MARYLAND
DEPARTMENT OF THE ENVIRONMENT

MDE Surface Observations

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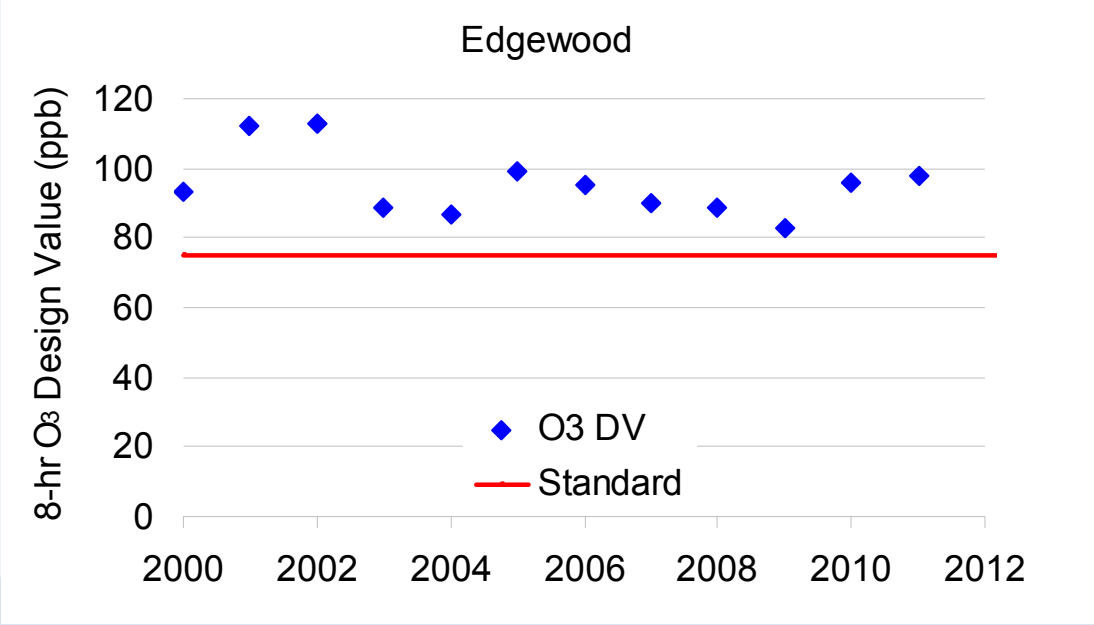
DISCOVER-AQ Data Analysis Workshop

February 14, 2012

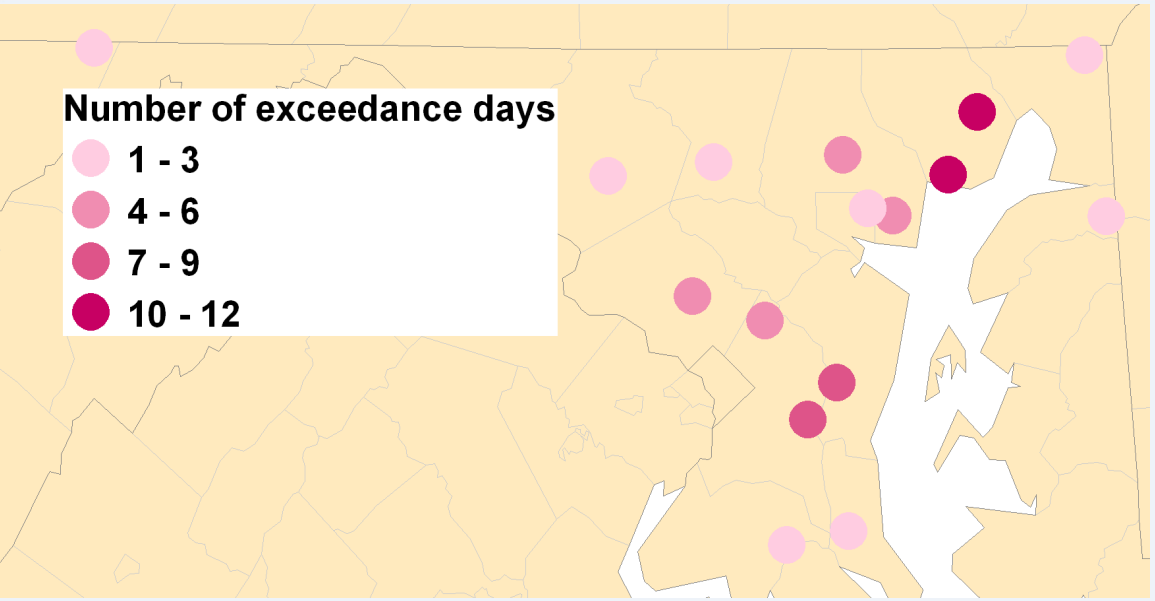
Explaining Edgewood

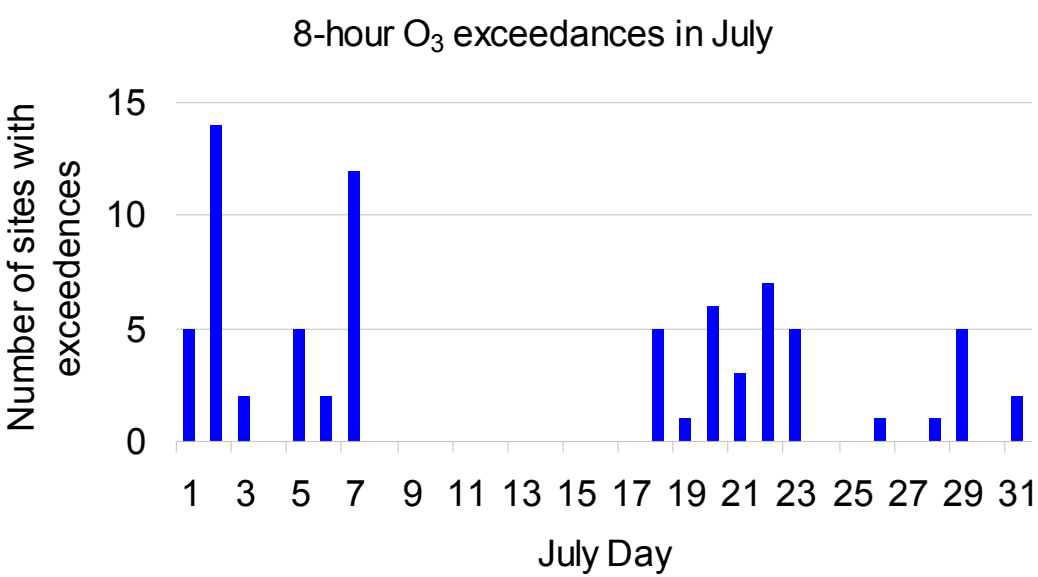
- Edgewood is above the EPA O_3 NAAQS of 75 ppb.
- To achieve the NAAQS we need EPA to adopt federal rules to reduce O_3 transport into MD and reduce mobile emissions.
- EPA prepared a technical analysis with 30 year average summer surface winds to show that Baltimore and surrounding counties are responsible for Edgewood O_3.
- Discover-AQ provides a wealth of data to understand what is happening during these exceedance days and show that regional transport does contribute.



Note: 2011data is preliminary and still needs to QA/QC

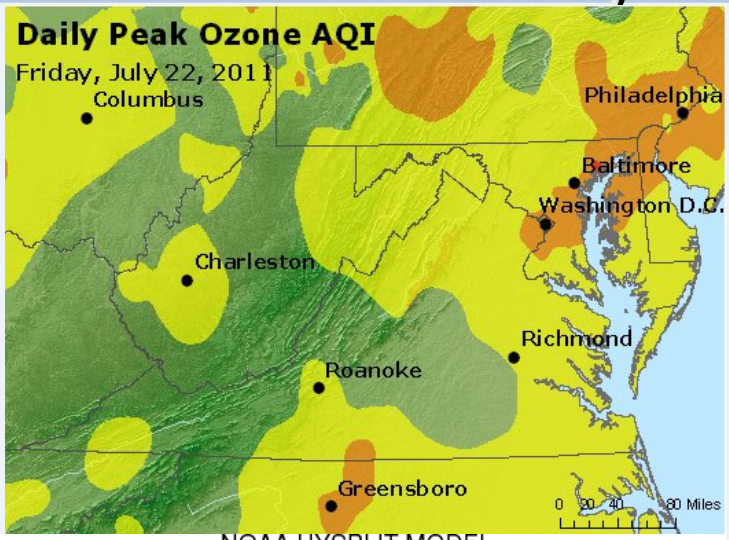
July O_3 summary



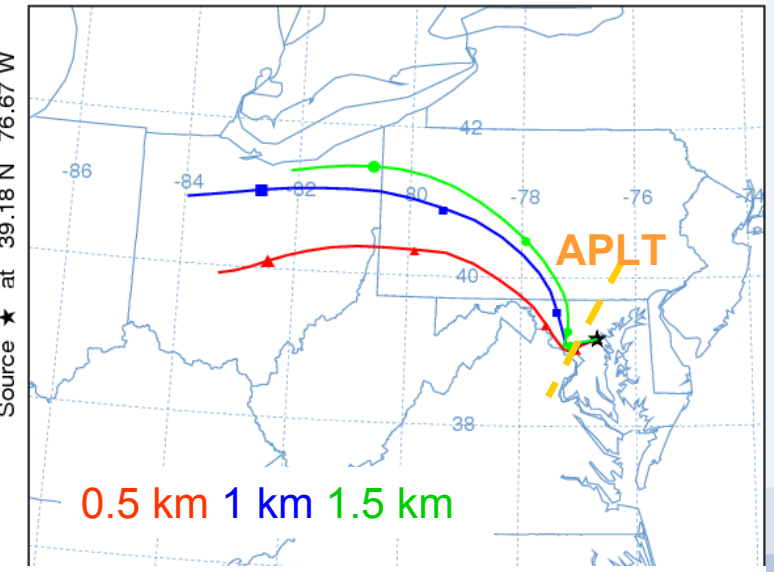


- In July Edgewood and Aldino had the most exceedance days (10 and 12).
- Edgewood had 3 code red days.
  - 8-hr avg. > 96 ppb
  - Examine July 22.

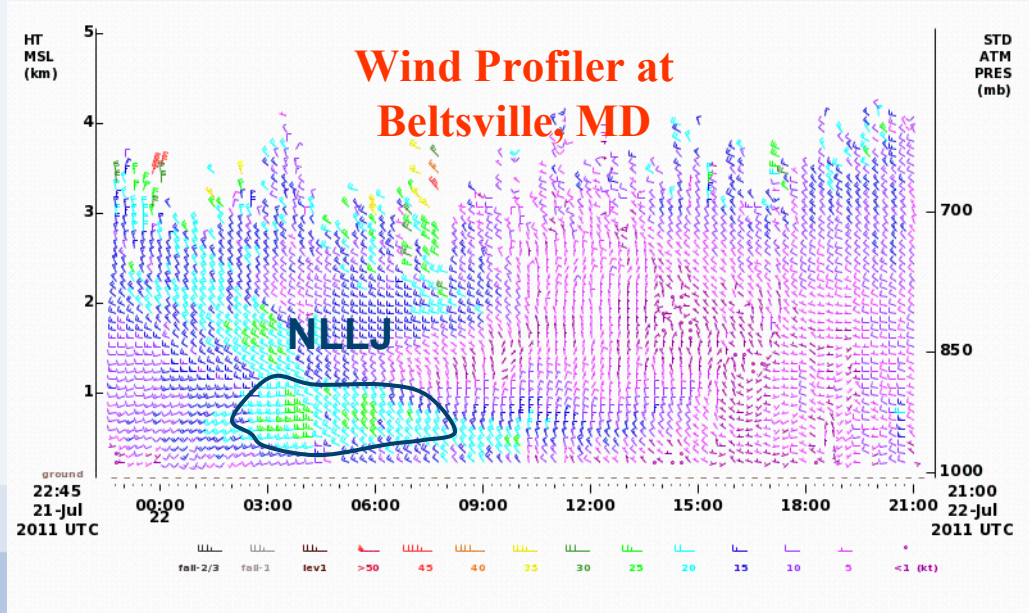
July 22 - Overview



NOAA HYSPLIT MODEL
Backward trajectories ending at 2100 UTC 22 Jul 11
NAM Meteorological Data

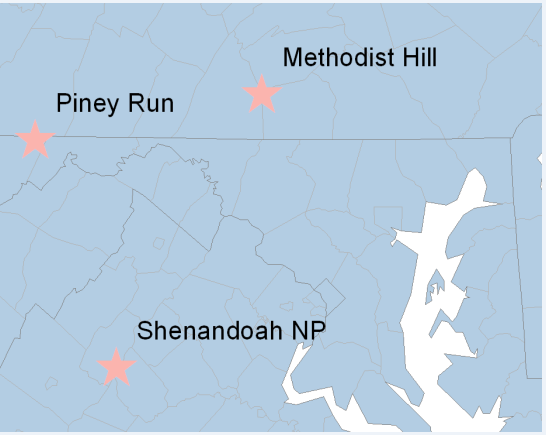


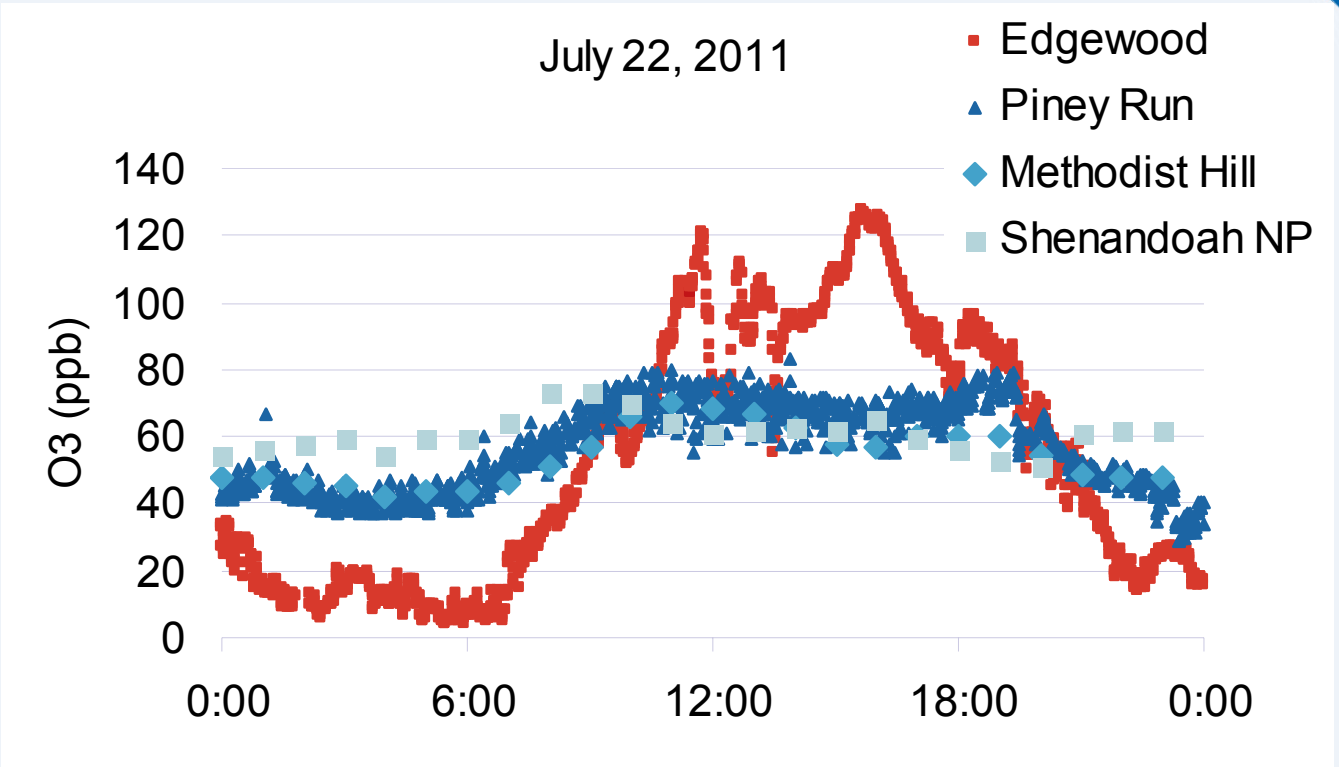
- Primary meteorological features
  - High pressure system off the coast
  - Max. temperature @ BWI at 106°F
  - NLLJ in the morning, stagnation in the afternoon
  - Transport regime was primarily from the west to northwest
  - An Appalachian Leeside Trough (APLT) near I95 corridor



Sources: NOAA MADIS, NOAA ARL, Airnow

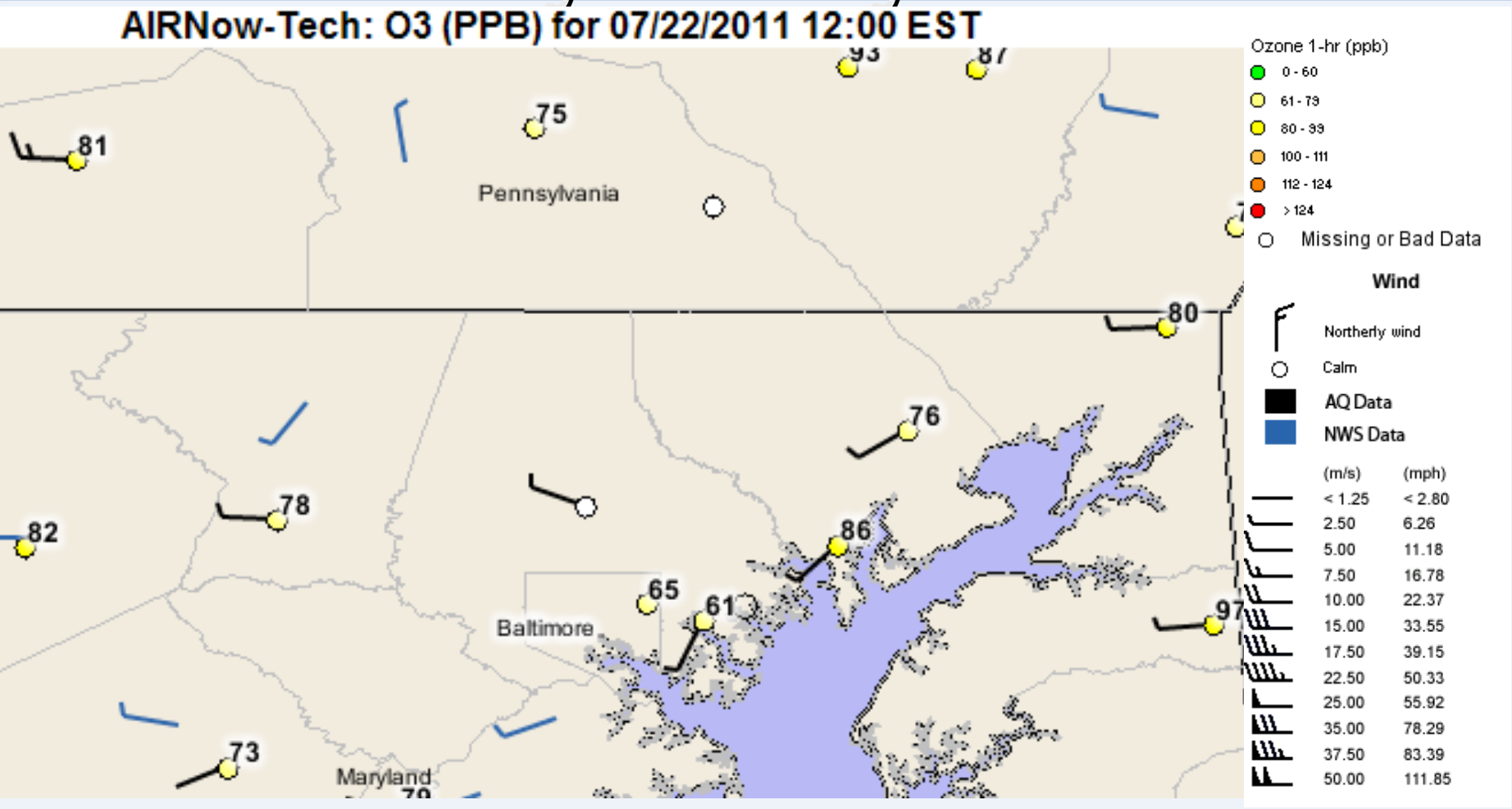
July 22- Transported O_3 into MD seen from Piney Run





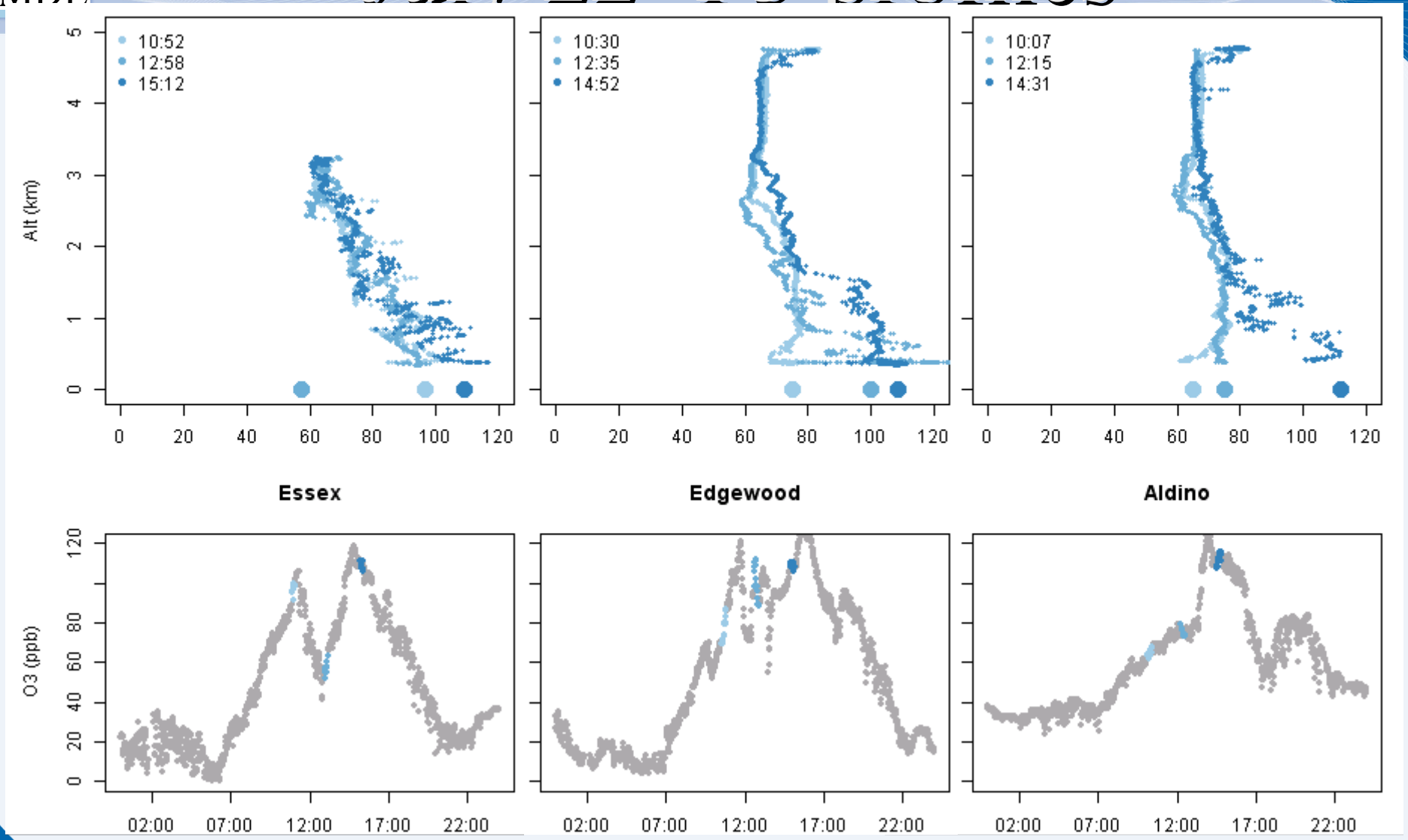
O_3 (50 ppb) at Piney Run and other elevated sites in morning may have been transported to the Baltimore area and then mix down in the morning.

July 22 Bay breeze



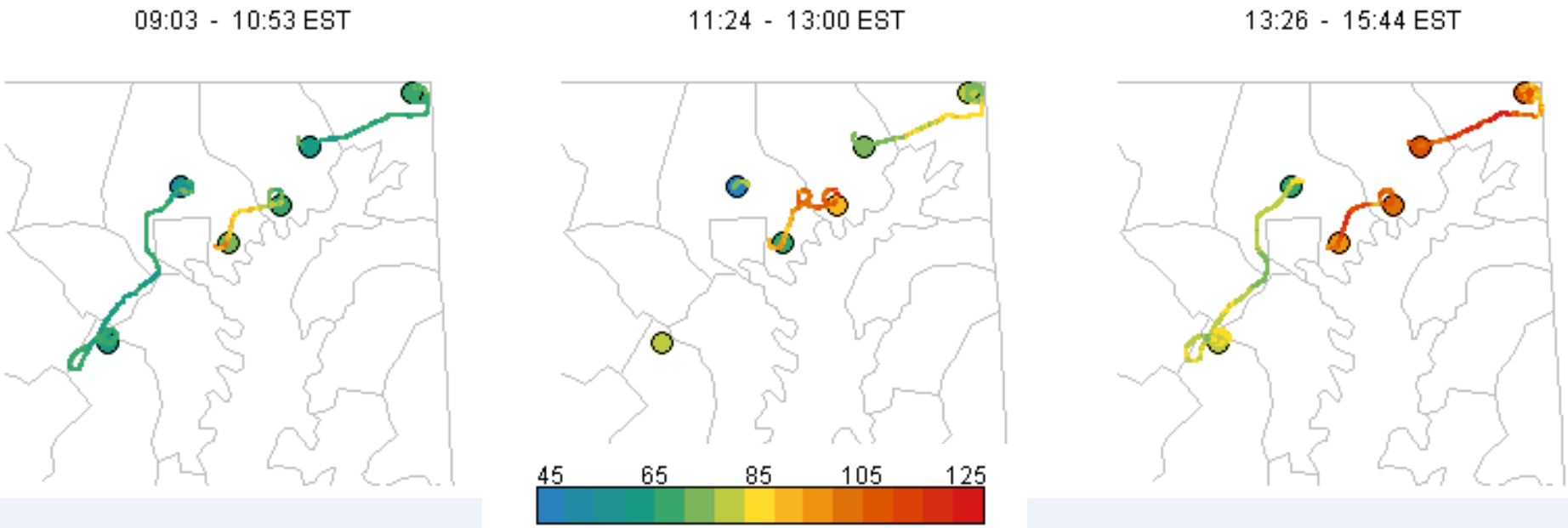
- Surface winds show bay breeze between Essex and Padonia
- No Bay breeze at Edgewood.

July 22- P3 profiles



- Elevated O_3 at Edgewood at 10:30 may have mixed down by the afternoon.
- Sharp O_3 decrease at noon (Essex, Edgewood)

July 22 P3 transects



O_3 from P3 only between 0.3-0.6 km

Surface O_3 circled in black.

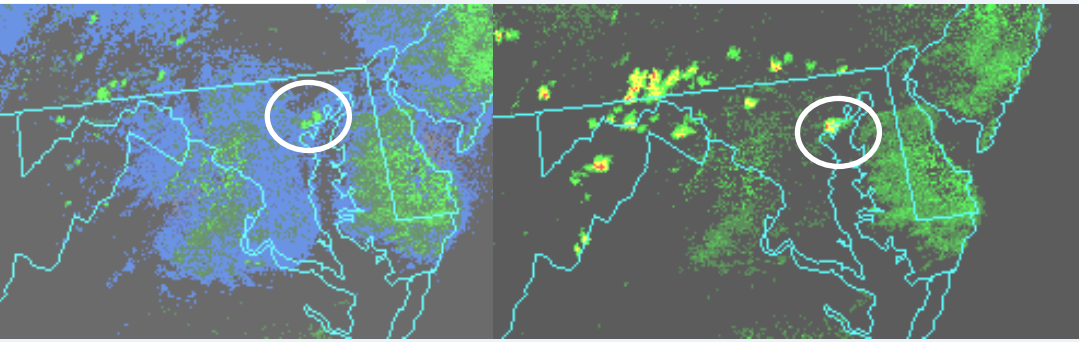
Elevated O_3 above Essex and Edgewood at 9:00 and 11:00 may have mixed down by 13:30.

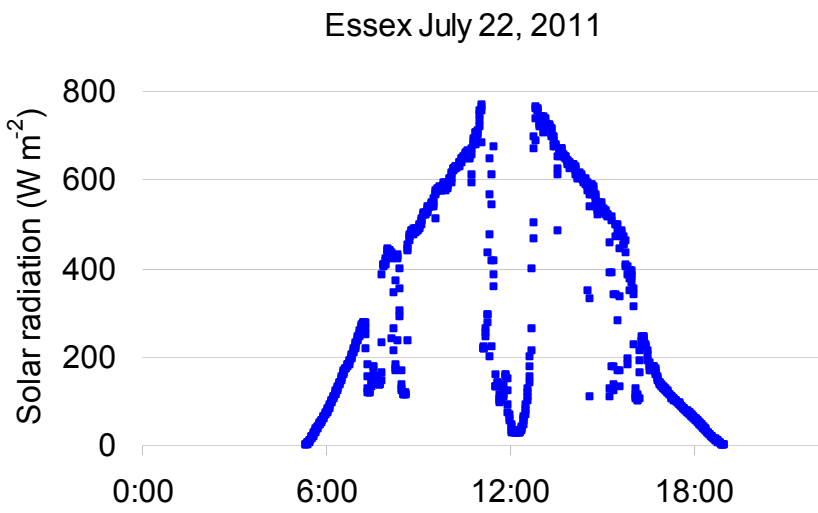
July 22 - Thunderstorms

NEXRAD 1km

1130 EST

1230 EST

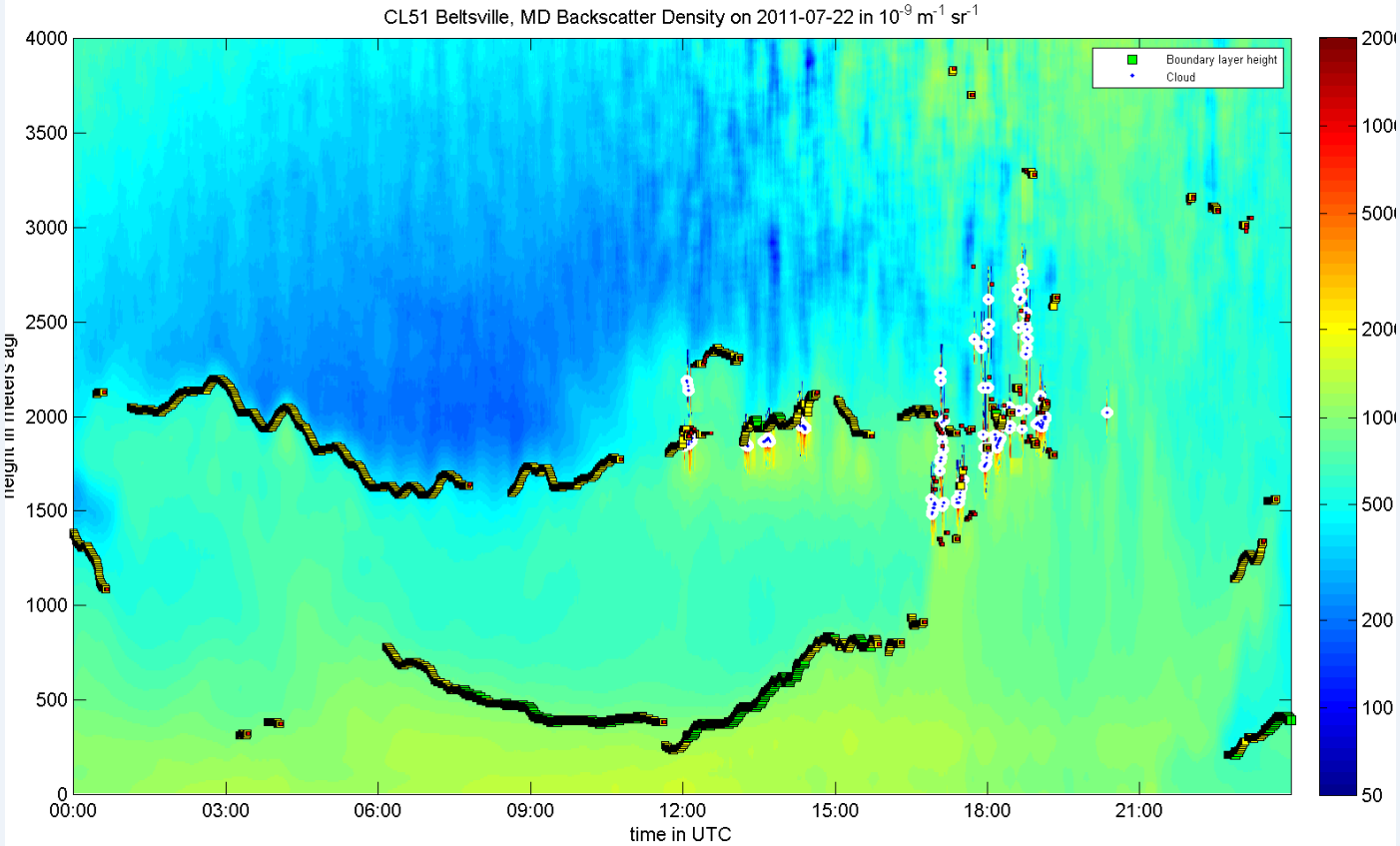




- Bay breeze at Essex may have been the trigger for thunderstorms early in the day
- Thunderstorm activity 1130-1230 EST.
  - Storm cells appear to extend to Edgewood
  - Cloud cover blocked out sun and stalled O_3 formation
  - Dissipated just before 13 EST
- Once clouds cleared…
  - The bay breeze formed again near Essex
  - O_3 was able to recover and reach high values later in the day

Courtesy: Laura Landry

Beltsville Ceilometer



- Ceilometer at Beltsville also shows clouds around 12 EST (18 UTC).
- Ceilometer data from MDE is not on the DISCOVER-AQ data site, but we can upload it if there is interest.

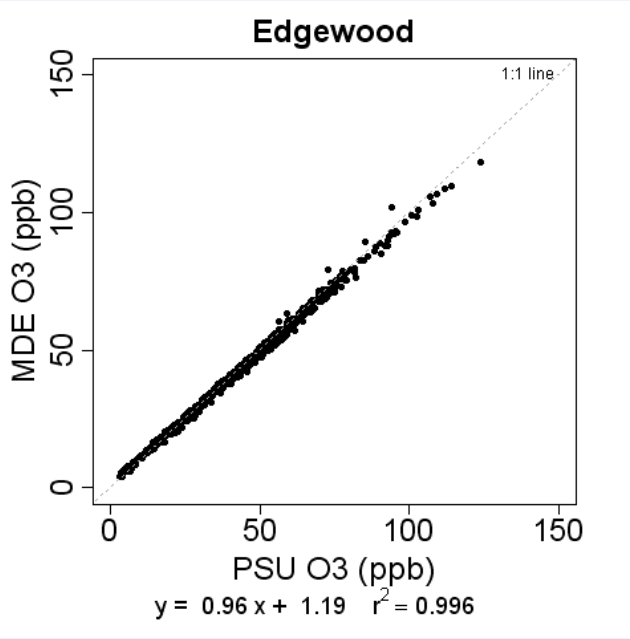
MDE trace gas data quality checks

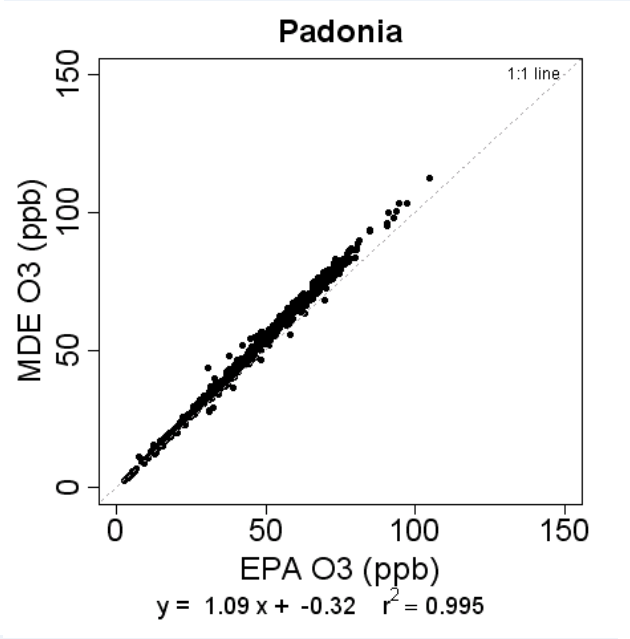
- A zero and span check is performed daily – just a 2-point check at zero and large value
  - O_3 (0 and 180 ppb)
- Every other week a precision check is performed – this is a one point check
  - O_3 (80 ppb)
- Once a quarter an audit is performed at least 4 levels
  - O3 (0, 40, 80, 120, 180 ppb)
- Once a quarter a calibration is performed at the same 4 levels
- A log book is maintained for each site (entered electronically) recording any issues.
- Even with all of these check in place, our Edgewood O_3 monitor was reading high in the beginning of July (thanks Doug and PSU!)
  - We replaced the instrument 7-7-11.

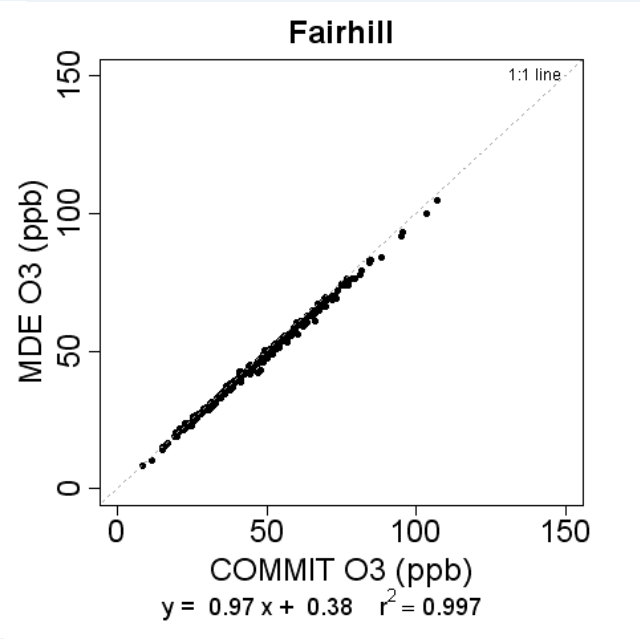
NOy at Beltsville and Aldino

- Ecotech 9843 NOy monitor at Aldino.
- Thermo Electron 42i NOy monitor at Beltsville.
- These instruments report NOy, NO and the difference (NOy – NO)
- The difference is labeled NO_2 but is not true NO_2 (just a label).
  - A little confusing.
  - "NO_2" label is currently in Beltsville and Aldino archived DISCOVER-AQ data → should we change the label?

MDE O_3 compared with research monitors

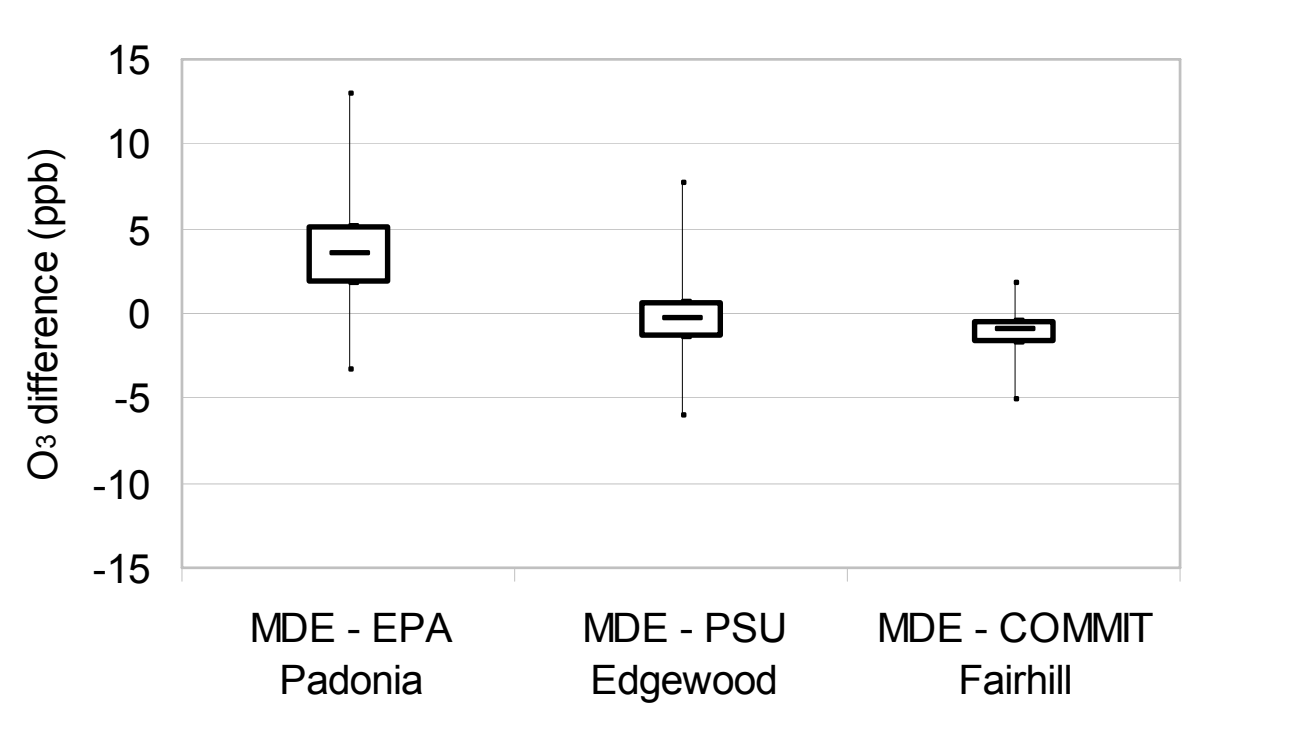






- MDE O_3 monitors compared well with research monitors.
  - Slopes within 10% and $r^2 > 0.99$

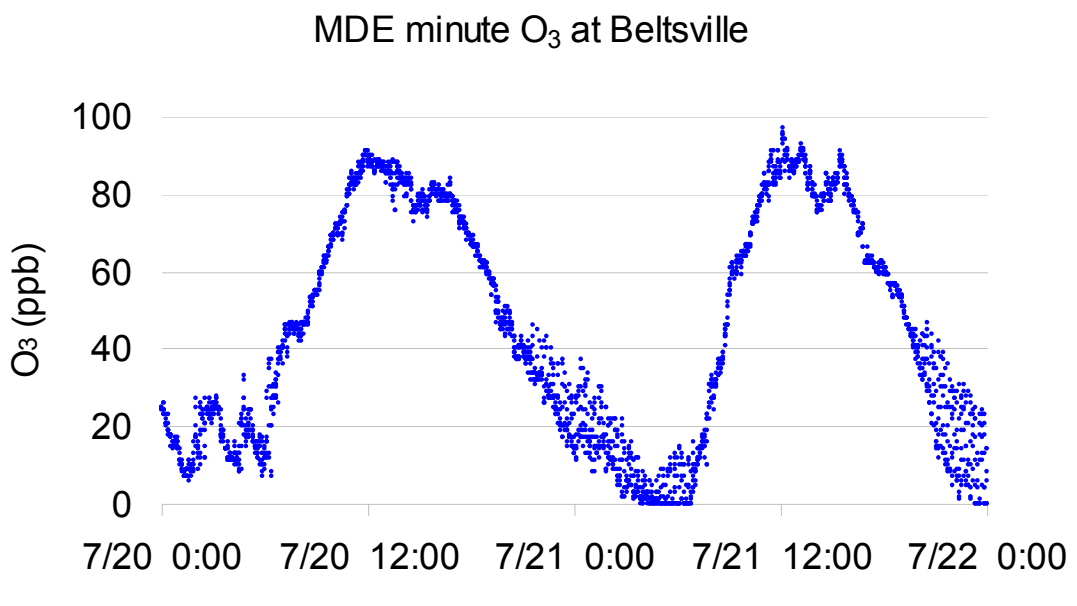
Comparing MDE hourly O_3 with research monitors

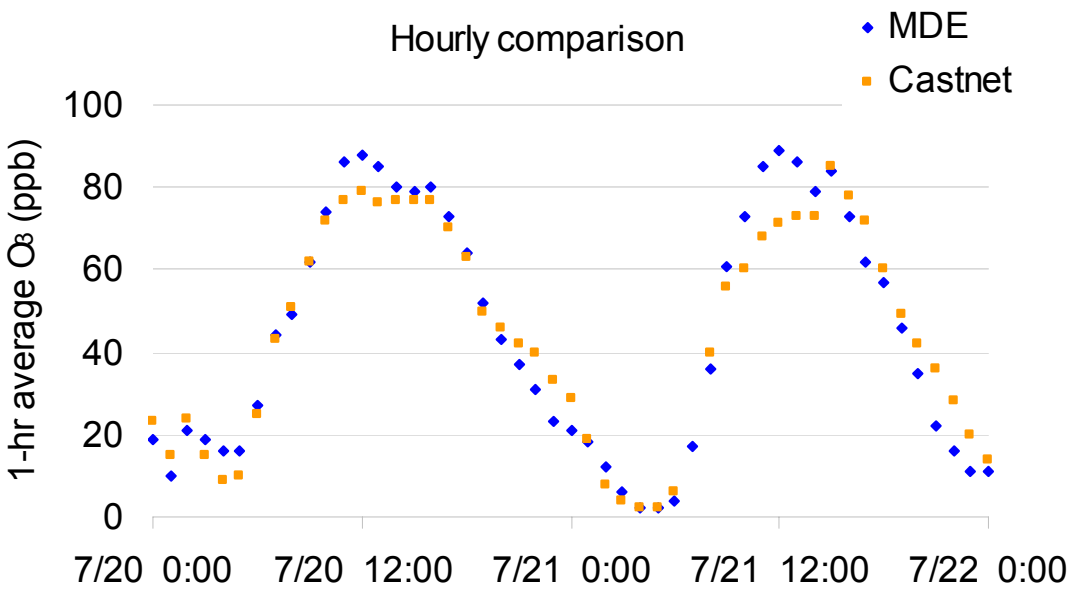


- 75% of differences are within ± 5 ppb.
- Differences at Edgewood and Fairhill are smaller than at Padonia
  - 75% within ± 2

Noisy minute O_3

- Some noisy minute O_3 found at Beltsville on July 20, 21, 22, 24, 25, 28, 29.
- Occurs in morning.
- No relationship with NOy → may be and instrumentation issue.
- On the evening of July 21, hourly O_3 at Beltsville smaller than at Castnet site (though Castnet is 5 km SE of Beltsville).

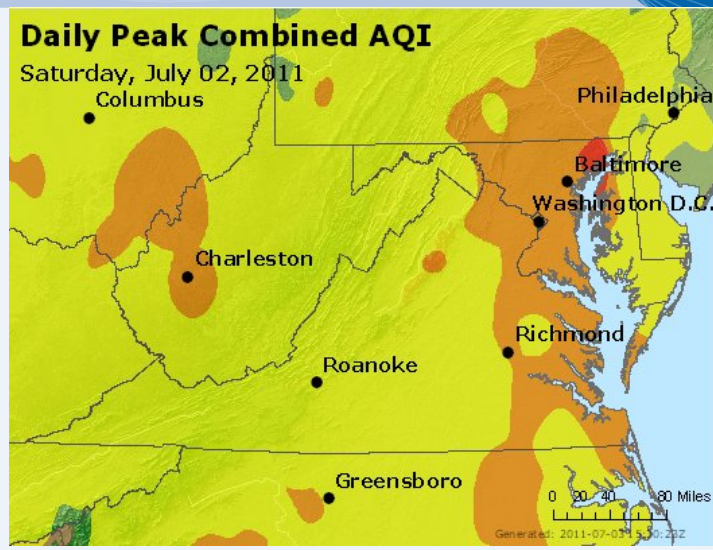


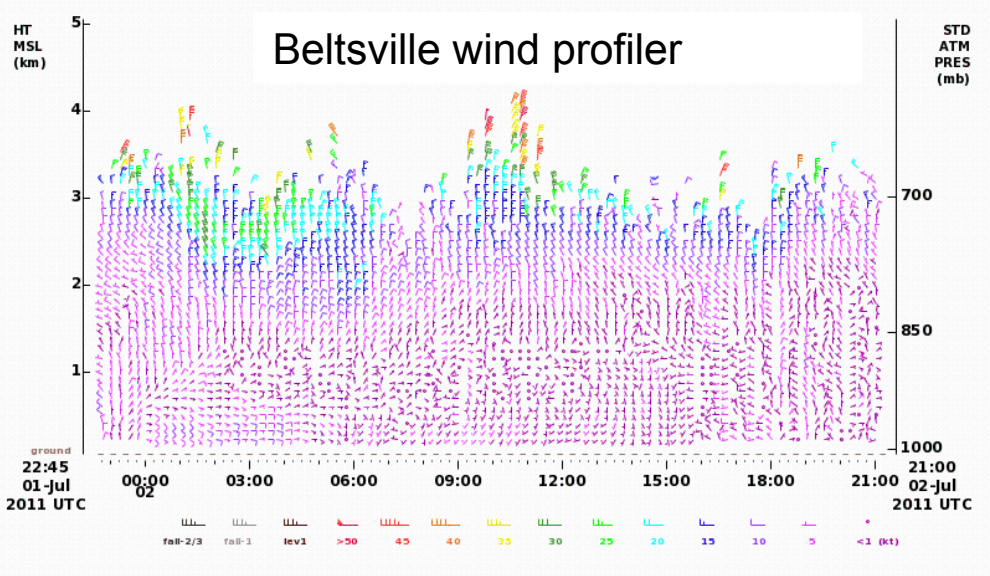


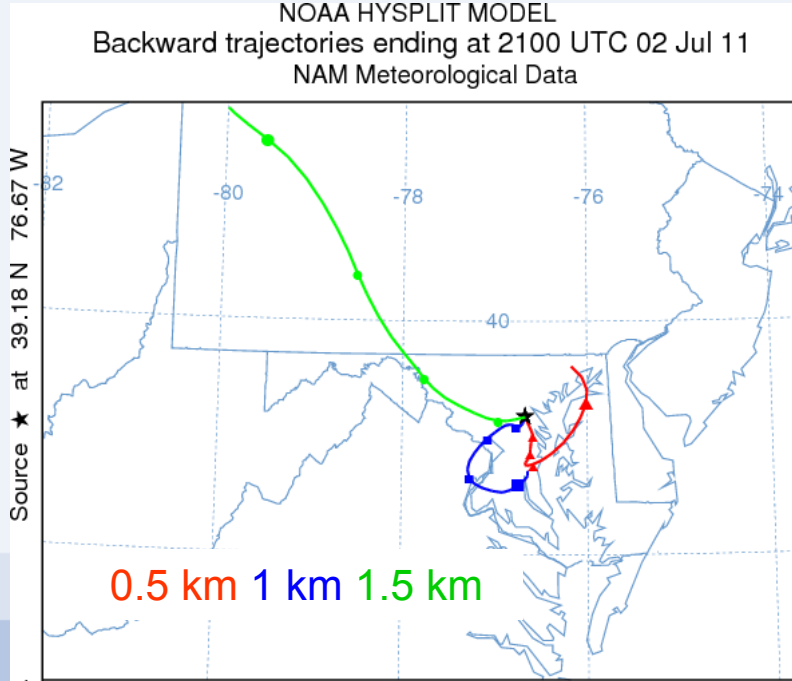
Extra slides

July 2, 2011

- Part of July 1-3 episode.
- Daily max 8-hour O_3 →107 ppb at Edgewood.
- Contributors:
  - High pressure system
  - Max. temperature @ BWI at 91 °F
  - Stagnant conditions throughout the day
  - Appalachian Lee Side Trough (APLT)
  - Bay breeze

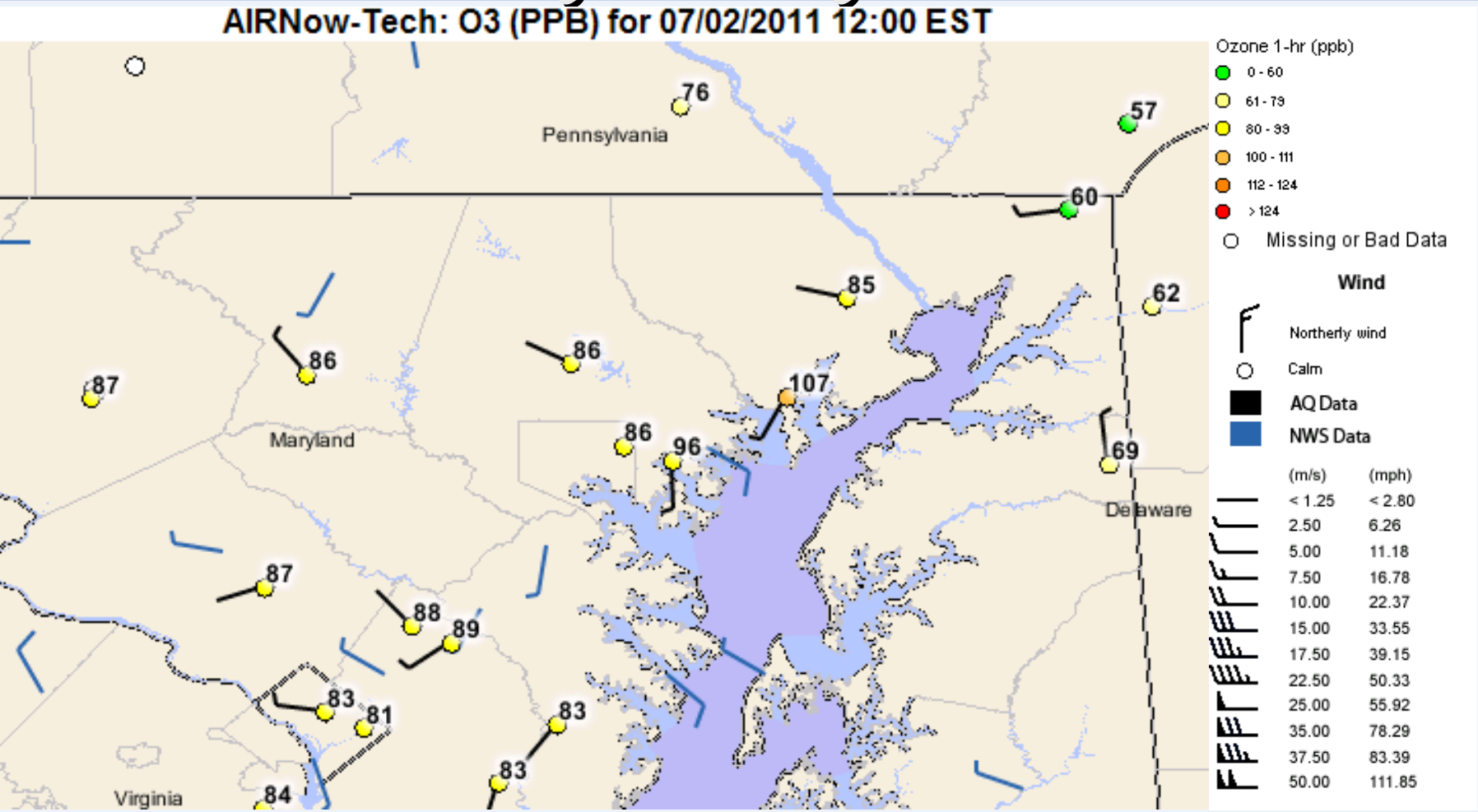






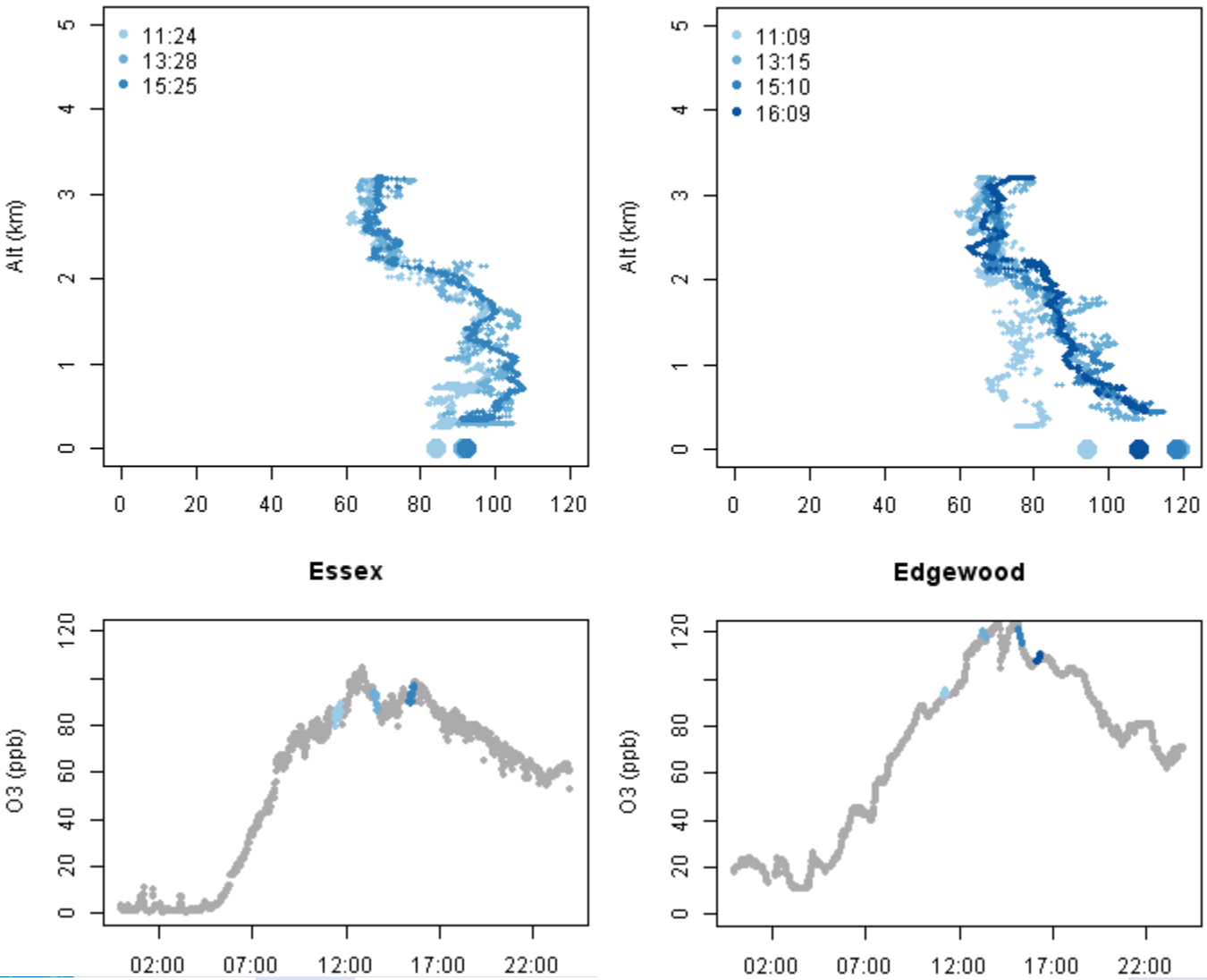
Sources: AIRNow, NOAA- ARL, NOAA MADIS, HU, PSU, Hysplit, Laura Landry-MDE

July 2 Bay Breeze



- Surface winds at Essex and Edgewood show onshore flow while winds at Padonia and Aldino show northwesterly winds.
- Sodar at Edgewood also shows onshore flow.

Bay breeze impacts Essex-Edgewood



- Stagnation leads to high O_3 around the region.
- Bay breeze contributes to code red O_3 at Edgewood, only code orange at Essex

Time is EST

- Essex → **87** ppb O_3 Code orange (75-95)
- Edgewood → **107** ppb O_3 Code red (96-115).

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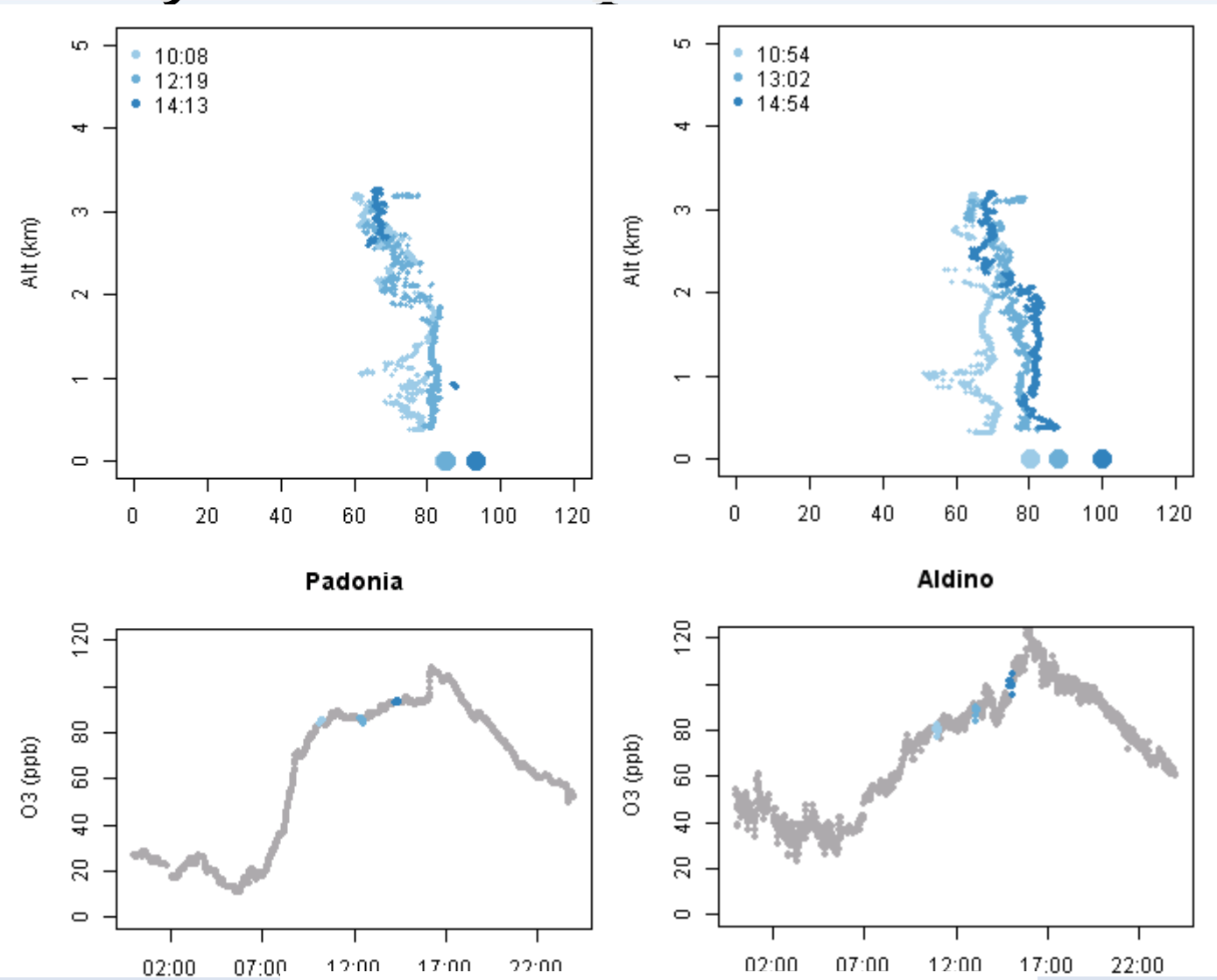
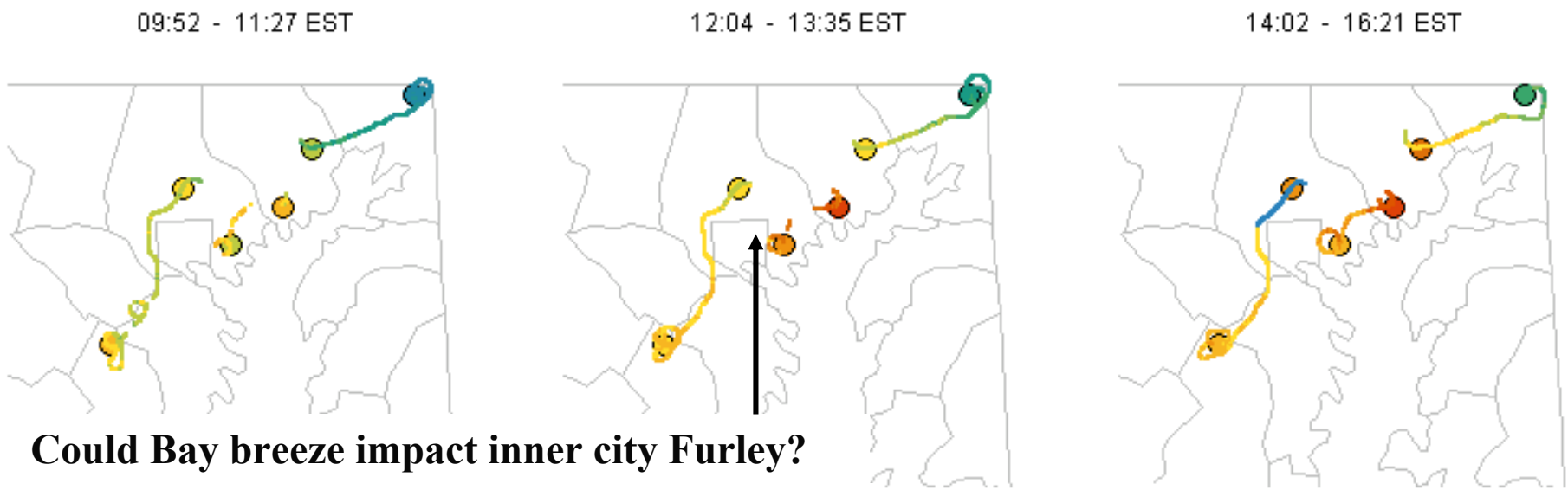
Bay breeze impacts Padonia -Aldino



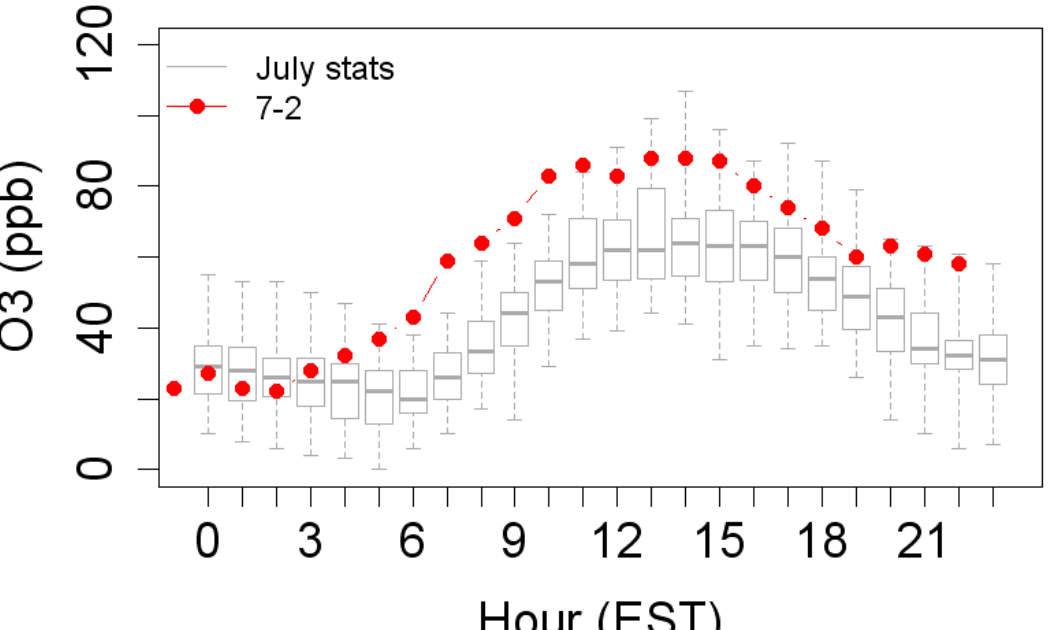
- Padonia→ 92 ppb O_3 Code orange (75-95)
- Aldino → 98 ppb O_3 Code red (96-115).

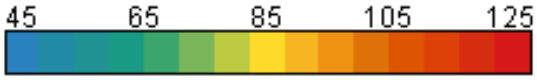
Time is EST

O_3 gradient in P3 transects



Could Bay breeze impact inner city Furley?





O_3 from P3 between 0.3 – 0.6 km

Surface O_3 circled in black.