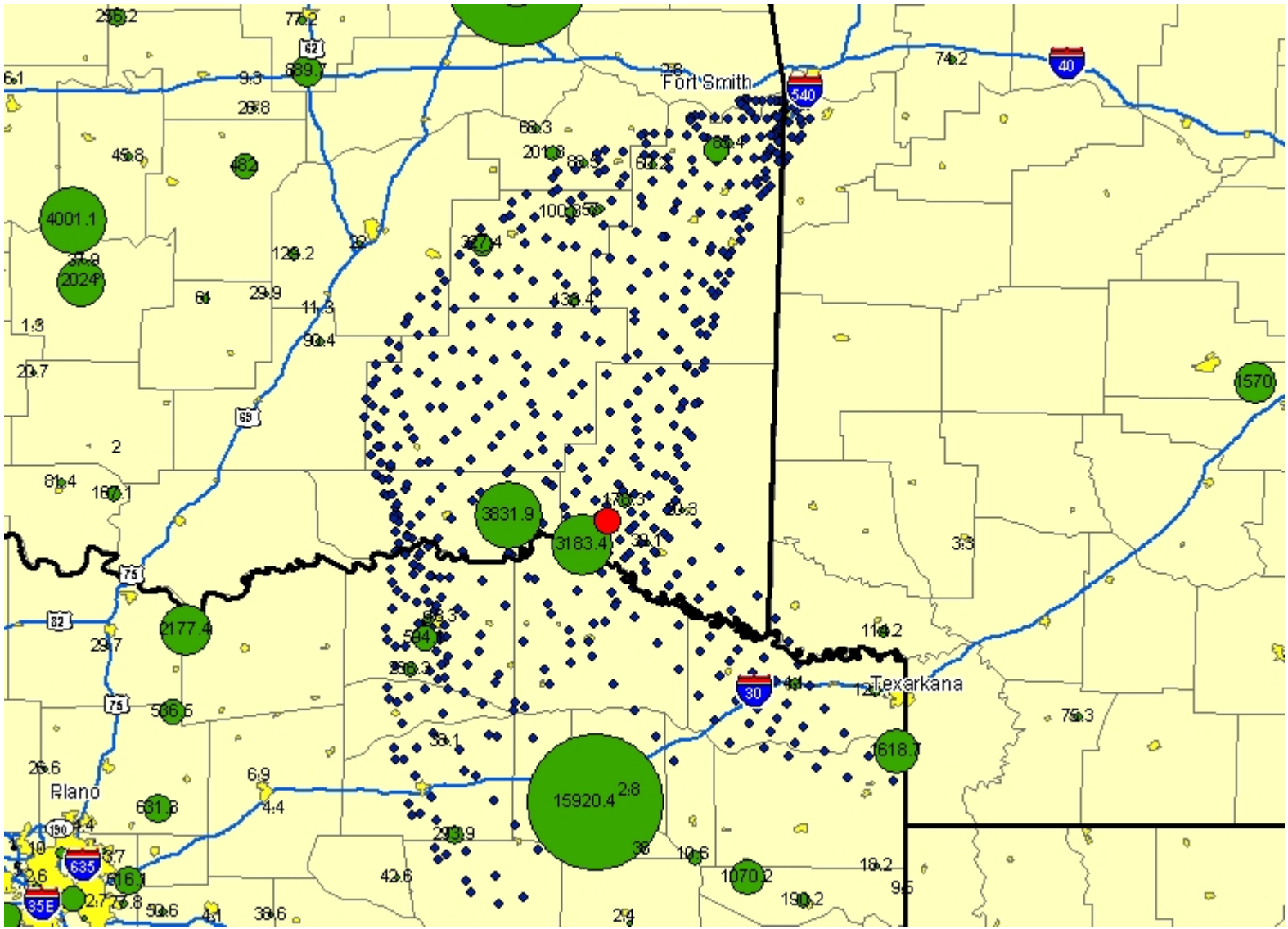
6-Days Elevated Ozone



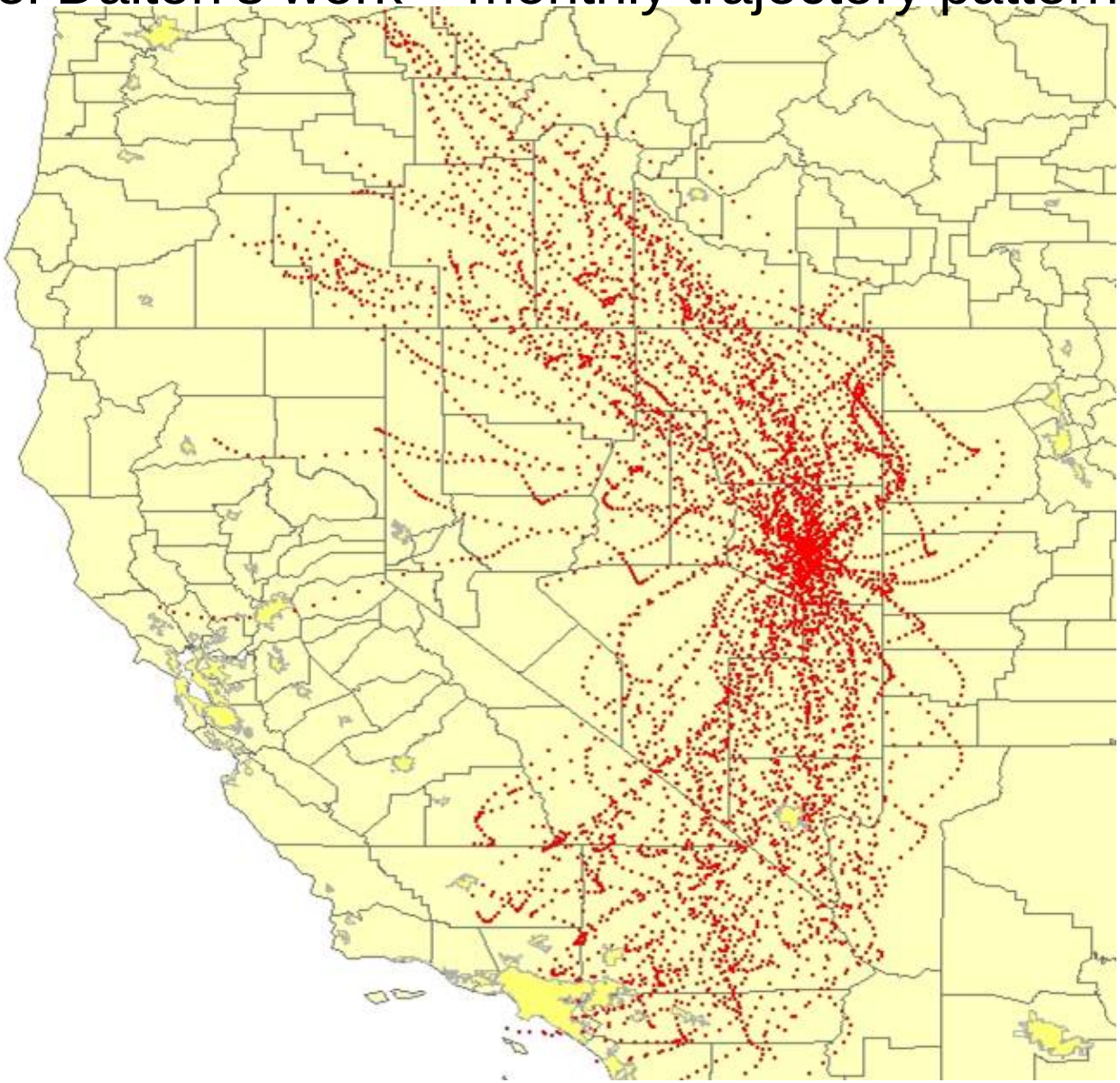
6 days Low Ozone



Highest Passive Ozone (24-hour sample)

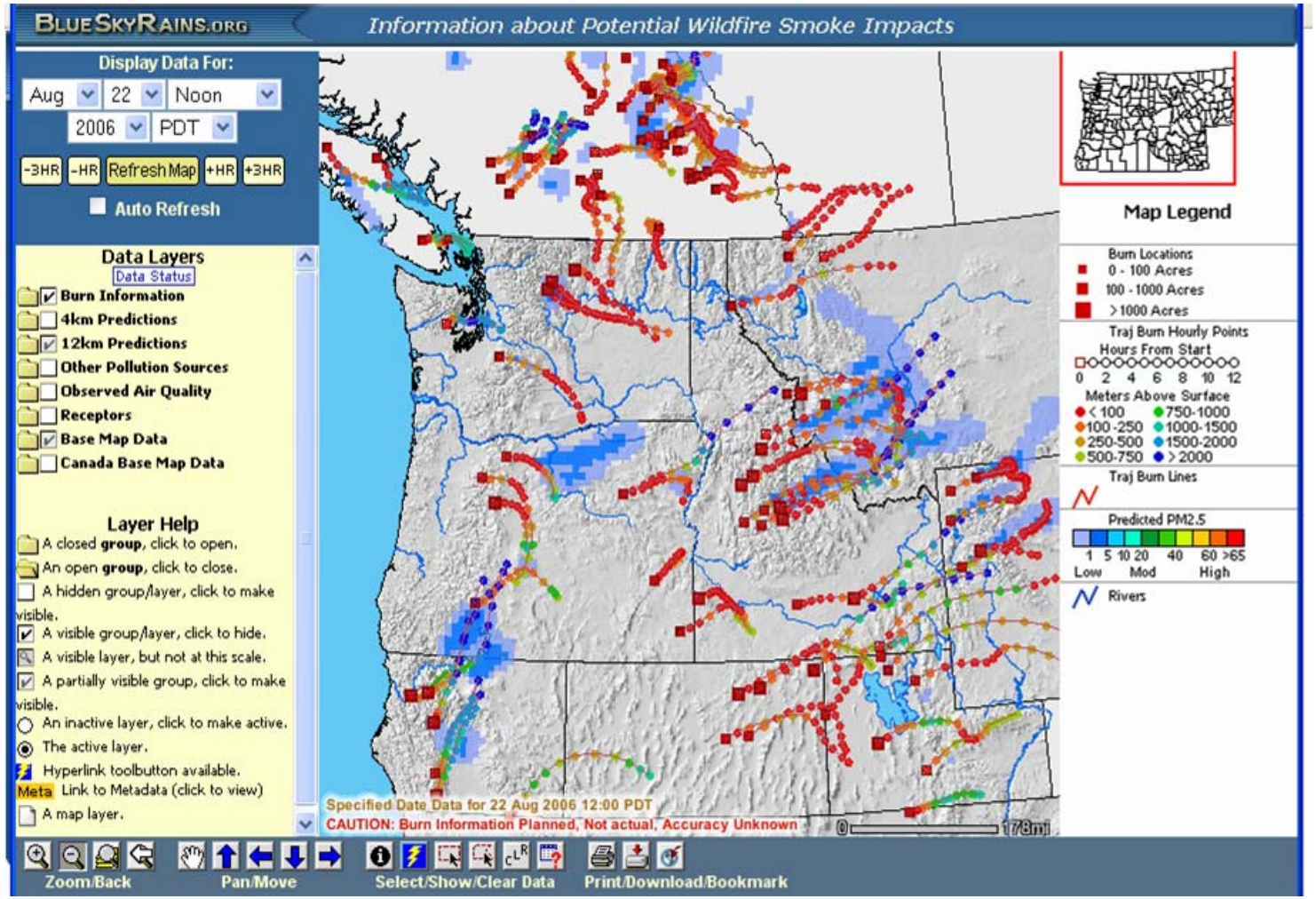


Eli Shoshone August 2002 Backward Trajectories (Michael Dalton's work – monthly trajectory patterns)



BlueSky – Wildfire Smoke Trajectories

http://www.blueskyrains.org/mapper.php



http://vista.cira.colostate.edu/views

IMPROVE Data

NOAA’s HYSPLIT Online Modeling Tool: A Backward Trajectory Demonstration

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HYSPLIT

On-line Transport and Dispersion Model

TRAJECTORY MODEL

- Compute trajectories
- Model results
- U.S. Trajectory Forecasts

DISPERSION MODEL

- Compute concentrations
- Model results

Publications using HYSPLIT results, maps or other READY products provided by NOAA ARL are requested to include an acknowledgement of, and citation to, the NOAA Air Resources Laboratory. Appropriate versions of the following are recommended:

Citation

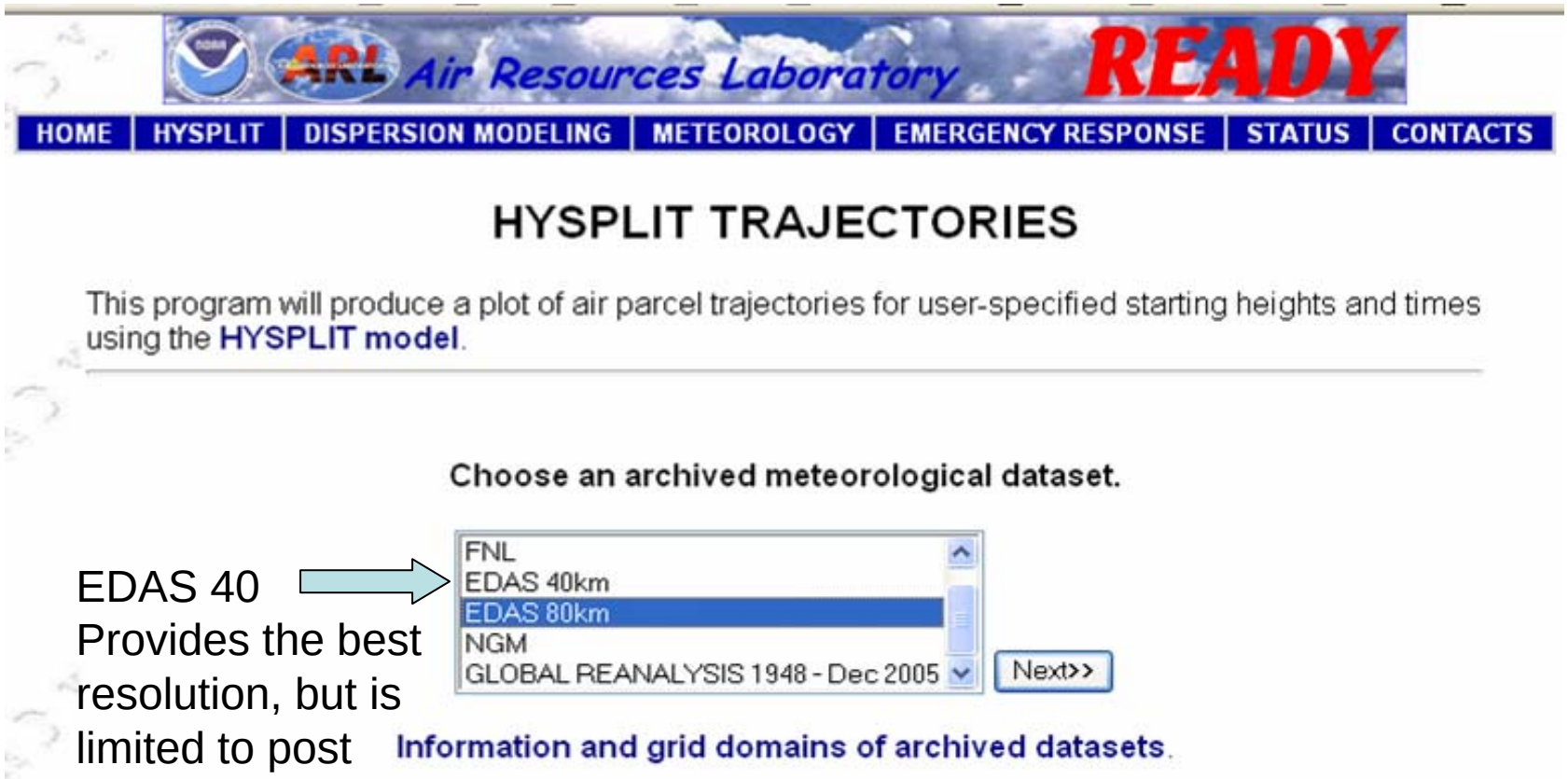
Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://www.arl.noaa.gov/ready/hysplit4.html). NOAA Air Resources Laboratory, Silver Spring, MD.

Rolph, G.D., 2003. Real-time Environmental Applications and Display sYstem (READY) Website (http://www.arl.noaa.gov/ready/hysplit4.html). NOAA Air Resources Laboratory, Silver Spring, MD.

Acknowledgment

The authors gratefully acknowledge the NOAA Air Resources Laboratory (ARL) for the provision of the HYSPLIT transport and dispersion model and/or READY website (http://www.arl.noaa.gov/ready.html) used in this publication.

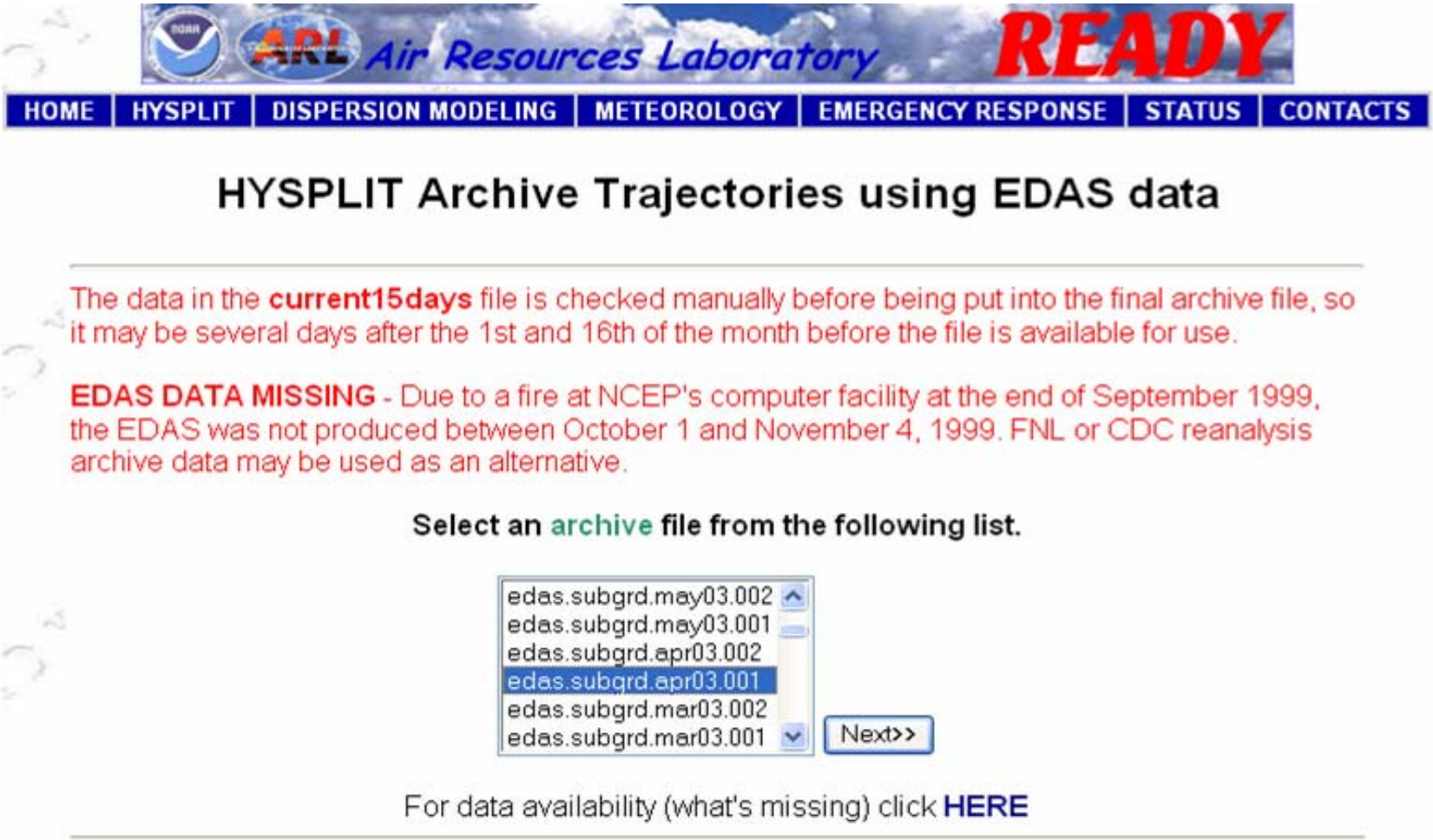
Select Compute trajectories



EDAS 40 Provides the best resolution, but is limited to post 2003 dates

Alaska may need to use global reanalysis

Select Met dataset



Select the date for the met data
apr03 is April 2003
001 is day 1 through 15 of the month
002 is day 16 to the end of the month

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EDAS TRAJECTORIES

Choose a Trajectory Starting Location...

1. Enter a WMO or ICAO station ID (i.e., dca) or a latitude/longitude pair (decimal degrees, XXX.XX):

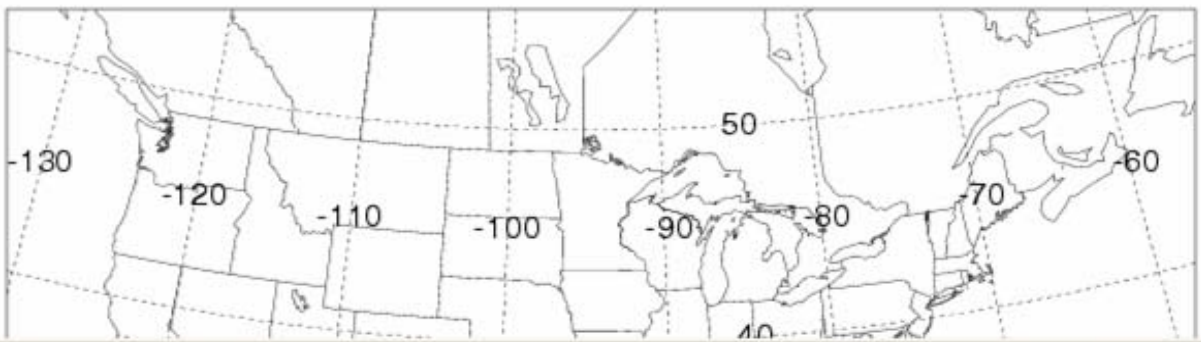
WMO ID: **Station lookup** **Convert Deg/Min/Sec into Decimal Degrees**

36.9222 Latitude (South is negative, i.e. -25.50):

-94.8389 Longitude (West is negative, i.e. -140.95) : Next>>

Or

2. click on a location on the following map(s):



Enter the Latitude, longitude of the monitoring site

MODEL SETUP SECTION

The EDAS archive file contains beginning at 0000 UTC 4/01/03.

List of missing EDAS data.

What is UTC time?

Help me with the inputs

Trajectory direction:	help	○ Forward			
		◉ Backward (You must change the default start time!)			
Vertical Motion:	help	◉ Model vertical velocity			
		○ Isobaric (constant pressure)			
Start time (UTC):	help	year 03	month 04	day 12	hour 22
Total run time (hours):	help	24			
Start a new trajectory every:	help	1 hrs	Maximum number of trajectories: 6		
Start latitude (degrees):	help	36.9222			
Start longitude (degrees):	help	-94.8389			
Start height 1:	help	4	◉ meters AGL	○ meters AMSL	
Start height 2:		0			
Start height 3:		0			
Plot projection:	help	◉ Default	○ Polar	○ Lambert	○ Mercator

Start longitude (degrees):	help	-94.8389			
Start height 1:	help	4	⊙ meters AGL	○ meters AMSL	
Start height 2:		0			
Start height 3:		0			
Plot projection:	help	⊙ Default	○ Polar	○ Lambert	○ Mercator
Vertical plot height units:	help	○ Pressure	⊙ meters AGL		
Label Interval:	help	○ No labels	⊙ 6 hours	○ 12 hours	○ 24 hours
Plot color trajectories?		⊙ Yes	○ No		
Zoom factor:	help	○ 0 (far)	○ 45	⊙ 75	○ 100 (close)
Create Java Animation?	help	○ Yes	⊙ No		
Graphic size (dpi):	help	○ 72	⊙ 96	○ 120	
Create Postscript file?	help	○ Yes	⊙ No		
Plot meteorological field along trajectory?	help	○ Yes	⊙ No	Note: Only choose one meteorological variable from below to plot	
Dump meteorological data along trajectory: NOTE: Only a maximum of 5 variables can be chosen at this time. Click the Help button for details.	help	☑ Terrain Height (m) ☐ Potential Temperature (K) ☑ Ambient Temperature (K) ☐ Rainfall (mm per hr) ☑ Mixed Layer Depth (m) ☐ Relative Humidity (%) ☑ Downward Solar Radiation Flux (W/m**2)			

MPORTANT...You may submit only one trajectory job at a time to the server. When the calculation is finished you will be permitted to submit another one.

Request trajectory | Default values

File Edit View Favorites Tools Help

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HYSPLIT Model Run Submitted.

You will need the following job number to access your results at a later time from the HYSPLIT Main Menu:

3872

NOTE: All graphics files will be removed after 6 hours.

HYSPLIT RUN RESULTS

File Edit View Favorites Tools Help

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HYSPLIT MODEL RESULTS FOR JOB NUMBER 3872

```
Complete Trajplot
Started Trajectory Drawing (Version: November 2005)
Complete Hysplit
Percent complete: 100.0
Percent complete:  96.7
Percent complete:  93.3
Percent complete:  90.0
Percent complete:  86.7
```

Your plot(s) are now available, but will be deleted in 6 hours:

Non-Javascript users click here for alternate links.

- Your Trajectory plot

- How to read the trajectory maps.
- Rescale the trajectory plot without rerunning the model.

- Plot meteorological time-height-section along trajectory(ies).
- Modify trajectory number 1.
- Modify trajectory number 2 (if available).
- Modify trajectory number 3 (if available).

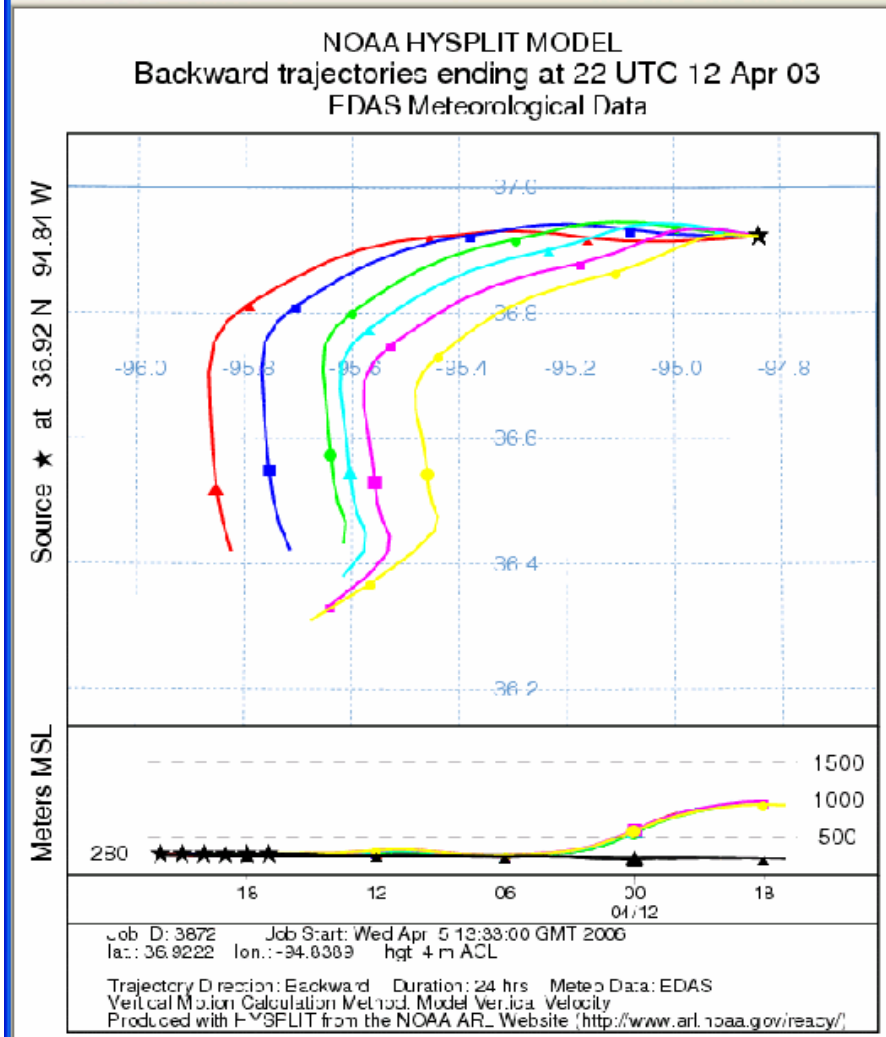
- Trajectory endpoints file.
- Trajectory endpoints format help. NEW

- HYSPLIT SETUP file.
- HYSPLIT CONTROL file.
- HYSPLIT MESSAGE (diagnostics) file.
  - MESSAGE file format help (pdf)

Start a new HYSPLIT model run.

http://www.arl.noaa.gov/data/ready/hysplitarc/3872_trj001.gif - Microsoft Internet Explorer

File Edit View Favorites Tools Help



Backward trajectories

Elevations of trajectories

CONTACTS

Done Internet

start http://www.arl.no... http://www.arl.no... My Documents C:\Documents and ... Microsoft PowerPoi... 6:28 AM

File Edit View Favorites Tools Help

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HYSPLIT MODEL RESULTS FOR JOB NUMBER 3872

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Complete Trajplot
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- HYSPLIT SETUP file.
- HYSPLIT CONTROL file.
- HYSPLIT MESSAGE (diagnostics) file.
  - MESSAGE file format help (pdf)

Start a new HYSPLIT model run.

http://www.arl.noaa.gov/data/ready/hysplitarc/tdump.3872.txt - Microsoft Internet Explorer

File Edit View Favorites Tools Help

```
 3      1
EDAS      3      4      1      0      0
EDAS      3      3     16      0      0
EDAS      3      4     16      0      0
 6 BACKWARD OMEGA
 3      4     12     22   36.922  -94.839      4.0
 3      4     12     21   36.922  -94.839      4.0
 3      4     12     20   36.922  -94.839      4.0
 3      4     12     19   36.922  -94.839      4.0
 3      4     12     18   36.922  -94.839      4.0
 3      4     12     17   36.922  -94.839      4.0
 5 PRESSURE AIR_TEMP MIXDEPTH TERR_MSL SUN_FLUX
 1      1      3      4     12     22      0      0      0.0   36.922  -94.839      4.0    982.9    299.1   2023.2    276.4    432.7
 2      1      3      4     12     22      0      0      0.0   36.922  -94.839      4.0    982.9    299.1   2023.2    276.4    432.7
 3      1      3      4     12     22      0      0      0.0   36.922  -94.839      4.0    982.9    299.1   2023.2    276.4    432.7
 4      1      3      4     12     22      0      0      0.0   36.922  -94.839      4.0    982.9    299.1   2023.2    276.4    432.7
 5      1      3      4     12     22      0      0      0.0   36.922  -94.839      4.0    982.9    299.1   2023.2    276.4    432.7
 6      1      3      4     12     22      0      0      0.0   36.922  -94.839      4.0    982.9    299.1   2023.2    276.4    432.7
 1      1      3      4     12     21      0      0     -1.0   36.917  -94.922      0.0    983.6    299.6   2212.3    270.1    600.0
 1      1      3      4     12     20      0      0     -2.0   36.914  -95.011      0.0    985.0    299.1   2100.5    263.9    725.8
 2      1      3      4     12     20      0      0     -2.0   36.923  -94.928      0.0    984.1    299.1   2090.8    271.7    725.0
 1      1      3      4     12     19      0      0     -3.0   36.915  -95.090      0.0    985.6    298.6   1960.2    262.9    851.4
 2      1      3      4     12     19      0      0     -3.0   36.926  -95.009      0.0    985.4    298.6   1968.1    264.5    850.4
 3      1      3      4     12     19      0      0     -3.0   36.928  -94.921      0.8    984.5    298.5   1967.6    272.6    850.0
 1      1      3      4     12     18      0      0     -4.0   36.920  -95.159      0.0    986.1    298.0   1835.5    262.3    976.6
 2      1      3      4     12     18      0      0     -4.0   36.933  -95.080      0.0    985.9    298.0   1835.4    263.9    975.7
 3      1      3      4     12     18      0      0     -4.0   36.937  -94.994      0.0    985.7    298.0   1836.1    265.6    975.0
 4      1      3      4     12     18      0      0     -4.0   36.933  -94.914      2.7    984.8    297.9   1846.4    273.5    975.0
 1      1      3      4     12     17      0      0     -5.0   36.927  -95.220      0.5    986.4    295.3   1307.0    262.3    922.9
 2      1      3      4     12     17      0      0     -5.0   36.939  -95.141      0.6    986.2    295.3   1307.0    264.0    922.5
 3      1      3      4     12     17      0      0     -5.0   36.944  -95.057      0.7    986.1    295.3   1306.9    265.3    922.1
 4      1      3      4     12     17      0      0     -5.0   36.941  -94.979      3.5    985.8    295.3   1308.6    268.0    922.0
 5      1      3      4     12     17      0      0     -5.0   36.932  -94.906      5.1    985.0    295.3   1315.1    274.9    922.3
 1      1      3      4     12     16      0      0     -6.0   36.930  -95.271      3.4    986.7    292.6    778.5    261.9    868.6
 2      1      3      4     12     16      0      0     -6.0   36.942  -95.194      3.6    986.5    292.6    778.5    263.5    868.7
 3      1      3      4     12     16      0      0     -6.0   36.945  -95.110      3.8    986.3    292.6    778.5    264.7    868.7
 4      1      3      4     12     16      0      0     -6.0   36.943  -95.033      6.7    986.3    292.6    778.4    265.5    868.8
 5      1      3      4     12     16      0      0     -6.0   36.934  -94.962      8.7    985.8    292.6    780.2    269.4    869.2
 6      1      3      4     12     16      0      0     -6.0   36.925  -94.896      8.1    985.1    292.6    783.3    275.6    869.8
```

Save text file for GIS integration