OTC 8-Hour Ozone SIP Modeling Performance

Massachusetts DEP

October 7, 2005

Background

- NYDEC set up the Ozone SIP modeling platform design and will perform CMAQ modeling runs
- UMD with support from MDE developed the meteorological fields for 2002 using MM5
- MANEVU is working with contractor and MANEVU to prepare base case and future case emission inventories
- OTC workgroups are preparing control strategies

CMAQ Model Set-up

- National RPO projection (Lambert conformal) centered at 40°N, 97°W
- Horizontal grid resolution at 36 and 12km with 22 levels in the vertical
- Models: CMAQ v4.4, SMOKE v2.1, MM5 v3.6-3
- 2002 Emissions developed through MANE-VU
- Boundary conditions (BCs) at 36km based on GEOSCHEM
- CMAQ exercised at 36km to provide 12km BCs
- Draft documentation in preparation

Modeling Domain

Model Assessment

- Simulation covers May 1 through September 29, 2002 with the first 14 days treated as “spin-up” period

- Spatial distribution of daily observed and predicted maximum 8-hour O_3 concentrations at 12 km posted at ftp://www.dec.state.ny.us/dar/air_research/mku

- Model evaluation statistics for daily maximum 1-hour and 8-hour O_3 posted at ftp://www.dec.state.ny.us/dar/air_research/kevin

Base Year 2002 Simulation and Results

- NYSDEC will provide overall model assessment over the OTR in this presentation
- Individual states will focus on model assessment for areas of particular interest

KEY PERFORMANCE GOALS

•Correctly Depict Spatial Patterns (*Failure here would raise doubts of the model's usefulness in simulating future scenarios*)

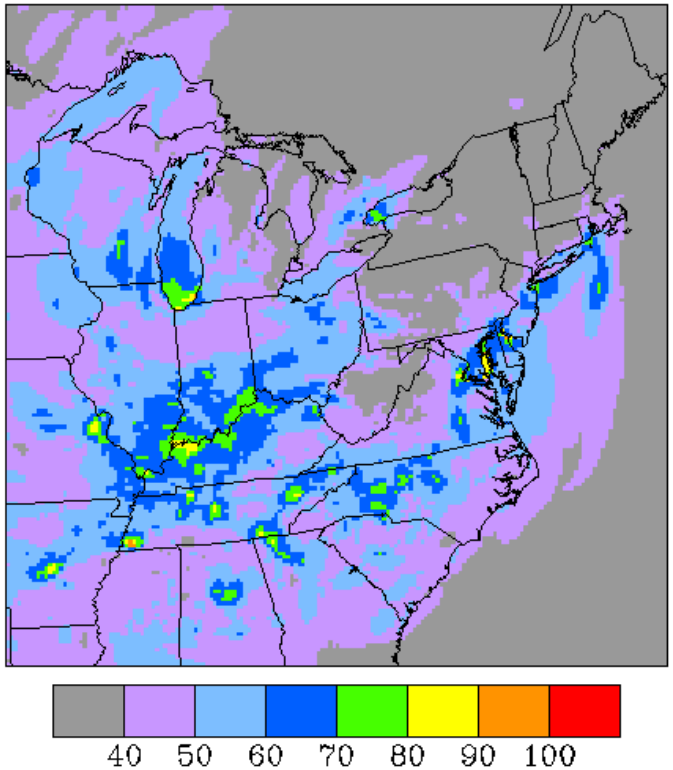
•Correctly Render Sea Breeze Effects and Gradients (*Of primary importance in many coastal areas)*

•Show No Strong Bias (*Consistent over or under-predicting better than random; underpredictions could mean weak model sensitivity to future case reductions*)

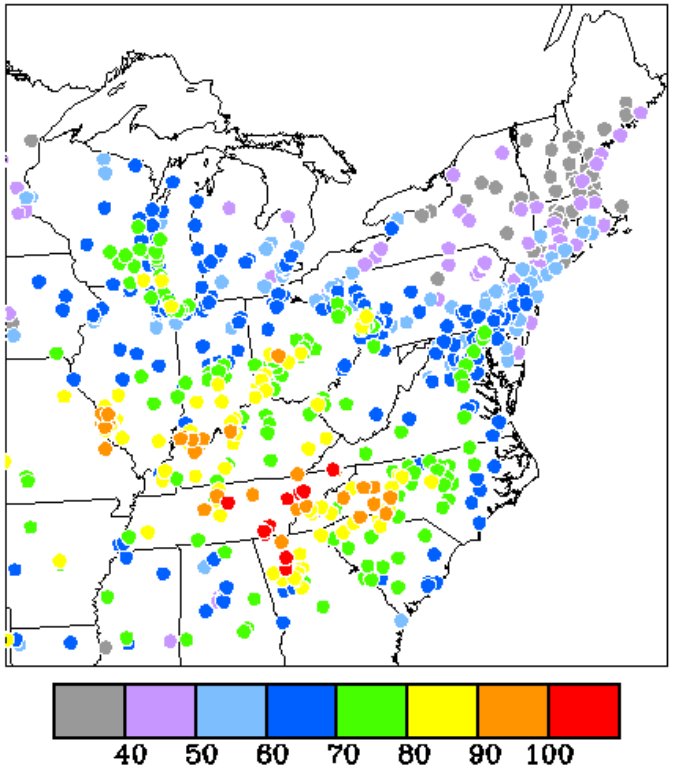
•Meet Statistical Acceptance Cut points

Excellent agreement with spatial pattern, but peak values are underpredicted

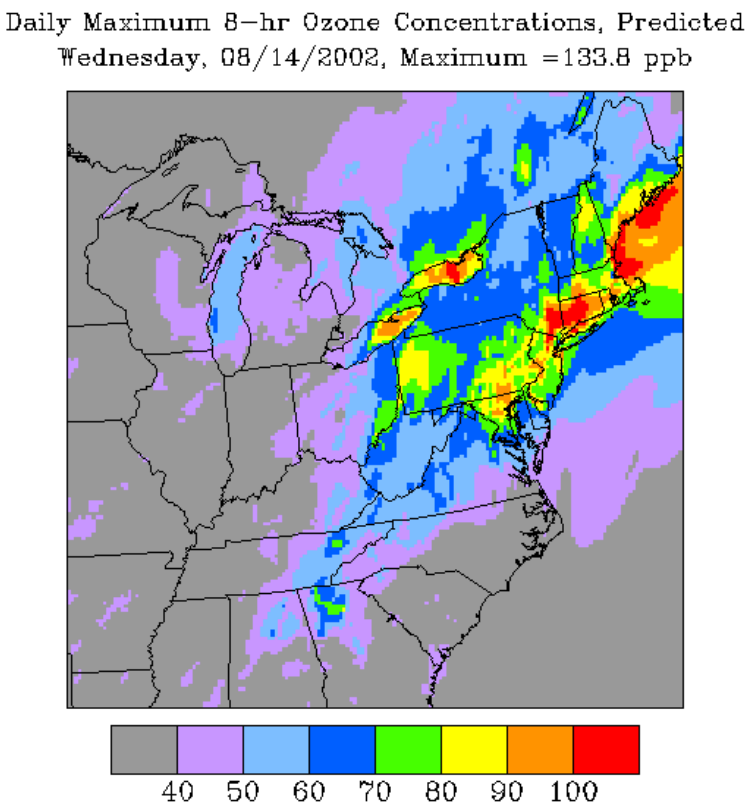
Daily Maximum 8-hr Ozone Concentrations, Predicted
Friday, 08/09/2002, Maximum = 98.1 ppb

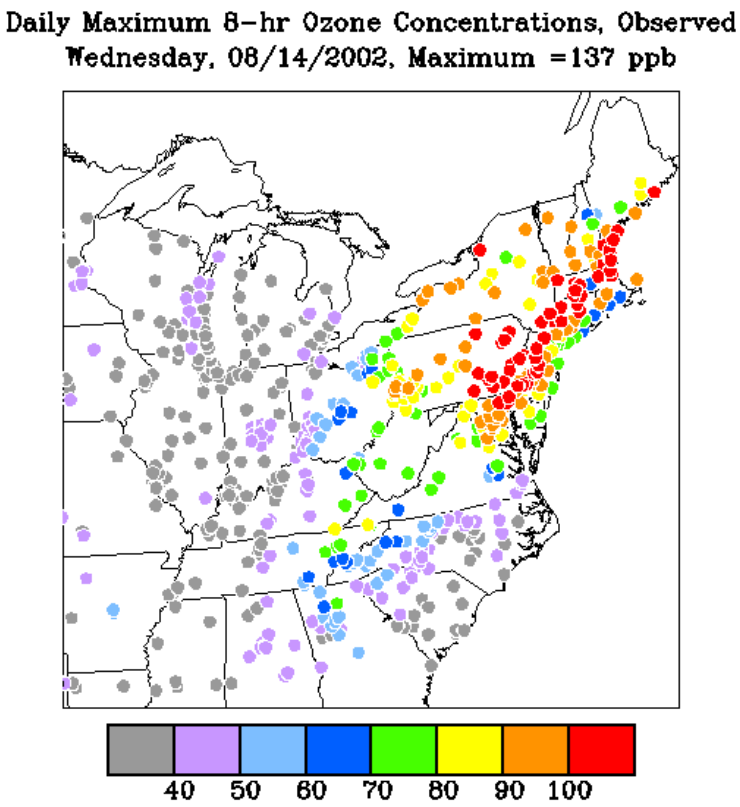


Daily Maximum 8-hr Ozone Concentrations, Observed
Friday, 08/09/2002, Maximum =113 ppb

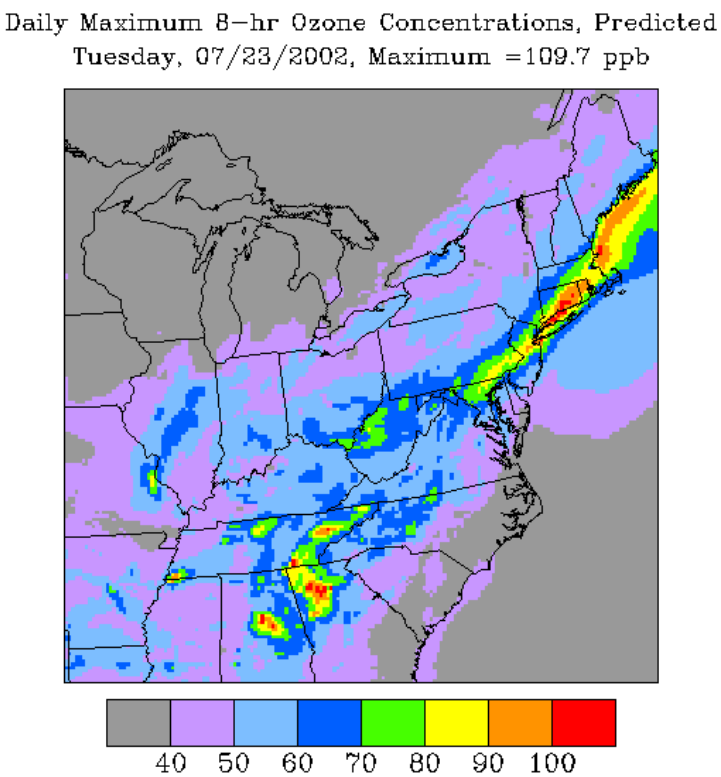


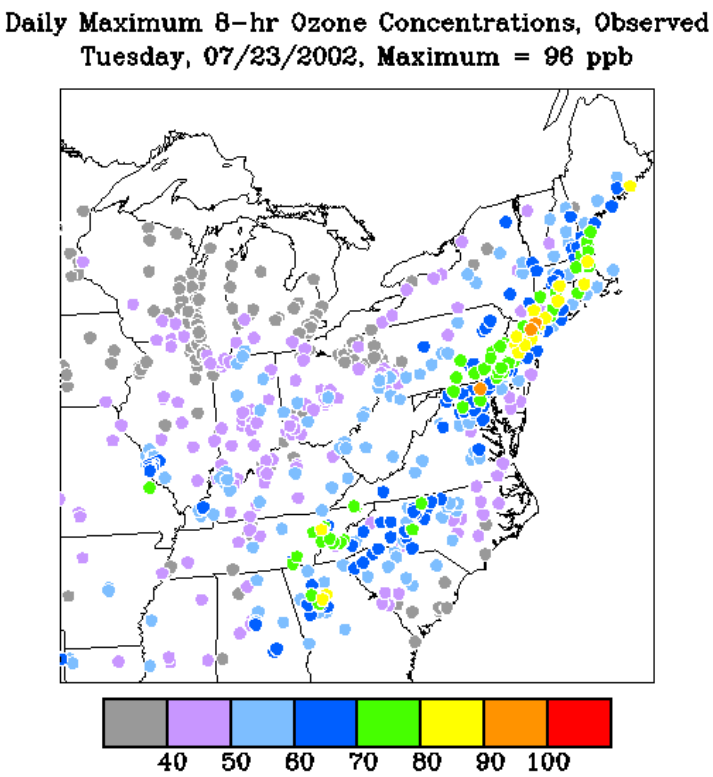
Pattern well replicated but peak values underpredicted



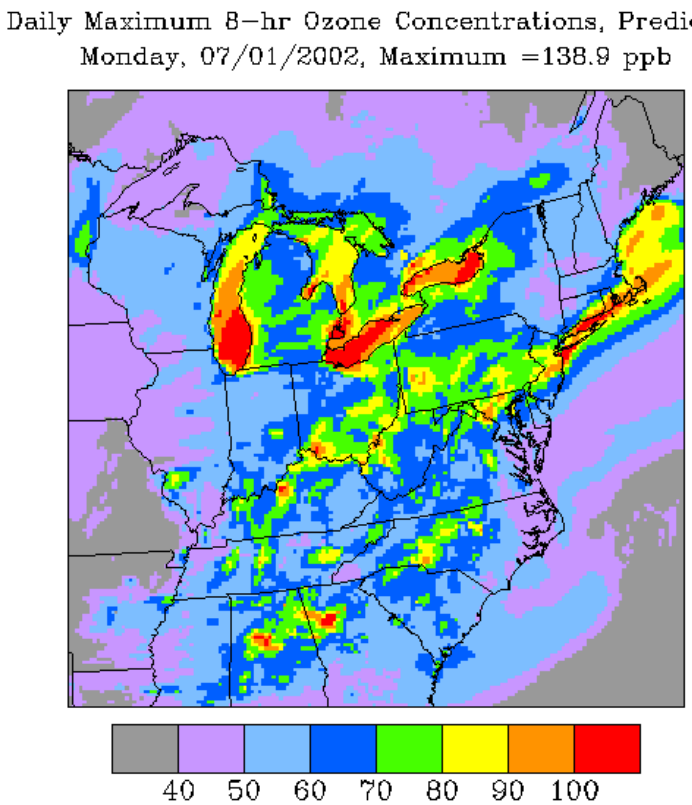


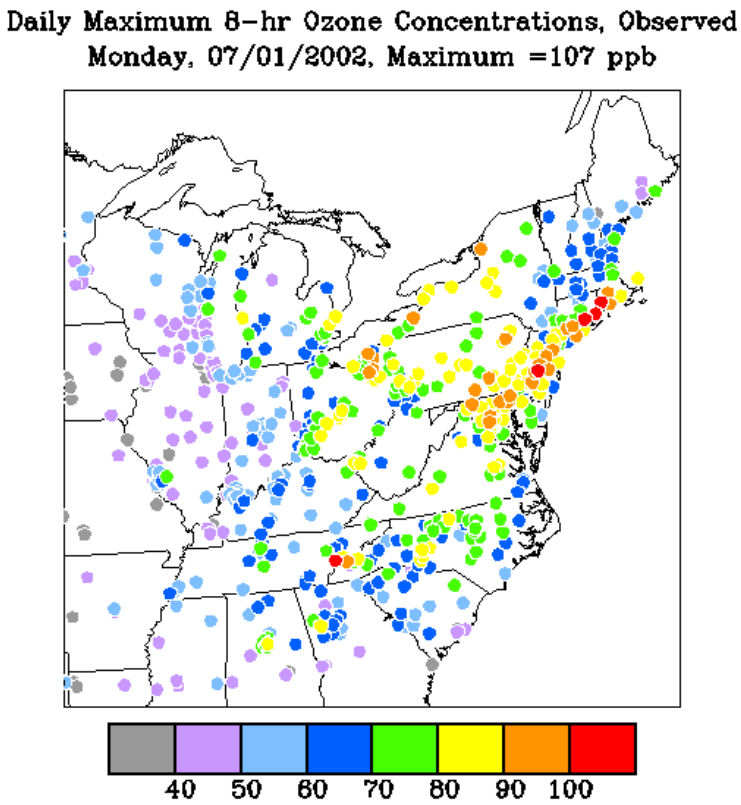
Northeast plume – good spatial agreement, but <u>overpredicted</u>; Good Depiction of Marine Influence along New England South Coast





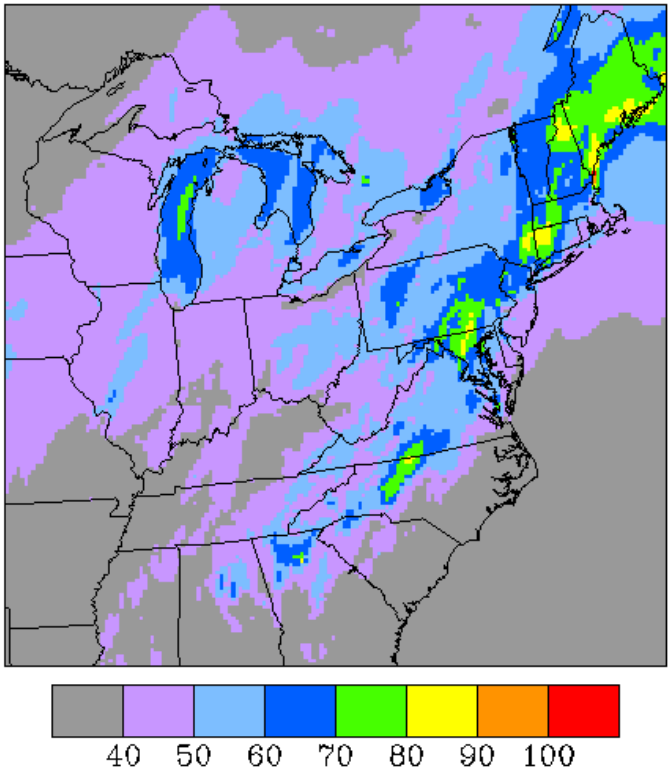
Good simulation of plume along New England South Coast



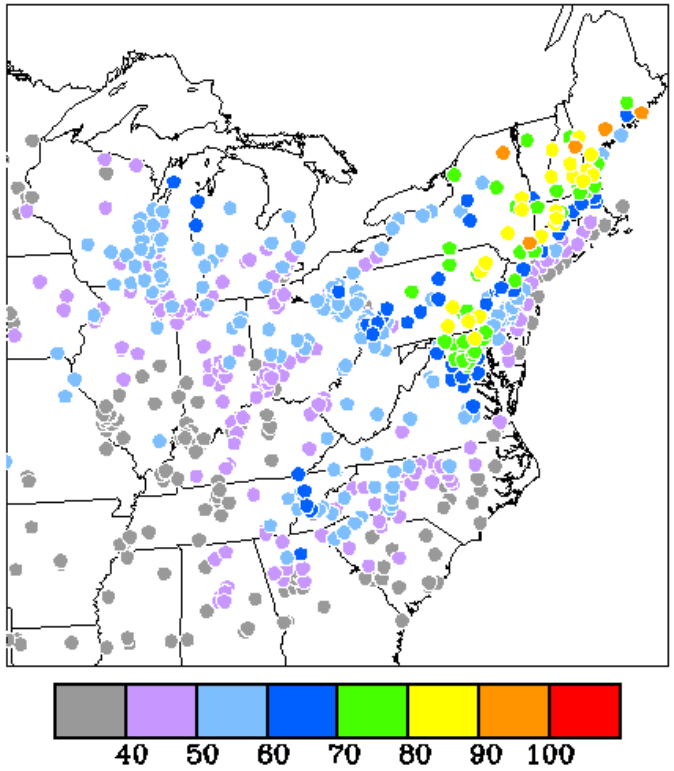


Cleaner Marine Boundary from DelMarVa Peninsula to Cape Cod Well Depicted

Daily Maximum 8-hr Ozone Concentrations, Predicted
Thursday, 08/15/2002, Maximum =100.4 ppb

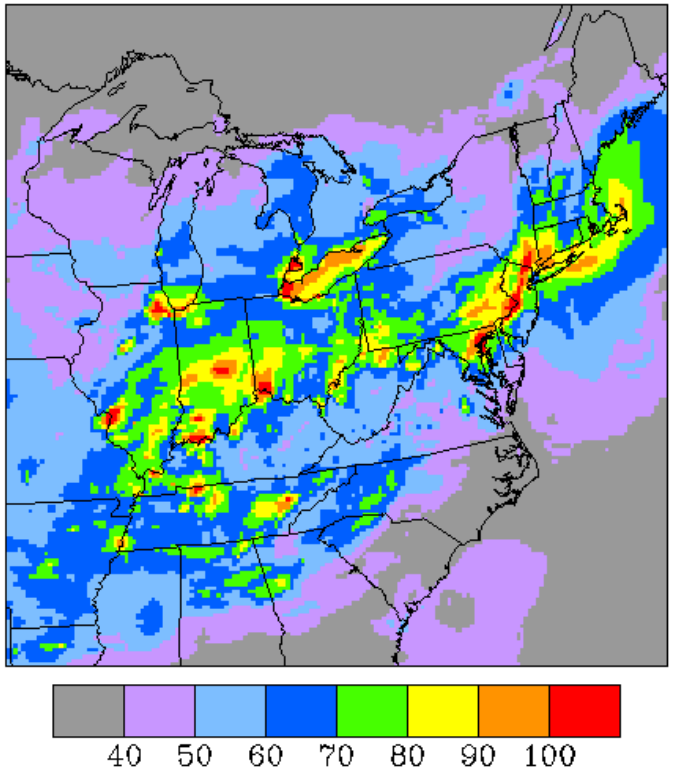


Daily Maximum 8-hr Ozone Concentrations, Observed
Thursday, 08/15/2002, Maximum =100 ppb

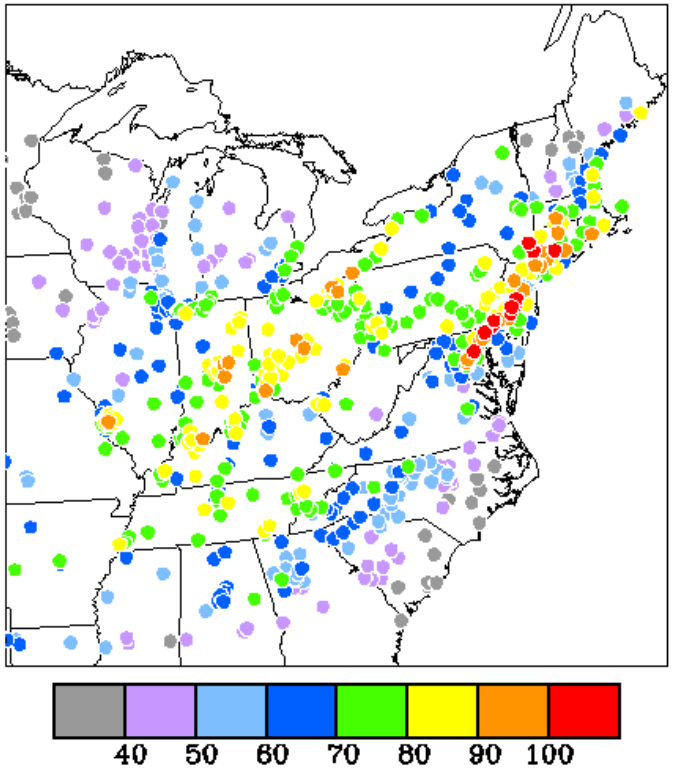


Narrow band of high ozone from Maryland to southwest New England Well Simulated

Daily Maximum 8-hr Ozone Concentrations, Predicted
Sunday, 08/04/2002, Maximum =121.2 ppb

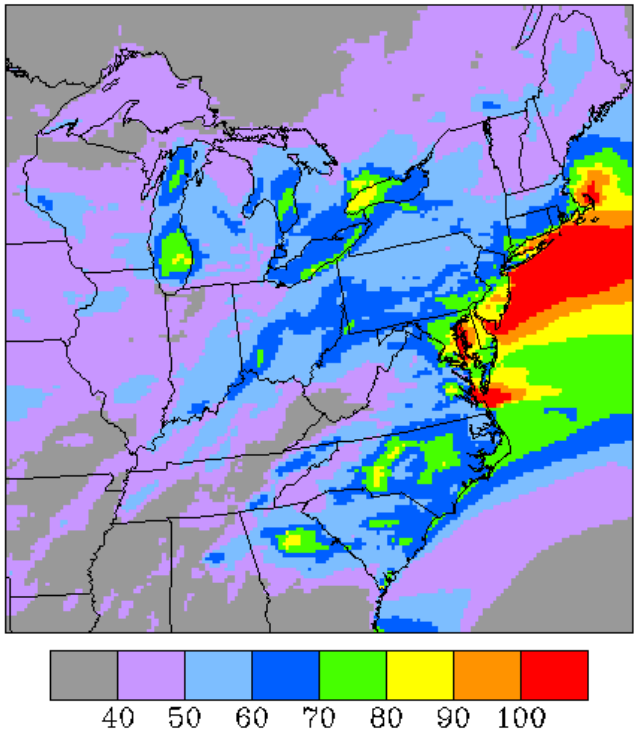


Daily Maximum 8-hr Ozone Concentrations, Observed
Sunday, 08/04/2002, Maximum =117 ppb

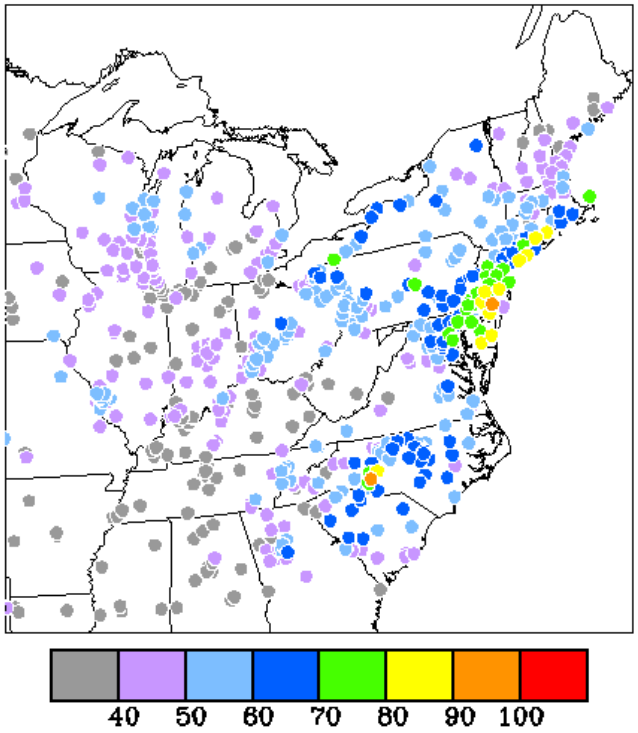


Questionable Treatment of Overwater Transport in Westerly Flow.

Daily Maximum 8-hr Ozone Concentrations, Predicted
Monday, 07/29/2002, Maximum =165.7 ppb



Daily Maximum 8-hr Ozone Concentrations, Observed
Monday, 07/29/2002, Maximum = 92 ppb



MASSACHUSETTS PERFORMANCE STATISTICS FOR 2002 CAA CMAQ RUN (OTB/OTW plus CAIR)							
Location	AIRS ID	Mean Normalized Gross Error %			Mean Normalized Bias %		
		1 hr daily max	8 hr daily max		1 hr daily max	8 hr daily max	
Truro	250010002	15.2	15.0		8.2	9.7	
Adams	250034002	14.7	14.6		-6.2	-7.3	
Fairhaven	250051002	14.2	15.6		5.3	6.1	
Lawrence	250090005	17.7	17.0		2.4	0.8	
Lynn	250092006	16.6	17.6		-7.5	-8.5	
Newbury	250094004	16.2	16.4		8.8	8.6	
Agawam	250130003	17.7	16.2		-7.6	-8.8	
Chicopee	250130008	17.2	16.6		-11.7	-12.4	
Amherst	250150103	15.5	14.3		-3.3	-2.1	
Ware	250154002	14.4	14.4		-6.7	-6.6	
Stow	250171102	16.8	14.9		-2.1	-5.4	
Milton	250213003	18.8	23.0		-15.9	-20.6	
Boston (Long Island)	250250041	19.1	22.4		-10.5	-15.4	
Boston	250250042	21.6	26.6		-18.9	-24.3	
Ware	250270015	18.5	17.5		-7.2	-10.1	
	All Monitors	16.9	17.5		-4.9	-6.4	

MAINE PERFORMANCE STATISTICS FOR 2002 CAA CMAQ RUN (OTB/OTW plus CAIR)						
Location	AIRS ID	Mean Normalized Gross Error %			Mean Normalized Bias %	
		1 hr daily max	8 hr daily max		1 hr daily max	8 hr daily max
Cape Elizabeth	230052003	17.3	15.4		-4.4	-5.9
ANP Cadillacc Mountain	230090102	17.9	15.2		-8.0	-5.8
ANP McFarland Hill	230090103	18.7	15.8		-4.3	-3.2
Castine	230090301	19.5	18.9		4.5	10.0
Gardiner	230112005	15.2	13.8		-6.4	-7.2
Port Clyde	230130004	20.1	20.3		6.9	8.0
North Lovell	230173001	17.5	15.7		-3.9	-8.4
Holden Rider Bluff	230194008	20.5	18.3		-12.5	-11.4
Reid State Park	230230004	19.2	19.7		12.5	14.1
West Buxton	230310038	16.6	15.6		-7.0	-6.9
Kennebunkport	230312002	17.8	16.6		-6.8	-9.8
Kittery	230313002	15.7	15.3		-6.3	-8.8
	All Monitors	18.0	16.7		-3.0	-2.9

NEW HAMPSHIRE PERFORMANCE STATISTICS FOR 2002 CAA CMAQ RUN (OTB/OTW plus CAIR)						
Location	AIRS ID	Mean Normalized Gross Error %			Mean Normalized Bias %	
		1 hr daily max	8 hr daily max		1 hr daily max	8 hr daily max
Laconia	330012004	18.7	17.8		-15.5	-14.1
Conway	330031002	18.6	16.9		-12.3	-11.8
Keene	330050007	16.5	15.1		0.2	-1.1
Summit	330074001	26.5	26.2		-25.0	-24.5
Mt Washington Base	330074002	17.3	16.7		-7.7	-5.8
Pittsburg	330074003	16.3	13.8		-12.8	-9.3
Haverhill	330090008	17.6	16.2		-12.8	-12.0
Manchester	330110020	16.8	15.3		-5.3	-7.4
Nashua	330111010	15.3	14.0		-4.6	-6.0
Miller State Park	330115001	18.7	19.0		-15.2	-15.5
Concord	330130007	16.5	15.1		-5.5	-9.7
Rye	330150012	18.3	16.0		-5.9	-8.2
Brnt	330150013	17.6	16.1		-6.9	-9.5
Portauth	330150015	15.9	15.3		-2.1	-1.8
Rochester	330173002	18.1	16.2		-7.3	-8.6
Claremont	330190003	16.7	15.4		-8.3	-9.9
	All Monitors	17.8	16.6		-9.2	-9.7

RHODE ISLAND PERFORMANCE STATISTICS FOR 2002 CAA CMAQ RUN (OTB/OTW plus CAIR)						
Location	AIRS ID	Mean Normalized Gross Error %			Mean Normalized Bias %	
		1 hr daily max	8 hr daily max		1 hr daily max	8 hr daily max
West Greenwich	440030002	12.6	11.0		-1.3	1.1
Providence	440071010	13.4	13.6		-2.7	-3.3
Narragansett	440090007	18.7	19.4		11.8	13.5
	All Monitors	14.9	14.7		2.6	3.8

CONNECTICUT PERFORMANCE STATISTICS FOR 2002 CAA CMAQ RUN (OTB/OTW plus CAIR)						
Location	AIRS ID	Mean Normalized Gross Error %			Mean Normalized Bias %	
		1 hr daily max	8 hr daily max		1 hr daily max	8 hr daily max
Greenwich	090010017	16.9	14.9		0.8	1.6
Danbury	090011123	17.4	16.2		-3.8	-3.8
Stratford	090013007	18.7	17.8		-1.1	-2.2
Westport	090019003	16.6	14.4		-1.4	-0.8
East hartford	090031003	15.4	14.5		1.2	1.8
Cornwall	090050005	17.5	17.8		-11.9	-14.3
Middletown	090070007	14.7	14.3		-0.5	0.8
Madison	090093002	17.0	15.5		2.6	2.9
Hamden	090099005	17.9	17.7		-2.2	-2.3
Groton	090110008	25.3	28.6		19.7	26.1
Stafford	090131001	13.8	13.3		-7.7	-5.2
	All Monitors	17.4	16.8		-0.4	0.4

Preliminary Evaluation

* *Good Spatial Agreement*
* *Coastal Gradients Fairly Well Depicted*
* *Tendency to Underpredict Fairly Consistent*
* *Questionable Handling of Overwater Ozone – May Not Be Critical*
* *Statistical Performance Acceptable*

<u>Overall Performance Good!</u>

Modeling Schedule

2009 CAA (OTB/OTW plus CAIR) Run

1. MANEVU 2009 CAA Emission Files (OTB/OTW plus CAIR) - late October

2. Other RPOs 2009 CAA Emission Files (OTB/OTW plus CAIR) - late September

3. Canada 2009 CAA Emission Files (or surrogate) - late October

4. 2009 CAA CMAQ Run - late November

5. 2009 CAA Design Values - late December

OTB means on the books
OTW means on the way and effective by 2009
CAIR means EPA's Clean Air interstate Rule

2009 CAA (OTB/OTW plus CAIR) Run

1. MANEVU 2009 CAA Emission Files (OTB/OTW plus CAIR) - late October

NESCAUM is preparing SMOKE-ready on-road input files and will provide them to other modeling centers in MANE-VU by end of September.

VISTAS will supply SMOKE-ready EGU files to MARAMA by end of September.

MACTEC will provide growth and control factors to NY DEC for area sources, off-road sources and non-EGU point sources by end of September. NY DEC will then run SMOKE to prepare CMAQ model-ready files for area sources, on and off-road mobile sources, and non-EGU point sources emission files by late October.

2009 CAA (OTB/OTW plus CAIR) Run

2. Other RPOs 2009 CAA Emission Files (OTB/OTW plus CAIR) - late September

VISTAS is presently updating their 2009 OTB/OTW plus CAIR emissions and they should have SMOKE-ready emission files for VISTAS, MRPO and CENRAP by end of September.

2009 CAA (OTB/OTW plus CAIR) Run

3. Canada 2009 CAA Emission Files (or surrogate) - late October

It will take 3 - 4 weeks for NY DEC to process 2009 (or 2010) Canadian emission inventories with SMOKE. NY DEC currently has 2010, 2015 and 2020 area and mobile Canadian emissions in SMOKE format. Decision is yet to be made on the Canadian 2009/2010 point sources. Target date for Canadian CMAQ model-ready emission files is late October.

2009 CAA (OTB/OTW plus CAIR) Run

4. 2009 CAA CMAQ Run - late November

It will take about 3 weeks to run CMAQ after all the CMAQ model-ready emission files have been obtained and prepared by NY DEC. So if CMAQ model-ready emission files were all set by late October, CMAQ model simulations results would be available in late November.

2009 CAA (OTB/OTW plus CAIR) Run

5. 2009 CAA Design Values - late December

An additional 4 to 5 weeks will be needed for analysis and to calculate 2009 design values at each MANEVU ozone monitor. Final ozone predictions in the OTR for the 2009 OTB/OTW plus CAIR scenario would be ready in late December.

OTC 2009 Control Strategy 1 Run

1. MANEVU 2009 OTC Control Strategy 1 – early December

2. Other RPOs 2009 CAA Emission Files (OTB/OTW plus CAIR) – late September (unless a new control strategy run is available from VISTAS)

3. Canada 2009 CAA Emission Files (or surrogate) – late October

4. 2009 CAA CMAQ Run – early January

5. 2009 CAA Design Values – January 22, 2006

OTC 2009 Control Strategy 1 Run

1. MANEVU 2009 OTC Control Strategy 1 – early December

OTC contractor will assemble emission reduction information for control programs by early November. OTC workgroups will design a control strategy scenario (or sensitivity run) by mid November. NY DEC will then run SMOKE to prepare CMAQ model-ready files for non-road, area and non-EGU point sources emission files by early December.

If needed, NESCAUM and MARAMA will prepare SMOKE-ready on-road input files by early December.

NY DEC will use the SMOKE-ready EGU files provided by VISTAS for 2009 OTB/OTW plus CAIR.

OTC 2009 Control Strategy 1 Run

2. Other RPOs 2009 CAA Emission Files (OTB/OTW plus CAIR) – late September (unless a new control strategy run is available from VISTAS)

NY DEC will use 2009 OTB/OTW plus CAIR files provided by VISTAS for 2009 OTB/OTW plus CAIR.

OTC 2009 Control Strategy 1 Run

3. Canada 2009 CAA Emission Files (or surrogate) – late October

NY DEC will use 2010 Canadian non-point emission files provided by Environment Canada and USEPA for OTR 2009 Control Strategy 1 emission files. Decision is yet to be made on the Canadian 2009/2010 point sources

OTC 2009 Control Strategy 1 Run

4. 2009 CAA CMAQ Run – early January

It will take about 3 weeks to run CMAQ after all the CMAQ model-ready emission files have been obtained and prepared by NY DEC. So if CMAQ model-ready emission files were all set by early December, CMAQ model simulations results would be available from NY DEC by January 1, 2006

OTC 2009 Control Strategy 1 Run

5. 2009 CAA Design Values – January 22, 2006

An additional 3 weeks will be needed for analysis and to calculate 2009 OTR Control Strategy 1 design values at each MANEVU ozone monitor. Final ozone predictions would be ready by January 22 OTC AD meeting.