

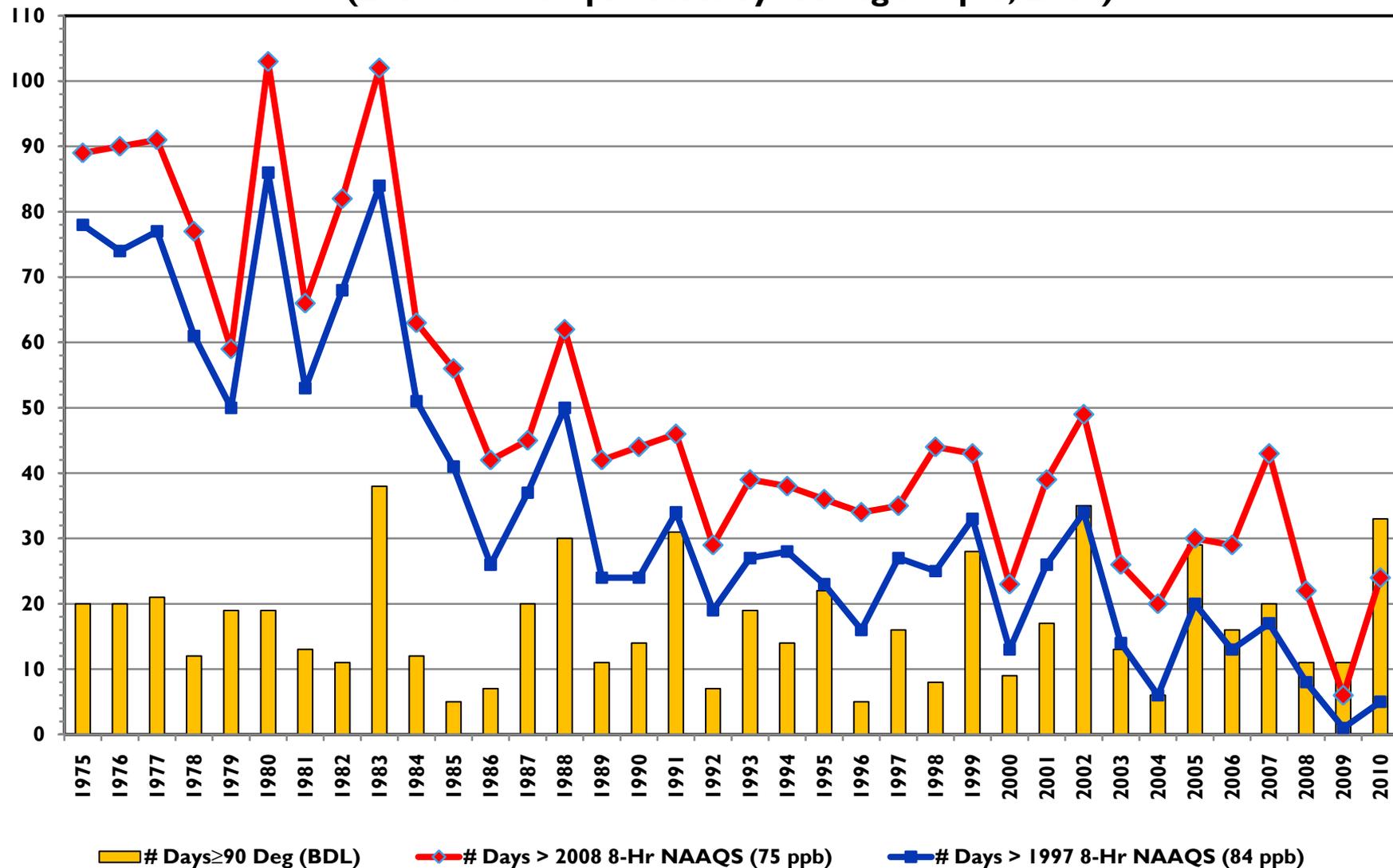
# 2010 NOAA Ozone Model Analysis



Michael Geigert, CT DEP

# Unusually warm summer over the northeast states

## Number of Ozone Exceedance Days in Connecticut Compared to the Number of "Hot" Days (2010 data are preliminary through Sep 9, 2010)



- 24 Days with at least one site  $> 75$  ppb
- Operational Model predicted 34 exceedance days- 22 correct days!
- Still over-predicting high days, but able to compensate
- Area of most concern are the coastal sites- recirculation off LIS

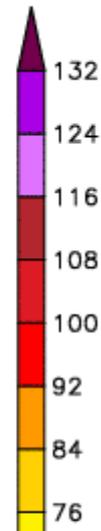
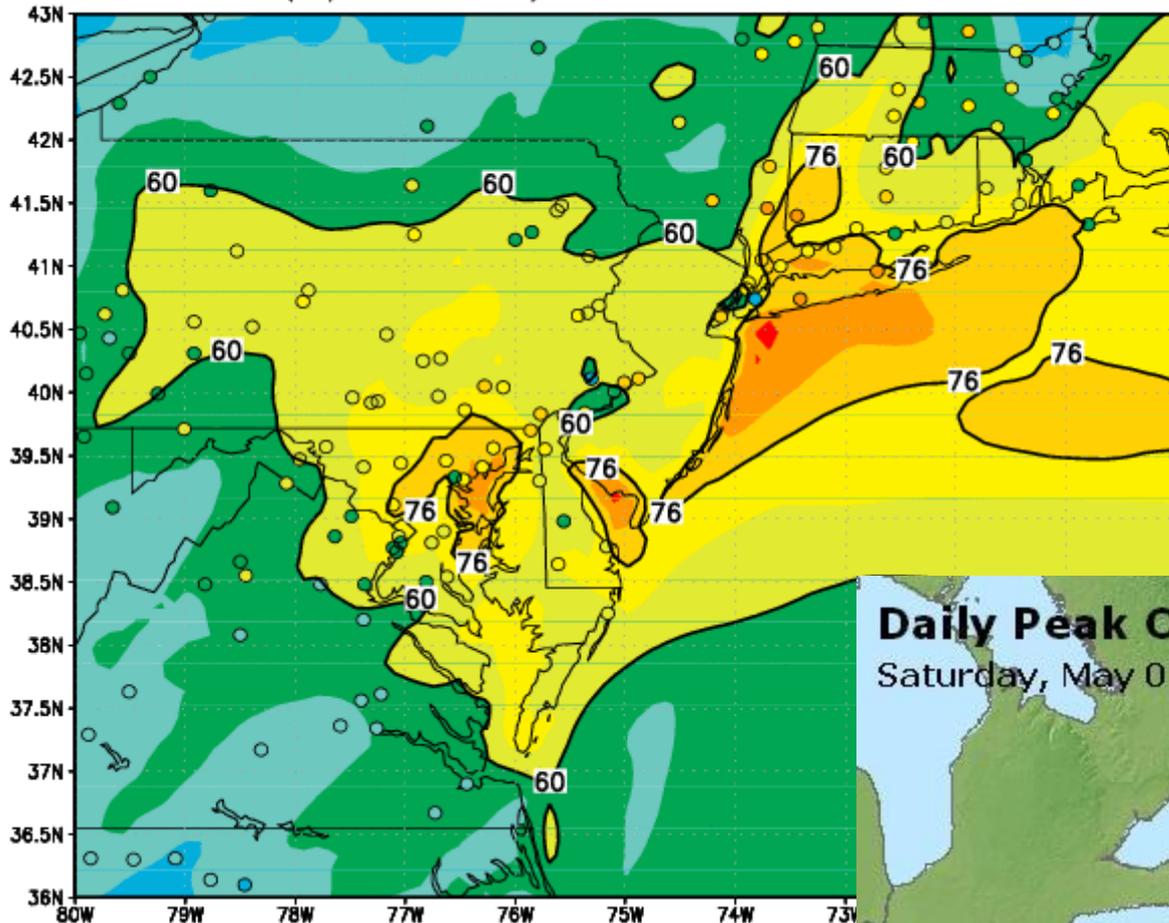
# May-June Model Performance

Date (2010)	Highest observed ppb	Highest Modeled Operational Category	Highest Modeled Experimental ppb	Modeled Exp-Obs ppb
May 1	88		87	-1
May 26	71		88	+16
May 31	50		80	+30
June 4	77		80	+30
June 5	76		85	+11
June 12	55		82	+27
June 19	75		84	+11
June 20	68		108	+40
June 24	78		104	+26
June 26	76		88	+12
June 27	84		100	+16
June 28	80		101	+21

# July- September Model Performance

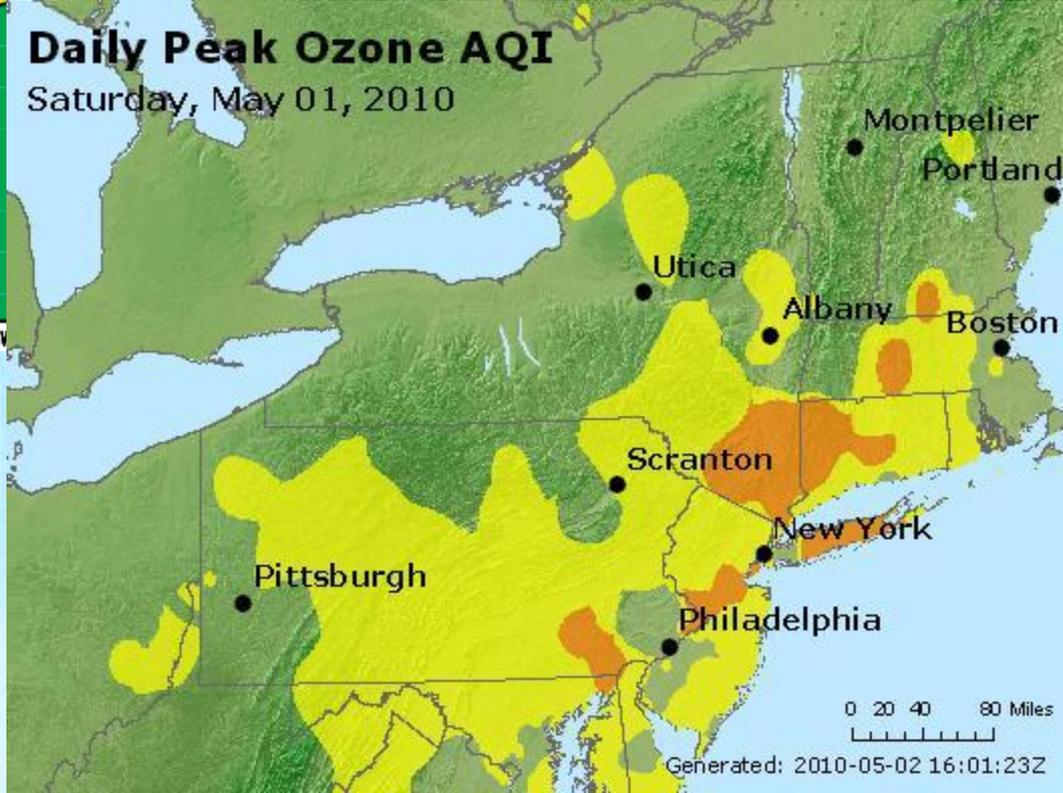
Date (2010)	Highest observed ppb	Highest Modeled Operational Category	Highest Modeled Experimental ppb	Modeled Exp-Obs ppb
July 4	82		92	+10
July 5	80		80	0
July 6	80		80	0
July 7	79		92	+13
July 12	84		80	-4
July 16	91		115	+24
July 17	81		96	+15
July 18	77		86	+9
July 19	78		70	-8
July 20	67		91	+24
July 21	79		100	+21
July 23	45		77	+32
July 24	68		100	+32
July 28	87		91	+4
August 1	54		82	+28
August 5	70		76	+6
August 9	83		104	+29
August 10	80		139	+59
August 17	82		97	+15
August 19	73		88	+15
August 31	69		84	+15
September 1	91		125	+34
September 2	101		116	+15
September 7	78		78	+0

5x (Operational) 8-hr max 01MAY2010



**May 1, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**  
Saturday, May 01, 2010



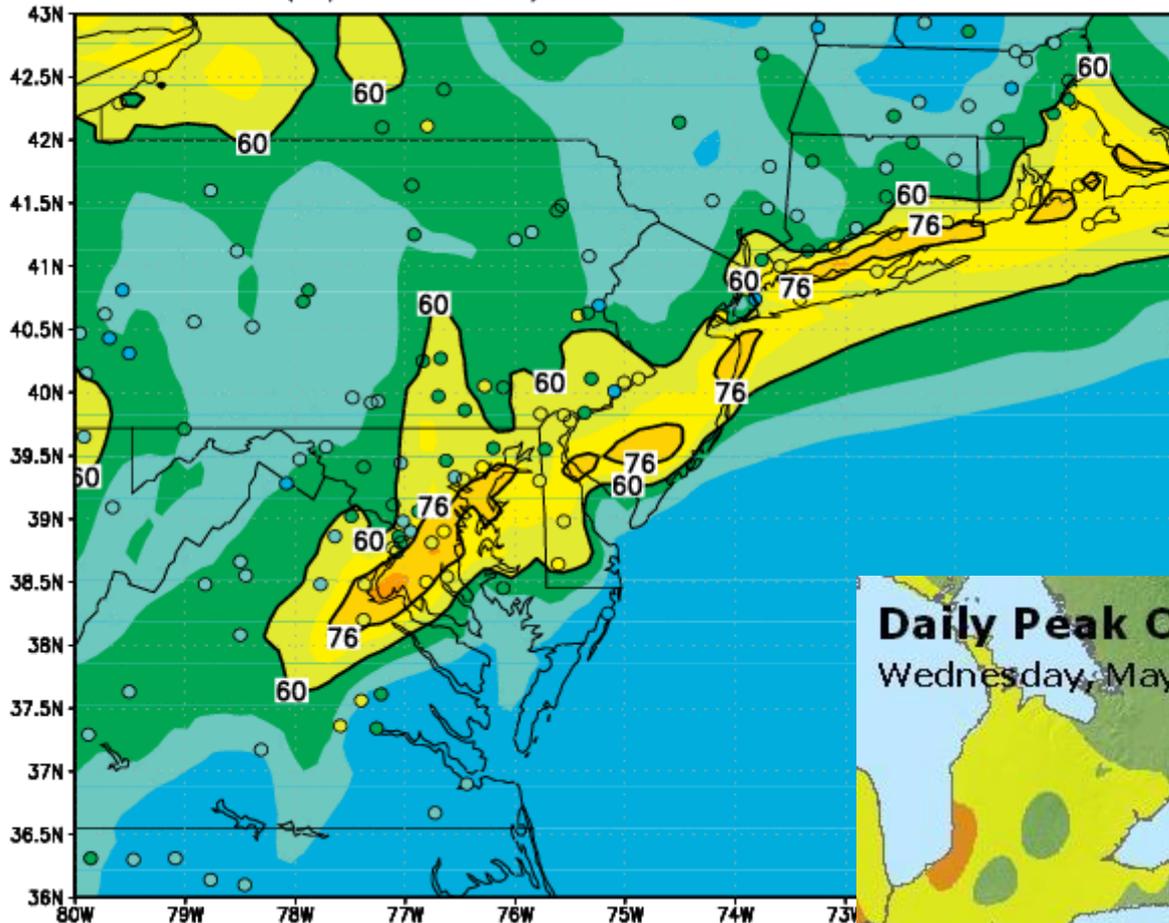
<b>Cornwall</b>	<b>05/01/10</b>	<b>0.087</b>
<b>Danbury</b>	<b>05/01/10</b>	<b>0.088</b>
<b>Middletown</b>	<b>05/01/10</b>	<b>0.080</b>



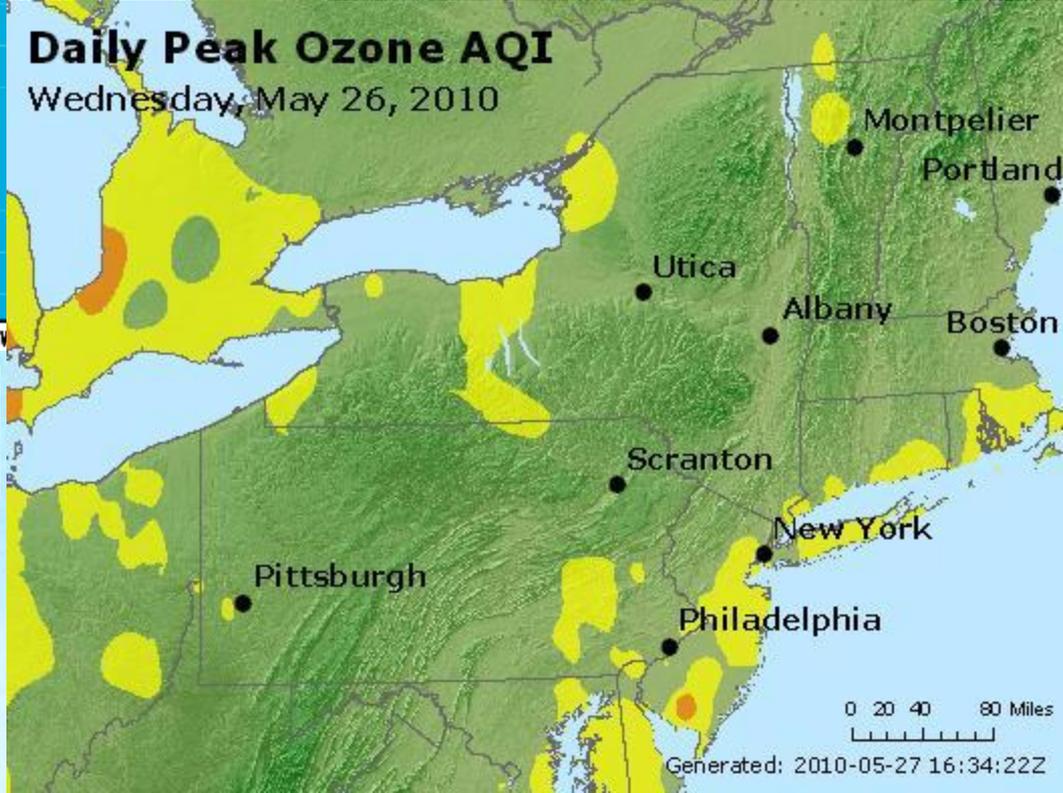
0 20 40 80 Miles

Generated: 2010-05-02 16:01:23Z

# 5x (Operational) 8-hr max 26MAY2010

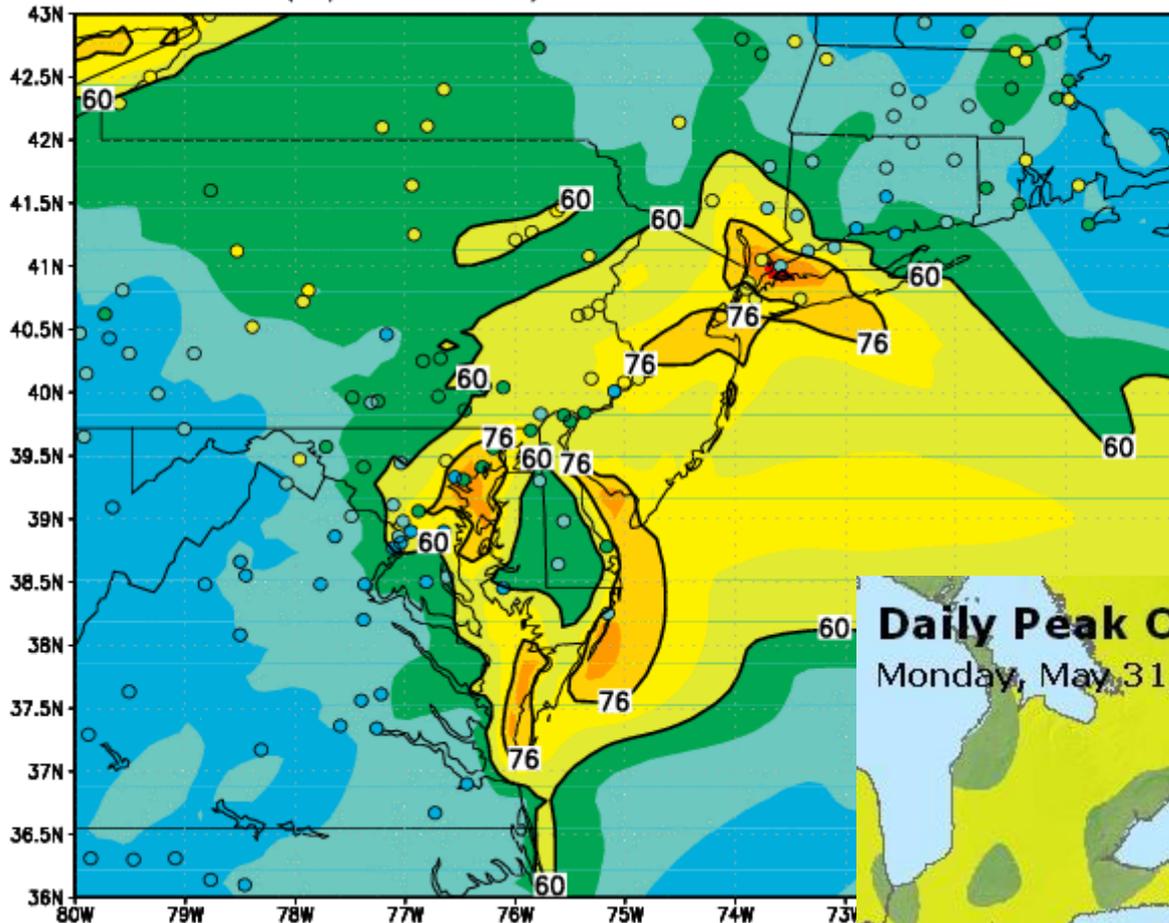


**May 26, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



<b>Madison</b>	<b>05/26/10</b>	<b>0.071</b>
<b>Stratford</b>	<b>05/26/10</b>	<b>0.068</b>
<b>Groton</b>	<b>05/26/10</b>	<b>0.067</b>

# 5x (Operational) 8-hr max 31MAY2010

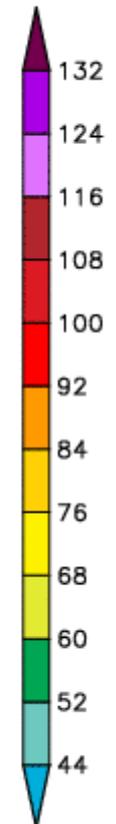
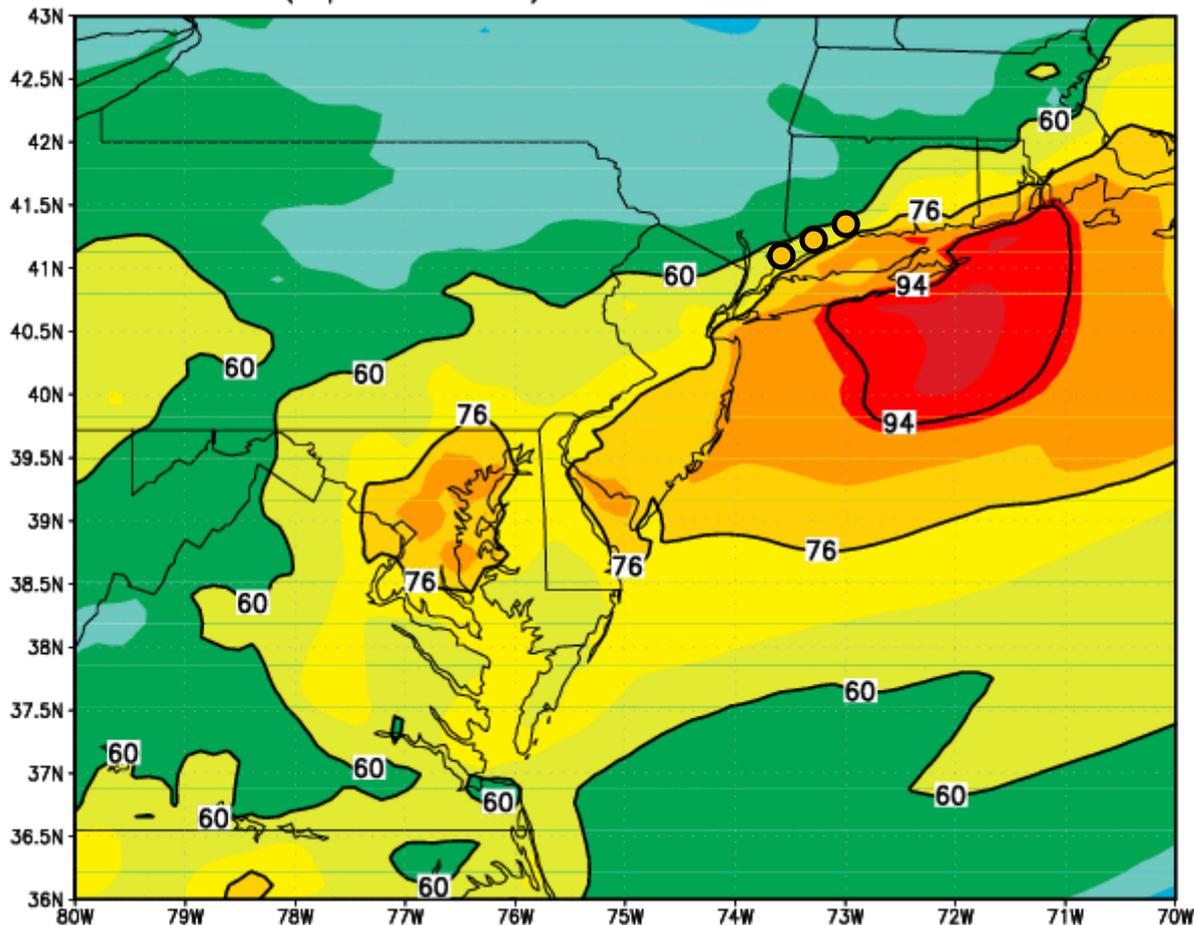


**May 31, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



<b>Greenwich</b>	<b>05/31/10</b>	<b>0.050</b>
<b>Stratford</b>	<b>05/31/10</b>	<b>0.049</b>
<b>Cornwall</b>	<b>05/31/10</b>	<b>0.050</b>

5x (Operational) 8-hr max 04JUN2010

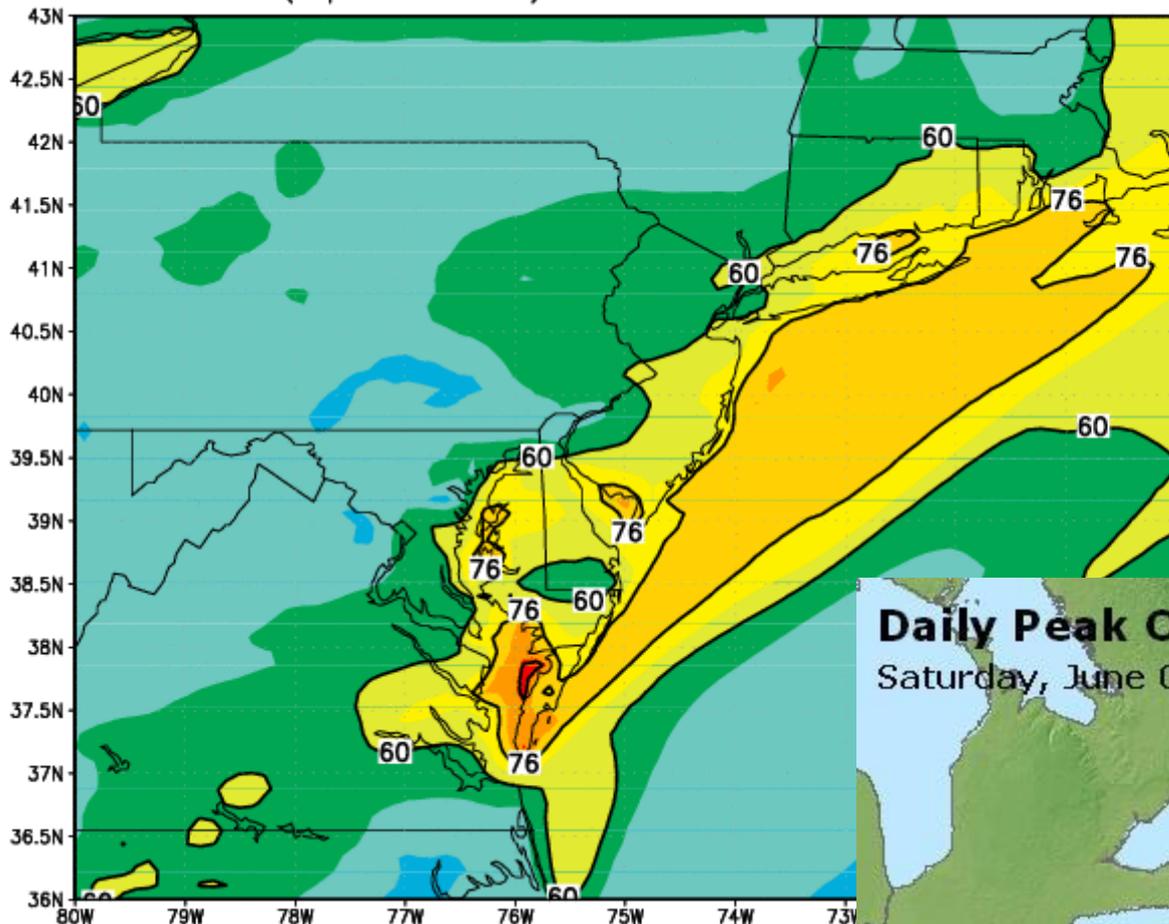


**June 4, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

<b>Greenwich</b>	<b>06/04/10</b>	<b>0.077</b>
<b>Stratford</b>	<b>06/04/10</b>	<b>0.077</b>
<b>Westport</b>	<b>06/04/10</b>	<b>0.077</b>



5x (Operational) 8-hr max 05JUN2010



**June 5, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

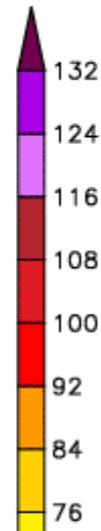
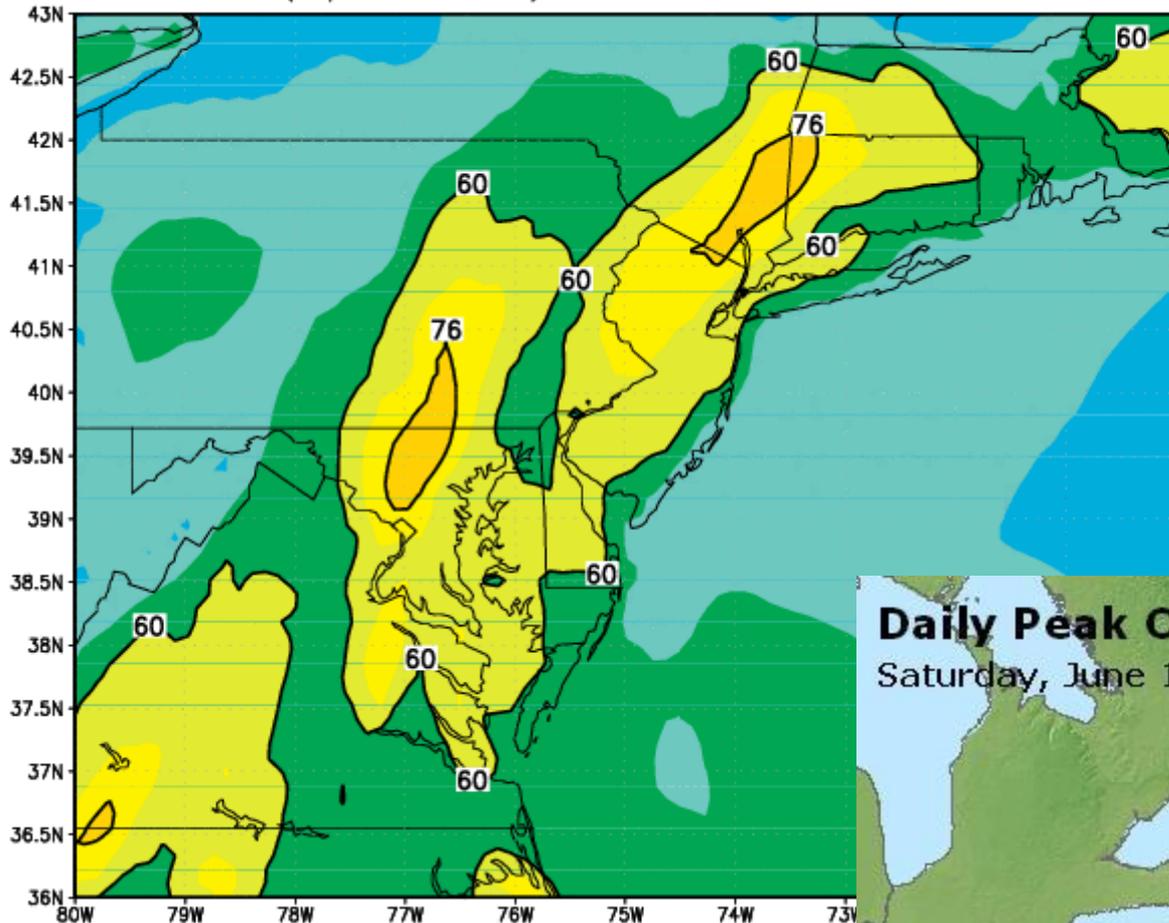
**Groton 06/05/10 0.076**



**Daily Peak Ozone AQI**  
Saturday, June 05, 2010



5x (Operational) 8-hr max 12JUN2010

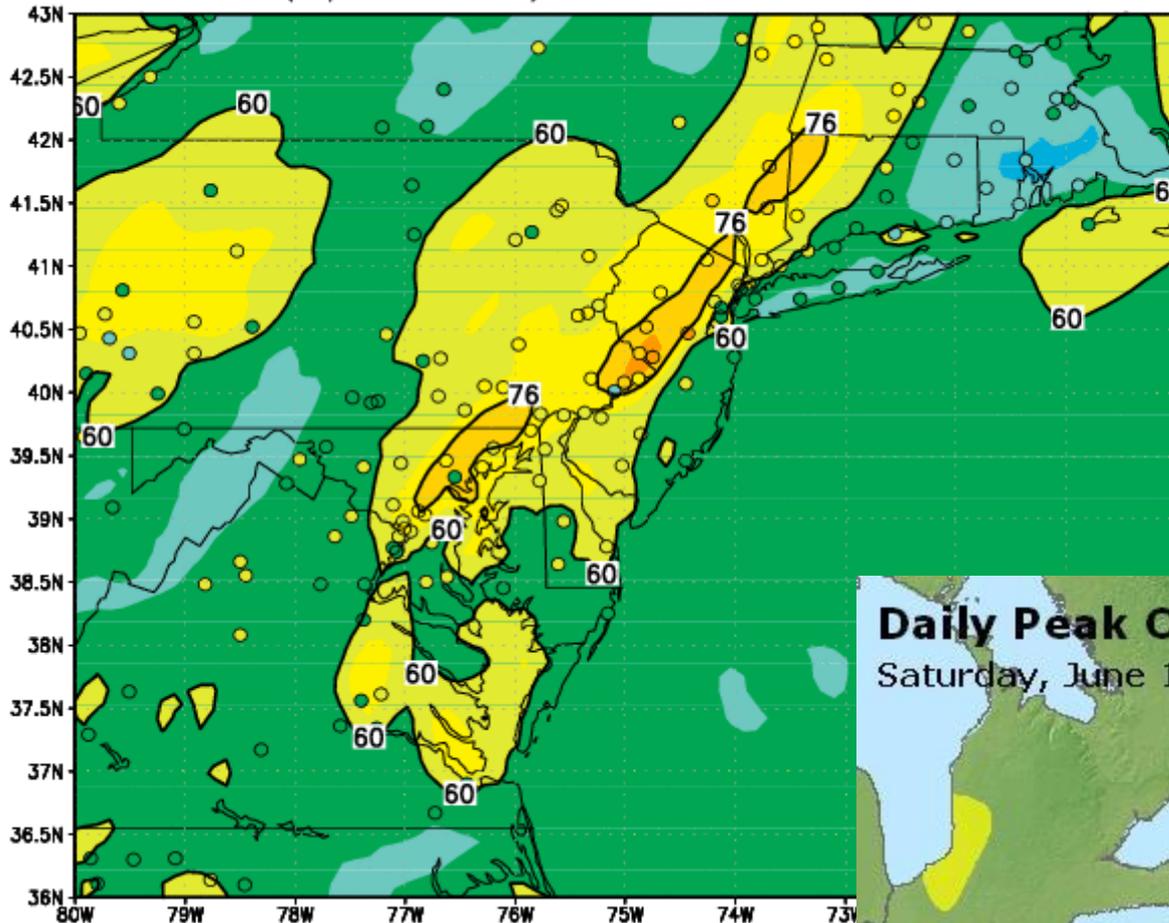


**June 12, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



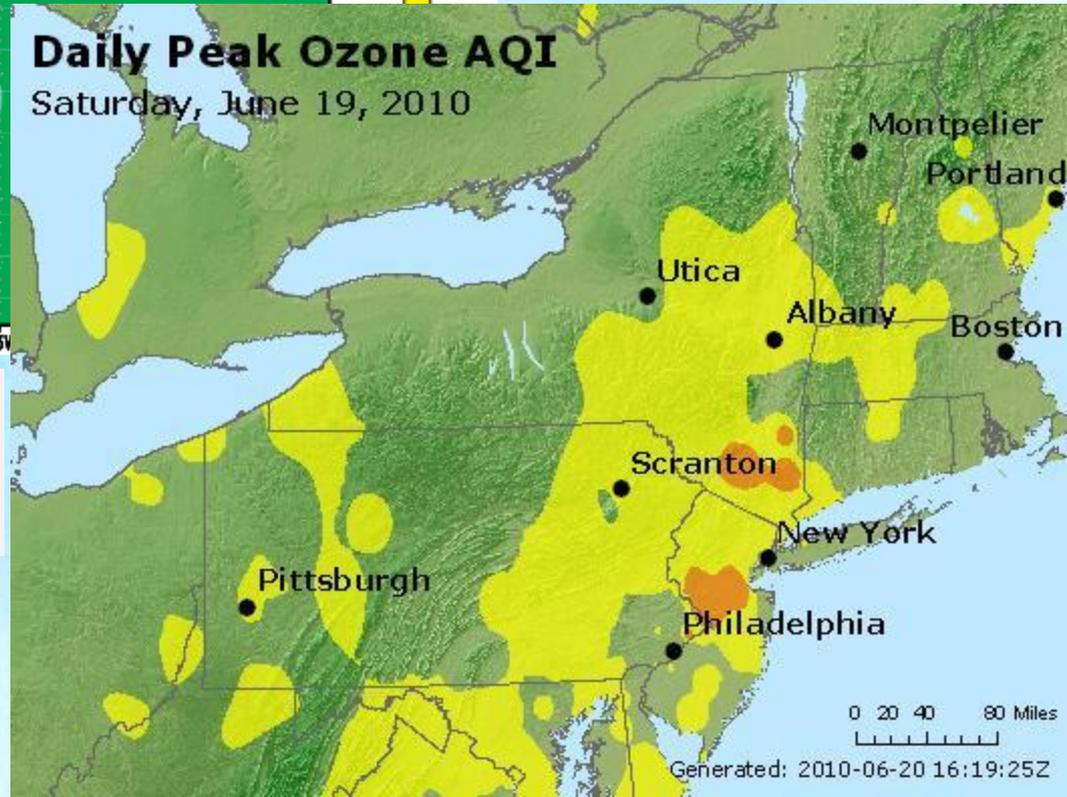
<b>Danbury</b>	<b>06/12/10</b>	<b>0.055</b>
<b>Stratford</b>	<b>06/12/10</b>	<b>0.054</b>
<b>Westport</b>	<b>06/12/10</b>	<b>0.050</b>

5x (Operational) 8-hr max 19JUN2010



**June 19, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

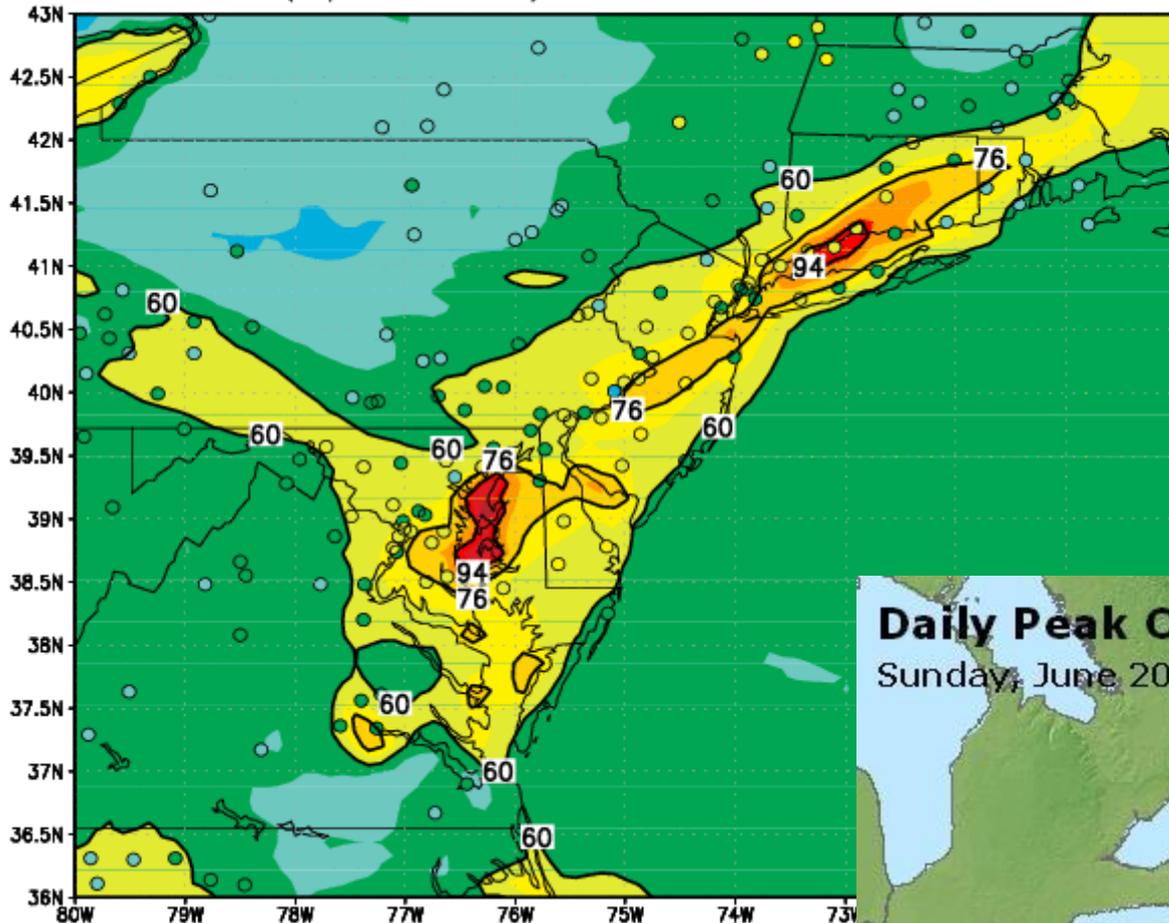
**Daily Peak Ozone AQI**  
Saturday, June 19, 2010



<b>Cornwall</b>	<b>06/19/10</b>	<b>?????</b>
<b>Danbury</b>	<b>06/19/10</b>	<b>0.075</b>
<b>Westport</b>	<b>06/19/10</b>	<b>0.063</b>
<b>E Hartford</b>	<b>06/19/10</b>	<b>0.061</b>



# 5x (Operational) 8-hr max 20JUN2010

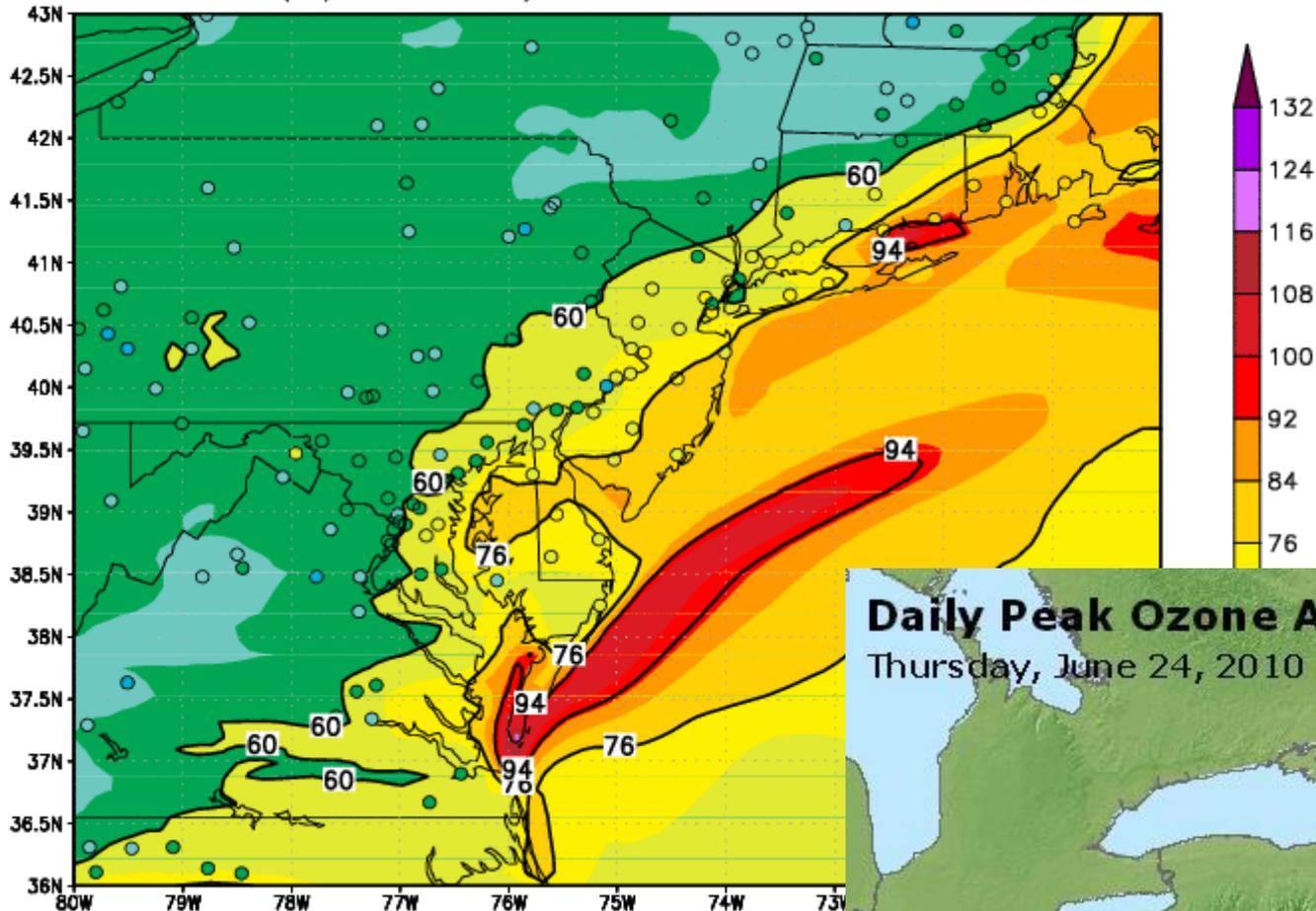


**June 20, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



<b>Westport</b>	<b>06/20/10</b>	<b>0.068</b>
<b>Greenwich</b>	<b>06/20/10</b>	<b>0.067</b>
<b>New Haven</b>	<b>06/20/10</b>	<b>0.065</b>

5x (Operational) 8-hr max 24JUN2010



**June 24, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

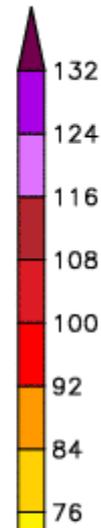
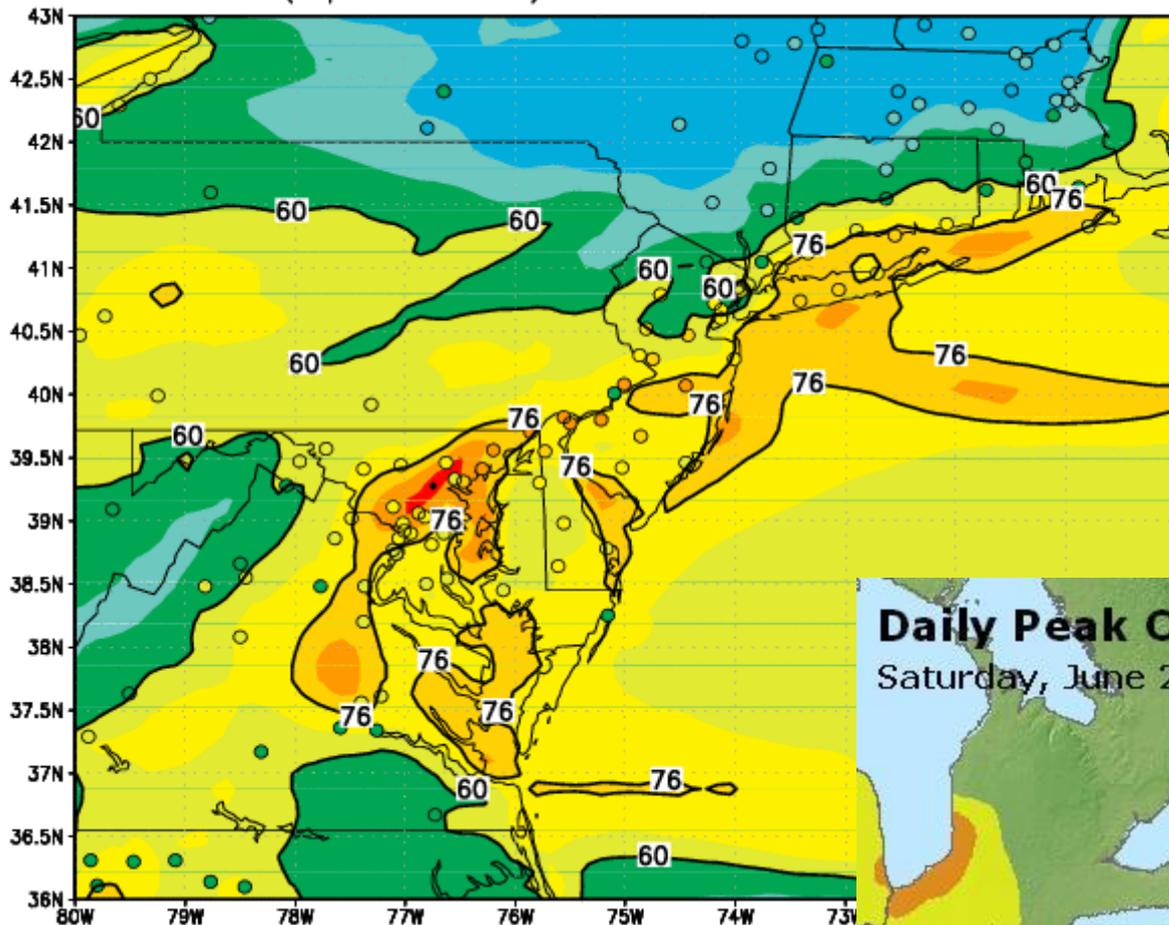
**Groton 06/24/10 0.078**



**Daily Peak Ozone AQI**  
Thursday, June 24, 2010



5x (Operational) 8-hr max 26JUN2010



**June 26, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

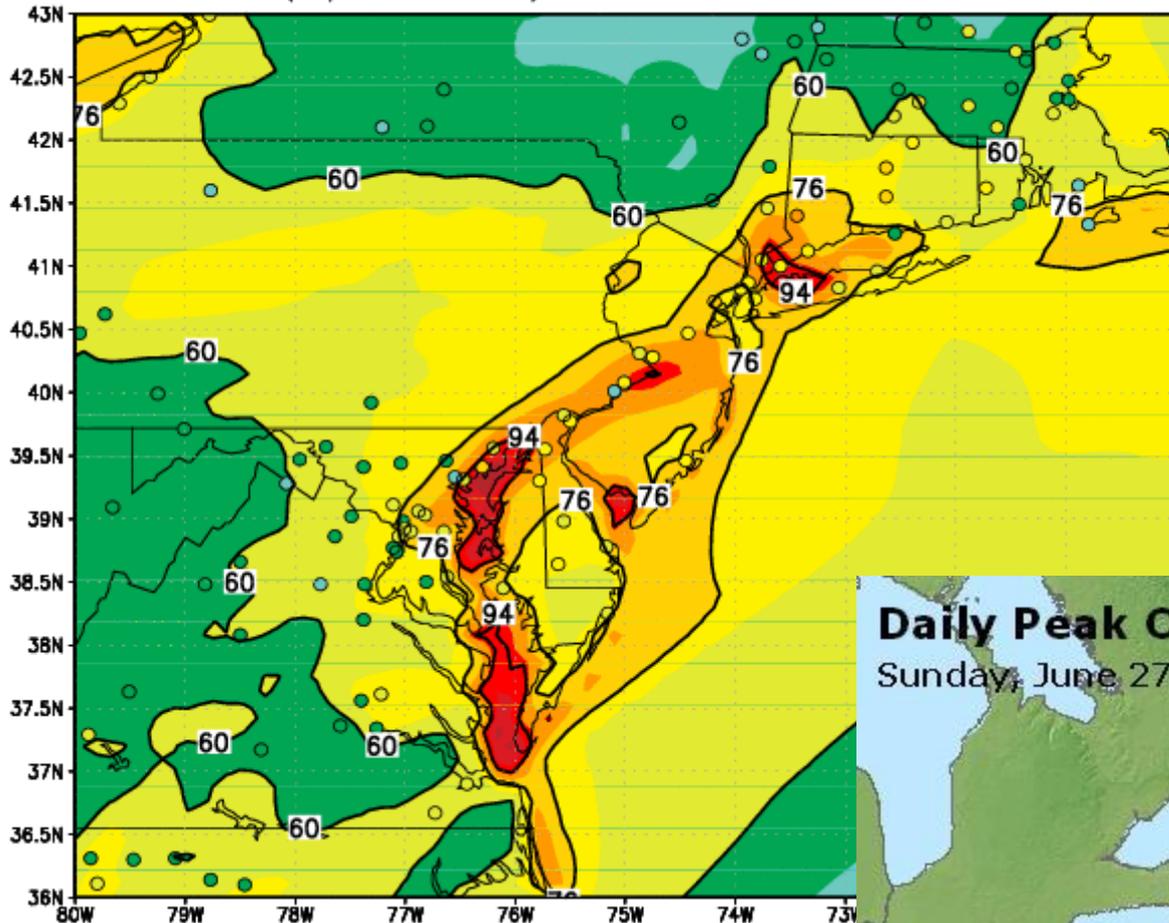
**Madison 06/26/10 0.076**



**Daily Peak Ozone AQI**  
Saturday, June 26, 2010

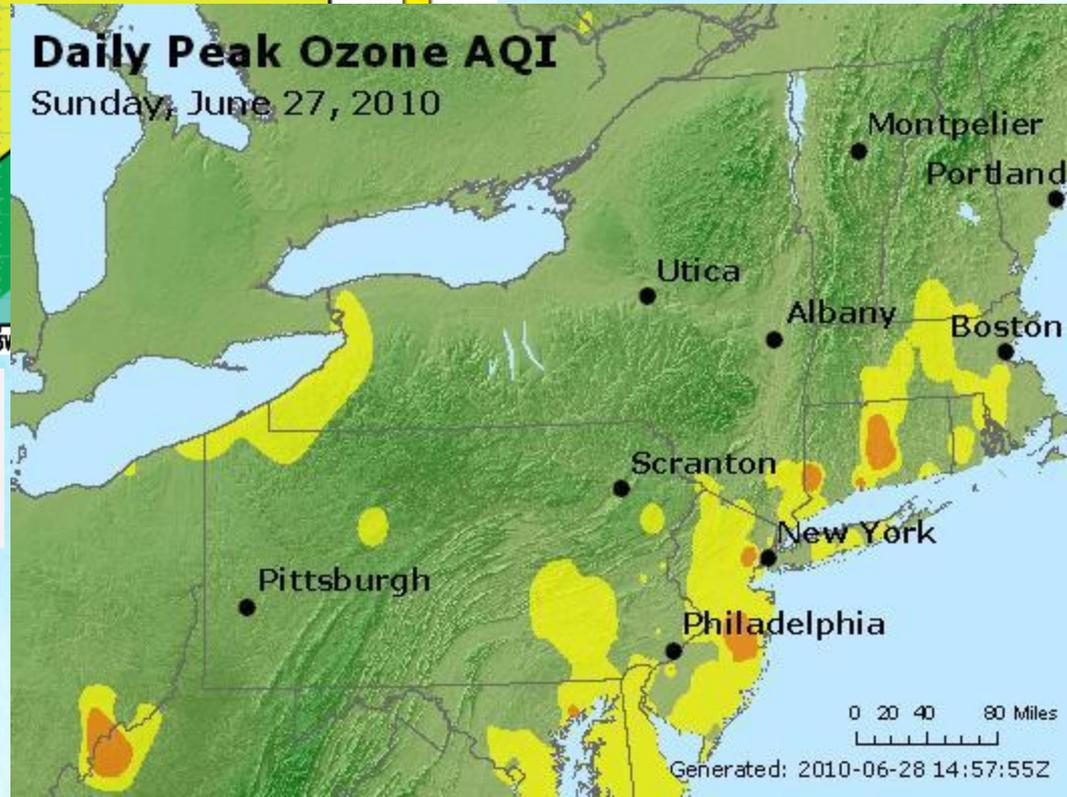


5x (Operational) 8-hr max 27JUN2010



**June 27, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**  
Sunday, June 27, 2010



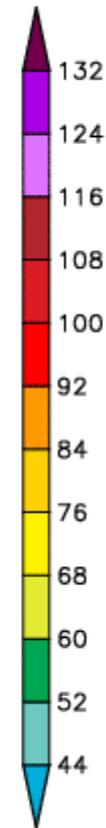
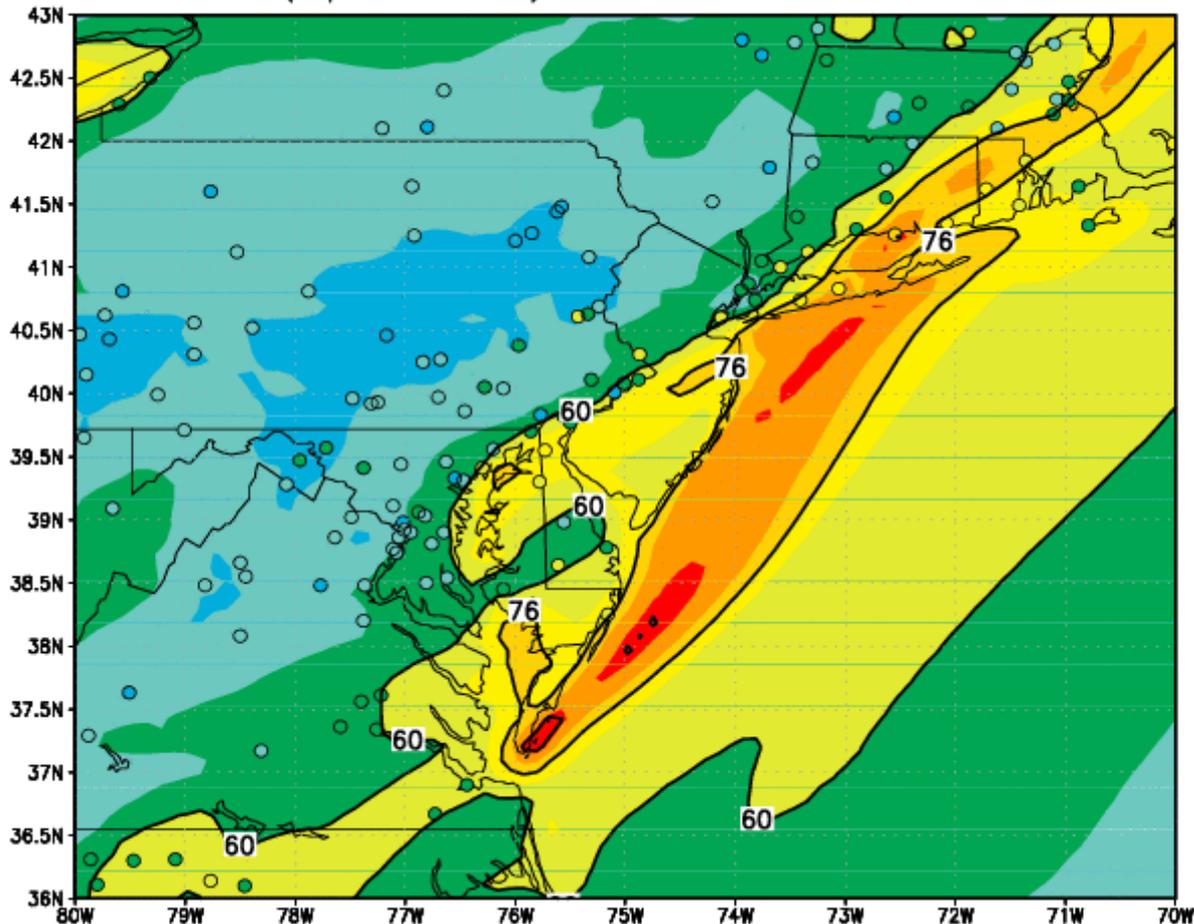
Danbury	06/27/10	0.084
East Hartford	06/27/10	0.076
Middletown	06/27/10	0.083
New Haven	06/27/10	0.076



0 20 40 80 Miles

Generated: 2010-06-28 14:57:55Z

5x (Operational) 8-hr max 28JUN2010



**June 28, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

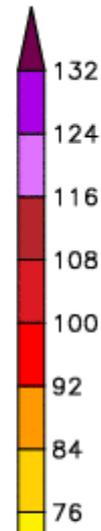
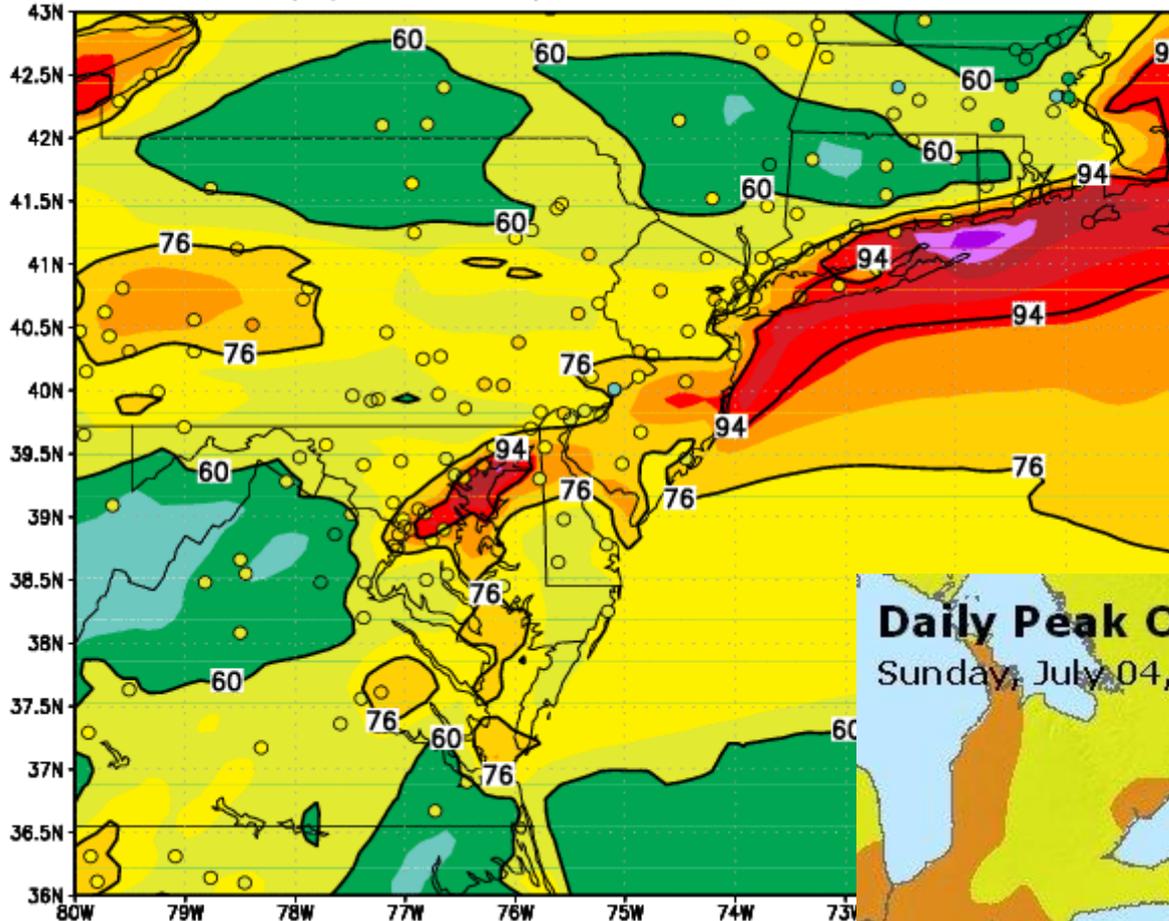
**Madison**

**06/28/10**

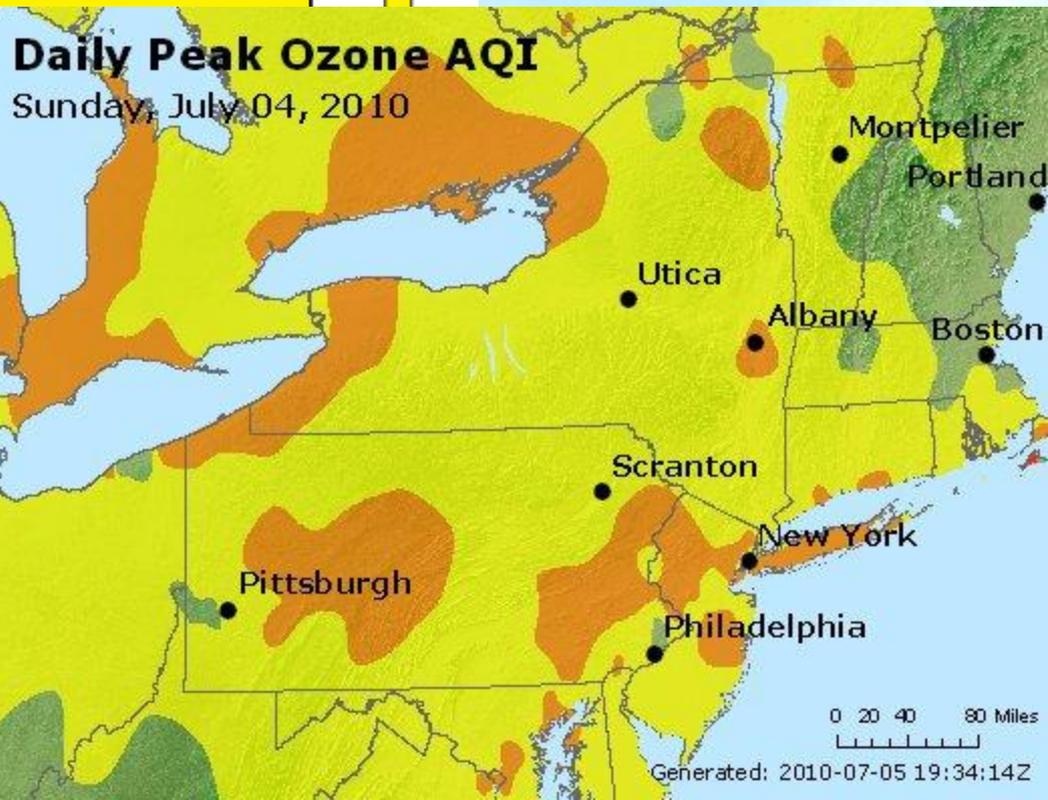
**0.080**



5x (Operational) 8-hr max 04JUL2010



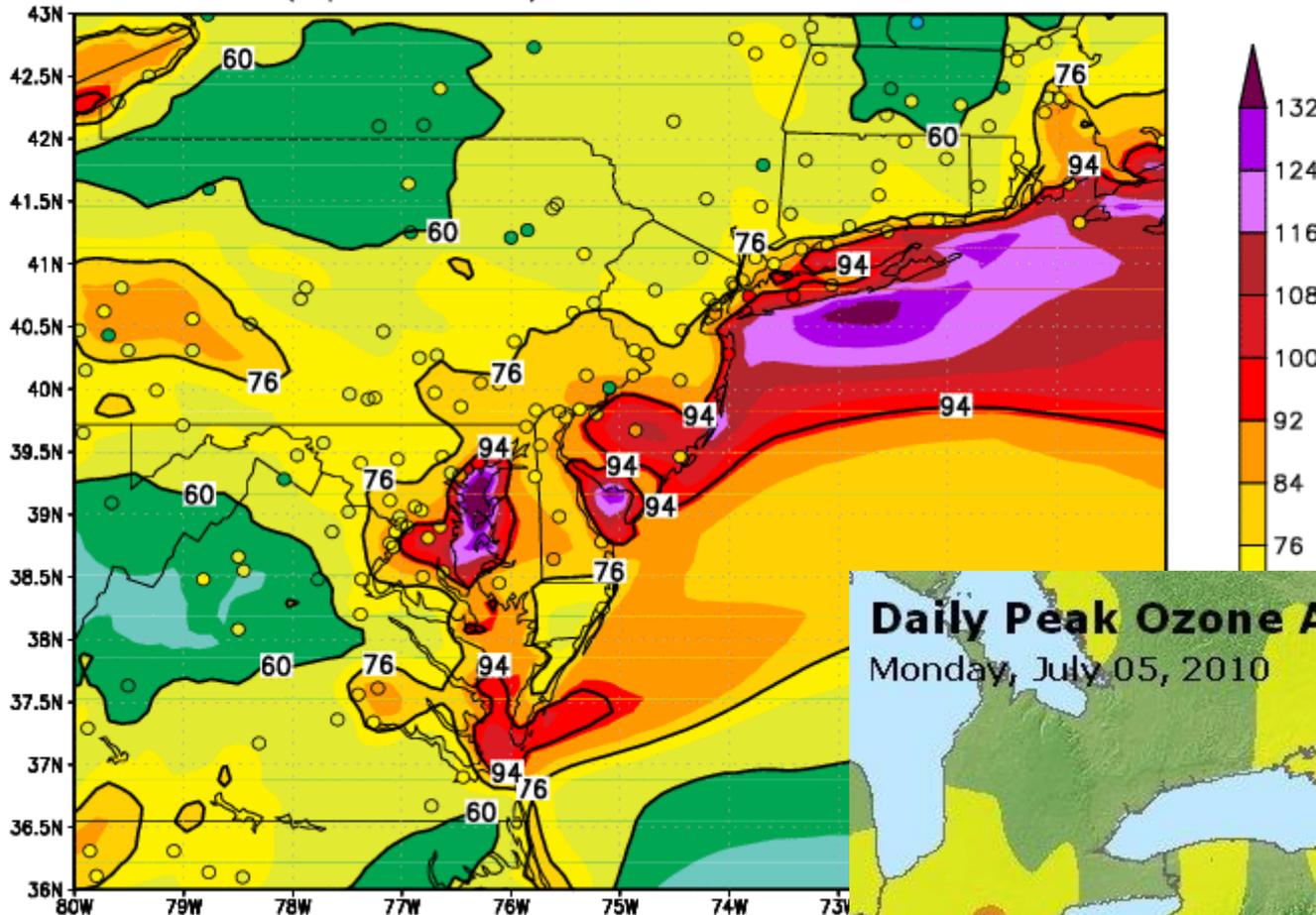
**July 4, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



<b>Madison</b>	<b>07/04/10</b>	<b>0.082</b>
<b>Stratford</b>	<b>07/04/10</b>	<b>0.079</b>

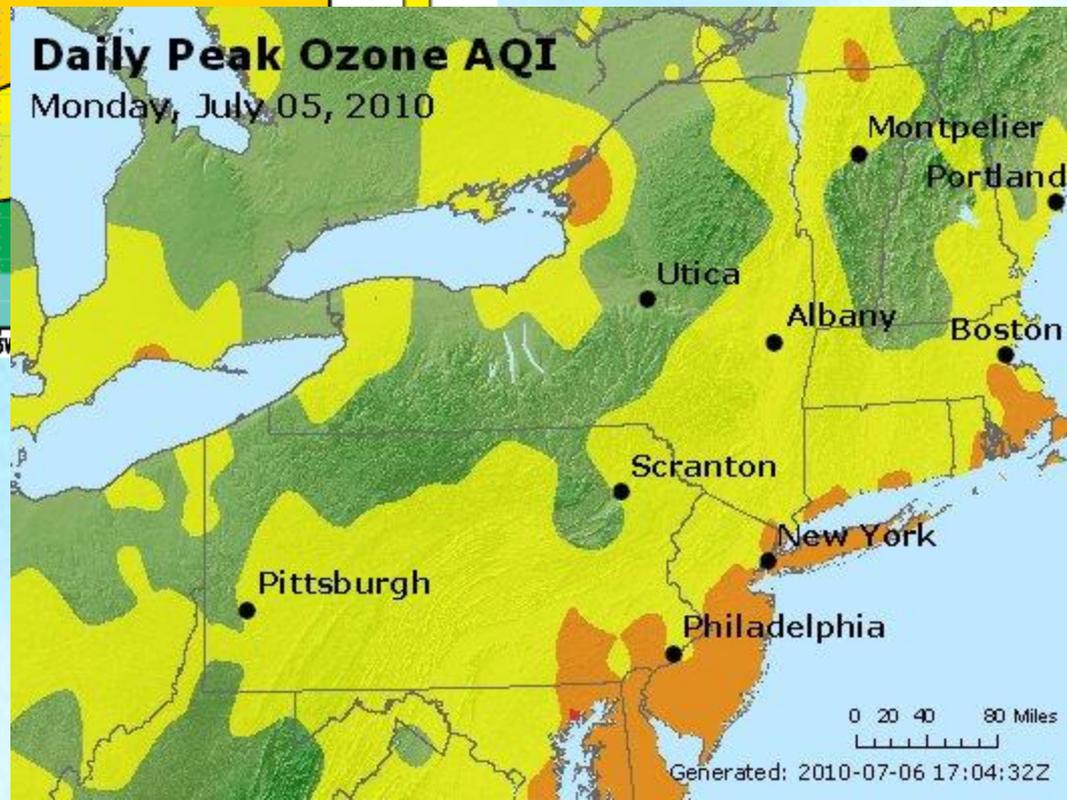


5x (Operational) 8-hr max 05JUL2010



**July 5, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

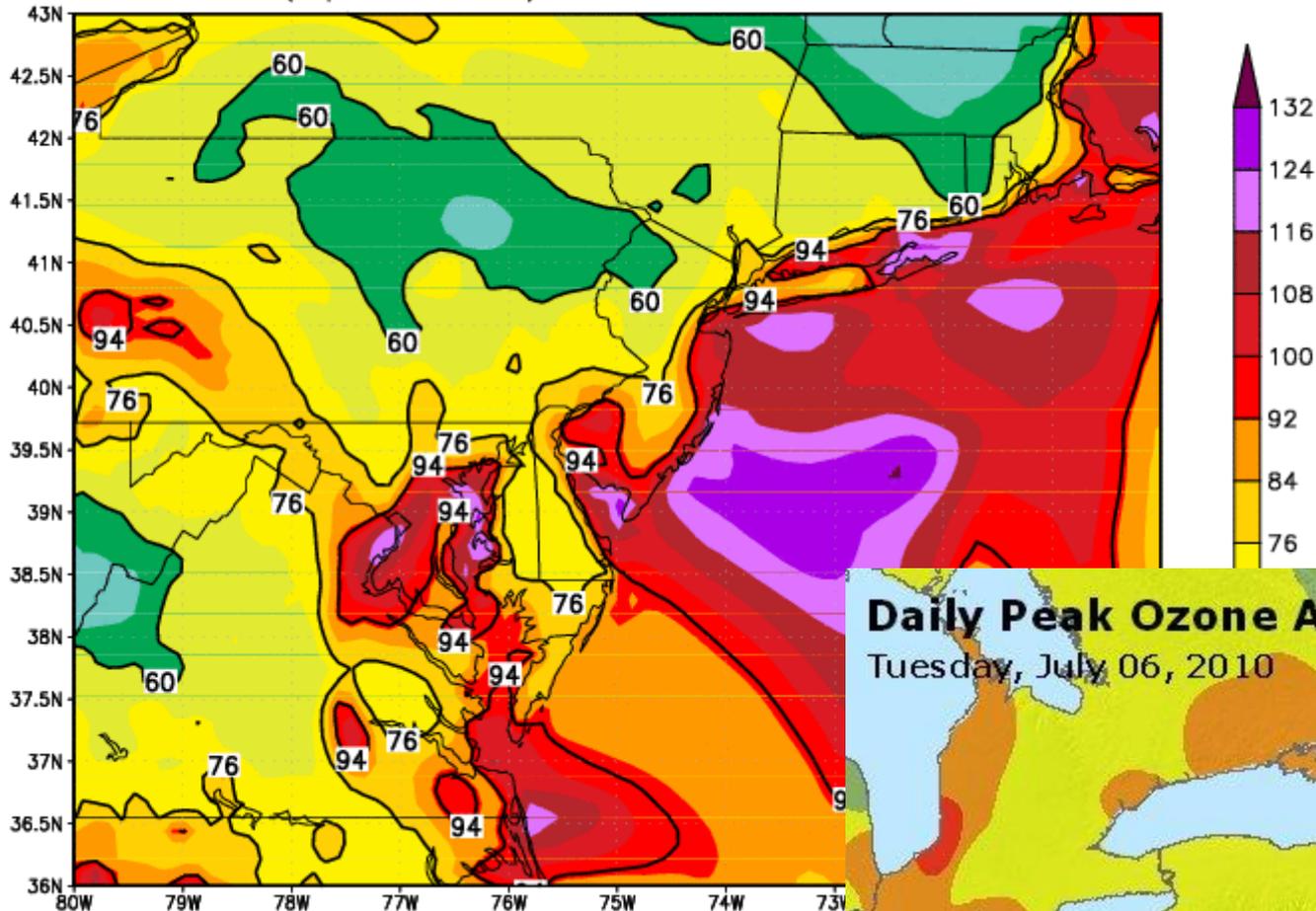
**Daily Peak Ozone AQI**  
Monday, July 05, 2010



<b>Madison</b>	<b>07/05/10</b>	<b>0.079</b>
<b>Stratford</b>	<b>07/05/10</b>	<b>0.080</b>
<b>Westport</b>	<b>07/05/10</b>	<b>0.079</b>

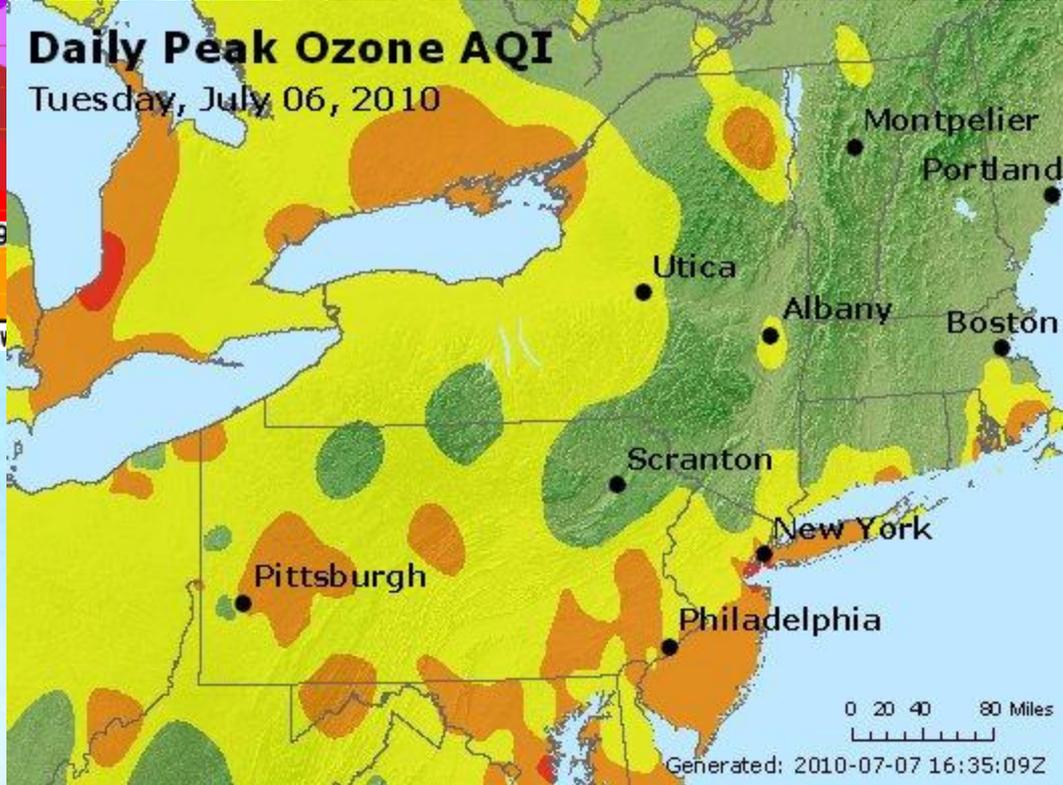


5x (Operational) 8-hr max 06JUL2010

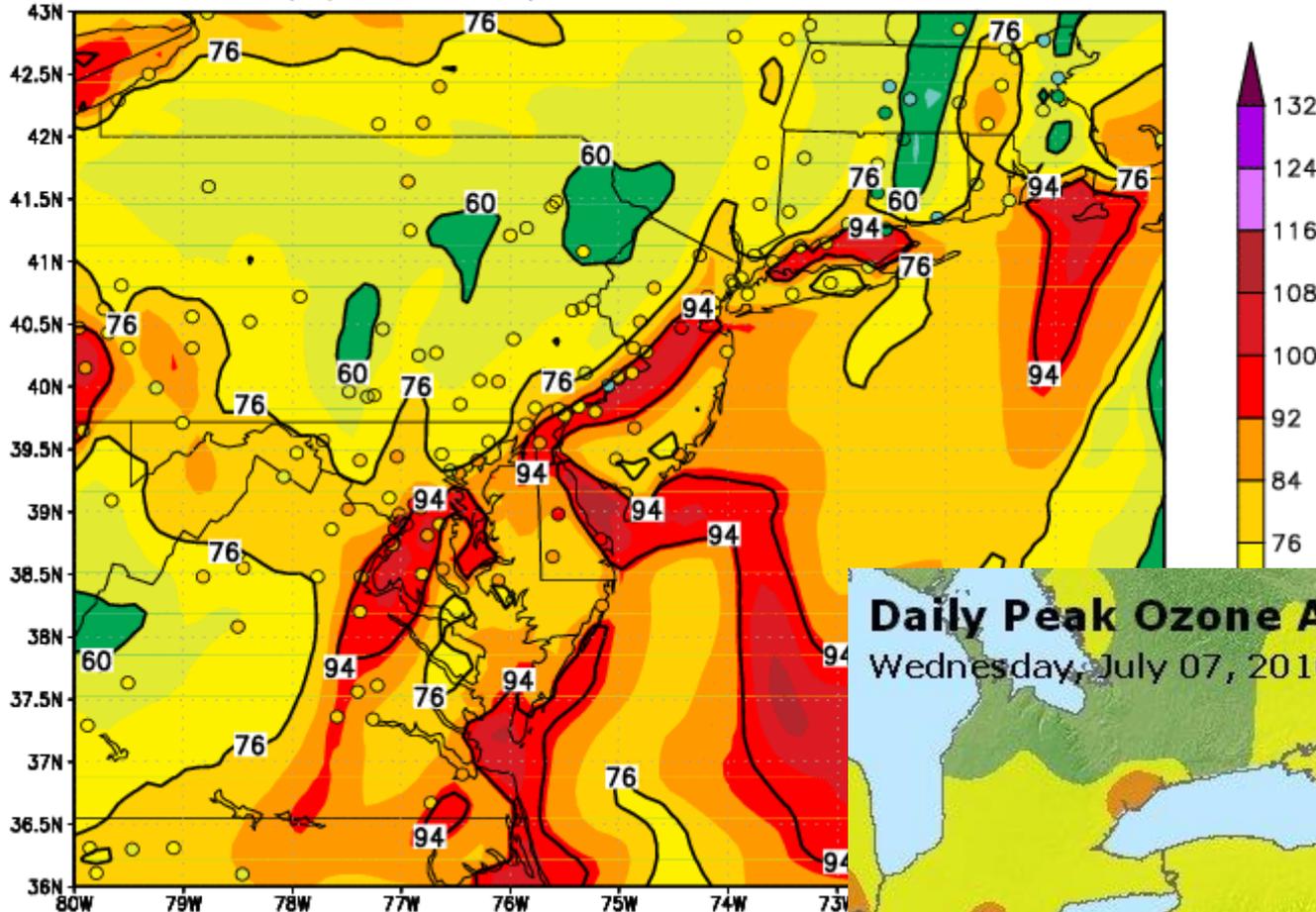


**July 6, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Madison 07/06/10 0.080**

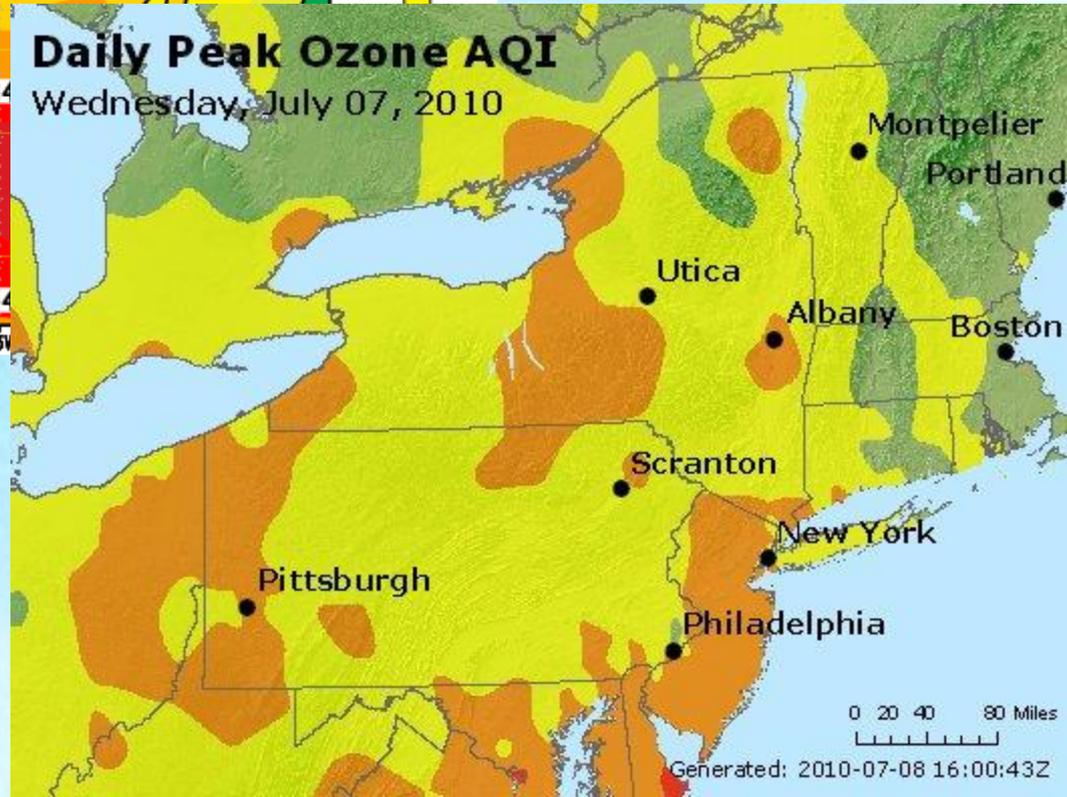


5x (Operational) 8-hr max 07JUL2010



**July 7, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**  
Wednesday, July 07, 2010



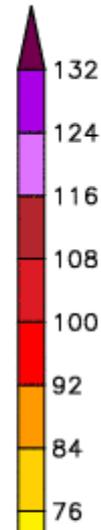
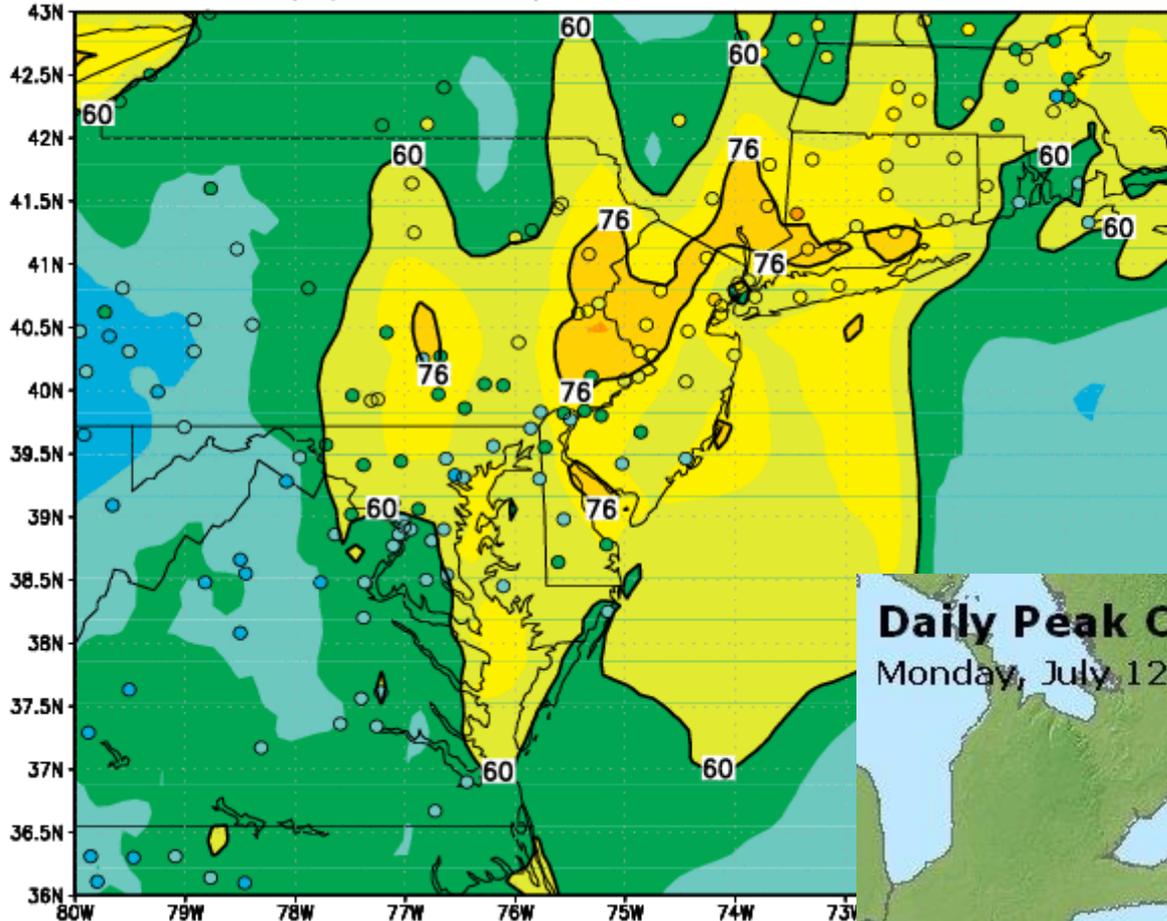
<b>Greenwich</b>	<b>07/07/10</b>	<b>0.079</b>
<b>Stratford</b>	<b>07/07/10</b>	<b>0.077</b>



0 20 40 80 Miles

Generated: 2010-07-08 16:00:43Z

5x (Operational) 8-hr max 12JUL2010



**July 12, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

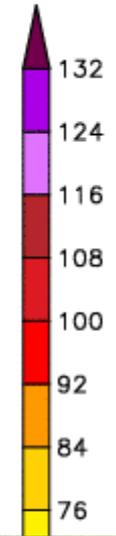
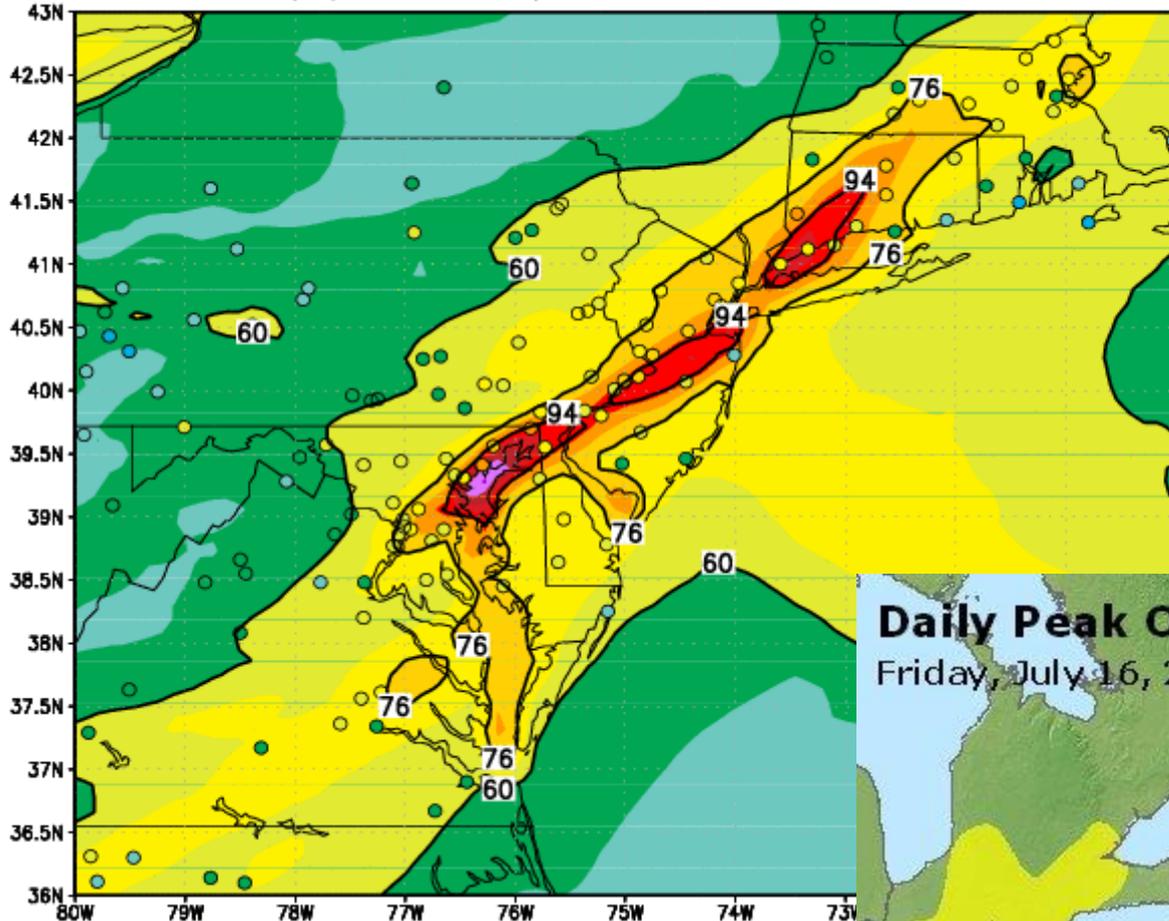
**Daily Peak Ozone AQI**  
Monday, July 12, 2010



<b>Danbury</b>	<b>07/12/10</b>	<b>0.084</b>
<b>Greenwich</b>	<b>07/12/10</b>	<b>0.082</b>
<b>Stratford</b>	<b>07/12/10</b>	<b>0.076</b>
<b>Westport</b>	<b>07/12/10</b>	<b>0.083</b>



5x (Operational) 8-hr max 16JUL2010



**July 16, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



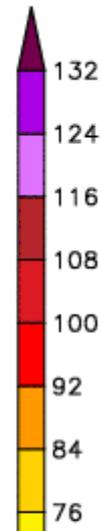
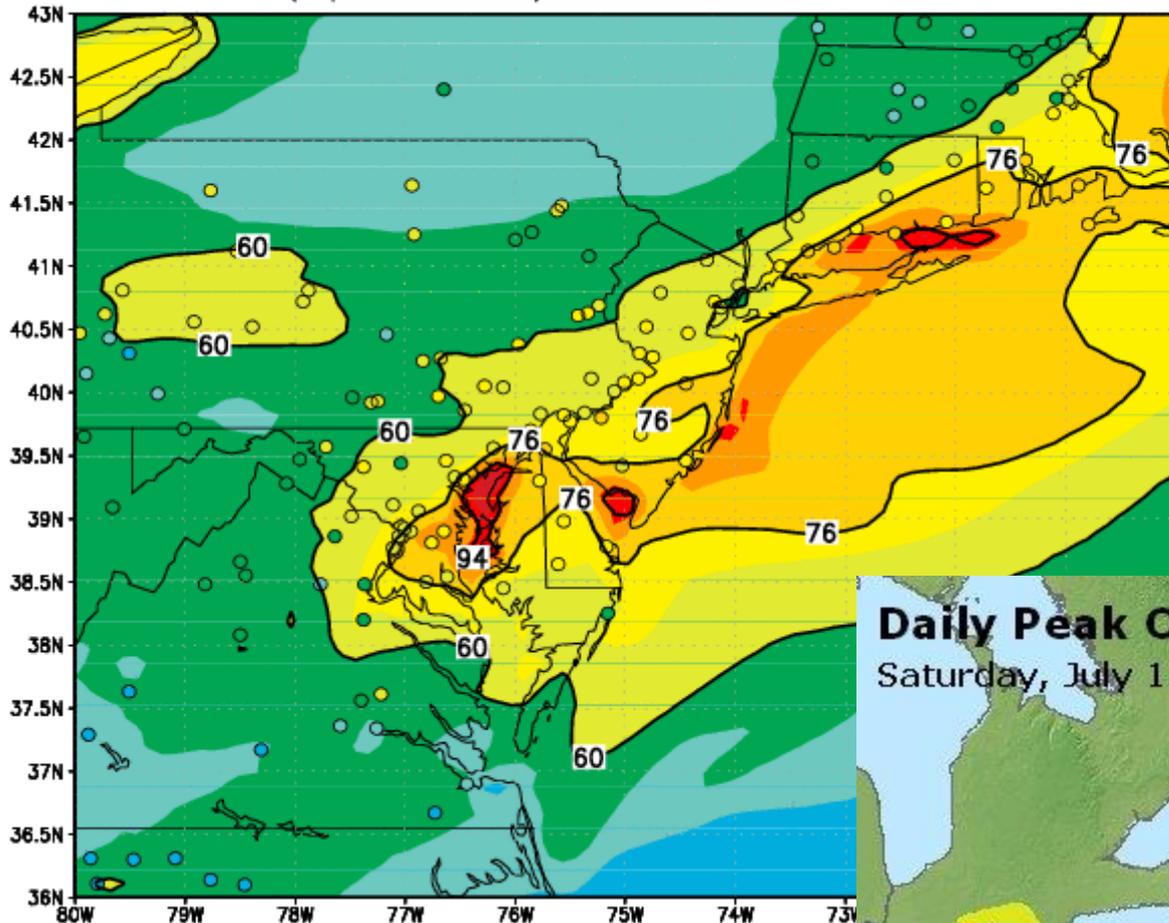
<b>Danbury</b>	<b>07/16/10</b>	<b>0.091</b>
<b>East Hartford</b>	<b>07/16/10</b>	<b>0.077</b>
<b>Middletown</b>	<b>07/16/10</b>	<b>0.078</b>
<b>Stafford</b>	<b>07/16/10</b>	<b>0.083</b>



0 20 40 80 Miles

Generated: 2010-07-17 15:54:43Z

5x (Operational) 8-hr max 17JUL2010



**July 17, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



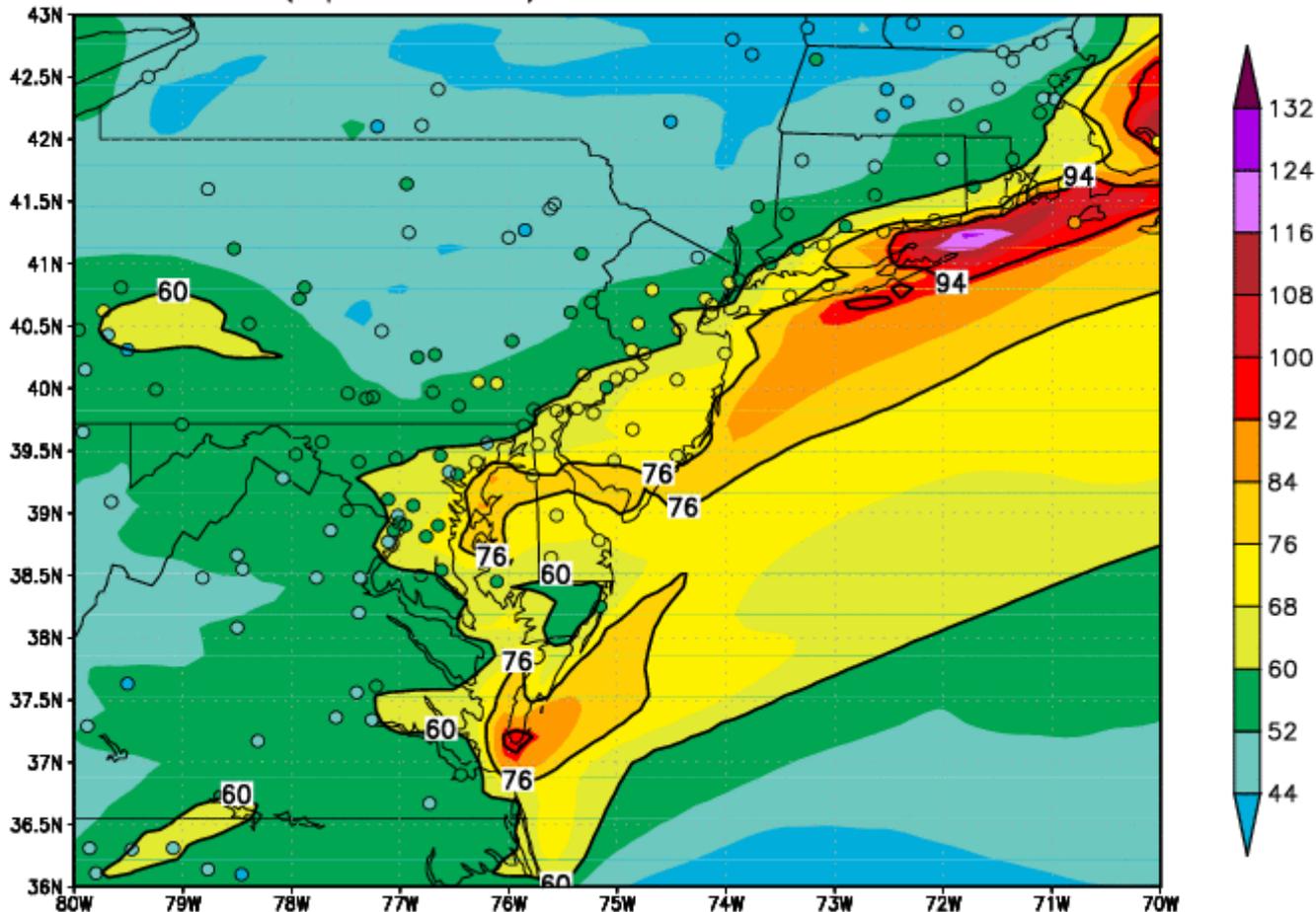
<b>Madison</b>	<b>07/17/10</b>	<b>0.081</b>
<b>Stratford</b>	<b>07/17/10</b>	<b>0.080</b>
<b>Westport</b>	<b>07/17/10</b>	<b>0.078</b>



0 20 40 80 Miles

Generated: 2010-07-18 15:40:58Z

5x (Operational) 8-hr max 18JUL2010



**July 18, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

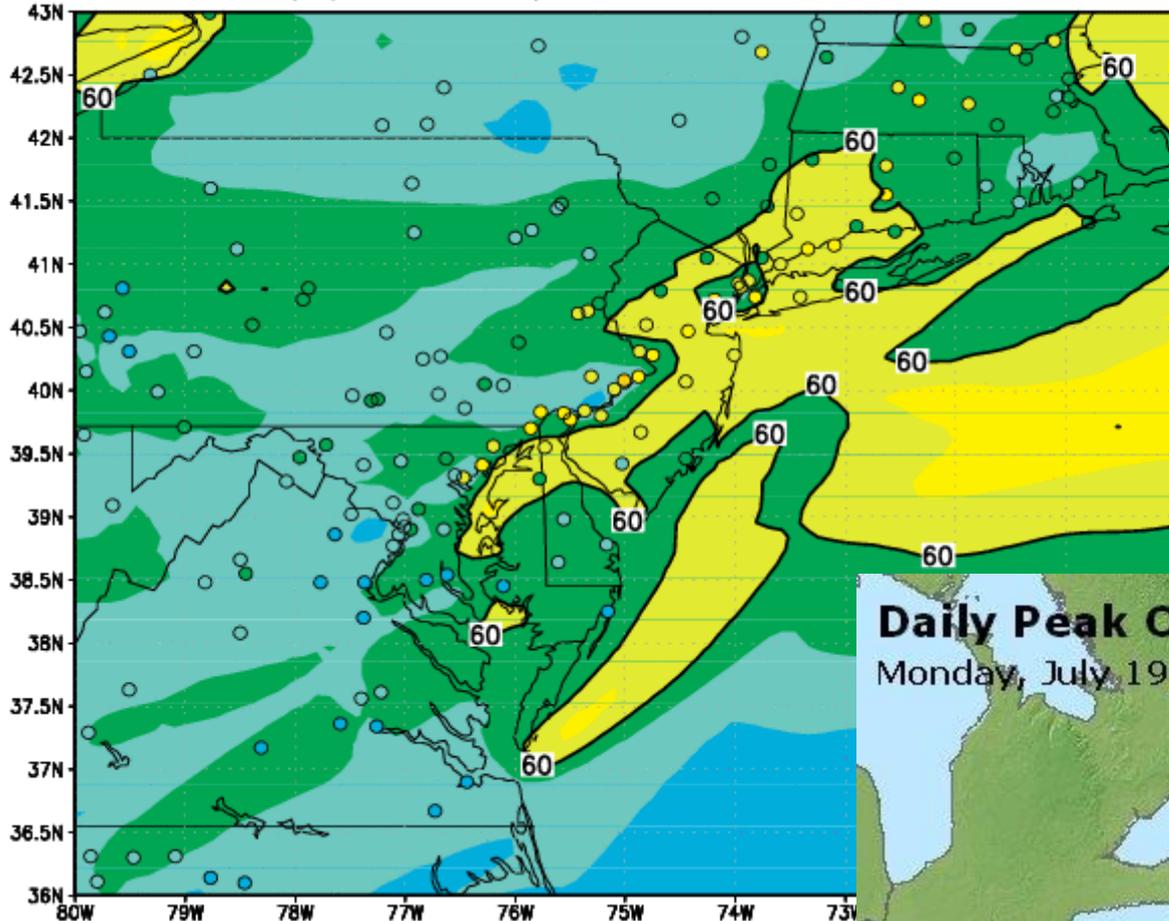
**Madison**

**07/18/10**

**0.077**



5x (Operational) 8-hr max 19JUL2010



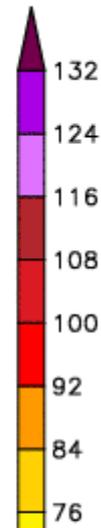
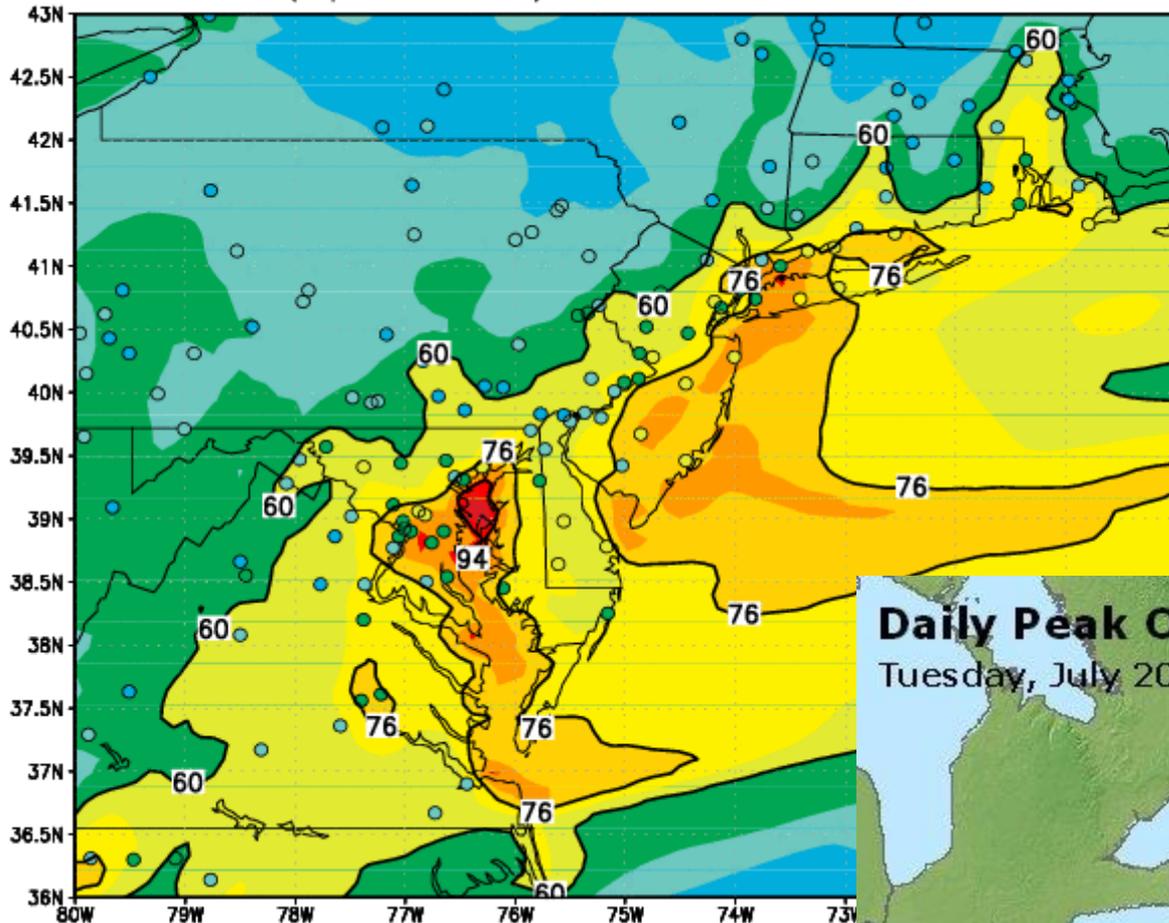
**July 19, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Stafford      07/19/10      0.078**

**Daily Peak Ozone AQI**  
Monday, July 19, 2010



5x (Operational) 8-hr max 20JUL2010



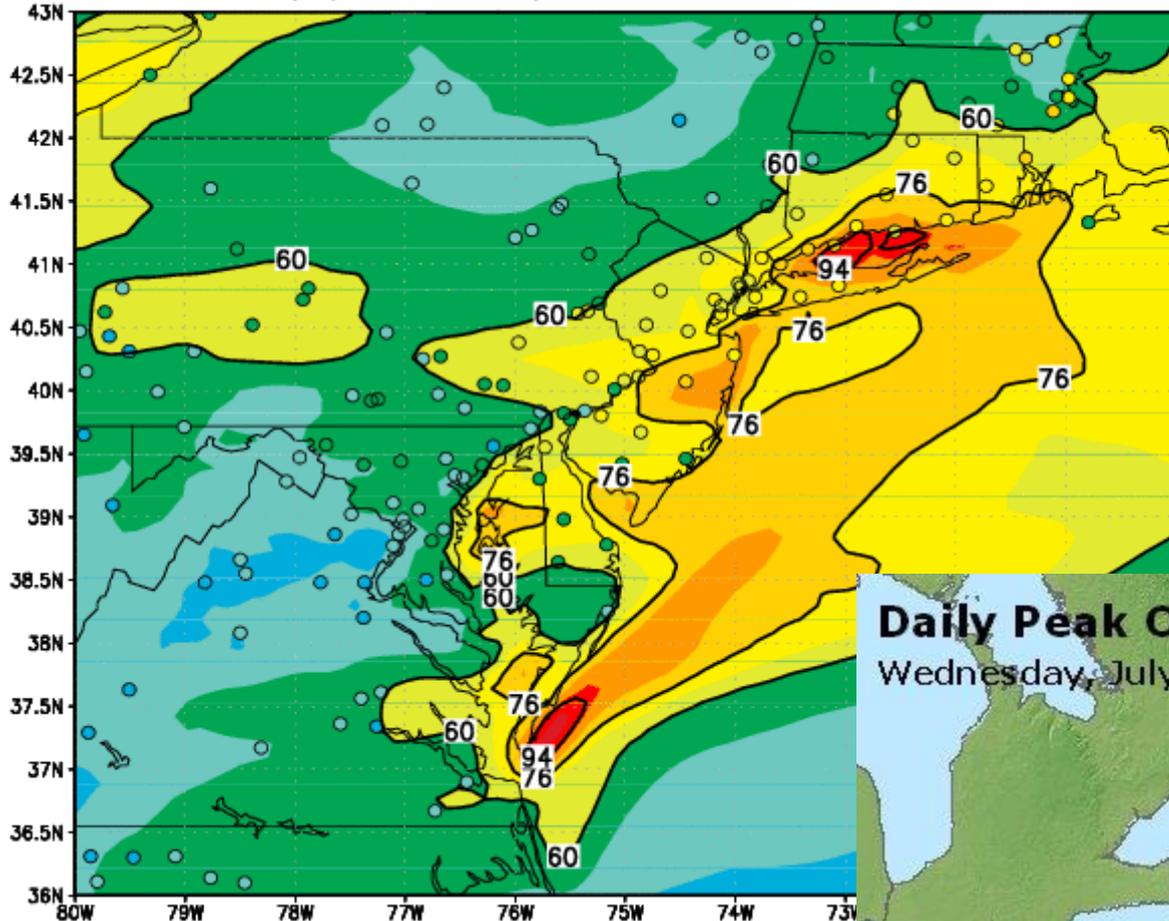
**July 20, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**  
Tuesday, July 20, 2010



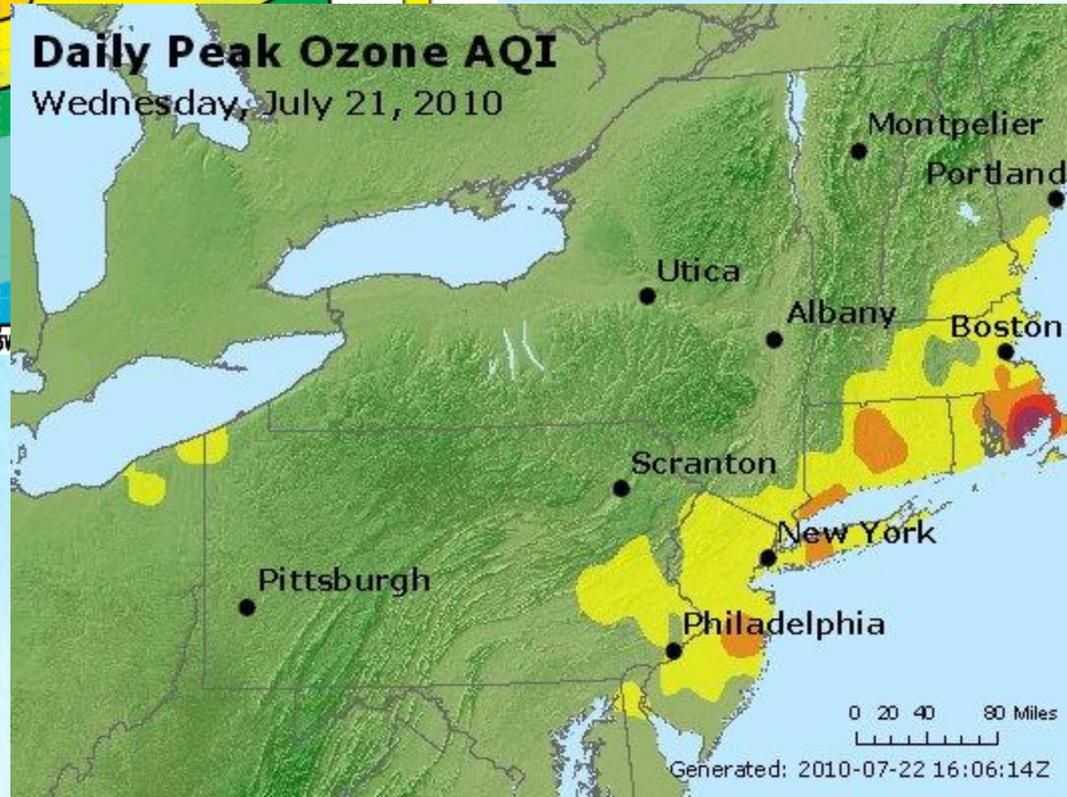
<b>Stratford</b>	<b>07/20/10</b>	<b>0.067</b>
<b>Madison</b>	<b>07/20/10</b>	<b>0.062</b>
<b>Westport</b>	<b>07/20/10</b>	<b>0.062</b>

5x (Operational) 8-hr max 21JUL2010



**July 21, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**  
Wednesday, July 21, 2010



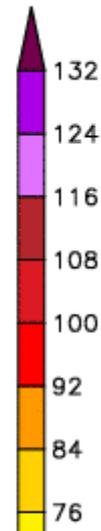
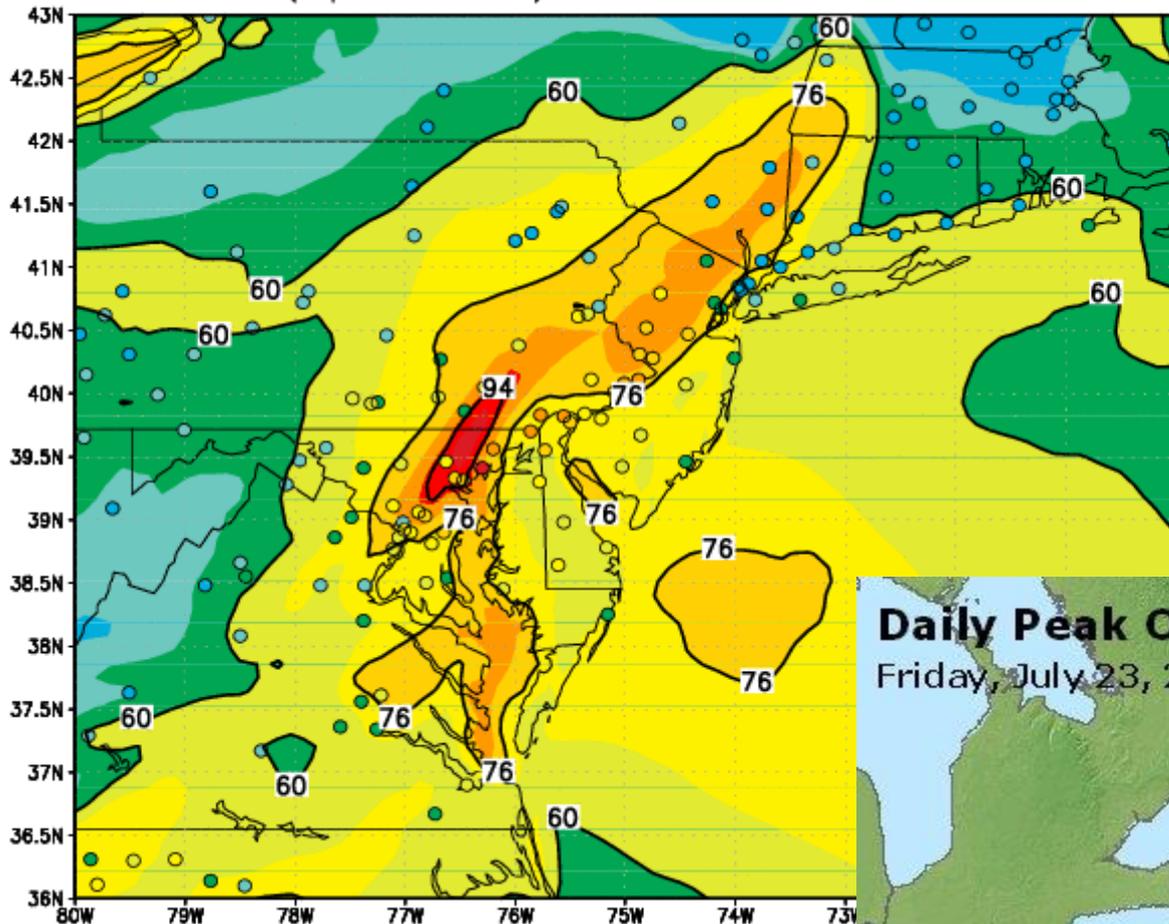
<b>Greenwich</b>	<b>07/21/10</b>	<b>0.076</b>
<b>Stratford</b>	<b>07/21/10</b>	<b>0.077</b>
<b>Westport</b>	<b>07/21/10</b>	<b>0.079</b>



0 20 40 80 Miles

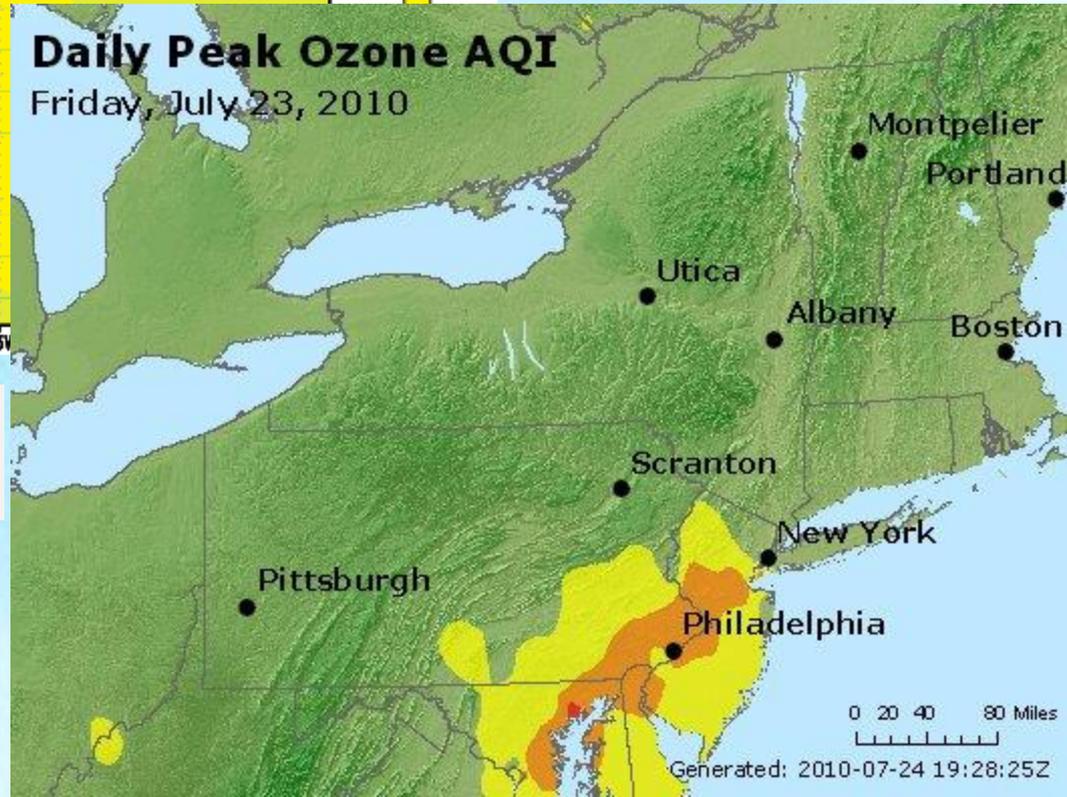
Generated: 2010-07-22 16:06:14Z

5x (Operational) 8-hr max 23JUL2010



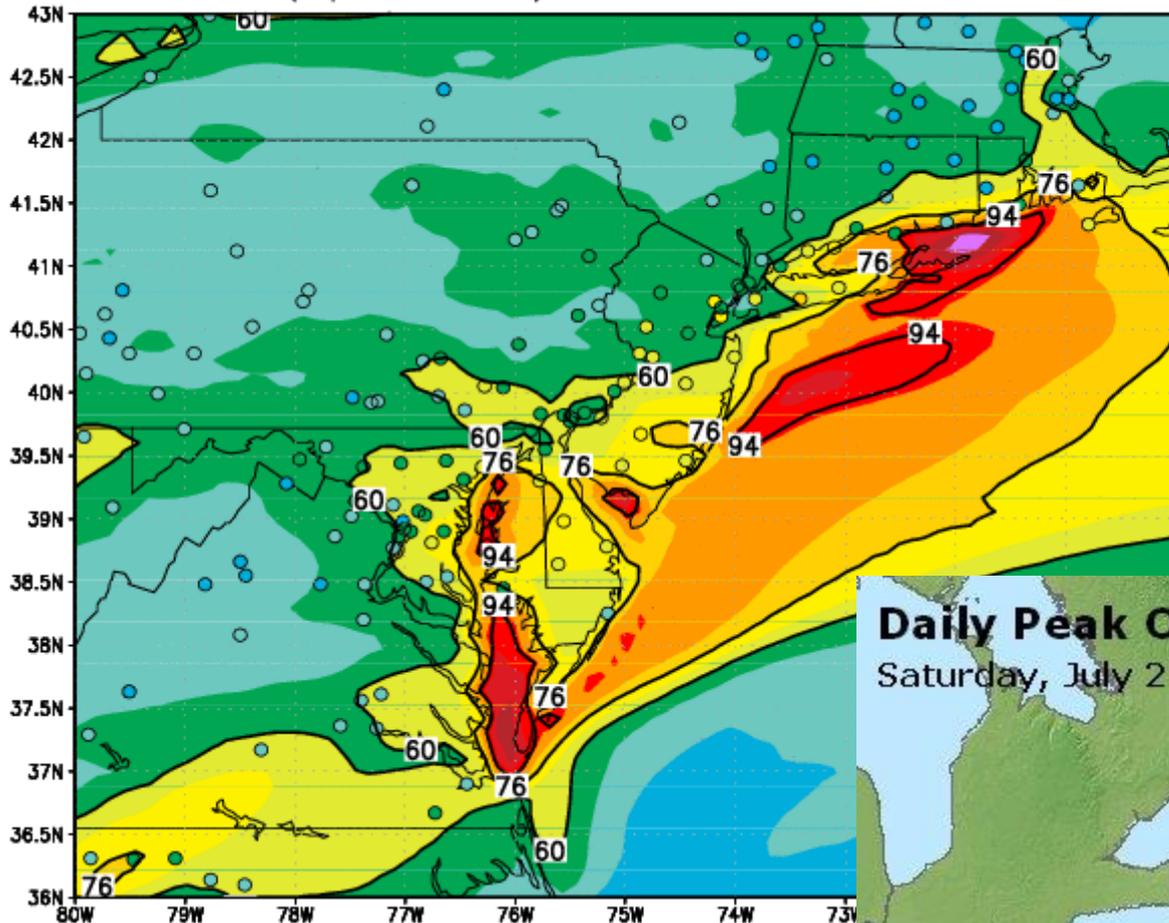
**July 23, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**  
Friday, July 23, 2010



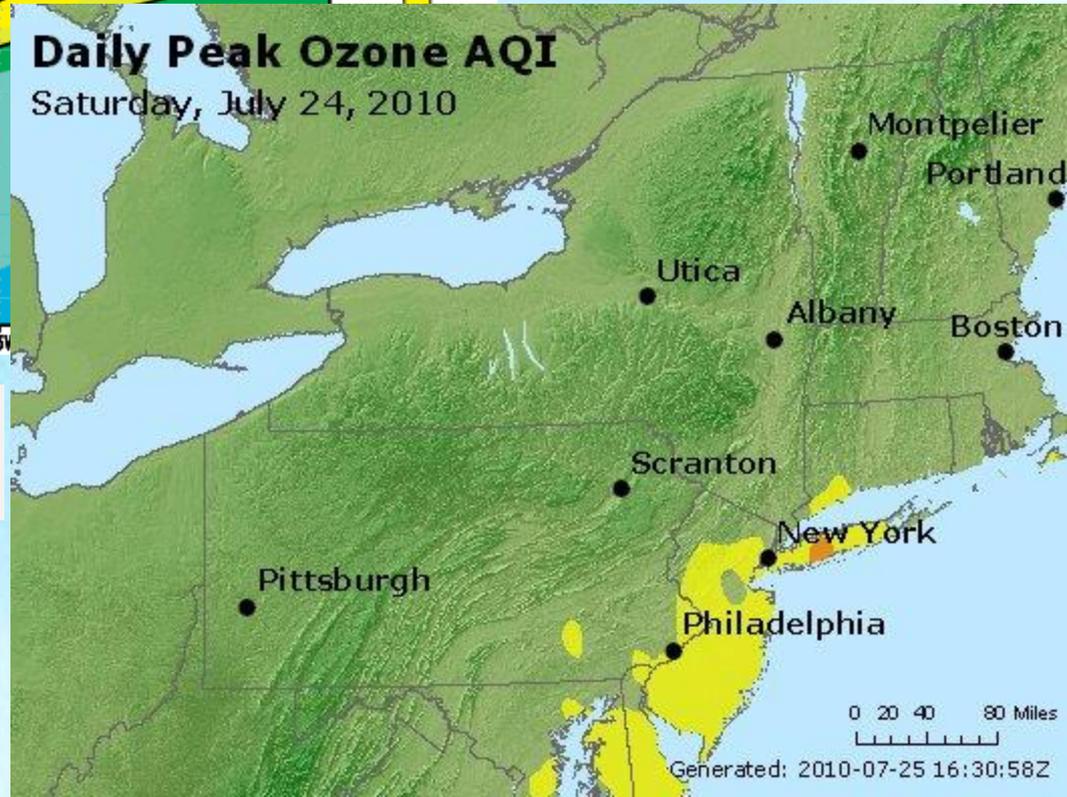
<b>Cornwall</b>	<b>07/23/10</b>	<b>0.045</b>
<b>Stratford</b>	<b>07/23/10</b>	<b>0.044</b>
<b>Groton</b>	<b>07/23/10</b>	<b>0.038</b>

5x (Operational) 8-hr max 24JUL2010



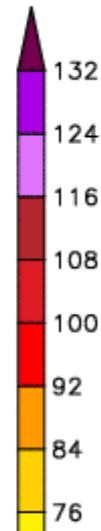
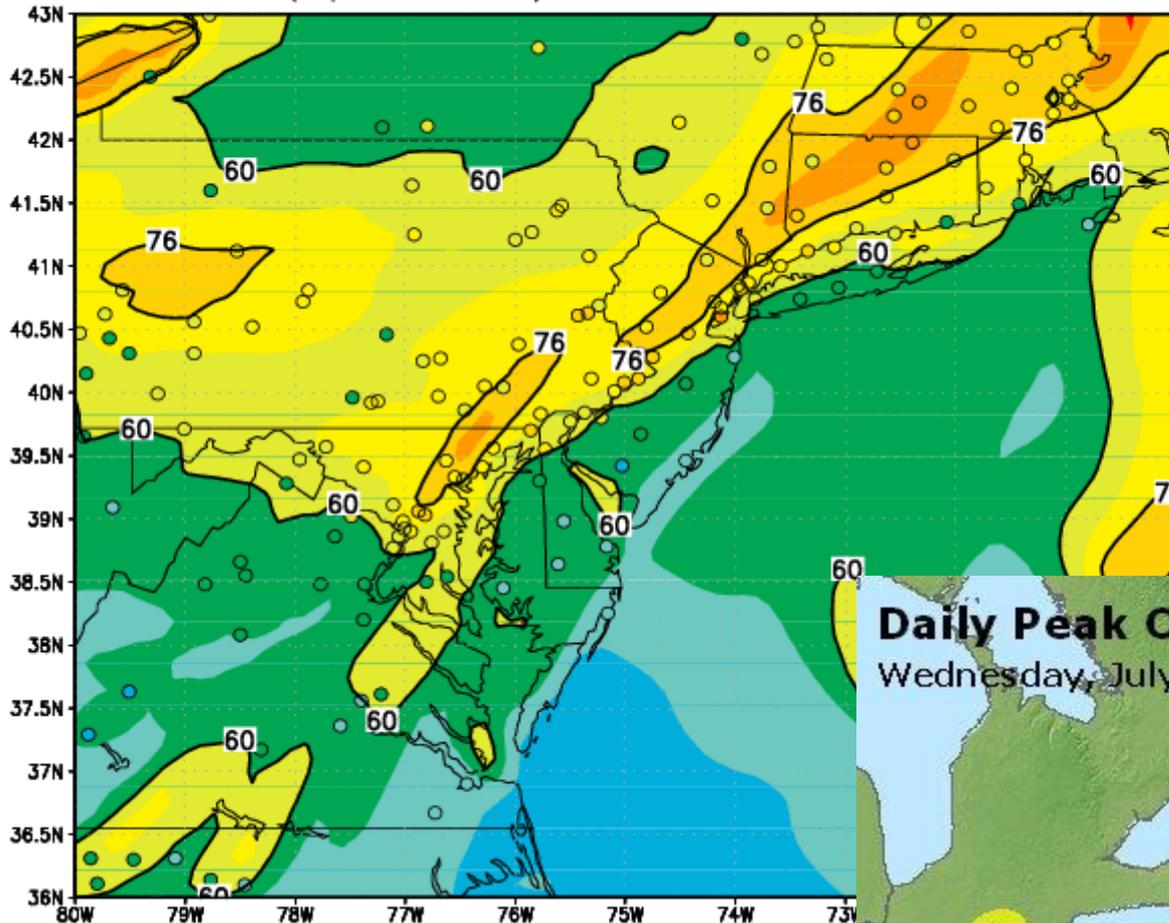
**July 24, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**  
Saturday, July 24, 2010



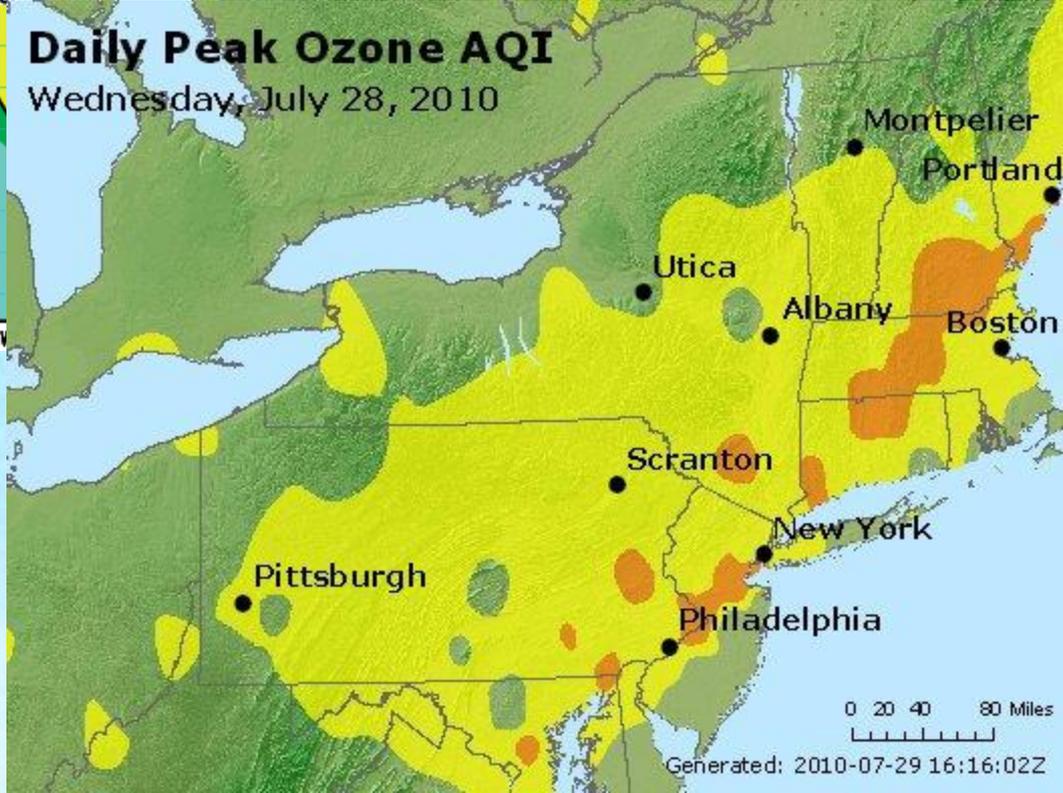
<b>Stratford</b>	<b>07/24/10</b>	<b>0.068</b>
<b>Westport</b>	<b>07/24/10</b>	<b>0.060</b>
<b>Greenwich</b>	<b>07/24/10</b>	<b>0.058</b>

5x (Operational) 8-hr max 28JUL2010



**July 28, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

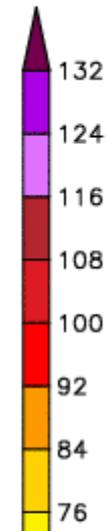
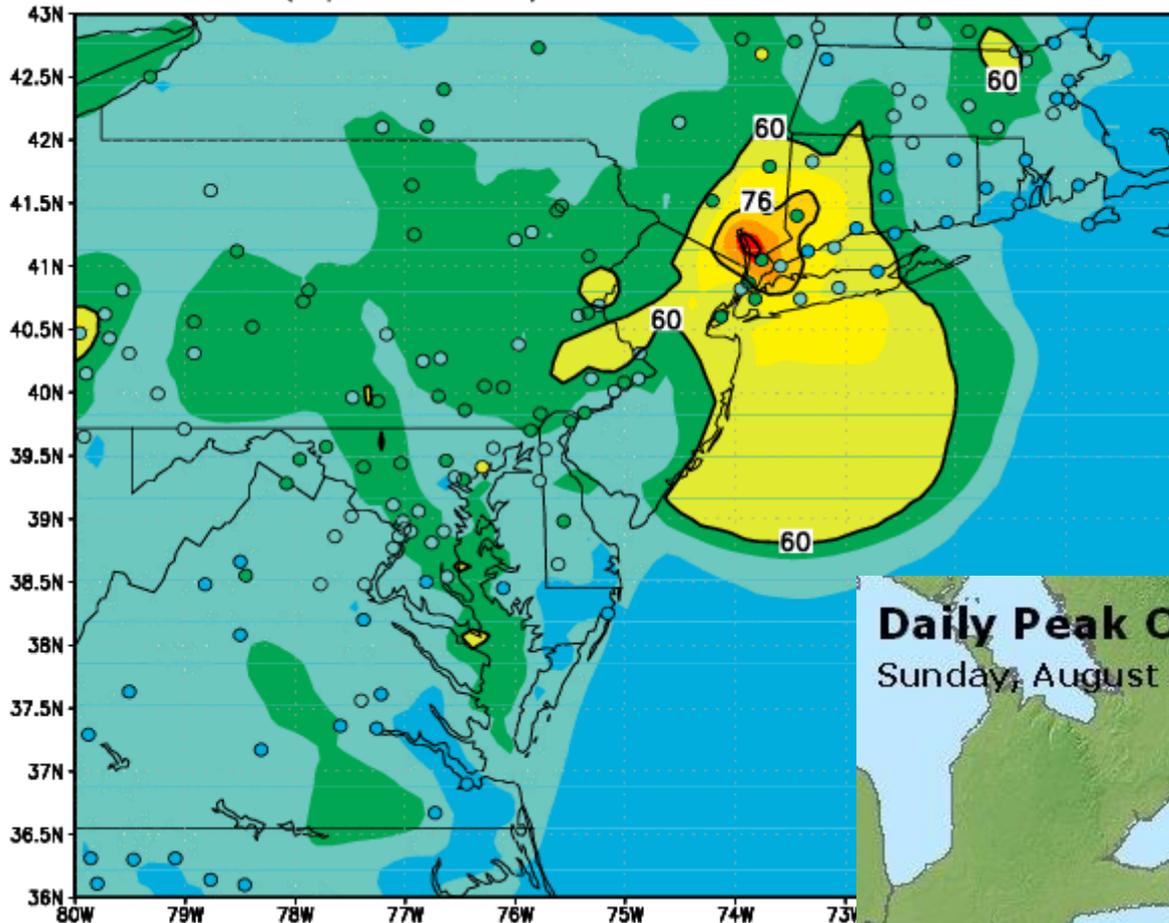
**Daily Peak Ozone AQI**  
Wednesday, July 28, 2010



<b>Danbury</b>	<b>07/28/10</b>	<b>0.076</b>
<b>East Hartford</b>	<b>07/28/10</b>	<b>0.079</b>
<b>Stafford</b>	<b>07/28/10</b>	<b>0.087</b>
<b>Westport</b>	<b>07/28/10</b>	<b>0.078</b>



# 5x (Operational) 8-hr max 01AUG2010

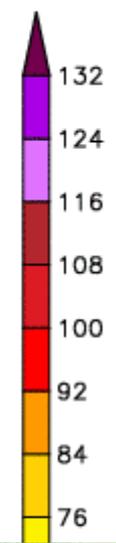
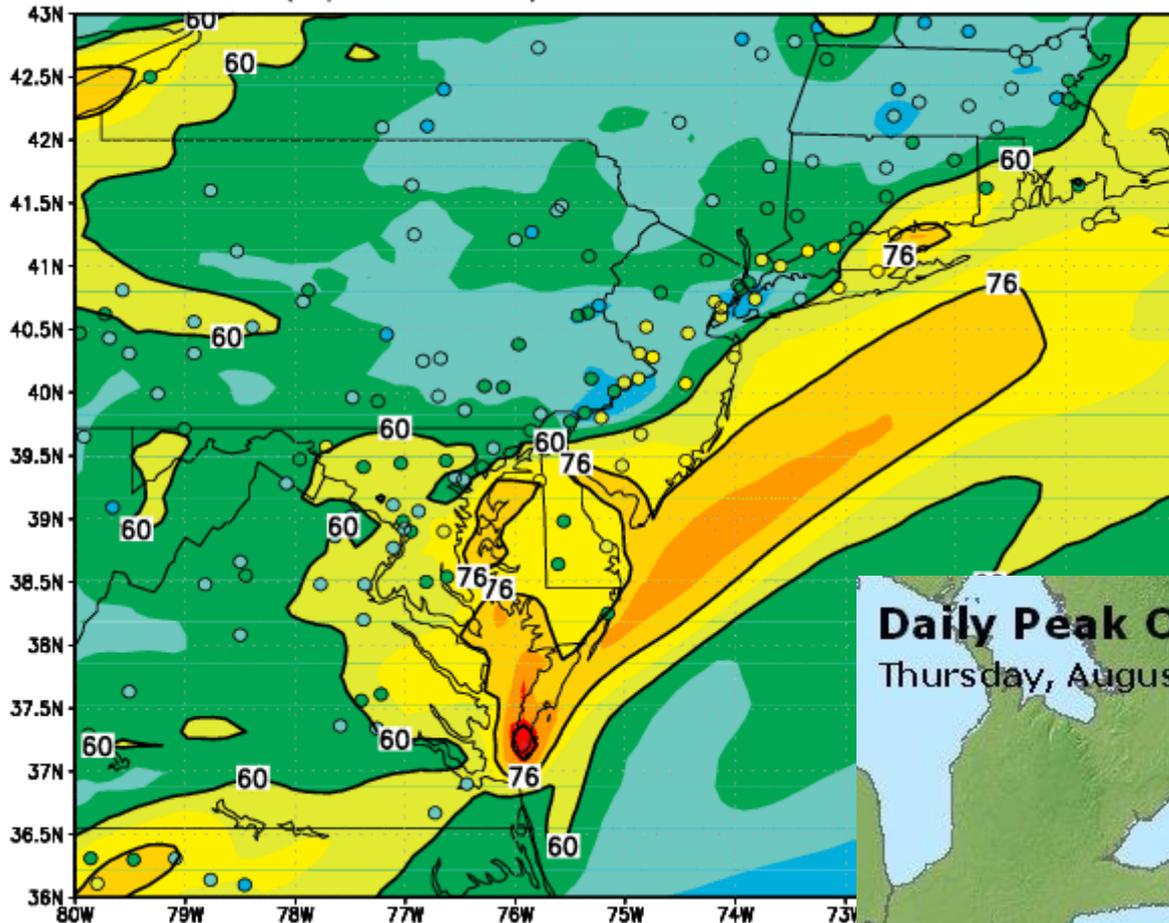


**August 1, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



<b>Danbury</b>	<b>08/01/10</b>	<b>0.054</b>
<b>Cornwall</b>	<b>08/01/10</b>	<b>0.049</b>
<b>Greenwich</b>	<b>08/01/10</b>	<b>0.048</b>

# 5x (Operational) 8-hr max 05AUG2010

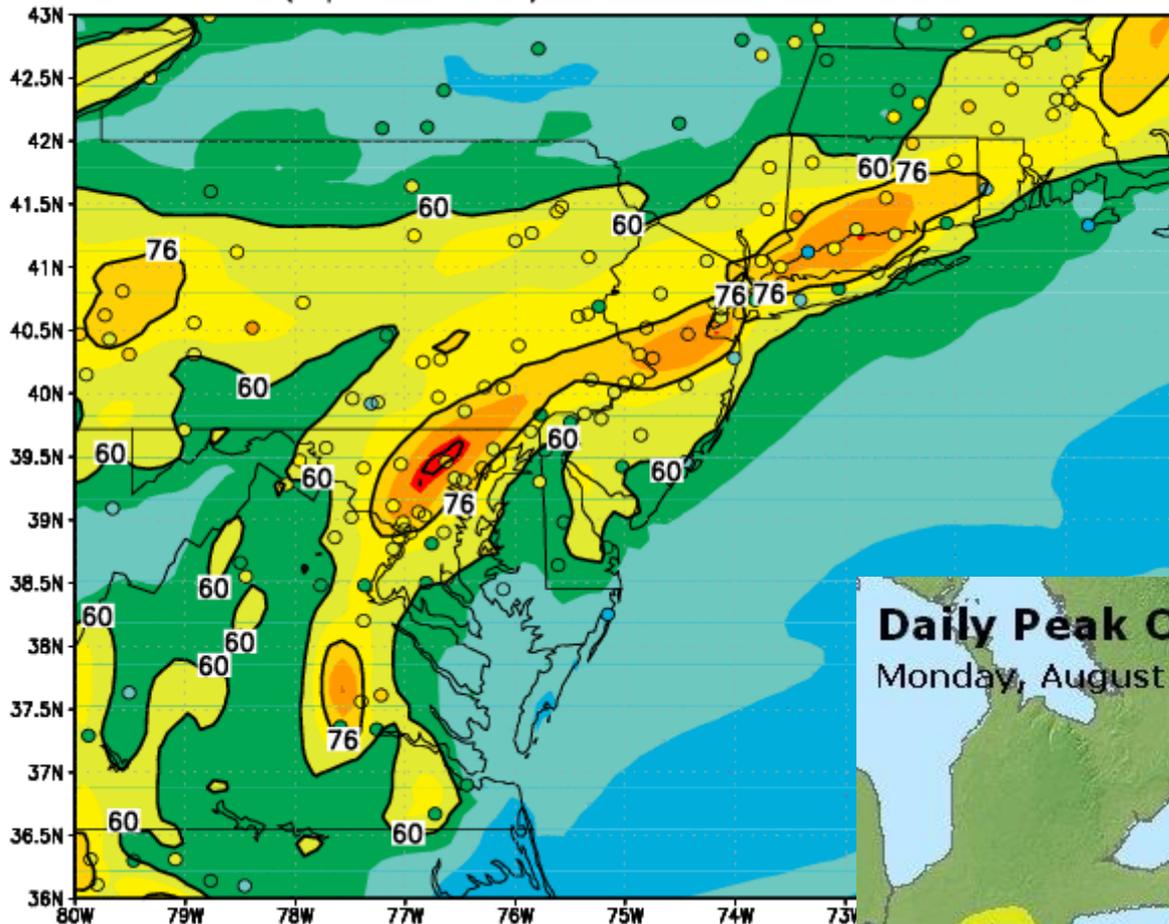


**August 5, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



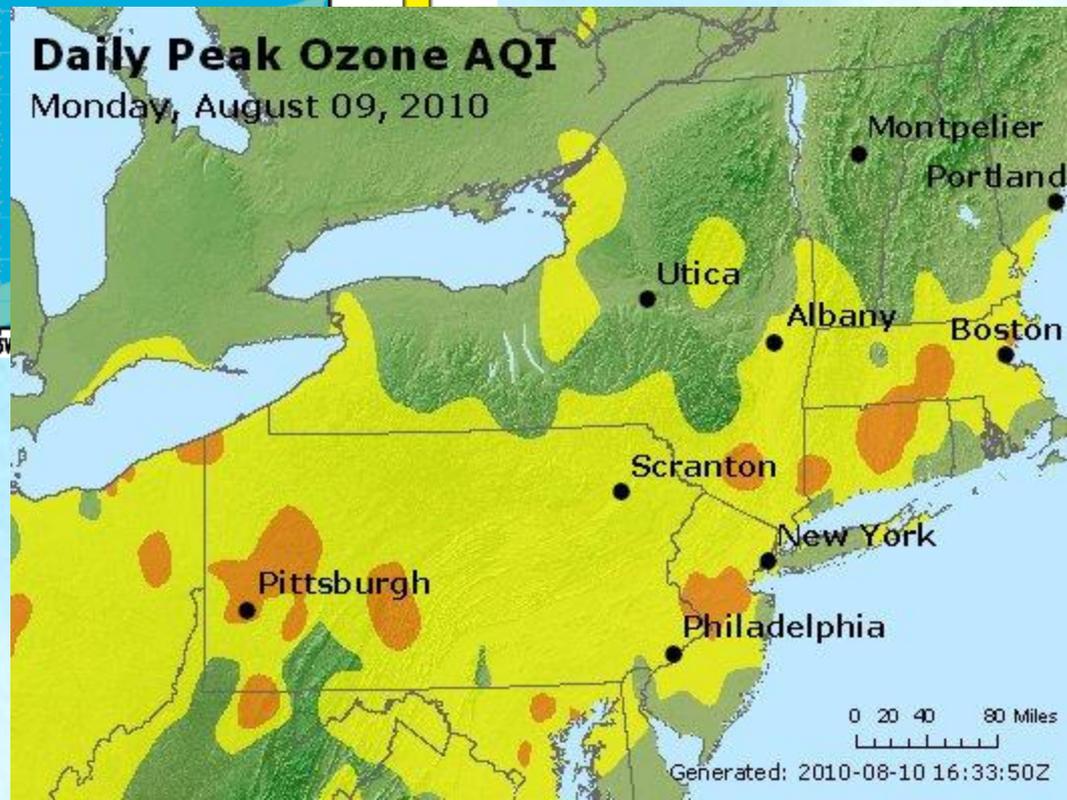
<b>Madison</b>	<b>08/05/10</b>	<b>0.070</b>
<b>Stratford</b>	<b>08/05/10</b>	<b>0.070</b>
<b>Westport</b>	<b>08/05/10</b>	<b>0.070</b>

5x (Operational) 8-hr max 09AUG2010



**August 9, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

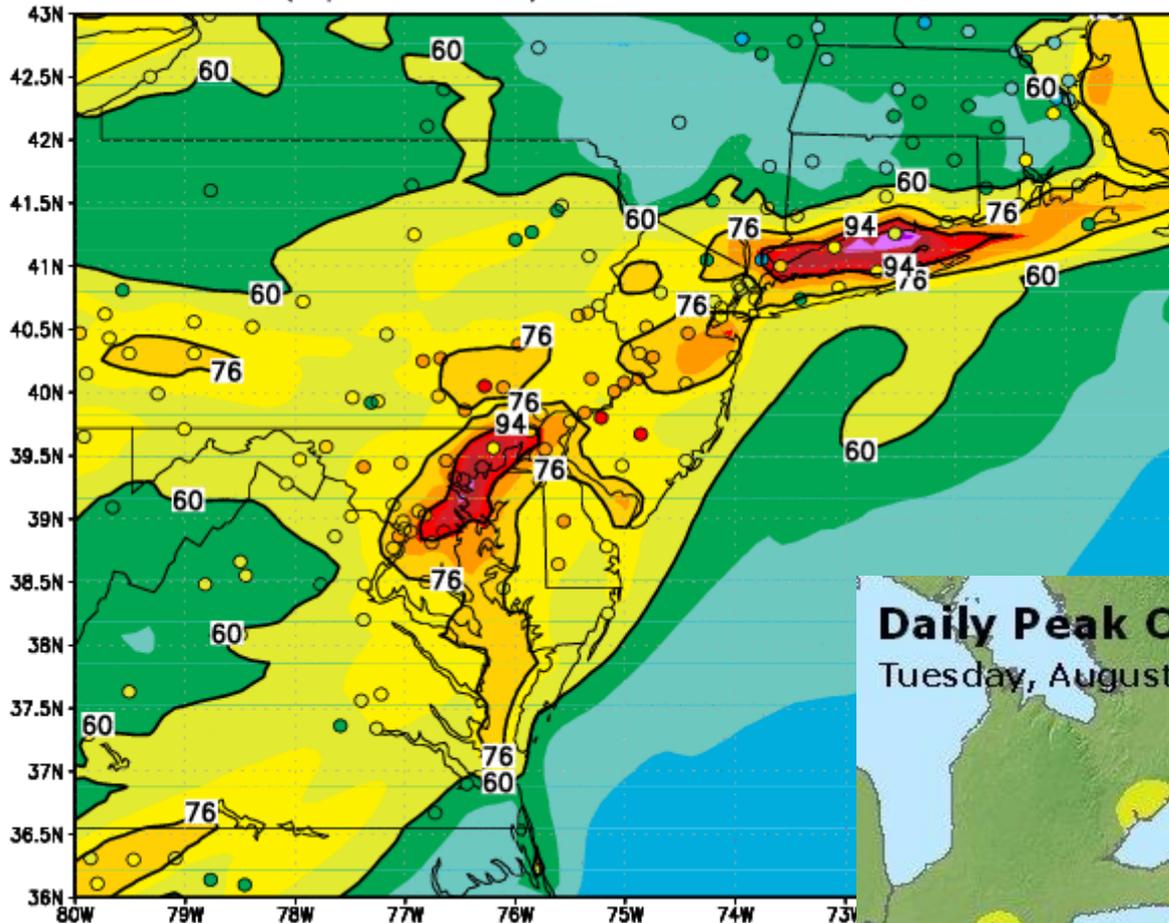
**Daily Peak Ozone AQI**  
Monday, August 09, 2010



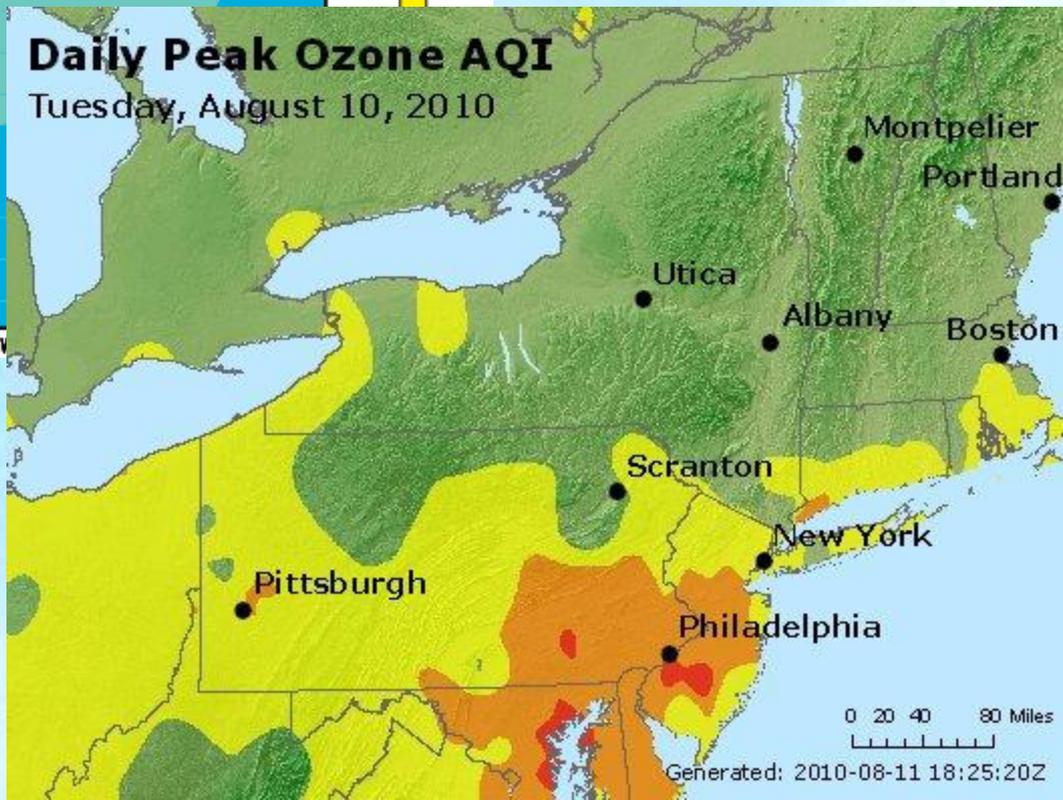
<b>Danbury</b>	<b>08/09/10</b>	<b>0.083</b>
<b>Middletown</b>	<b>08/09/10</b>	<b>0.081</b>
<b>Stafford</b>	<b>08/09/10</b>	<b>0.082</b>



5x (Operational) 8-hr max 10AUG2010



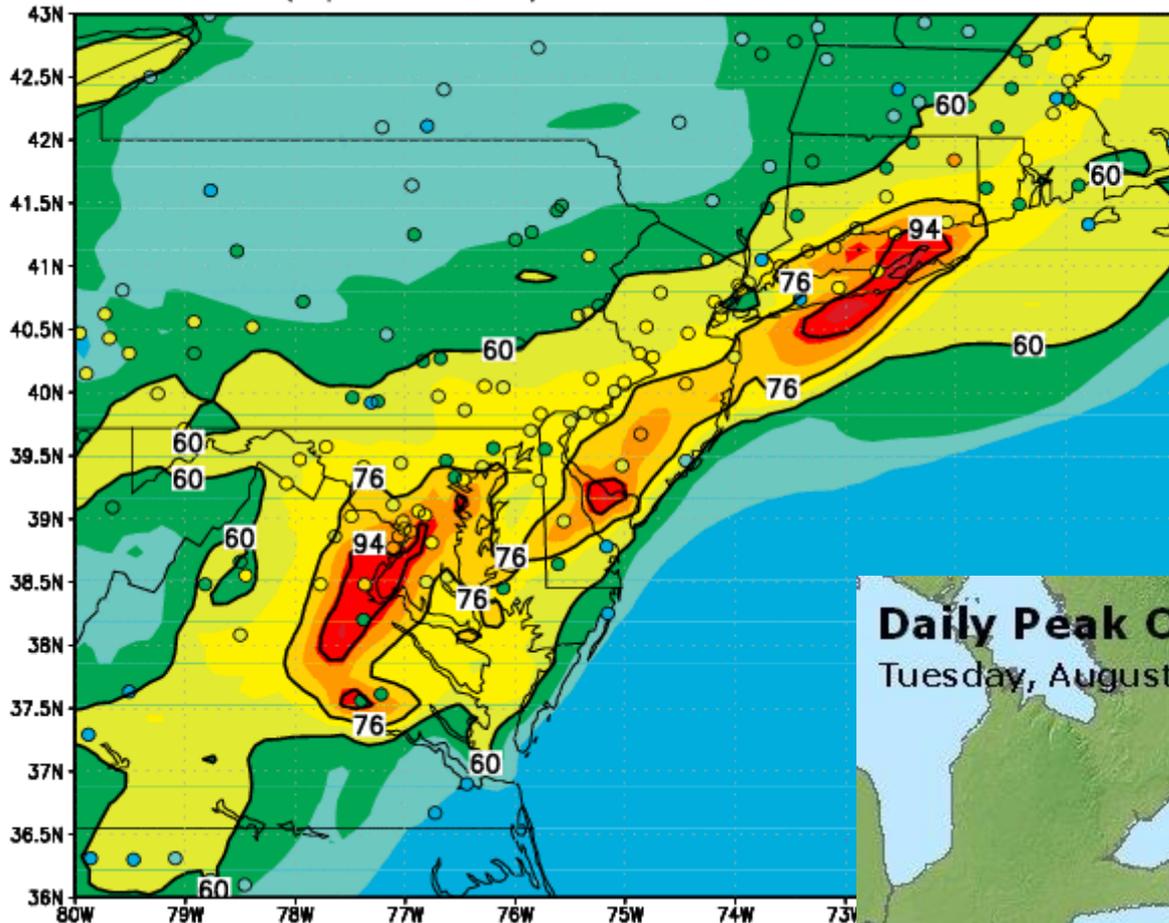
**August 10, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



<b>Greenwich</b>	<b>08/10/10</b>	<b>0.080</b>
<b>Westport</b>	<b>08/10/10</b>	<b>0.076</b>

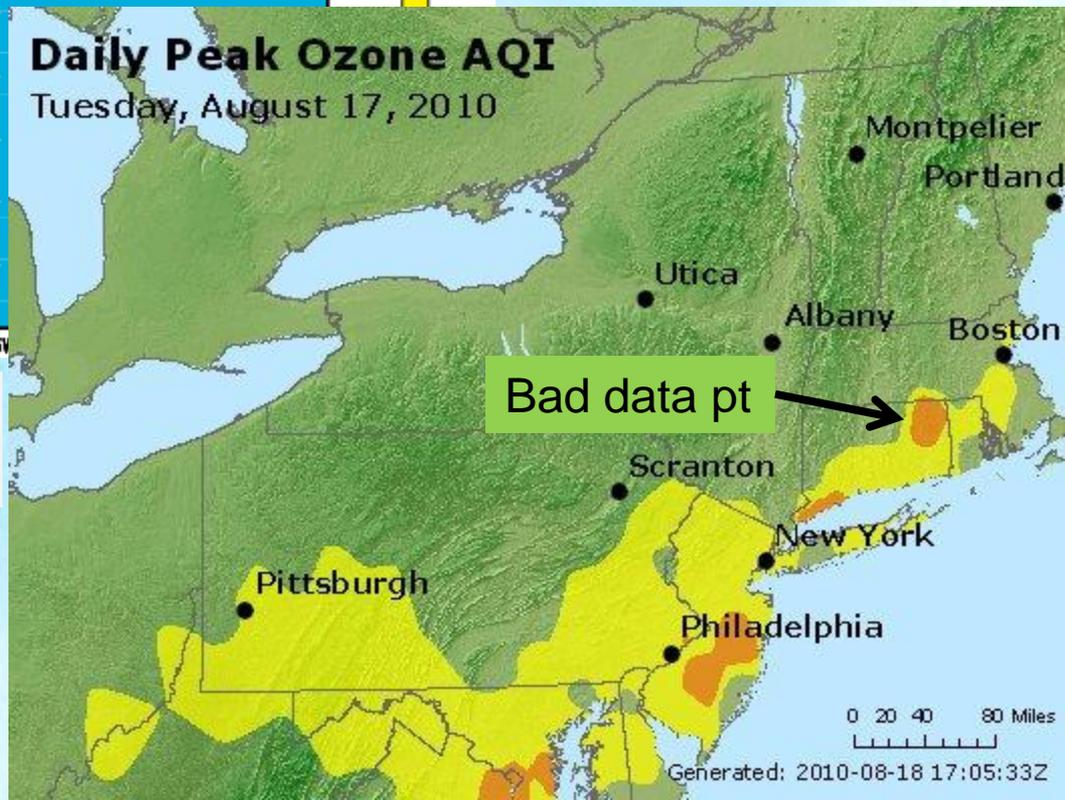


5x (Operational) 8-hr max 17AUG2010



**August 17, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

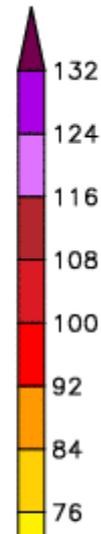
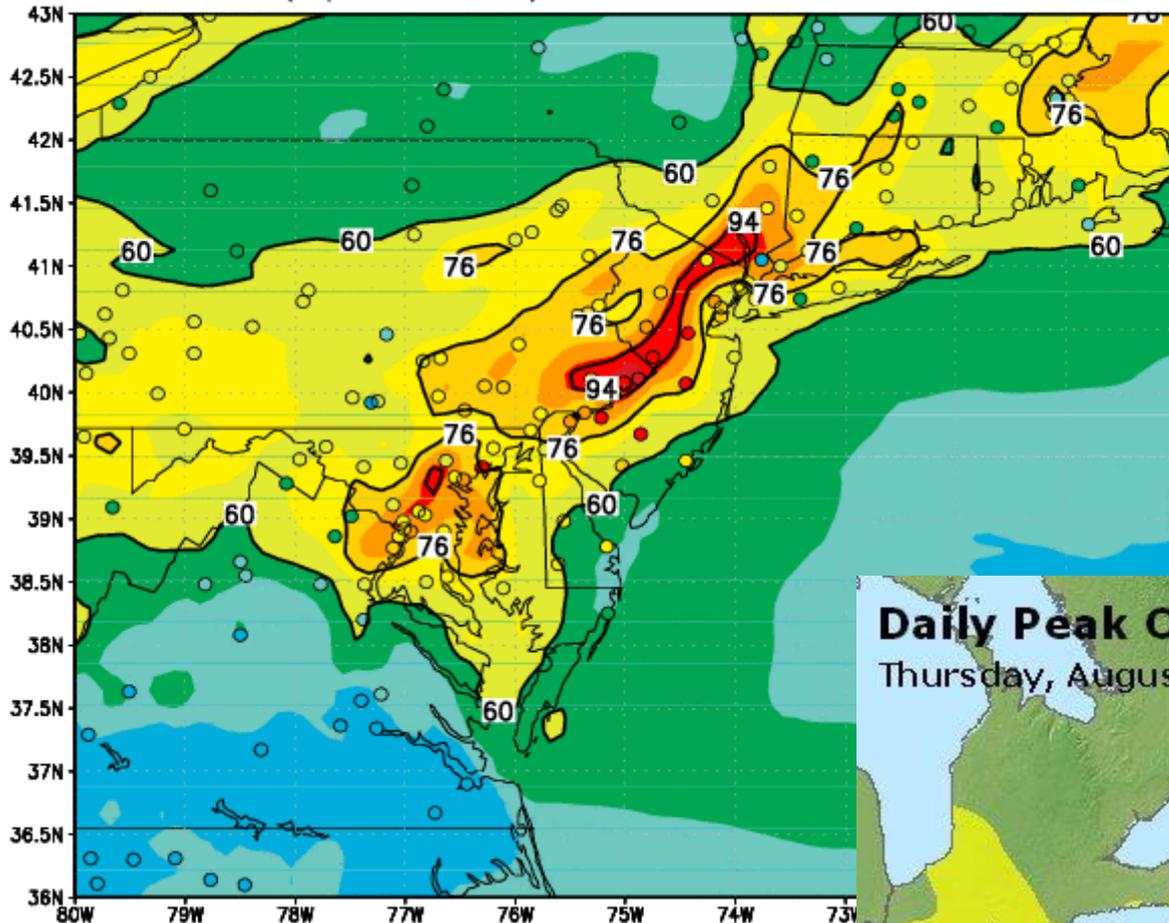
**Daily Peak Ozone AQI**  
Tuesday, August 17, 2010



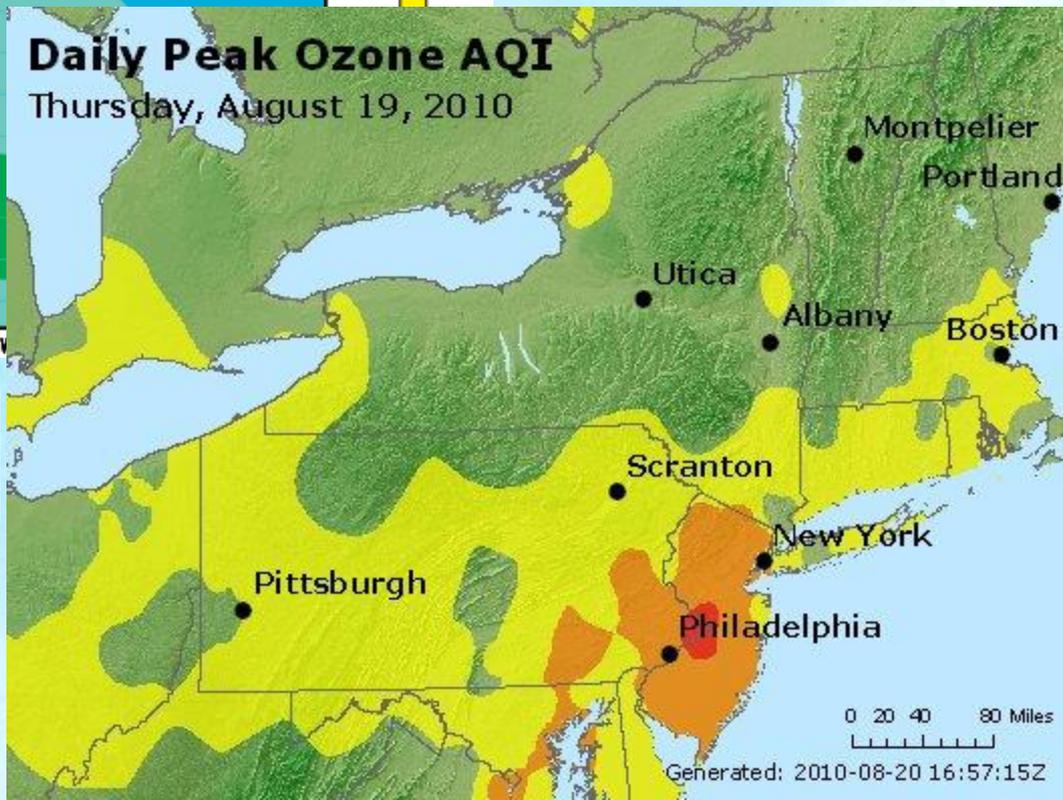
Greenwich	08/17/10	0.082
Stratford	08/17/10	0.077
Westport	08/17/10	0.077



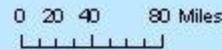
# 5x (Operational) 8-hr max 19AUG2010



**August 19, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

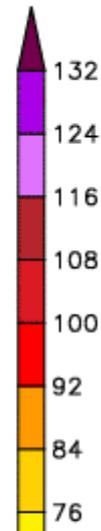
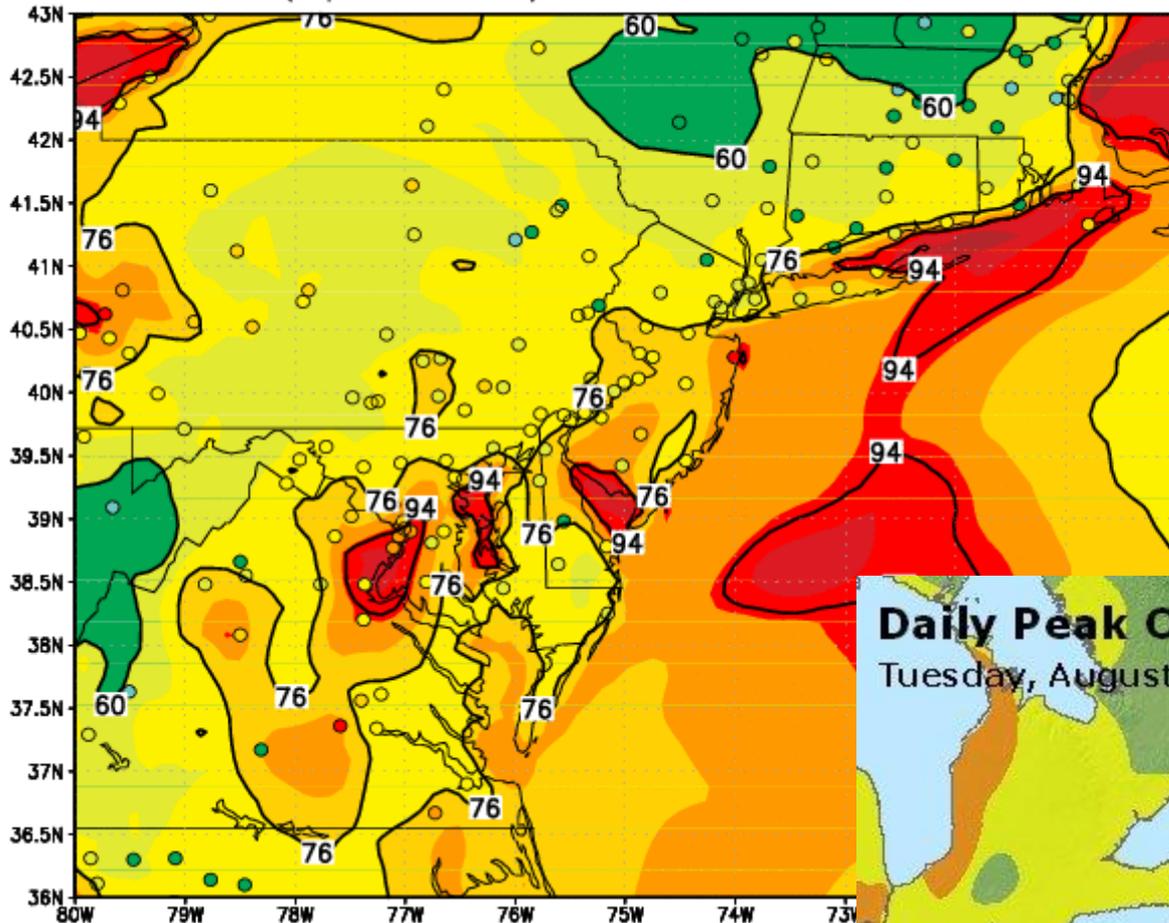


<b>Stafford</b>	<b>08/19/10</b>	<b>0.073</b>
<b>Danbury</b>	<b>08/19/10</b>	<b>0.071</b>
<b>Madison</b>	<b>08/19/10</b>	<b>0.071</b>

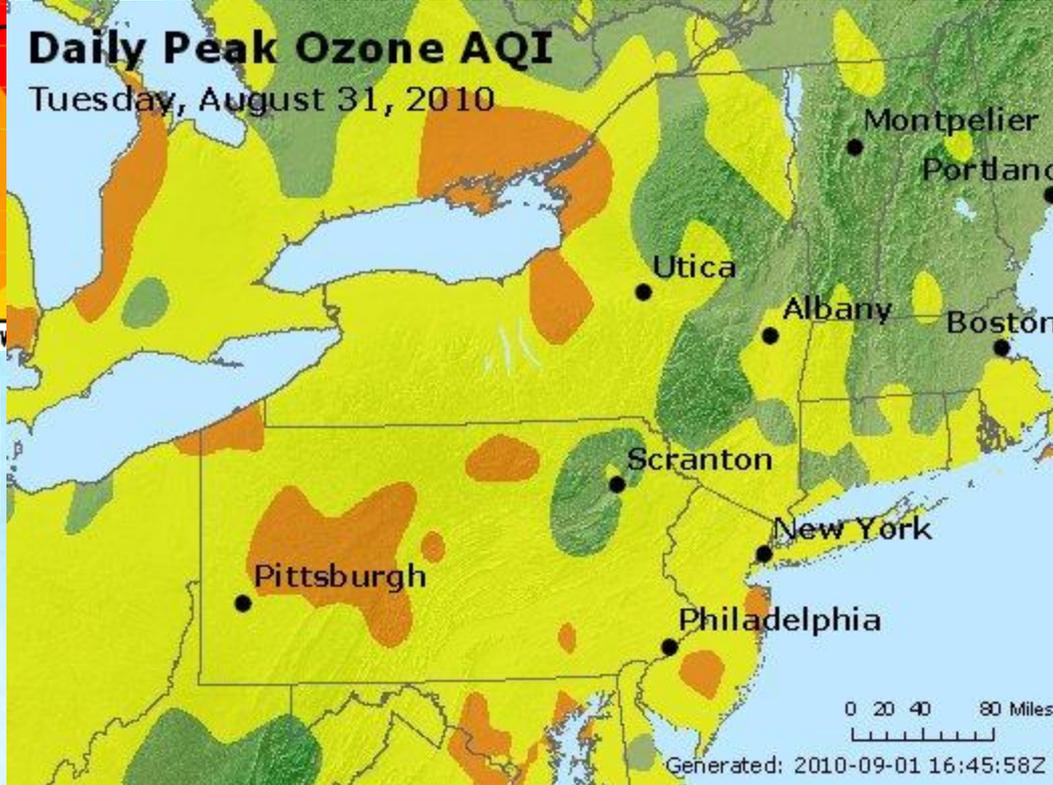


Generated: 2010-08-20 16:57:15Z

# 5x (Operational) 8-hr max 31AUG2010

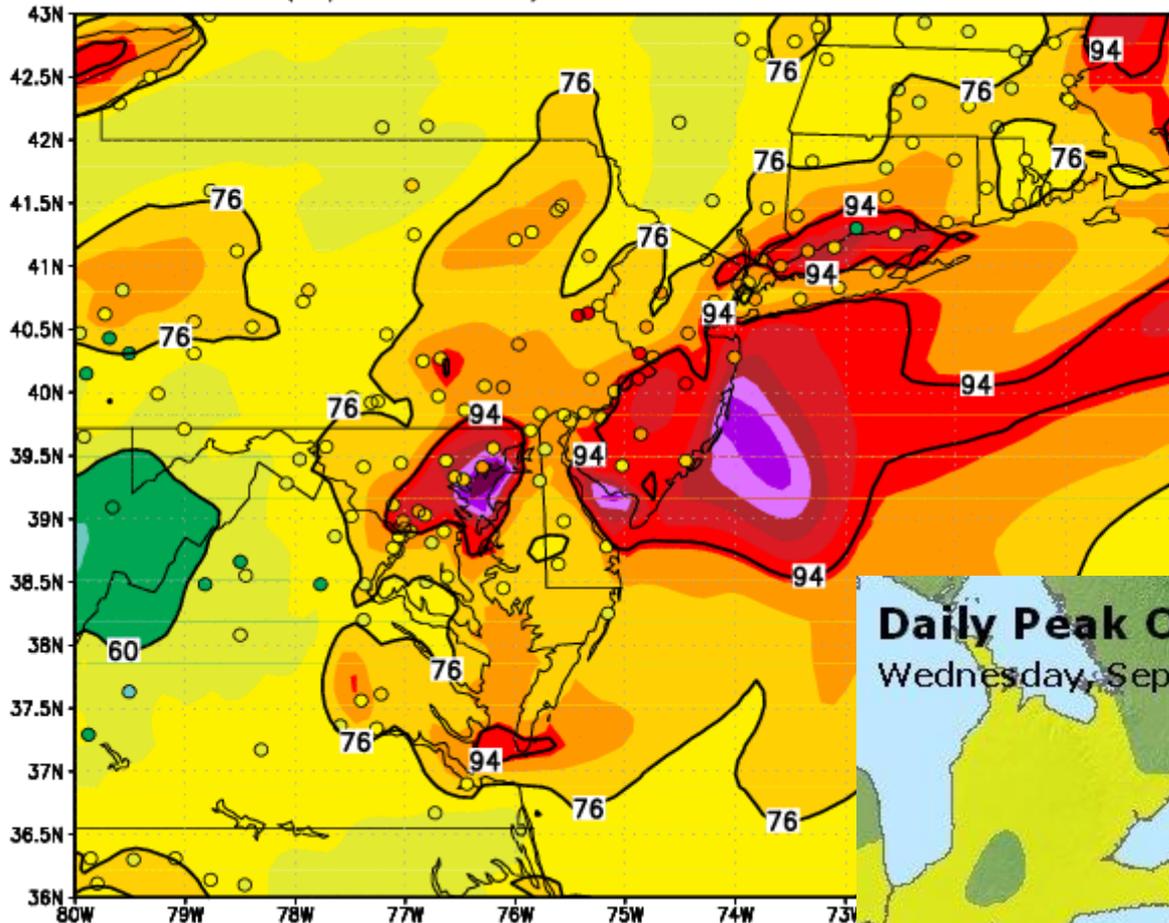


**August 31, 2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



<b>Groton</b>	<b>08/31/10</b>	<b>0.069</b>
<b>Greenwich</b>	<b>08/31/10</b>	<b>0.066</b>
<b>Madison</b>	<b>08/31/10</b>	<b>0.066</b>

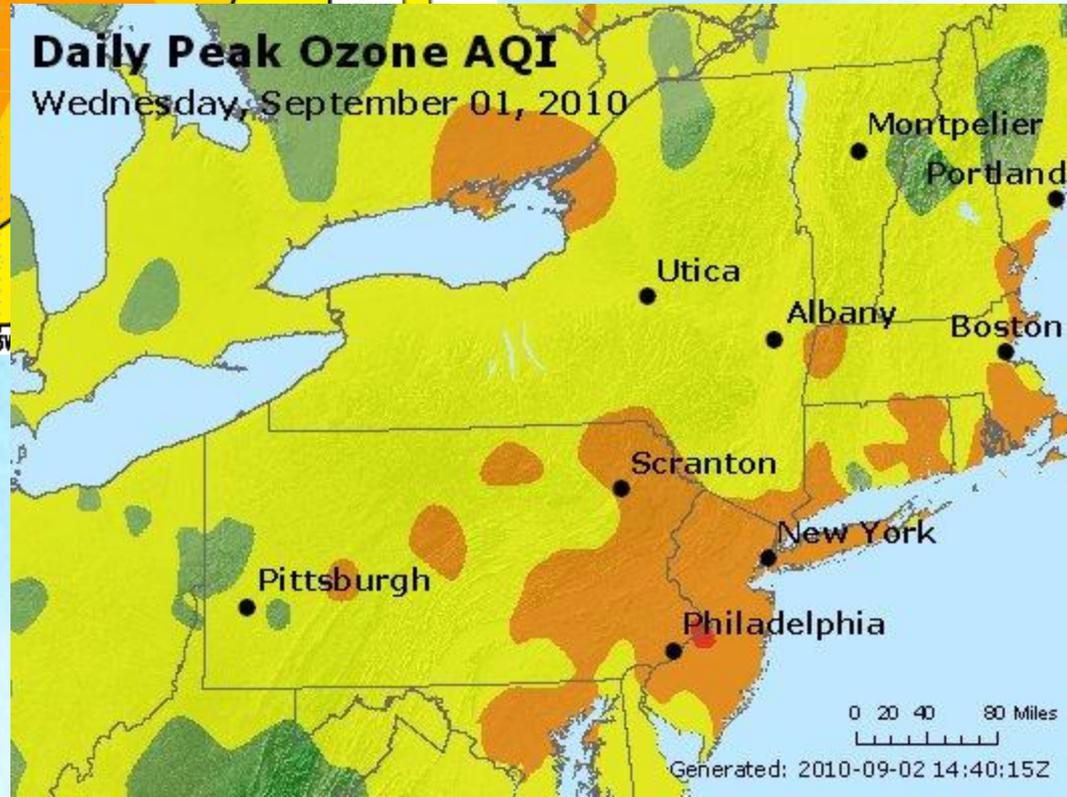
5x (Operational) 8-hr max 01SEP2010



**September 1,  
2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**

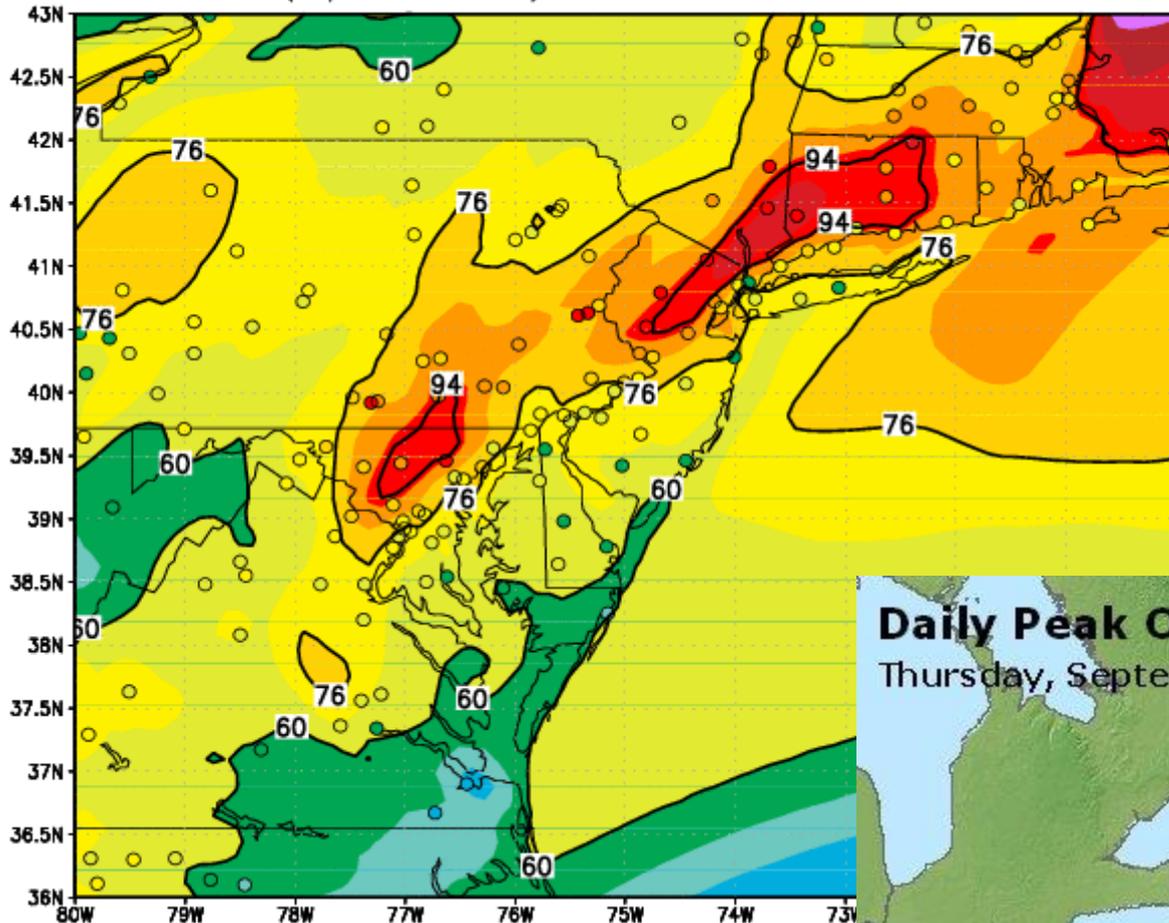
Wednesday, September 01, 2010



<b>Danbury</b>	<b>09/01/10</b>	<b>0.076</b>
<b>Greenwich</b>	<b>09/01/10</b>	<b>0.091</b>
<b>Groton</b>	<b>09/01/10</b>	<b>0.078</b>
<b>Middletown</b>	<b>09/01/10</b>	<b>0.079</b>
<b>Stratford</b>	<b>09/01/10</b>	<b>0.080</b>
<b>Westport</b>	<b>09/01/10</b>	<b>0.087</b>



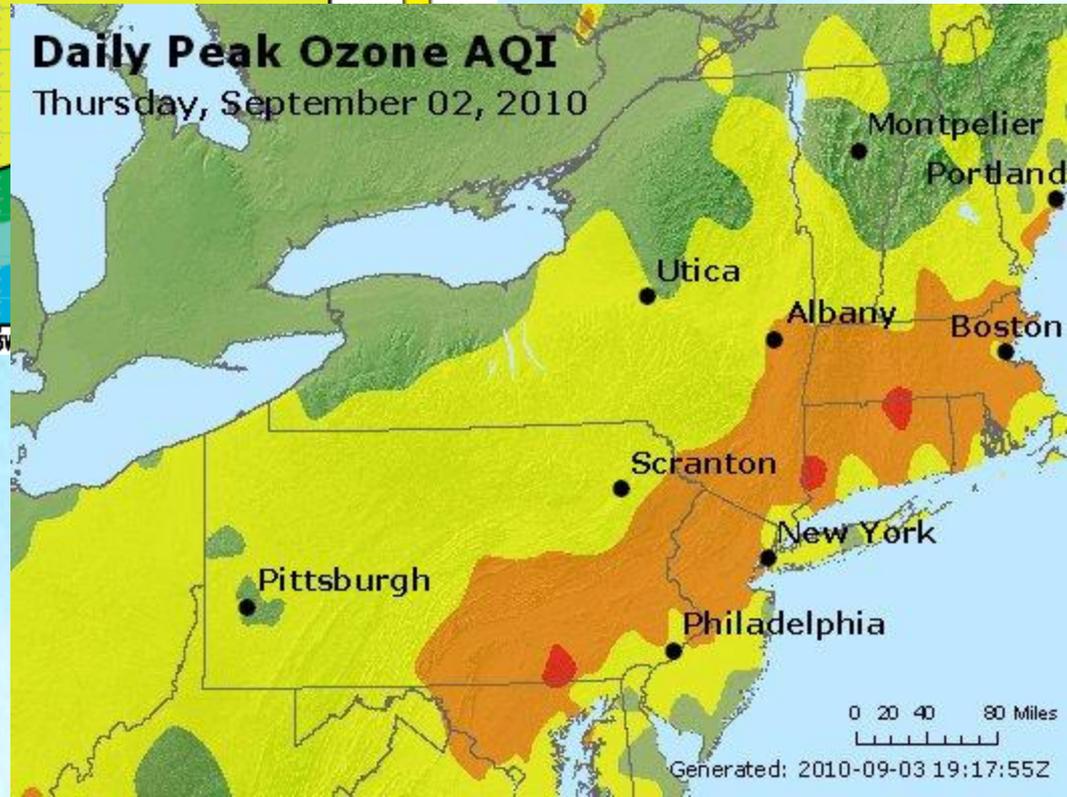
5x (Operational) 8-hr max 02SEP2010



**September 2,  
2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**

**Daily Peak Ozone AQI**

Thursday, September 02, 2010

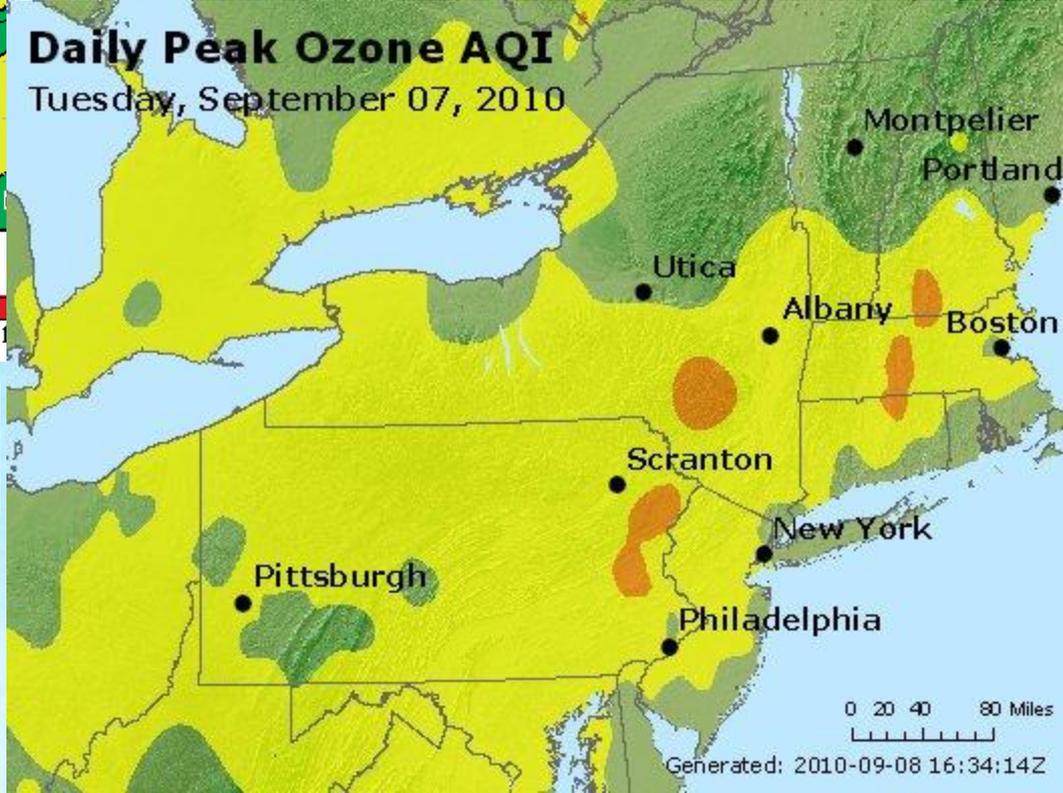
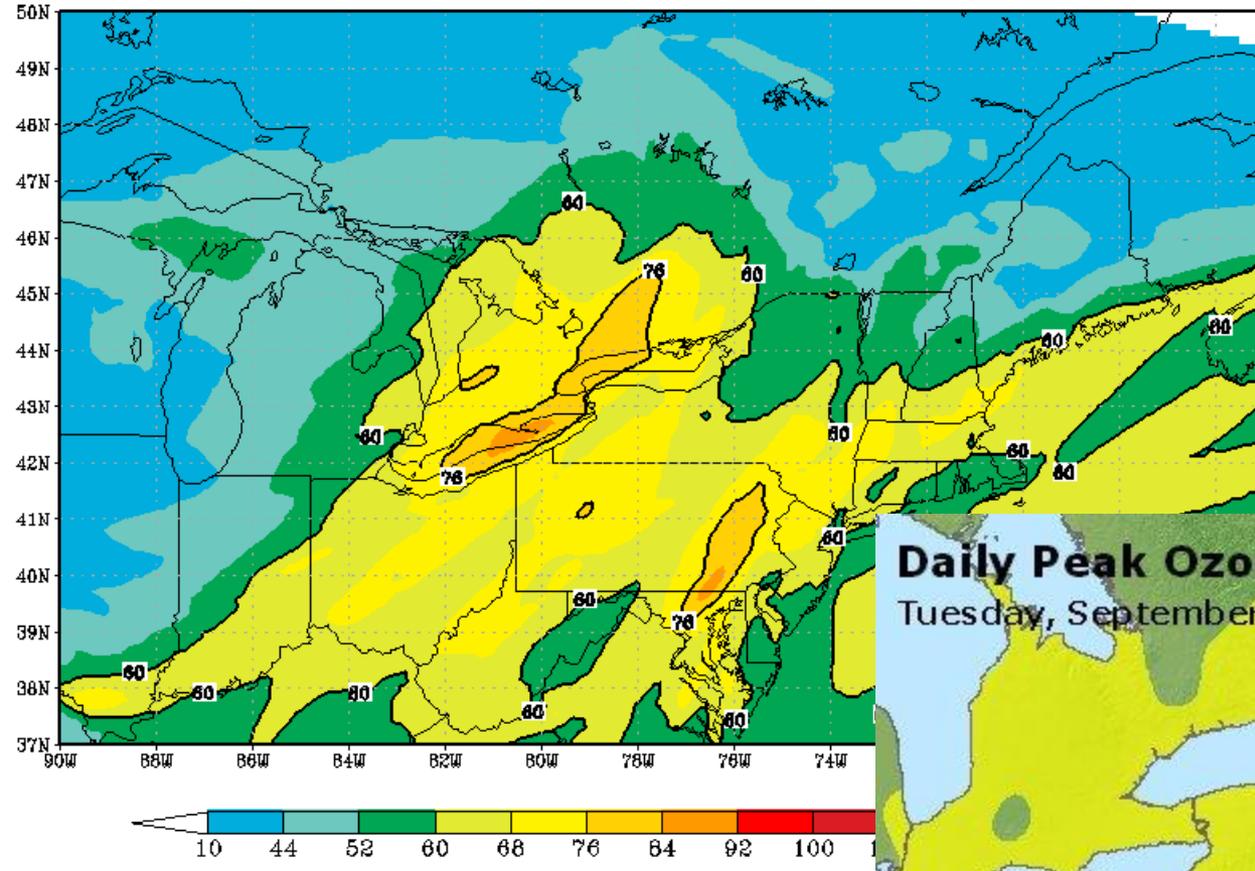


Cornwall	09/02/10	0.083
Danbury	09/02/10	0.097
East Hartford	09/02/10	0.089
Middletown	09/02/10	0.086
Stafford	09/02/10	0.101
Westport	09/02/10	0.079



(prd) 12Z 25H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 07 SEP 2010

**September 7,  
2010  
Operational  
Vs. Observed  
8-hr Ozone ppb**



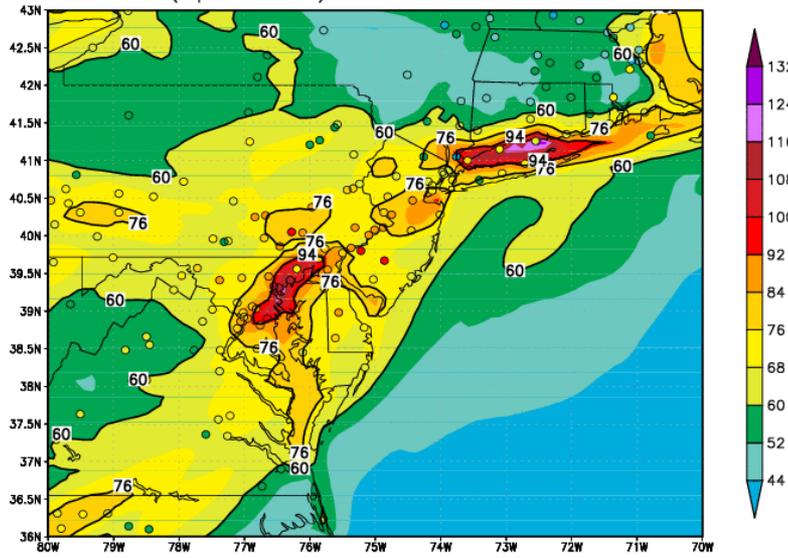
<b>Stafford</b>	<b>09/07/10</b>	<b>0.078</b>
<b>Danbury</b>	<b>09/07/10</b>	<b>0.071</b>
<b>Cornwall</b>	<b>09/07/10</b>	<b>0.068</b>

# What Happened on August 10<sup>th</sup>?

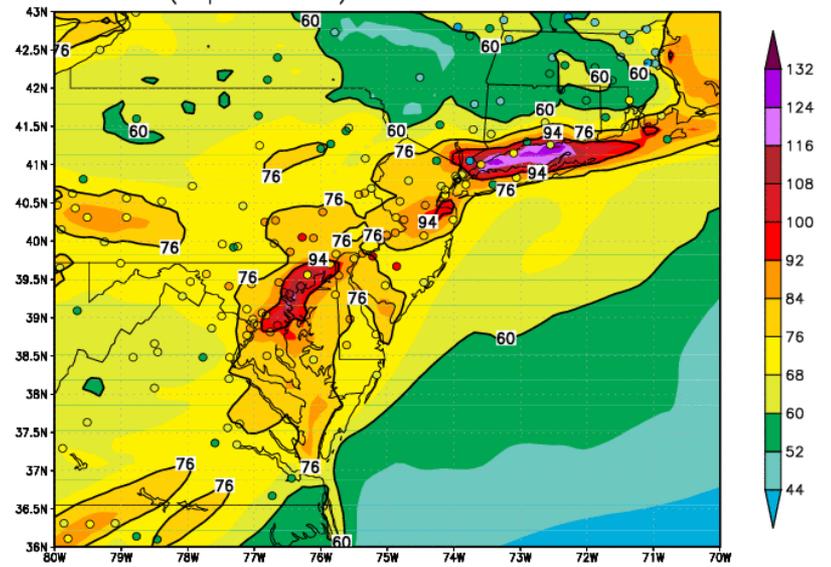
## Highest Over-prediction

City	Date	Forecast AQI	Forecast Category	Obs. AQI	Obs. Category
<b>Bridgeport</b>	08/10/2010	<b>157</b>	4	<b>109</b>	3
Danbury	08/10/2010	93	2	<b>109</b>	3
<b>Greenwich</b>	08/10/2010	<b>180</b>	4	<b>106</b>	3
Hartford	08/10/2010	51	2	41	1
<b>Madison</b>	08/10/2010	<b>156</b>	4	71	2
Middletown	08/10/2010	<b>110</b>	3	61	2
New Haven	08/10/2010	<b>142</b>	3	49	1
New London-Groton	08/10/2010	109	3		
Stafford	08/10/2010	64	2	48	1
Stratford	08/10/2010	<b>141</b>	3	93	2
Torrington	08/10/2010	47	1	41	1
<b>Westport</b>	08/10/2010	<b>180</b>	4	<b>109</b>	3

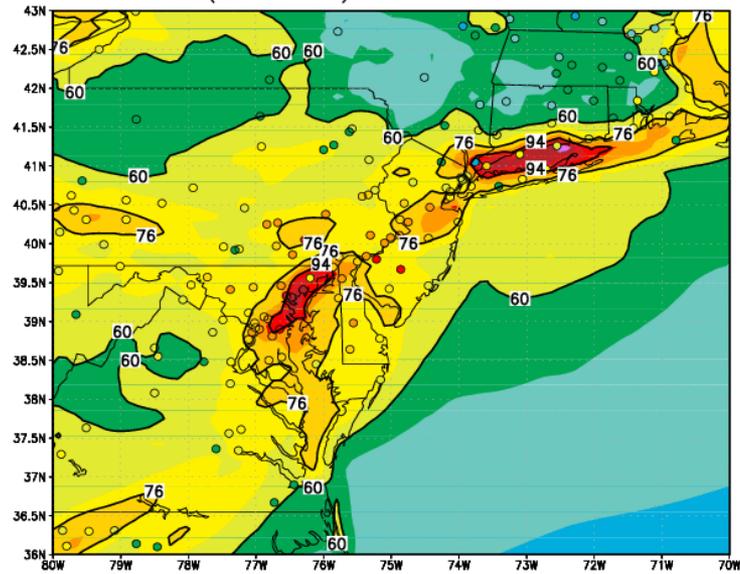
5x (Operational) 8-hr max 10AUG2010



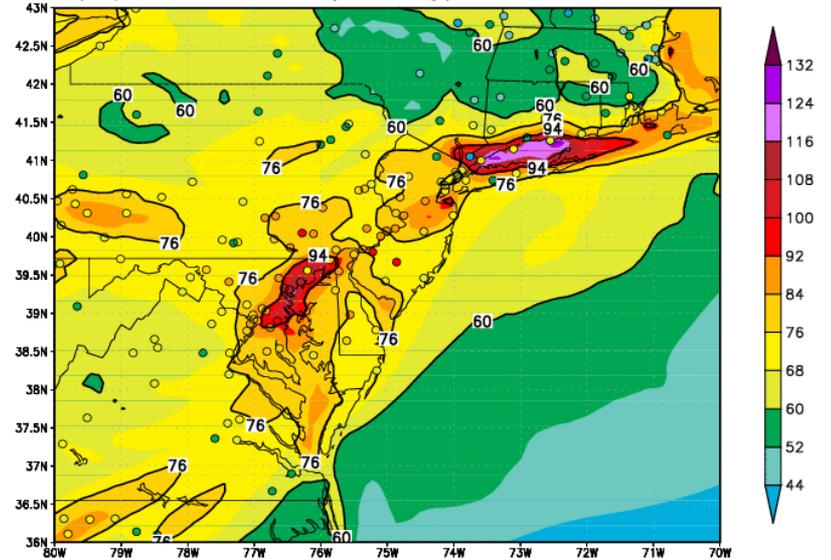
5x (Experimental) 8-hr max 10AUG2010



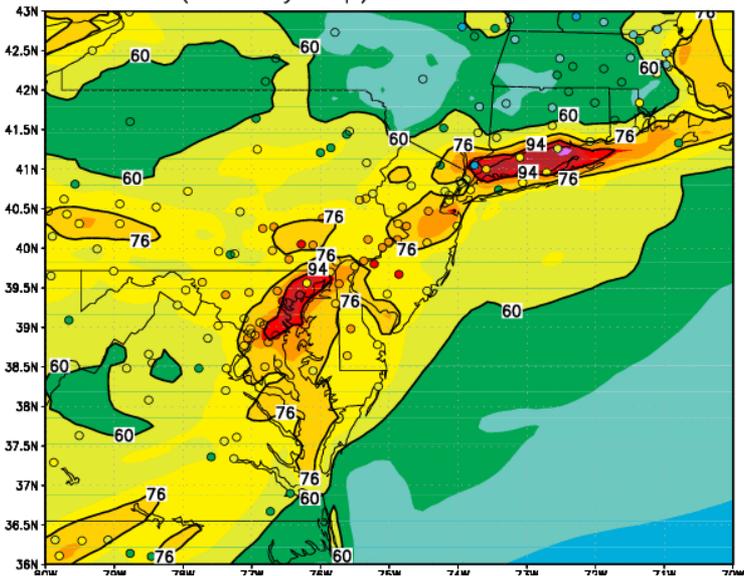
Test2 (Combined) 8-hr max 10AUG2010



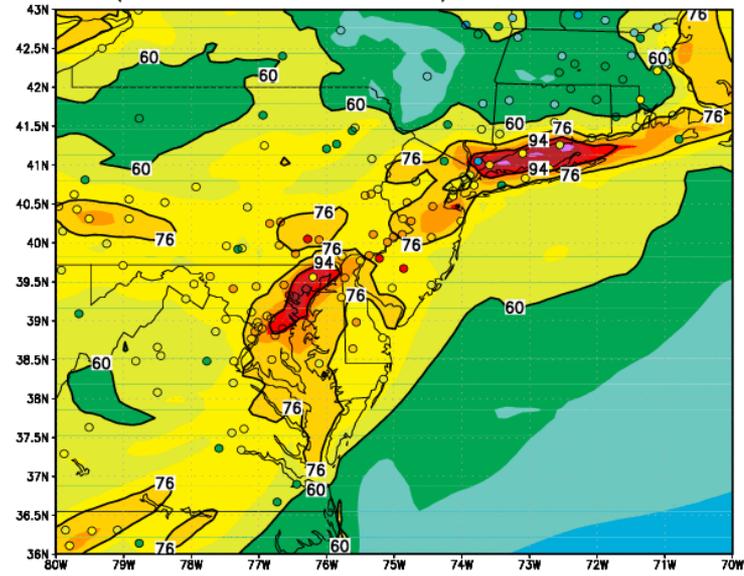
Ctrl (Experimental 12z cycle only) 8-hr max 10AUG2010



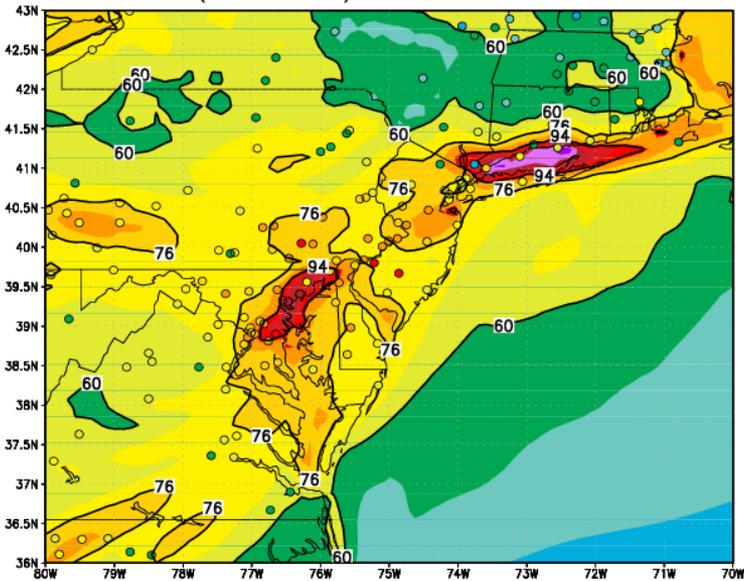
Test3 (New Dry Dep) 8-hr max 10AUG2010



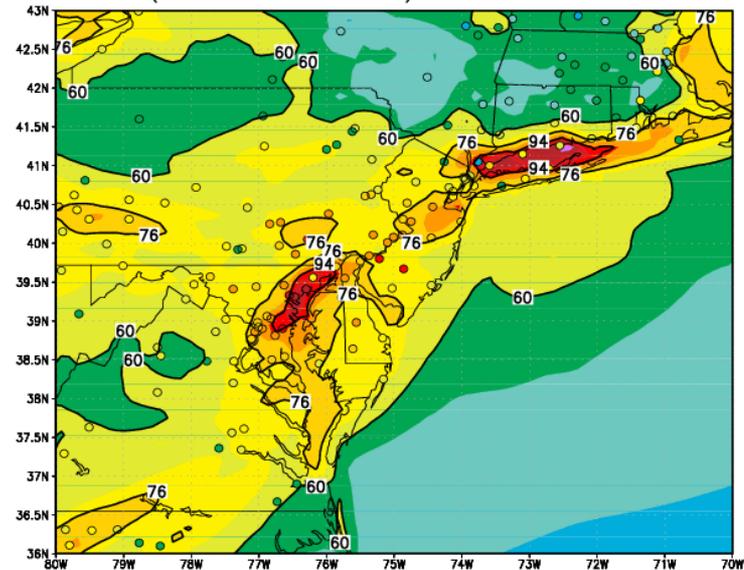
Test4 (Min PBL=100m - water) 8-hr max 10AUG2010



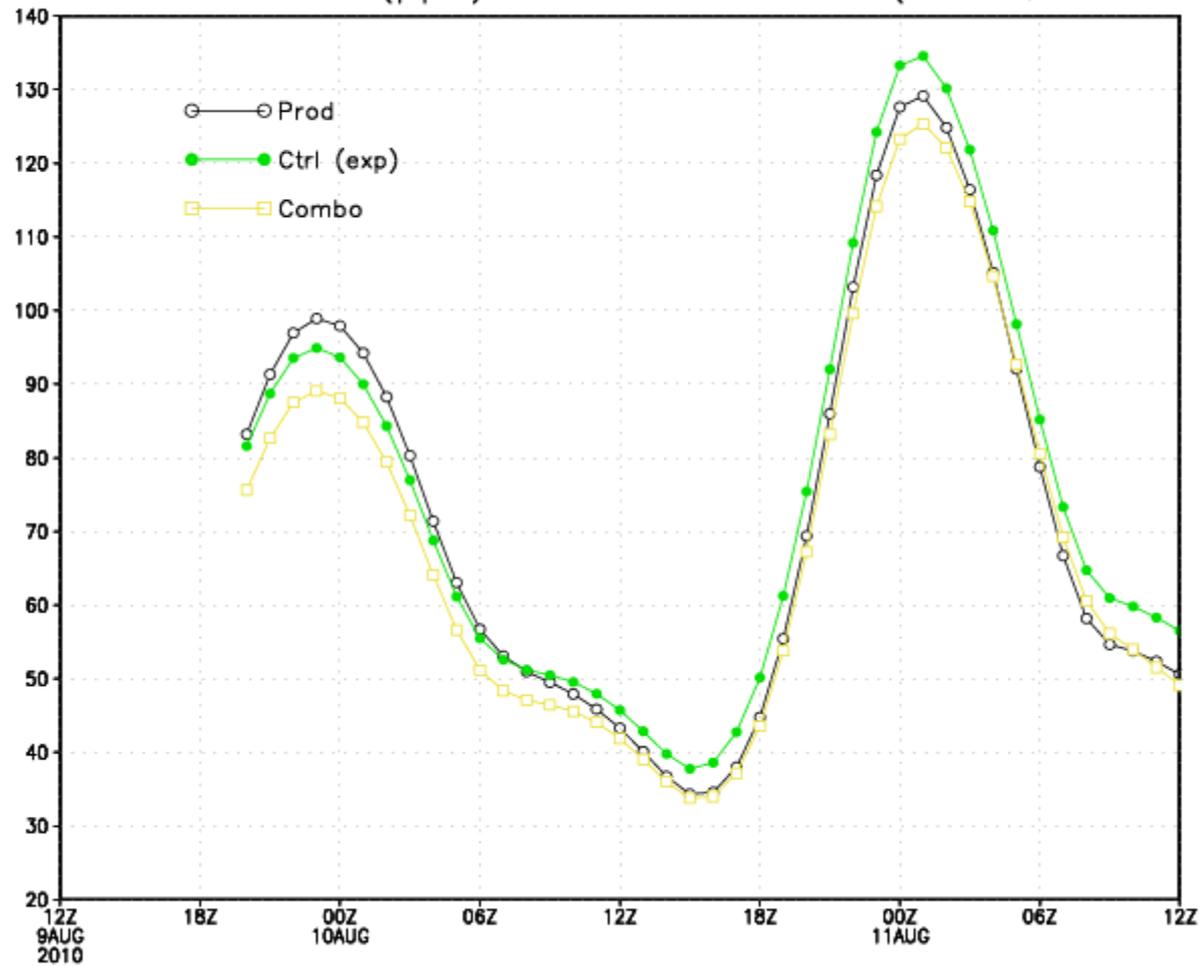
Test1 (Chem LBC) 8-hr max 10AUG2010



Test5 (New fire emissions) 8-hr max 10AUG2010

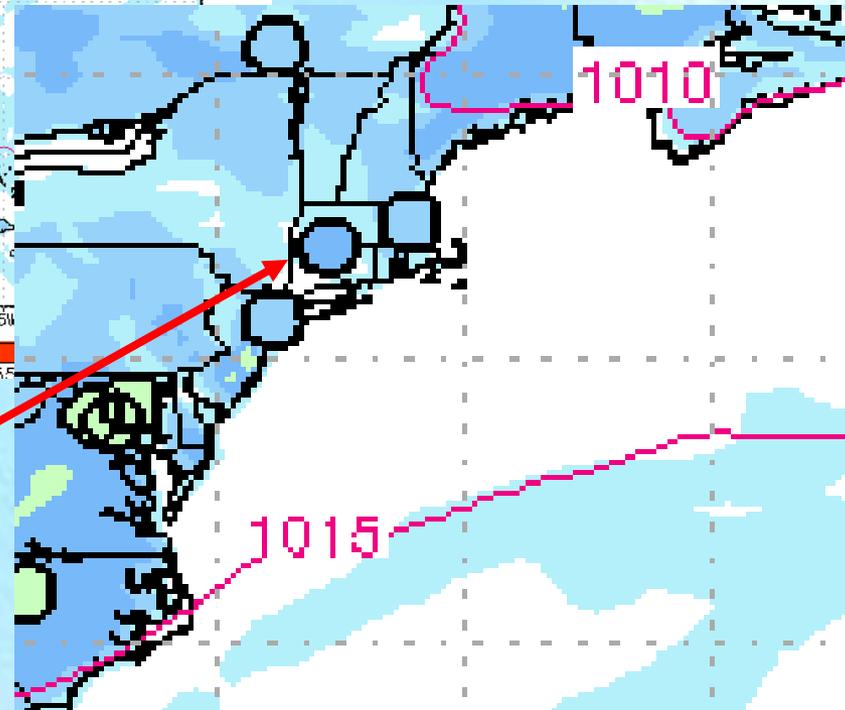
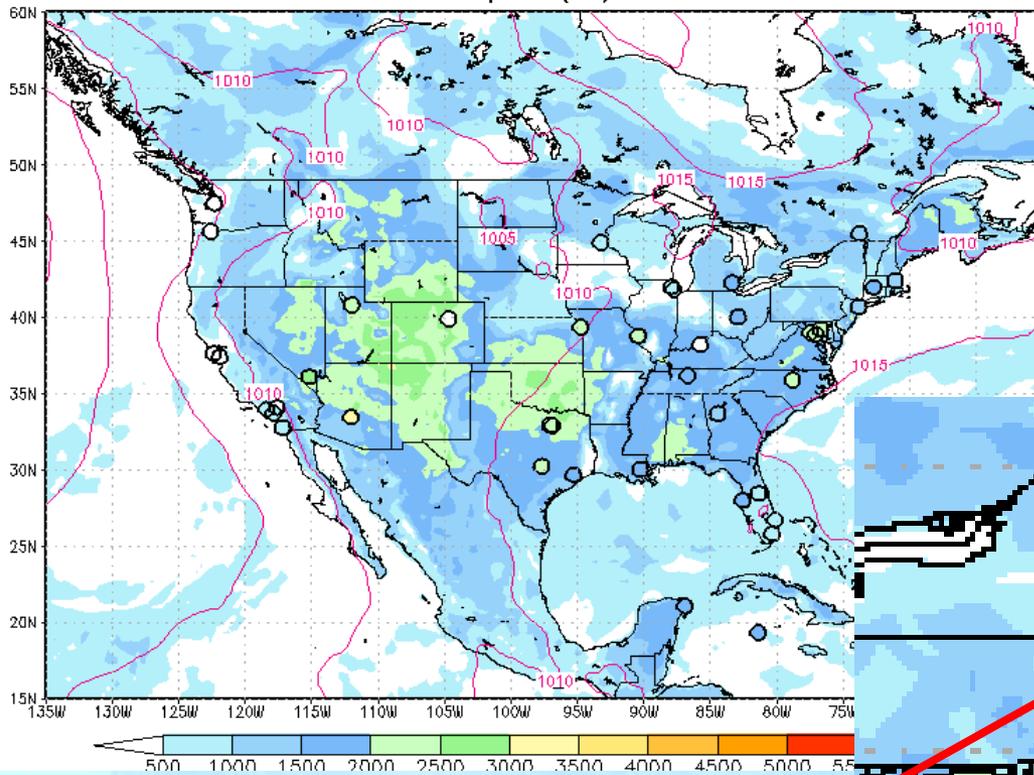


# 8-Hr ave ozone (ppb) near Madison CT (41.24, -72.57)



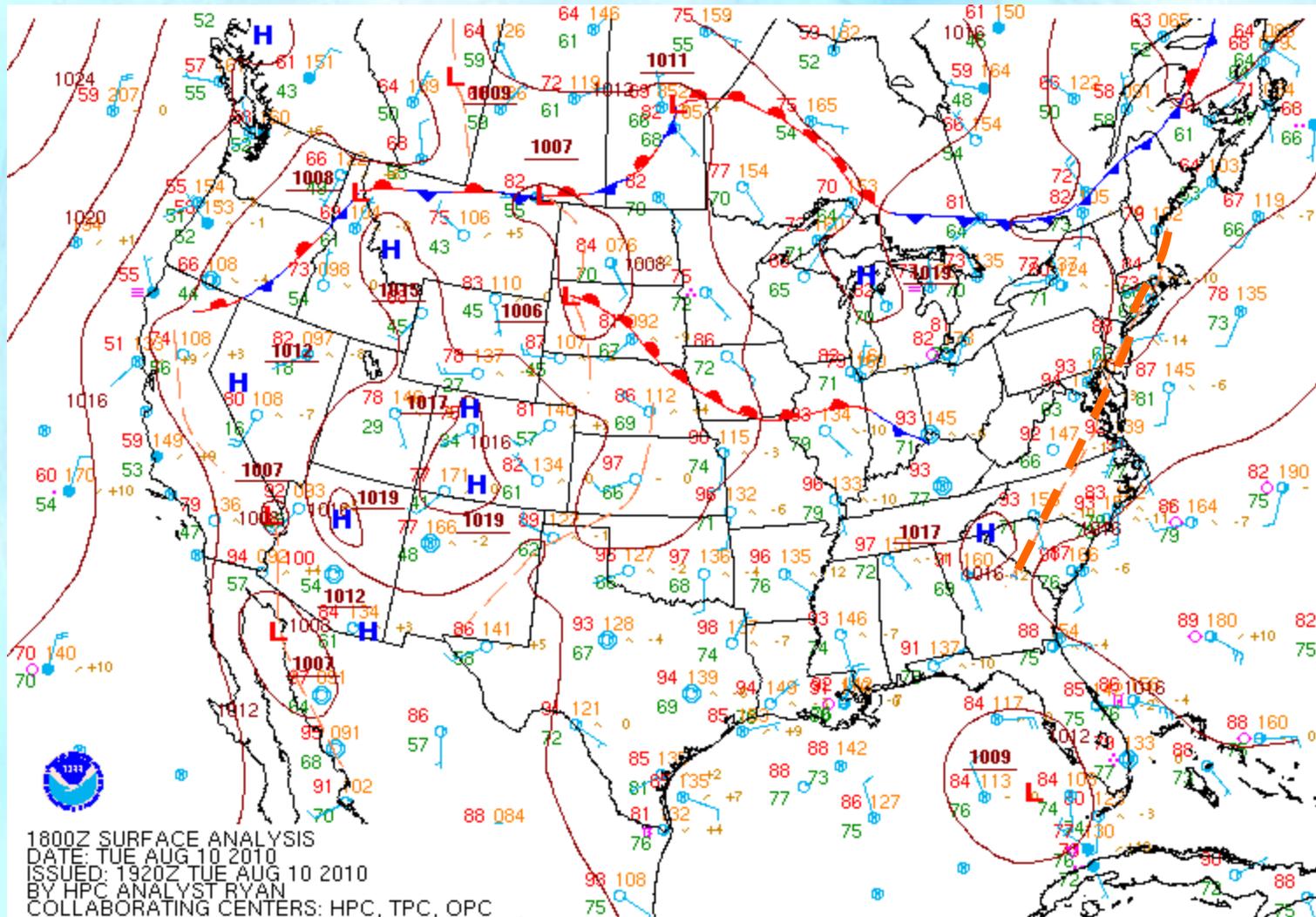
Combo run reduces ozone by 5-10 ppb compare to prod (at peaks)

# 30hr fcst NAM PBL depth (Ri) Valid 18Z10AUG2010

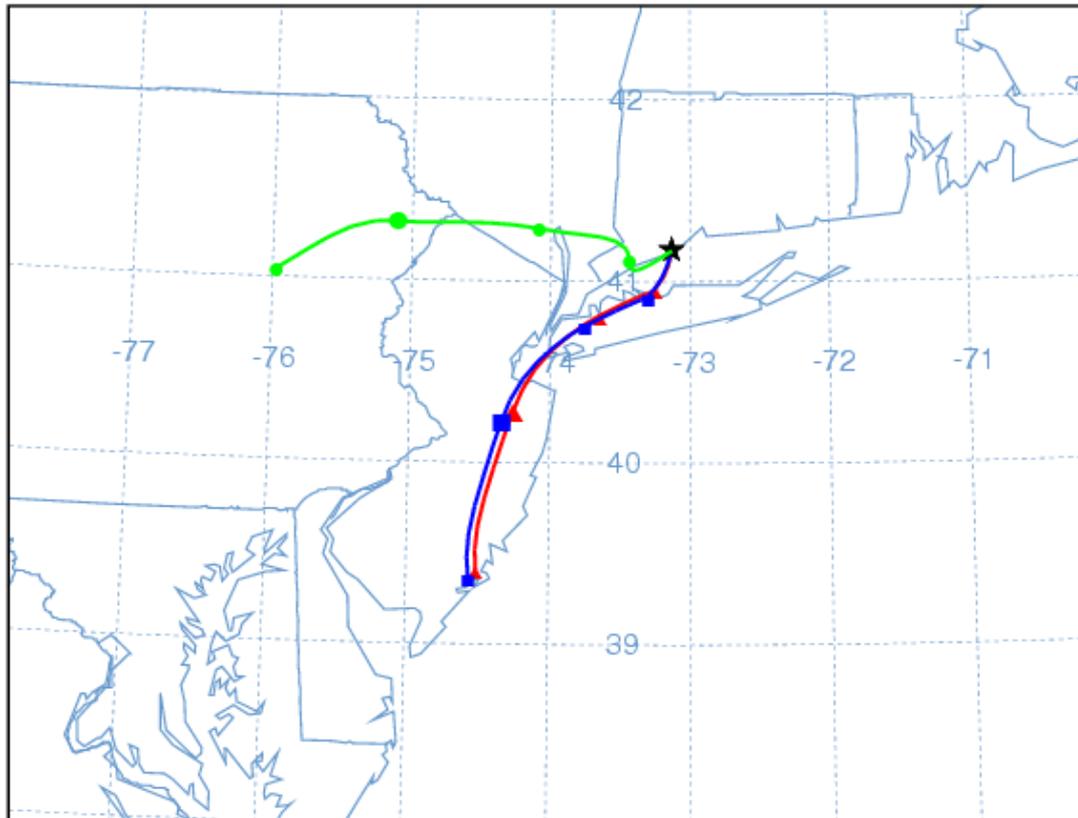


OBS PBL higher than Ri PBL  
from NMM but not significantly

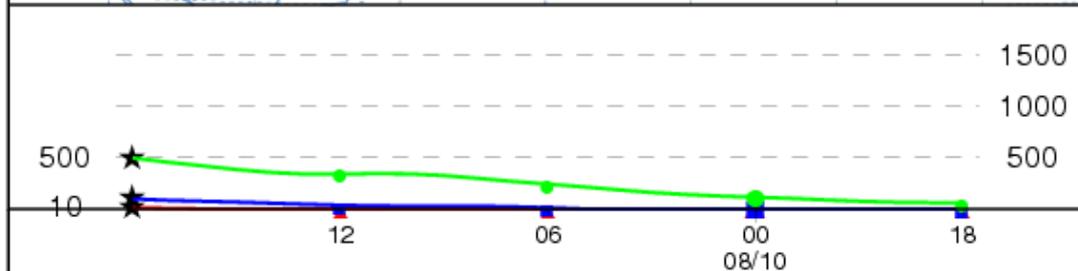
# Weak trough draped across mid-Atlantic coast (18z Aug 10)



Source ★ at 41.17 N 73.13 W



Meters AGL



Job ID: 308912 Job Start: Thu Sep 9 19:01:59 UTC 2010  
Source 1 lat.: 41.17 lon.: -73.13 hghts: 10, 100, 500 m AGL

Trajectory Direction: Backward Duration: 24 hrs  
Vertical Motion Calculation Method: Model Vertical Velocity  
Meteorology: 0000Z 08 Aug 2010 - GDAS1

**Model predicts area of high ozone buildup over LIS that is advected to CT coast**

**Daily Peak Ozone AQI**

Tuesday, August 10, 2010



# Conclusions

- Operational Model performed well for alerting exceedances
- Hit rate of 22/24 days = 92% for State.
- Over predicted 34/22 = 55% excess.
- Need to confirm accumulation of very high ozone off the coast, especially EXP.

**Good Job NCEP!**