Exploring a Pollution Event

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A very important chemical reaction:

\[ \text{NO} + O_3 \rightarrow \text{NO}_2^* + O_2 \]

Notes:
NOx = NO + NO2
NOy = NOx + all other reactive oxides of nitrogen
NO reacts with ozone driving ozone concentrations down
NO2 reacts with VOCs in sunlight and produces ozone
The 5th and 6th is Saturday, Sunday
Quapaw Site on July 22, 2004 – Site’s highest 8-hr Ozone

93 ppb as an 8-hour average
What were other 8-Hour ozone concentrations on July 22, 2004?
I selected ozone for one state at a time and merged the resulting data in a spreadsheet.
Since these data have spatial references for each monitoring site (lat, long) I can easily put this data into GIS software. Then I can use gradients to make higher concentrations appear as larger circles on the map.
Area 8-hr Ozone on July 22, 2004
I can also use GIS extensions to help illustrate.

8-hr Ozone on July 22, 2004 with Prediction Contours (ESRI Geostatistical Analyst)
I can use Air Data or other resources to get point source emissions data, map it and make the size of the circles proportional to emissions. I can also use NOAA’s Air Resources Laboratory’s HYSPLIT software to perform backward trajectories from monitoring sites on the day of concern.
# HYSPLIT Trajectory Model

## Model Run Details

**Meteorology:** EDAS40  
**Source Location:** Lat: 36.922222 Lon: -94.838889  
The EDAS40 archive file contains data beginning at 0000 UTC 7/16/04.

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<th>Change Default Model Parameters and Display Options</th>
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### Trajectory direction:

- [ ] Forward
- [ ] Backward

### Vertical Motion:

- [ ] Model vertical velocity
- [ ] Isobaric
- [ ] Isentropic

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<thead>
<tr>
<th>Start time (UTC):</th>
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<td>[help]</td>
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<th>Total run time (hours):</th>
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<td>[help]</td>
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<th>Start a new trajectory every:</th>
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July 22, 2004, 24-hour Backward Trajectories (NOAA Air Resource Laboratory HYSPLIT Model)

- proportional NOx point source emissions – 2002 EI

Quapaw Site
Now I have some suspect areas that may have contributed to the problem (something near the three coal-fired power plants). I can use ARL’s HYSPLIT software to run forward dispersions from the power plants to see where the model indicates their emissions were when I had the high concentration. In this example I set the model to average concentrations from 100 m to ground level and set it for a 48-hour release beginning 48-hours prior to the high concentration at the Quapaw site.
Oologah Power Plant 48-hr dispersion
(NOAA Air Resource Laboratory HYSPLIT Model)
GRDA Power Plant 48-hr dispersion
(NOAA Air Resource Laboratory HYSPLIT Model)
Muskogee Power Plant 48-hr dispersion
(NOAA Air Resource Laboratory HYSPLIT Model)
Combined 48-hr dispersion
(NOAA Air Resource Laboratory HYSPLIT Model)
26.5% of Oklahoma facility NOx emissions are from Muskogee, Mayes and Rogers Counties (1999)

22.9% of Oklahoma facility NOx emissions are from three NE Oklahoma coal-fired power plants (1999)
A tutorial is being developed with step-by-step screen shots using this example. Every step in GIS software will be included. If you would like a copy when it is completed please email me at: glenn.gehring@nau.edu