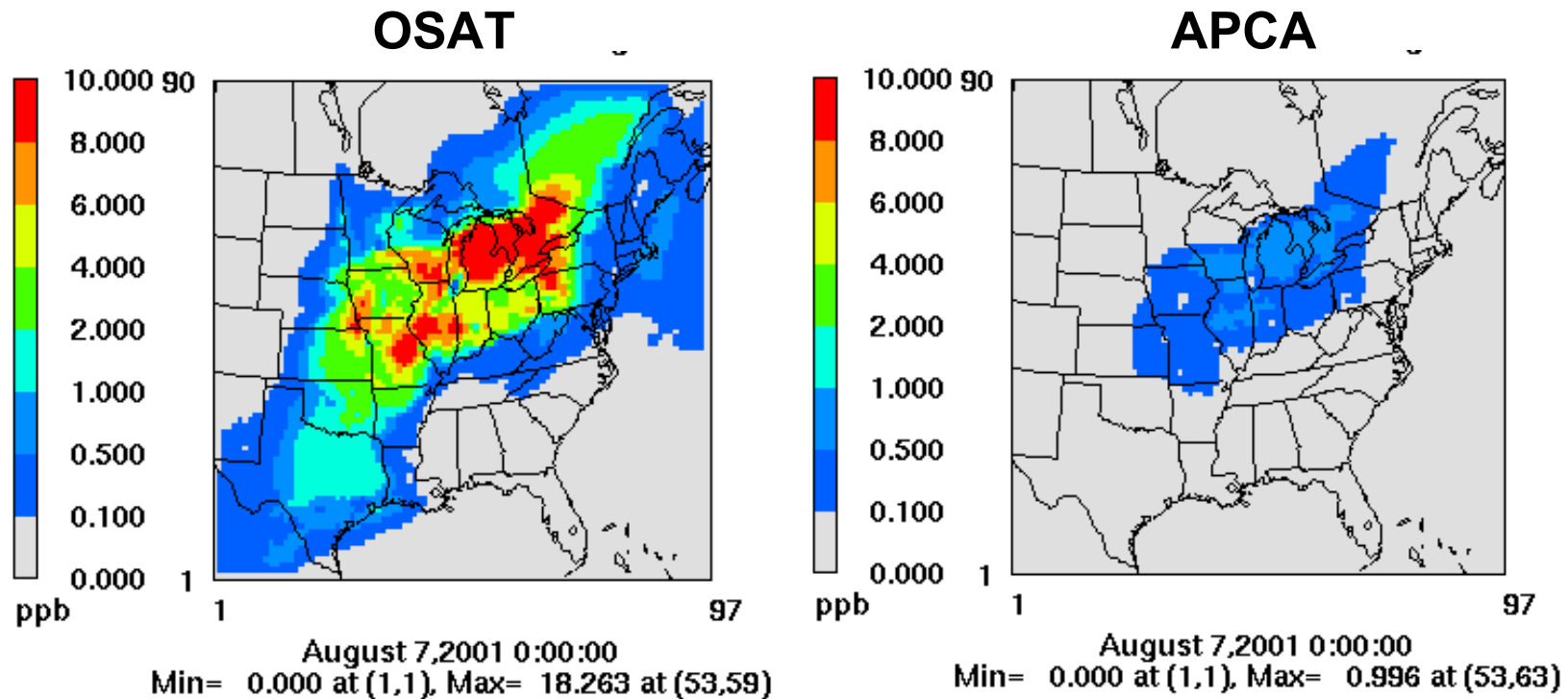


Ozone Source Apportionment Tool
CAMx4.20(beta)

Kirk Baker
May 2005
MRPO/LADCO

Biogenic Contribution: OSAT v. APCA

Ozone Attributed to Biogenic VOC in OSAT and APCA



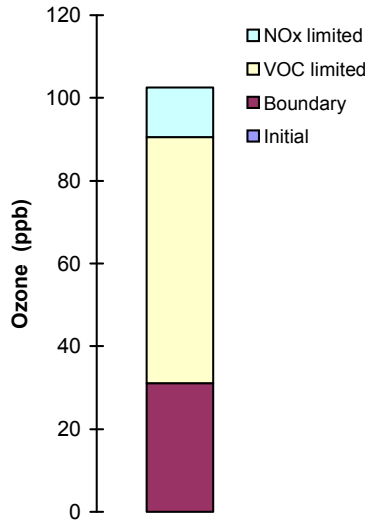
APCA apportionment selected (regulatory relevant apportionment):
Biogenic VOC + Anthropogenic NOX = apportionment to
anthropogenic NOX even if VOC limited

**Plots from Margaret McCourtney (MN APCA)*

OSAT Source Apportionment

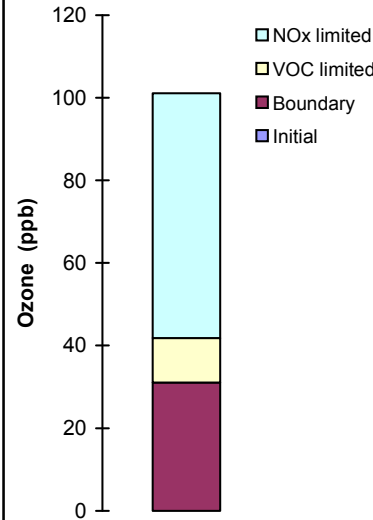
APCA Source Apportionment

Contributions By Type



VOC limited, so O3 is being apportioned to biogenic VOC source category.

Contributions By Type



“NOX limited”, so O3 is being apportioned to onroad and elevated point NOX source categories.

Receptor = Cedar Crk
 Time = 16 To 17
 Date = 8/7/2001
 Scenario = 4rpos.36.14.baseEOSATv403
 Total Ozone = 102 ppb

Detailed Ozone Apportionment

Source Area	Emission Group	Percent Ozone from			Time Emitted	Recirculation Likely
		NOx	VOC	Total		
IC				0%		
BC				30%		
MN	Biogenics	1%	44%	44%		★
MN	OnRoad	3%	4%	7%		
MN	NonRoad	3%	1%	4%		
WI	Biogenics	0%	4%	4%		
MN	OtherArea	0%	3%	3%		
MN	Elev Point	3%	0%	3%		
All Others				4%		

Receptor = Cedar Crk
 Time = 16 To 17
 Date = 8/7/2001
 Scenario = 4rpos.36.14.baseEAPCAv403
 Total Ozone = 101 ppb

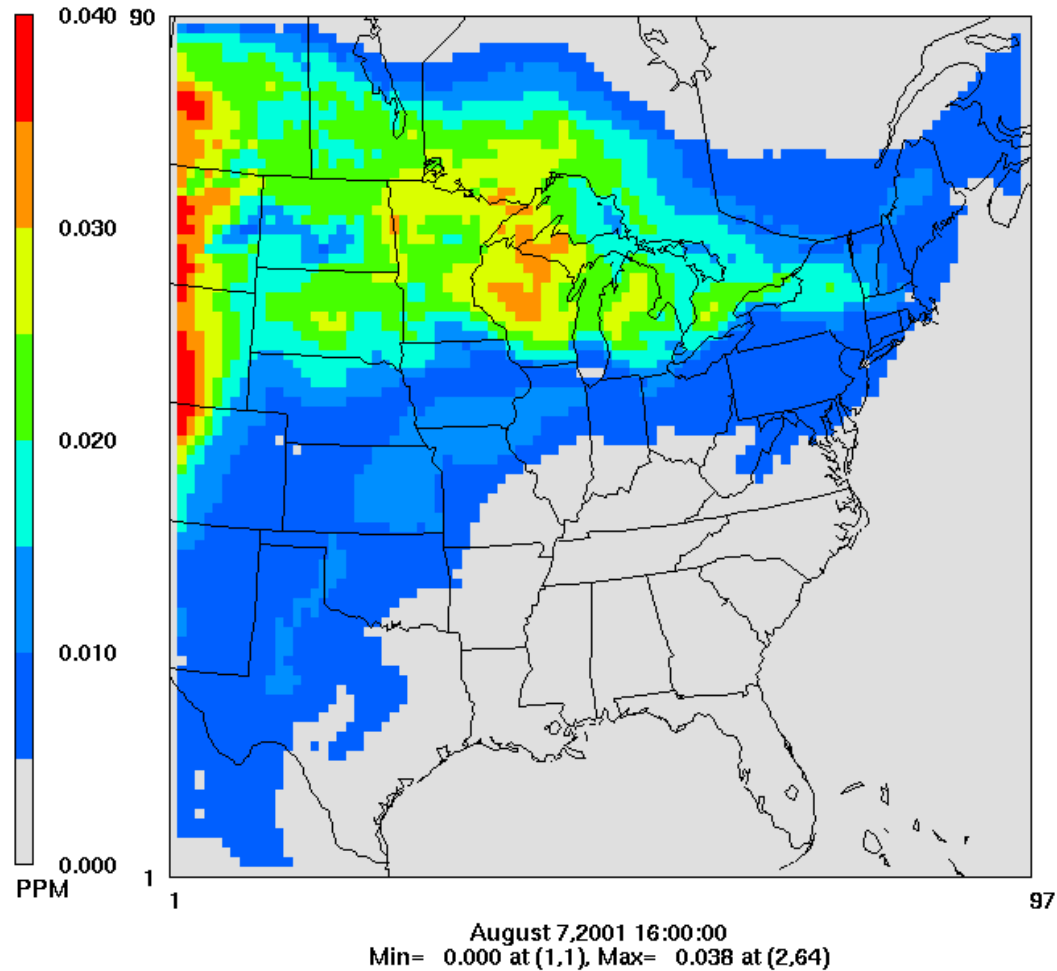
Detailed Ozone Apportionment

Source Area	Emission Group	Percent Ozone from			Time Emitted	Recirculation Likely
		NOx	VOC	Total		
IC				0%		
BC				31%		
MN	OnRoad	24%	4%	28%		★
MN	Elev Point	18%	0%	18%		
MN	NonRoad	12%	1%	13%		
MN	OtherArea	2%	3%	5%		
MN	Biogenics	1%	1%	1%		
WI	OnRoad	1%	0%	1%		
All Others				3%		

*Plots from Margaret McCourtney (MN APCA)

Boundary Condition Attribution (West)

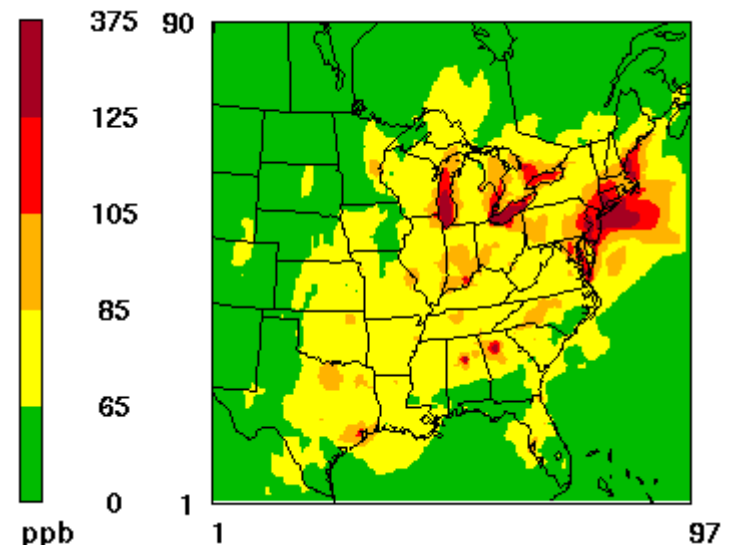
August 7, 2001 at Hour 16



**Plots from Margaret McCourtney (MN APCA)*

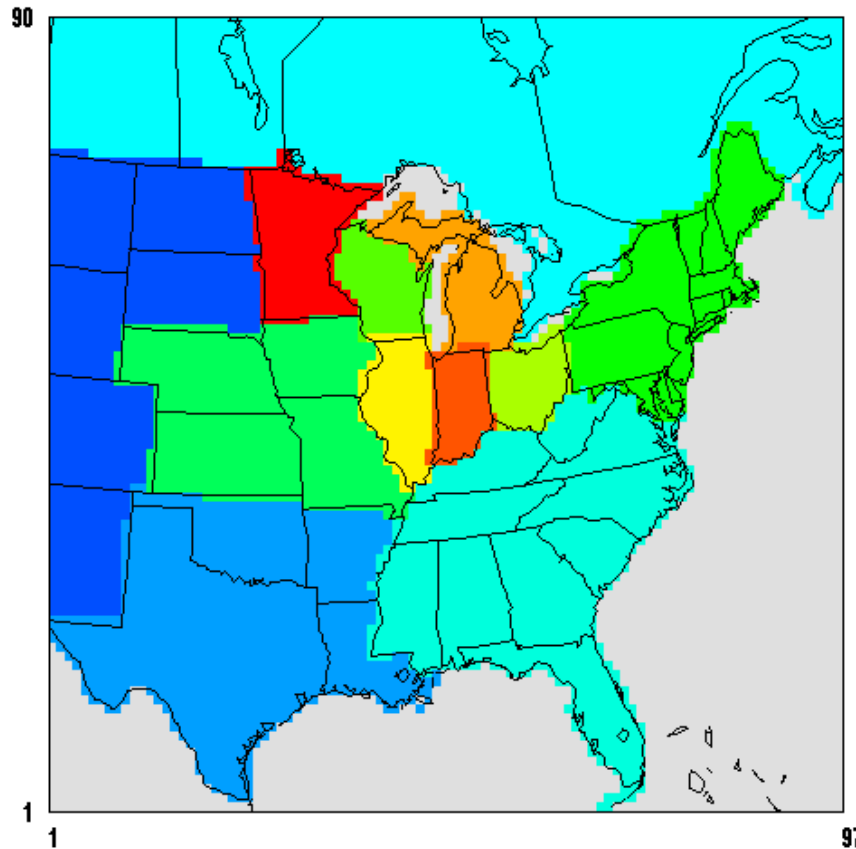
Ozone Source Apportionment

- Applied to “on the way” 2009 emissions
- Maximum source apportionment for Summer 2002 is shown
- O3V: ozone from source category VOC
- O3N: ozone from source category NOX
- Highly efficient compared to zero-out runs
- Does not fundamentally change the model chemistry regimes the way zero-out runs would
- ~ 3 hrs to run an episode day with OSAT
 - 1.15 hrs to run episode day * 5 emissions categories * 13 regions = 74 hrs of zero out brute force equivalent run time



Source Regions & Emissions Groups

- 1 Atlantic Ocean, Gulf of Mexico, Mexico, Great Lakes
- 2 WRAP
- 3 CENRAP South
- 4 Canada
- 5 VISTAS
- 6 CENRAP North
- 7 MANEVU
- 8 Wisconsin
- 9 Ohio
- 10 Illinois
- 11 Michigan
- 12 Indiana
- 13 Minnesota

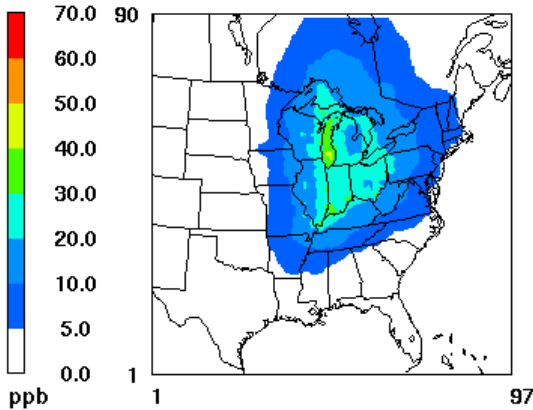


1. Biogenics
2. Other Area
3. Point
4. Nonroad
5. Onroad

Ozone Attributed to MRPO Emissions

O3N - point - mrpo

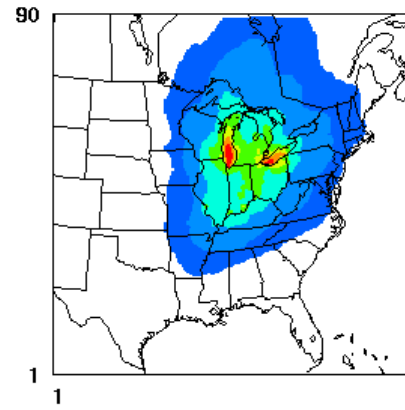
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 42.3 at (49,55)

O3N - onroad - mrpo

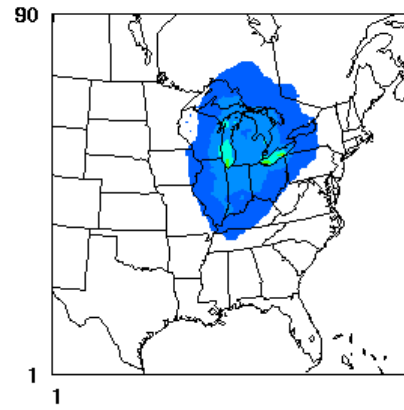
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 69.6 at (48,55)

O3N - nonroad - mrpo

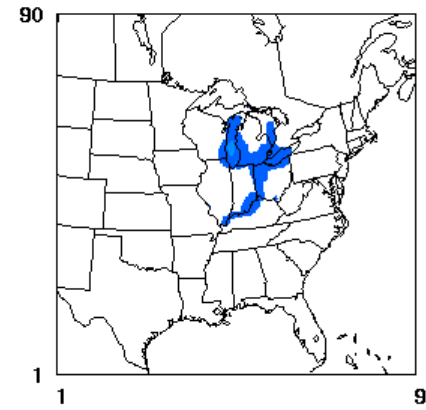
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 43.7 at (63,55)

O3N - area - mrpo

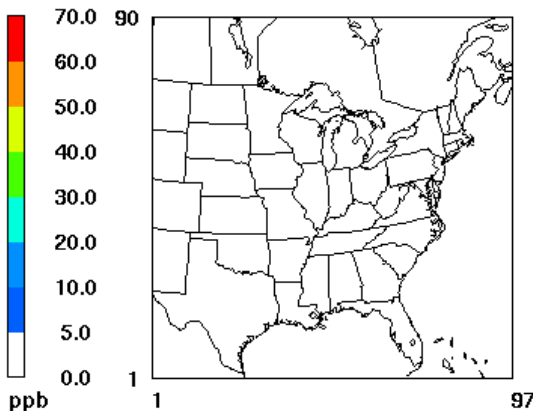
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 11.9 at (48,57)

O3V - point - mrpo

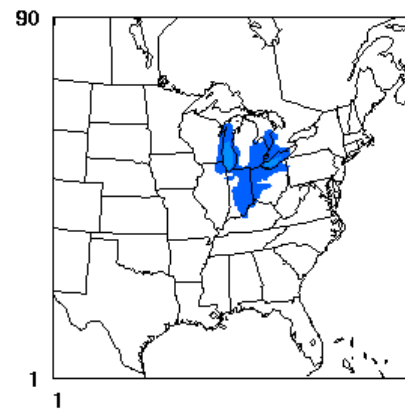
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 3.2 at (48,54)

O3V - onroad - mrpo

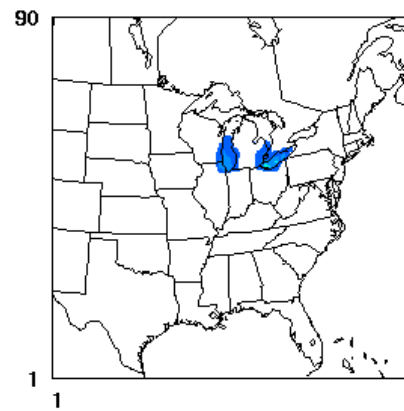
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 15.1 at (48,54)

O3V - nonroad - mrpo

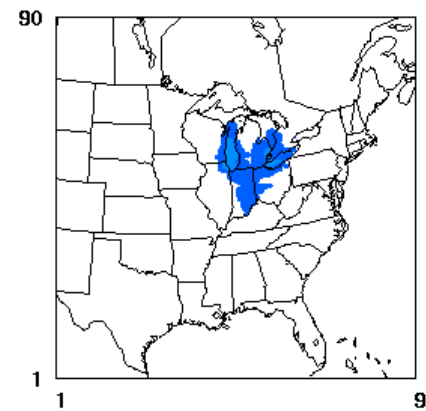
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 22.0 at (58,53)

O3V - area - mrpo

basel_2009
36km grid LADCO

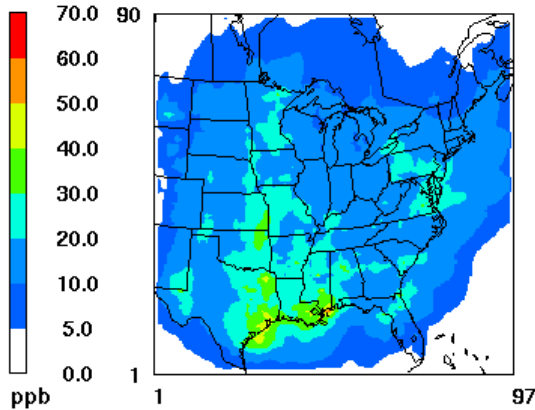


June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 17.7 at (47,56)

Ozone Attributed to non-MRPO Emissions

O3N - point - outside

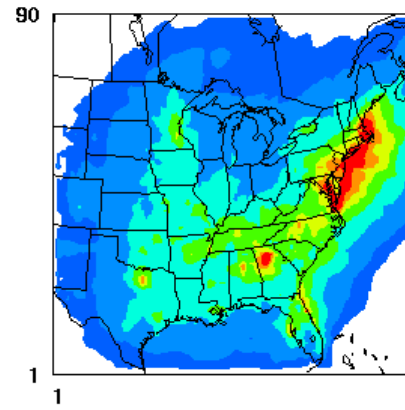
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 53.7 at (48,16)

O3N - onroad - outside

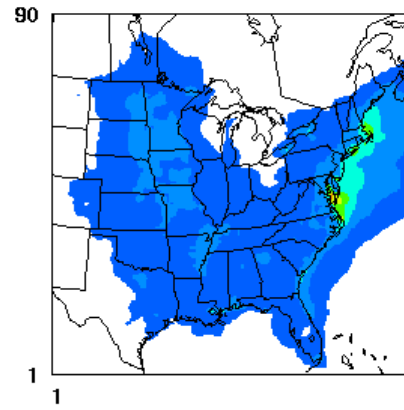
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 94.5 at (77,42)

O3N - nonroad - outside

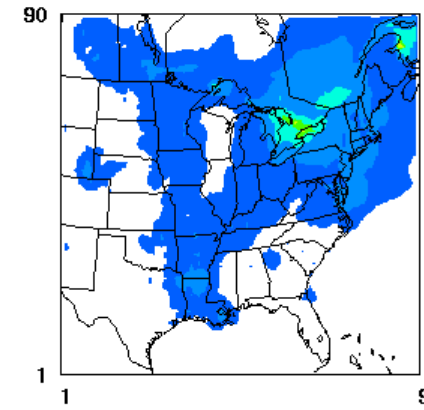
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 51.6 at (76,45)

O3N - area - outside

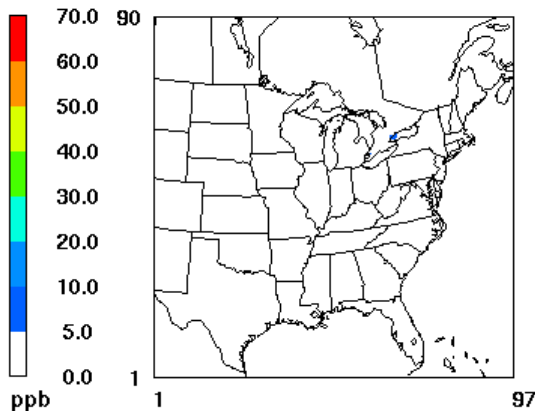
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 48.8 at (92,82)

O3V - point - outside

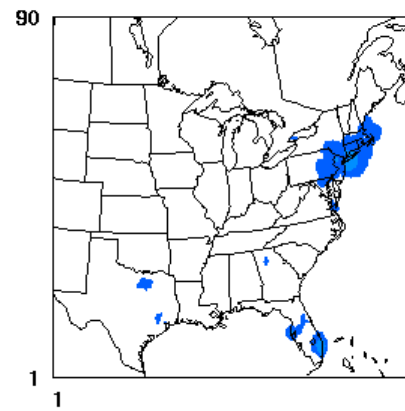
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 6.6 at (65,60)

O3V - onroad - outside

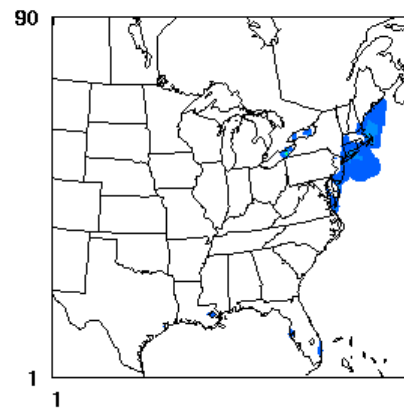
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 15.2 at (73,8)

O3V - nonroad - outside

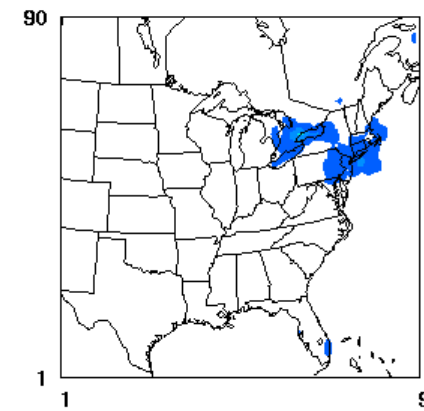
basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 34.1 at (64,56)

O3V - area - outside

basel_2009
36km grid LADCO



June 1,2002 0:00:00
Min= 0.0 at (1,1), Max= 20.9 at (66,61)

Particulate Source Apportionment Tool
CAMx4.20(beta)

Kirk Baker
May 2005
MRPO/LADCO

Source Regions & Emissions Groups

1 Atlantic Ocean, Gulf of Mexico, Mexico, Great Lakes

2 WRAP

3 CENRAP South

4 Canada

5 VISTAS

6 CENRAP North

7 MANEVU

8 Wisconsin

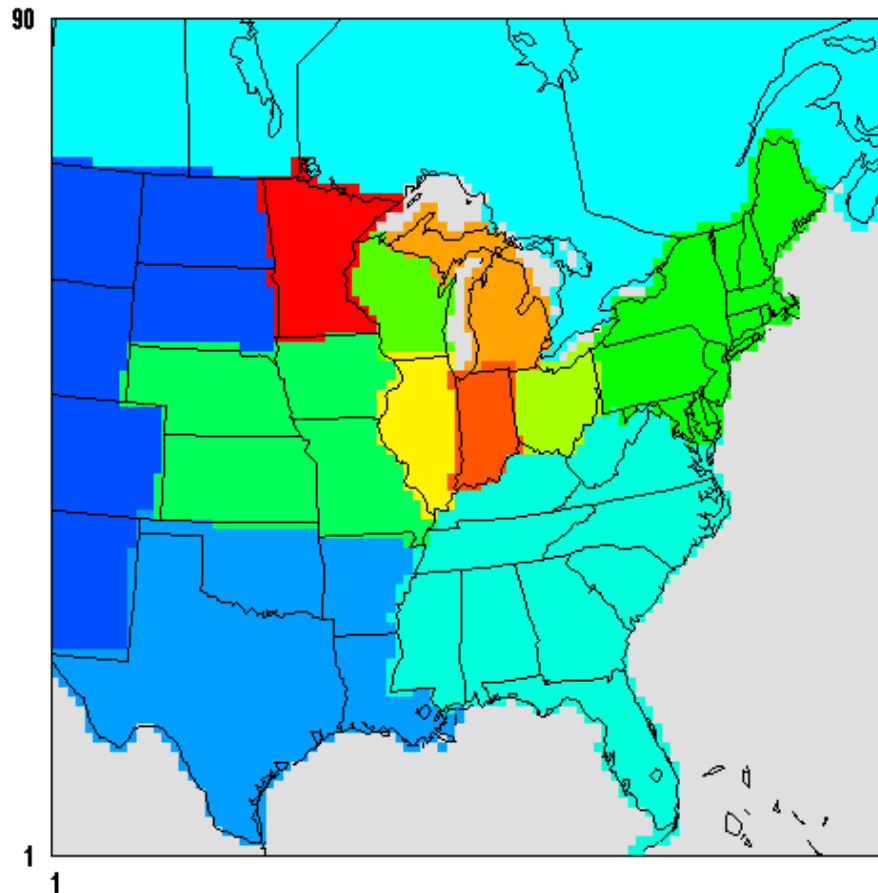
9 Ohio

10 Illinois

11 Michigan

12 Indiana

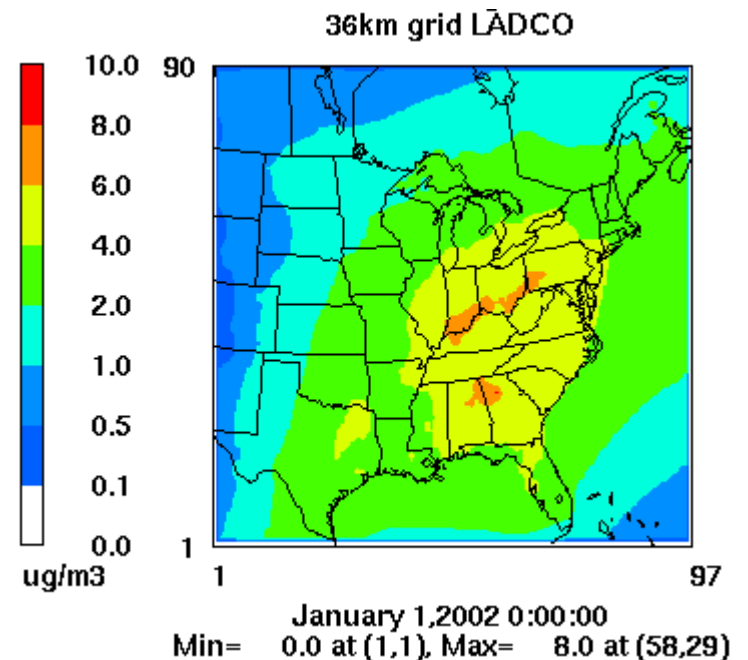
13 Minnesota



1. Biogenics
2. Other Area
3. Point
4. Nonroad
5. Onroad
6. Ammonia

PSAT: SULFATE

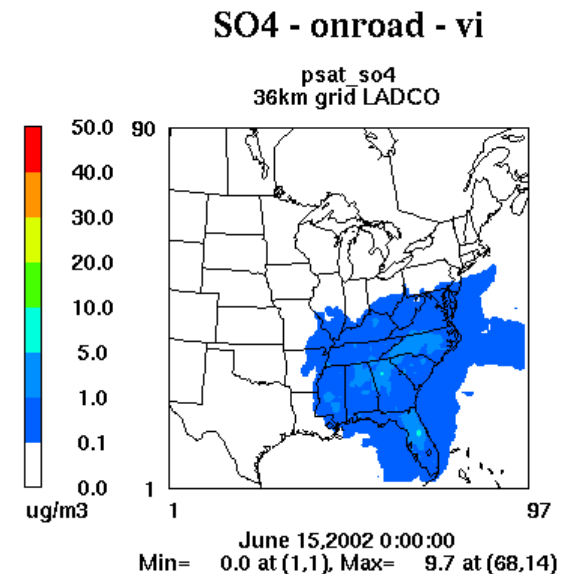
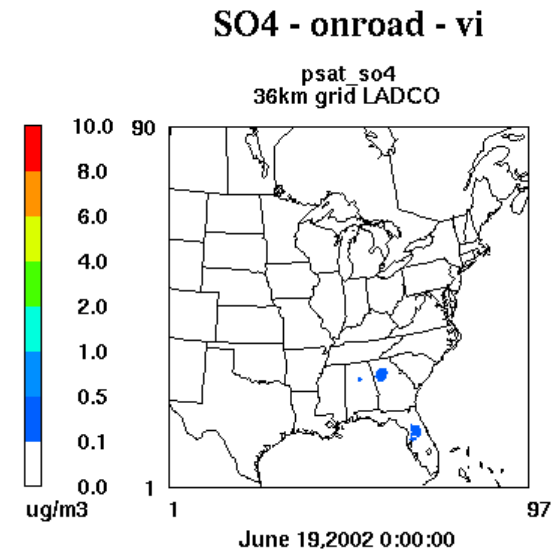
- Present episode average results; averaged over all days in July and August 2002
- Results shown by RPO for Mane-Vu, Vistas, northern tier of Cenrap States and southern tier of Cenrap States
- Individual State results: OH, MI, IN, IL, WI, and MN



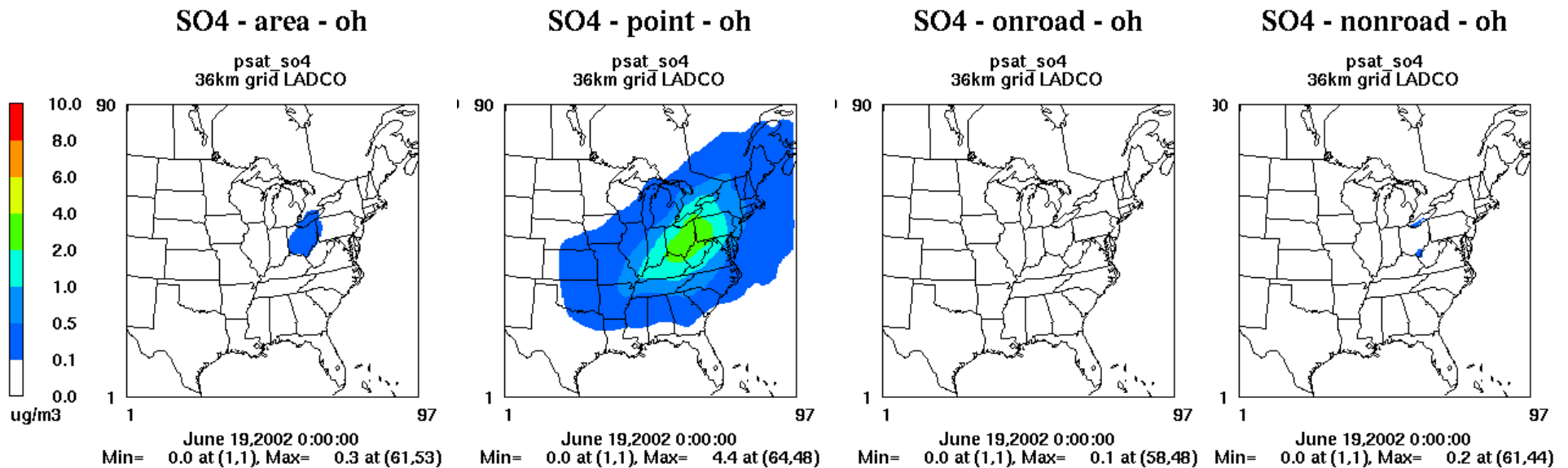
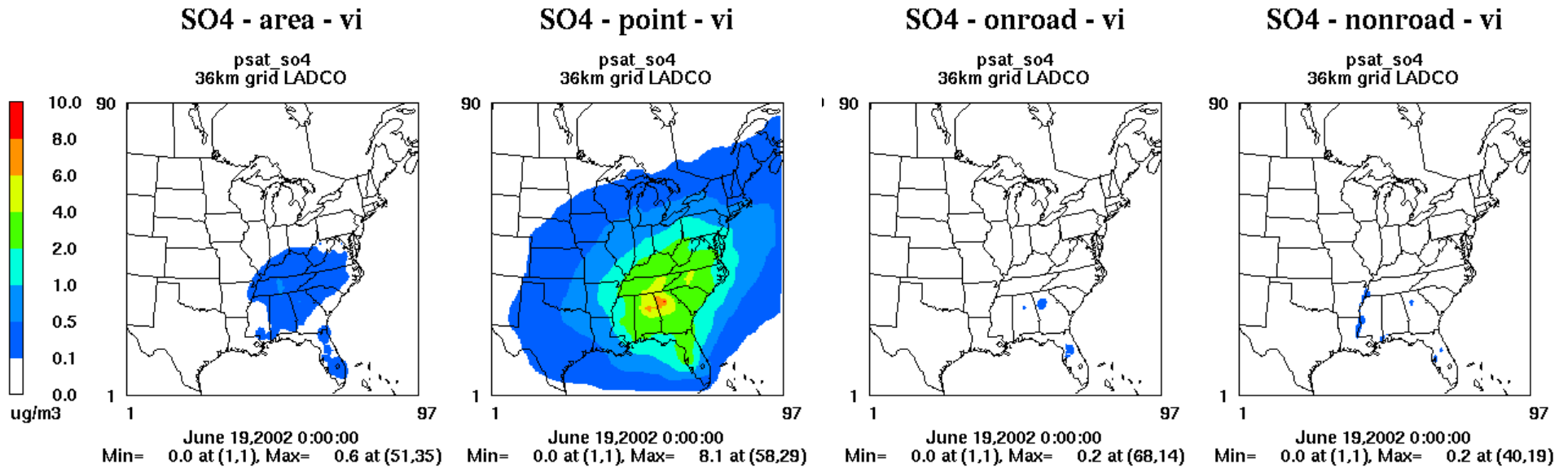
Average v. Maximum & Efficiency

- Episode average plot (top right)
- Episode maximum plot (bottom right)
- Average plot peaks at .2 ug/m³
- Maximum plot peaks at 9.7 ug/m³

- ~ 3 hrs/episode day for SULFATE PSAT run
- Brute force zero out run-time equivalent = 1.15 hr/episode day * 6 emission groups * 13 source regions = 90 hours/episode day

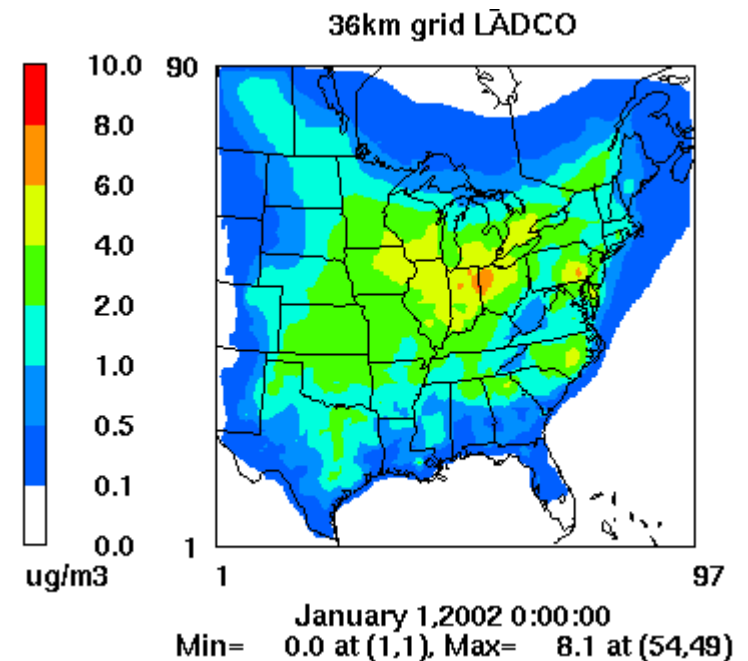


PSAT: Sulfate Ion



PSAT - Nitrate

- Episode average of 14 days in January 2002
- ~ 5.5 hours to run an episode day
- Results shown by RPO for Mane-Vu, Vistas, northern tier of Cenrap States and southern tier of Cenrap States
- Individual State results: OH, MI, IN, IL, WI, and MN

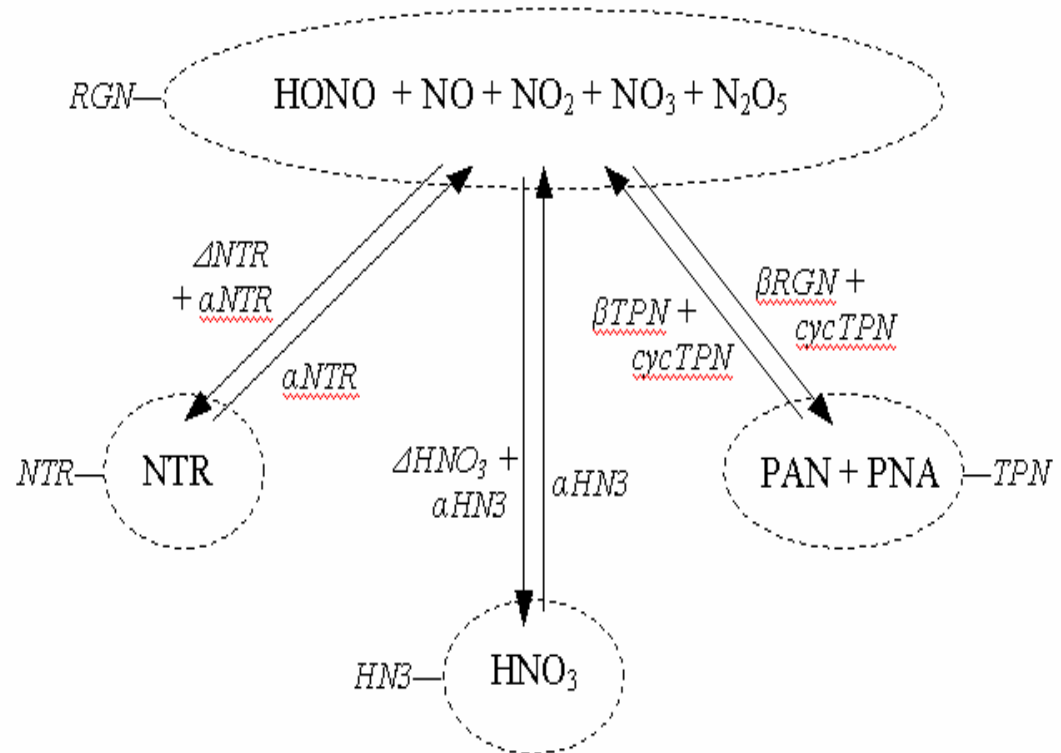


PSAT - Nitrate

- Source apportionment of ammonium nitrate is performed independently for the ammonium and the nitrate (likely from different source categories)
- PM_{2.5} nitrate (PNO₃) apportioned to NO_x sources
- PM_{2.5} ammonium (PNH₄) apportioned to NH₃ sources
- PSAT results should be used in conjunction with sensitivity runs to fully realize which regions will benefit from ammonia or NO_x emissions reductions from specific categories

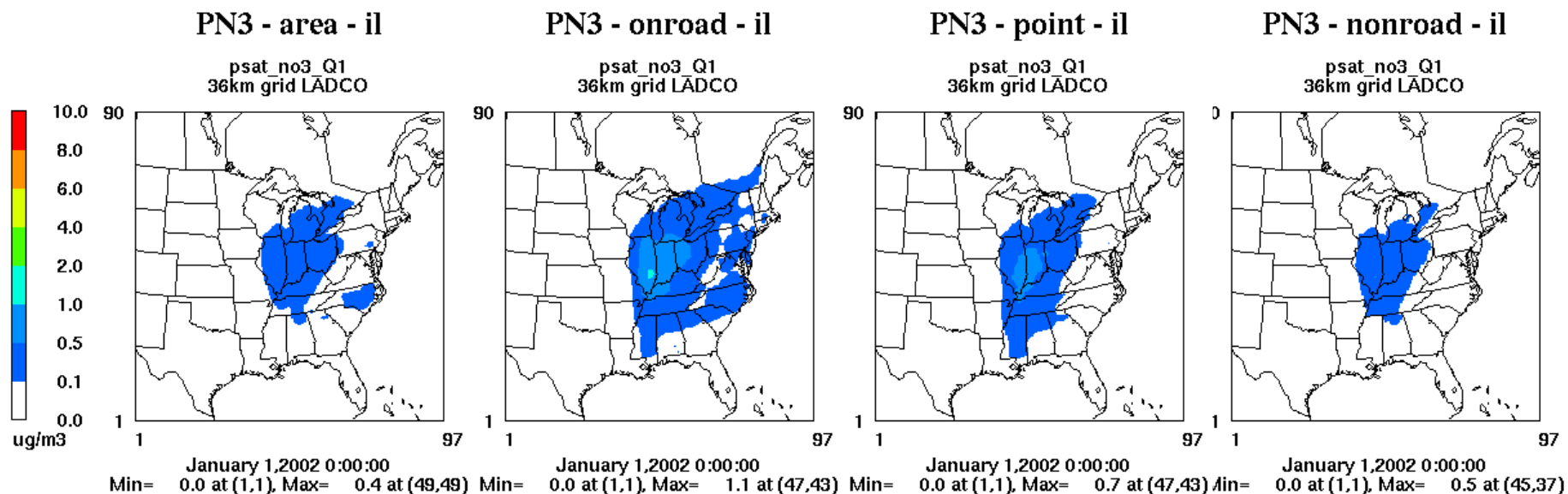
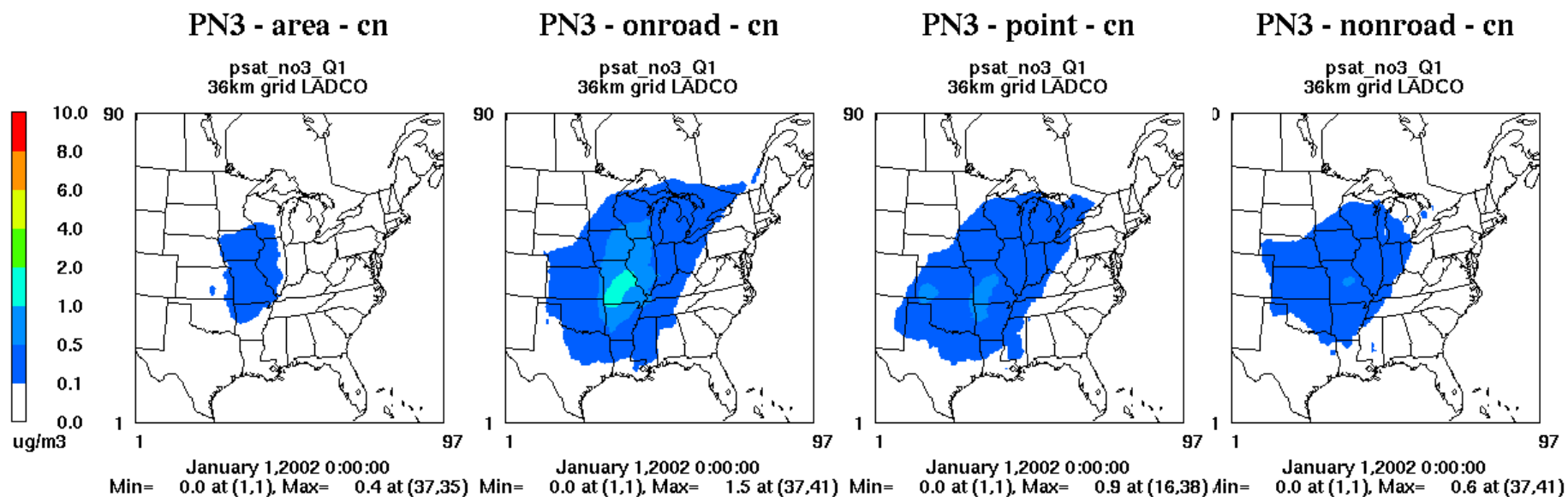
PSAT NO_y Tracking for Gasses

- PSAT tracks 4 groups of NO_y gasses
 - RGN
 - TPN
 - HN3
 - NTR
- Conversion of RGN to TPN is reversible – rapidly or slowly
- Conversion of RGN to HN3 and NTR is slowly reversible



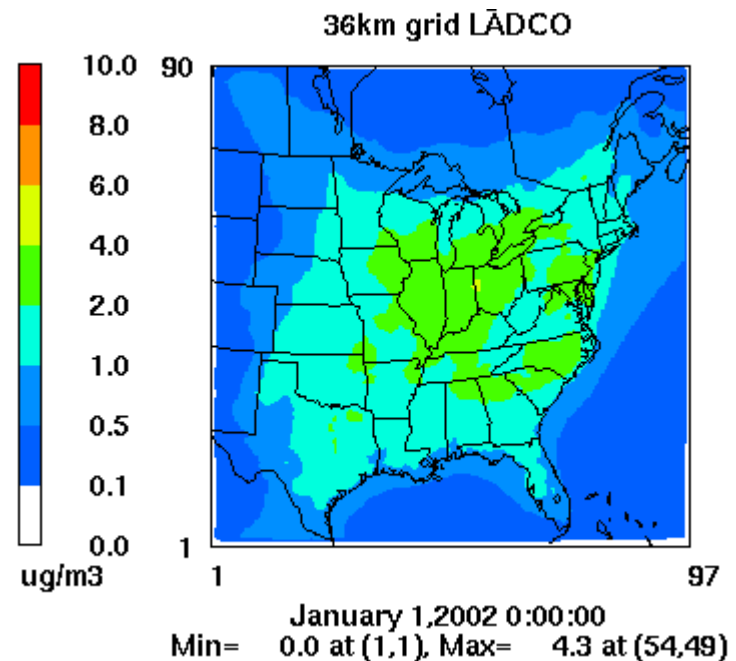
Source: Greg Yarwood ENVIRON

PSAT: Nitrate Ion



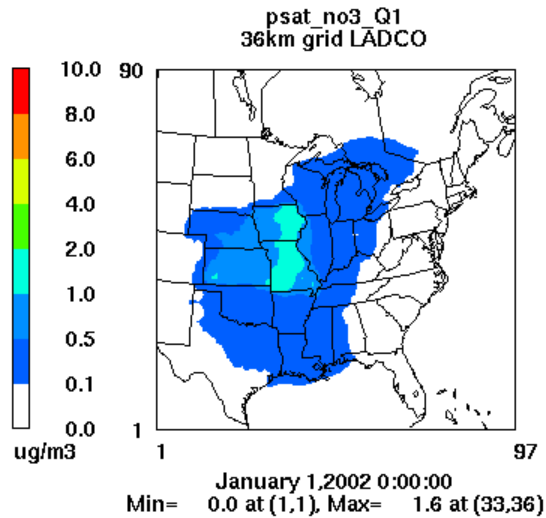
PM2.5 Ammonium Ion

- Episode average of 14 days in January 2002
- ~ 5.5 hours to run an episode day
- Results shown by RPO for Mane-Vu, Vistas, northern tier of Cenrap States and southern tier of Cenrap States
- Individual State results: OH, MI, IN, IL, WI, and MN

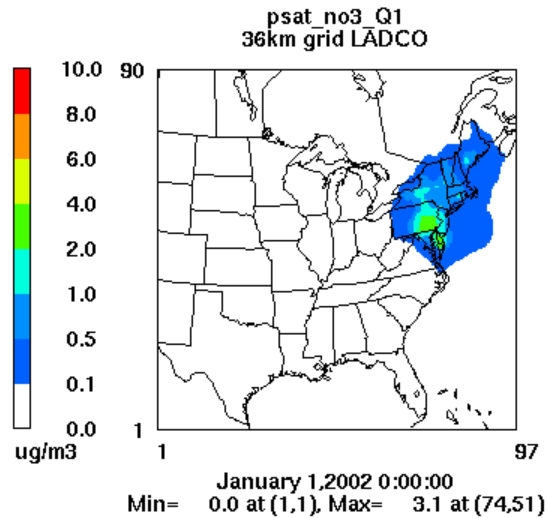


PNH4: Agricultural Ammonia (CMU)

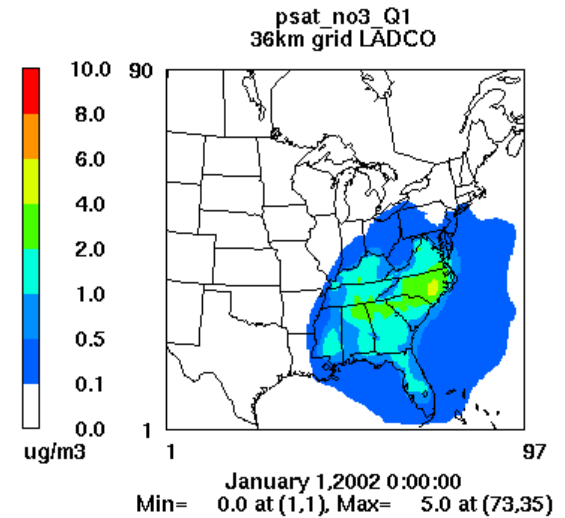
PN4 - nh3 - cn



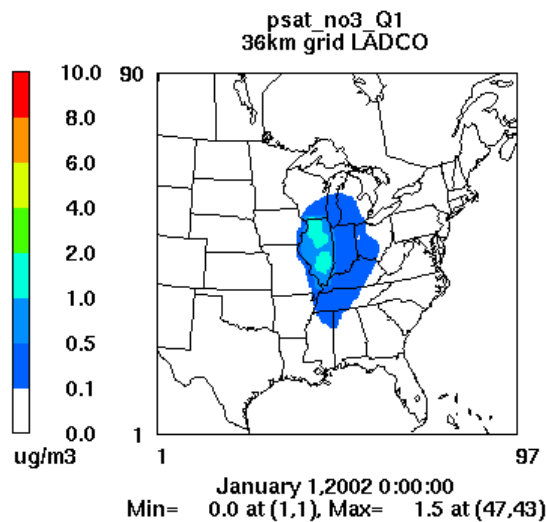
PN4 - nh3 - mv



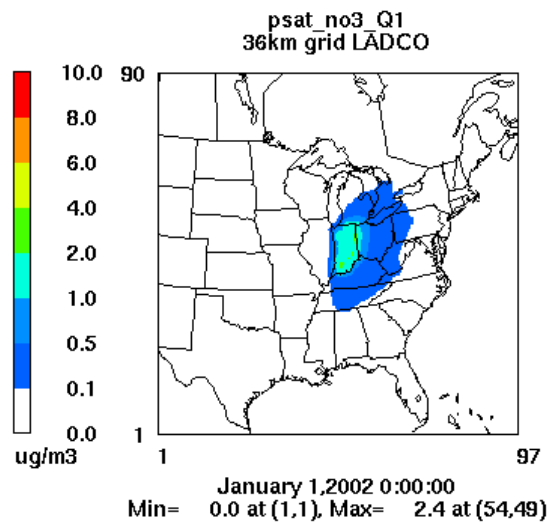
PN4 - nh3 - vi



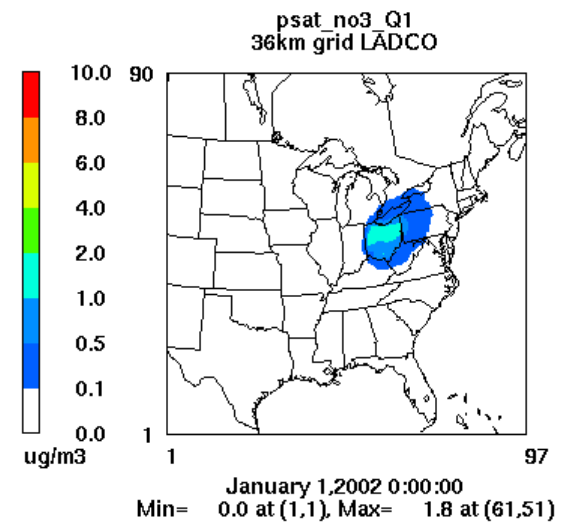
PN4 - nh3 - il



PN4 - nh3 - in

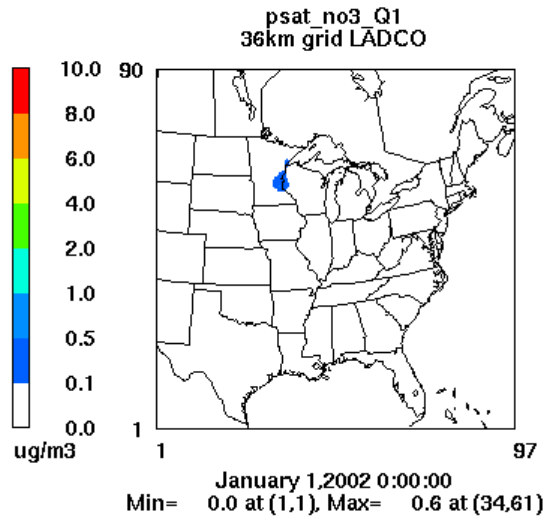


PN4 - nh3 - oh

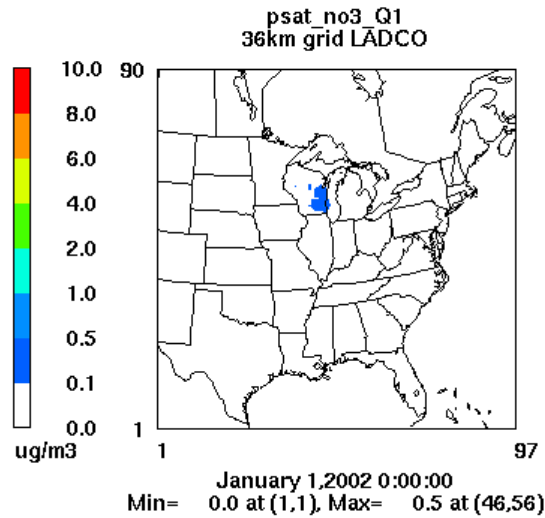


PNH4: Onroad

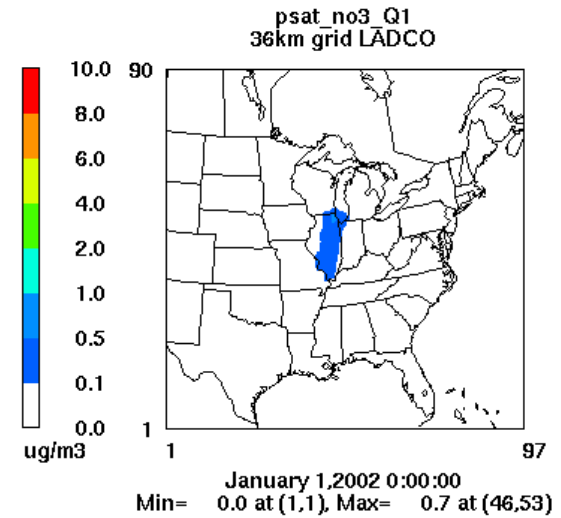
PN4 - onroad - mn



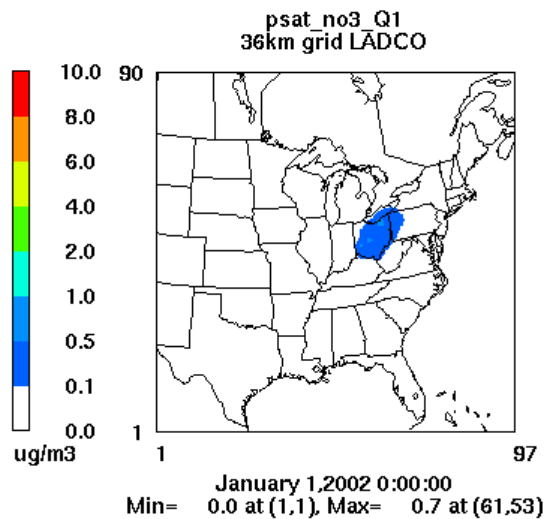
PN4 - onroad - wi



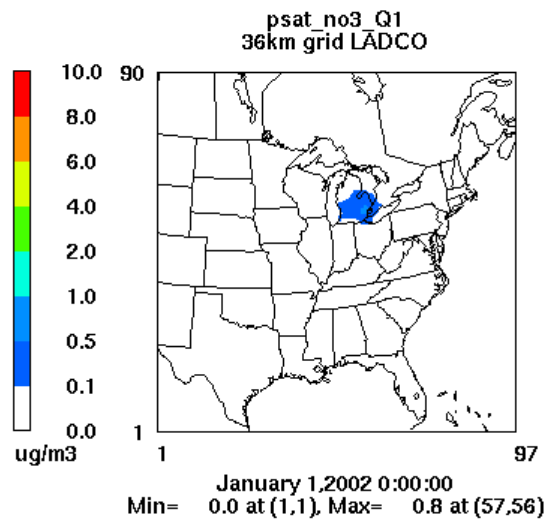
PN4 - onroad - il



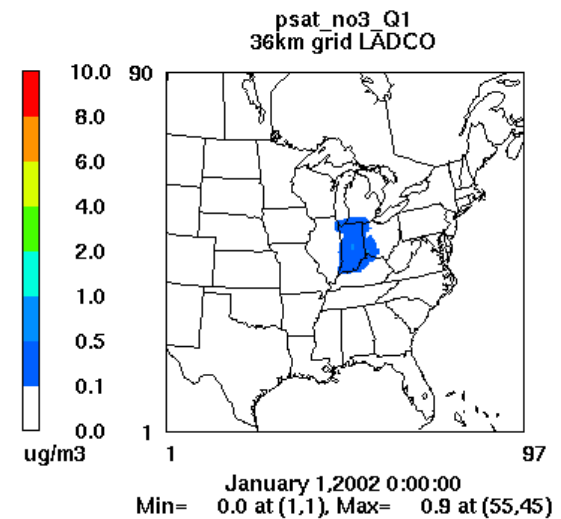
PN4 - onroad - oh



PN4 - onroad - mi



PN4 - onroad - in

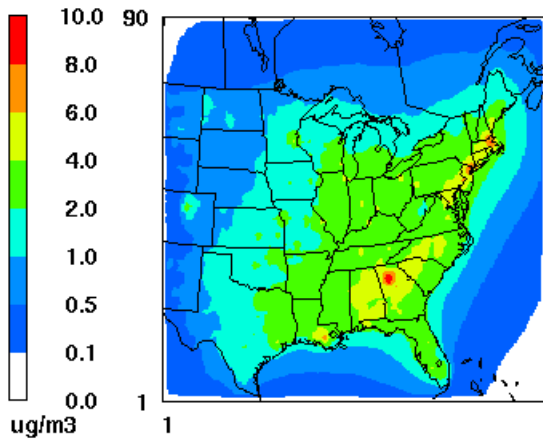


PSAT - SOA

- Episode average of 14 days in June 2002
- ~ 10 hours to run an episode day
- Source apportionment of SOA only, primary PM_{2.5} OC tracked separately
- Results shown by RPO for Mane-Vu, Vistas, northern tier of Cenrap States and southern tier of Cenrap States
- Individual State results: OH, MI, IN, IL, WI, and MN

Total PM2.5 OC

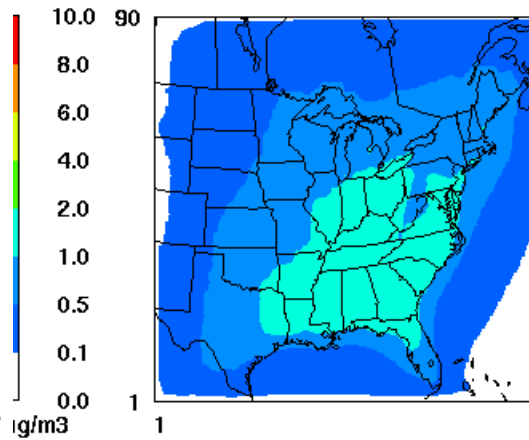
Annual Average ORG
36km grid LADCO



January 1, 2002 0:00:00
Min= 0.0 at (1,1), Max= 10.8 at (58,29)

Secondary OC

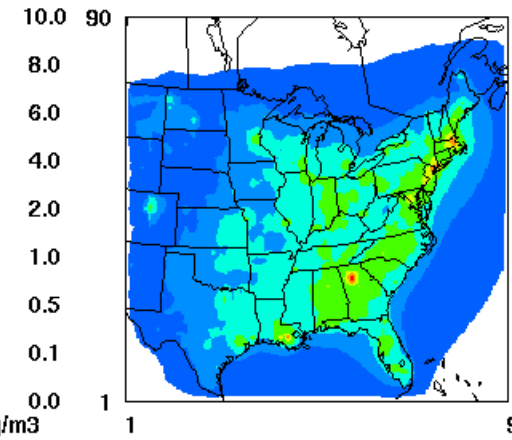
Annual Average SOA
36km grid LADCO



January 1, 2002 0:00:00
Min= 0.0 at (1,1), Max= 1.9 at (60,27)

Primary OC

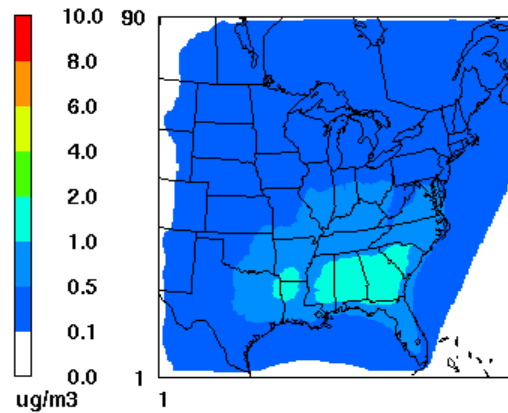
Annual Average POA
36km grid LADCO



January 1, 2002 0:00:00
Min= 0.0 at (1,1), Max= 9.2 at (79,55)

Biogenic SOA

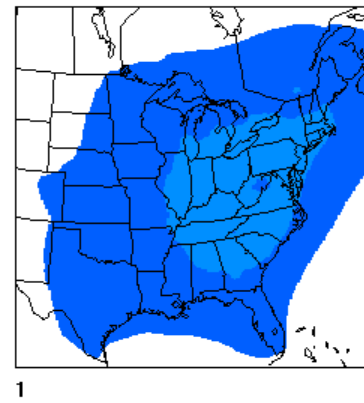
Annual Average BSOA
36km grid LADCO



January 1, 2002 0:00:00
Min= 0.0 at (1,1), Max= 1.3 at (60,27)

Anthropogenic SOA

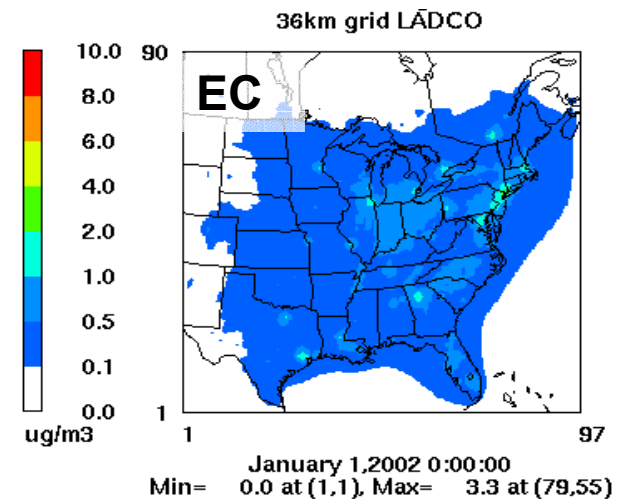
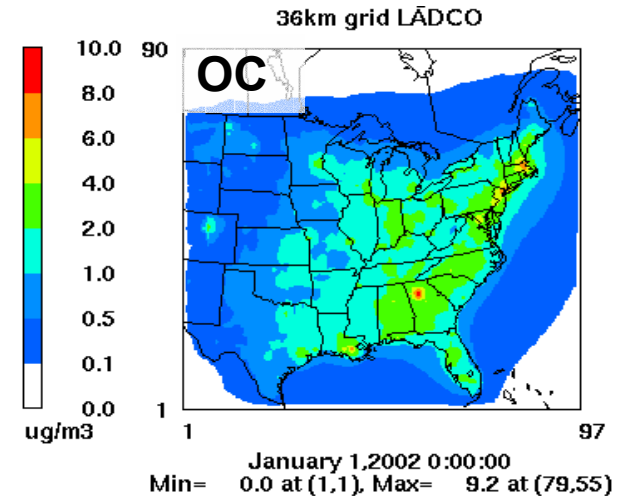
Annual Average ASOA
36km grid LADCO



January 1, 2002 0:00:00
Min= 0.0 at (1,1), Max= 0.7 at (55,59)

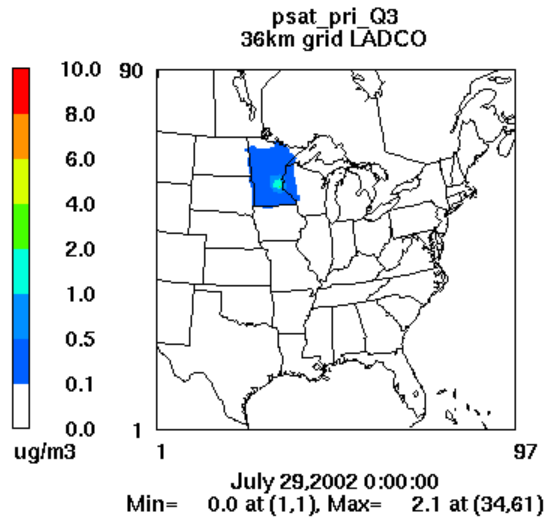
PSAT – Primary OC and EC

- Episode average of 14 days in June 2002
- ~ 5.5 hours to run an episode day
- Source apportionment of primary PM_{2.5} OC and Primary PM_{2.5} EC only
- Results shown by RPO for Mane-Vu, Vistas, northern tier of Cenrap States and southern tier of Cenrap States
- Individual State results: OH, MI, IN, IL, WI, and MN

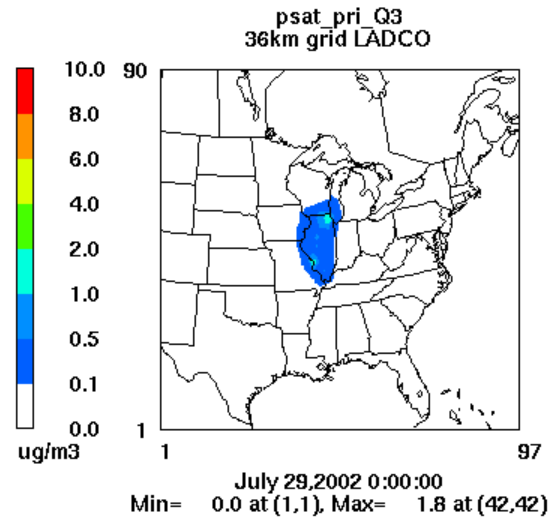


Primary OC: Area (Summer)

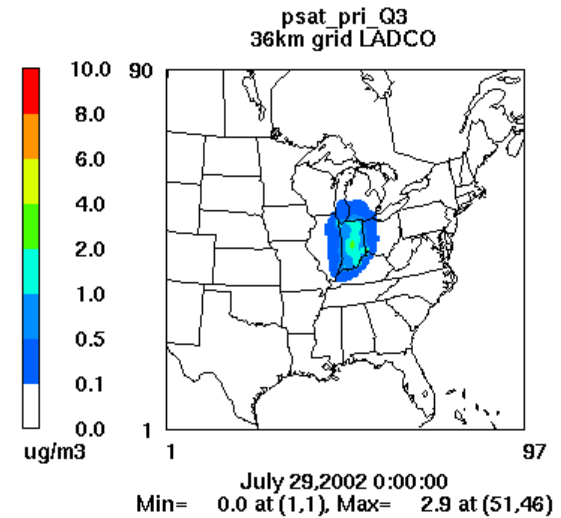
POC - area - mn



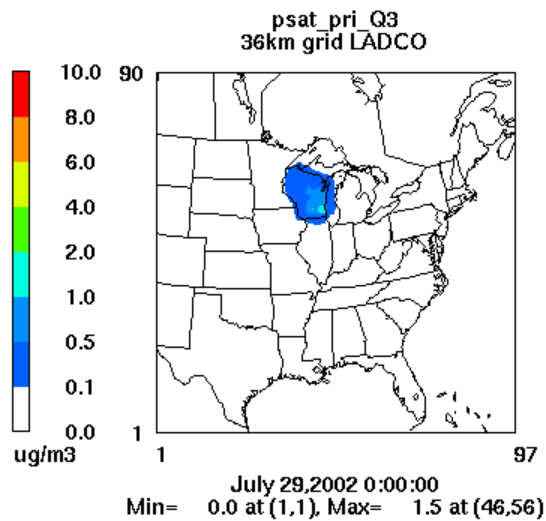
POC - area - il



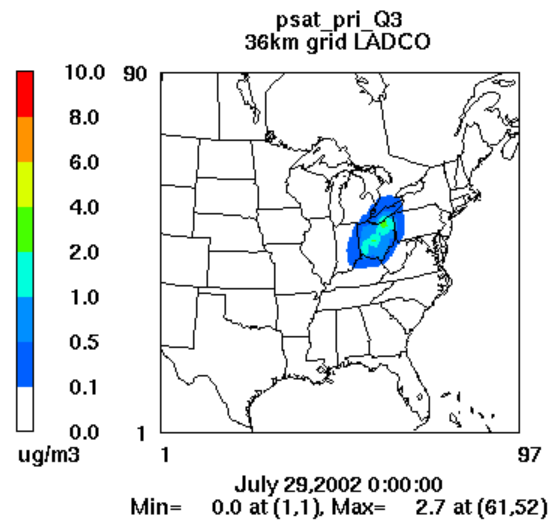
POC - area - in



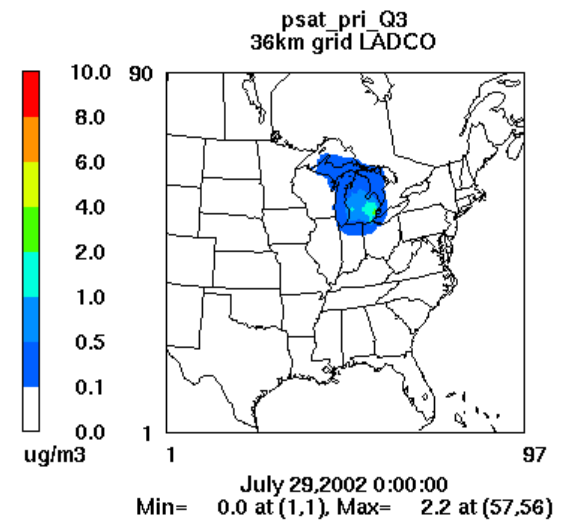
POC - area - wi



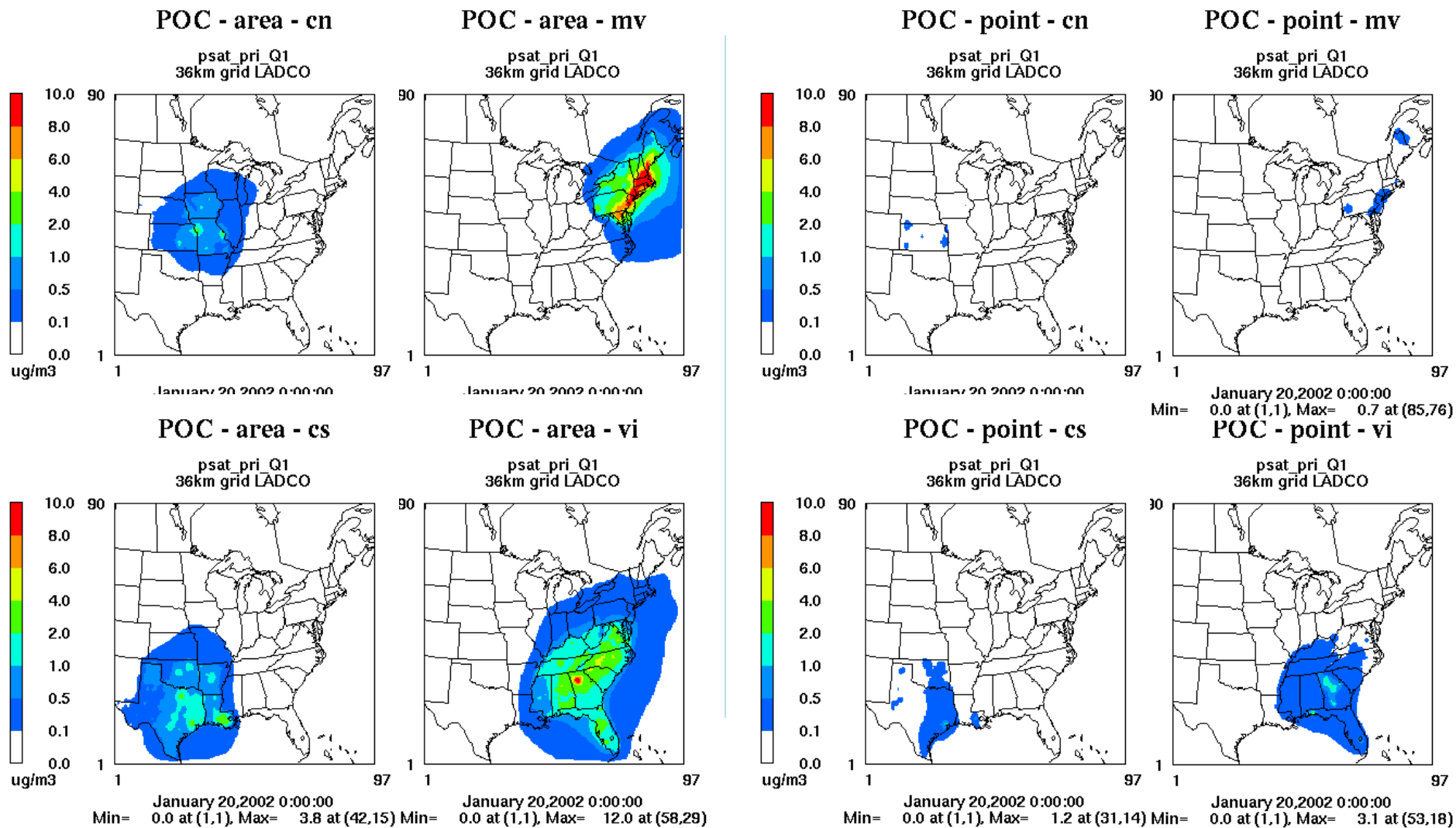
POC - area - oh



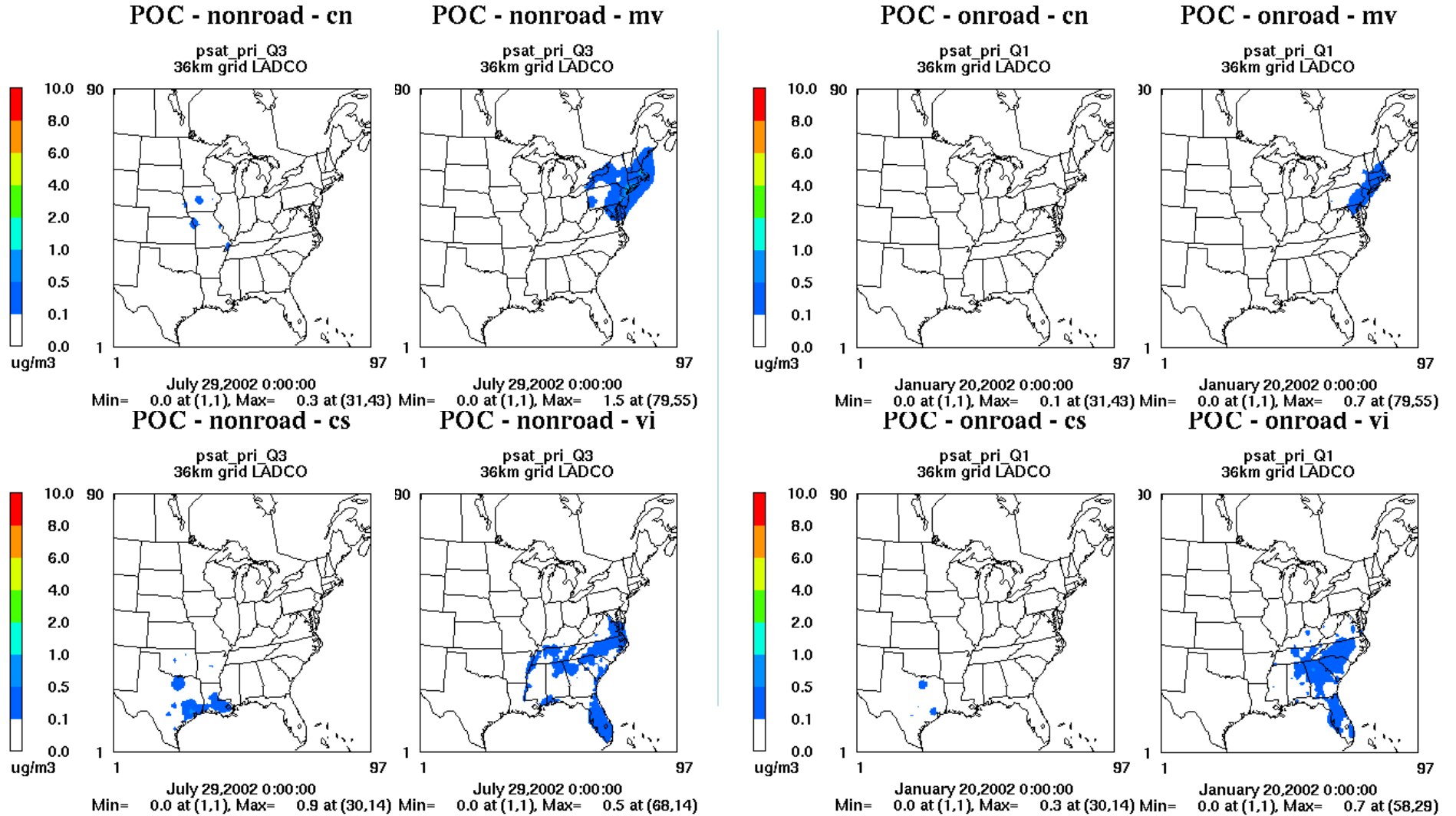
POC - area - mi



PSAT: Primary OC

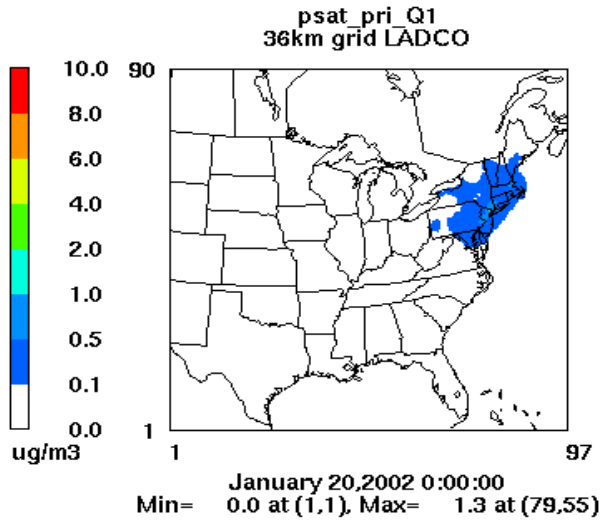


PSAT: Primary OC

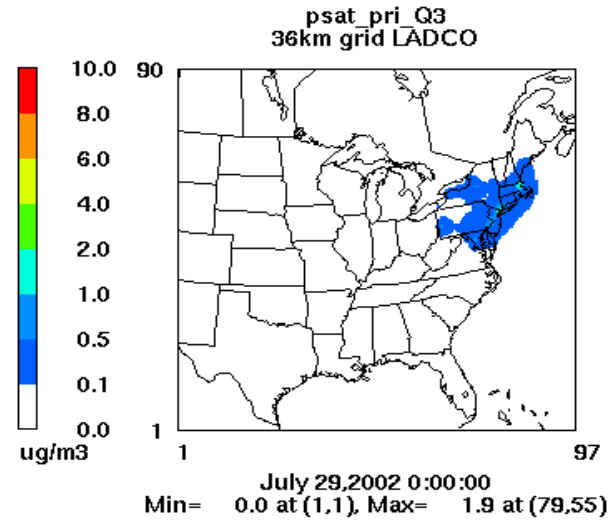


PSAT: EC

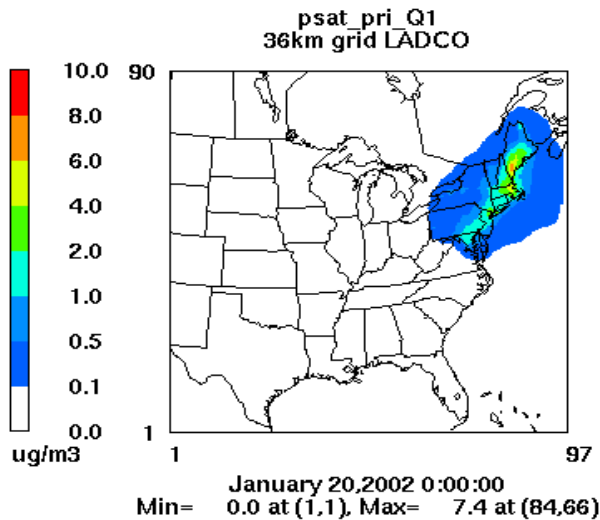
PEC - onroad - mv



PEC - nonroad - mv



PEC - area - mv



PEC - point - mv

