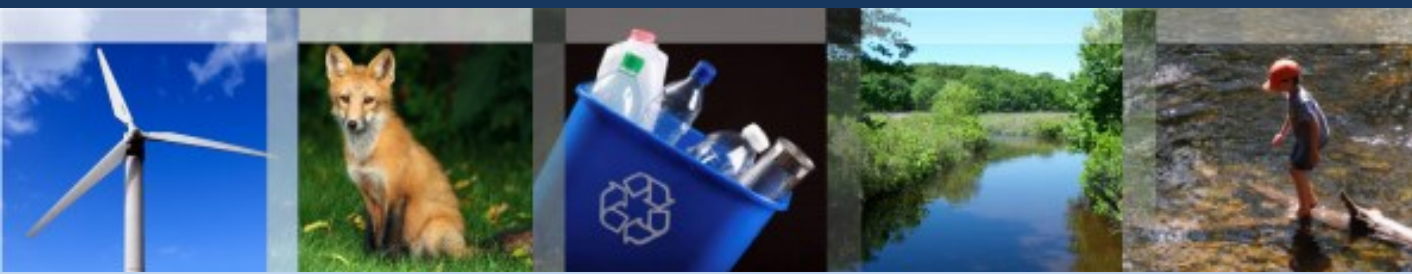




# Connecticut Department of Energy and Environmental Protection



# State of Connecticut NOAA Ozone Model Analysis 2015 Focus Group

September 10, 2015  
Michael Geigert



Connecticut Department of Energy and Environmental Protection

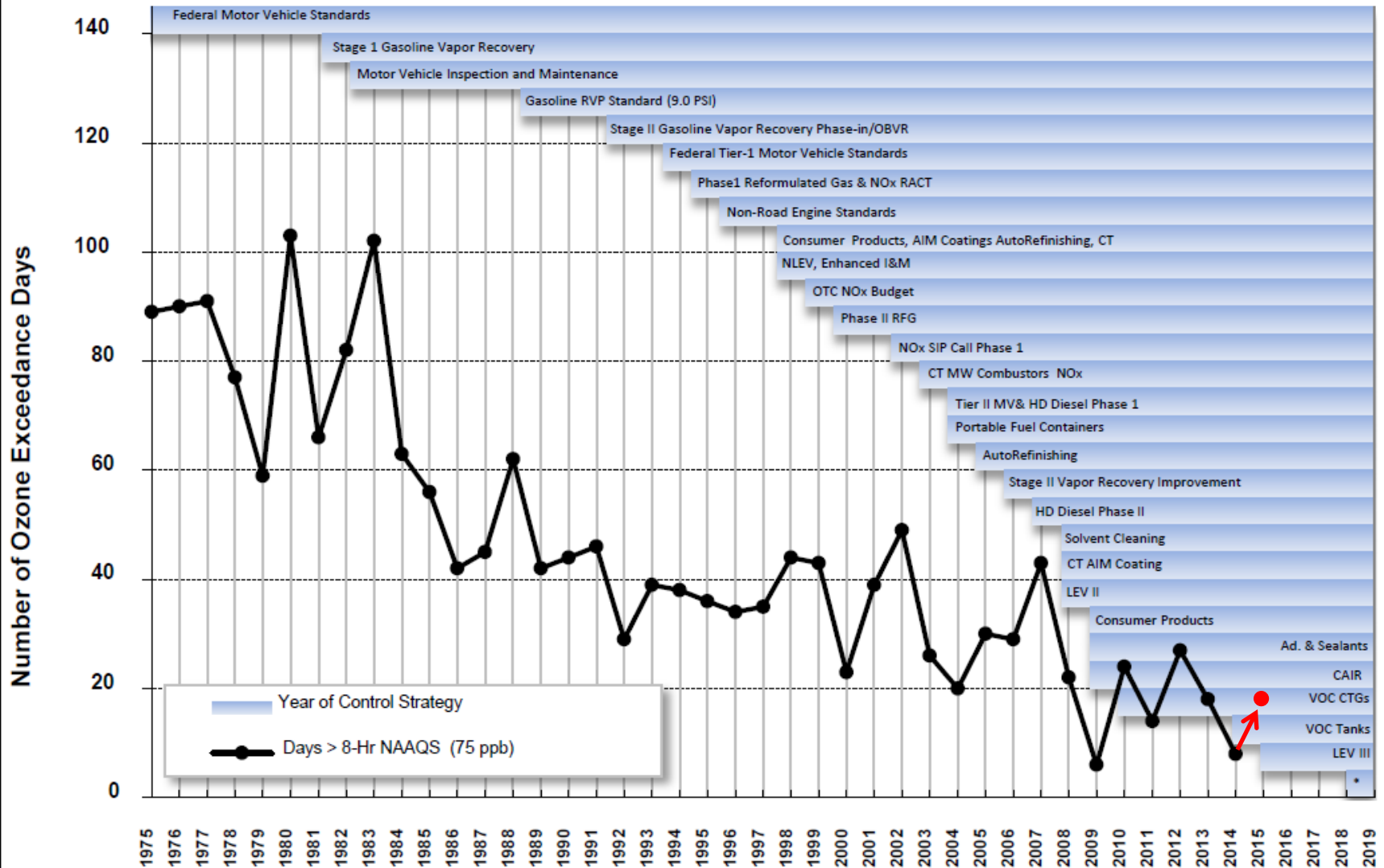
# Ozone in Connecticut 2014 vs. 2015

- Had 8 exceedance days in 2014, but 2 worst sites had 7 days, so more concentrated;
- 2015 has 18 exceedance days by September 2<sup>nd</sup>, but worst site has 8 of them, so is more spread around.
- The 2015 NOAA 06z day before run predicted exceedances in 11/18 days (61%), whereas in 2014, the 12z day before was 100% correct for 8 days



# Trend Graph

## Connecticut 8-Hour (75 ppb) Ozone Exceedance Day Trends and Implemented Control Strategies

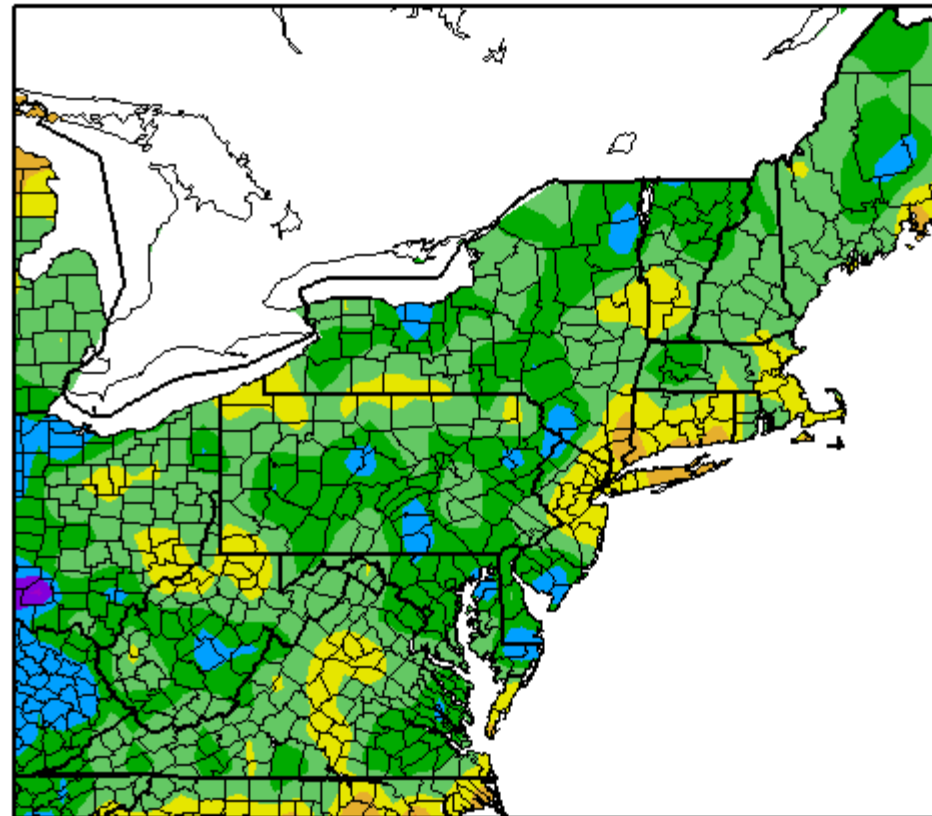


\* NOx RACT Fuel Burning Sources, MWC NOx Reductions and Federal Tier 3 Motor Vehicle /Fuel Requirements

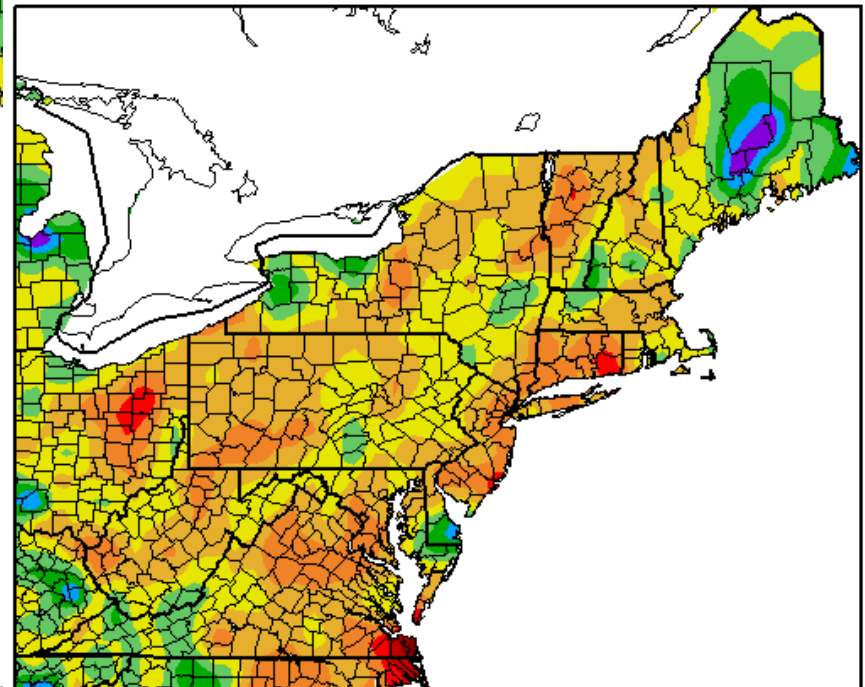
# Summer Precipitation Summary

- Overall a wetter summer for east coast, except CT
- August, however, paints a different story

Departure from Normal Precipitation (in)  
6/1/2015 – 8/31/2015



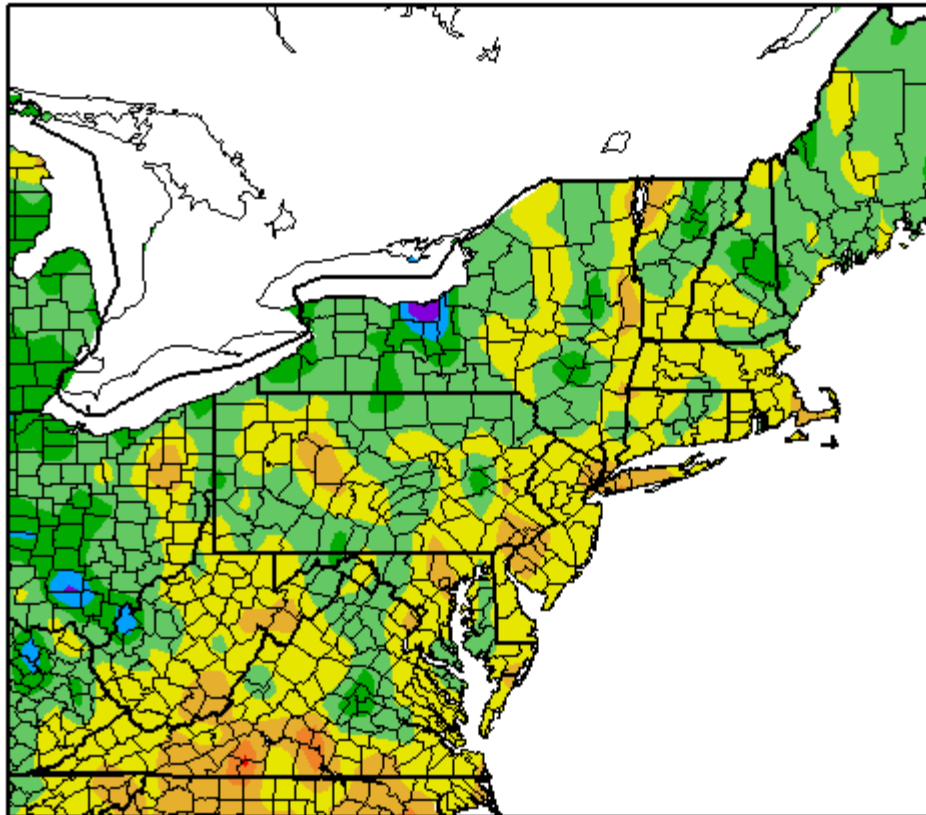
Departure from Normal Precipitation (in)  
8/1/2015 – 8/31/2015



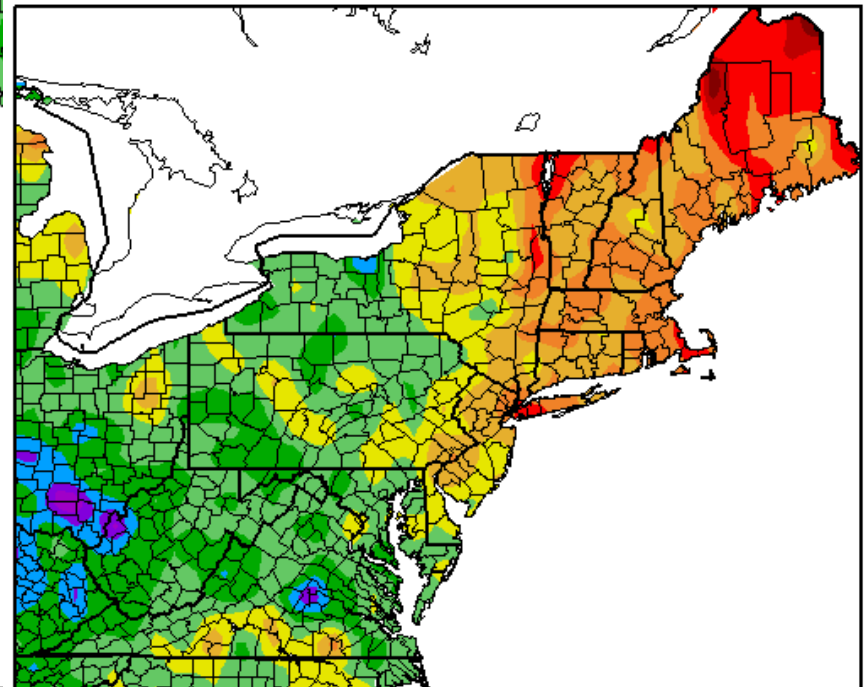
# Summer Temperature summary

- Overall, somewhat warmer over the south and coastal areas
- August is cooler mid-Atlantic and warmer in Northeast

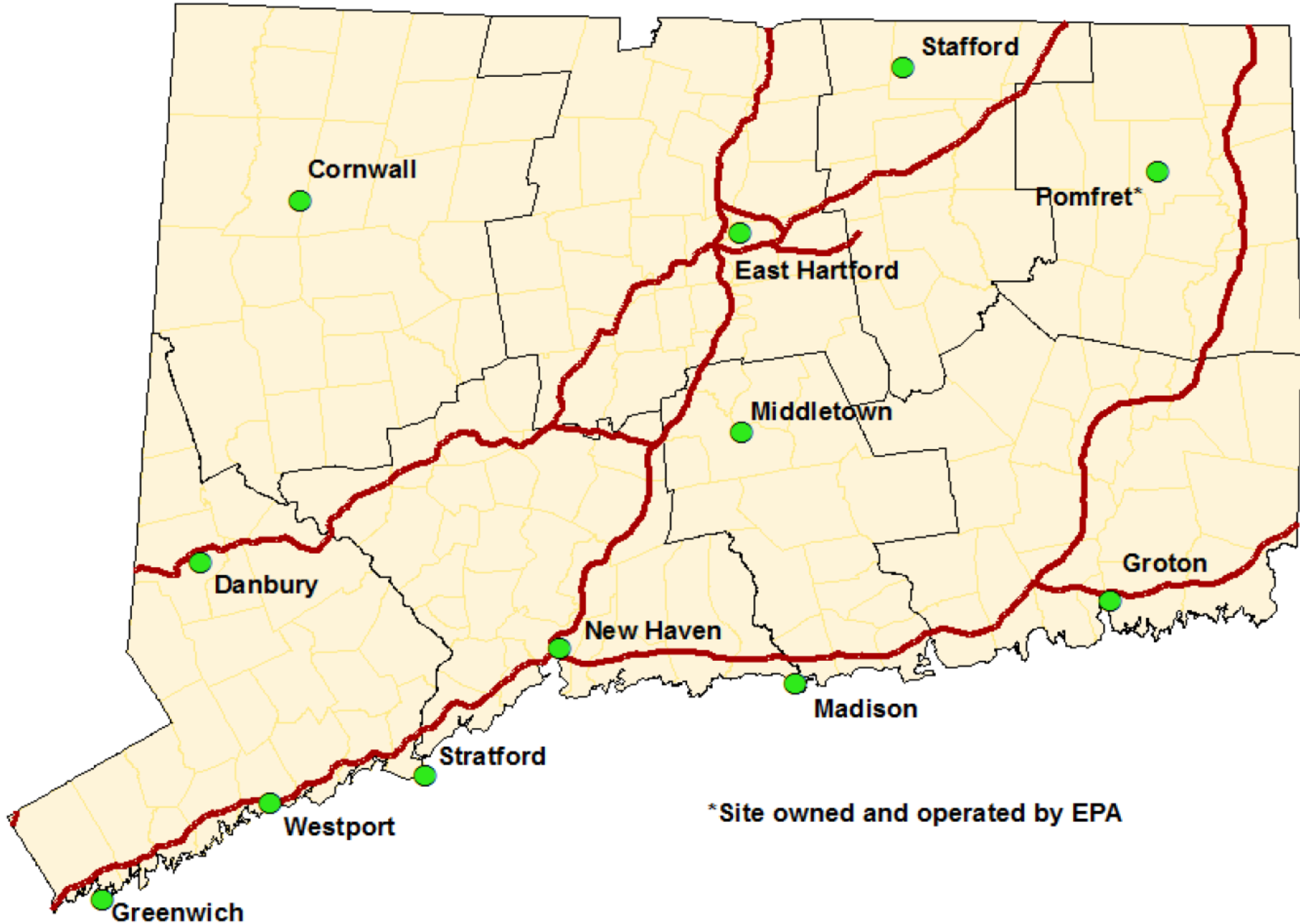
Departure from Normal Temperature (F)  
6/1/2015 – 8/31/2015



Departure from Normal Temperature (F)  
8/1/2015 – 8/31/2015



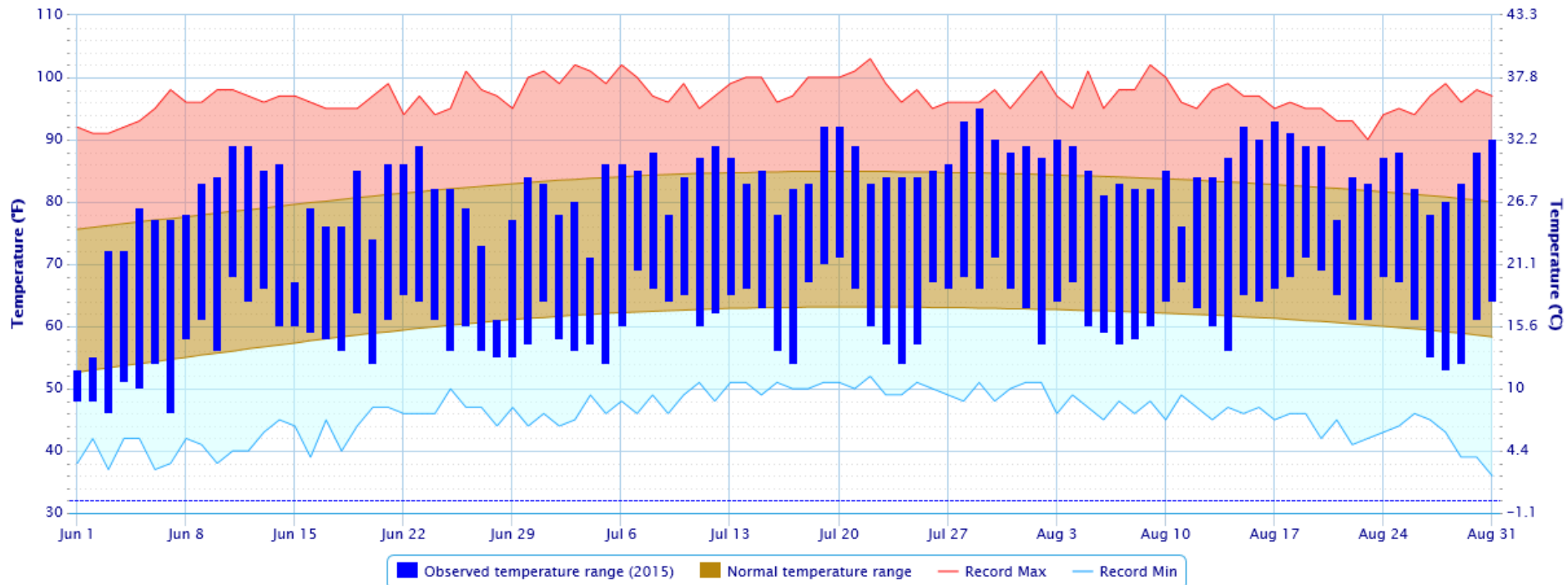
# CT ozone Monitors



# 14 Days over 90 degrees at BDL Hartford

Daily Temperature Data - HARTFORD BRADLEY INTL AP, CT

Period of Record - 1949-01-01 to 2015-09-01. Normals period: 1981-2010. Click and drag to zoom chart.



Powered by ACIS



Connecticut Department of Energy and Environmental Protection



**Connecticut Department of Energy & Environmental Protection  
8-Hour Ozone Daily Maximums\*  
May 2015**

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Abington	M	M	52	67	M	48	61	70	40	48	40	57	46	55	63	45	52	49	33	29	49	53	42	67	61	59	41	47	46	30	20
Cornwall	42	49	55	76	M	54	66	84	42	44	50	59	45	58	67	M	M	M	43	45	52	54	49	66	71	67	53	51	46	51	34
Danbury	39	49	55	71	66	47	60	84	41	39	41	56	31	49	65	43	51	45	35	30	44	52	42	68	70	77	48	54	50	44	28
East Hartford	40	47	57	70	64	45	67	79	40	50	42	54	36	55	60	50	54	51	36	31	48	53	42	64	65	72	54	55	53	39	29
Greenwich	42	44	51	61	68	49	56	62	43	30	30	61	38	54	63	42	57	46	36	32	41	53	46	63	60	62	49	54	41	33	49
Groton	40	40	46	64	67	49	61	57	43	39	26	57	41	53	58	46	56	49	37	30	45	55	48	63	58	49	40	42	43	26	34
Madison	42	40	45	63	M	44	57	58	44	33	27	66	37	53	55	42	57	50	39	33	46	53	49	65	59	55	43	48	41	32	32
Middletown	42	46	56	69	70	47	65	78	40	47	39	60	36	55	64	48	56	49	35	32	47	51	44	70	62	67	47	55	46	33	31
New Haven	43	44	49	56	47	48	35	58	42	33	20	53	38	48	46	42	46	50	33	32	39	53	44	64	61	59	36	50	39	31	36
Stafford	39	45	54	72	61	50	67	74	41	52	47	51	43	53	61	47	52	51	36	29	45	51	42	62	61	72	49	53	43	40	32
Stratford	43	44	49	63	69	46	54	55	46	35	27	63	39	53	57	43	56	50	41	32	45	53	47	63	58	57	46	50	40	28	33
Westport	42	44	48	61	M	44	60	64	40	35	28	58	32	52	59	39	61	43	31	30	41	52	45	64	60	62	44	52	39	33	40
# days > Federal Standard				1				2																		3					

Good (0-59 ppb)

Moderate (60-75 ppb)

Unhealthy for Sensitive Groups (76-95 ppb)

Unhealthy (96-115 ppb)

Very Unhealthy (116 > ppb)

Units - parts per billion (ppb)

Federal Standard = 75 ppb

M = missing data

\* Data is preliminary and has not been quality assured

**Connecticut Department of Environmental Protection  
8-Hour Ozone Daily Maximums\*  
June 2015**

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Abington	28	28	37	40	44	40	43	45	45	60	65	M	M	M	28	41	39	48	43	31	34	44	56	40	44	42	29	28	31	50	
Cornwall	31	28	33	43	42	48	52	48	54	62	56	72	43	44	40	40	36	47	48	37	37	44	53	38	44	43	39	35	35	52	
Danbury	24	20	39	40	47	41	53	50	53	60	68	79	41	50	37	42	46	51	43	37	35	47	55	38	46	41	32	29	29	55	
East Hartford	24	22	41	42	48	44	48	48	54	61	59	66	45	48	35	46	50	52	48	33	31	43	61	38	44	41	31	29	28	55	
Greenwich	33	19	38	39	45	45	44	48	60	61	86	67	46	50	41	41	48	50	47	42	39	53	68	47	49	52	36	31	37	51	
Groton	30	26	32	36	41	39	41	46	44	52	86	59	41	42	37	37	39	41	48	39	40	47	54	43	50	43	33	29	44	53	
Madison	29	24	34	37	43	40	43	M	50	55	91	62	49	51	44	44	36	45	58	39	41	56	58	44	48	51	37	33	46	53	
Middletown	28	20	37	36	40	44	45	48	50	66	74	64	46	49	40	45	51	46	48	33	35	43	63	38	50	41	32	28	32	54	
New Haven	25	18	36	40	49	45	47	47	48	54	93	69	50	57	42	43	46	49	46	39	37	46	47	39	42	45	36	29	30	55	
Stafford	26	25	37	36	45	38	45	47	50	62	57	58	37	41	34	42	35	50	40	33	30	42	62	38	41	33	31	30	23	50	
Stratford	30	21	36	39	46	37	45	51	56	62	95	64	52	55	43	43	38	49	52	42	40	57	67	M	49	50	38	30	41	54	
Westport	21	15	35	36	43	38	44	48	56	61	92	63	47	49	37	58	50	49	45	37	37	51	69	42	51	47	33	28	37	51	
# days > Federal Standard											4	5																			

Good (0-59 ppb)

Moderate (60-75 ppb)

Unhealthy for Sensitive Groups (76-95 ppb)

Unhealthy (96-115 ppb)

Very Unhealthy (116 > ppb)

Units - parts per billion (ppb)

Federal Standard = 75 ppb

M = missing data

\* Data is preliminary and has not been quality assured

**Connecticut Department of Energy & Environmental Protection  
8-Hour Ozone Daily Maximums\*  
July 2015**

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Abington	69	42	39	32	45	55	38	38	31	36	37	48	54	M	42	35	52	37	50	47	49	37	36	34	32	49	47	42	60	40	38
Cornwall	55	40	51	51	45	64	46	41	36	37	42	48	64	42	37	42	67	49	63	44	48	38	38	38	43	57	60	48	67	47	38
Danbury	60	45	41	43	52	68	50	35	39	39	40	53	74	46	40	37	67	55	72	50	58	32	39	34	45	63	66	41	70	46	39
East Hartford	60	40	48	38	46	70	38	36	40	41	43	47	62	43	45	46	65	51	69	46	53	36	37	38	42	57	61	43	53	51	37
Greenwich	69	48	56	49	62	59	52	51	45	43	48	70	62	42	43	49	56	52	79	65	M	43	46	47	56	60	55	75	84	46	46
Groton	71	44	44	43	60	51	39	65	39	41	50	56	48	43	44	37	56	39	63	71	70	41	49	45	41	48	44	56	79	34	59
Madison	78	46	47	48	59	51	45	69	45	43	57	65	51	43	41	49	58	43	60	77	73	43	M	52	45	57	55	68	87	42	61
Middletown	72	47	48	39	55	63	41	44	38	42	49	50	57	41	44	47	61	49	67	58	61	38	38	39	40	51	55	47	69	46	40
New Haven	58	49	52	44	60	60	40	45	40	40	42	44	55	43	47	48	M	46	62	49	60	38	39	38	46	57	54	53	67	28	42
Stafford	56	37	42	32	44	64	41	37	36	34	38	44	50	M	35	34	58	45	59	42	48	37	34	35	34	54	57	41	54	53	34
Stratford	75	47	53	52	60	59	49	57	44	40	53	62	57	49	43	50	60	48	80	73	76	42	50	49	53	56	59	70	79	45	55
Westport	68	48	49	46	62	59	48	53	41	41	51	63	62	42	39	42	58	52	86	64	73	42	46	45	44	57	52	74	79	44	46
# days > Federal Standard	6																		7	8	9								10		

Good (0-59 ppb)

Moderate (60-75 ppb)

Unhealthy for Sensitive Groups (76-95 ppb)

Unhealthy (96-115 ppb)

Units - parts per billion (ppb)

Federal Standard = 75 ppb

M = missing data

**Connecticut Department of Energy & Environmental Protection  
8-Hour Ozone Daily Maximums\*  
August 2015**

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Abington	50	43	57	64	41	27	37	30	26	34	34	38	33	51	31	44	54	58	38	34	31	36	22	31	46	42	34	32	46	64	48
Cornwall	45	54	76	55	40	30	34	33	30	46	41	33	34	63	59	44	68	70	48	35	45	40	36	64	56	38	29	28	52	56	46
Danbury	50	59	79	60	42	35	40	34	33	43	34	35	35	65	74	49	69	70	46	35	41	44	35	71	71	44	34	28	56	75	51
East Hartford	48	53	73	60	40	25	39	35	30	41	32	35	30	57	69	42	65	74	42	37	30	66	38	50	54	42	32	29	41	65	48
Greenwich	59	60	70	66	51	41	41	44	38	40	41	44	46	69	89	71	84	M	43	31	47	51	36	76	66	53	42	50	72	74	61
Groton	68	44	57	71	55	44	38	36	31	32	37	48	48	56	77	64	77	61	31	36	31	41	27	21	49	54	43	33	54	68	80
Madison	73	55	61	81	60	50	40	43	31	33	43	53	49	65	80	57	64	62	34	37	26	47	29	27	53	56	52	44	59	71	84
Middletown	55	54	66	77	45	28	36	33	28	34	37	37	34	60	76	57	72	68	37	34	25	47	26	44	50	44	35	42	57	74	54
New Haven	55	55	53	69	48	38	43	37	33	33	41	44	34	61	84	69	81	65	35	36	27	52	29	48	50	49	38	31	56	80	58
Stafford	44	47	66	56	35	27	29	25	27	39	36	36	31	53	56	41	58	62	38	35	25	31	22	37	47	38	30	29	47	54	44
Stratford	64	52	65	79	54	50	43	39	37	40	43	52	51	68	86	66	86	63	39	34	37	55	32	55	60	56	33	M	M	M	72
Westport	61	M	68	69	51	40	M	M	M	40	40	45	45	71	87	70	92	62	38	30	39	49	34	68	63	53	40	46	71	85	69
# days > Federal Standard			11	12											13		14							15						16	17

Good (0-59 ppb)

Moderate (60-75 ppb)

Unhealthy for Sensitive Groups (76-95 ppb)

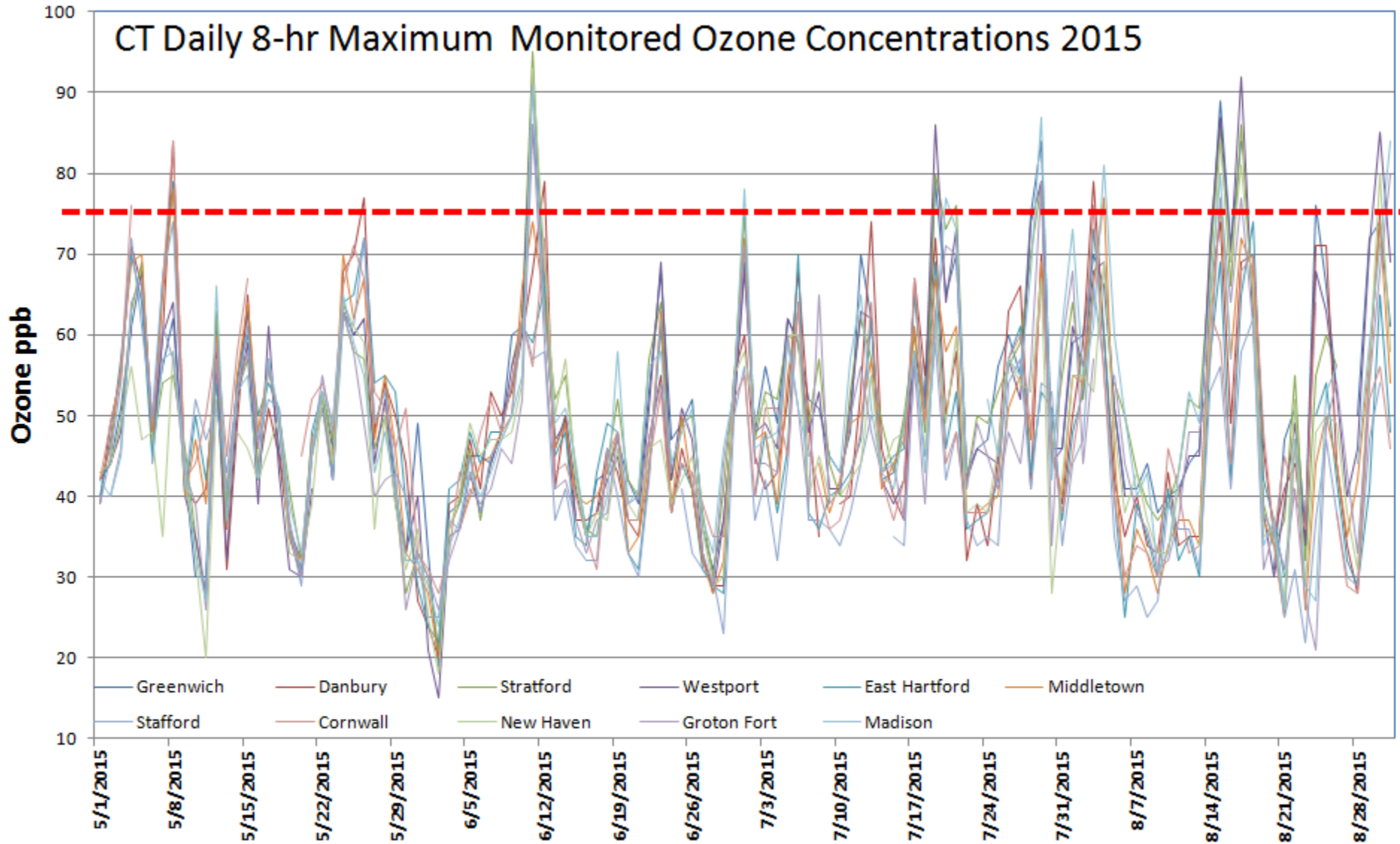
Unhealthy (96-115 ppb)

Units - parts per billion (ppb)

Federal Standard = 75 ppb

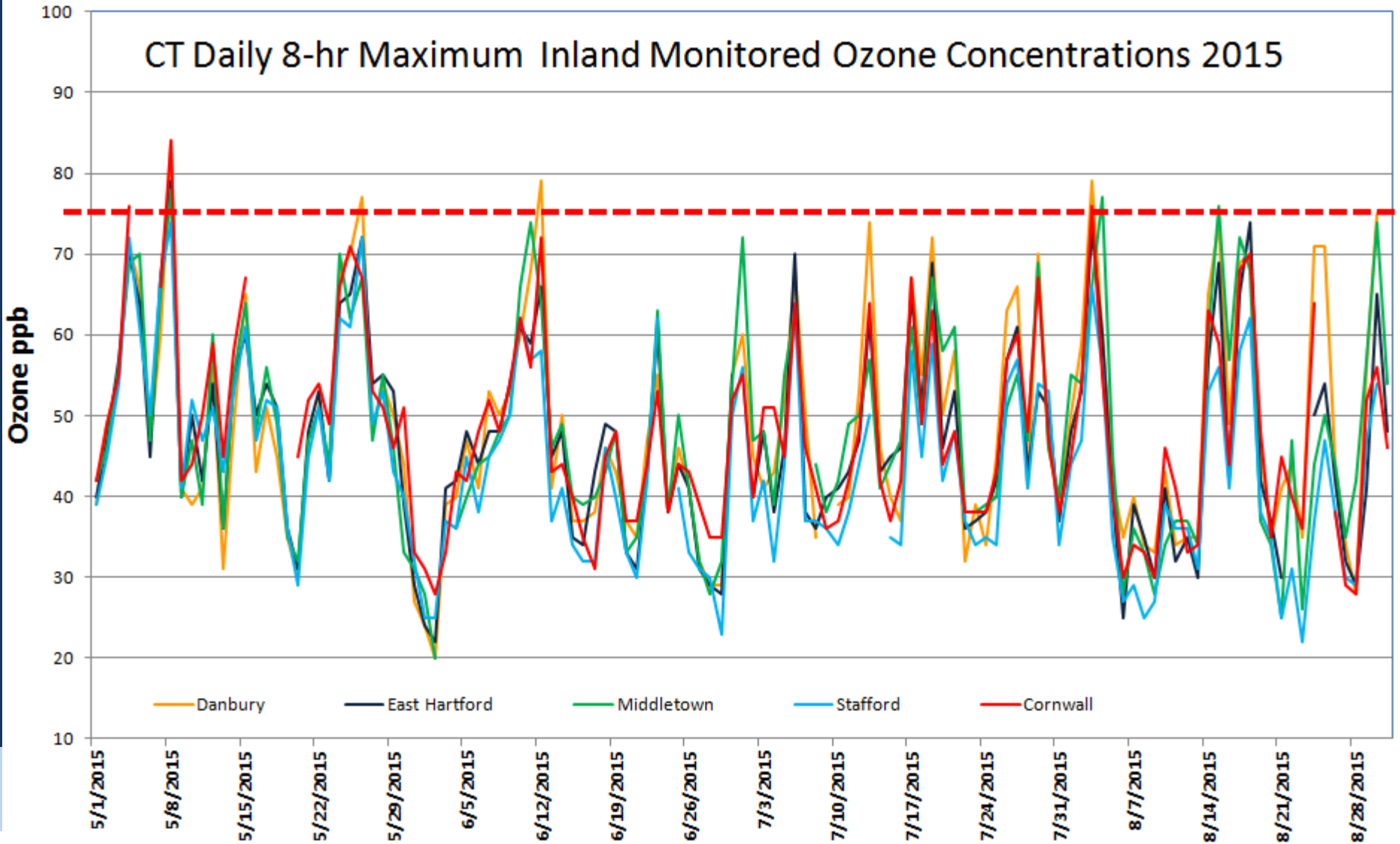
M = missing data

# All Monitors



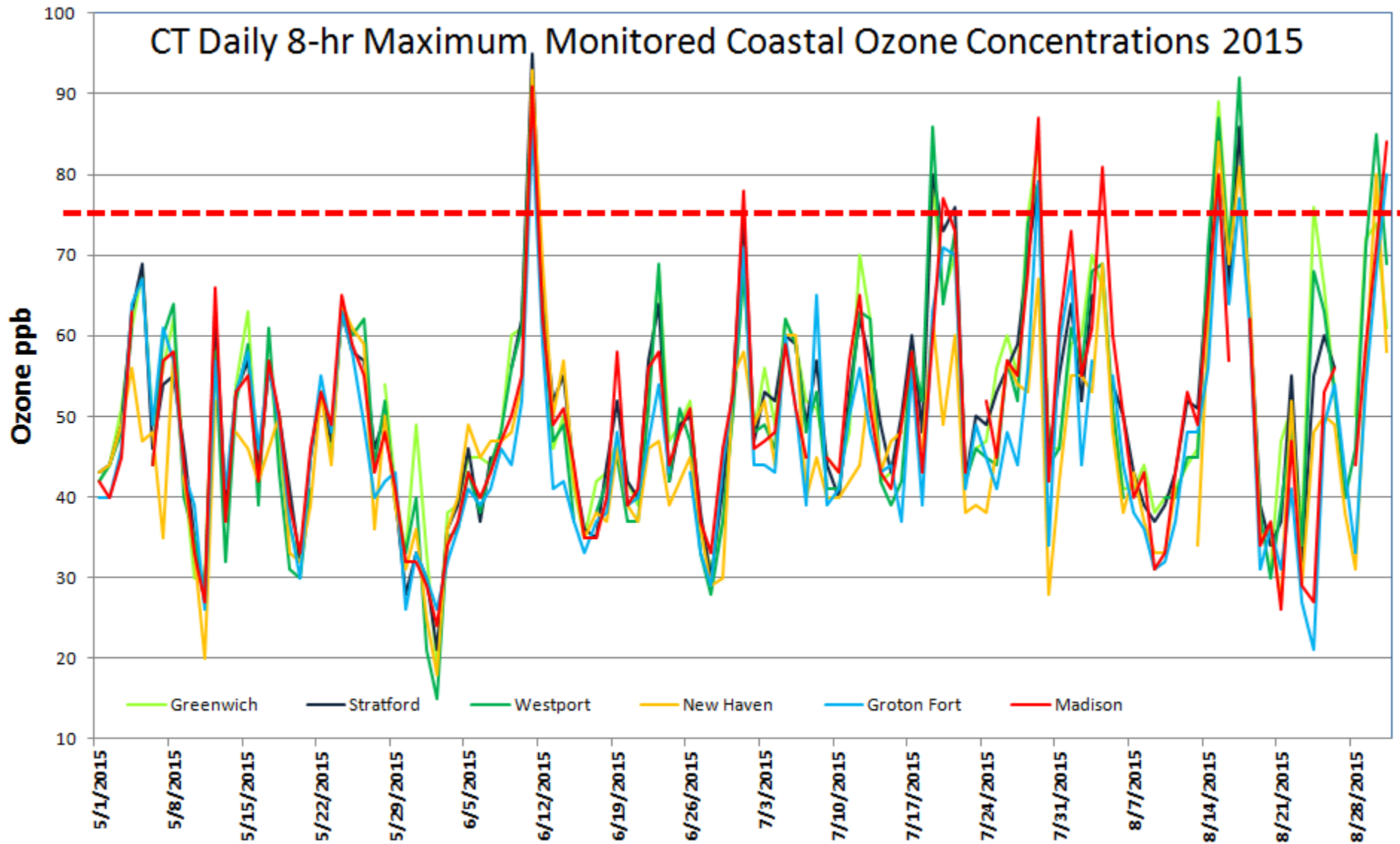
# Inland Monitors

CT Daily 8-hr Maximum Inland Monitored Ozone Concentrations 2015



# Coastal Monitors

CT Daily 8-hr Maximum Monitored Coastal Ozone Concentrations 2015



# May 5- July 21 Observed and NOAA 06z (day before)

Date (LST)	5/4/2015	NOAA 06z	5/8/2015	NOAA 06z	5/26/2015	NOAA 06z	6/11/2015	NOAA 06z	6/12/2015	NOAA 06z
Greenwich	61	57	62	59	62	53	86	75	67	74
Danbury	71	65	84	79	77	61	68	51	79	68
Stratford	63	56	55	61	57	53	95	85	64	62
Westport	61	58	64	60	62	53	92	75	63	68
East Hartford	70	67	79	80	72	58	59	50	66	61
Middletown	69	62	78	74	67	54	74	55	64	57
Stafford	72	66	74	70	72	60	57	47	58	59
Cornwall	76	60	84	76	67	68	56	45	72	63
New Haven	56	58	58	67	59	55	93	76	69	61
Groton Fort	64	57	57	56	49	47	86	76	59	52
Madison	63	62	58	57	55	51	91	92	62	68

Date (LST)	7/1/2015	NOAA 06z	7/19/2015	NOAA 06z	7/20/2015	NOAA 06z	7/21/2015	NOAA 06z
Greenwich	69	62	79	107	65	60	70	77
Danbury	60	59	72	75	50	51	58	54
Stratford	75	72	80	106	73	61	76	92
Westport	68	69	86	100	64	57	73	86
East Hartford		69	69	70	46	49	53	56
Middletown	72	67	67	71	58	51	61	68
Stafford	56	65	59	62	42	49	48	53
Cornwall	55	51	63	56	44	44	48	48
New Haven	58	73	62	87	49	57	60	88
Groton Fort	71	53	63	74	71	61	70	66
Madison	78	61	60	87	77	69	73	79



# July 29- Sept 2- Observed and NOAA 06z (day before)

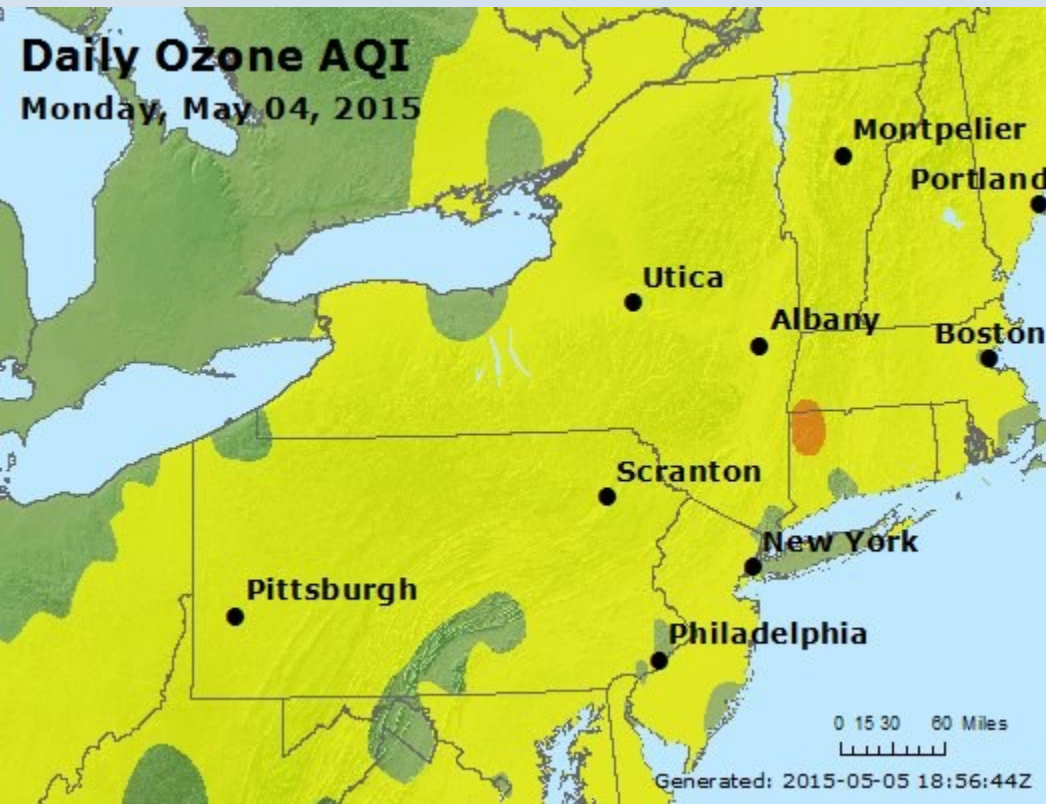
Date (LST)0	7/29/2015	NOAA 06z	8/3/2015	NOAA 06z	8/4/2015	NOAA 06z	8/15/2015	NOAA 06z	8/17/2015	NOAA 06z
Greenwich	84	87	70	69	66	64	89	74	84	93
Danbury	70	53	79	74	60	66	74	53	69	69
Stratford	79	98	65	66		60	86	112	86	107
Westport	79	89	68	69	69	63	87	83	92	102
East Hartford	53	49	73	72	60	58	69	52	65	81
Middletown	69	65	66	64	77	54	76	54	72	87
Stafford	54	47	66	68	56	55	56	51	58	73
Cornwall	67	43	76	71	55	66	59	48	68	51
New Haven	67	87	53	70	69	59	84	83	81	105
Groton Fort	79	76	57	52		51	77	97	77	90
Madison	87	90	61	58	81	55	80	115		102

Date (LST)	8/24/2015	NOAA 06z	8/30/2015	NOAA 06z	8/31/2015	NOAA 06z	9/2/2015	NOAA 06z
Greenwich	76	81	74	81	61	63	78	83
Danbury	71	77	75	56		57	65	61
Stratford	55	89		93	72	70	75	90
Westport	68	92	85	85	69	63	78	88
East Hartford	50	73	65	53	48	56	53	55
Middletown	44	71	74	64	54	58	75	67
Stafford	37	69	54	53		75	54	54
Cornwall	64	69	56	49	46	54	50	49
New Haven	48	83	80	83	58	65	34	86
Groton Fort	21	58	68	85	80	80	72	73
Madison	27	74	71	93	84	88	78	82

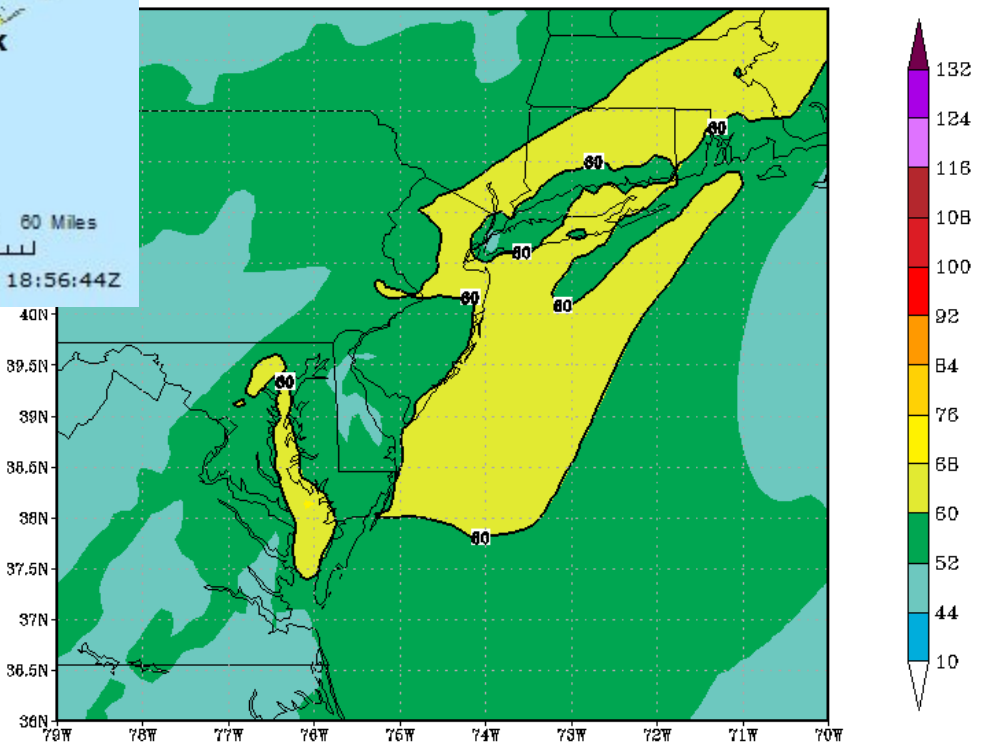
# Model Maps

- 18 days of contoured AQI modeled vs. observed 8-hour ozone
- Used 06z day before run, since this gives us initial forecast for next day
- We often check the 12z run, when there is a questionable exceedance
- Model usually starts out under-predicting ozone in the Spring, but trends to over-prediction some time in July

# May 4, 2015

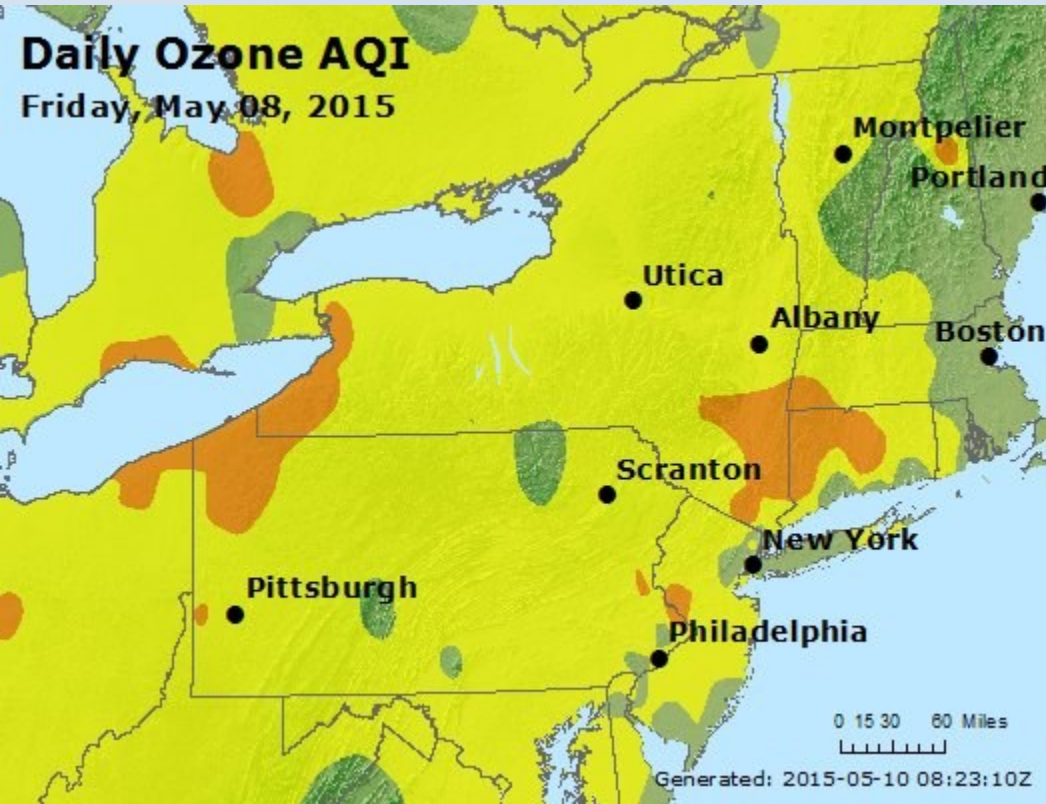


-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 04 MAY 2015

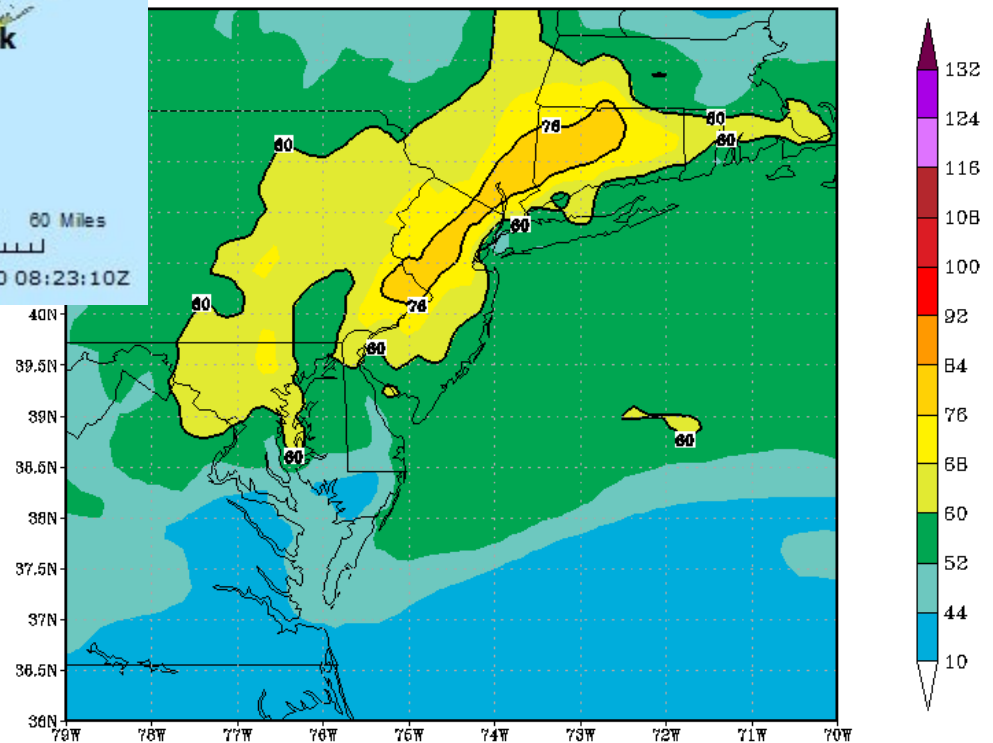


Connecticut Department

# May 8, 2015

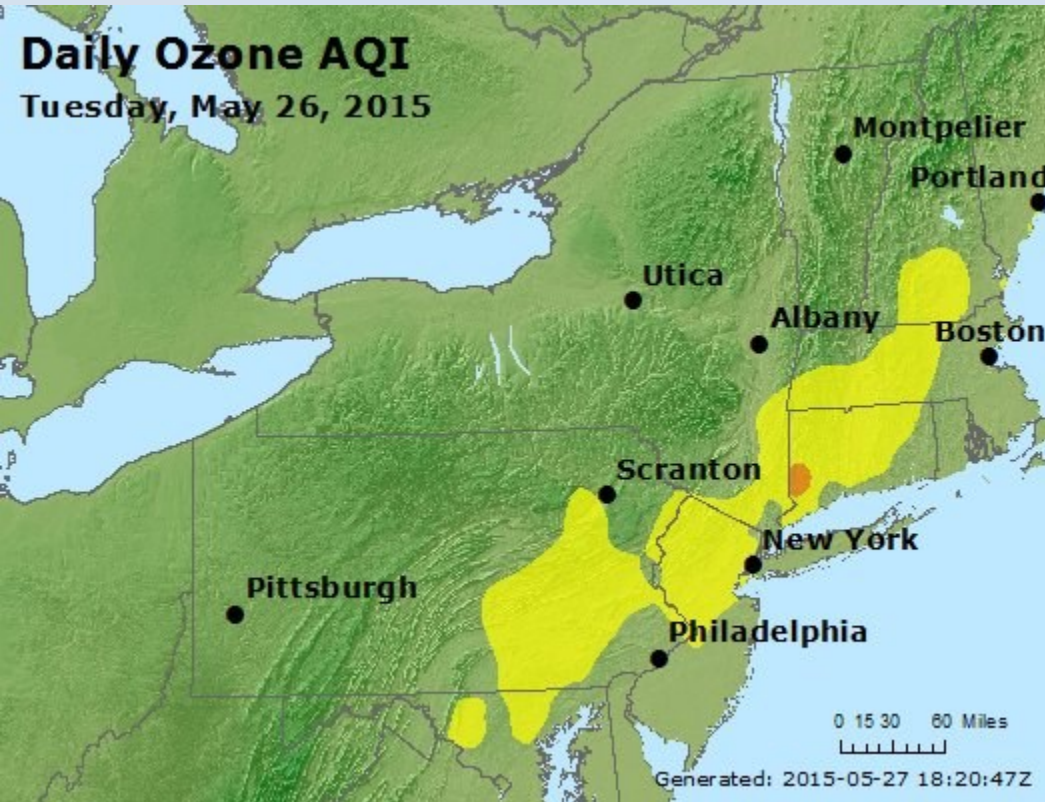


-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 08 MAY 2015

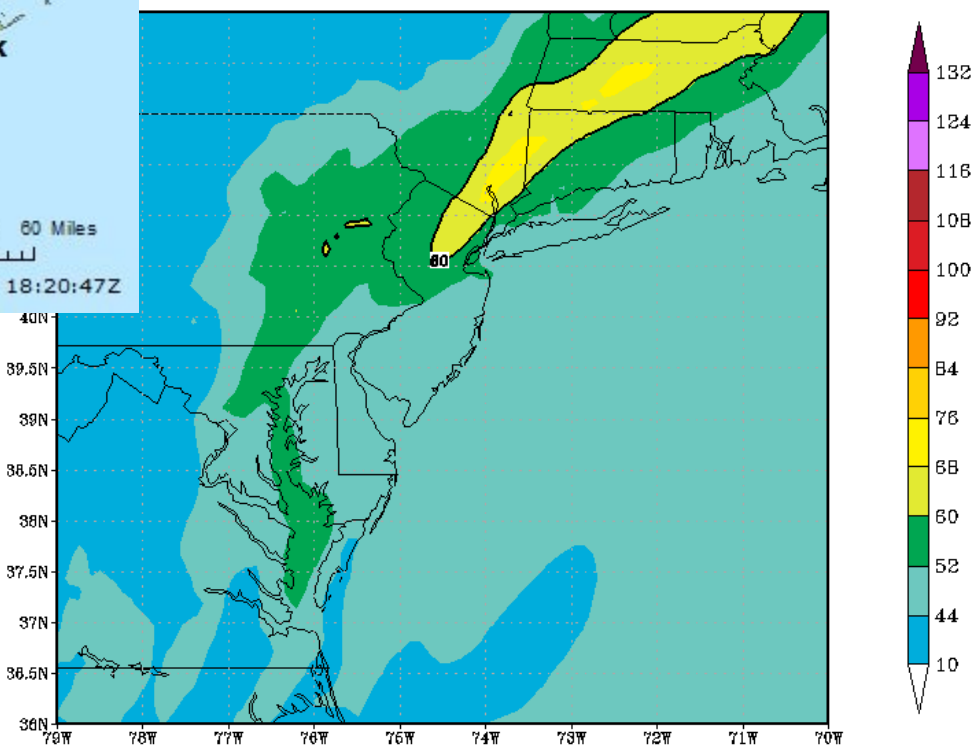


Connecticut Department

# May 26, 2015

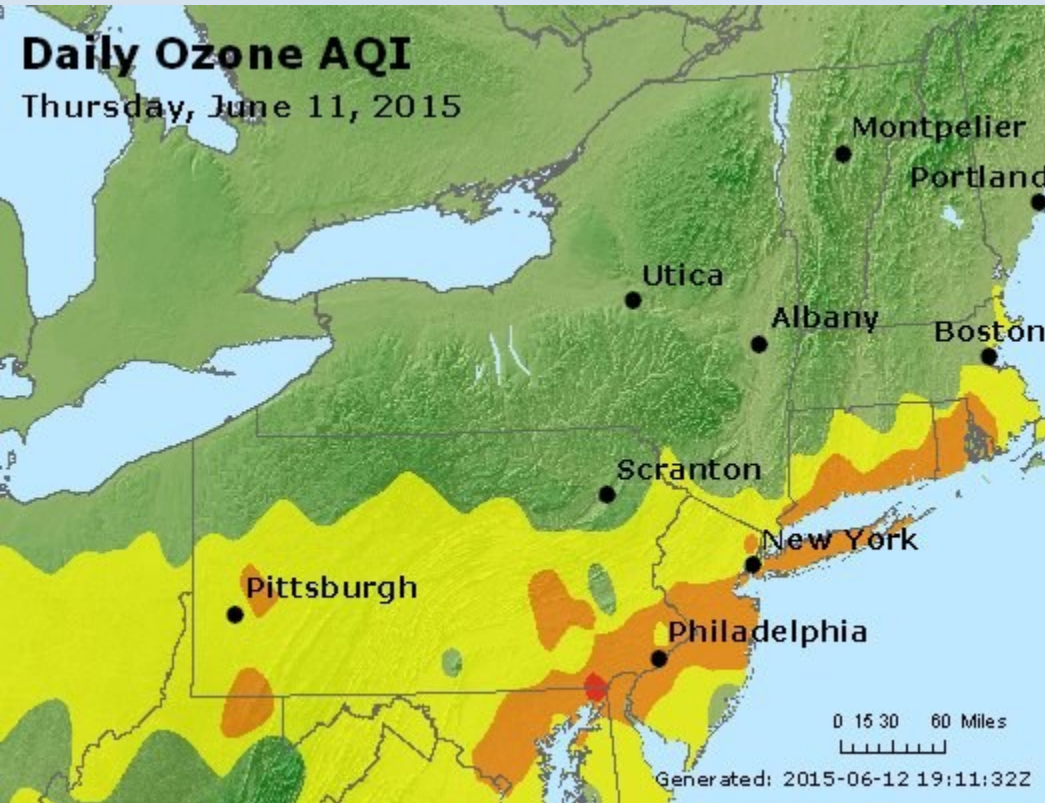


-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 26 MAY 2015

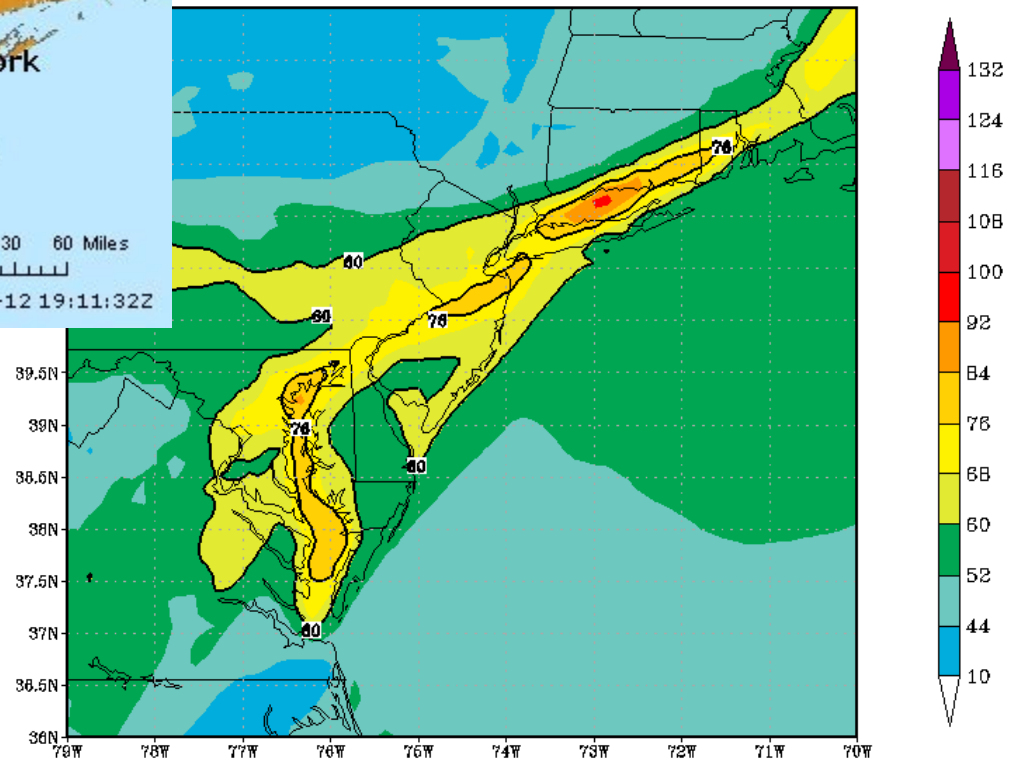


Connecticut Department

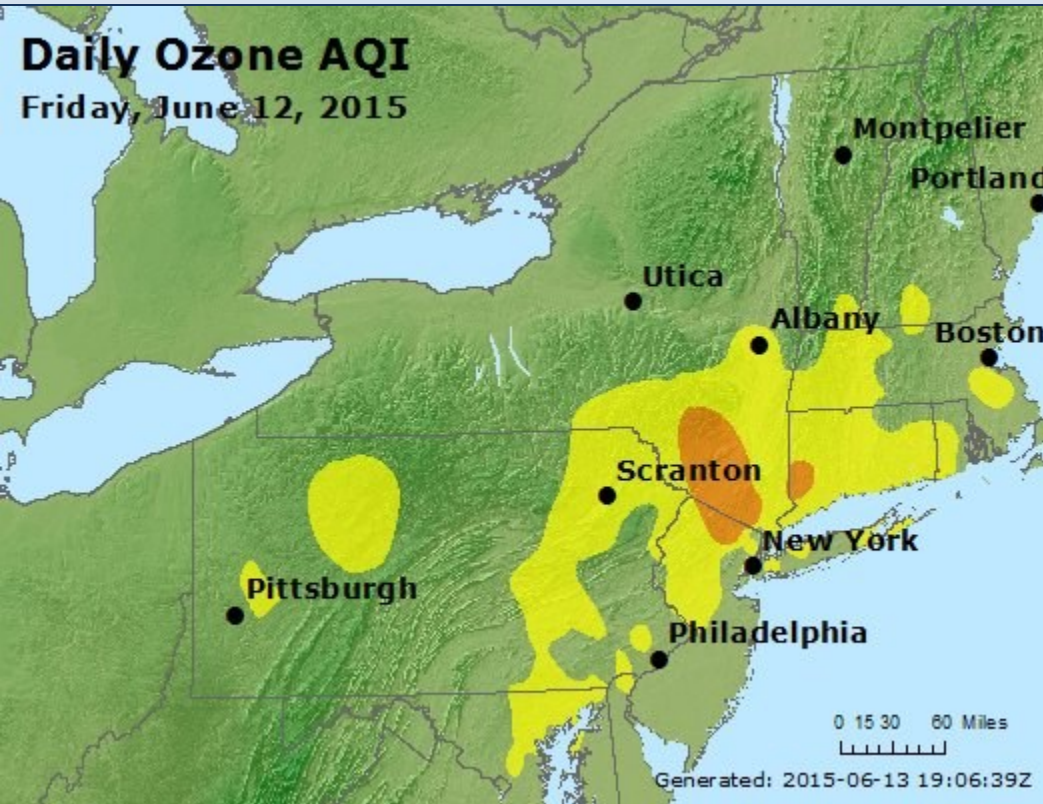
# June 11, 2015



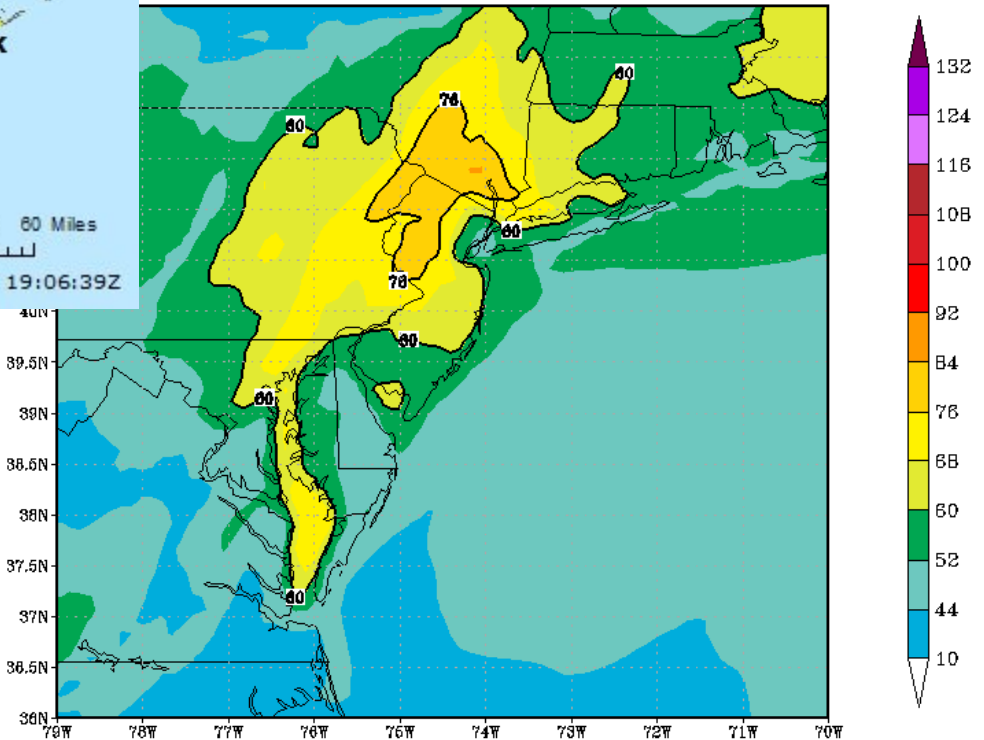
48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 11 JUN 2015



# June 12, 2015

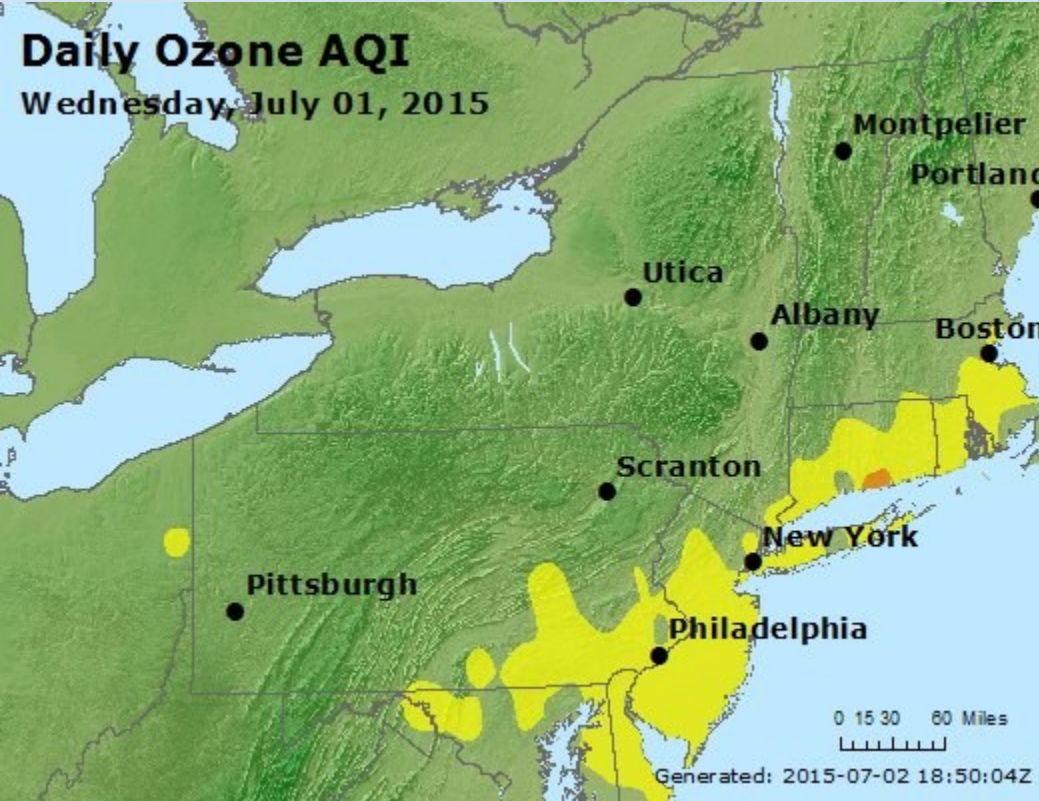


-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 12 JUN 2015

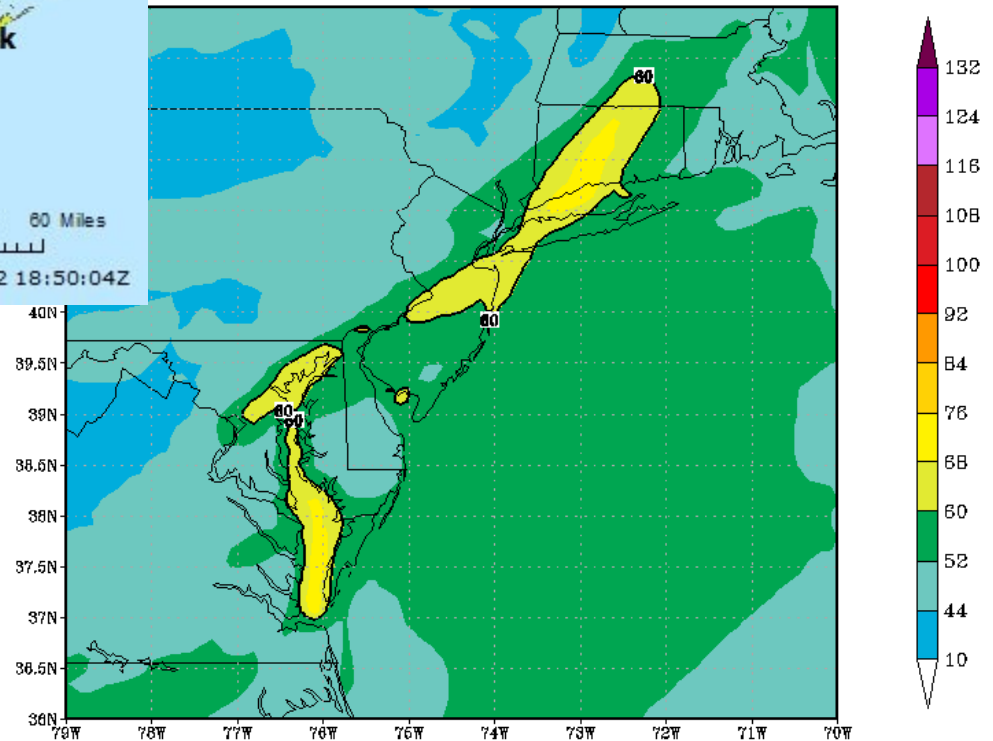


Connecticut Department

# July 1, 2015



-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 01 JUL 2015



Connecticut Department



# Late July Over- Predictions

- The model typically begins over-predicting the LIS plume some time in July
- What meteorology causes this?
- PBL is the obvious suspect, if layer is modeled too shallow
- But 12km NAM tends to over predict surface temperatures around LIS too ( as we shall see)

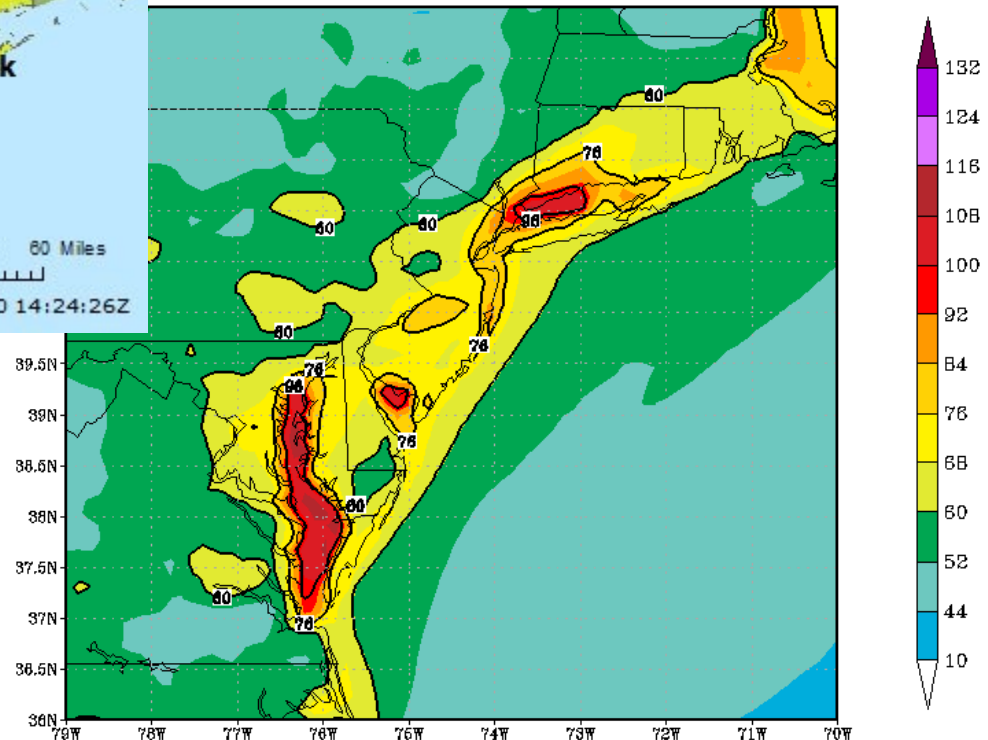


# July 19, 2015

06z run shows extreme over-prediction, but 24 hours later...



-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 19 JUL 2015

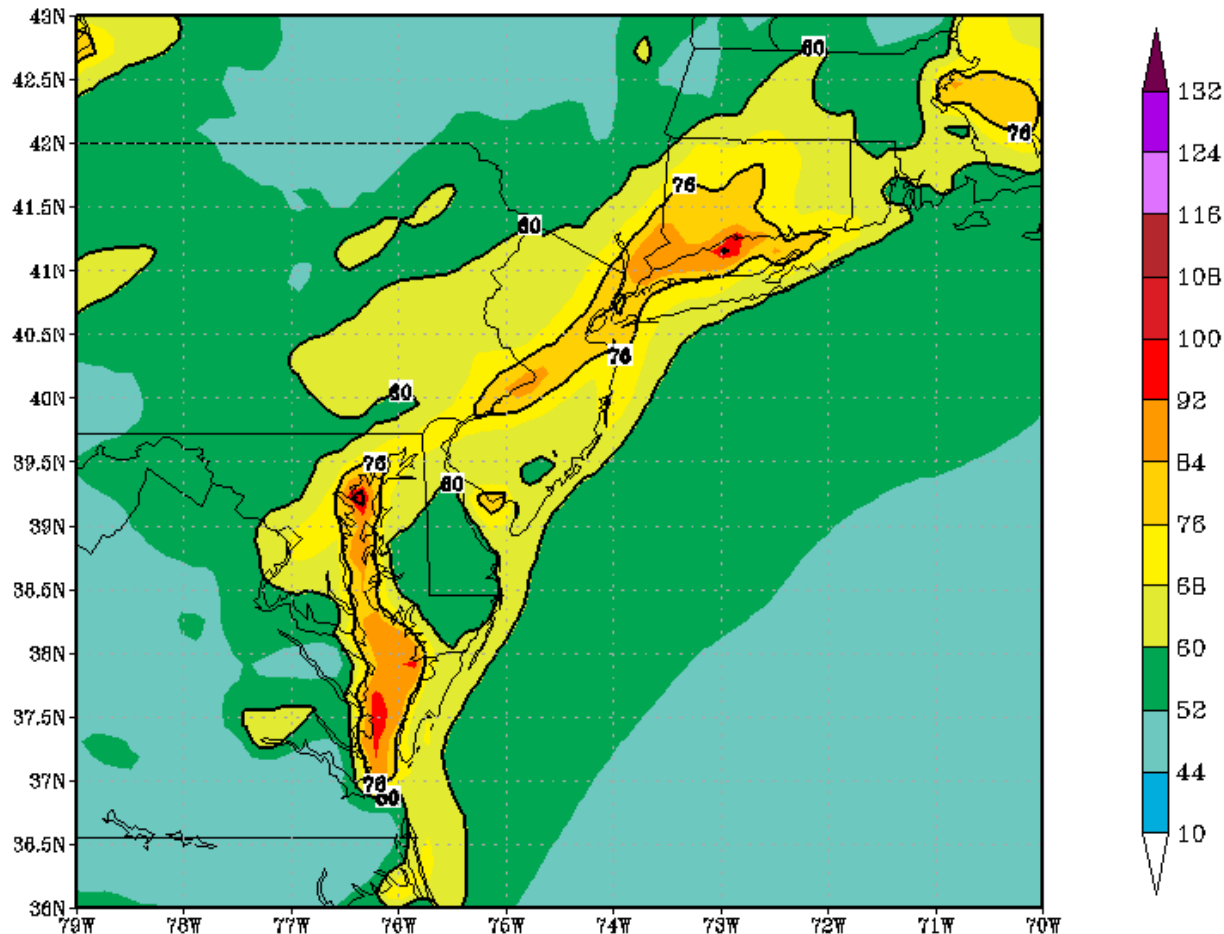


Connecticut Department

# July 19, 2015 same day model run

- Same day 06z run shows more realistic concentrations
- What meteorological factors caused this?

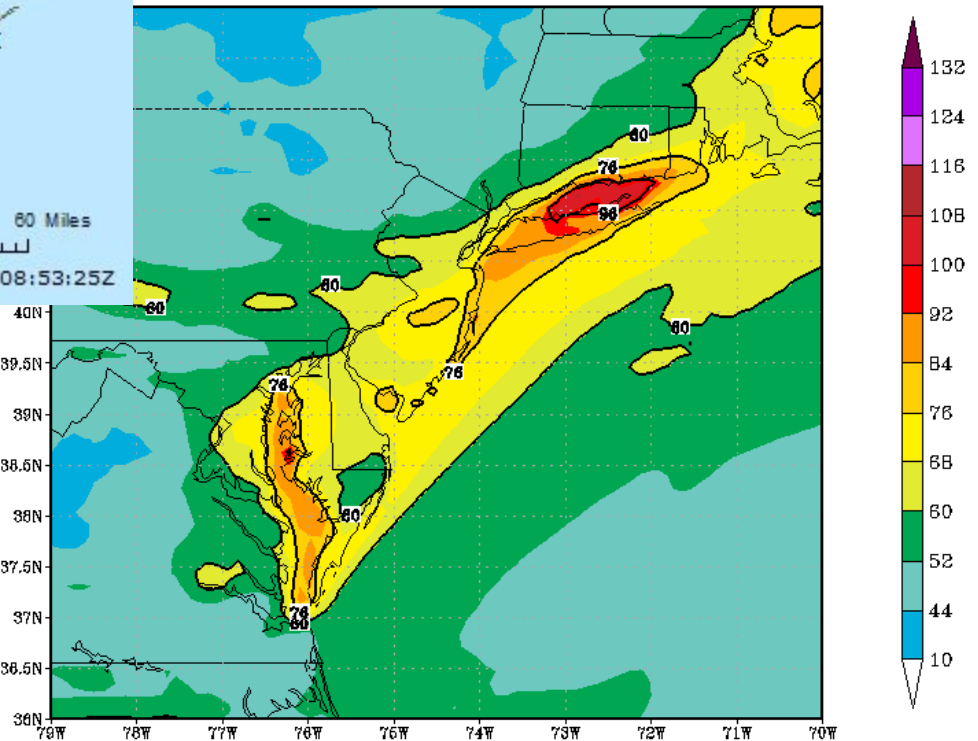
(prd) 06Z 7H-30H 1st d 8h max sf O<sub>3</sub> (ppbv) Valid 19 JUL 2015



# July 20, 2015

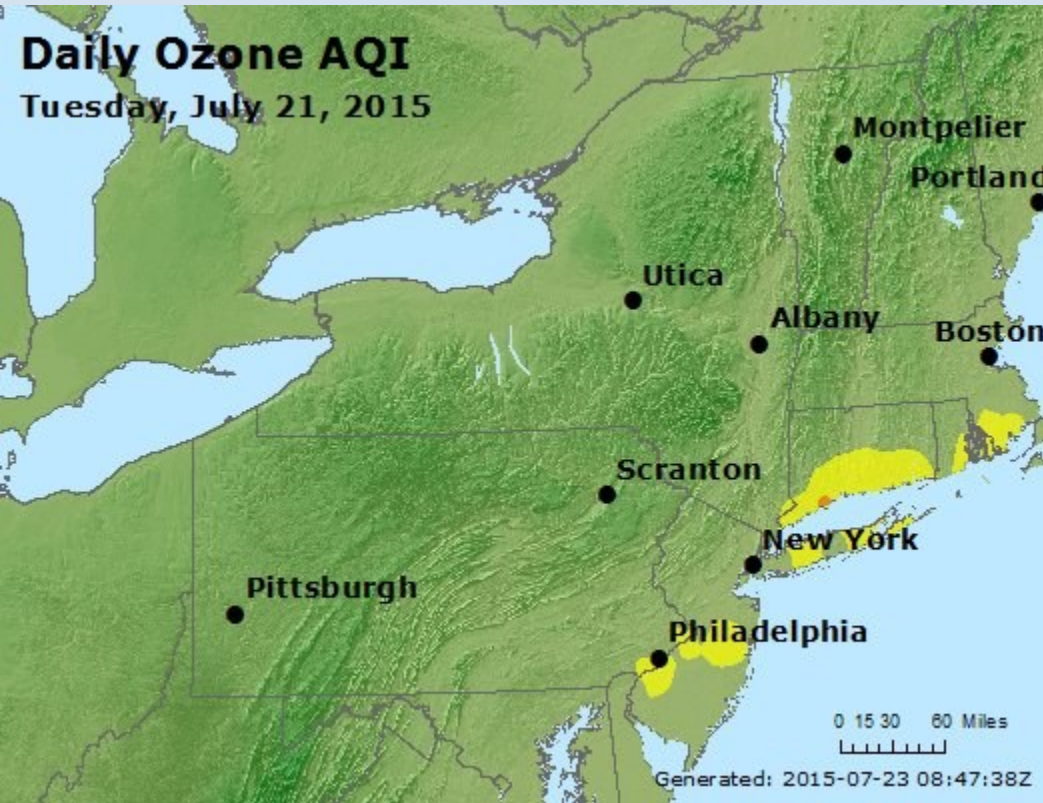


-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 20 JUL 2015

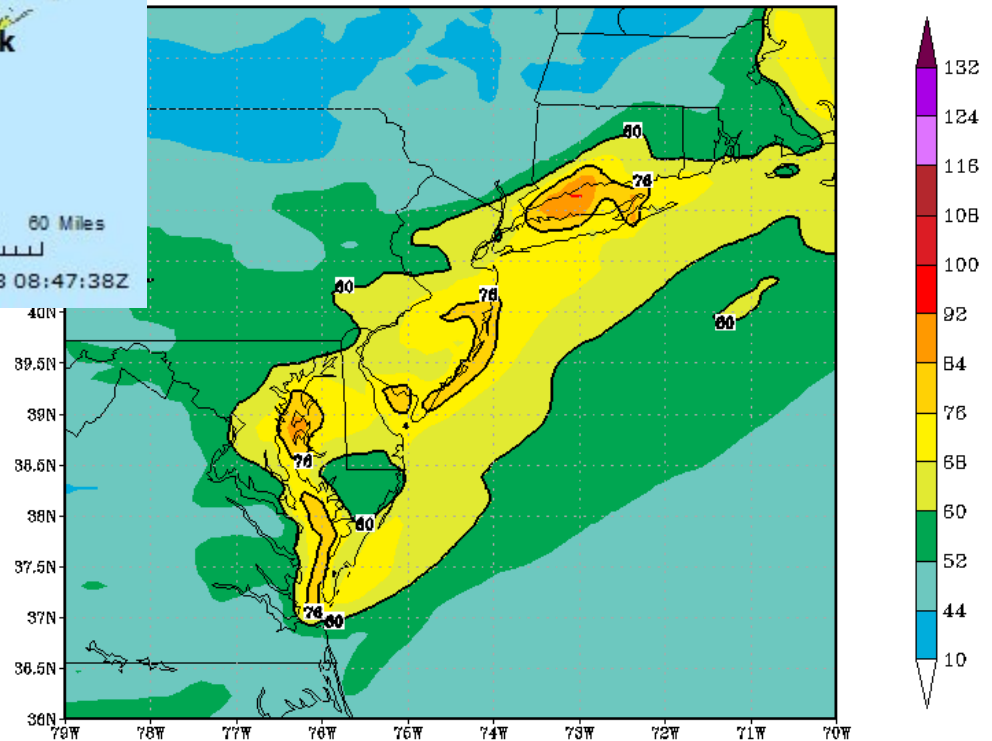


Connecticut Department

# July 21, 2015

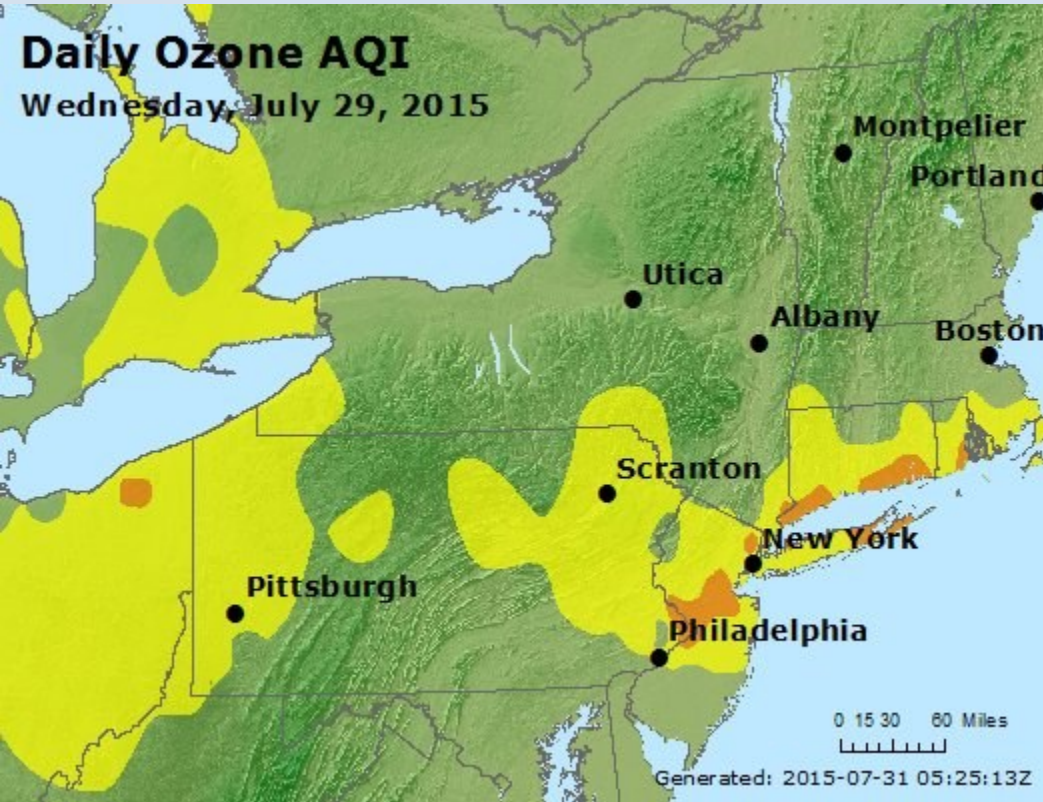


-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 21 JUL 2015

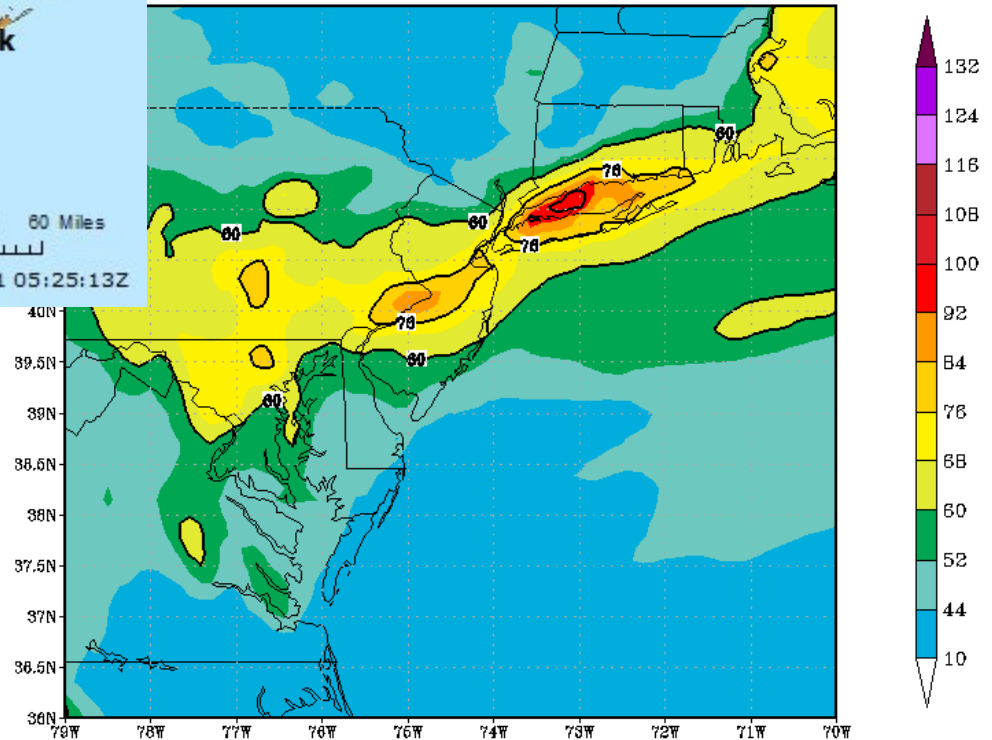


Connecticut Department

# July 29, 2015

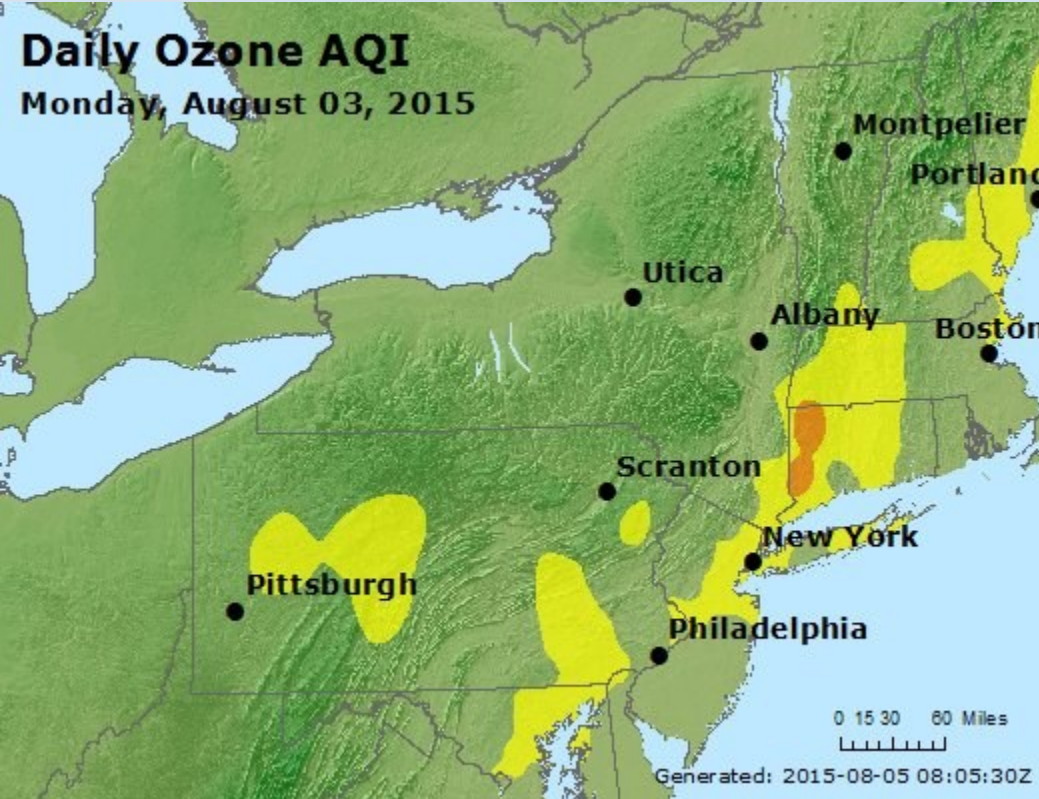


-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 29 JUL 2015

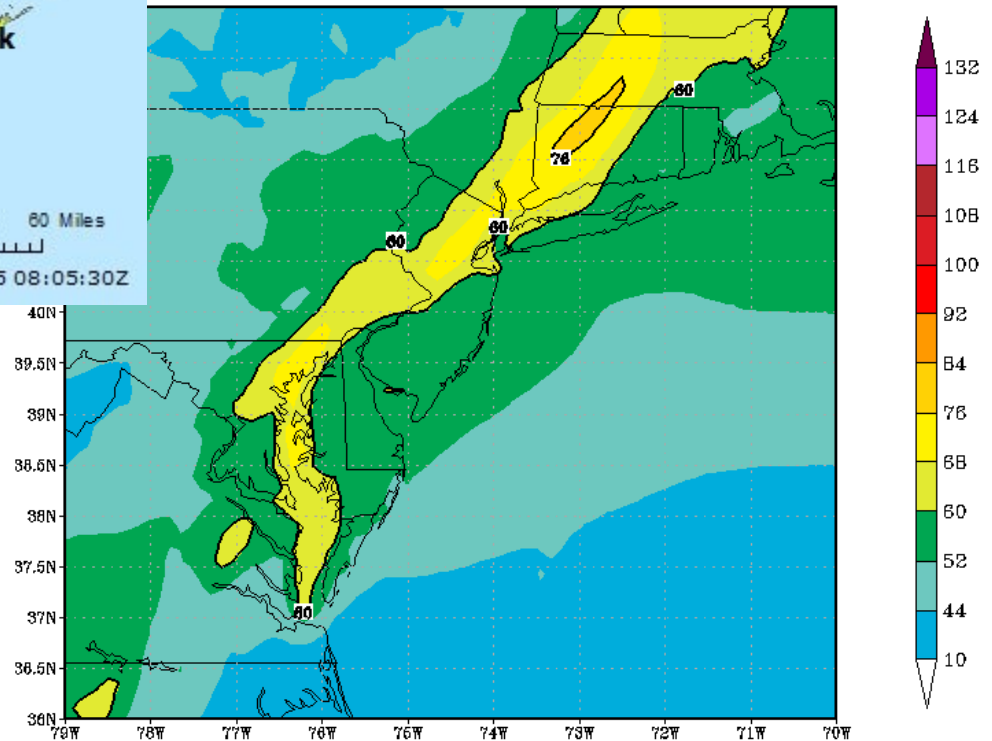


Connecticut Department

# August 3, 2015



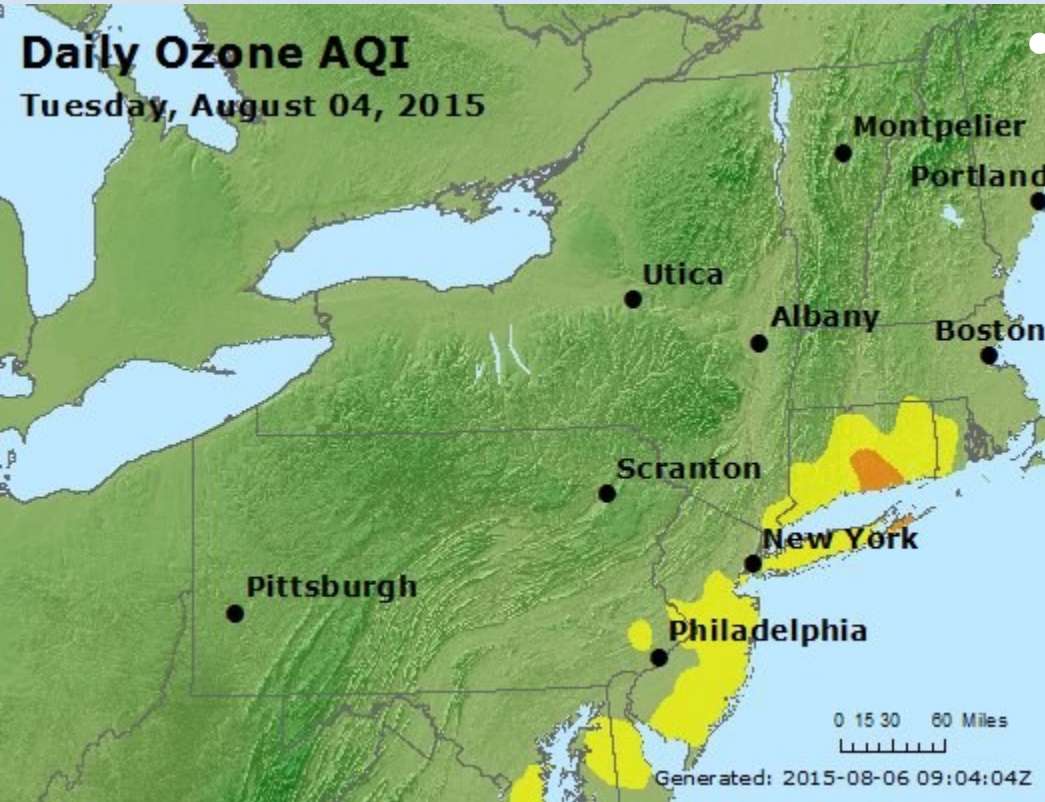
-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 03 AUG 2015



Connecticut Department

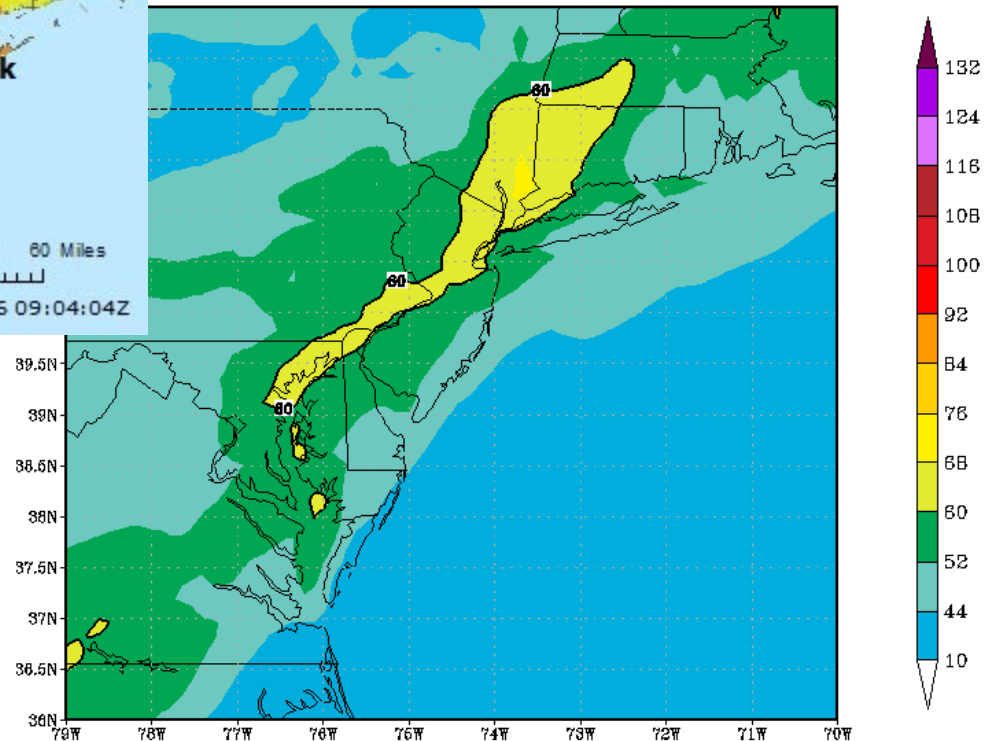
# August 4, 2015

**Daily Ozone AQI**  
Tuesday, August 04, 2015



- 06z run appears to have misplaced the plume but 24 hours later...

-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 04 AUG 2015

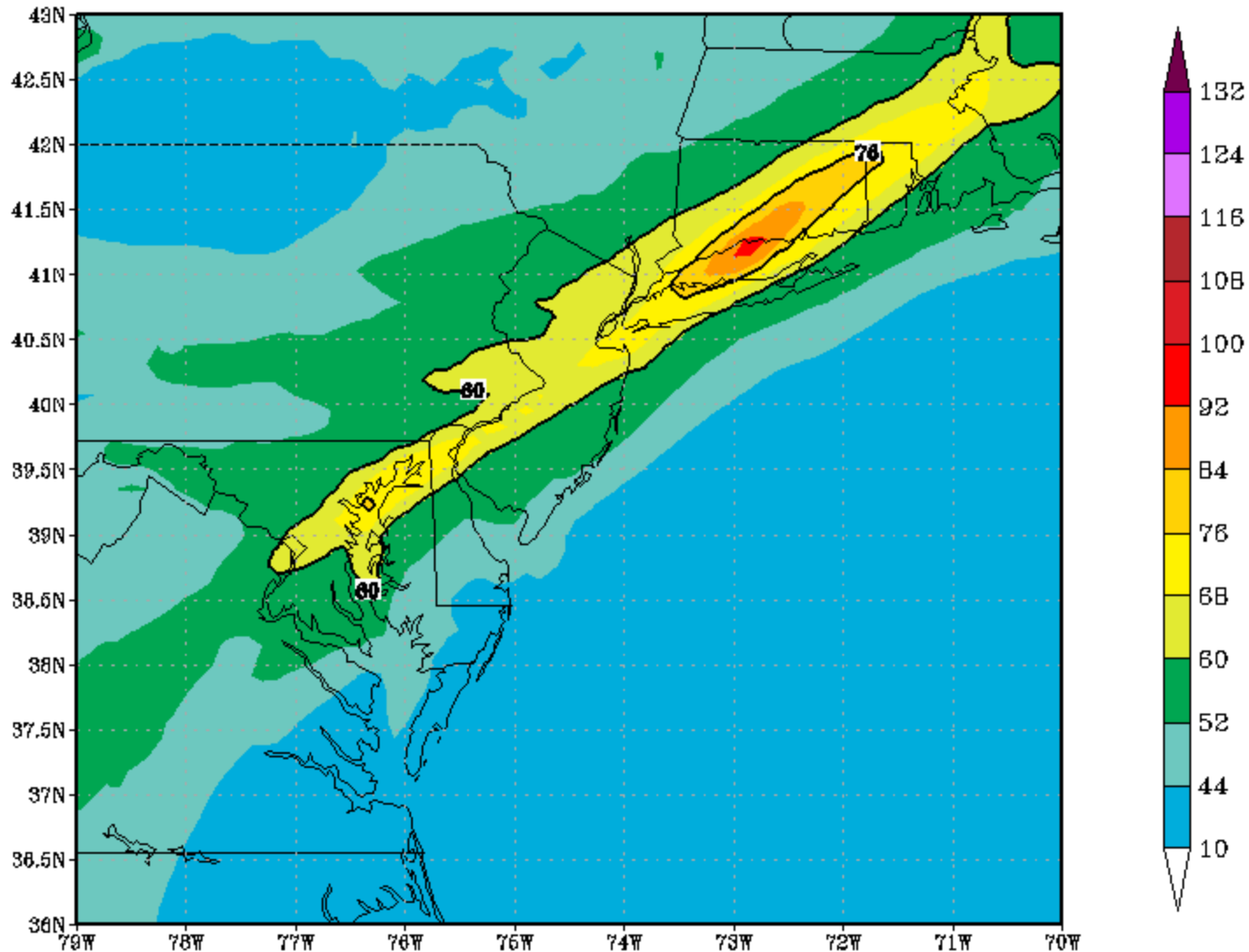


Connecticut Department

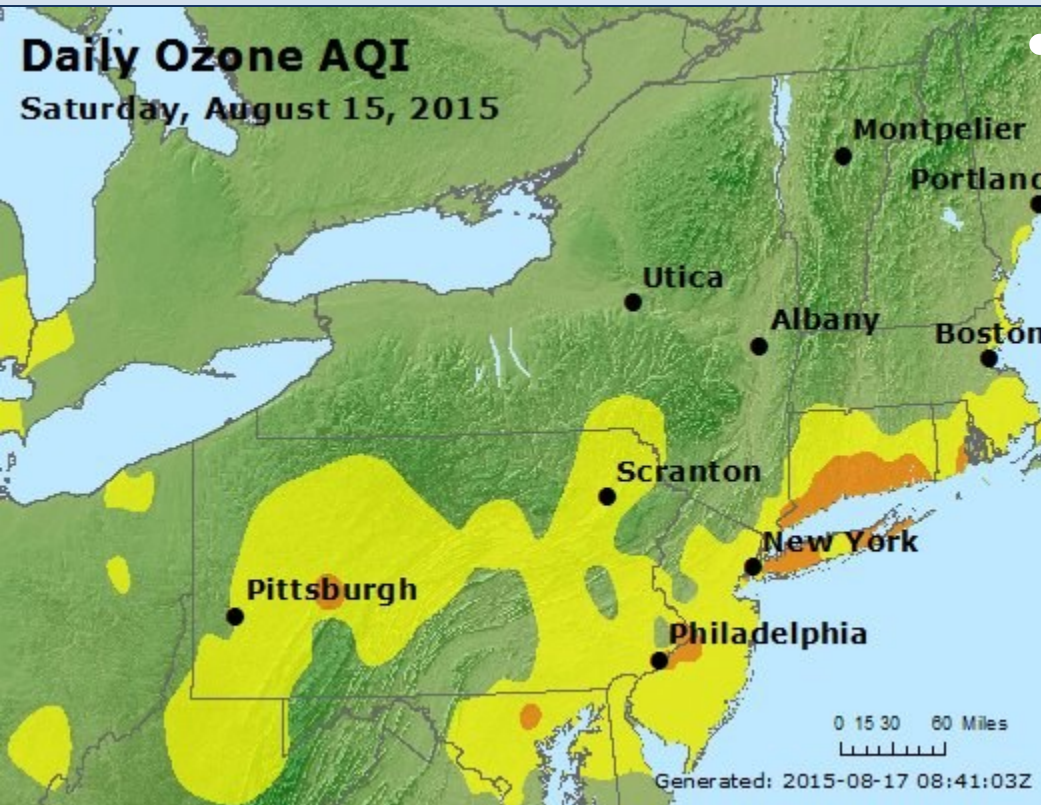


# August 4, 2015 revisited

(prd) 06Z 7H-30H 1st d 8h max sf O<sub>3</sub> (ppbv) Valid 04 AUG 2015

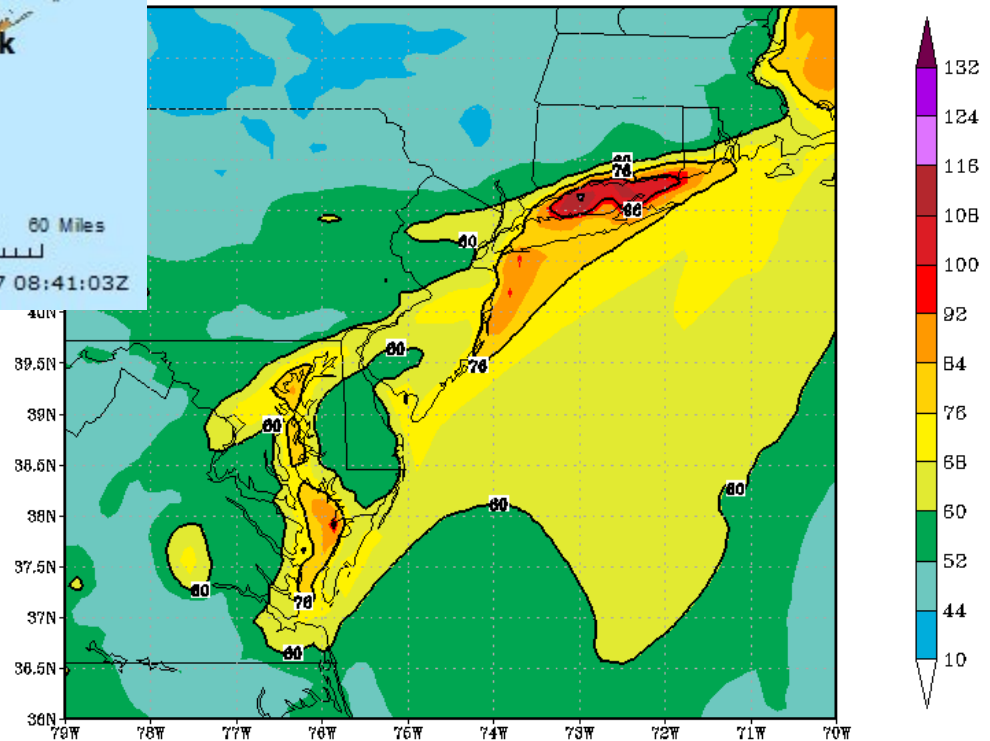


# August 15, 2015



- 06z run appears to have placed a 110 ppb 8-hr plume in LIS, but 24 hours later...

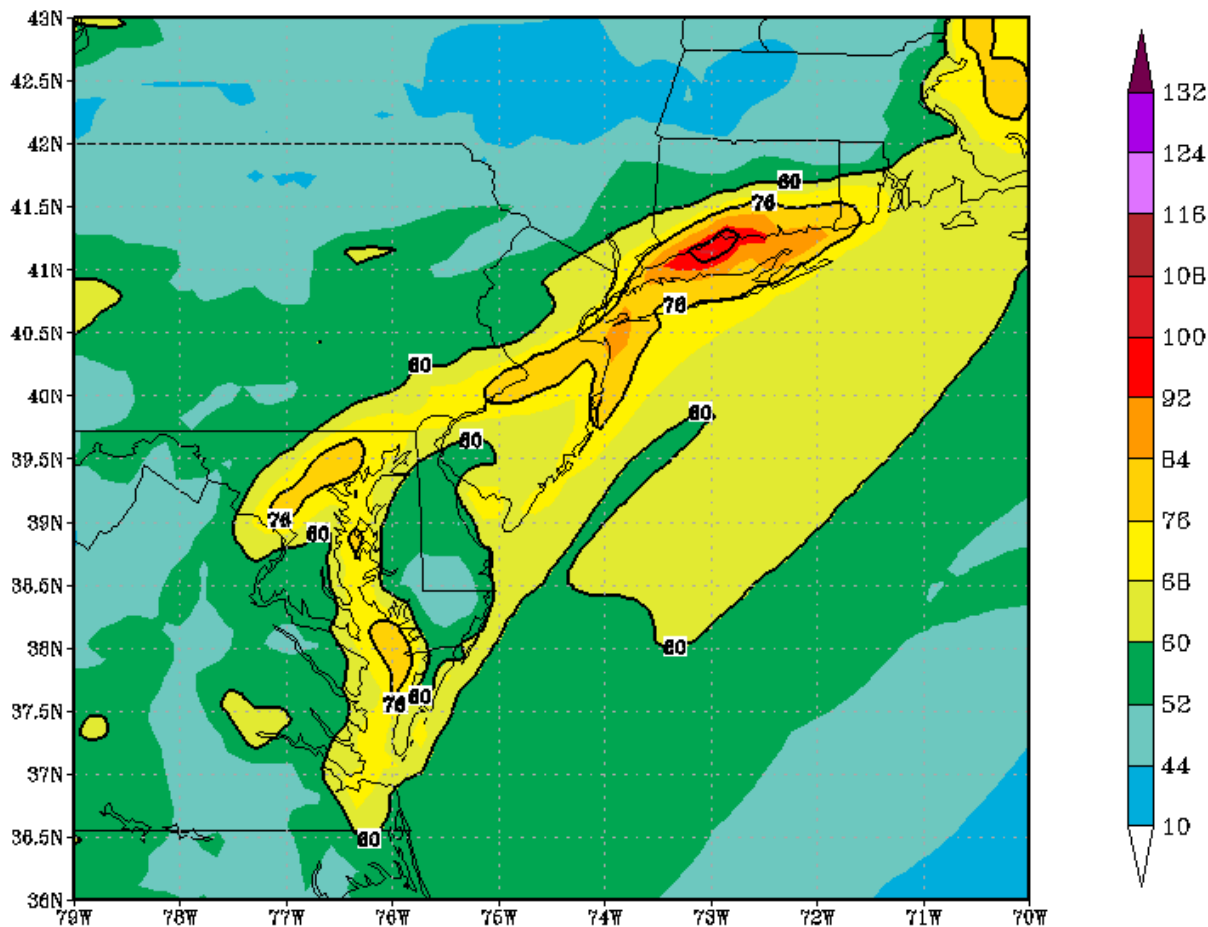
-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 15 AUG 2015



# August 15, 2015

- The same day 06z run reduces the plume by 20 ppb
- 1 hr levels were > 132; now maximum = 120 ppb

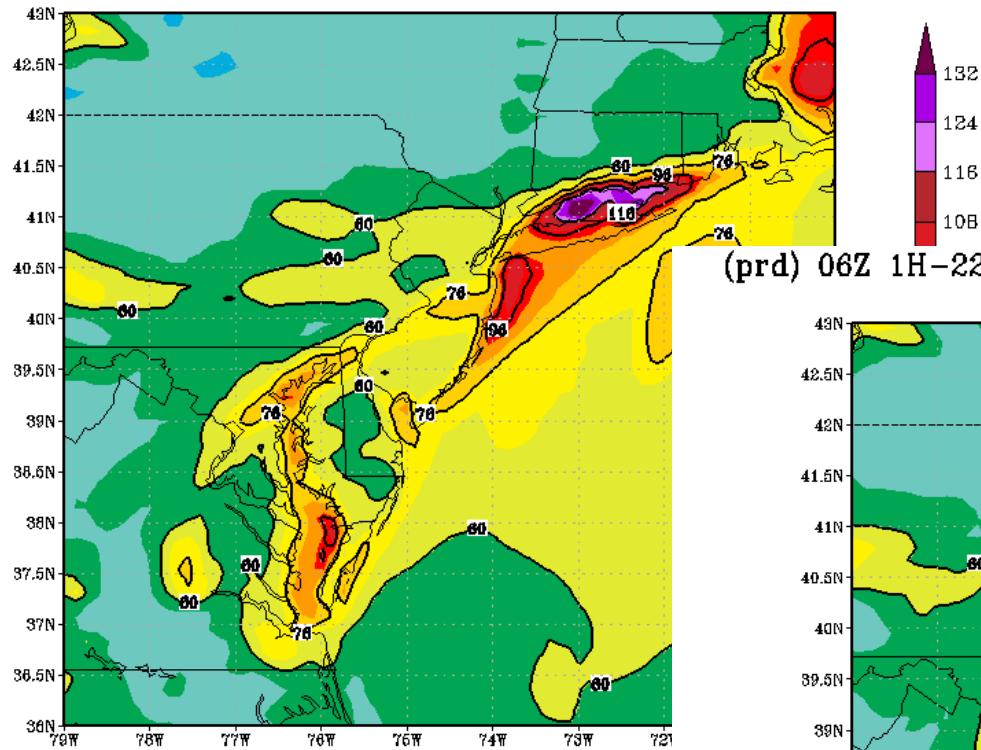
(prd) 06Z 7H-30H 1st d 8h max sf O<sub>3</sub> (ppbv) Valid 15 AUG 2015



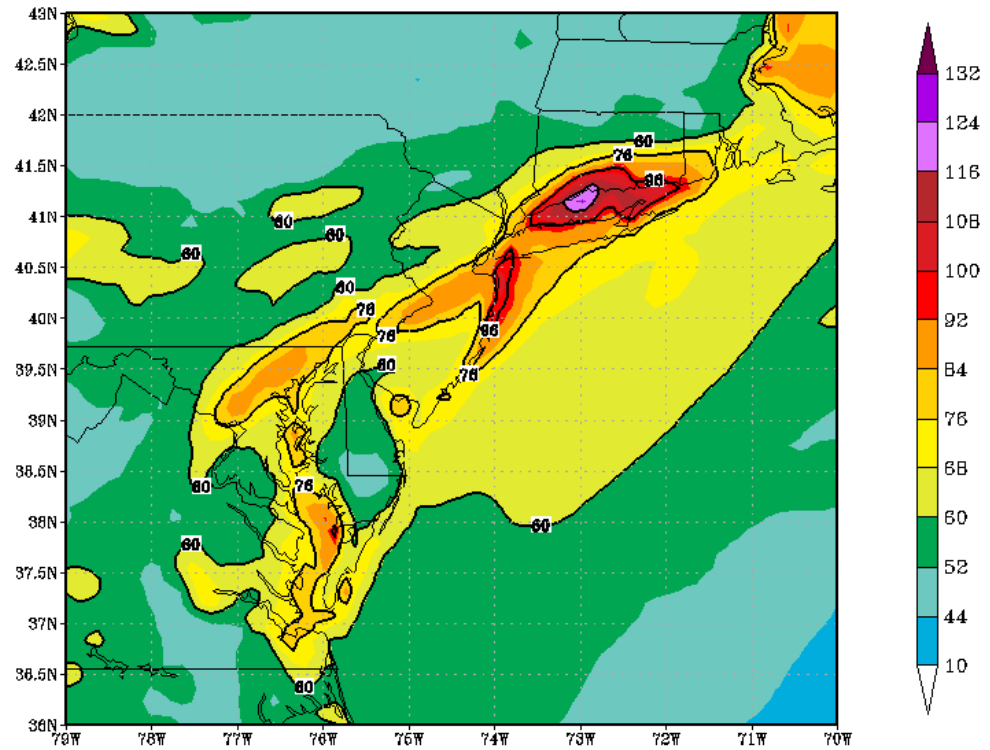
# August 15, 2015 1-hour maximums

- 1 hr levels were > 132; now maximum = 120 ppb

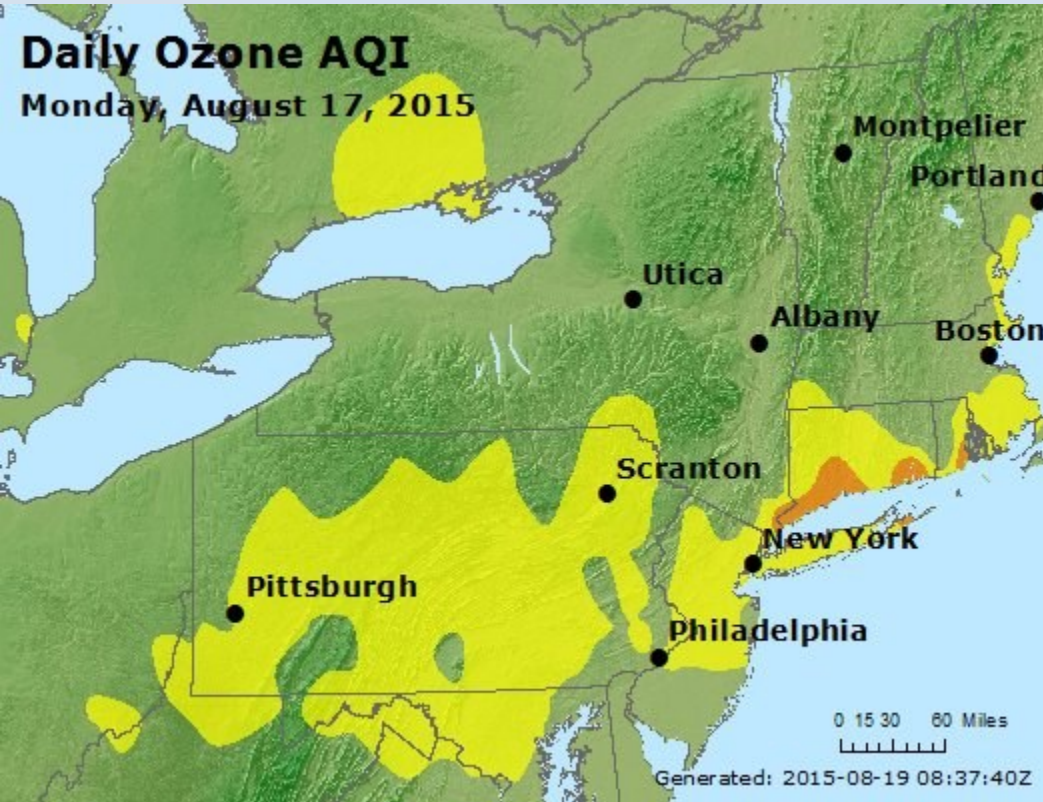
(prd) 06Z 23H-46H 2 day 1h max sf O<sub>3</sub> (ppbv) Valid 15 AUG 2015



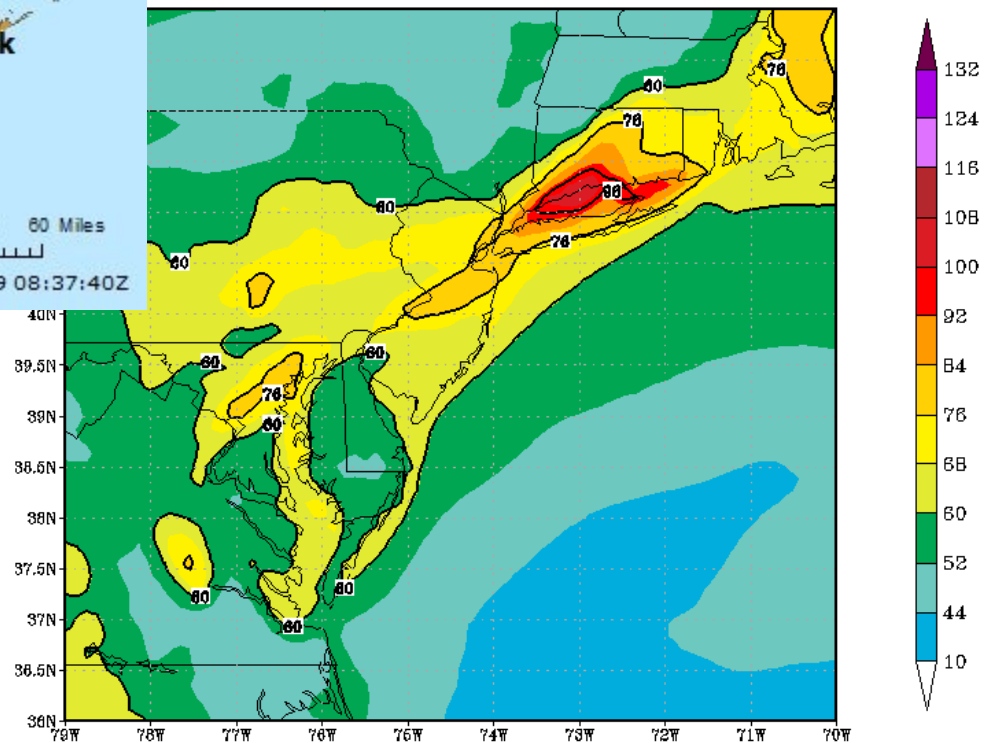
(prd) 06Z 1H-22H 1st d 1h max sf O<sub>3</sub> (ppbv) Valid 15 AUG 2015



# August 17, 2015



-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 17 AUG 2015



Connecticut Department

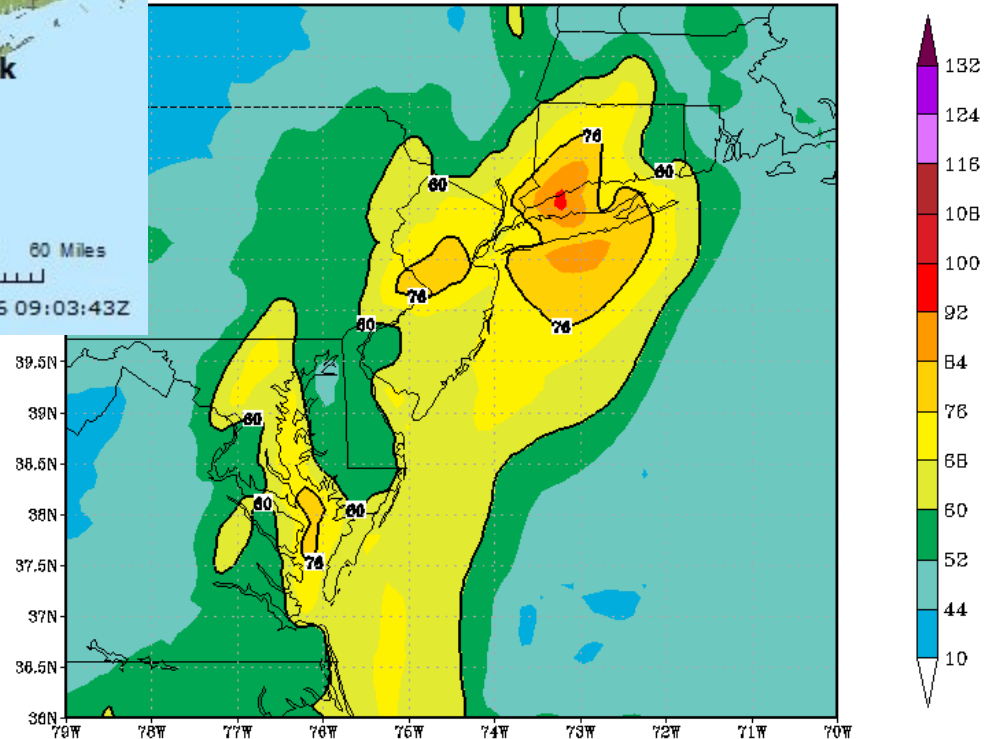
# August 24, 2015

**Daily Ozone AQI**  
Monday, August 24, 2015



- 06z run over estimates plume by 15 ppb, but 36 hours later...

-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 24 AUG 2015

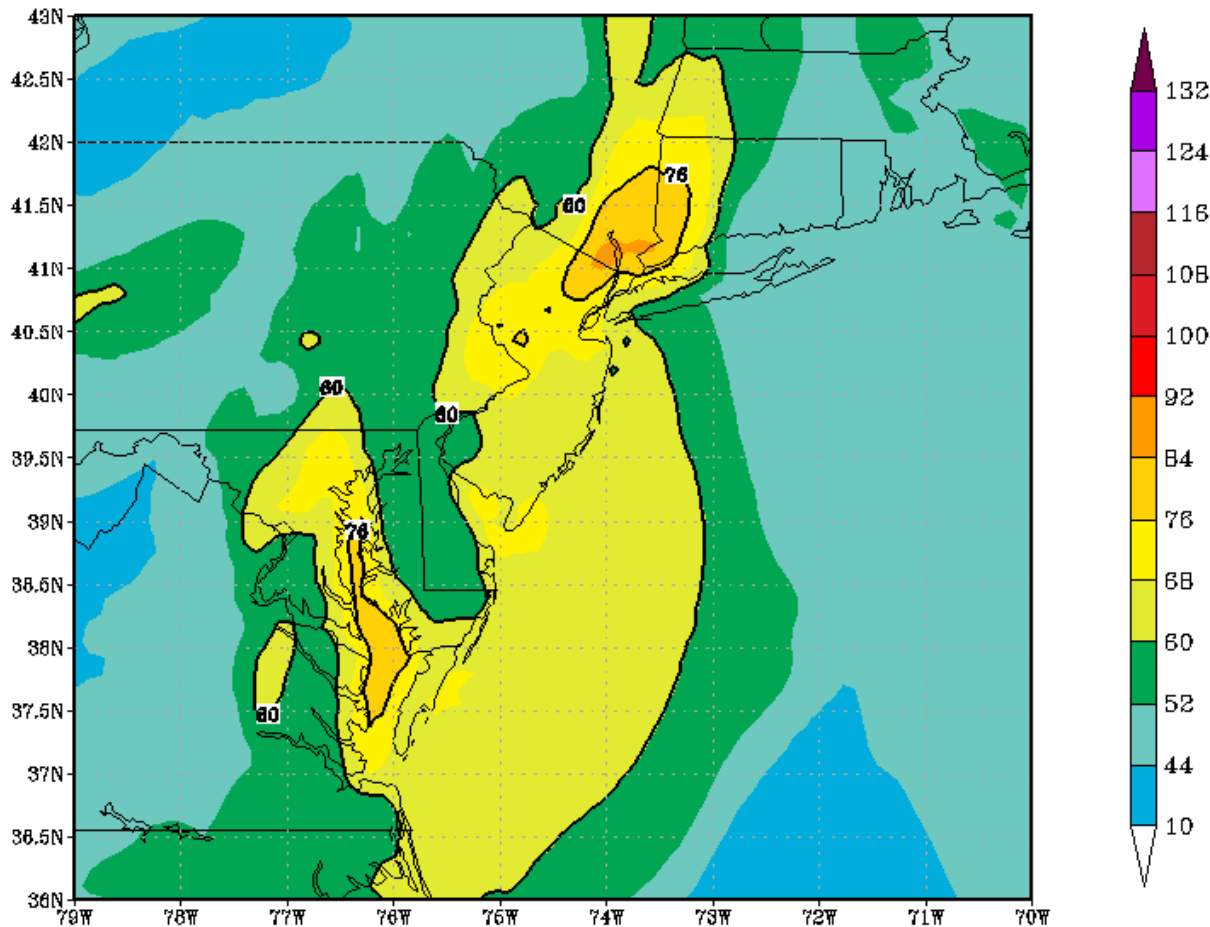


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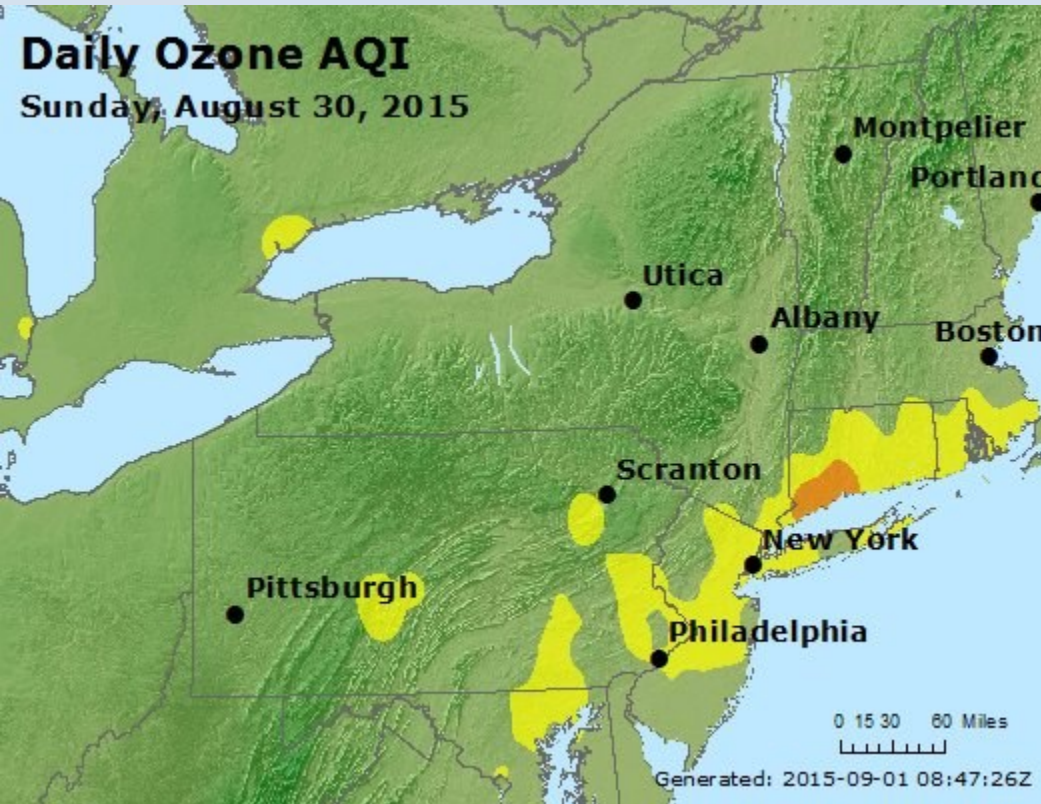
# August 24, 2015, revisited

- 12z run provides a more reasonable estimate
- Still almost 10 ppb high

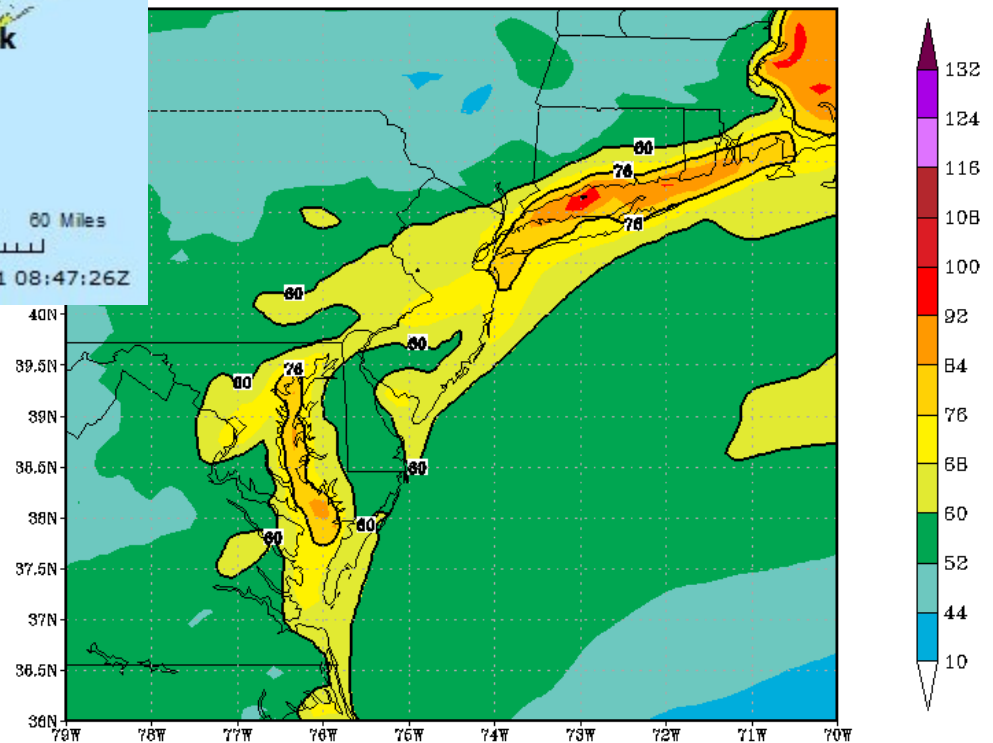
(prd) 12Z 1H-24H 1st d 8h max sf O<sub>3</sub> (ppbv) Valid 24 AUG 2015



# August 30, 2015



-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 30 AUG 2015

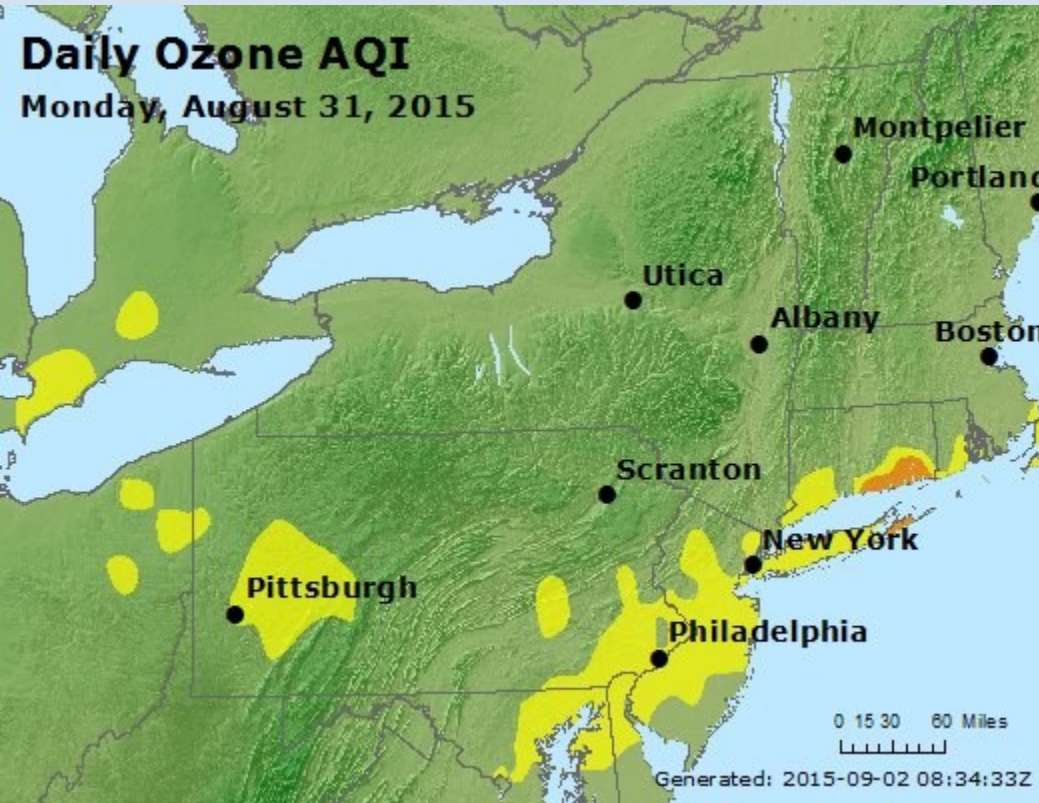


Connecticut Department

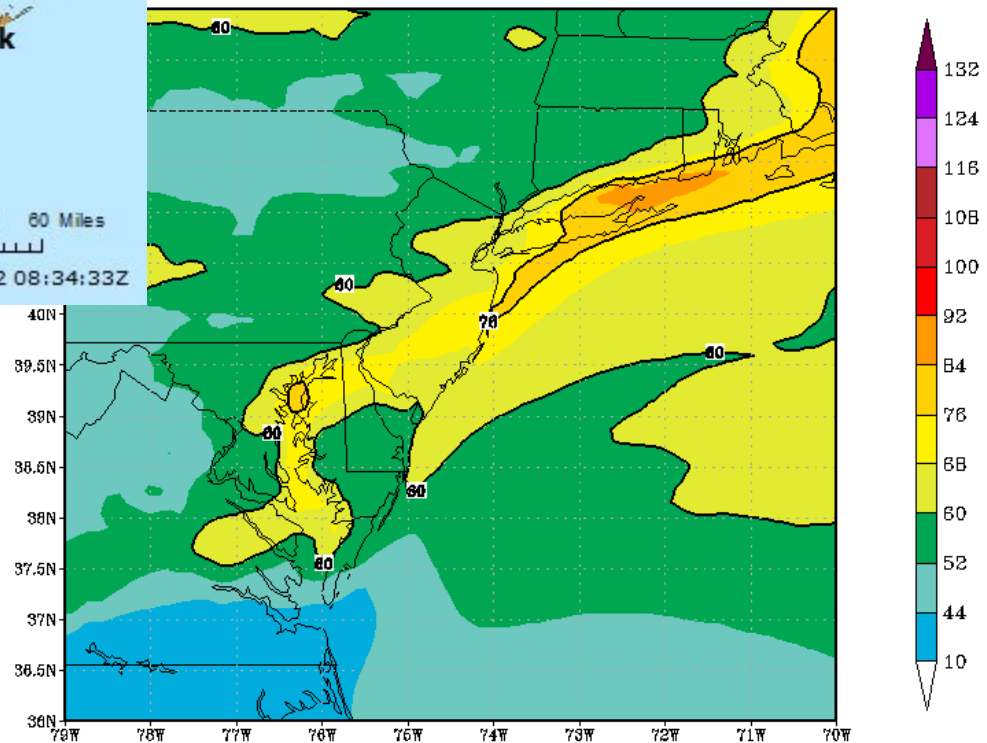


# August 31, 2015

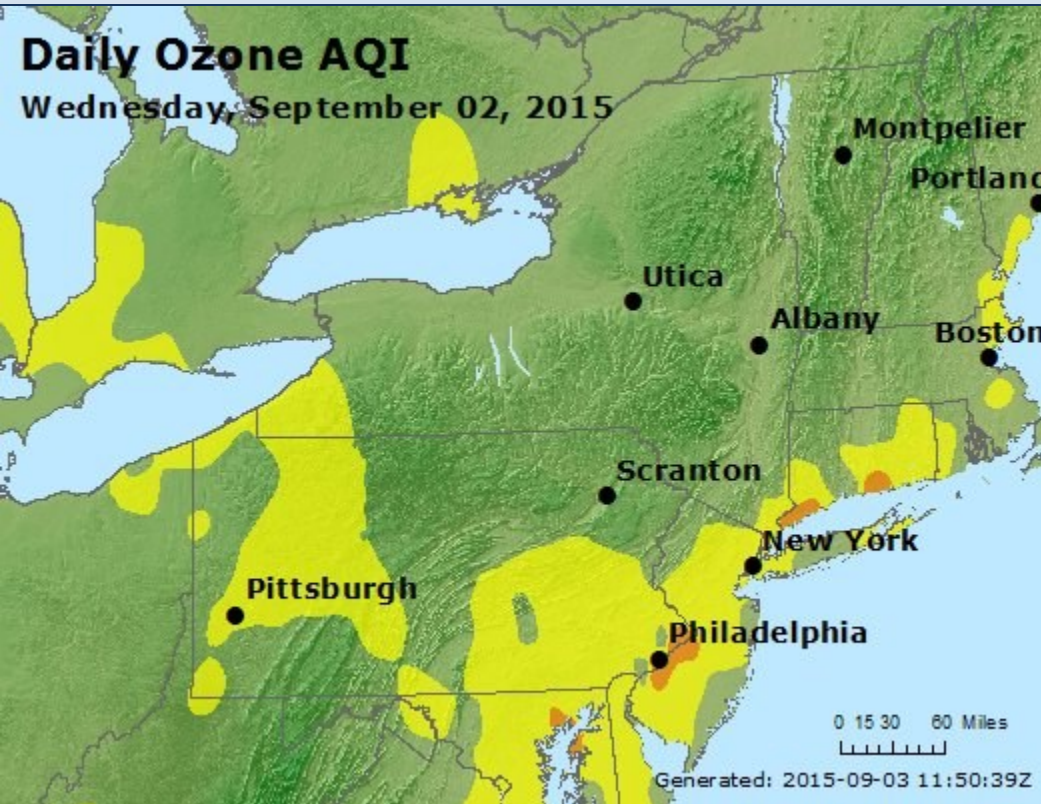
- By late August, the LIS plume seems to be simmering down...



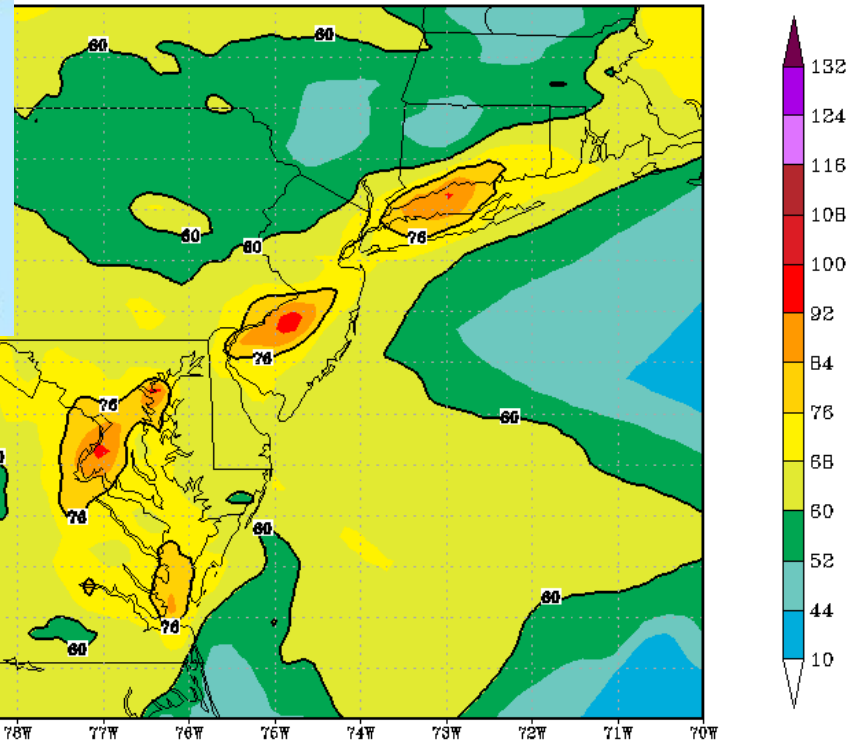
-48H 2 day 8h max sf  $O_3$  (ppbv) Valid 31 AUG 2015



# September 2, 2015



-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 02 SEP 2015



Connecticut Department

# July 12<sup>th</sup> Over- Prediction

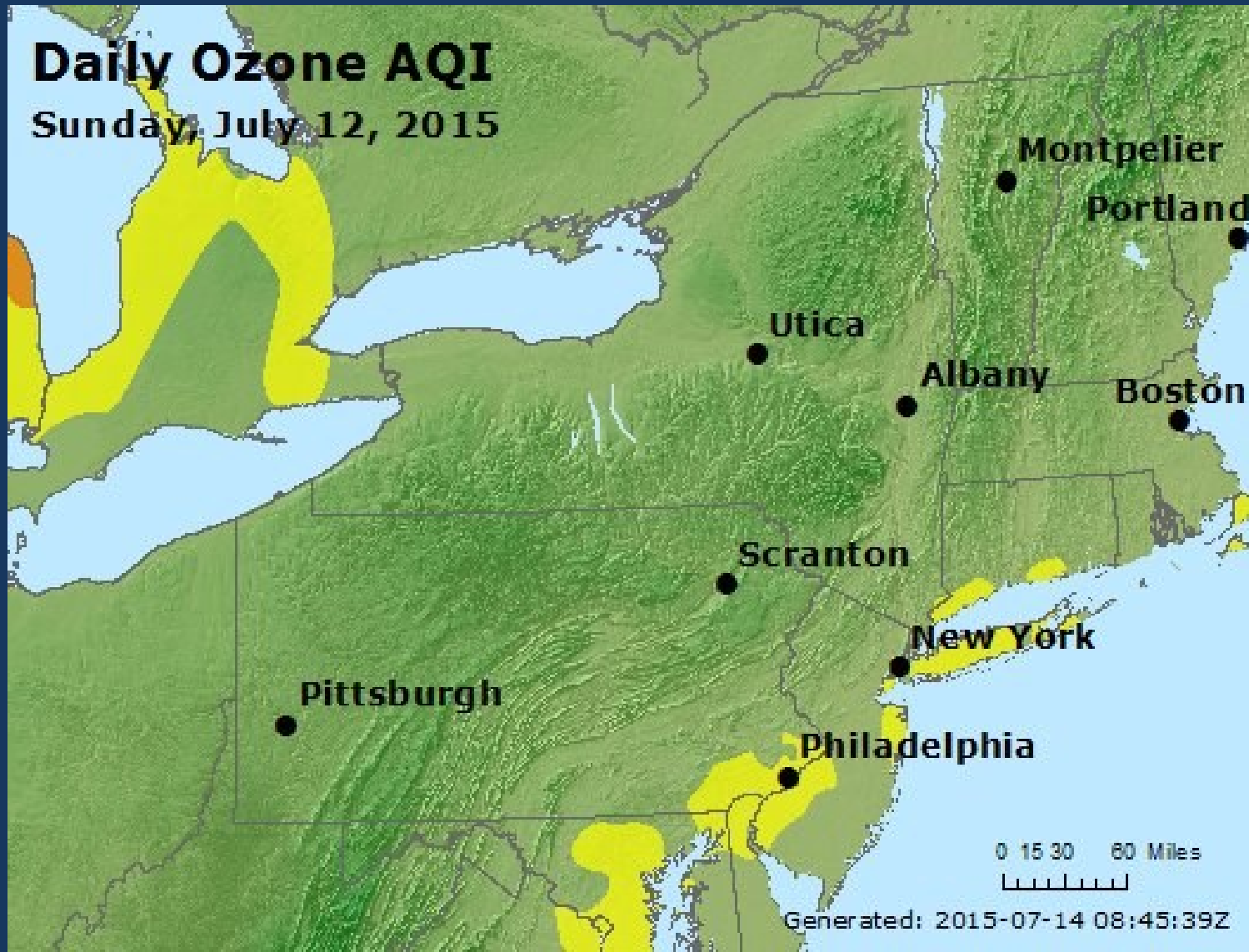
- Fridays' NAM forecast for Sunday suggested that the weather pattern would be conducive for an ozone exceedance along coastal CT/NY and RI
- No NOAA model available for that time period, but the Barons MAQSIP model suggested high moderate and the CMAQ model showed USG
- Because of this, CT forecasted USG ozone levels along the CT coast for Sunday
- Later NOAA model runs would also predict USG levels
- However, USG levels of ozone were not observed at any monitor



# July 12, 2015 Ozone Forecast (ppb) and Observed Values

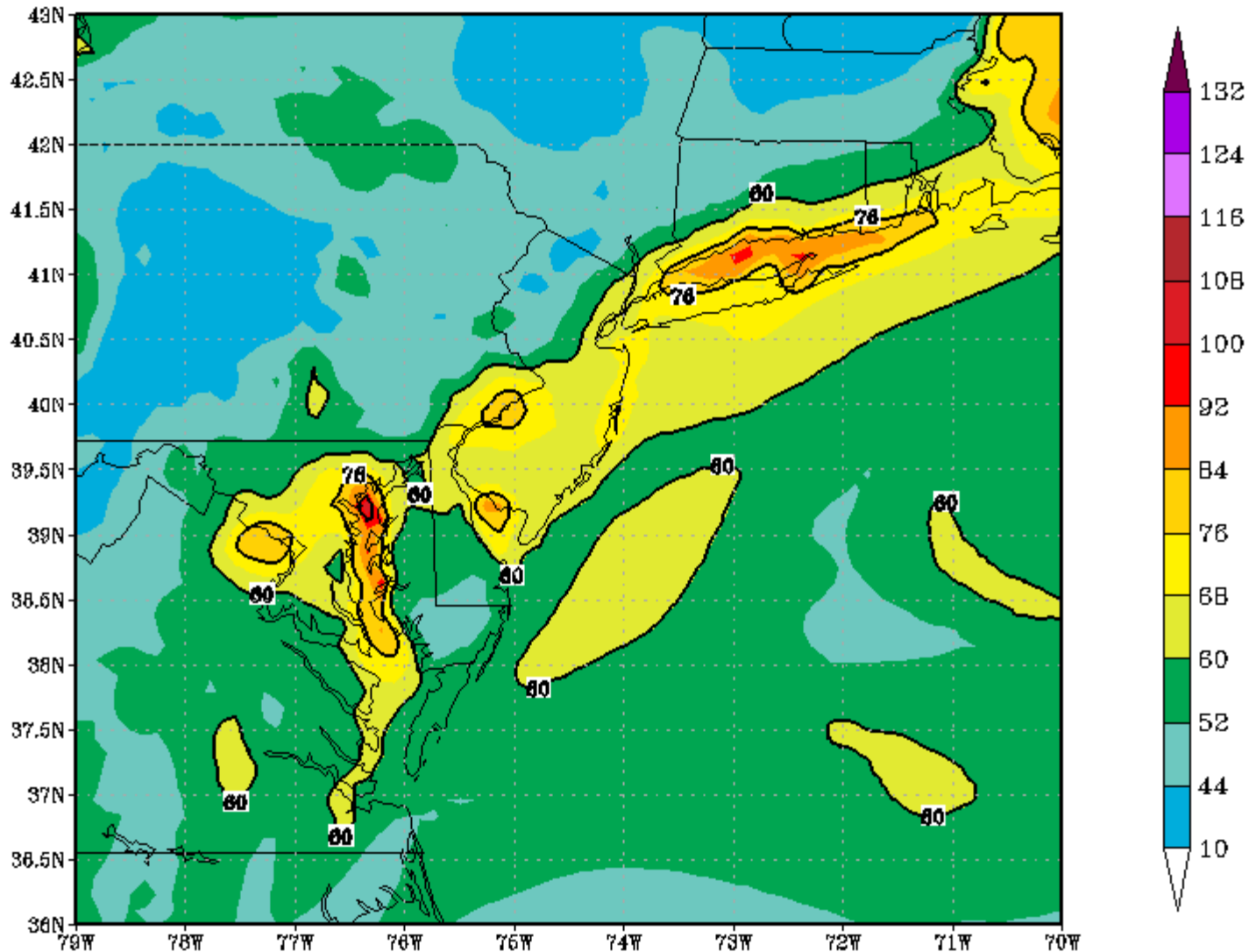
Site/Site AQS/Param/POC	Date (LST)	Max Observed	NOAA 06z	CTDEEP Forecast
Cornwall/090050005/O3/1	7/12/2015	48	46	62
Danbury/090011123/O3/1	7/12/2015	53	54	70
East Hartford/090031003/O3/1	7/12/2015	47	53	72
Greenwich/090010017/O3/1	7/12/2015	70	79	80
Groton Fort Gri/090110124/O3/1	7/12/2015	56	81	80
Madison-Beach R/090099002/O3/1	7/12/2015	65	93	80
Middletown/090070007/O3/1	7/12/2015	50	61	74
New Haven - Cri/090090027/O3/1	7/12/2015	44	81	80
Stafford/090131001/O3/1	7/12/2015	44	49	70
Stratford/090013007/O3/1	7/12/2015	62	90	80
Westport/090019003/O3/1	7/12/2015	63	80	80

# Ozone AQI for the Northeast

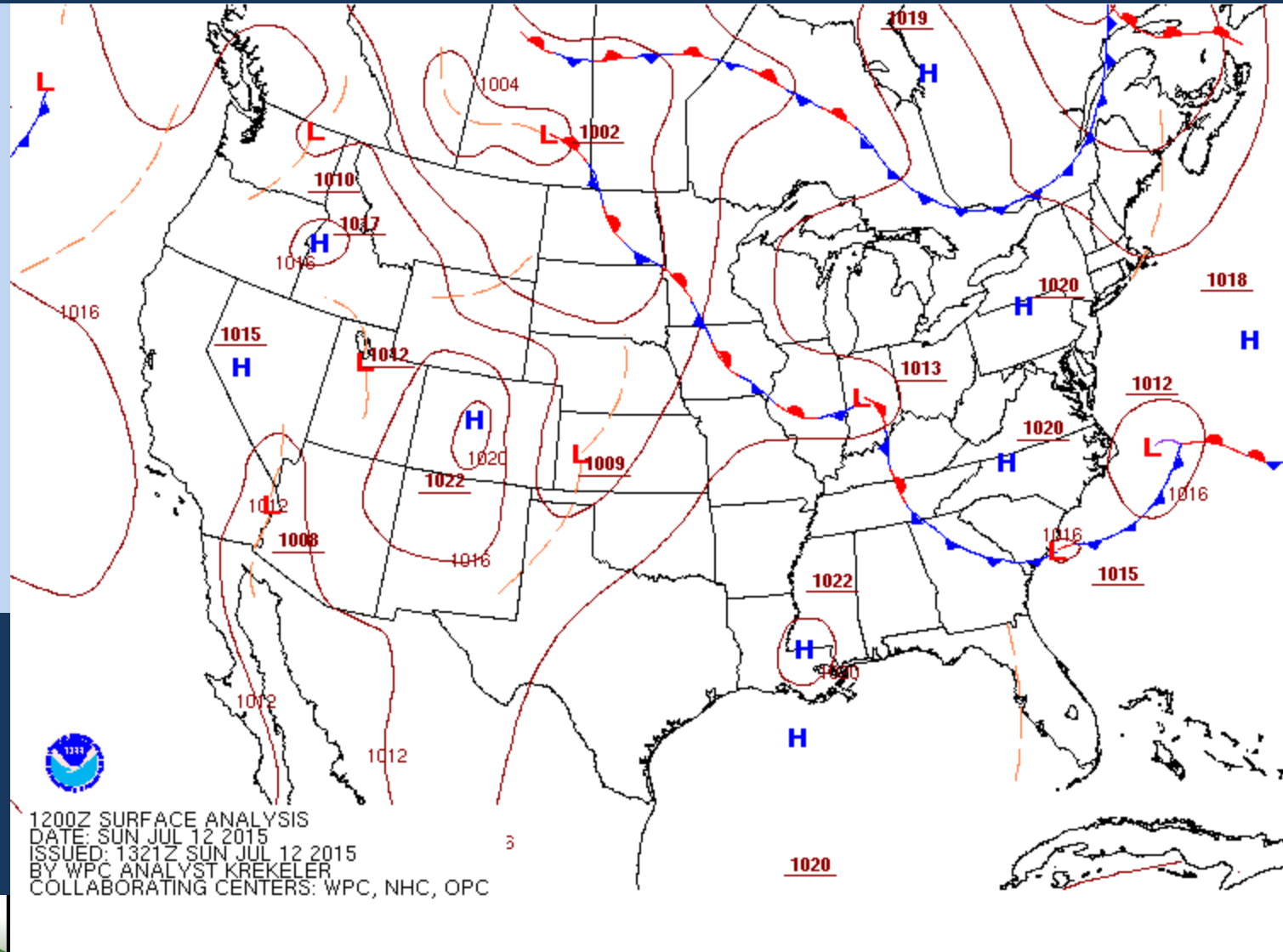


# NOAA Model: 06z July 12, 2015

(prd) 06Z 7H-30H 1st d 8h max sf O<sub>3</sub> (ppbv) Valid 12 JUL 2015

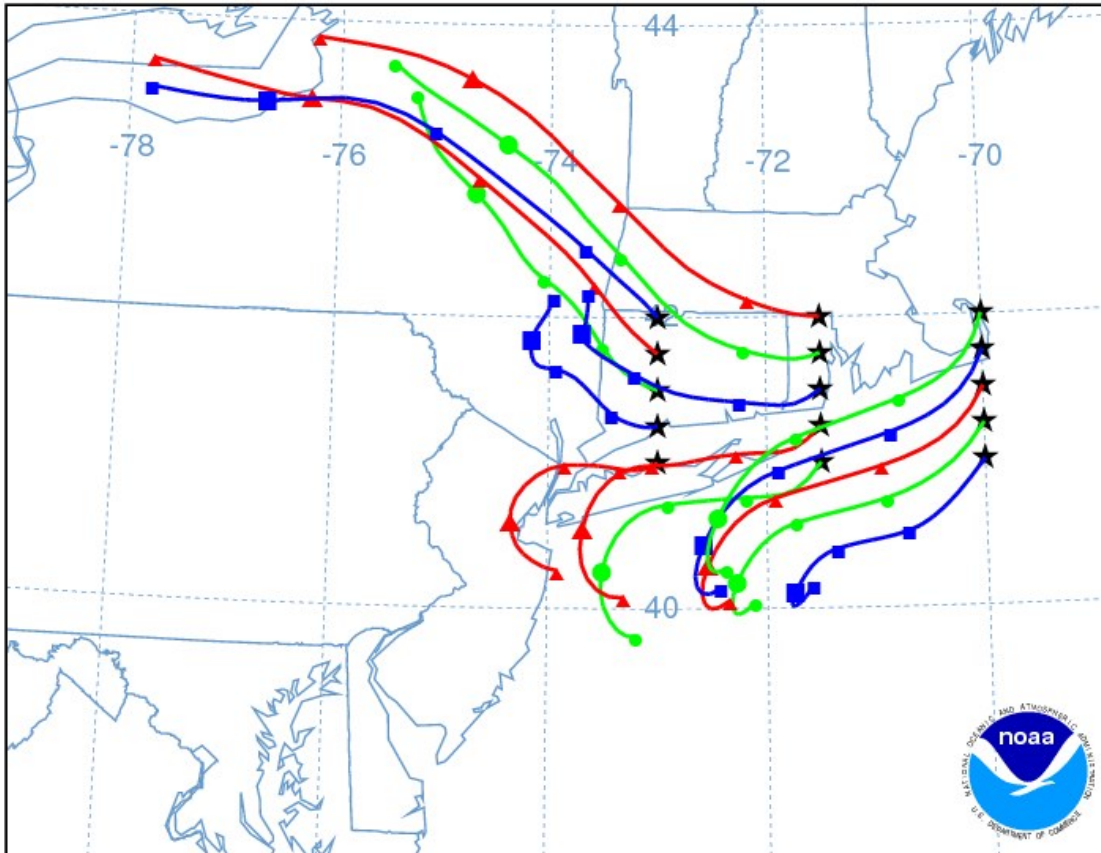


# Surface Map Animation Showing Ocean Low

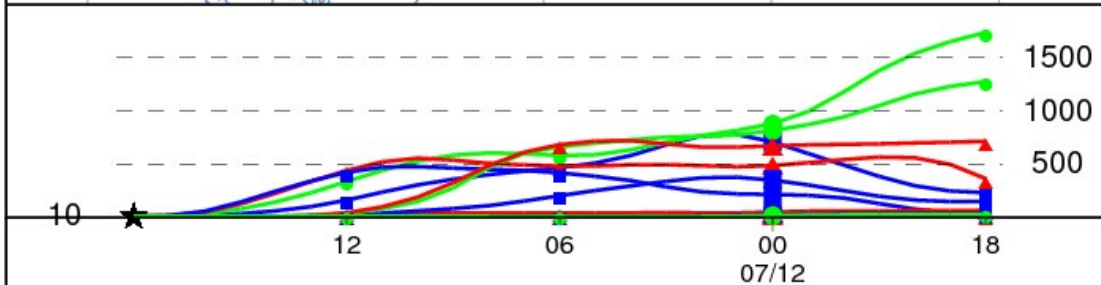


Connecticut Department of Energy and Environmental Protection

Source ★ at multiple locations



Meters AGL



Job ID: 129060 Job Start: Fri Jul 10 17:59:19 UTC 2015  
 Source 1 lat.: 41.000000 lon.: -73.000000 height: 10 m AGL

Trajectory Direction: Backward Duration: 24 hrs  
 Vertical Motion Calculation Method: Model Vertical Velocity  
 Meteorology: 1200Z 10 Jul 2015 - GFS

## 24-hour back trajectories ending at 18z, July 12<sup>th</sup> (10 meter ending height)

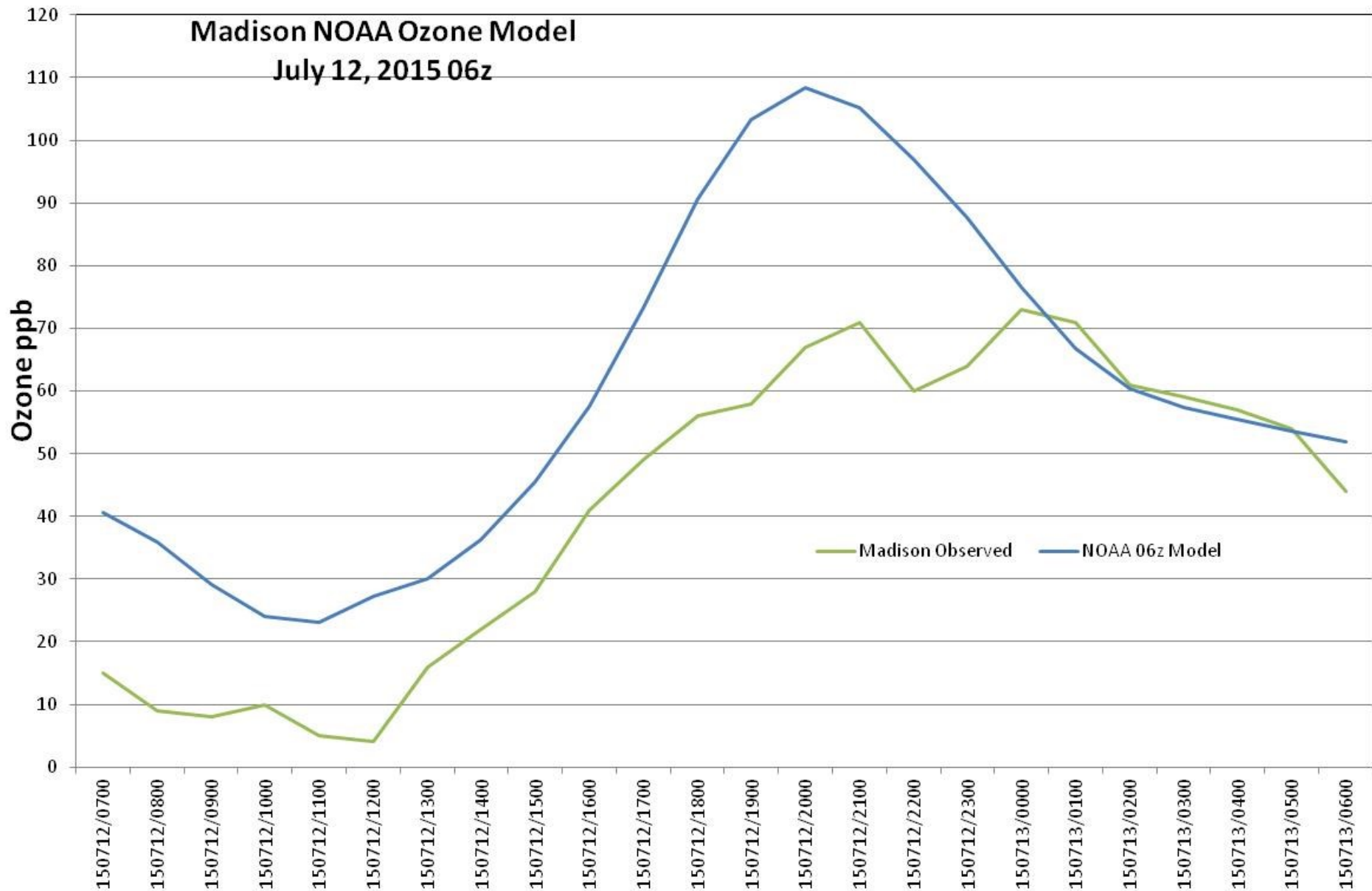
- NAM back trajectories forecast on Friday for Sunday at 18z showed a typical pattern of ozone transported into LIS and then ready to be transported northward with the seabreeze.
- Weak synoptic patterns were also forecast that would enable the seabreeze.



# Madison Observed vs Modeled

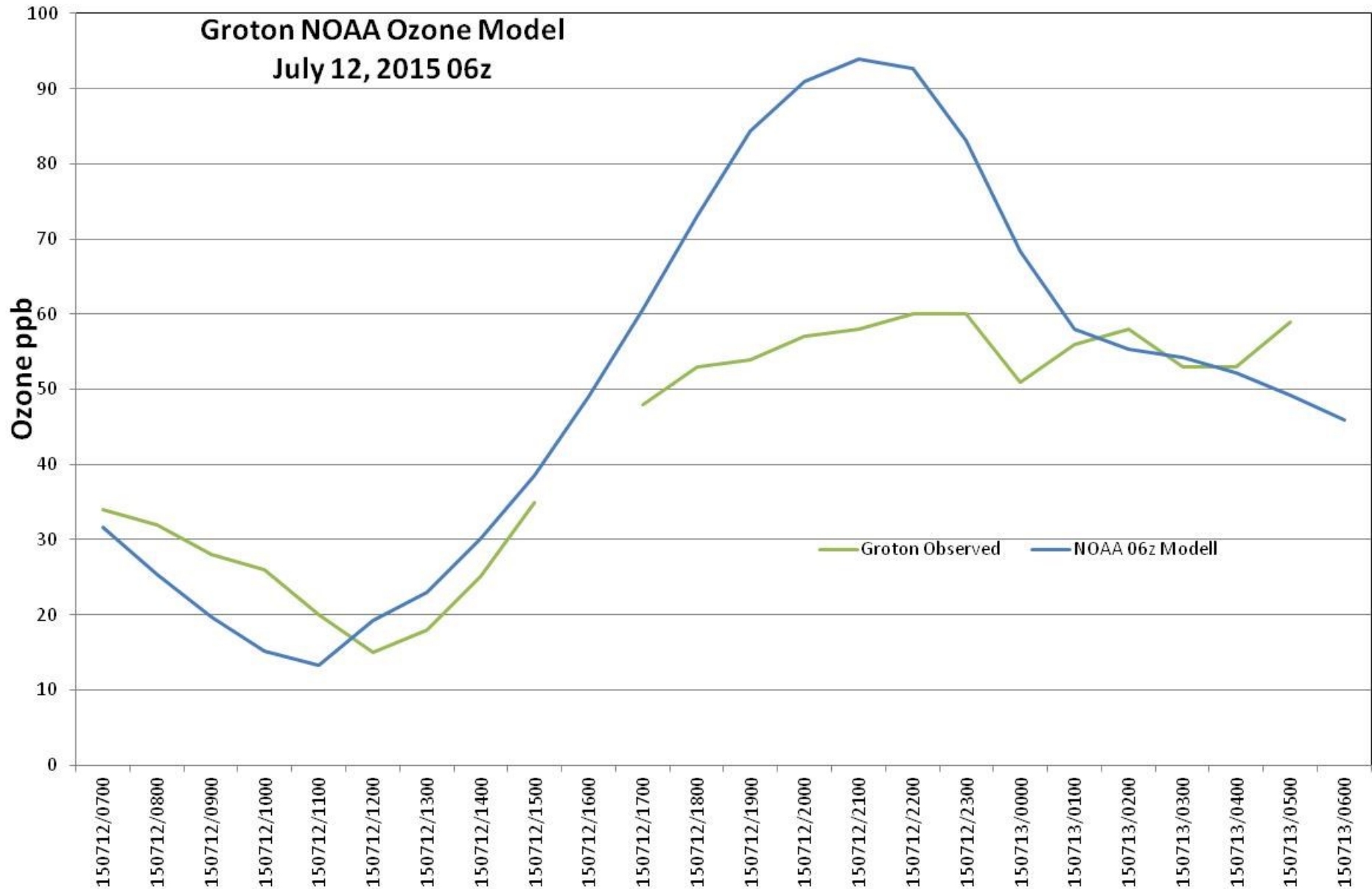
Madison NOAA Ozone Model

July 12, 2015 06z

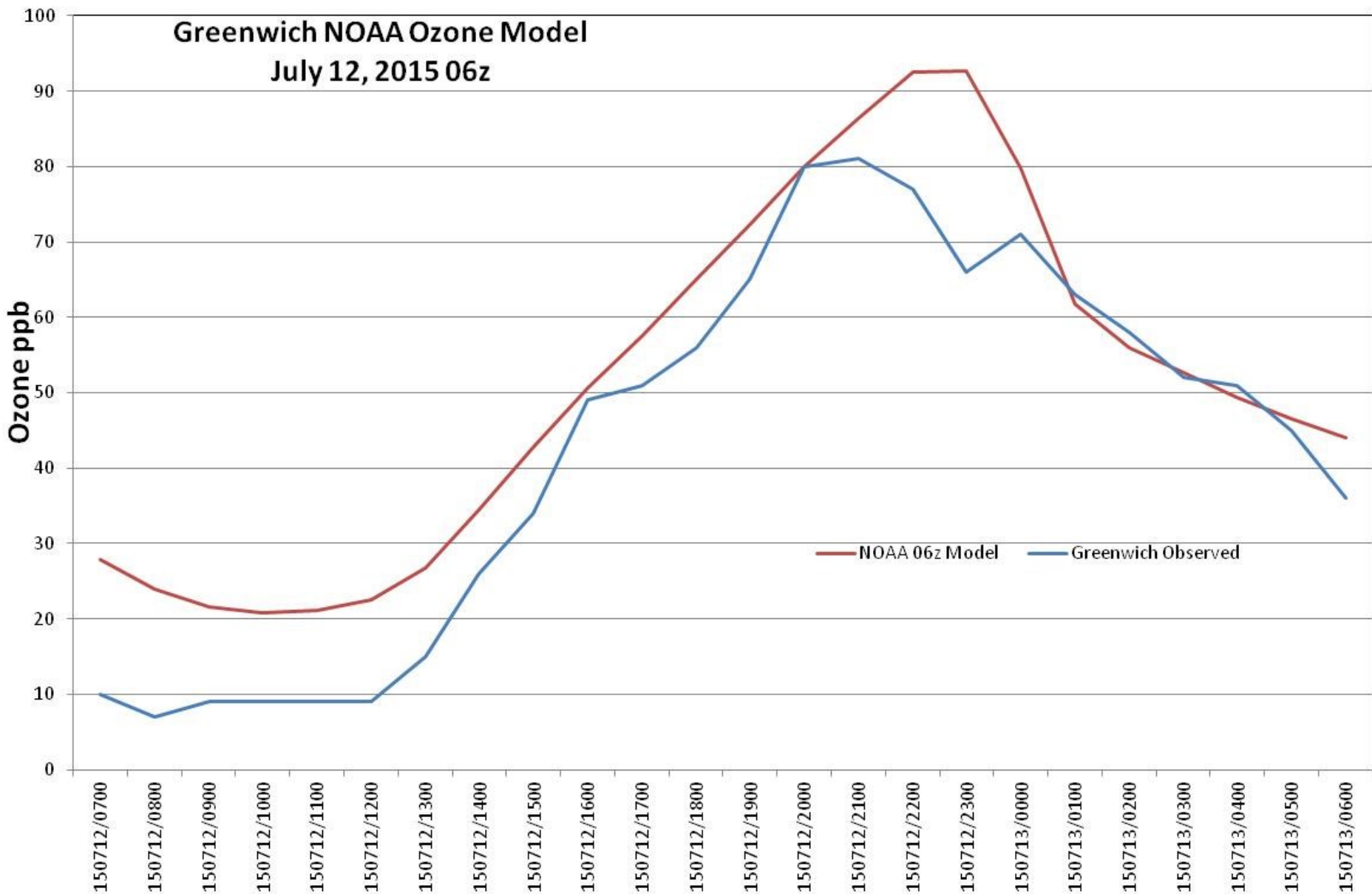


# Groton Observed vs Modeled

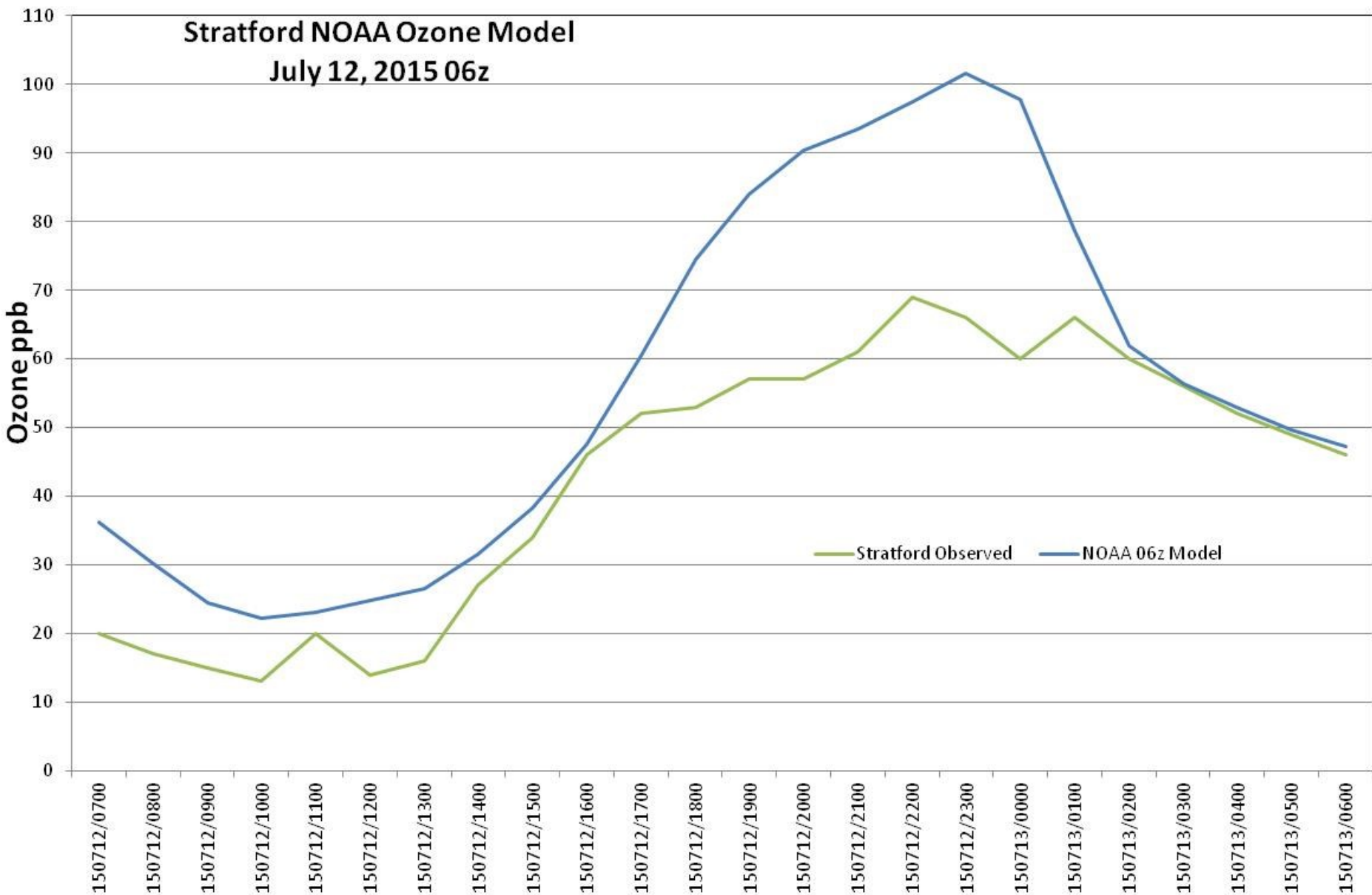
Groton NOAA Ozone Model  
July 12, 2015 06z




# Greenwich Observed vs Modeled



# Stratford Observed vs Modeled

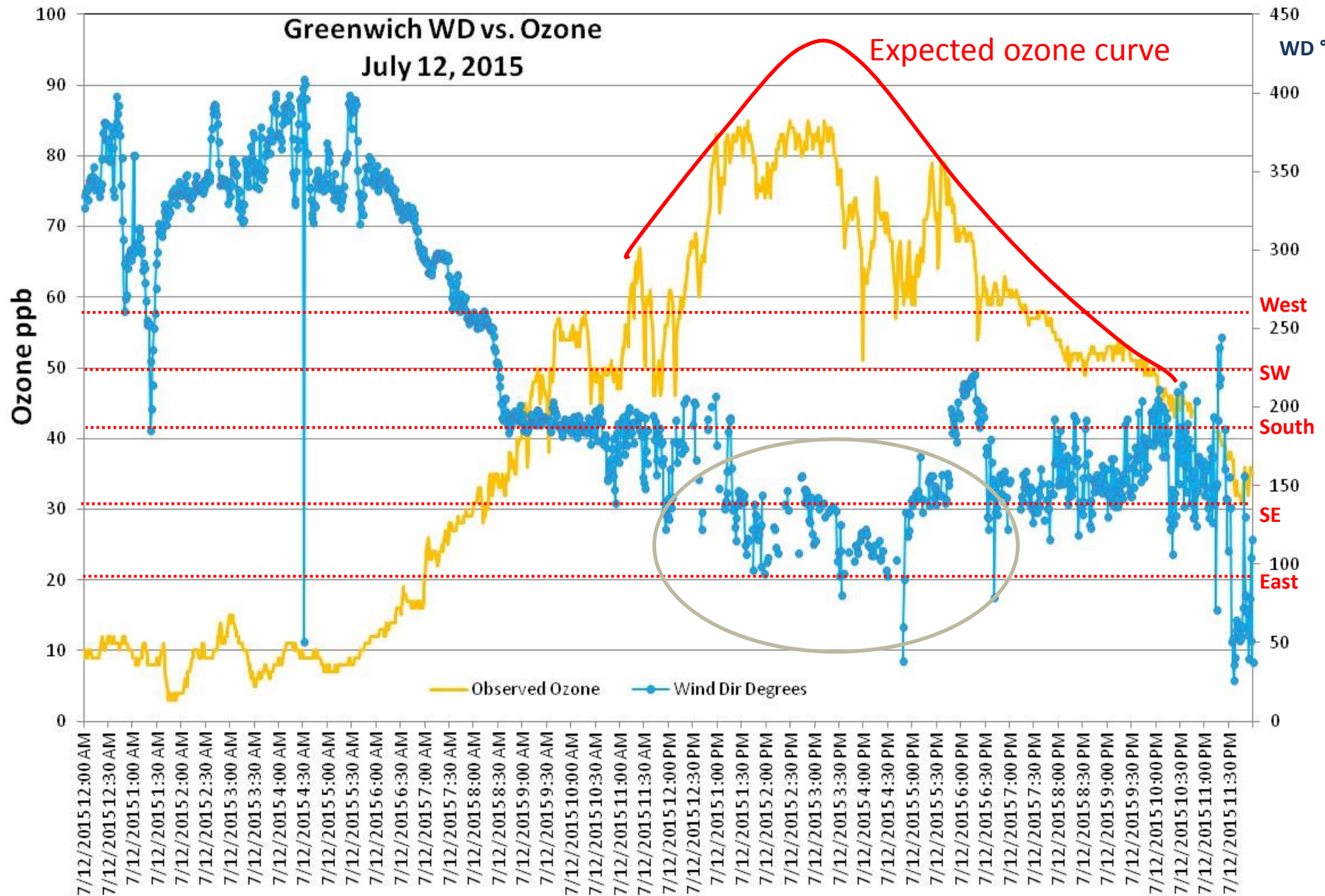


- 
- Irregularity of observed ozone curve suggests that expected sea-breeze was disrupted.
  - NAM model was predicting influence of ocean 'low' by Monday, mixing in the maritime air
  - It's possible that 'low' developed sooner and stronger than forecast by NAM
  - The Greenwich wind direction trace vs. ozone shows how sensitive it is to wind direction



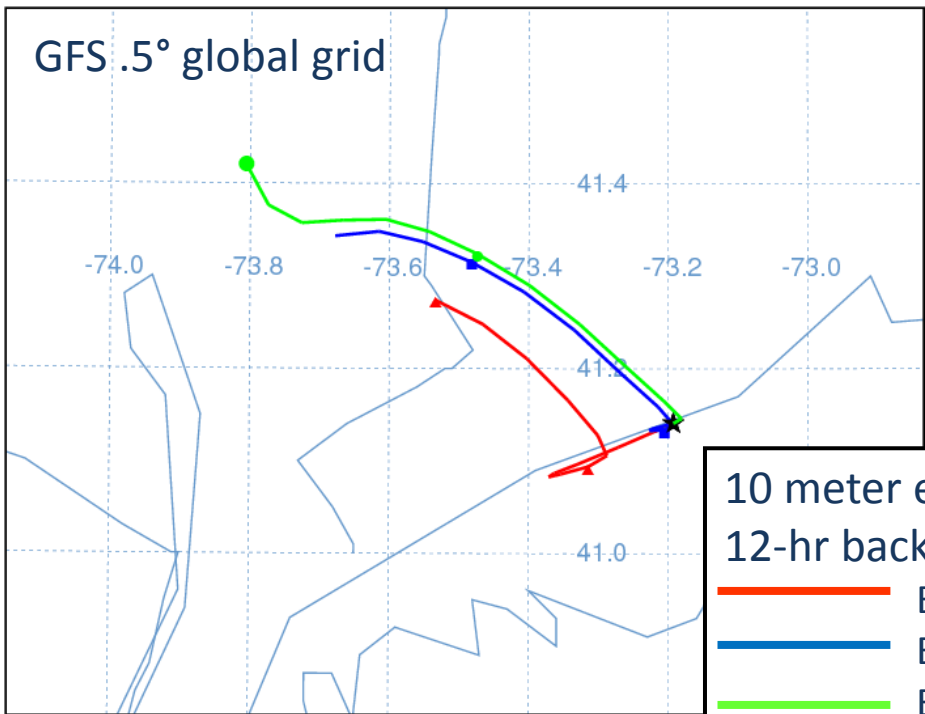
# Wind Direction vs. Minute Ozone at Greenwich

Note the ozone ppb deviation from expected curve when wind shifted towards the east



Source ★ at 41.14 N 73.19 W

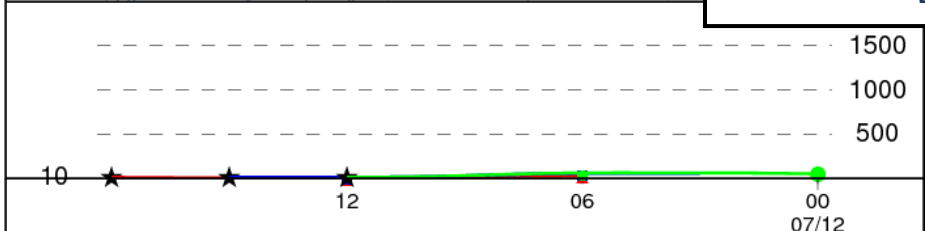
GFS .5° global grid



10 meter end heights  
12-hr back trajectories

- Ending 18z
- Ending 15z
- Ending 12z

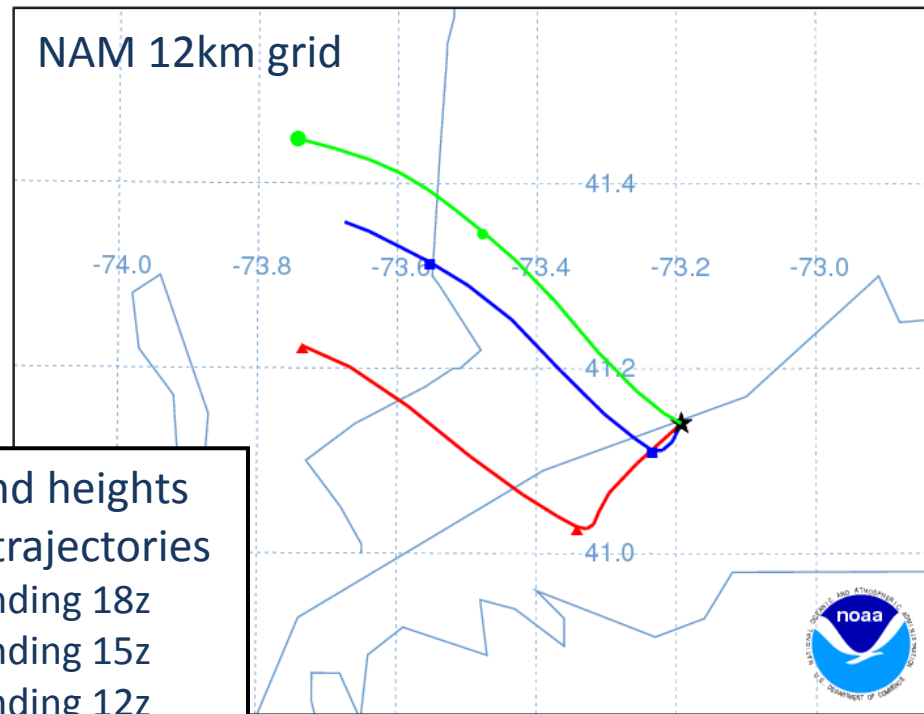
Meters AGL



Job ID: 111441      Job Start: Wed Jul 15 13:02:22 UTC 2015  
 Source 1   lat.: 41.141000   lon.: -73.192600   height: 10 m AGL  
 Trajectory Direction: Backward   Duration: 12 hrs  
 Vertical Motion Calculation Method:   Model Vertical Velocity  
 Meteorology: 0000Z 12 Jul 2015 - GDAS0p5

Source ★ at 41.14 N 73.19 W

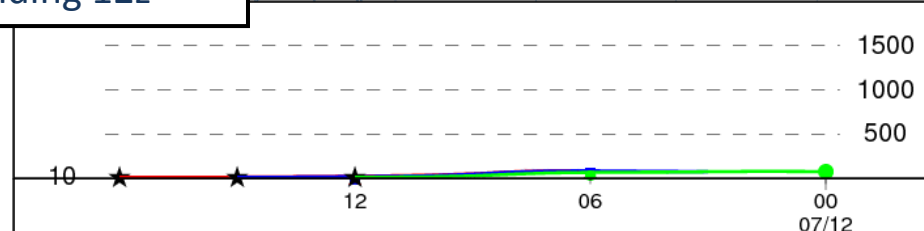
NAM 12km grid



10 meter end heights  
12-hr back trajectories

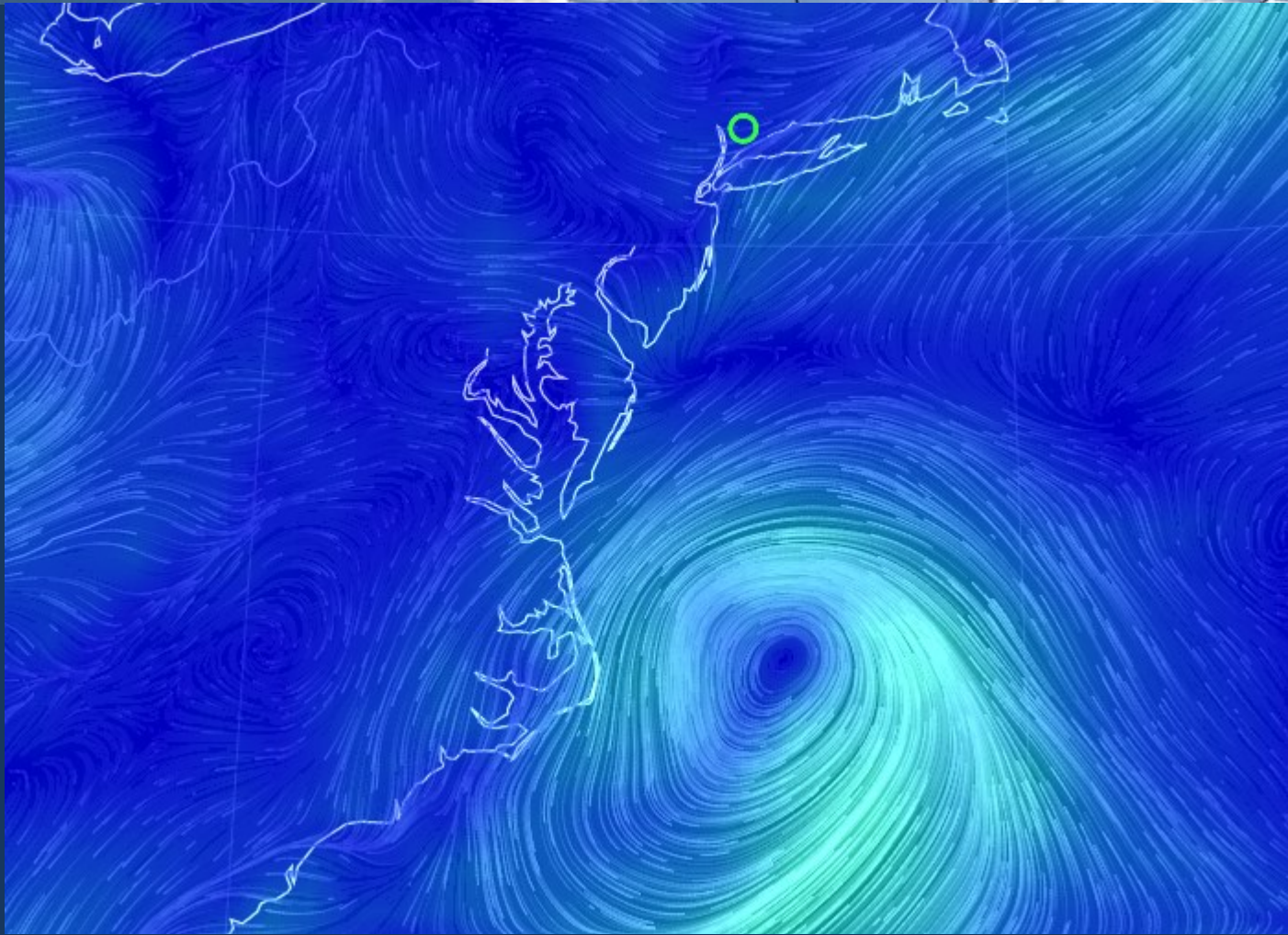
- Ending 18z
- Ending 15z
- Ending 12z

Meters AGL



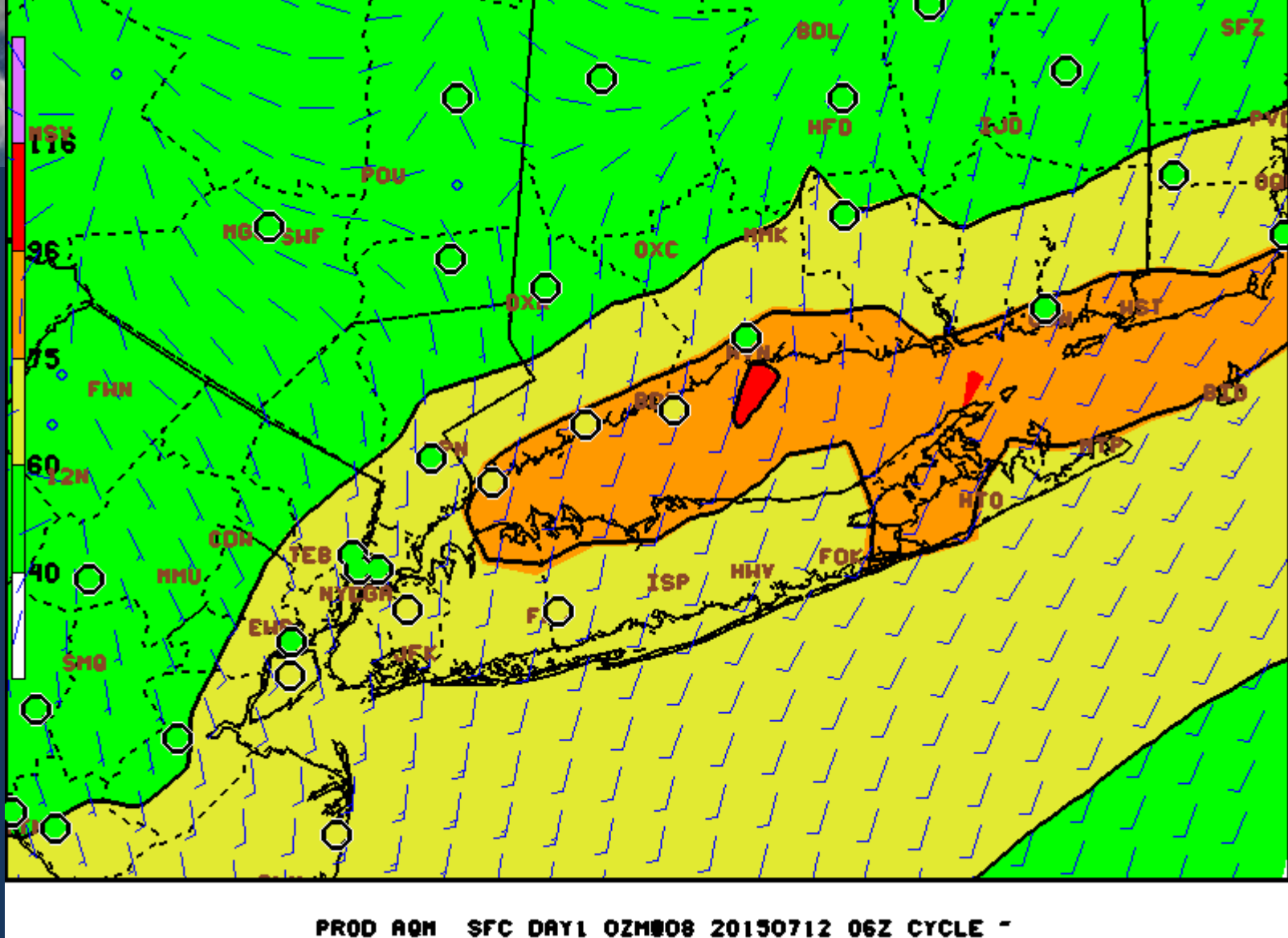
Job ID: 111572      Job Start: Wed Jul 15 13:08:56 UTC 2015  
 Source 1   lat.: 41.141000   lon.: -73.192600   height: 10 m AGL  
 Trajectory Direction: Backward   Duration: 12 hrs  
 Vertical Motion Calculation Method:   Model Vertical Velocity  
 Meteorology: 0000Z 12 Jul 2015 - NAM12

- Modeled trajectories don't have the time or grid resolution to explain the sea breeze interaction
- These both show southwest winds to Bridgeport from 1200- 1800 UTC



GFS 18z windstream analysis further exemplifies prevailing southwest winds over LIS while tropical system gets going to the south.





- This graphic shows the extent of the model over prediction
- The wind barbs are at the time mid-point of the 8-hr max. This shows a consistent south to southwest wind.



Another factor could be the known high temperature bias for the NAM 12 km model.



Jeff McQueen (NOAA) provided these graphics showing an improvement of LIS temperatures using the 4km nested NAM (top)



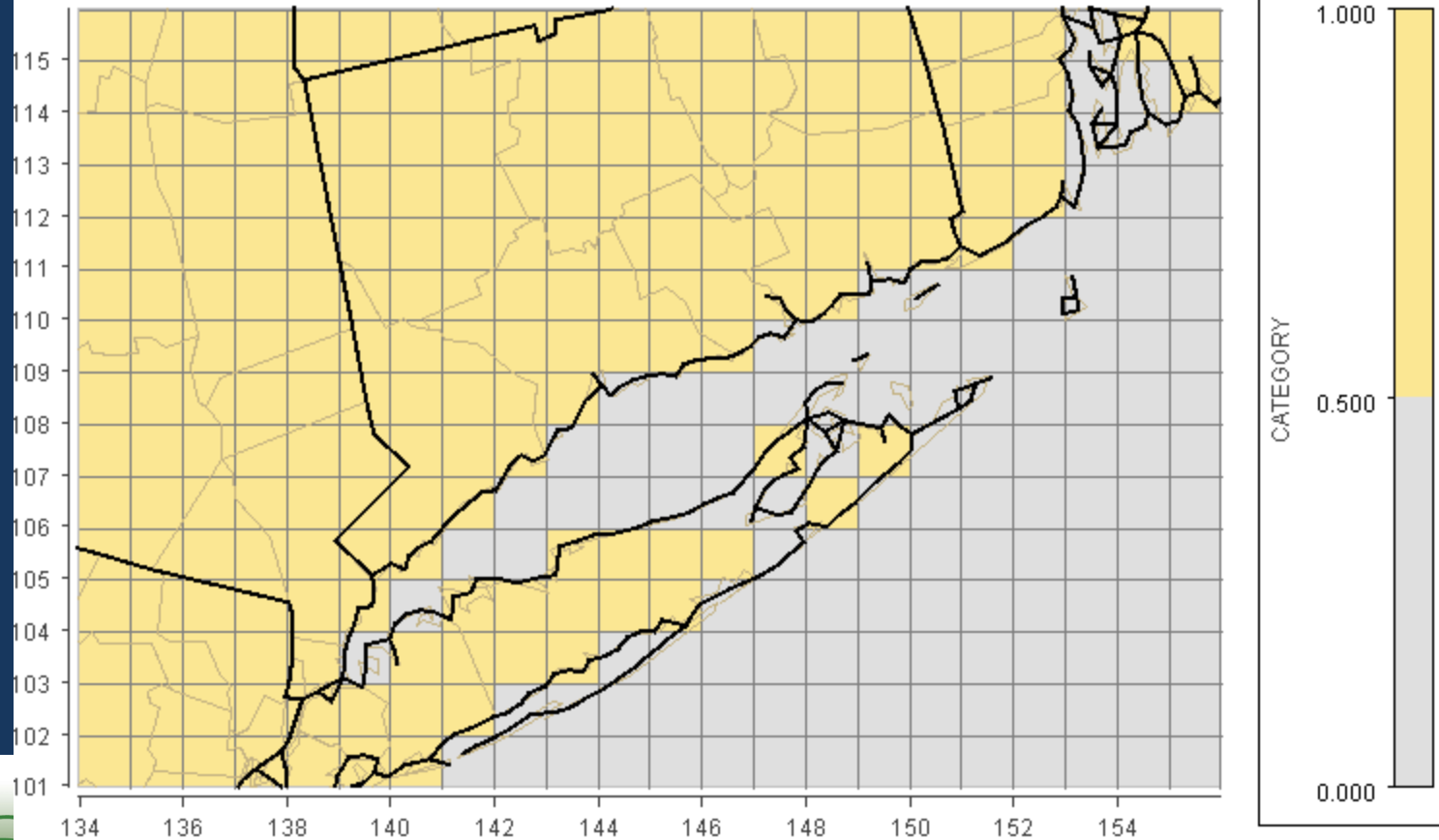
A larger concern is that the 12km NAM uses land cover for western LIS rather than water. Thus it will always 'run hot'.



# Verdi Land surface grid LW-Mask(UMD)

## Layer 1 LWMASK[1]

[1]=GRIDCRO2D.cdf



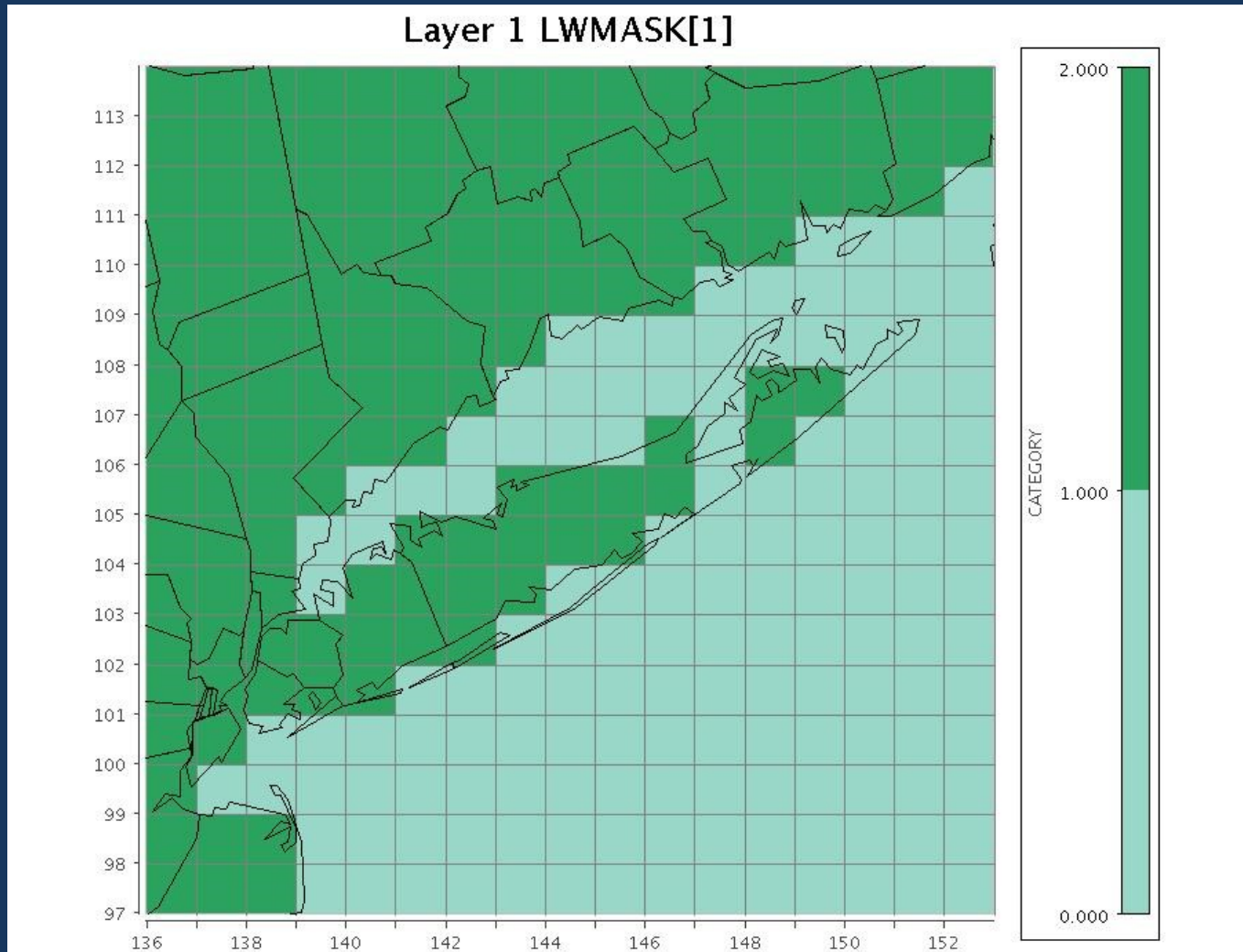
July 28, 2007 01:00:00 UTC

Min (141, 101) = 0.000, Max (135, 101) = 1.000

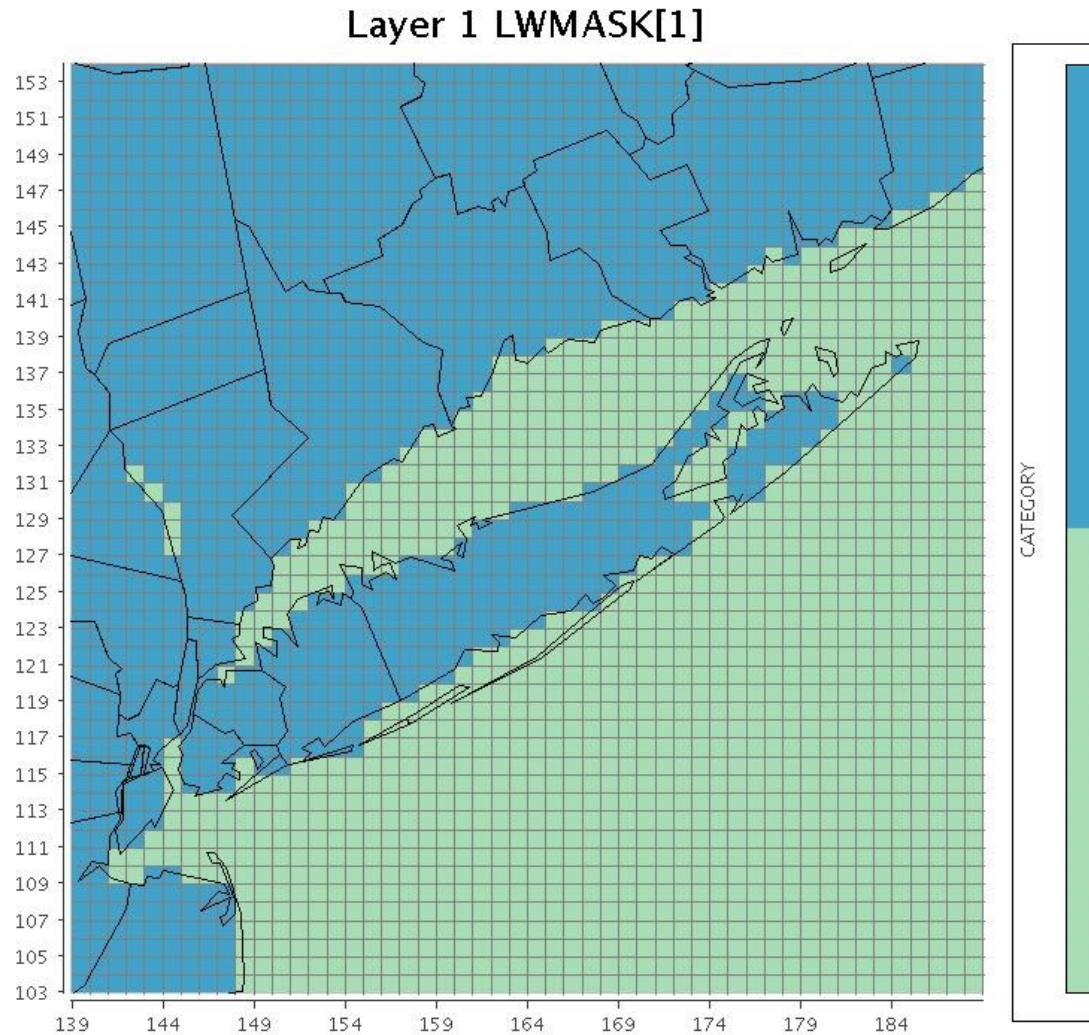


# NYDEC Verdi Land Surface Grid

(note more water grids than UMD)



# Future NYDEC 4km CMAQ Grid



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# Conclusions

- A finer model grid could have improved the model output, assuming the meteorology is well characterized;
- Although NOAA model had less hits than last year, it was still a valuable tool, notwithstanding the over-prediction
- Ozone forecasting beyond 2 days is still a formidable task, however, running the NOAA model to **72 hours** should be pursued to aid in weekend forecasts;
- More research needs to be done on the LIS land/sea boundary, perhaps ozonesondes, flights etc. during events;
- Need to know real concentration of LIS plume!

