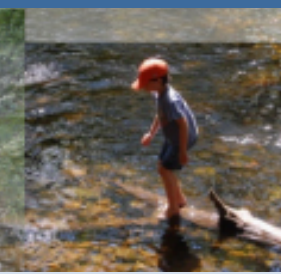
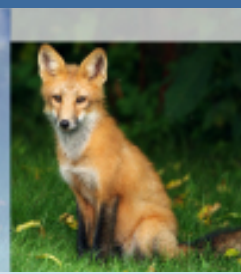




# Connecticut Department of Energy and Environmental Protection



Connecticut Department of  
**ENERGY &  
ENVIRONMENTAL  
PROTECTION**

# NOAA Ozone Model Analysis 2012 for Connecticut

Sept 13-14, 2012  
Presented by Michael Geigert  
NOAA Focus Group Workshop



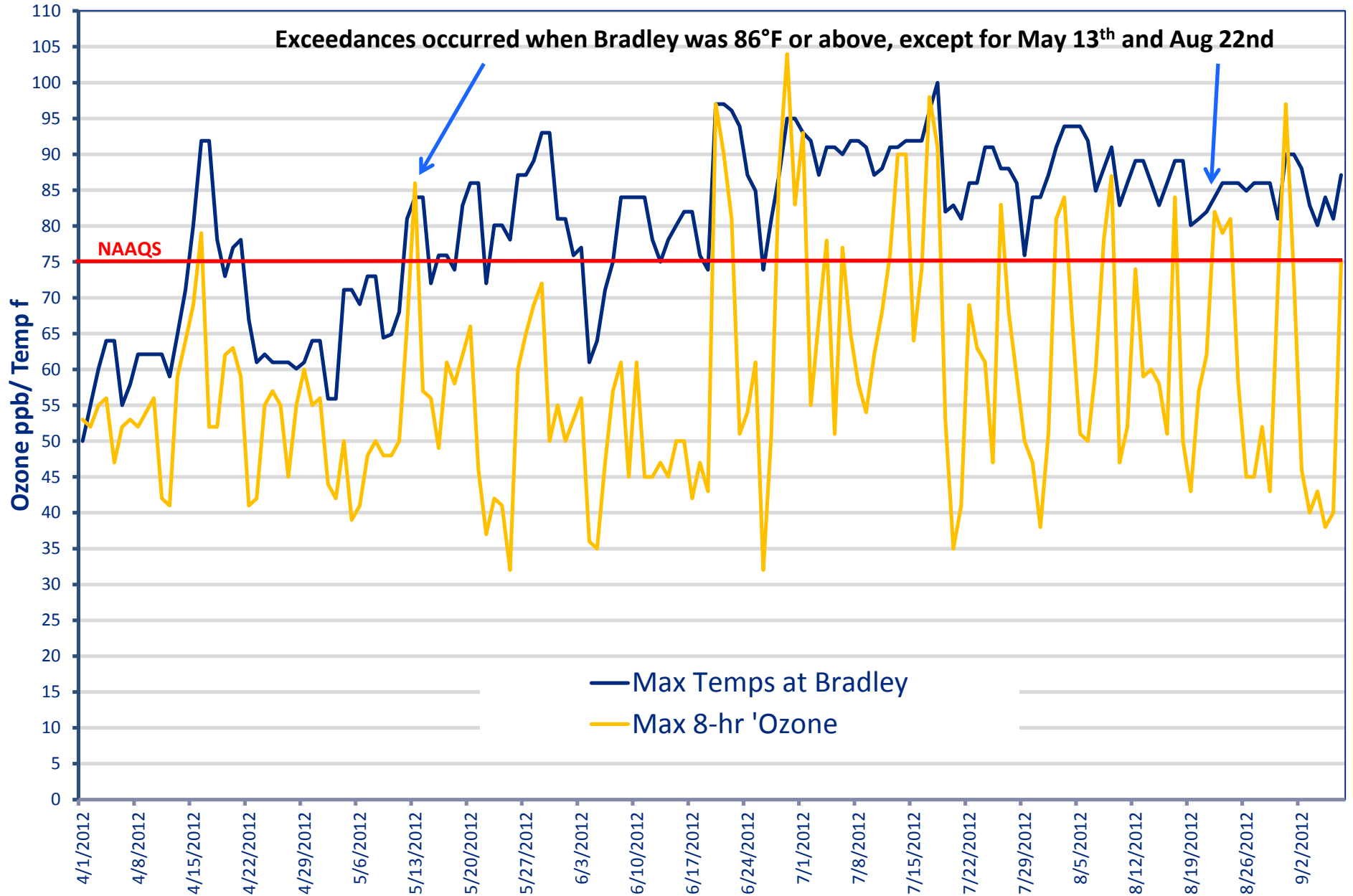
Connecticut Department of Energy and Environmental Protection

# NOAA Ozone Model Predictions (PRD)

- Model predicted CT ozone exceedances (code orange) for 19/26 days (73%)
- Considered a success when at least one site verifies a code orange exceedance ( $\geq 76$ ppb)
- Most exceedances were coastal CT (17/26)
- Very few false alarm days!
- CTDEEP forecasted 14/26 correctly (54%)
- Exceedances occur at lower high max temps at Bradley with new NAAQS



# Bradley High temps vs Max 8-hr Ozone

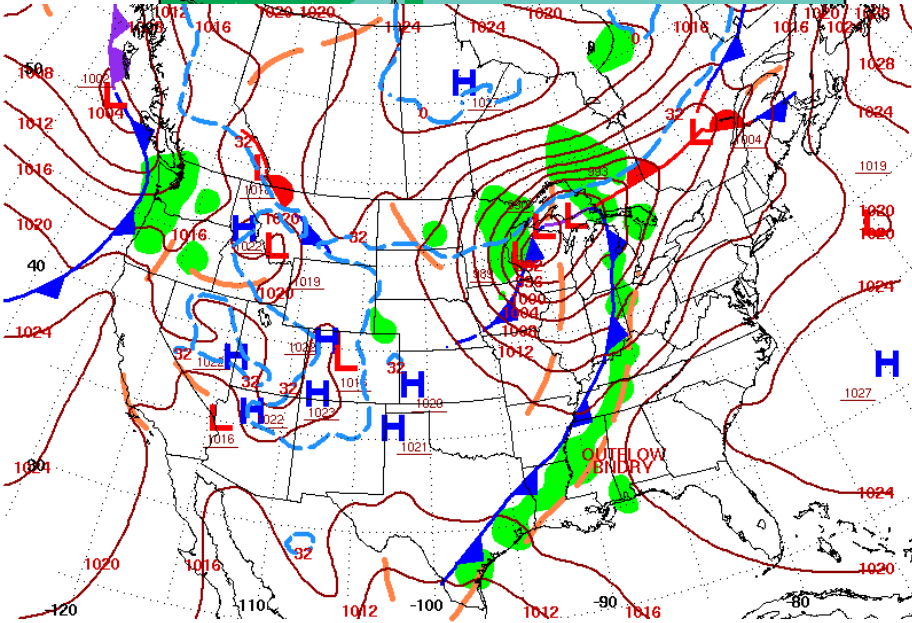
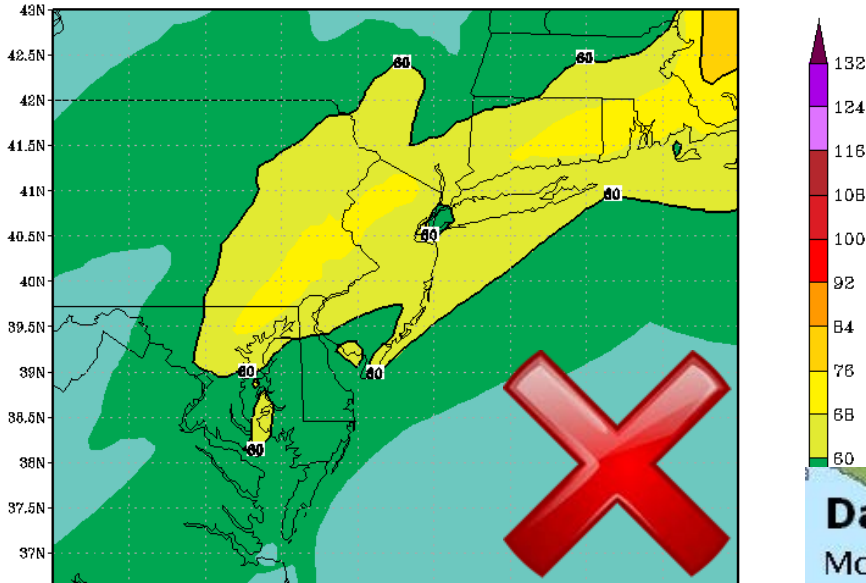




# April 16, 2012

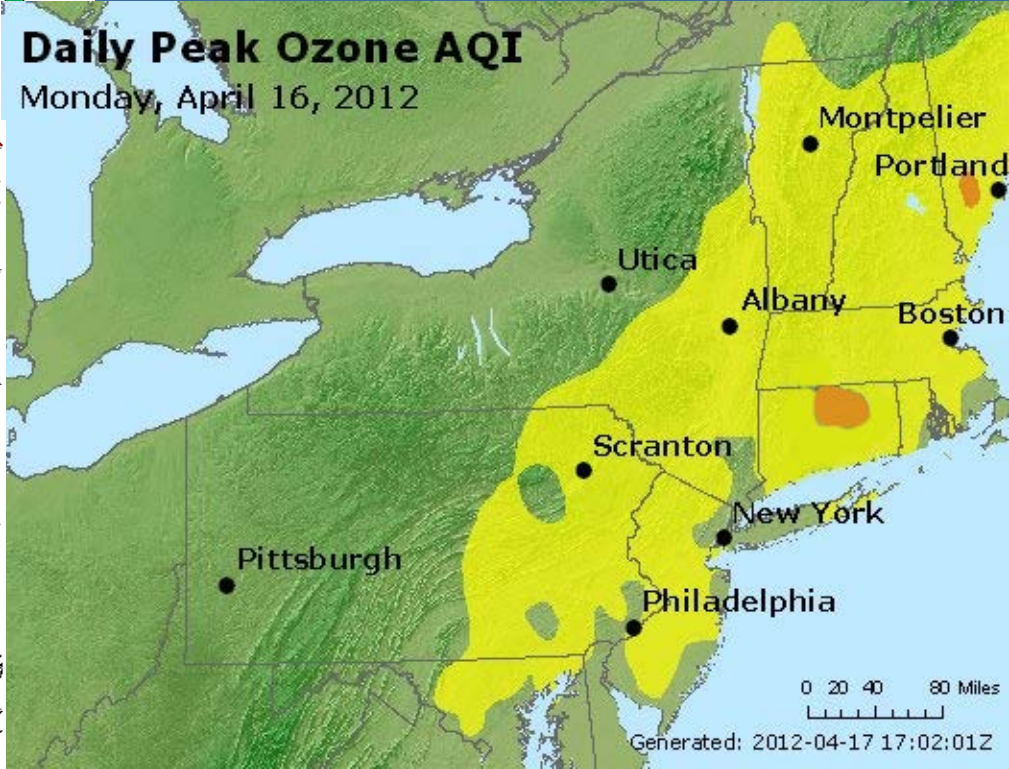
(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 16 APR 2012

- Model still under-predicts early season events, but only slightly
- Bradley temp was 92 degrees!



Surface Weather Map at 7:00 A.M. EST

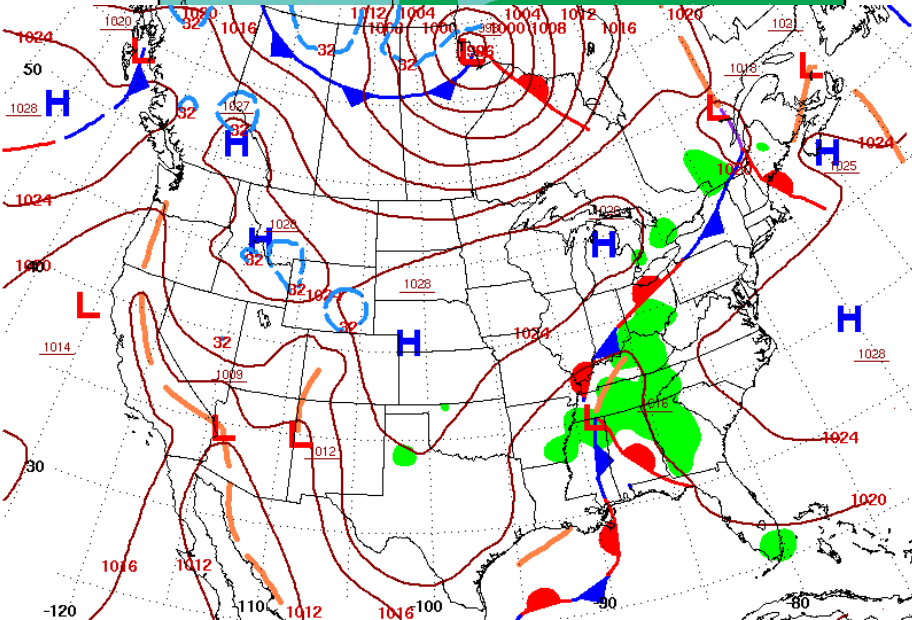
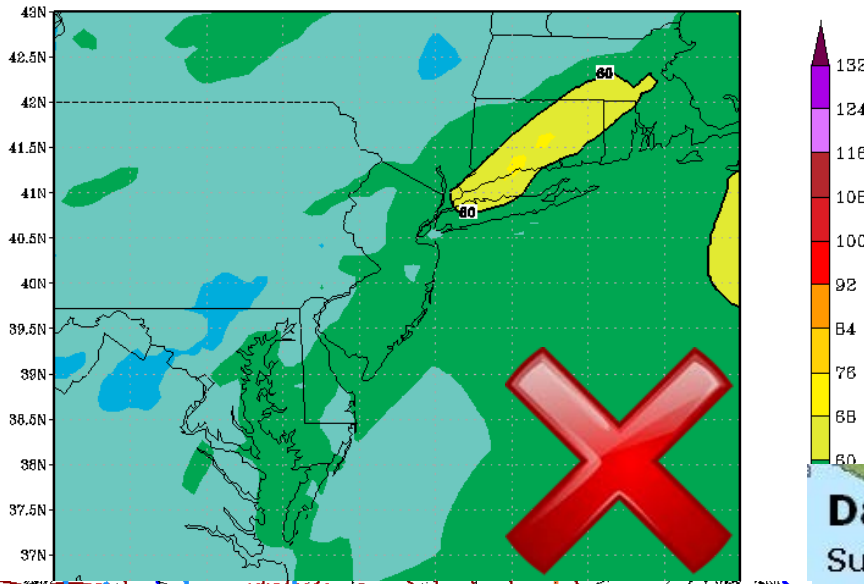
**Daily Peak Ozone AQI**  
Monday, April 16, 2012



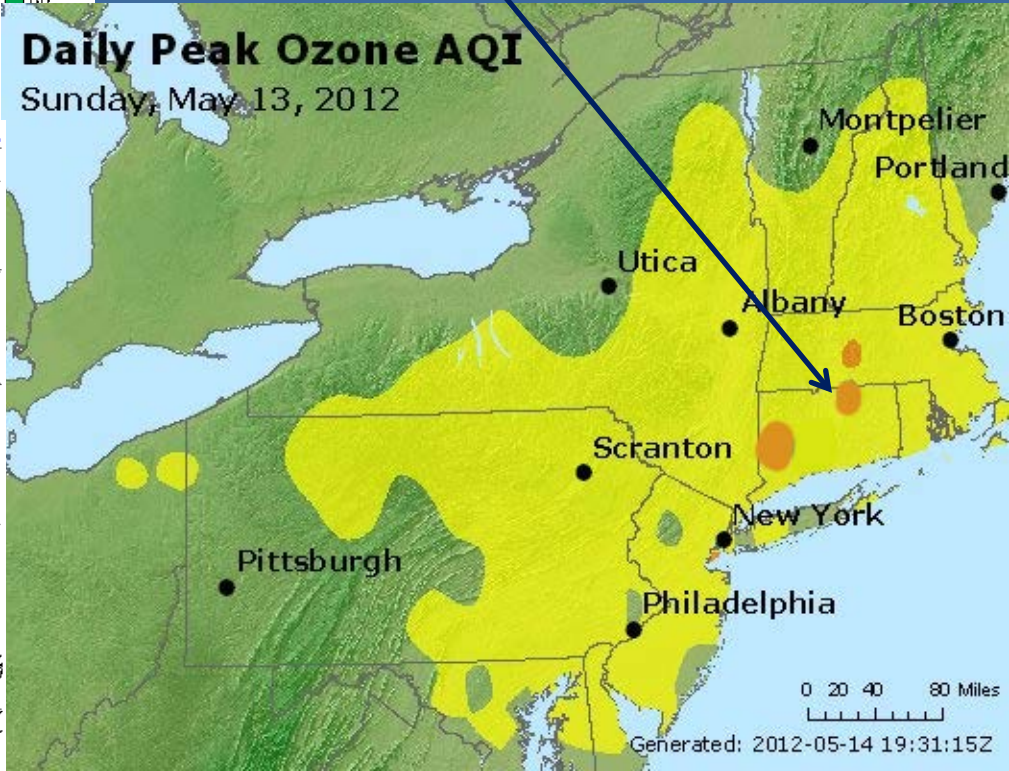
# May 13, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 13 MAY 2012

- Model had right idea again!
- Max Bradley temp only 84 degrees
- We forecasted 46ppb at Stafford, verified at 86 ppb!



Surface Weather Map at 7:00 A.M. E.S.T.



0 20 40 80 Miles

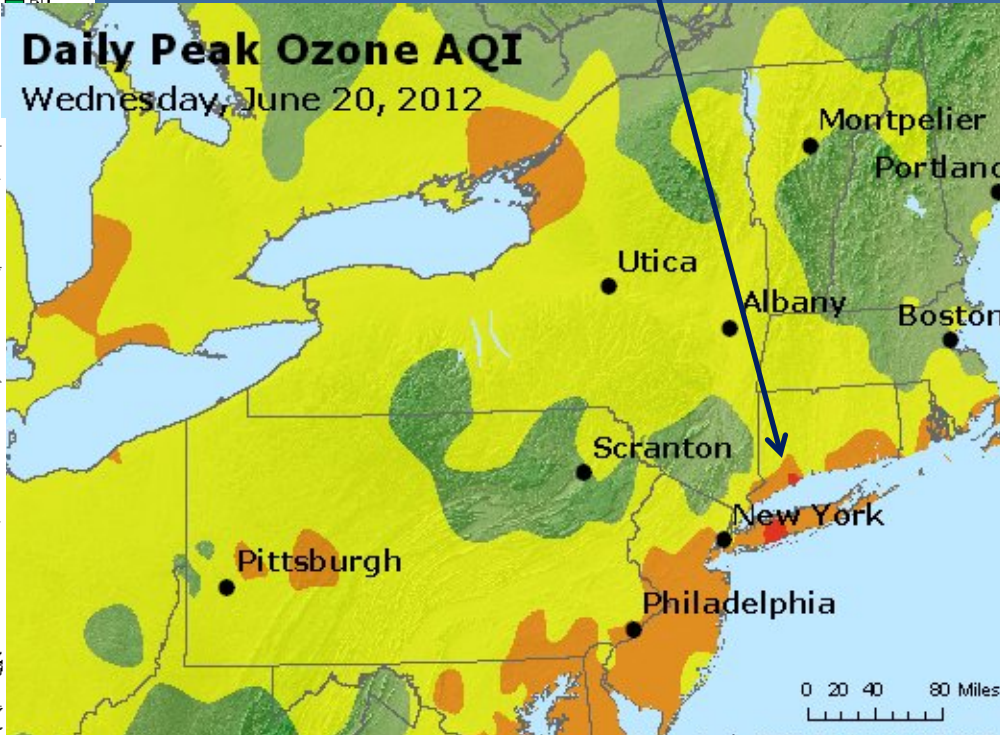
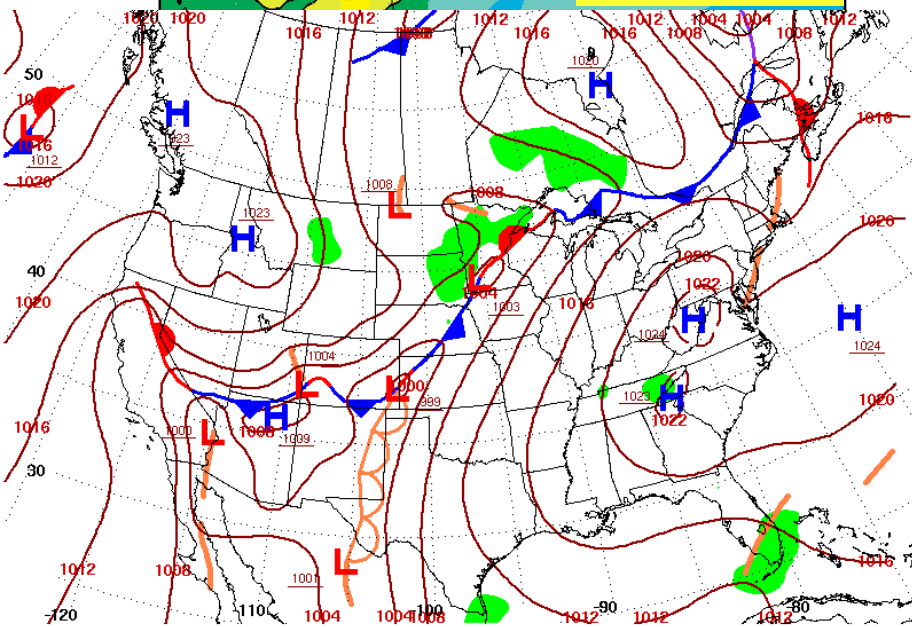
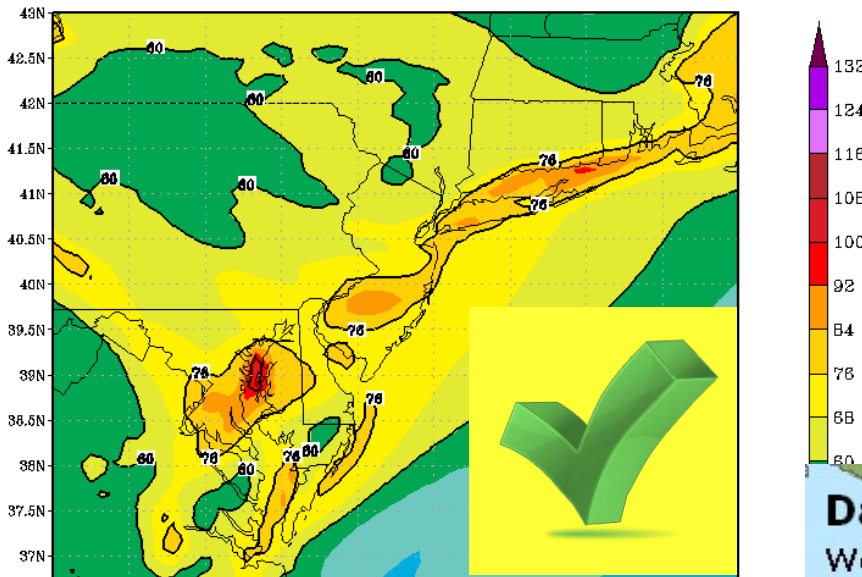
Generated: 2012-05-14 19:31:15Z



# June 20, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 20 JUN 2012

- Coastal trough with mid-Atlantic high
- Surface winds west to northwest, becoming southwest along coast
- Very GOOD model forecast
- We forecast 80 ppb Stratford, verified at 97ppb

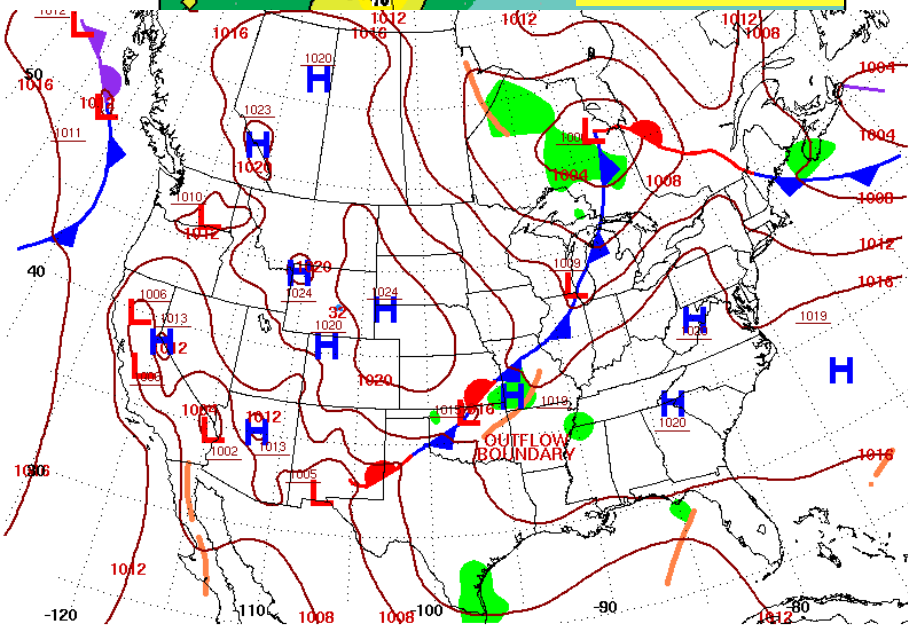
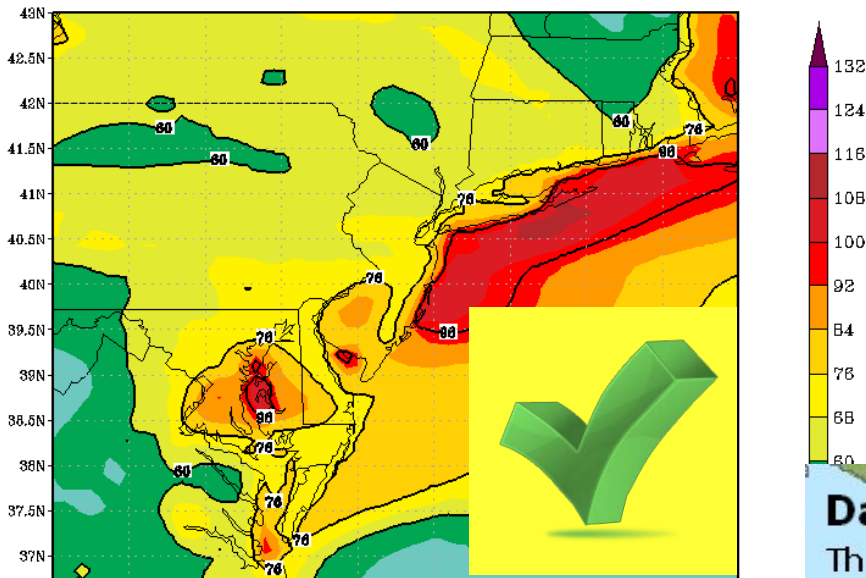


Generated: 2012-06-21 16:27:56Z

# June 21, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 21 JUN 2012

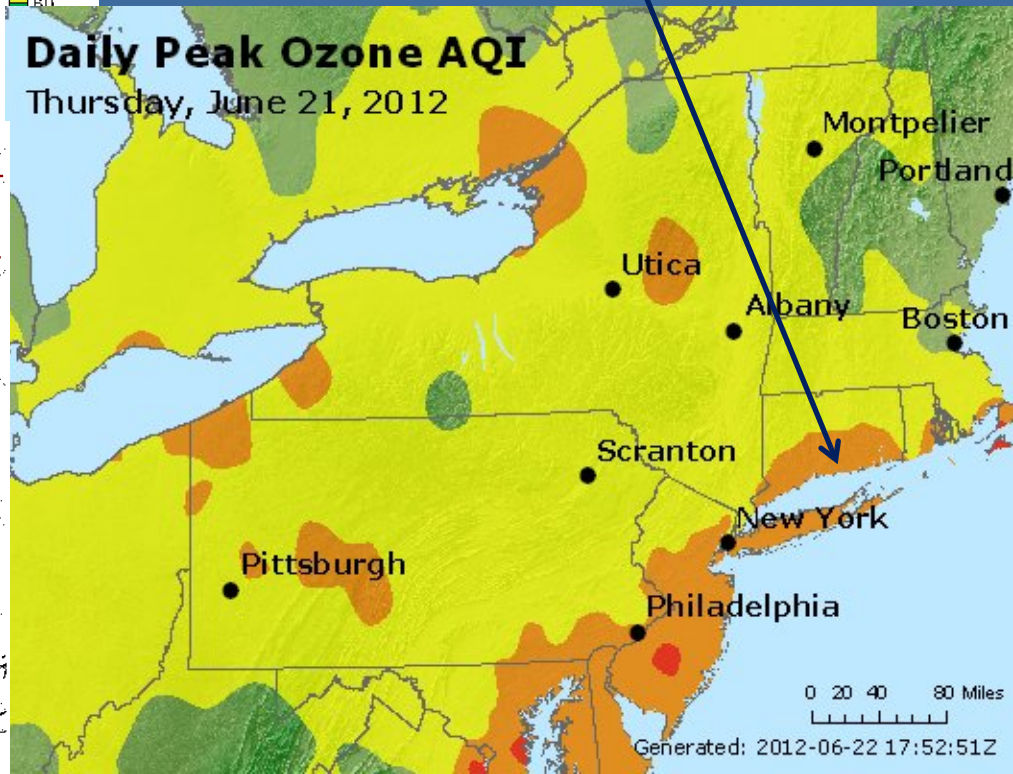
- Surface winds west northwest
- Ozone pooling over LIS advects in on sea breeze to immediate coast
- This occurred several times with mid-Atlantic high pressure regimes
- We forecast 83 ppb at Madison, verified at 90 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

## Daily Peak Ozone AQI

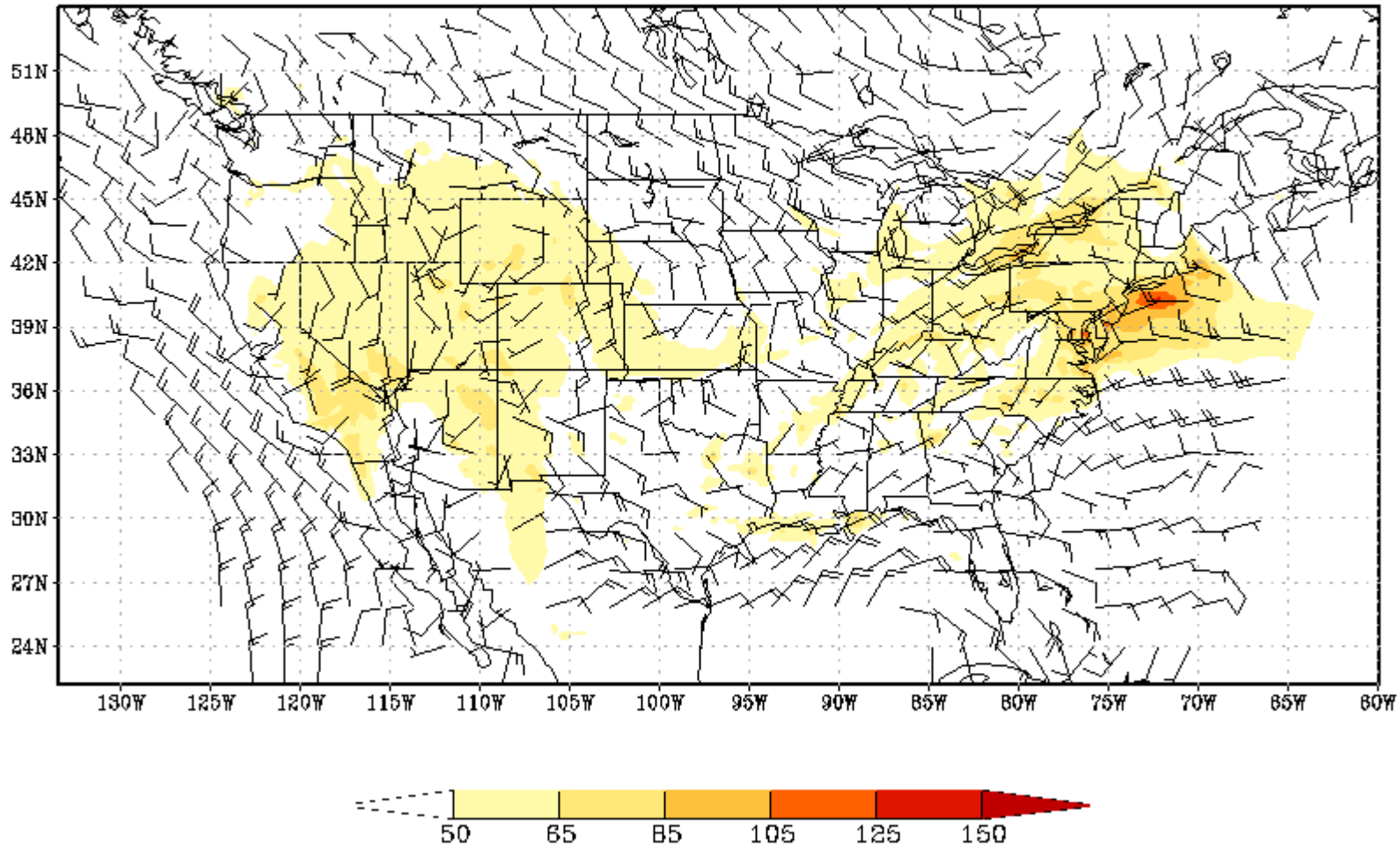
Thursday, June 21, 2012





# June 21, 2012

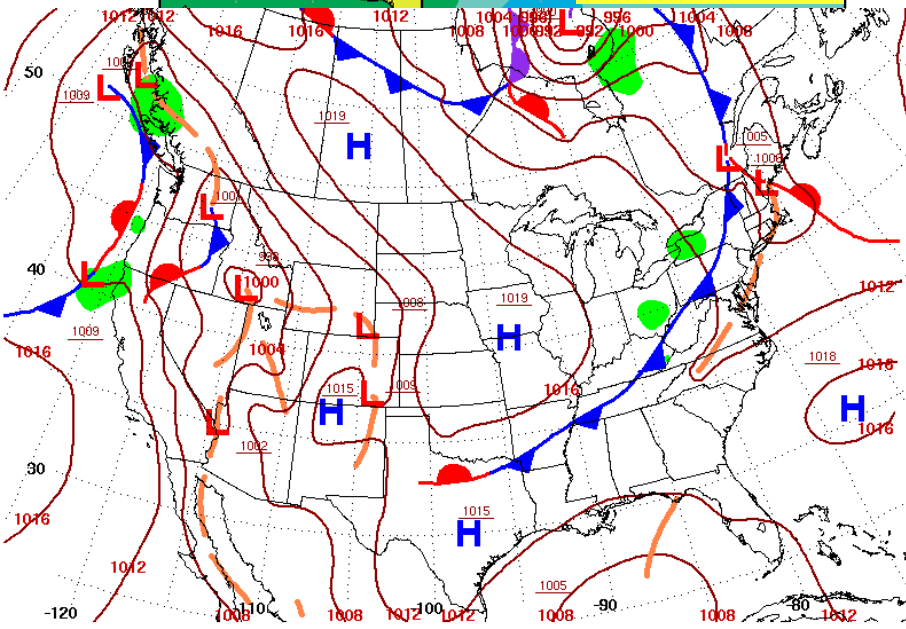
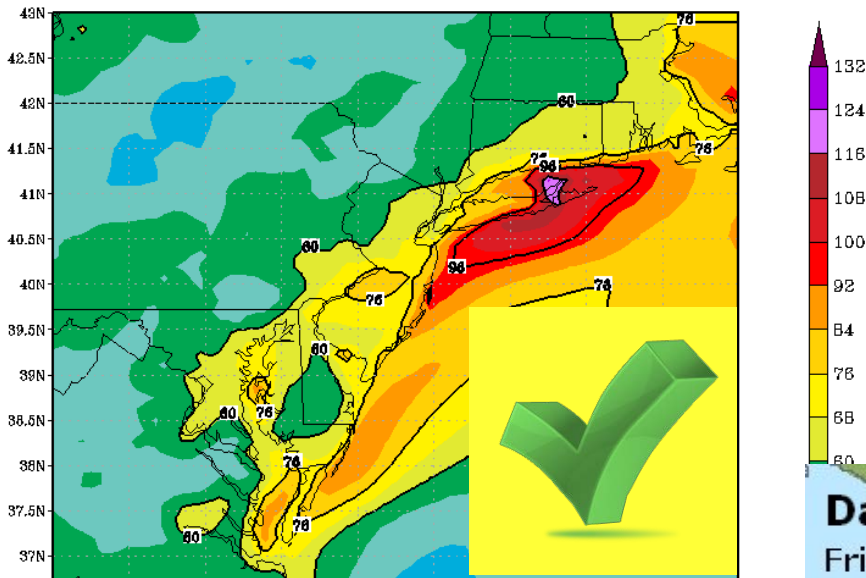
sigma=0.9975 O<sub>3</sub> (ppbv) 14H VALID 20Z 21 JUN 2012



# June 22, 2012

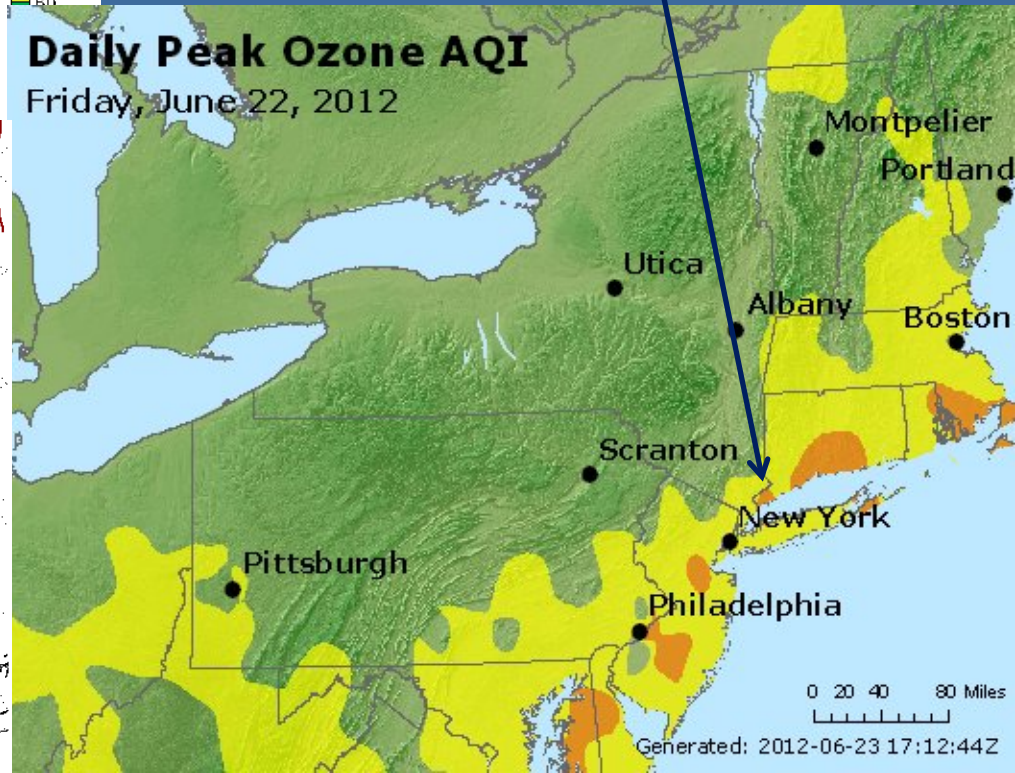
(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 22 JUN 2012

- Pre-frontal trough hangs off coast and sea-breeze advects ozone
- Model again handles this scenario well
- We forecast 75 ppb at Greenwich, verified at 81 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

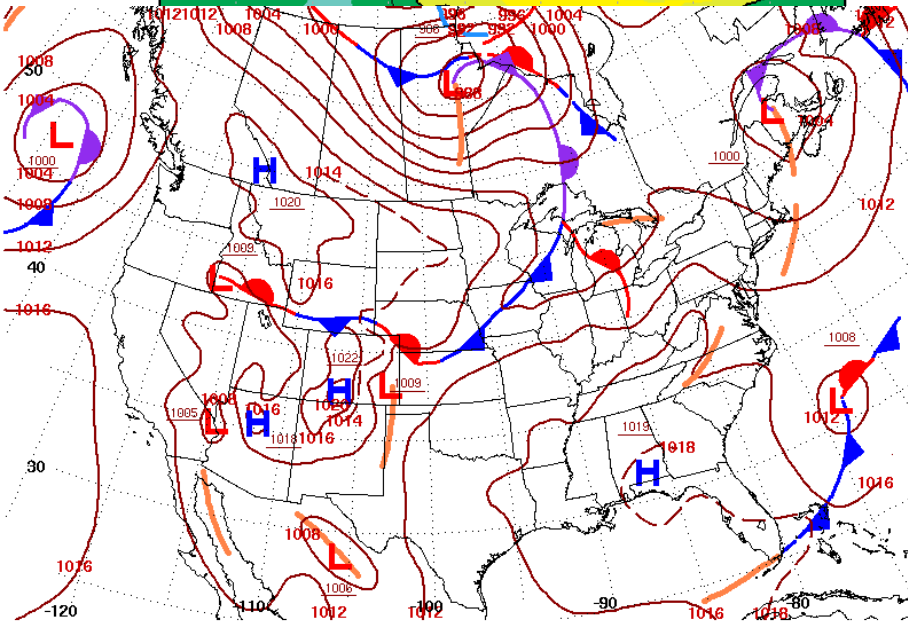
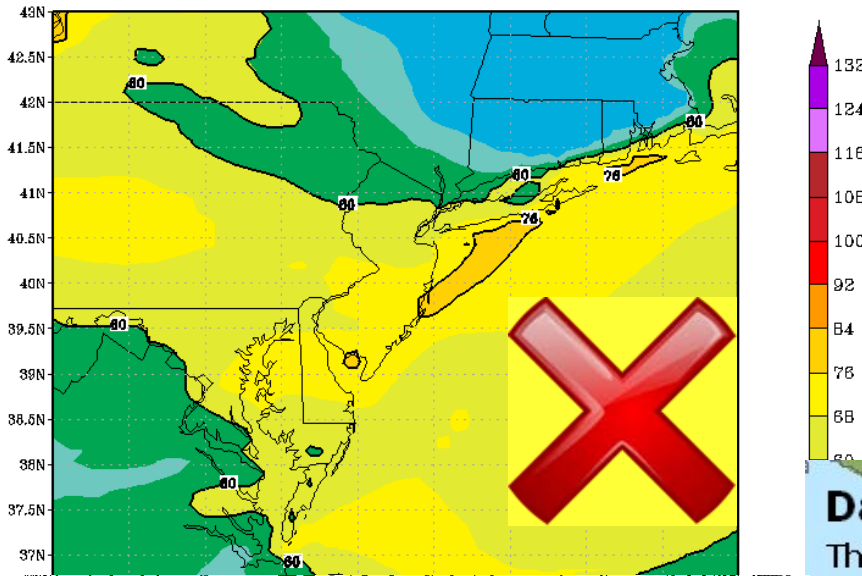
## Daily Peak Ozone AQI Friday, June 22, 2012



# June 28, 2012

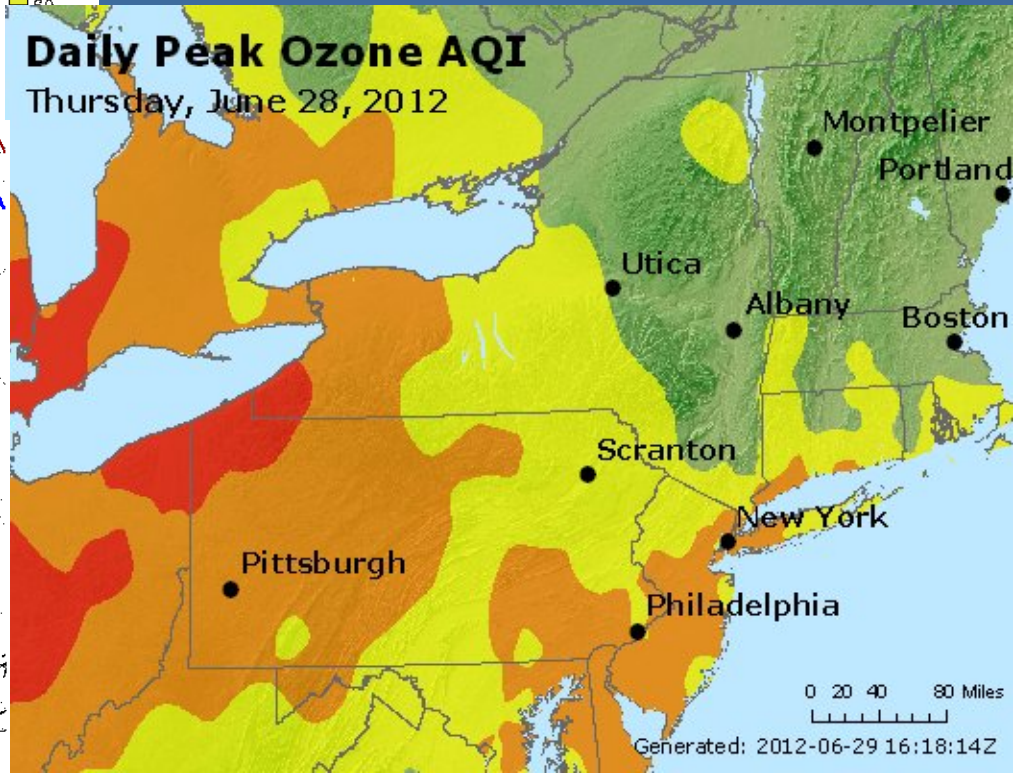
(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 28 JUN 2012

- Mid-Atlantic High produces westerly surface winds with local sea breezes again.
- We forecast 56 ppb at Greenwich, verified at 88ppb!
- Expected northwest surface winds to dominate at coast.



Surface Weather Map at 7:00 A.M. E.S.T.

## Daily Peak Ozone AQI Thursday, June 28, 2012

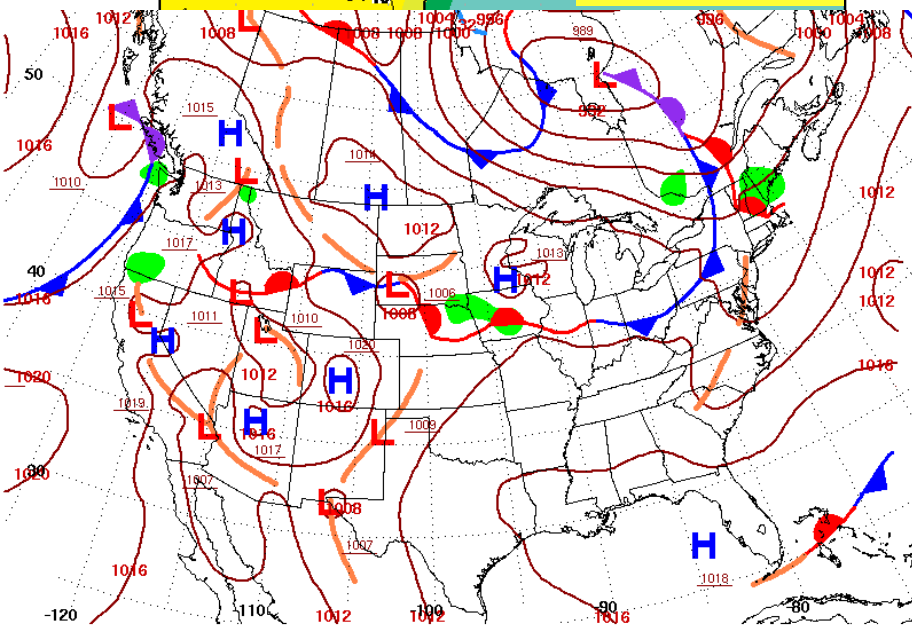
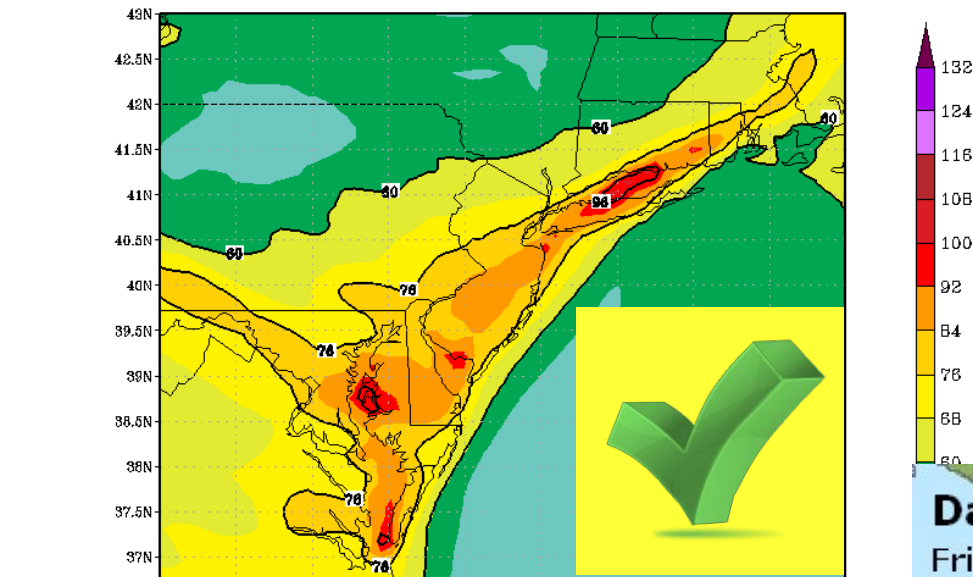




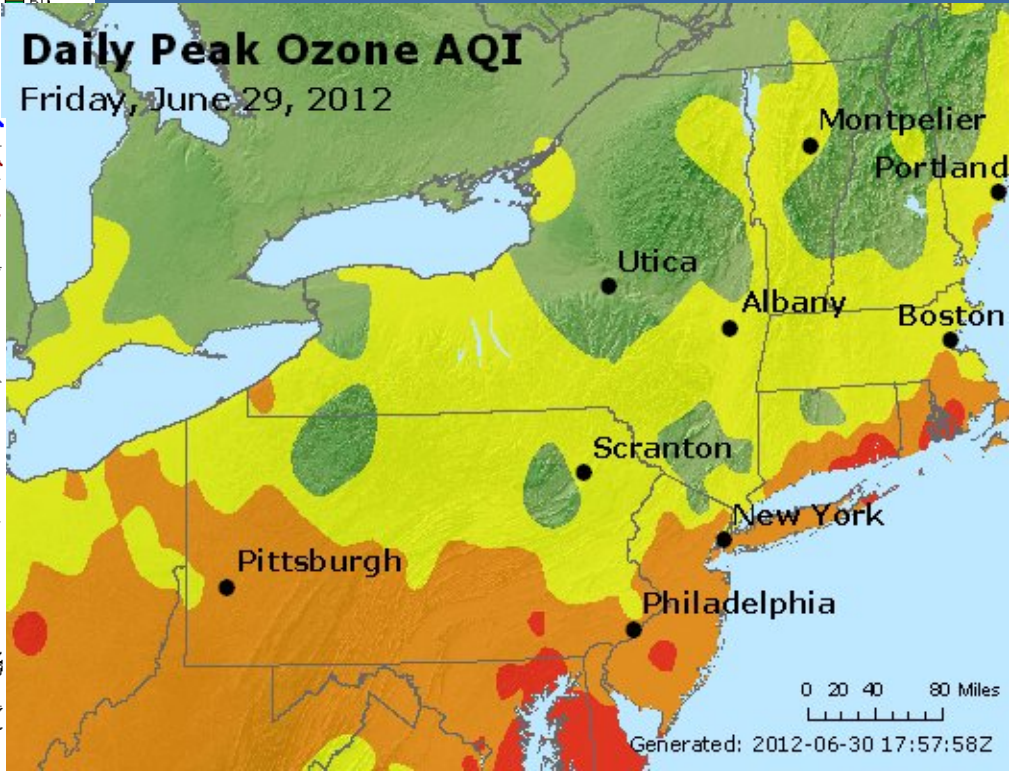
# June 29, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 29 JUN 2012

- Pre-frontal trough with southwest winds along coast
- We forecast 77 ppb at Groton, verified at 104 ppb!
- Historically, the NOAA model has over-predicted the LIS plume by 10-20ppb, but this year is different.
- Quasi-stationary pre-frontal troughs?



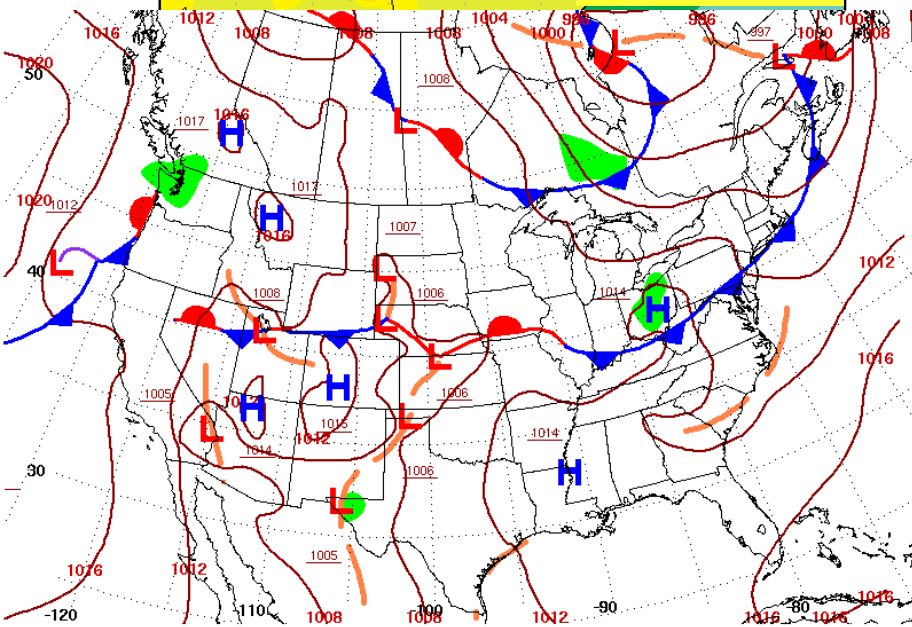
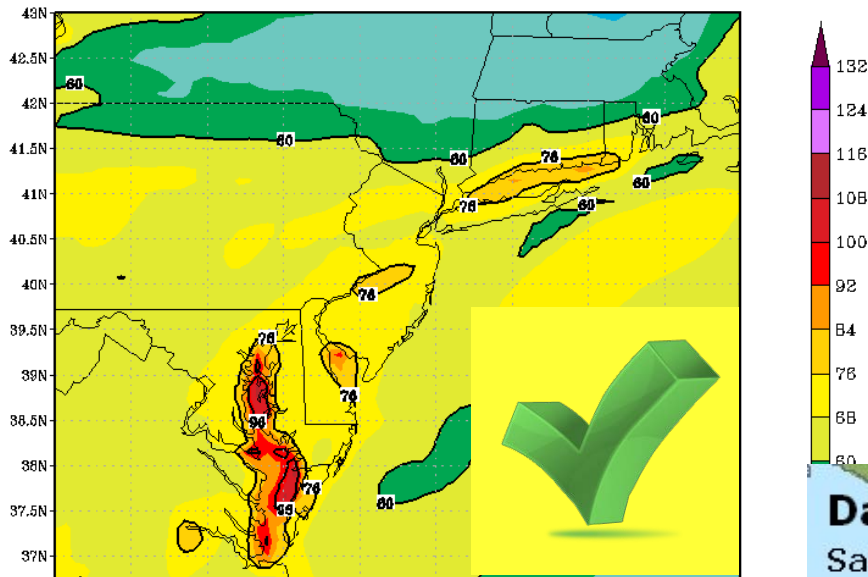
Surface Weather Map at 7:00 A.M. E.S.T.



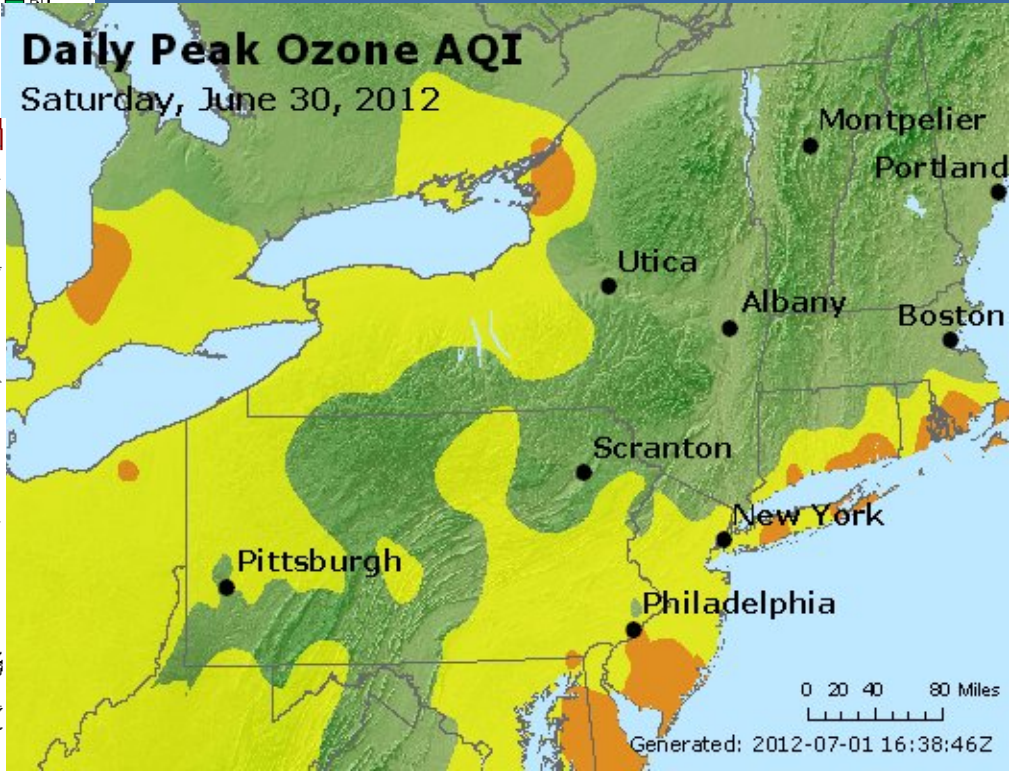
# June 30, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 30 JUN 2012

- Weak cold front stalls along coast with southwest winds occurring along coast.
- We forecast 80 ppb at Groton, verified at 83 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

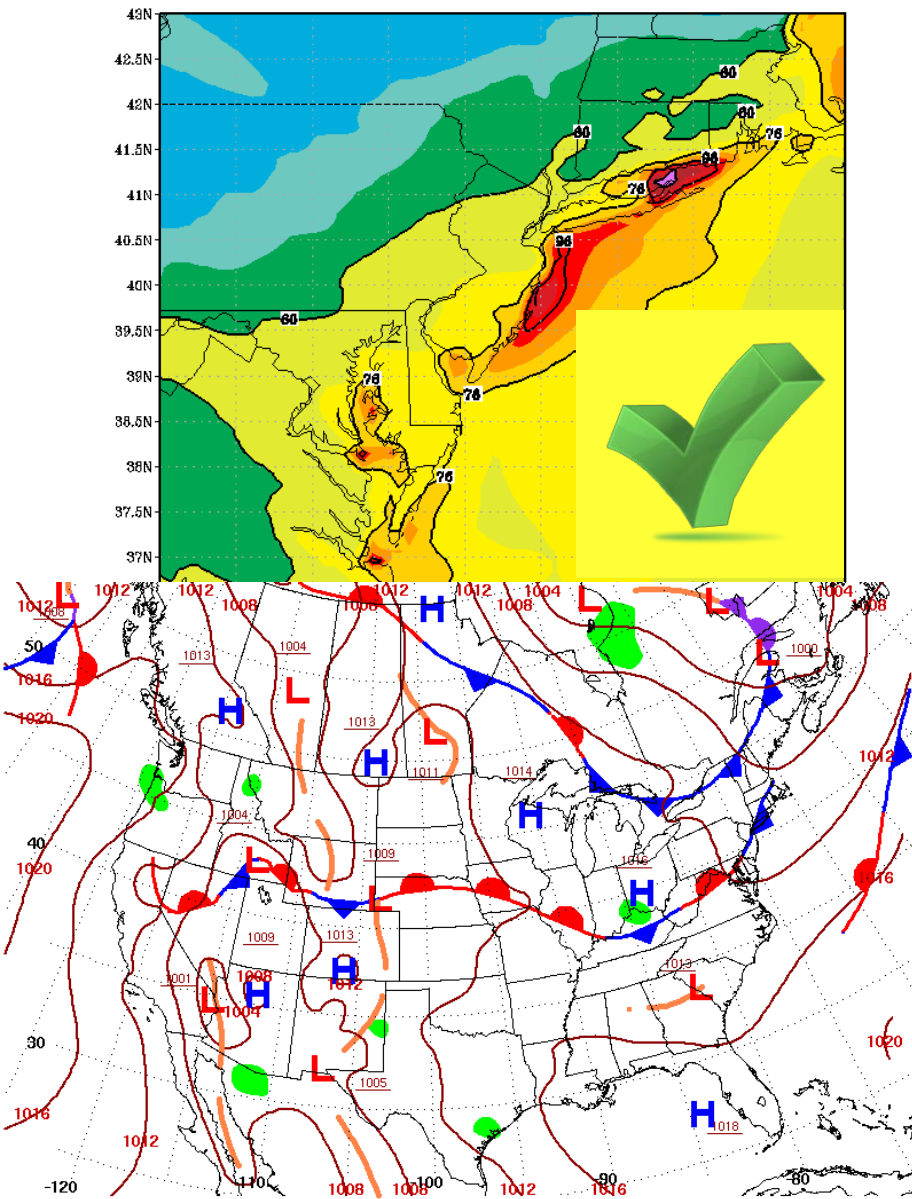




# July 1, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 01 JUL 2012

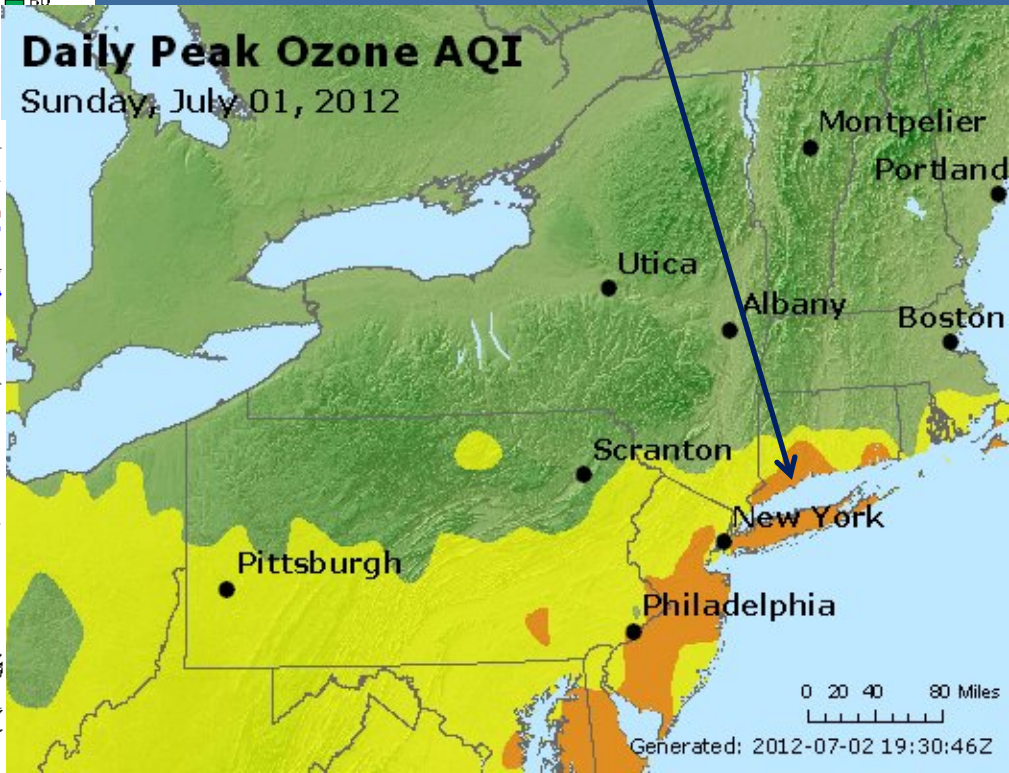
- Weak cold front dissipates along coast
- Same scenario- northwest winds inland, southwest along coast
- We forecast 72 ppb at Stratford, verified at 93 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

## Daily Peak Ozone AQI

Sunday, July 01, 2012



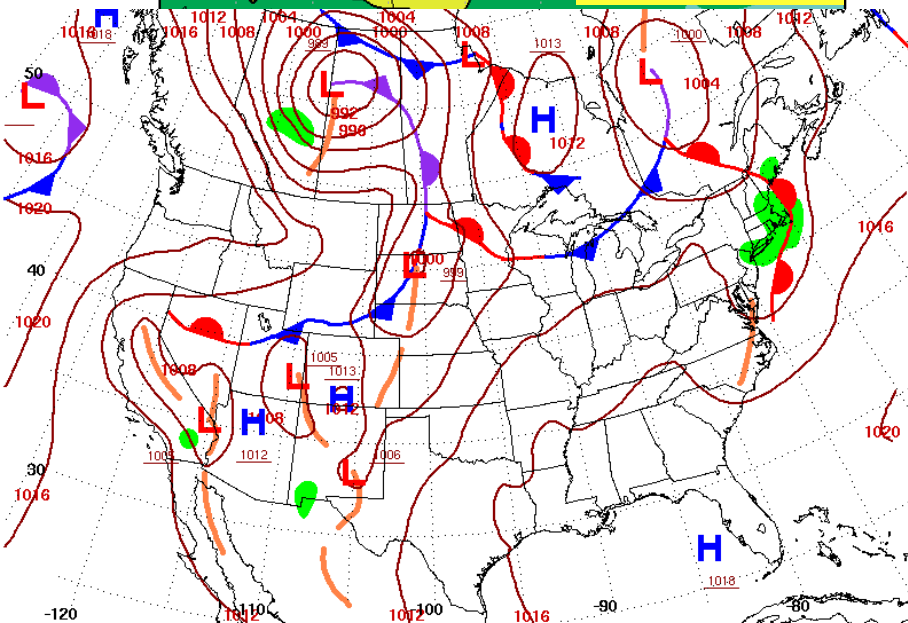
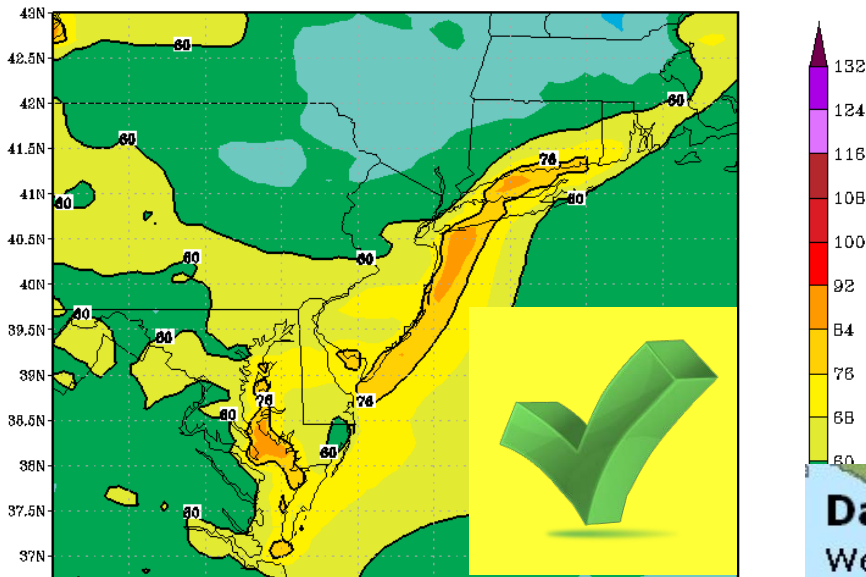
Generated: 2012-07-02 19:30:46Z



# July 4, 2012

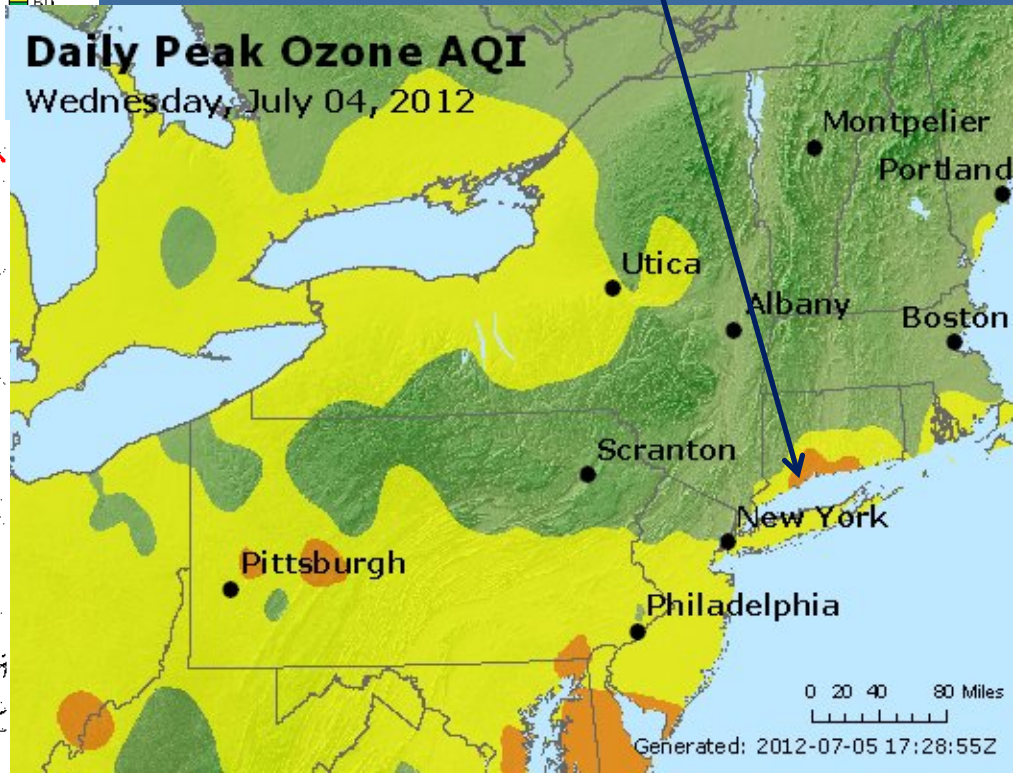
(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 04 JUL 2012

- Weak warm front, but northwest winds inland and southwest along coast
- We forecast 75ppb at Stratford, verified at 78 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

## Daily Peak Ozone AQI Wednesday, July 04, 2012

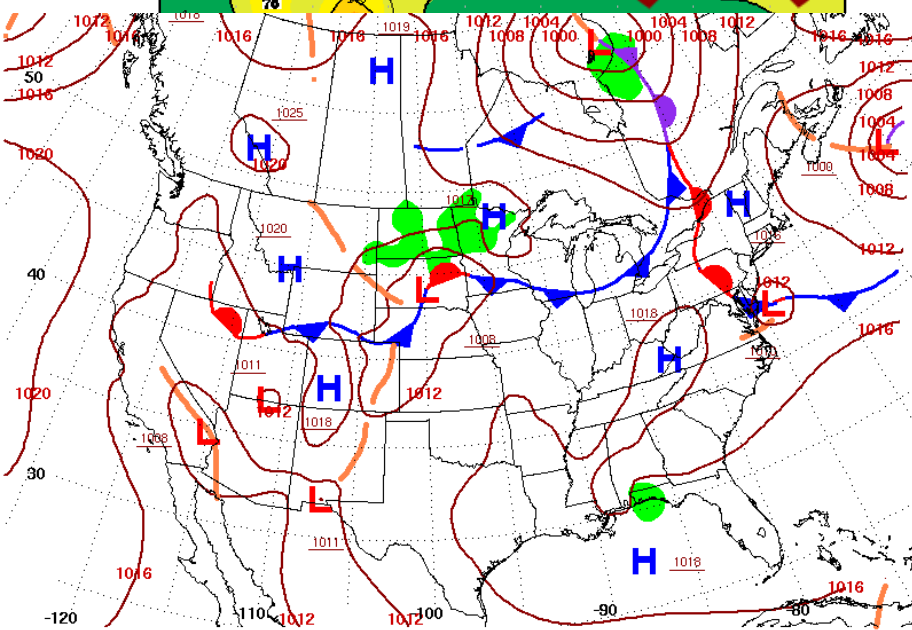
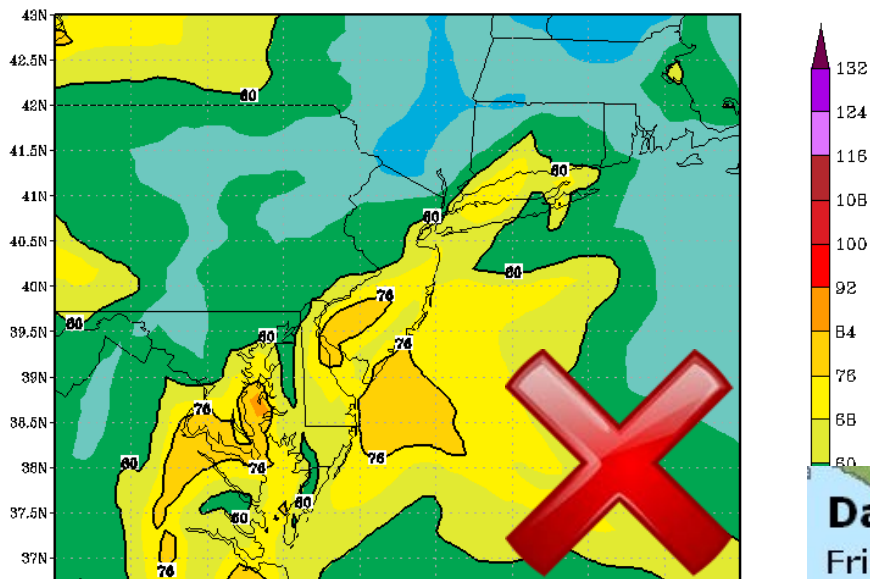


Generated: 2012-07-05 17:28:55Z

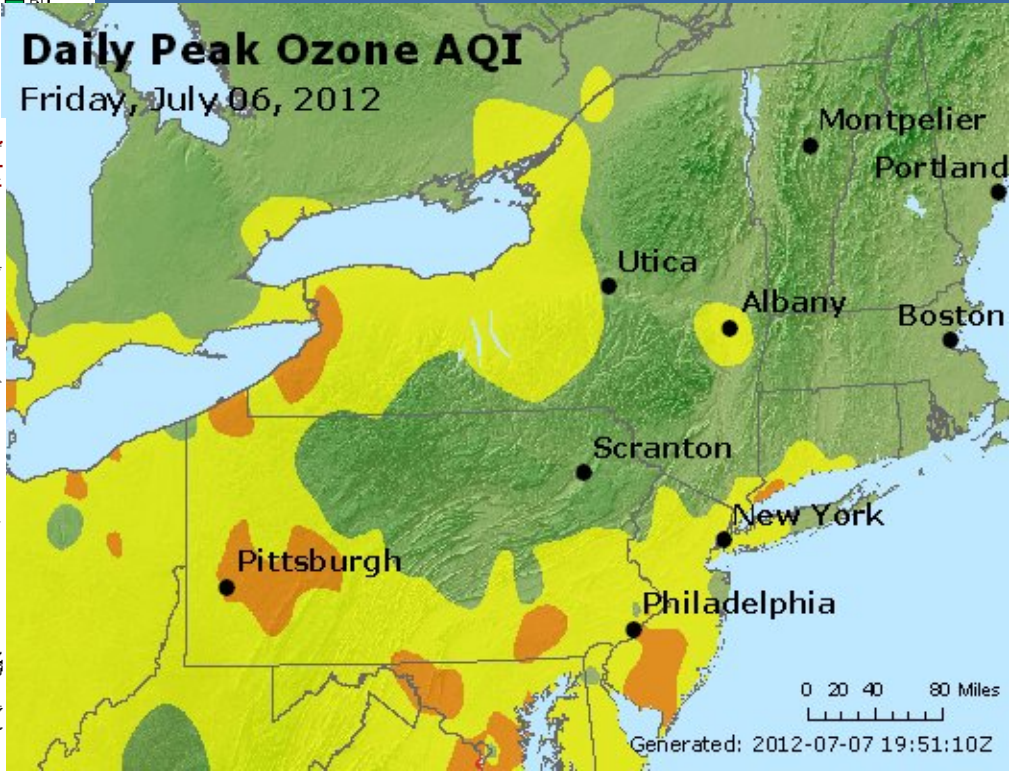
# July 6, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 06 JUL 2012

- Warm front passage late in the day
- Model had right idea, just a slight under-prediction
- We forecast 72 ppb at Westport, verified at 77 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

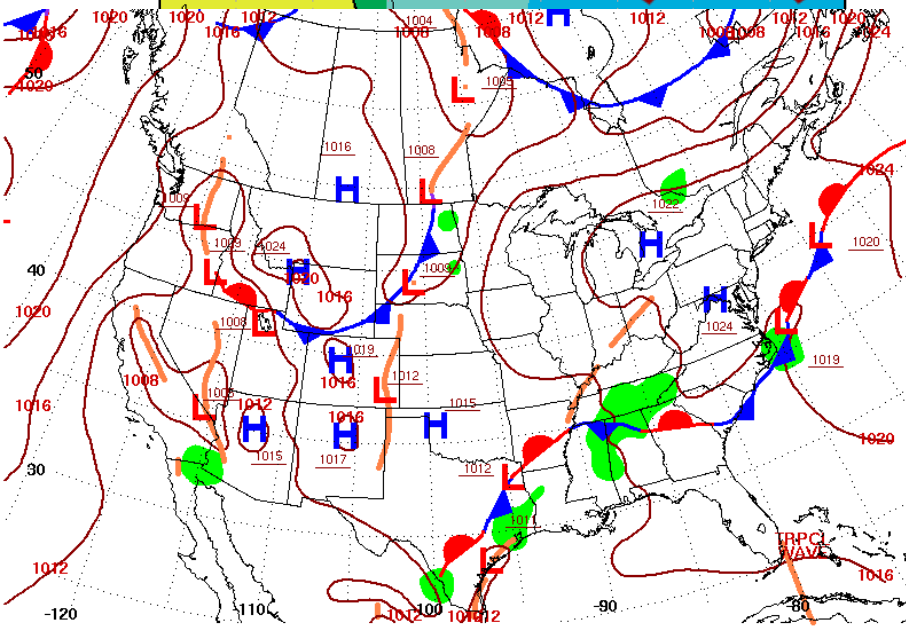
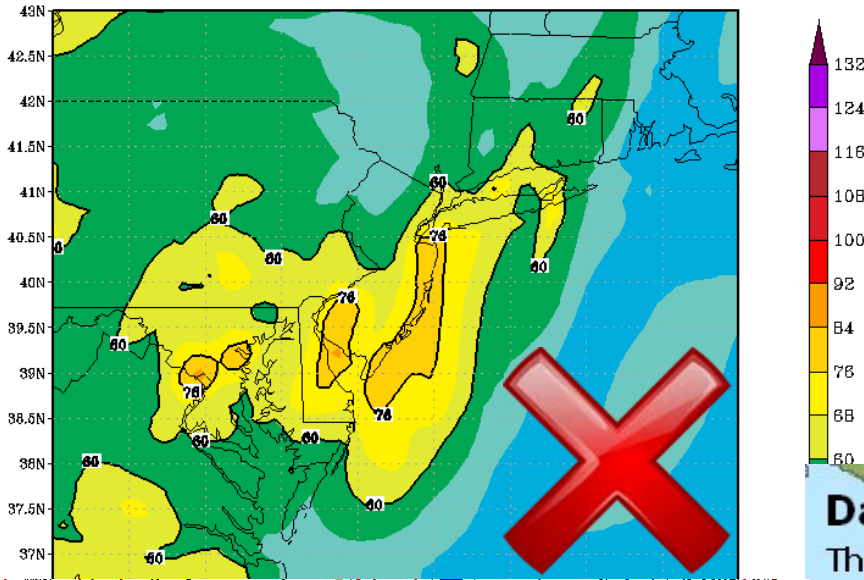




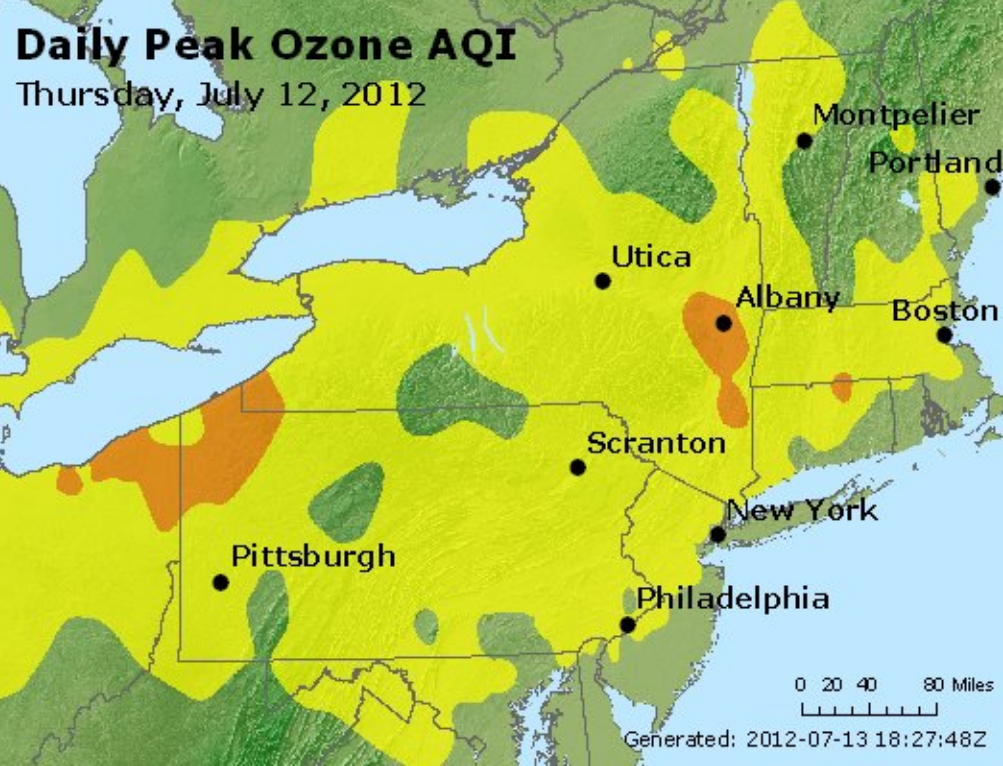
# July 12, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 12 JUL 2012

- Mostly southeast surface winds in CT
- Model under predicted, but had right idea
- We predicted 58 ppb at Stafford, verified at 76 ppb
- Probably emissions from I-95 corridor were enough for the low exceedance



Surface Weather Map at 7:00 A.M. E.S.T.



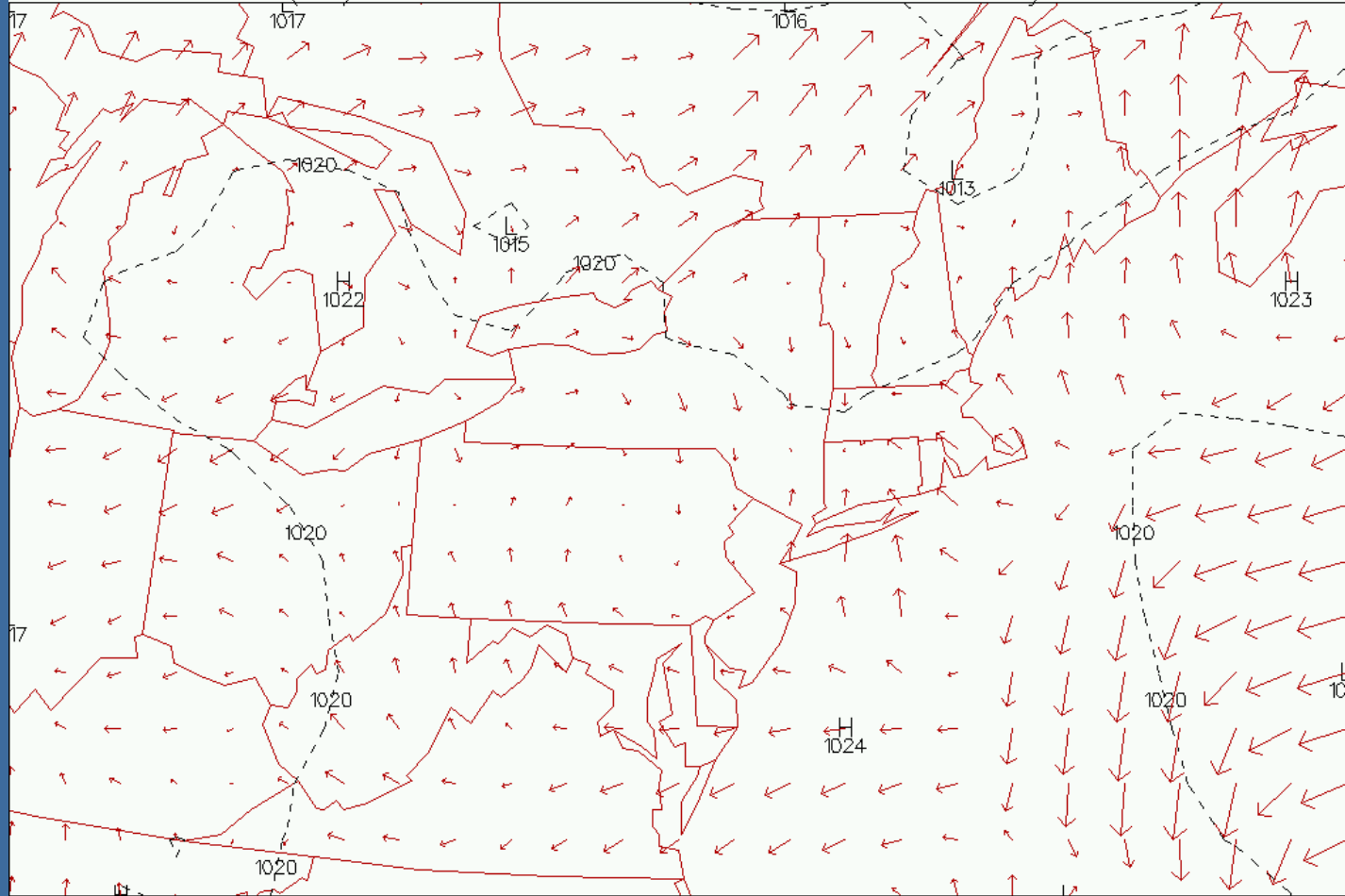


# July 12, 2012

Plymouth State Weather Center

Surface Winds (m/s)  
Sea level Pressure (mb)

WXP analysis for 18Z 12 JUL 12  
WXP analysis for 18Z 12 JUL 12



INTERVAL: 4.0

MAX: 11.3  
LO: 1012.6 HI: 1023.7

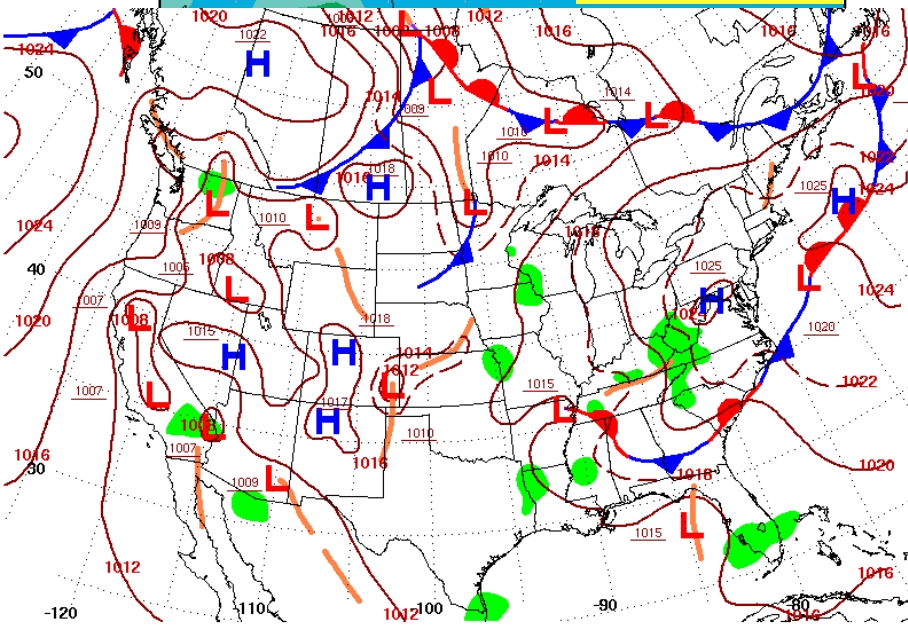
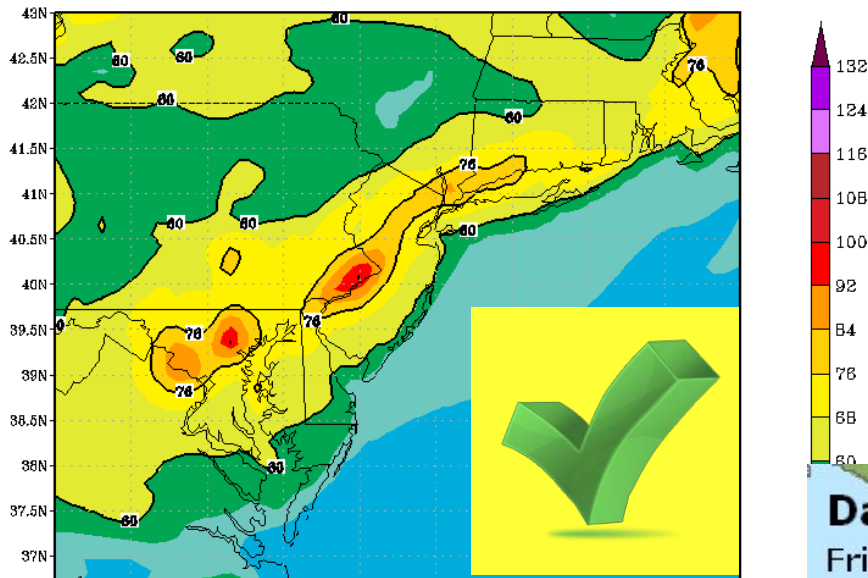


Connecticut Department of Energy and Environmental Protection

# July 13, 2012

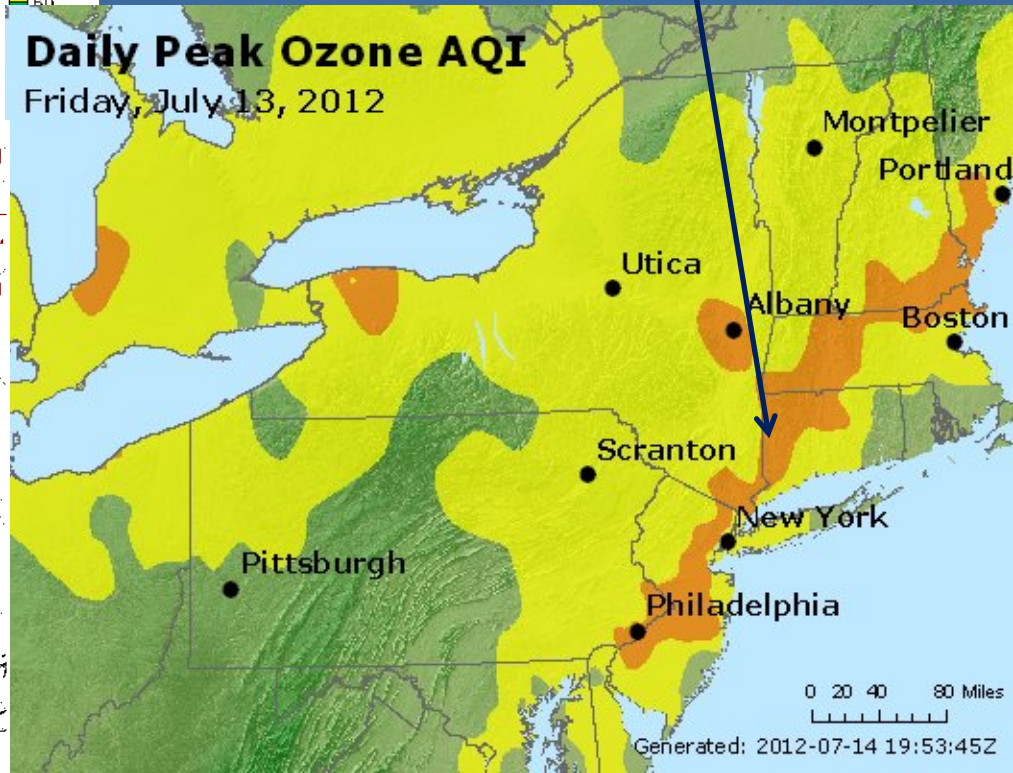
(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 13 JUL 2012

- Mostly southerly winds, turning southwest in western CT
- We forecasted 79 ppb in Danbury, verified at 90 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

## Daily Peak Ozone AQI Friday, July 13, 2012

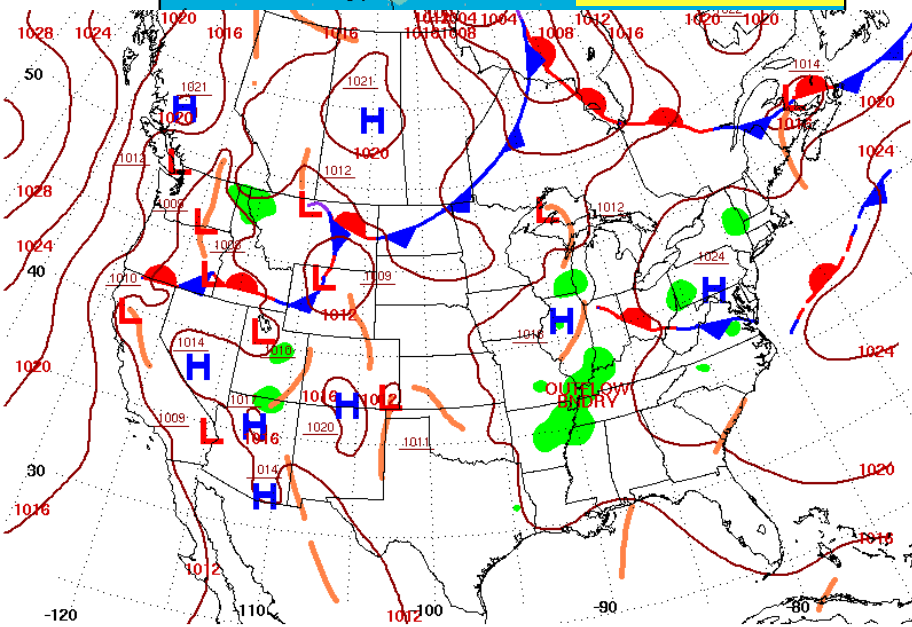
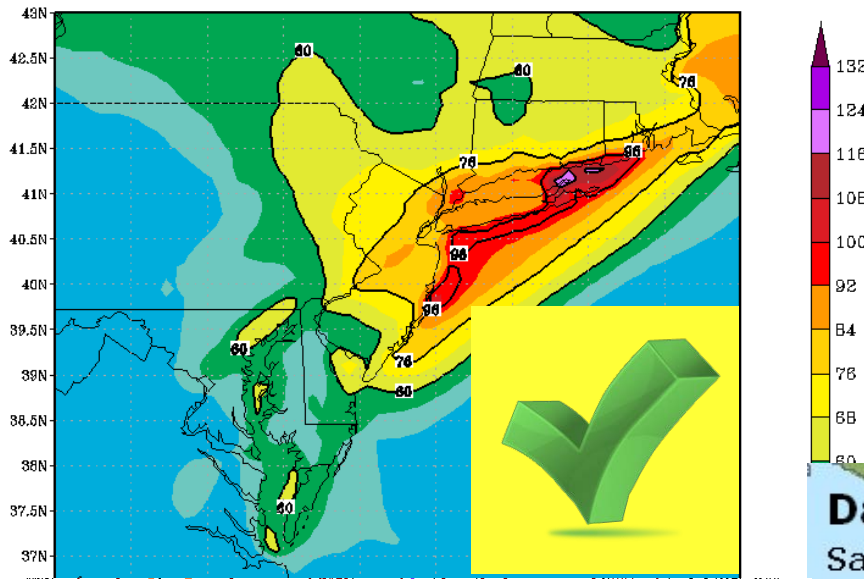




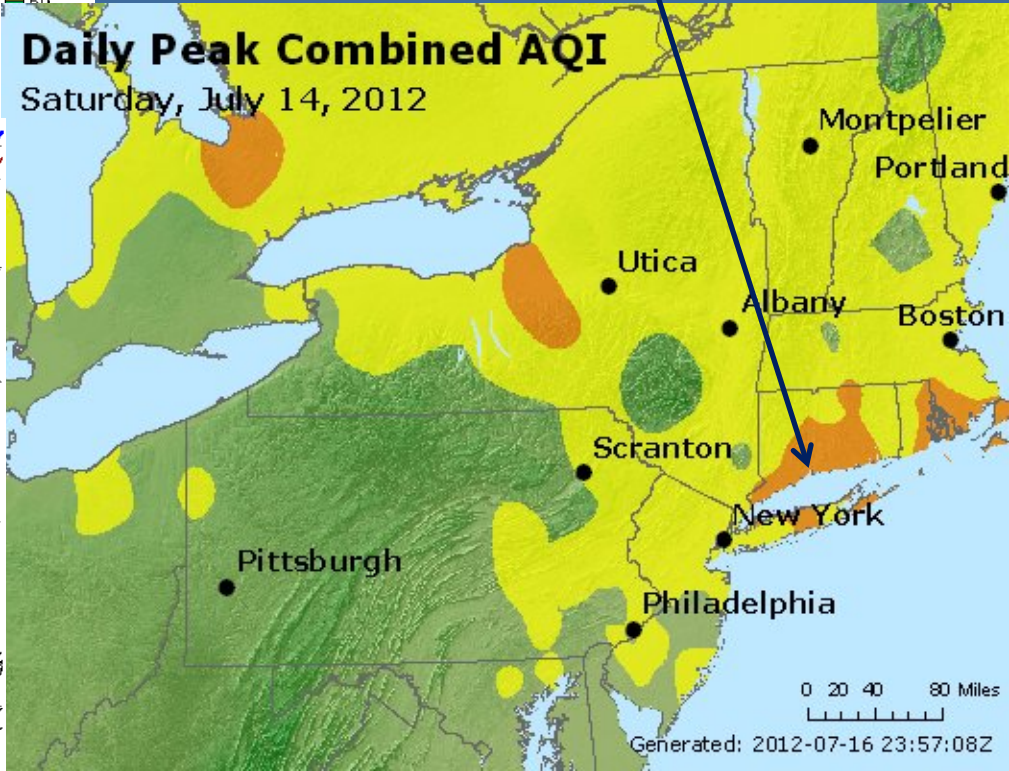
# July 14, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 14 JUL 2012

- Mid-Atlantic high scenario- westerly winds inland, southwest at coast
- We forecast 79 ppb at New Haven, verified at 90 ppb



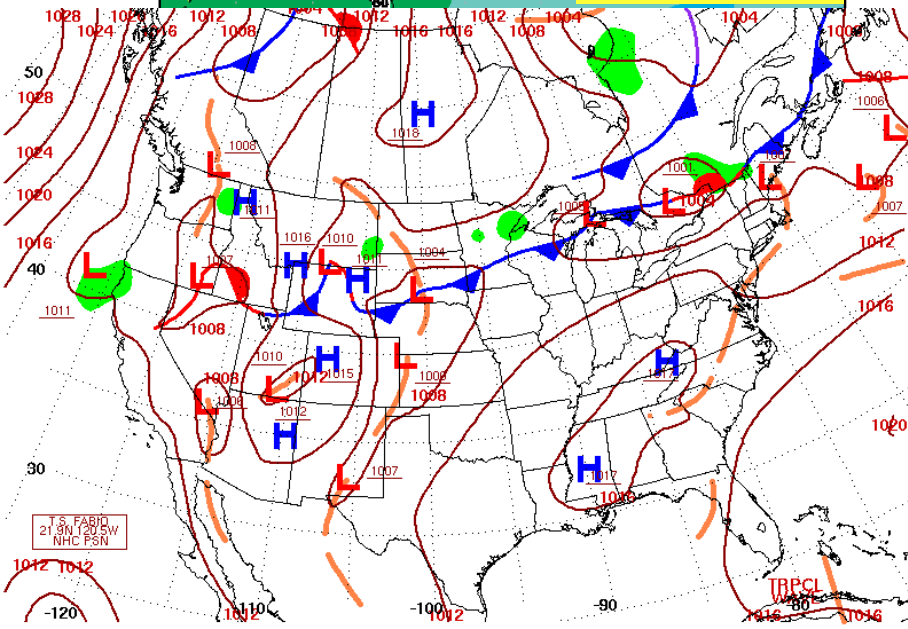
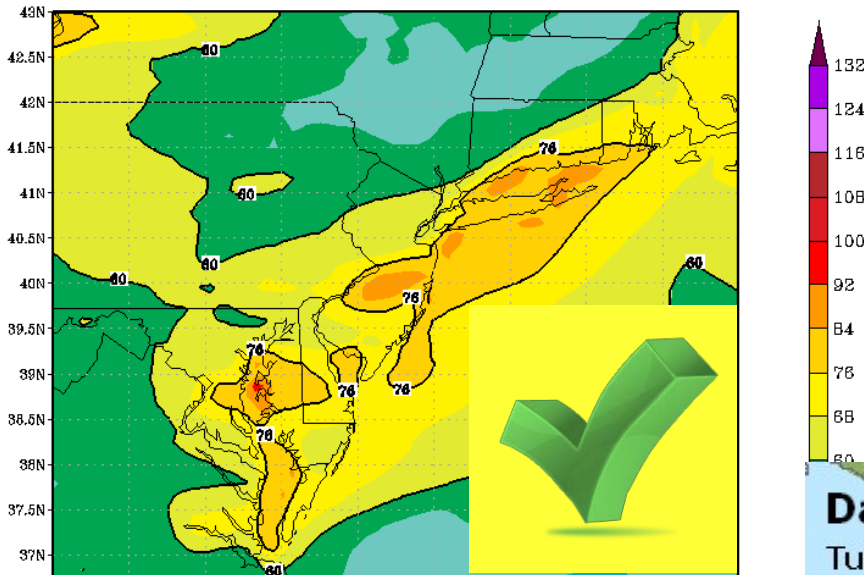
Surface Weather Map at 7:00 A.M. E.S.T.



# July 17, 2012

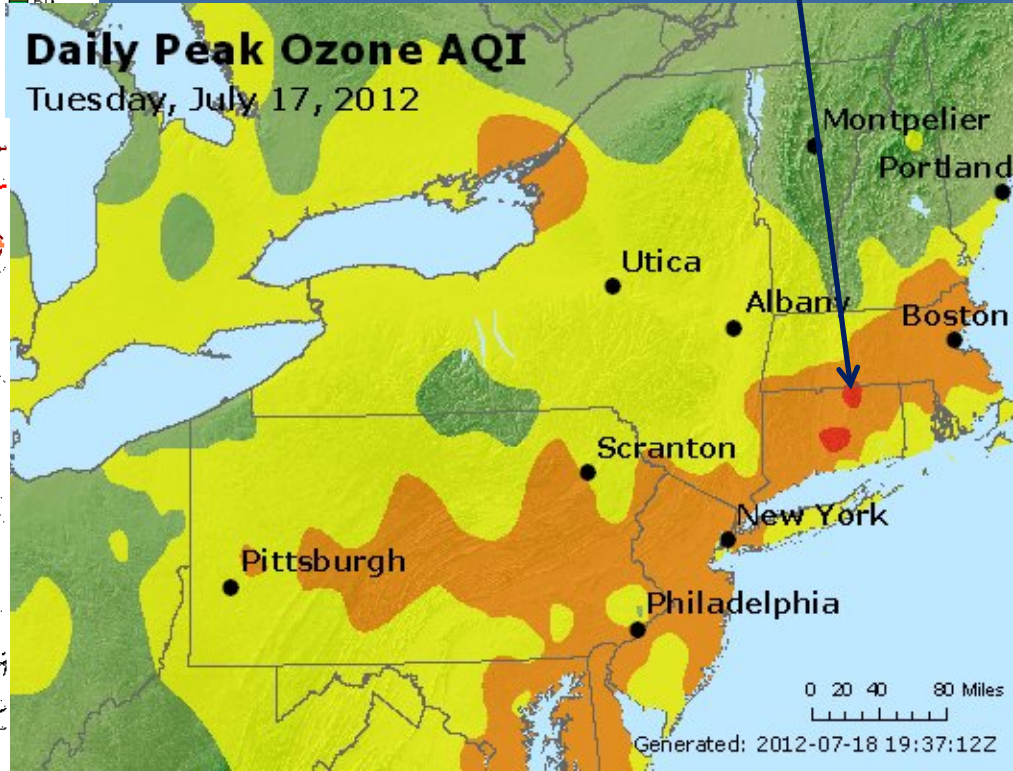
(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 17 JUL 2012

- Southwest winds in western CT, turned southerly towards the east, advecting ozone further north
- We forecasted USG along coast, but only 70 ppb at Stafford (verified at 96 ppb)
- Model missed the northerly ozone transport



Surface Weather Map at 7:00 A.M. E.S.T.

## Daily Peak Ozone AQI Tuesday, July 17, 2012

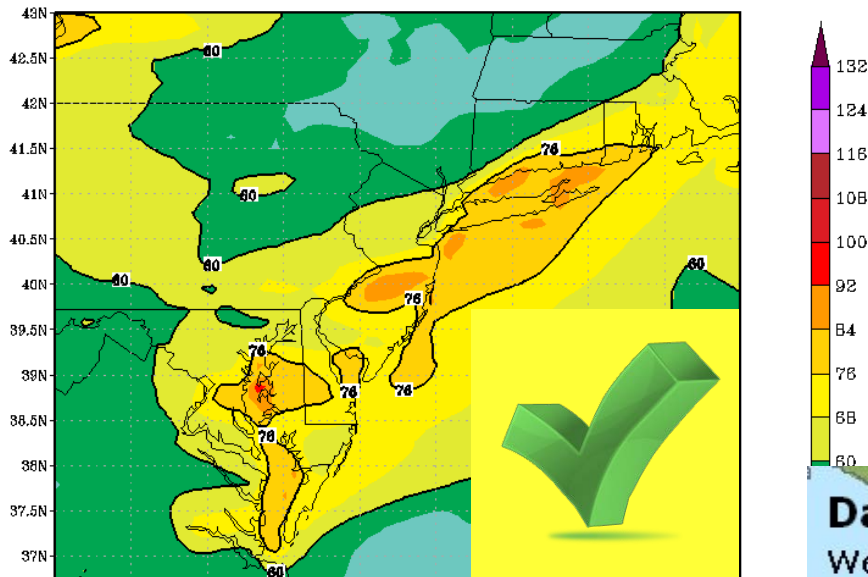




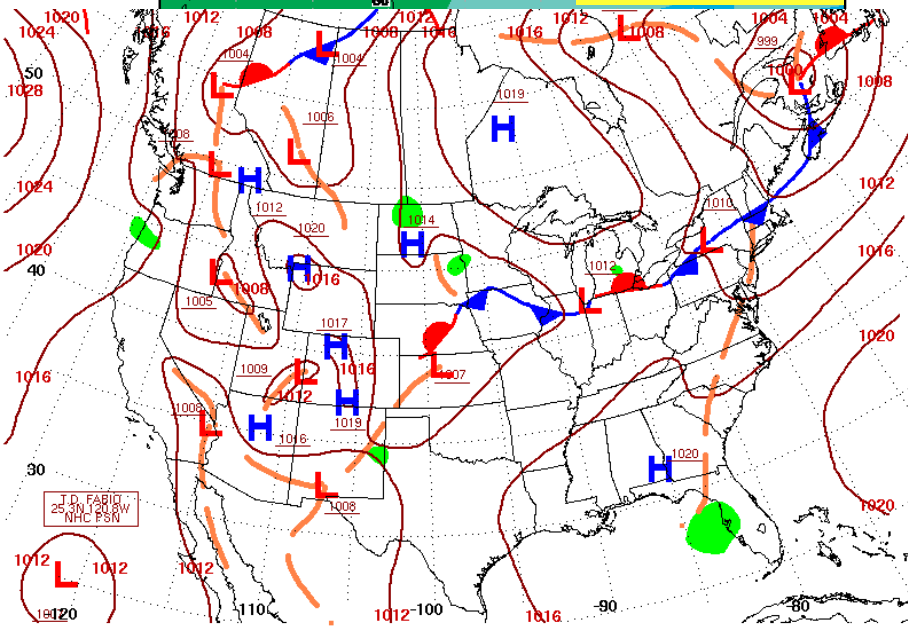
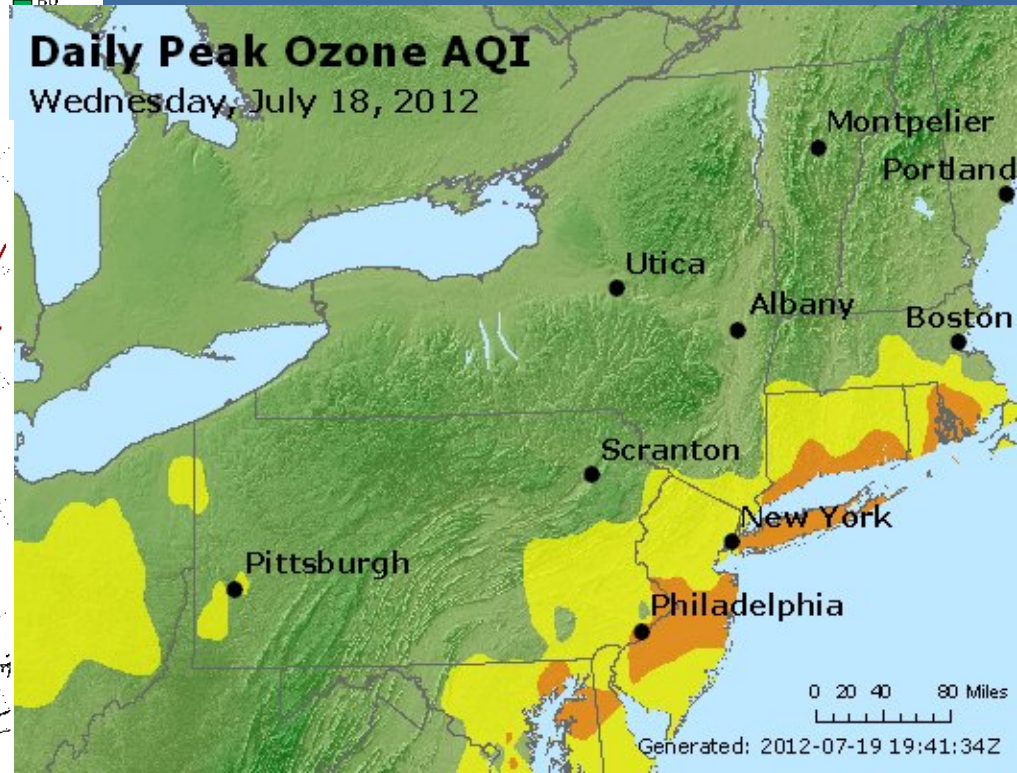
# July 18, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 17 JUL 2012

- Pre-frontal trough with southwest winds along the coast
- We forecast 78 ppb at Groton, verified at 91 ppb



## Daily Peak Ozone AQI Wednesday, July 18, 2012

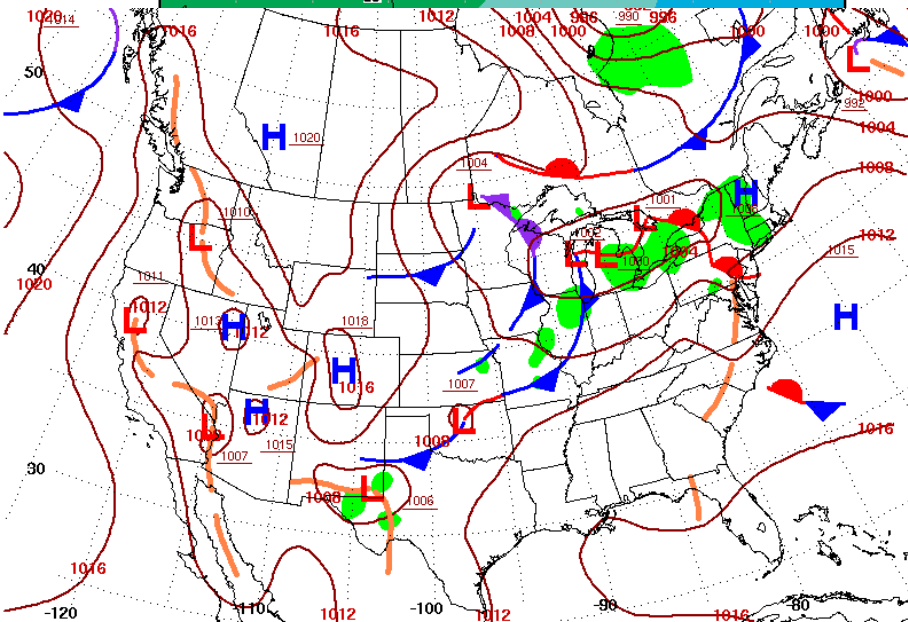
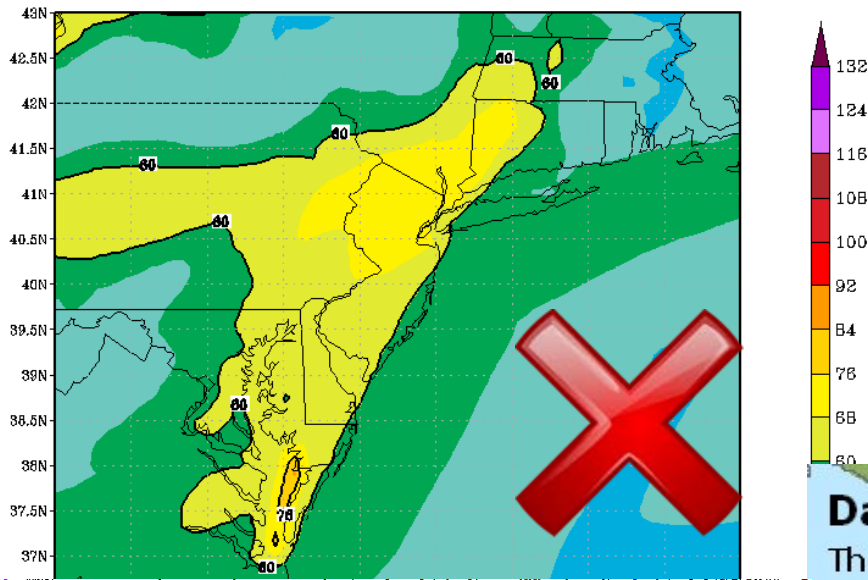


Surface Weather Map at 7:00 A.M. E.S.T.

# July 26, 2012

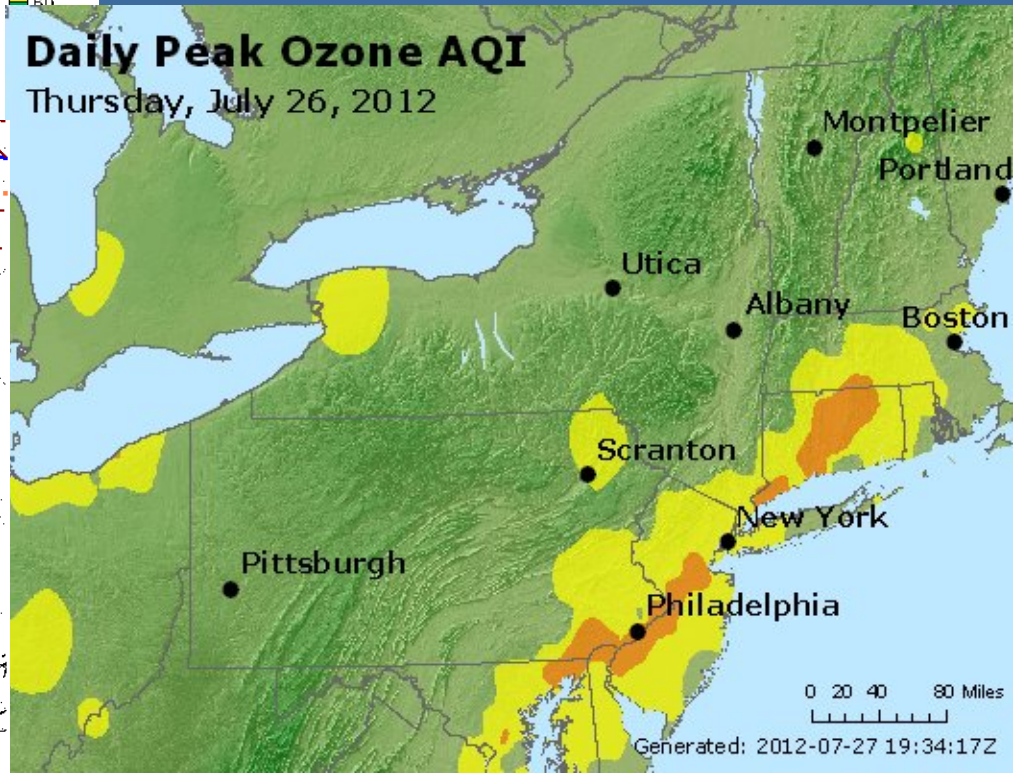
(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 26 JUL 2012

- Broad southwest flow develops after warm front passage
- Model slightly under predicted this event by 10-15 ppb
- We predicted 58 ppb at Stafford, verified at 83 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

## Daily Peak Ozone AQI Thursday, July 26, 2012



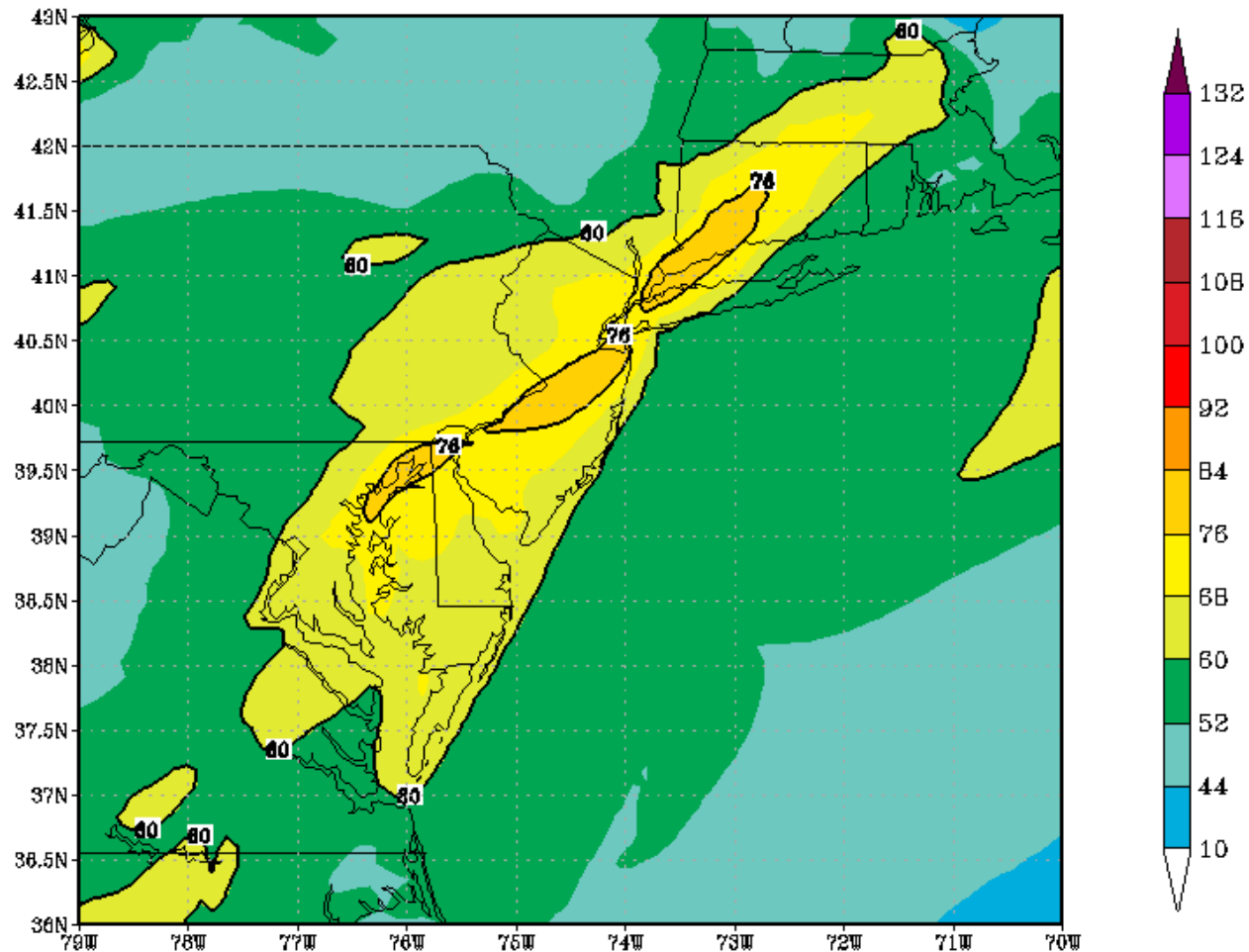
Generated: 2012-07-27 19:34:17Z



# July 26, 2012

- However, same –day prediction picked it up which means meteorology changed.

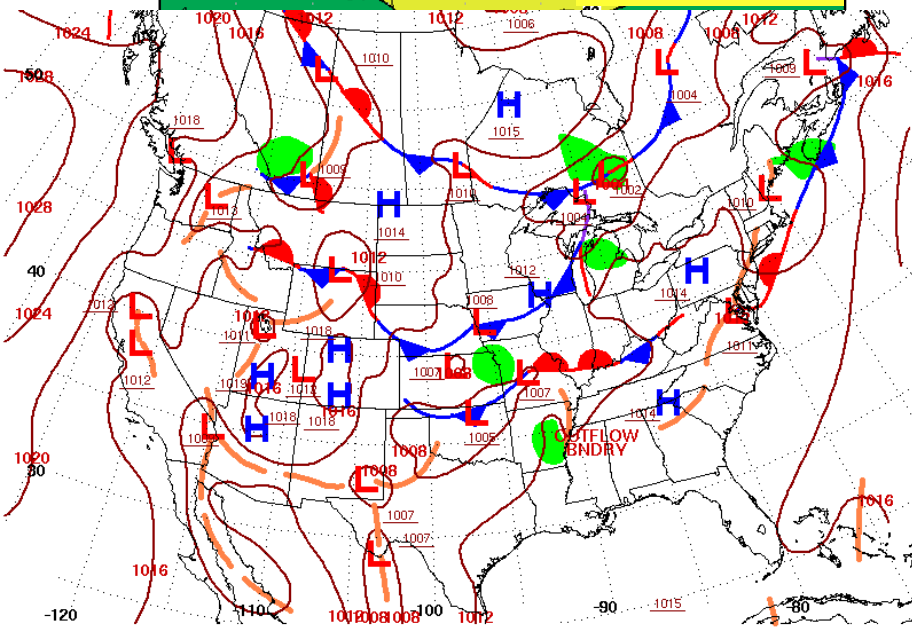
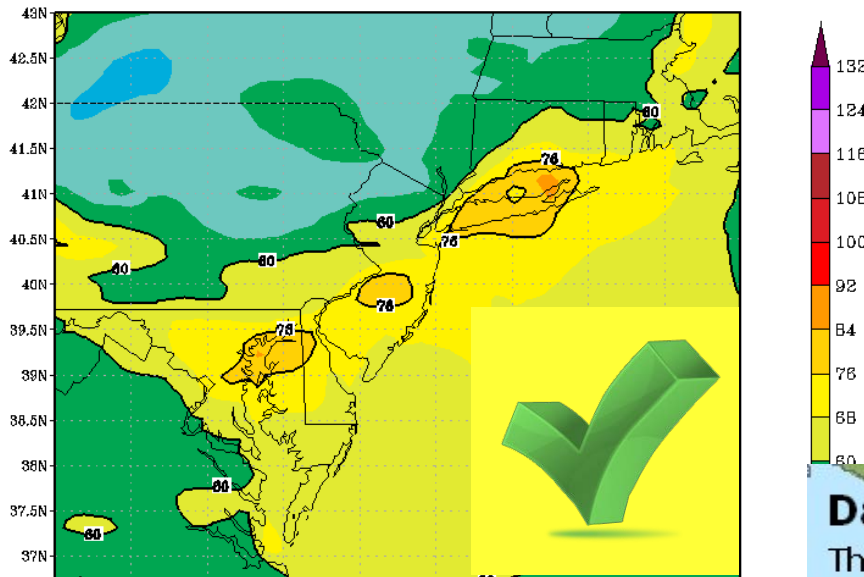
(prd) 06Z 7H-30H 1st d 8h max sf O<sub>3</sub> (ppbv) Valid 26 JUL 2012



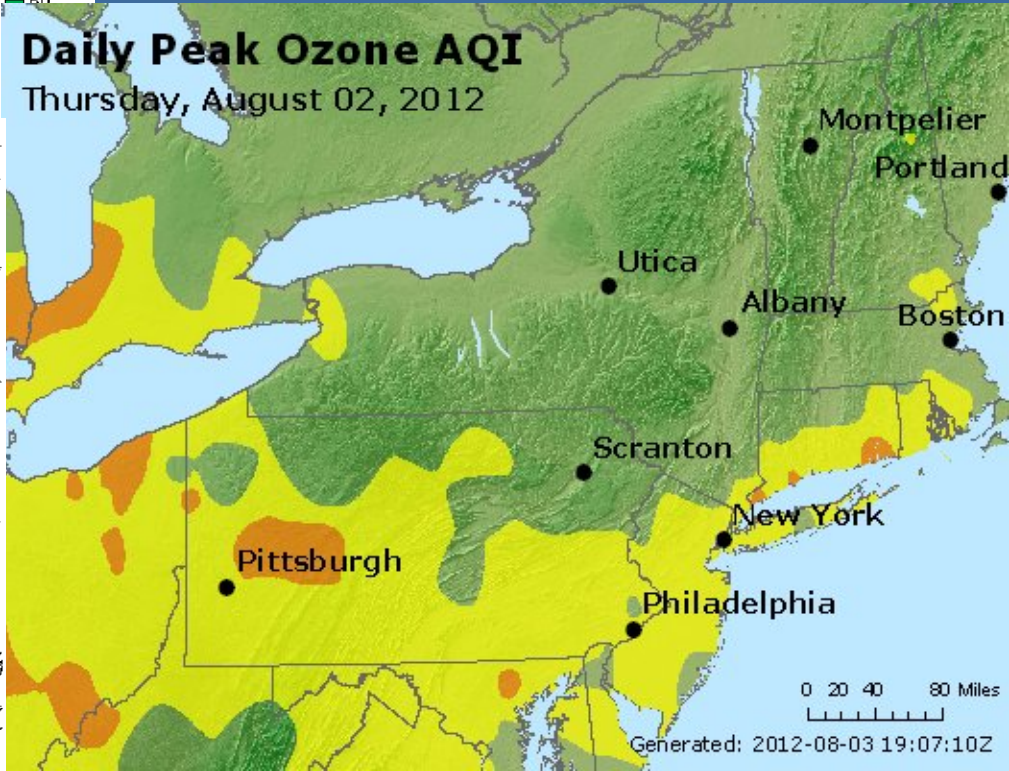
# August 2, 2012

(prd) 12Z 25H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 02 AUG 2012

- Winds turn southwesterly during the day with weak high pressure
- We forecasted 78 ppb at Greenwich, verified at 81 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

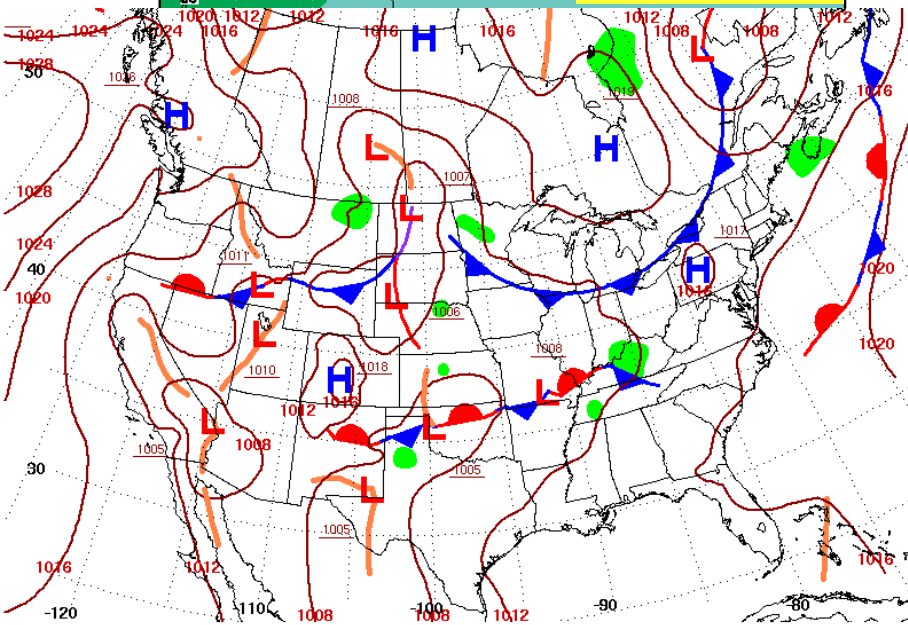
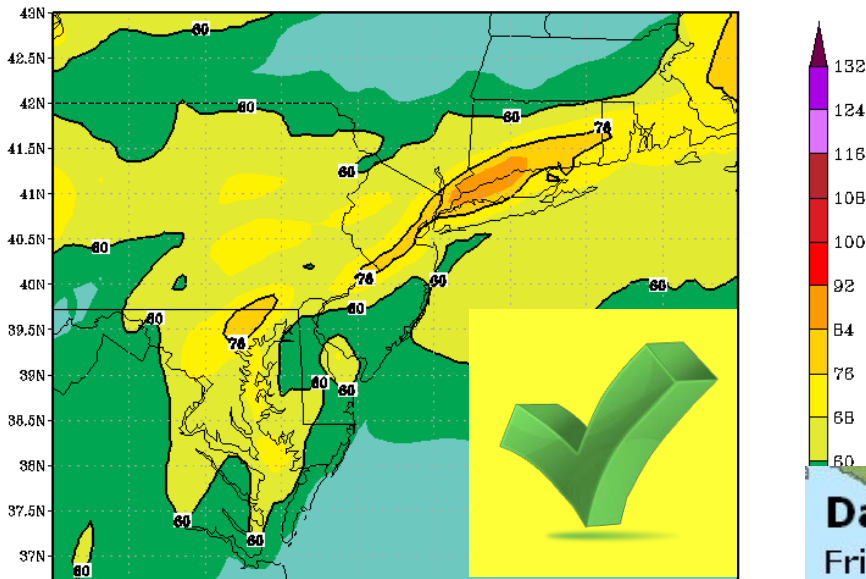




# August 3, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 03 AUG 2012

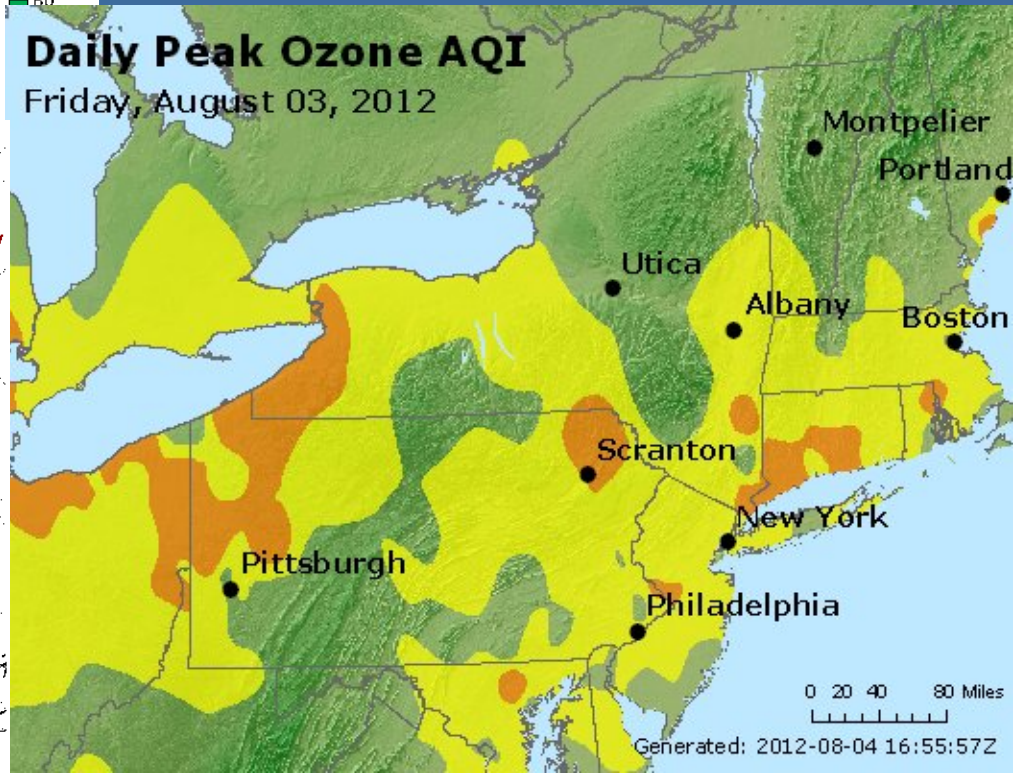
- Southwest winds with approaching cold front
- Model performed well
- We forecasted 84 ppb at Stratford, verified at 84 ppb



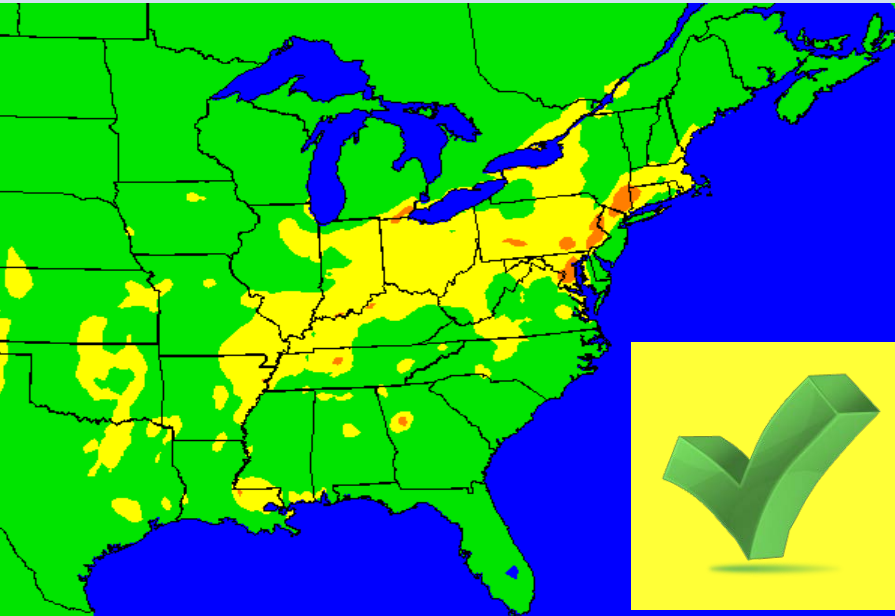
Surface Weather Map at 7:00 A.M. E.S.T.

## Daily Peak Ozone AQI

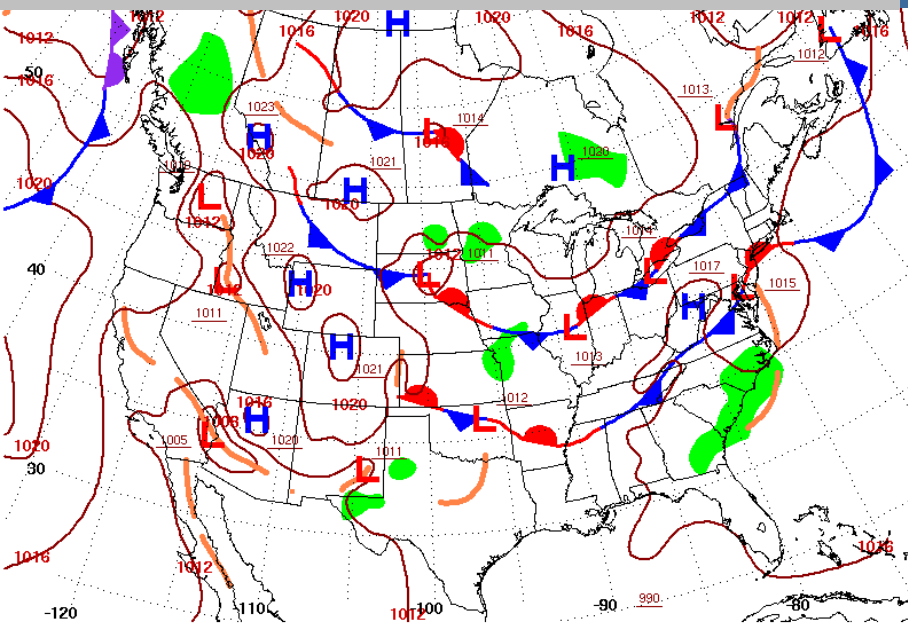
Friday, August 03, 2012



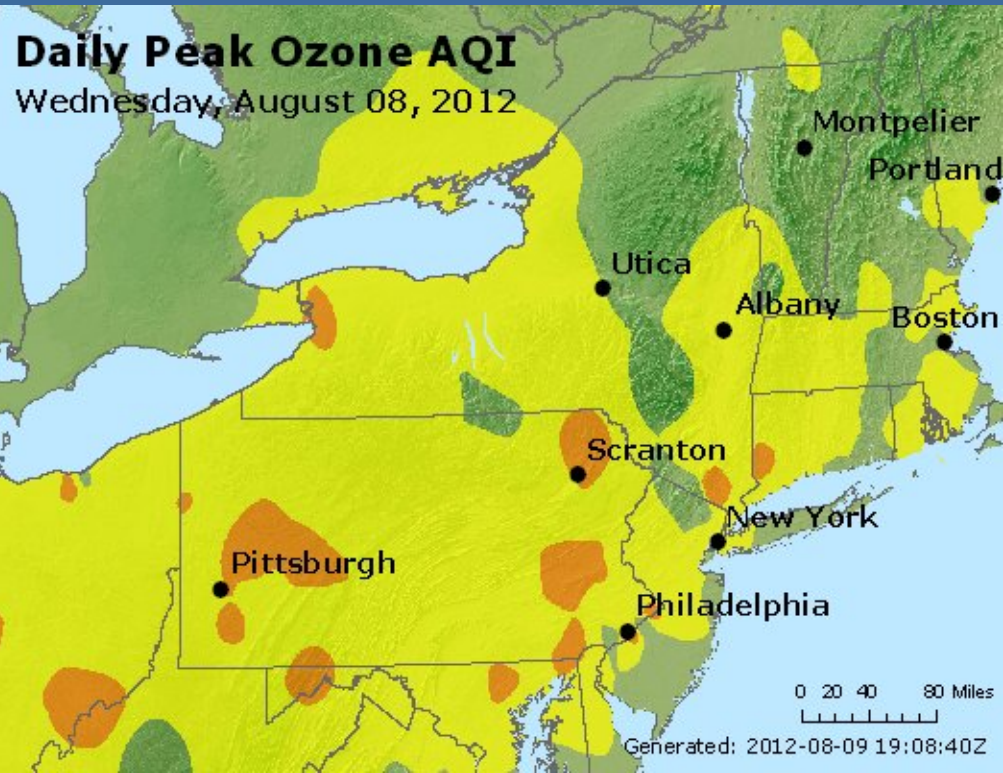
# August 8, 2012



- Mostly southerly winds, so expected maritime influence
- Model got it right!
- We forecasted 59 ppb at Danbury, verified at 78!

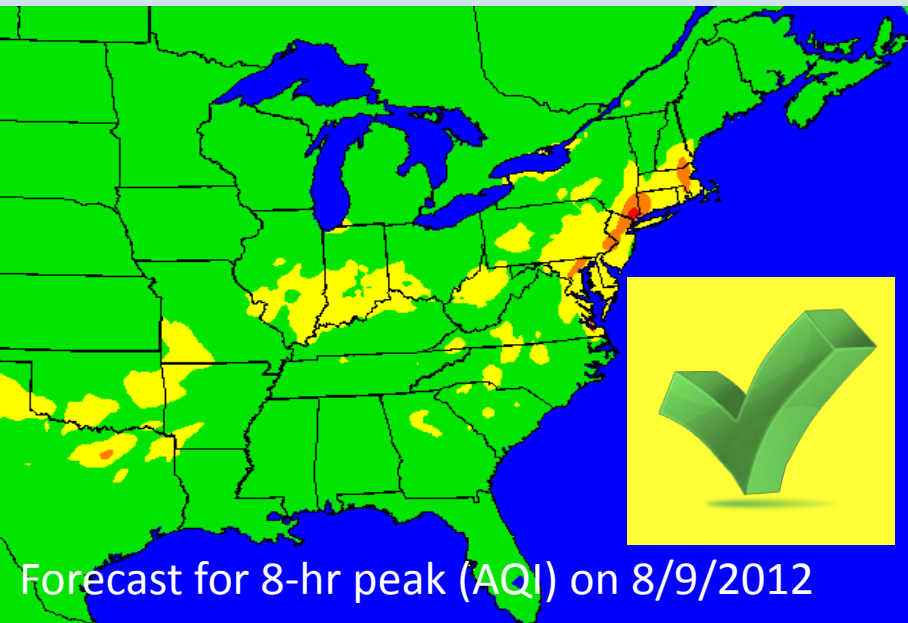


Surface Weather Map at 7:00 A.M. E.S.T.

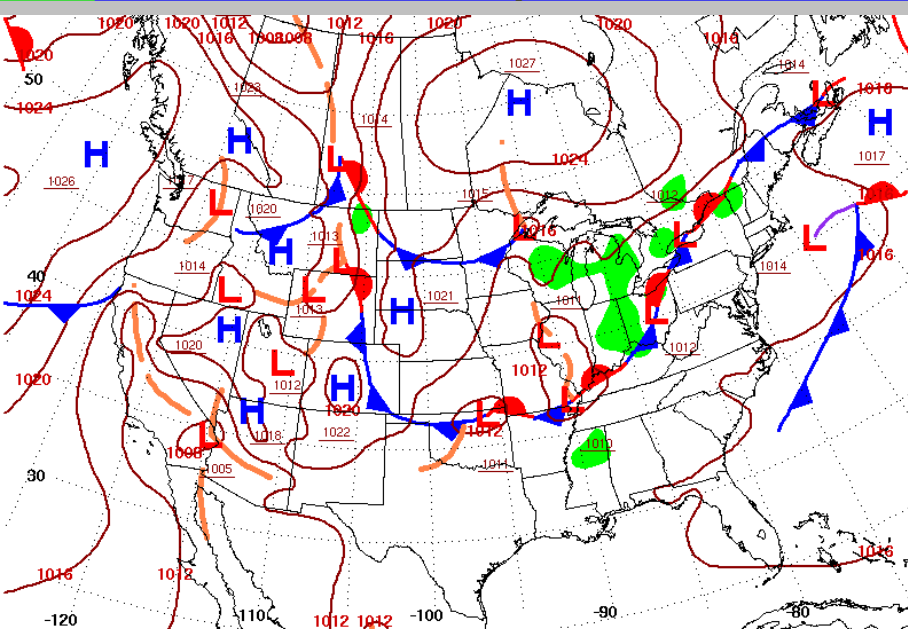




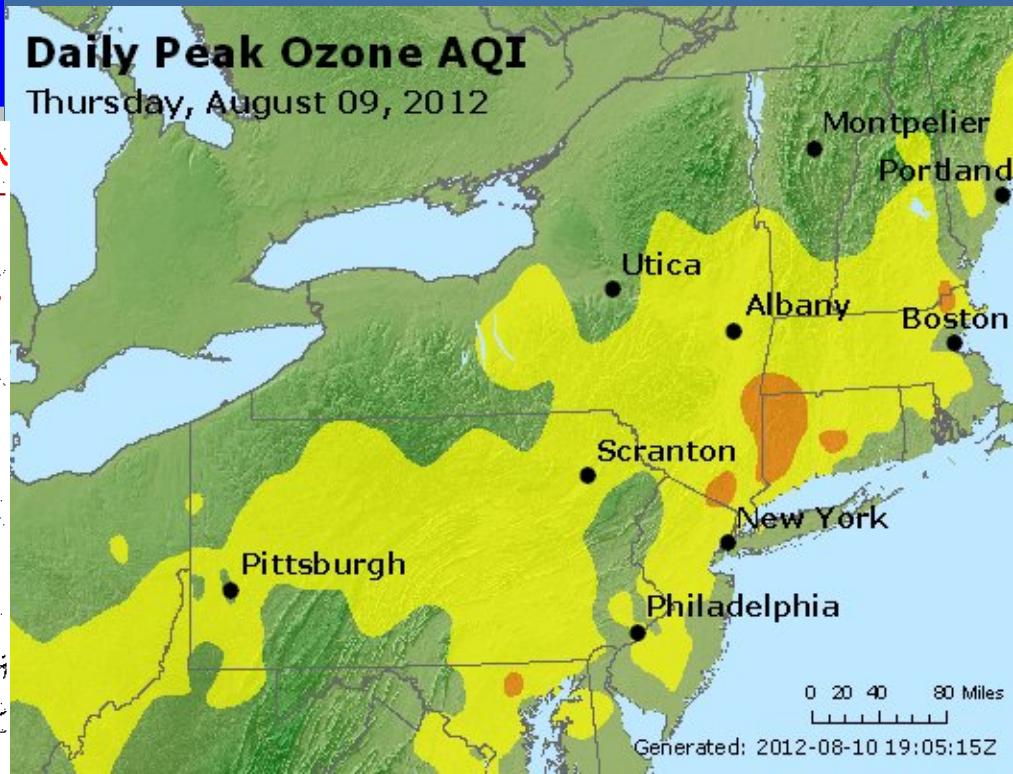
# August 9, 2012



- Another case of southerly winds at surface
- We forecasted at 79 ppb at Danbury, verified at 87 ppb



## Daily Peak Ozone AQI Thursday, August 09, 2012

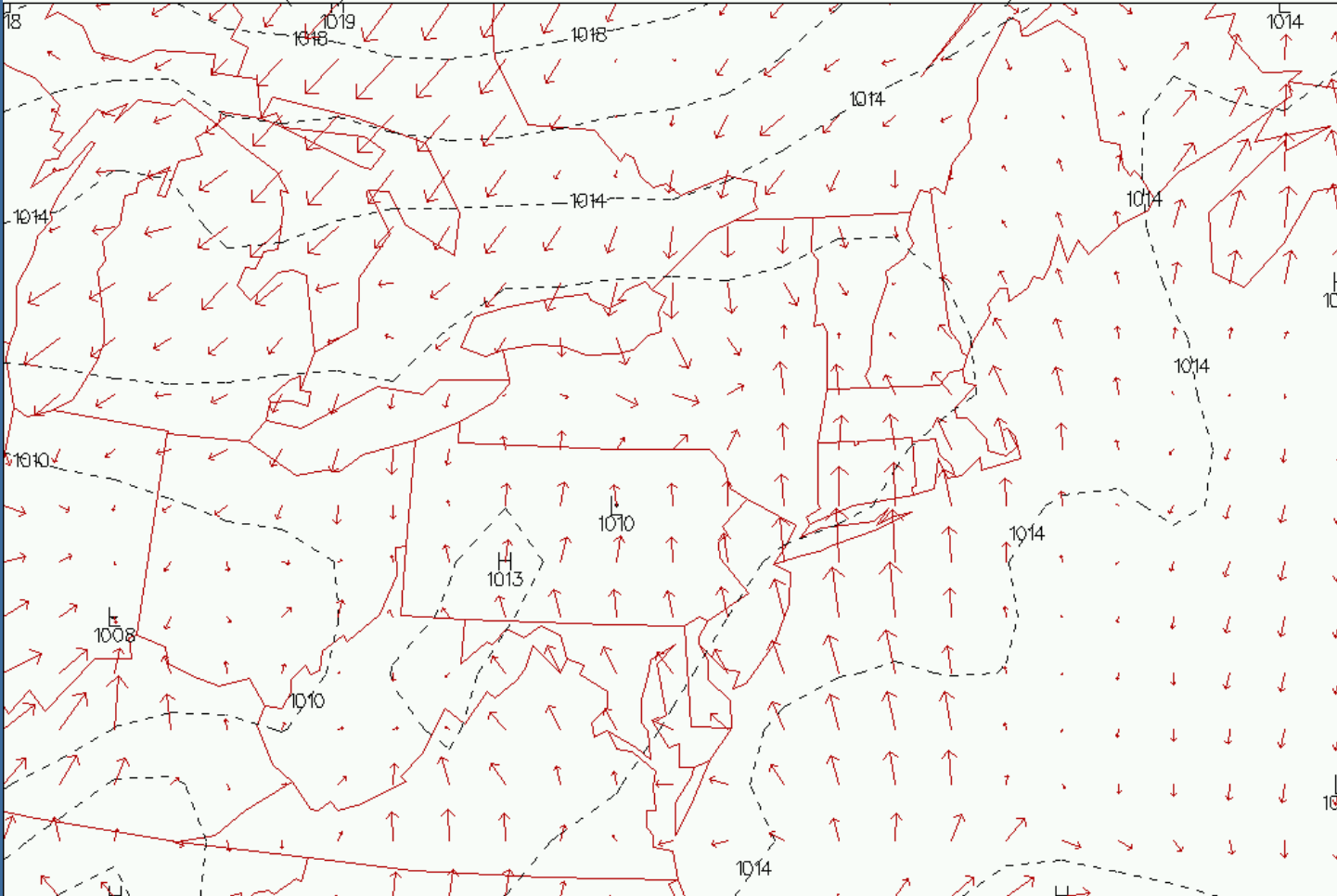


# August 9, 2012

▼ Plymouth State Weather Center ▼

Surface Winds (m/s)  
Sea level Pressure (mb)

WXP analysis for 20Z 9 AUG 12  
WXP analysis for 20Z 9 AUG 12



INTERVAL: 2.0

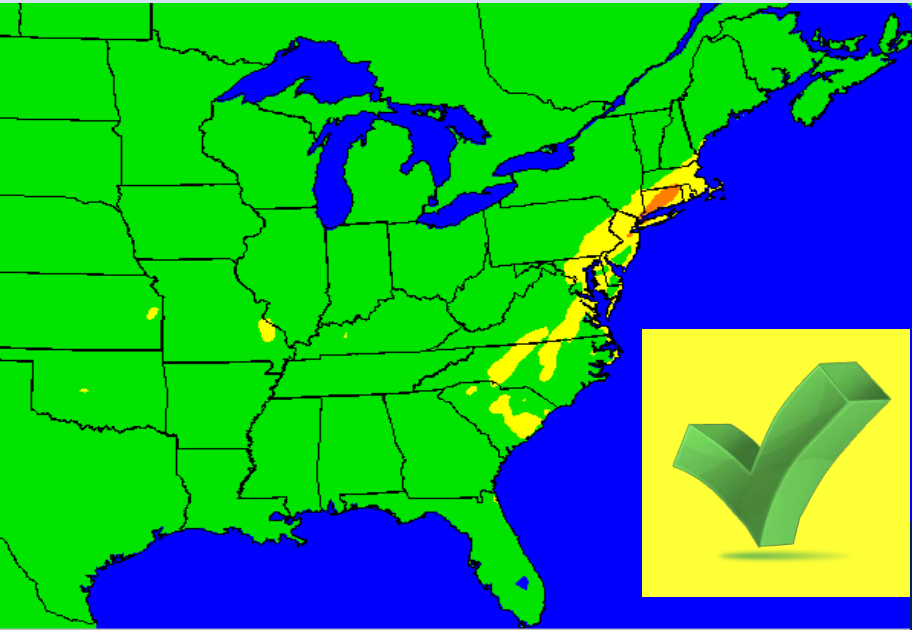
MAX: 7.62  
LO: 1008.0 HI: 1019.3



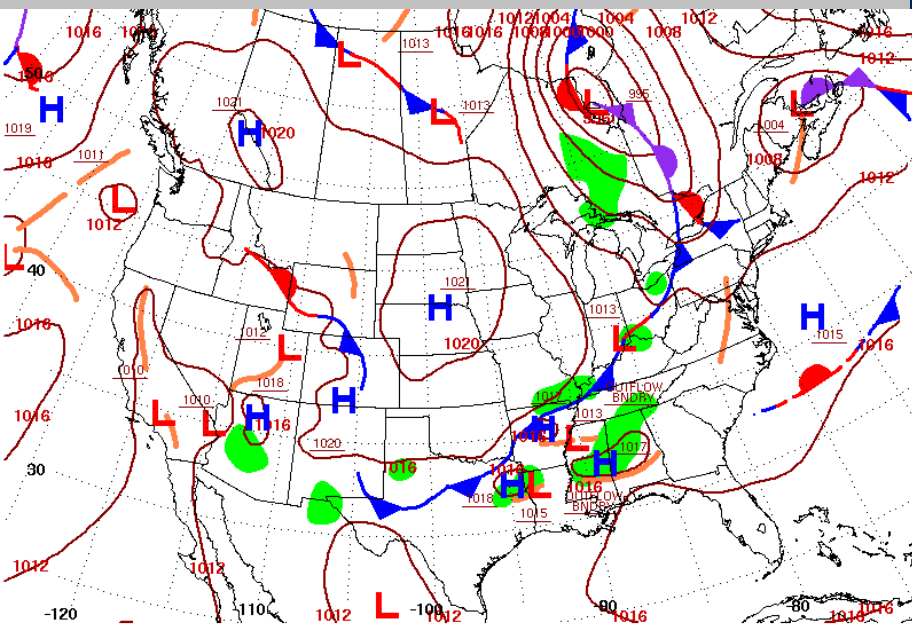
Connecticut Department of Energy and Environmental Protection



# August 17, 2012

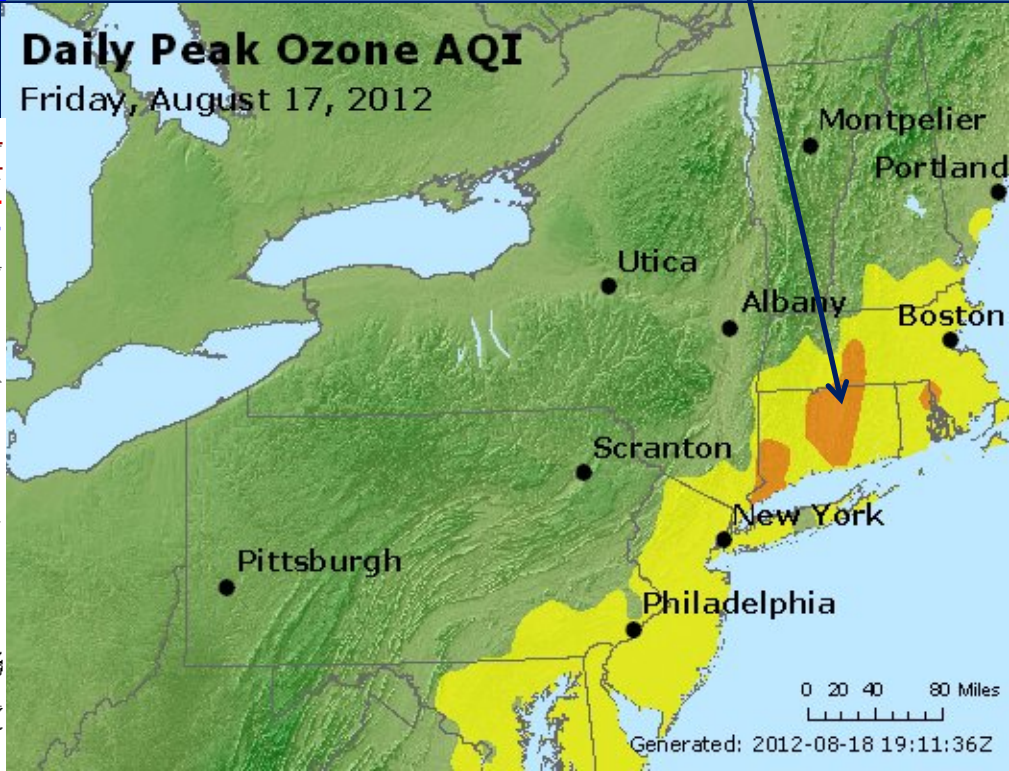


- South to southwest surface winds, advected ozone from I-95 corridor
- We forecasted 71 ppb at Stafford, verified at 83 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

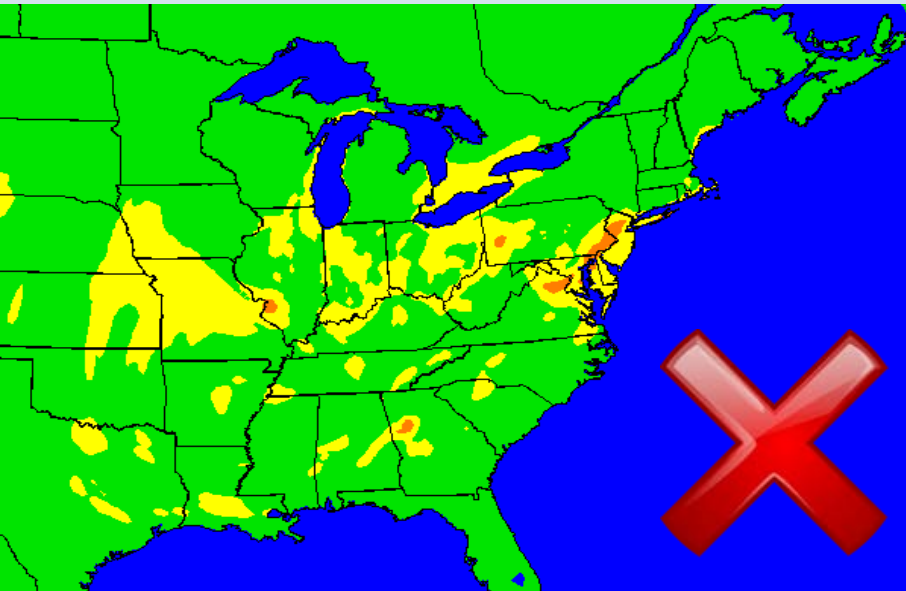
## Daily Peak Ozone AQI Friday, August 17, 2012



0 20 40 80 Miles

Generated: 2012-08-18 19:11:36Z

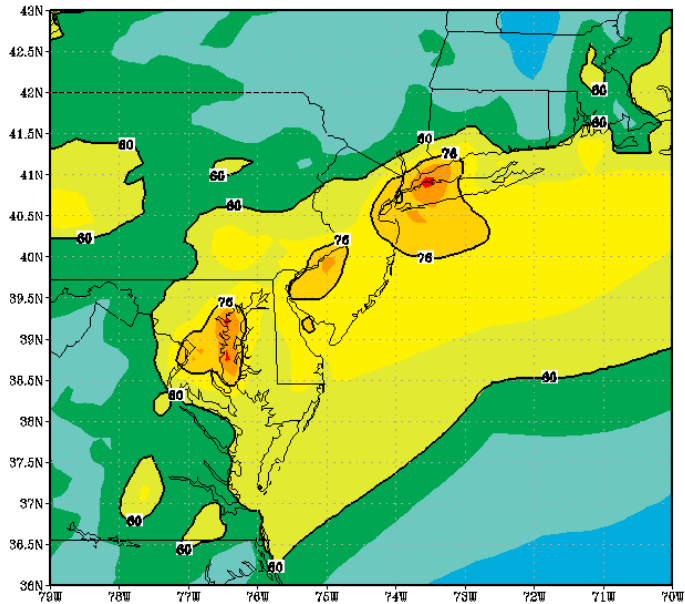
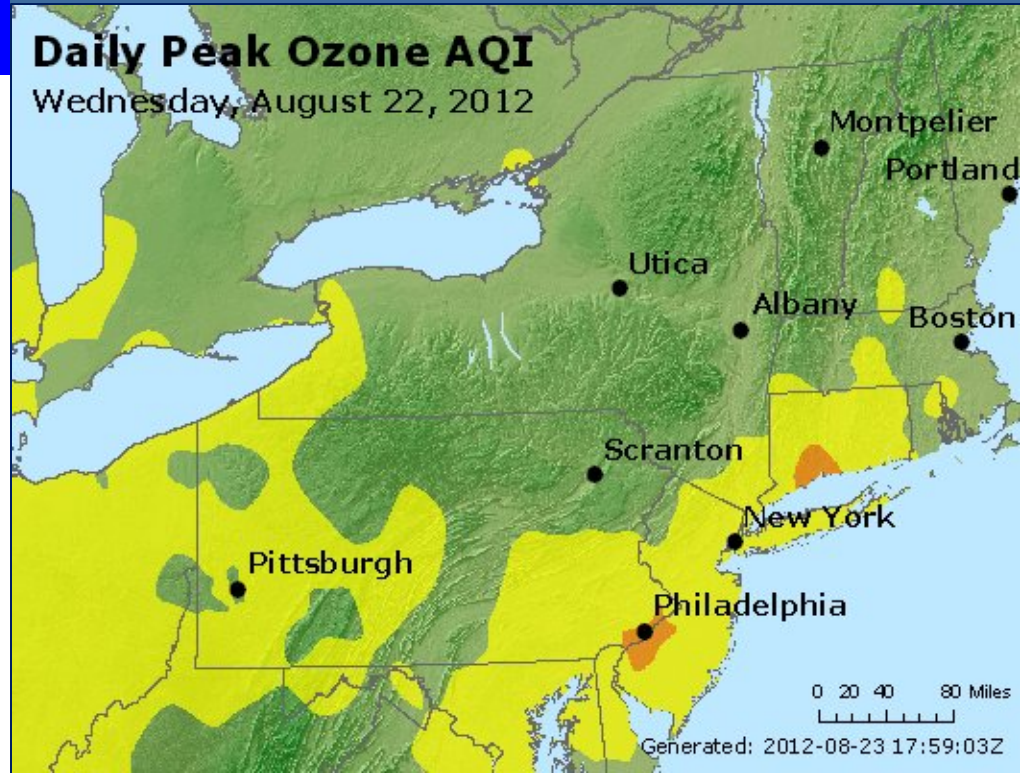
# August 22, 2012



(prd) 06Z 7H-30H 1st d 8h max sf O<sub>3</sub> (ppbv) Valid 22 AUG 2012

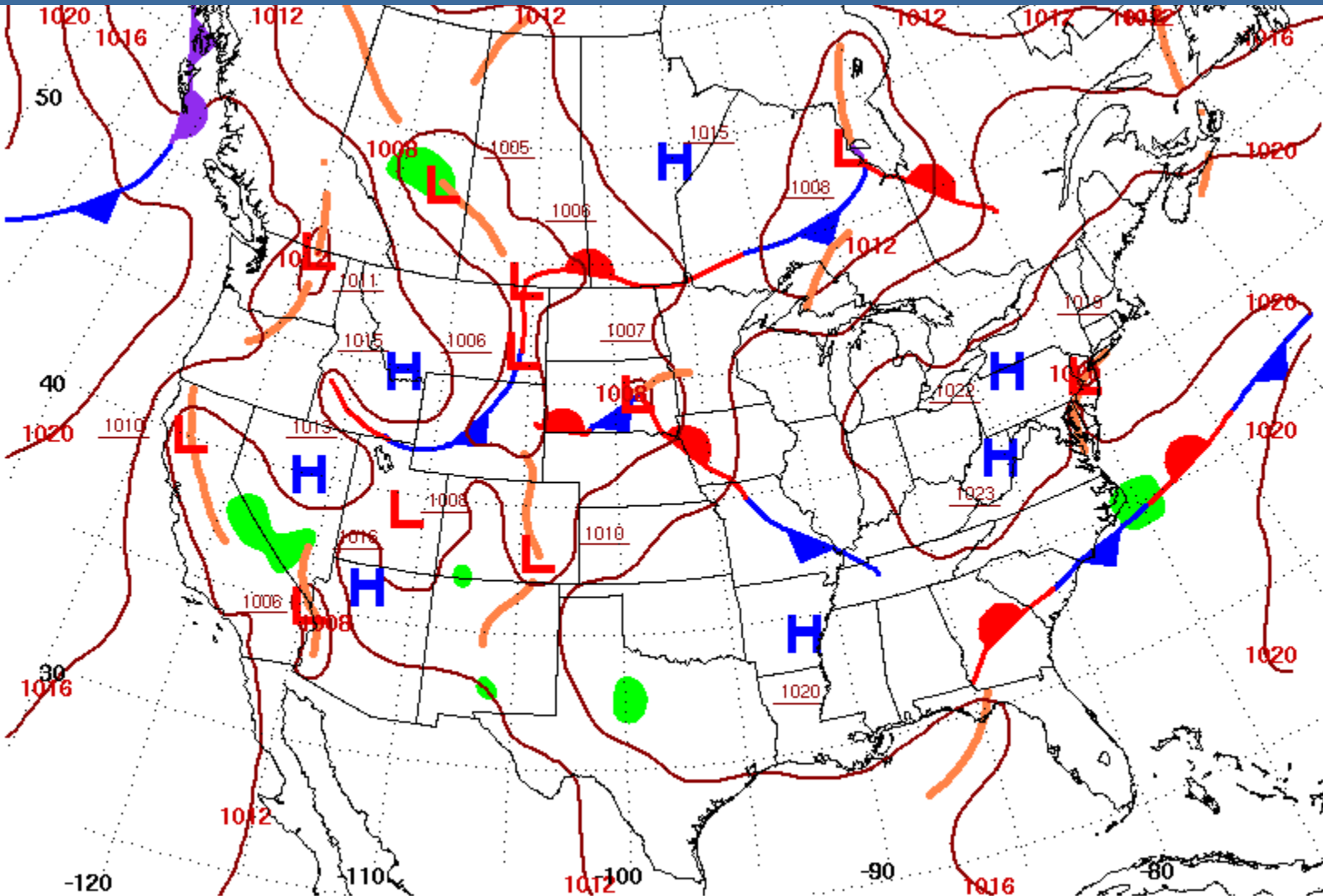
- Weak trough off the coast made this hard to predict (next slide). Same day model forecast picked up the exceedance
- We forecasted 72 ppb at Stratford, verified at 82 ppb

## Daily Peak Ozone AQI Wednesday, August 22, 2012





# August 22, 2012

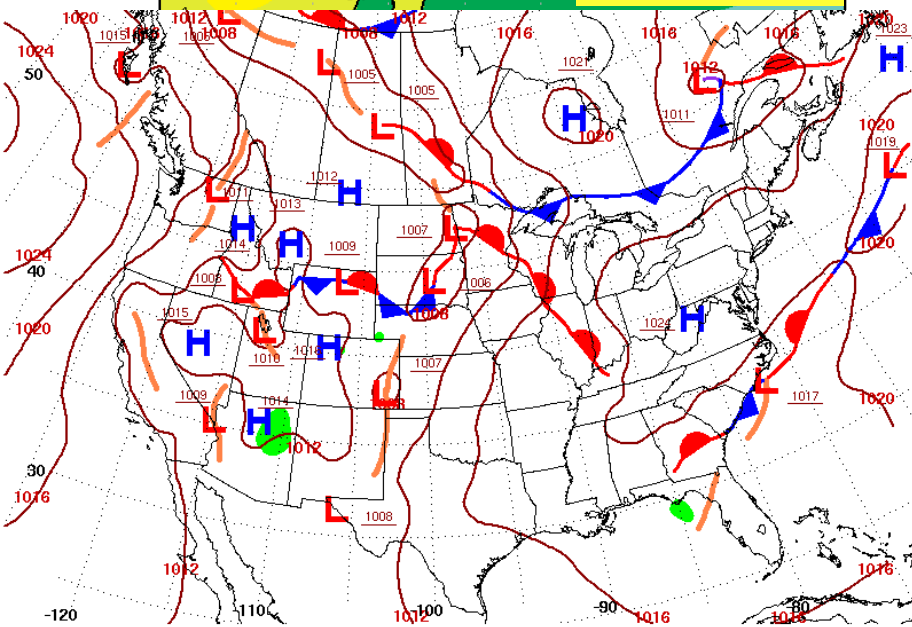
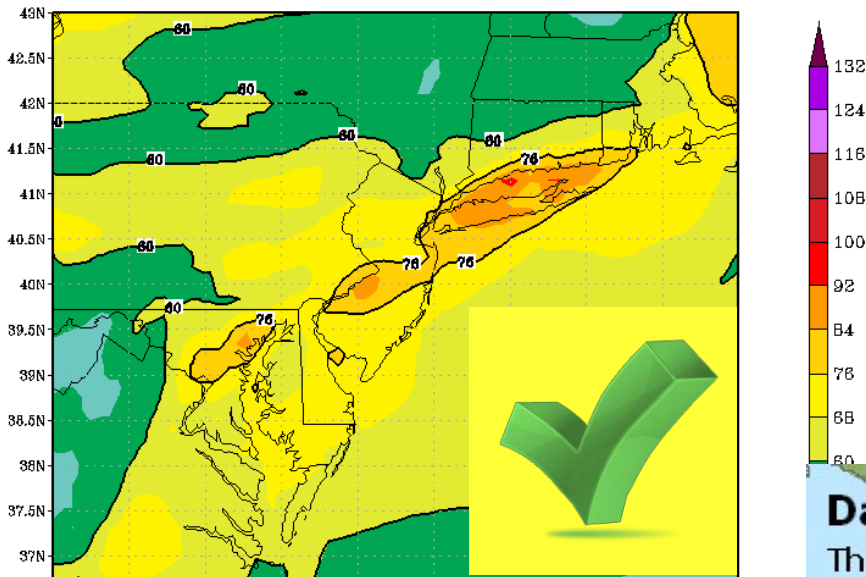


Surface Weather Map at 7:00 A.M. E.S.T.

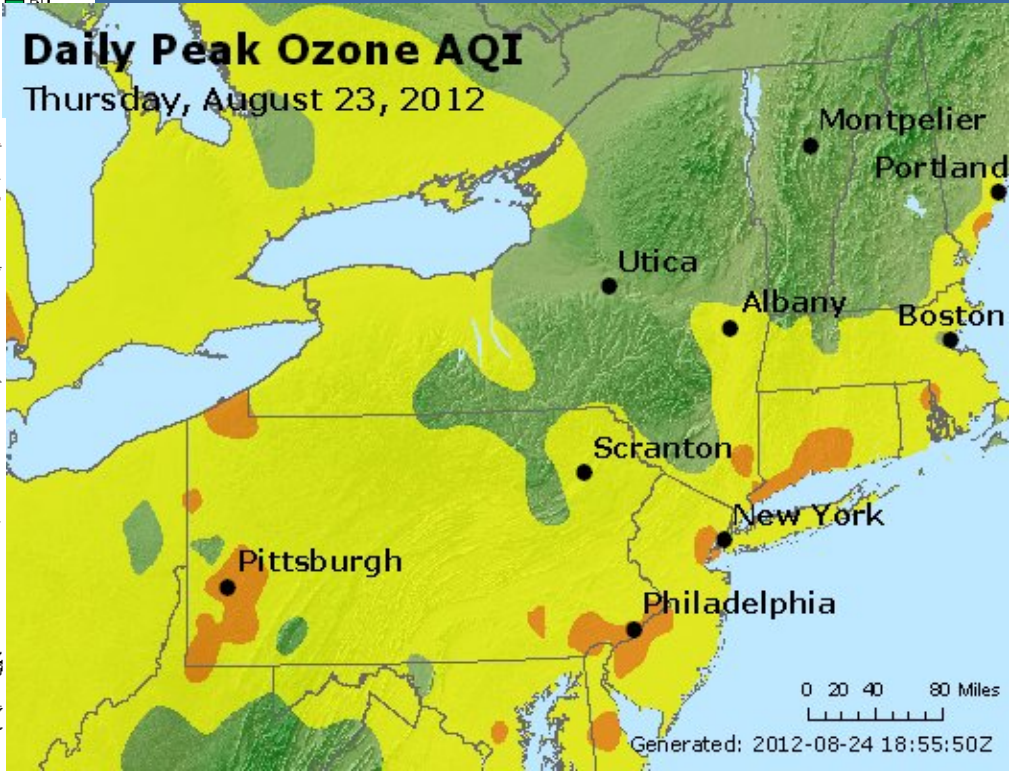
# August 23, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 23 AUG 2012

- Mid-Atlantic high scenario- light westerly winds turn southerly along coast
- We forecasted 76 ppb at Westport, verified at 77 ppb



Surface Weather Map at 7:00 A.M. E.S.T.



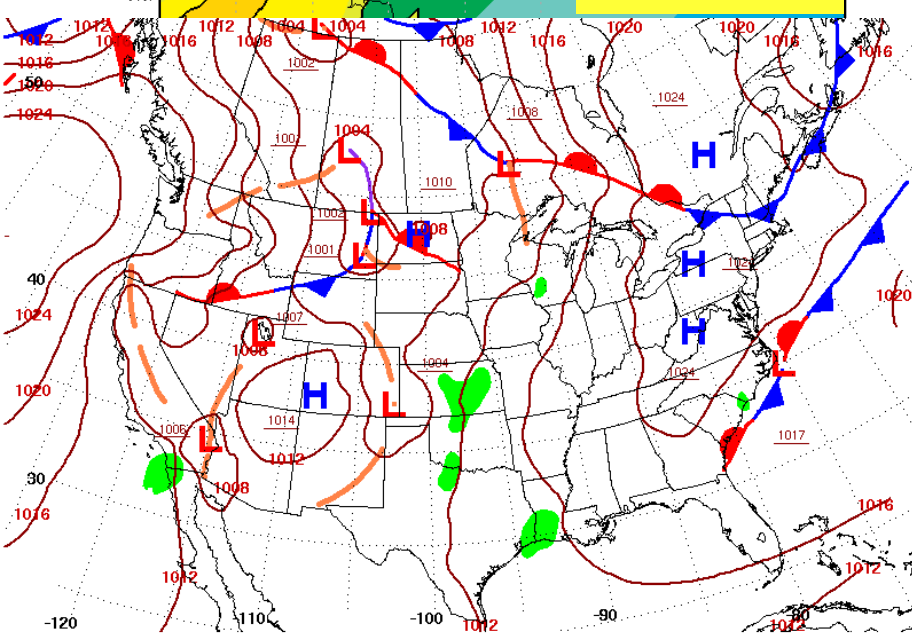
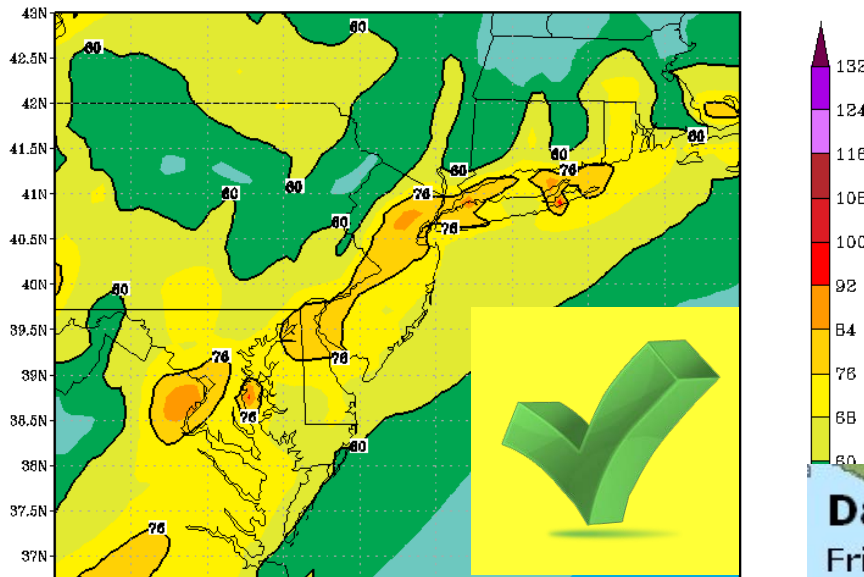
Generated: 2012-08-24 18:55:50Z



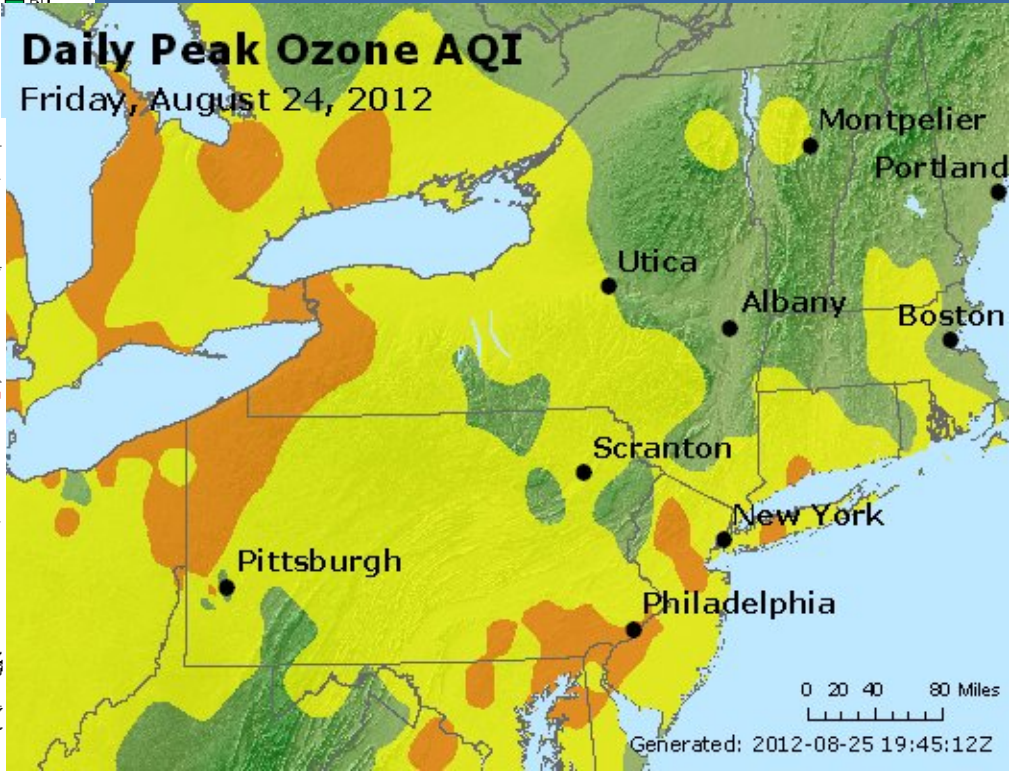
# August 24, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 24 AUG 2012

- Variable winds turn southerly along coast
- We forecasted 71 ppb at Stratford, verified at 81 ppb



Surface Weather Map at 7:00 A.M. E.S.T.

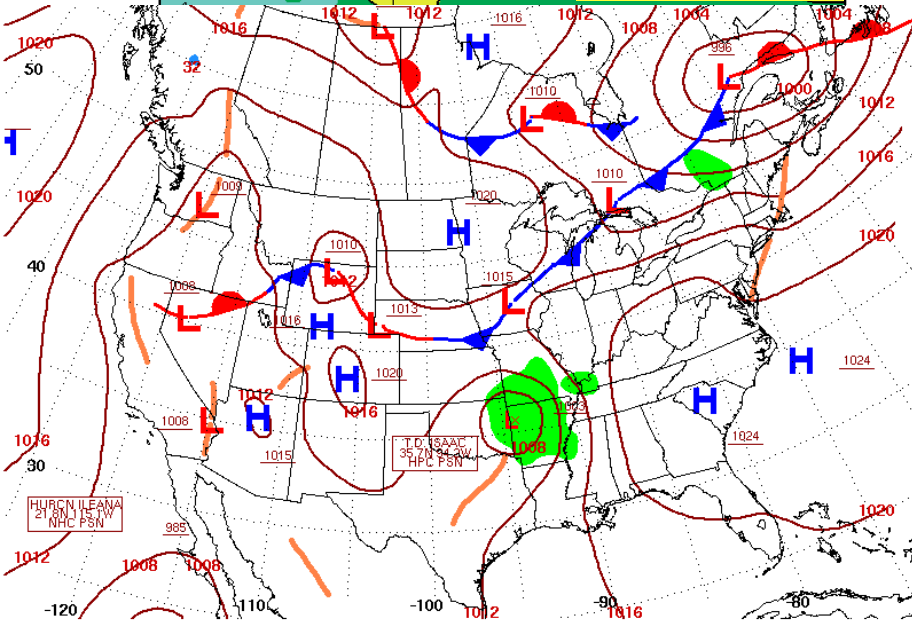
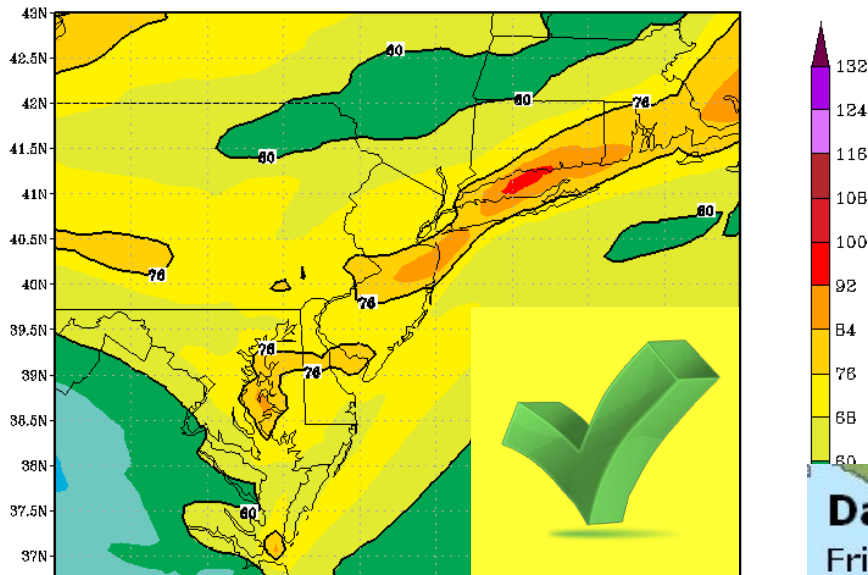


Generated: 2012-08-25 19:45:12Z

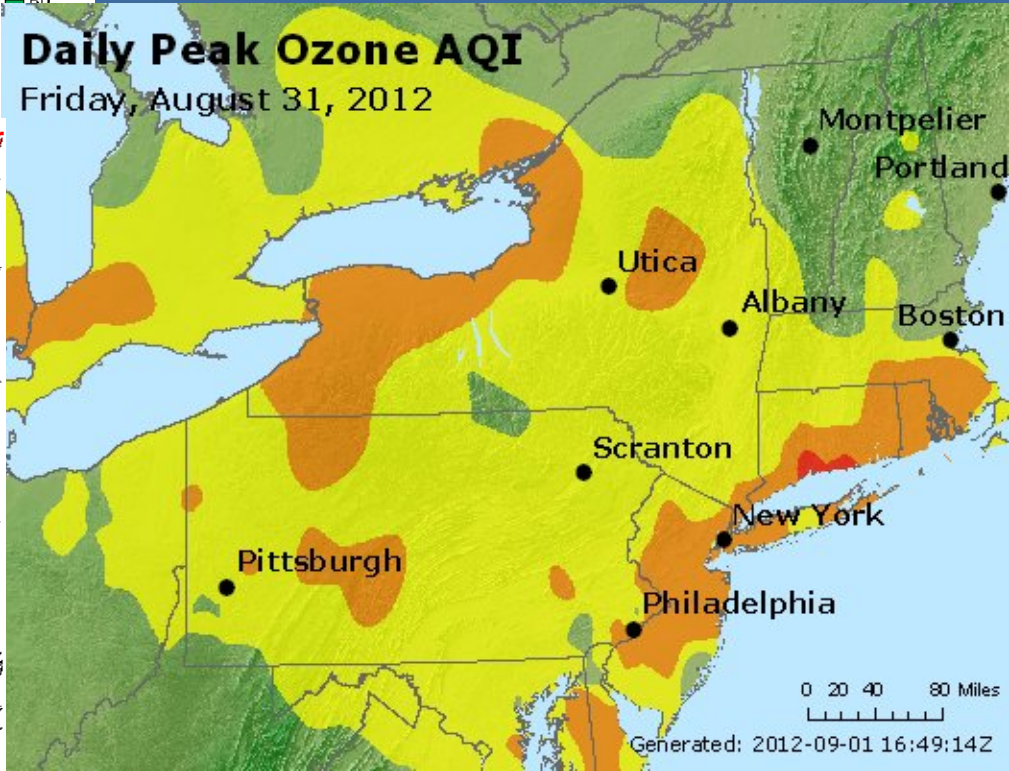
# August 31, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 31 AUG 2012

- Broad southwest flow develops across the State
- We forecasted 83 ppb in Madison, verified at 97 ppb



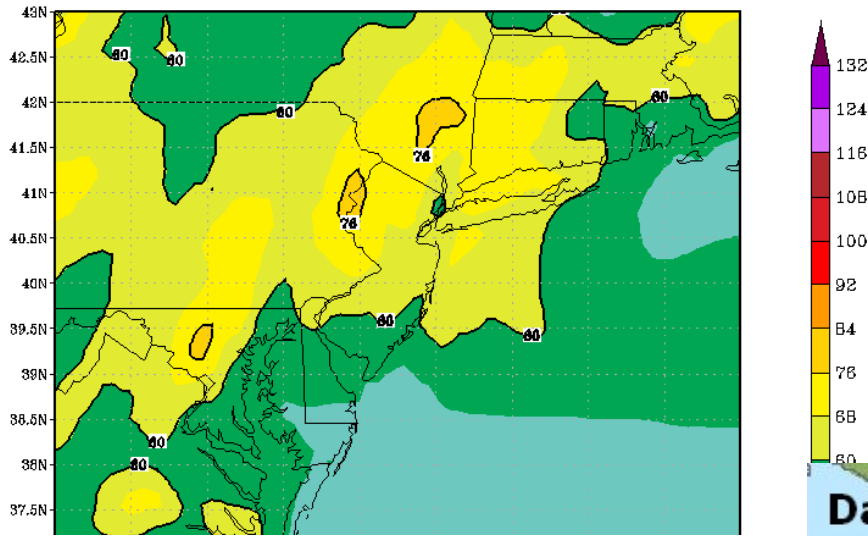
Surface Weather Map at 7:00 A.M. E.S.T.





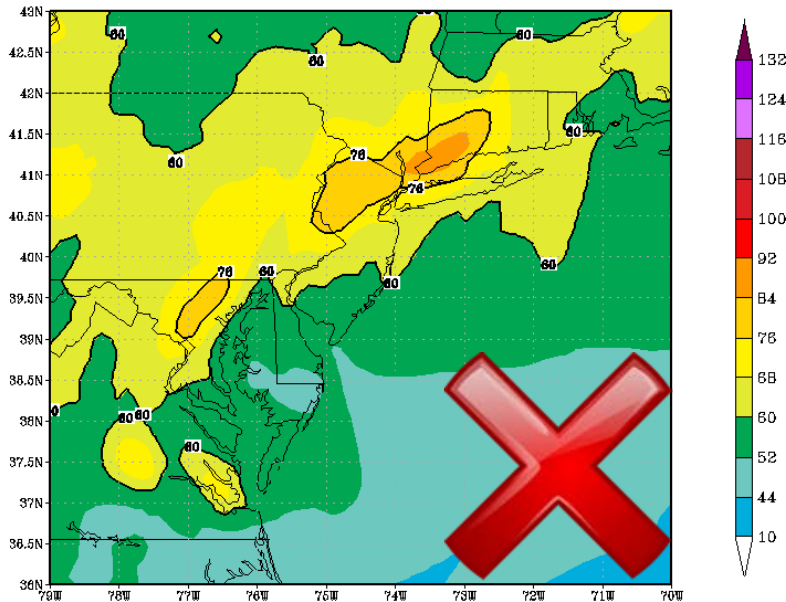
# September 7, 2012

(prd) 06Z 31H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 07 SEP 2012



- A rare case of over-prediction
- Since model performed well with the mid-Atlantic high scenario, we went for it!
- We forecasted 79 ppb at Danbury, but it verified only at 75 ppb

(prd) 12Z 25H-48H 2 day 8h max sf O<sub>3</sub> (ppbv) Valid 07 SEP 2012



**Daily Peak Ozone AQI**  
Friday, September 07, 2012







# Conclusions

- The NOAA model outperformed our forecasts- 73% vs. 54%
- The NOAA model past record of over-predicting during July-August didn't occur this year!
- Many cases of prefrontal troughs with southwest winds along coast handled well by model
- We expected days with southerly winds to have more maritime 'clean' air, but southwest winds aloft mixed down

