Transport Science and the Law

Air Quality Applied Sciences Team
5th Semi-Annual Meeting (AQAST 5)

University of Maryland
College Park, MD
June 5, 2013
About NESCAUM

• Northeast States for Coordinated Air Use Management

• Association of 8 Northeast state air agencies

• Formed in 1967

• Technical and policy support for air quality & climate initiatives
Talk Outline

I. My policy-relevant science questions

II. Transport science and the law
   A. Clean Air Act federal/state roles
   B. History of pollution transport rules
   C. EPA approach to “significant contribution”
   D. Court’s approach to “significant contribution”

III. How might this end?
My Science Questions

1. Peak day NOx emissions & high ozone days
   i. How well do AQ grid models handle?
   ii. Can satellites detect?

2. Does tighter or different ozone standard mean new strategies?
   i. Winter VOCs or NOx?
   ii. Methane?

3. Is the 8-hour, 4th annual max., 3-year average ozone NAAQS “stable” over time for planning purposes?
Transport Science and the Law
3 Views of Air Pollution Transport

(simplified)
Science’s View

Transport Regimes Observed During NARSTO-Northeast
EPA’s View

The arrows show the “linkages” between upwind and downwind states. Arrows point from upwind states that contribute 1% of the NAAQS or more to nonattainment and/or maintenance in other downwind states. A key to these state linkages appears below.

Key to Arrows
- Upwind-Downwind Linkage for Ozone
- Upwind-Downwind Linkage for Annual PM\(_{2.5}\)
- Upwind-Downwind Linkage for Daily PM\(_{2.5}\)

Legend:
- States controlled for both fine particles (annual SO\(_2\) and NO\(_x\)) and ozone (ozone season NO\(_x\)) (21 States)
- States controlled for fine particles only (annual SO\(_2\) and NO\(_x\)) (2 States)
- States controlled for ozone only (ozone season NO\(_x\)) (5 States)
- States not covered by the Cross-State Air Pollution Rule
Court’s View
Clean Air Act

Federal/State Roles:

• EPA sets national ambient air quality standards

• States, not EPA, choose strategies to meet
CAA Requirements for States

Each State *shall within 3 years* of a new national air quality standard have a plan that:

A. Includes enforceable emission limits and other measures
B. Provides for monitoring and analyzing air data
C. Has an enforcement program

*D. Prohibits in-state emissions from significantly contributing to violations of air standards downwind*

E.-M. …and so on.
EPA’s “Significant Contribution” Test

2-part test for ozone:

1. Upwind states are linked to downwind problems if exceeding a threshold amount of ozone contribution based on AQ modeling

2. For linked states, NOx reduction amount set by $/ton control cost
A Brief History of Transport Rules

1st: 1998 “NOx SIP Call”
   – Mostly upheld by court

2nd: 2005 “CAIR”
   – Remanded by court

3rd: 2010 “CSAPR”
   – Vacated by court
Court’s “Significant Contribution” Test

1. Upwind reductions must be “proportional” across all upwind states
   – Cost only used to lower upwind reduction amounts

2. States have no obligation to address significant contribution in plans prior to EPA quantifying amount
   – Court-created exception in list of required plan elements Congress gave in Clean Air Act
What is “Proportional”? 

1. Based on emissions reductions (e.g., NOx tons)?

2. Based on ambient pollutant contributions (e.g., ppb)?

3. Some other proportional approach?
### Court Example in CSAPR Ruling

<table>
<thead>
<tr>
<th>State</th>
<th>Contribution (NAAQS Units)</th>
<th>Relative Contribution</th>
<th>Proportional Share (NAAQS Units)</th>
<th>Percent Reduction in Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home State</td>
<td>90 (NAAQS=100)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Upwind A</td>
<td>10</td>
<td>10/60 = 0.167</td>
<td>0.167 * 50 = 8.35</td>
<td>8.35 / 10 = 83%</td>
</tr>
<tr>
<td>Upwind B</td>
<td>20</td>
<td>20/60 = 0.333</td>
<td>0.333 * 50 = 16.65</td>
<td>16.65 / 20 = 83%</td>
</tr>
<tr>
<td>Upwind C</td>
<td>30</td>
<td>30/60 = 0.500</td>
<td>0.500 * 50 = 25.00</td>
<td>25.00 / 30 = 83%</td>
</tr>
<tr>
<td>Total Upwind States</td>
<td>60, but only 50 are above the NAAQS</td>
<td>1.00</td>
<td>50</td>
<td>83%</td>
</tr>
</tbody>
</table>

Table developed by EPA
### Rolling 3-yr Avg. of Ozone Std.

*E.g., Michigan ozone monitors – annual 4th max., 8-hr, 3-yr averages*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-1999</td>
<td>0.094</td>
<td>0.089</td>
<td>0.087</td>
<td>0.092</td>
<td>0.097</td>
<td>0.093</td>
<td>0.089</td>
<td>0.088</td>
<td>0.093</td>
<td>0.086</td>
<td>0.081</td>
<td>0.074</td>
<td>0.078</td>
<td>0.078</td>
<td>0.084</td>
</tr>
<tr>
<td>1998-2000</td>
<td>0.089</td>
<td>0.089</td>
<td>0.086</td>
<td>0.088</td>
<td>0.083</td>
<td>0.083</td>
<td>0.080</td>
<td>0.082</td>
<td>0.076</td>
<td>0.072</td>
<td>0.069</td>
<td>0.070</td>
<td>0.075</td>
<td>0.075</td>
<td>0.075</td>
</tr>
<tr>
<td>1999-2001</td>
<td>0.096</td>
<td>0.088</td>
<td>0.087</td>
<td>0.091</td>
<td>0.086</td>
<td>0.084</td>
<td>0.079</td>
<td>0.084</td>
<td>0.078</td>
<td>0.076</td>
<td>0.071</td>
<td>0.075</td>
<td>0.075</td>
<td>0.074</td>
<td>0.075</td>
</tr>
<tr>
<td>2000-2002</td>
<td>0.092</td>
<td>0.088</td>
<td>0.087</td>
<td>0.090</td>
<td>0.093</td>
<td>0.089</td>
<td>0.084</td>
<td>0.078</td>
<td>0.080</td>
<td>0.075</td>
<td>0.075</td>
<td>0.070</td>
<td>0.074</td>
<td>0.076</td>
<td>0.074</td>
</tr>
<tr>
<td>2001-2003</td>
<td>0.092</td>
<td>0.088</td>
<td>0.087</td>
<td>0.090</td>
<td>0.093</td>
<td>0.089</td>
<td>0.084</td>
<td>0.078</td>
<td>0.080</td>
<td>0.075</td>
<td>0.075</td>
<td>0.070</td>
<td>0.074</td>
<td>0.076</td>
<td>0.074</td>
</tr>
<tr>
<td>2002-2004</td>
<td>0.086</td>
<td>0.083</td>
<td>0.084</td>
<td>0.083</td>
<td>0.088</td>
<td>0.080</td>
<td>0.075</td>
<td>0.077</td>
<td>0.074</td>
<td>0.072</td>
<td>0.068</td>
<td>0.069</td>
<td>0.076</td>
<td>0.075</td>
<td>0.076</td>
</tr>
<tr>
<td>2003-2005</td>
<td>0.089</td>
<td>0.086</td>
<td>0.086</td>
<td>0.090</td>
<td>0.085</td>
<td>0.082</td>
<td>0.077</td>
<td>0.079</td>
<td>0.076</td>
<td>0.074</td>
<td>0.068</td>
<td>0.069</td>
<td>0.076</td>
<td>0.075</td>
<td>0.074</td>
</tr>
<tr>
<td>2004-2006</td>
<td>0.085</td>
<td>0.083</td>
<td>0.083</td>
<td>0.082</td>
<td>0.087</td>
<td>0.080</td>
<td>0.077</td>
<td>0.078</td>
<td>0.074</td>
<td>0.072</td>
<td>0.067</td>
<td>0.068</td>
<td>0.074</td>
<td>0.074</td>
<td>0.074</td>
</tr>
<tr>
<td>2005-2007</td>
<td>0.082</td>
<td>0.082</td>
<td>0.083</td>
<td>0.082</td>
<td>0.085</td>
<td>0.080</td>
<td>0.078</td>
<td>0.073</td>
<td>0.077</td>
<td>0.073</td>
<td>0.073</td>
<td>0.068</td>
<td>0.068</td>
<td>0.071</td>
<td>0.071</td>
</tr>
<tr>
<td>2006-2008</td>
<td>0.087</td>
<td>0.082</td>
<td>0.082</td>
<td>0.081</td>
<td>0.086</td>
<td>0.081</td>
<td>0.078</td>
<td>0.072</td>
<td>0.076</td>
<td>0.073</td>
<td>0.074</td>
<td>0.069</td>
<td>0.071</td>
<td>0.075</td>
<td>0.075</td>
</tr>
<tr>
<td>2007-2009</td>
<td>0.081</td>
<td>0.081</td>
<td>0.082</td>
<td>0.080</td>
<td>0.078</td>
<td>0.073</td>
<td>0.076</td>
<td>0.073</td>
<td>0.071</td>
<td>0.065</td>
<td>0.066</td>
<td>0.046</td>
<td>0.071</td>
<td>0.071</td>
<td>0.071</td>
</tr>
<tr>
<td>2008-2010</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2009-2011</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2010-2012</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>1997-1999</td>
<td>0.094</td>
<td>0.089</td>
<td>0.087</td>
<td>0.092</td>
<td>0.097</td>
<td>0.093</td>
<td>0.089</td>
<td>0.088</td>
<td>0.093</td>
<td>0.086</td>
<td>0.08</td>
<td>0.074</td>
<td>0.078</td>
<td>0.084</td>
<td></td>
</tr>
<tr>
<td>1998-2000</td>
<td>0.089</td>
<td>0.089</td>
<td>0.089</td>
<td>0.086</td>
<td>0.088</td>
<td>0.083</td>
<td>0.083</td>
<td>0.080</td>
<td>0.082</td>
<td>0.076</td>
<td>0.076</td>
<td>0.079</td>
<td>0.071</td>
<td>0.075</td>
<td></td>
</tr>
<tr>
<td>1999-2001</td>
<td>0.096</td>
<td>0.088</td>
<td>0.087</td>
<td>0.087</td>
<td>0.091</td>
<td>0.086</td>
<td>0.084</td>
<td>0.079</td>
<td>0.084</td>
<td>0.078</td>
<td>0.06</td>
<td>0.071</td>
<td>0.075</td>
<td>0.078</td>
<td></td>
</tr>
<tr>
<td>2000-2002</td>
<td>0.092</td>
<td>0.088</td>
<td>0.087</td>
<td>0.090</td>
<td>0.093</td>
<td>0.089</td>
<td>0.084</td>
<td>0.078</td>
<td>0.080</td>
<td>0.075</td>
<td>0.05</td>
<td>0.070</td>
<td>0.074</td>
<td>0.076</td>
<td></td>
</tr>
<tr>
<td>2001-2003</td>
<td>0.081</td>
<td>0.079</td>
<td>0.082</td>
<td>0.082</td>
<td>0.086</td>
<td>0.080</td>
<td>0.078</td>
<td>0.073</td>
<td>0.076</td>
<td>0.073</td>
<td>0.071</td>
<td>0.065</td>
<td>0.066</td>
<td>0.071</td>
<td></td>
</tr>
<tr>
<td>2002-2004</td>
<td>0.086</td>
<td>0.083</td>
<td>0.084</td>
<td>0.083</td>
<td>0.088</td>
<td>0.083</td>
<td>0.080</td>
<td>0.075</td>
<td>0.077</td>
<td>0.074</td>
<td>0.072</td>
<td>0.068</td>
<td>0.069</td>
<td>0.076</td>
<td></td>
</tr>
<tr>
<td>2003-2005</td>
<td>0.089</td>
<td>0.086</td>
<td>0.087</td>
<td>0.084</td>
<td>0.089</td>
<td>0.082</td>
<td>0.077</td>
<td>0.079</td>
<td>0.076</td>
<td>0.074</td>
<td>0.072</td>
<td>0.067</td>
<td>0.068</td>
<td>0.074</td>
<td></td>
</tr>
<tr>
<td>2004-2006</td>
<td>0.085</td>
<td>0.083</td>
<td>0.083</td>
<td>0.082</td>
<td>0.087</td>
<td>0.080</td>
<td>0.077</td>
<td>0.072</td>
<td>0.078</td>
<td>0.074</td>
<td>0.072</td>
<td>0.066</td>
<td>0.066</td>
<td>0.071</td>
<td></td>
</tr>
<tr>
<td>2005-2007</td>
<td>0.082</td>
<td>0.082</td>
<td>0.083</td>
<td>0.085</td>
<td>0.080</td>
<td>0.078</td>
<td>0.072</td>
<td>0.073</td>
<td>0.077</td>
<td>0.073</td>
<td>0.071</td>
<td>0.068</td>
<td>0.067</td>
<td>0.071</td>
<td></td>
</tr>
<tr>
<td>2006-2008</td>
<td>0.087</td>
<td>0.082</td>
<td>0.081</td>
<td>0.086</td>
<td>0.081</td>
<td>0.080</td>
<td>0.078</td>
<td>0.073</td>
<td>0.076</td>
<td>0.073</td>
<td>0.071</td>
<td>0.069</td>
<td>0.071</td>
<td>0.076</td>
<td></td>
</tr>
<tr>
<td>2007-2009</td>
<td>0.081</td>
<td>0.077</td>
<td>0.078</td>
<td>0.079</td>
<td>0.085</td>
<td>0.080</td>
<td>0.078</td>
<td>0.077</td>
<td>0.083</td>
<td>0.077</td>
<td>0.072</td>
<td>0.067</td>
<td>0.070</td>
<td>0.075</td>
<td></td>
</tr>
<tr>
<td>2008-2010</td>
<td>0.091</td>
<td>0.089</td>
<td>0.087</td>
<td>0.085</td>
<td>0.084</td>
<td>0.082</td>
<td>0.080</td>
<td>0.079</td>
<td>0.086</td>
<td>0.080</td>
<td>0.078</td>
<td>0.074</td>
<td>0.076</td>
<td>0.079</td>
<td></td>
</tr>
<tr>
<td>2009-2011</td>
<td>0.084</td>
<td>0.087</td>
<td>0.085</td>
<td>0.085</td>
<td>0.086</td>
<td>0.082</td>
<td>0.080</td>
<td>0.085</td>
<td>0.080</td>
<td>0.078</td>
<td>0.075</td>
<td>0.069</td>
<td>0.069</td>
<td>0.076</td>
<td></td>
</tr>
<tr>
<td>2010-2012</td>
<td>0.084</td>
<td>0.087</td>
<td>0.085</td>
<td>0.086</td>
<td>0.084</td>
<td>0.082</td>
<td>0.080</td>
<td>0.085</td>
<td>0.080</td>
<td>0.078</td>
<td>0.075</td>
<td>0.067</td>
<td>0.069</td>
<td>0.076</td>
<td></td>
</tr>
</tbody>
</table>

**Period Used by EPA**

E.g., Michigan ozone monitors – annual 4th max., 8-hr, 3-yr averages
Designated Ozone Nonattainment Areas, 75 ppb NAAQS

Nonattainment areas are indicated by color. When only a portion of a county is shown in color, it indicates that only that part of the county is within a nonattainment area boundary.
“Violating” Ozone Sites (2010-2012)

Nonattainment areas are indicated by color. When only a portion of a county is shown in color, it indicates that only that part of the county is within a nonattainment area boundary.
Summary

1. Science and legal views of air pollution transport differ

2. Recent court decisions have confused regulatory approach
How Might this End?

1. Extent of current ozone problem may still lead to similar result for new transport rule, but much delayed in time

2. Many states are arguing for deeper NOx reductions on state-by-state basis

3. There may be a more stringent ozone health standard next time