Performance of the NAQFC in Philadelphia during Summer 2015

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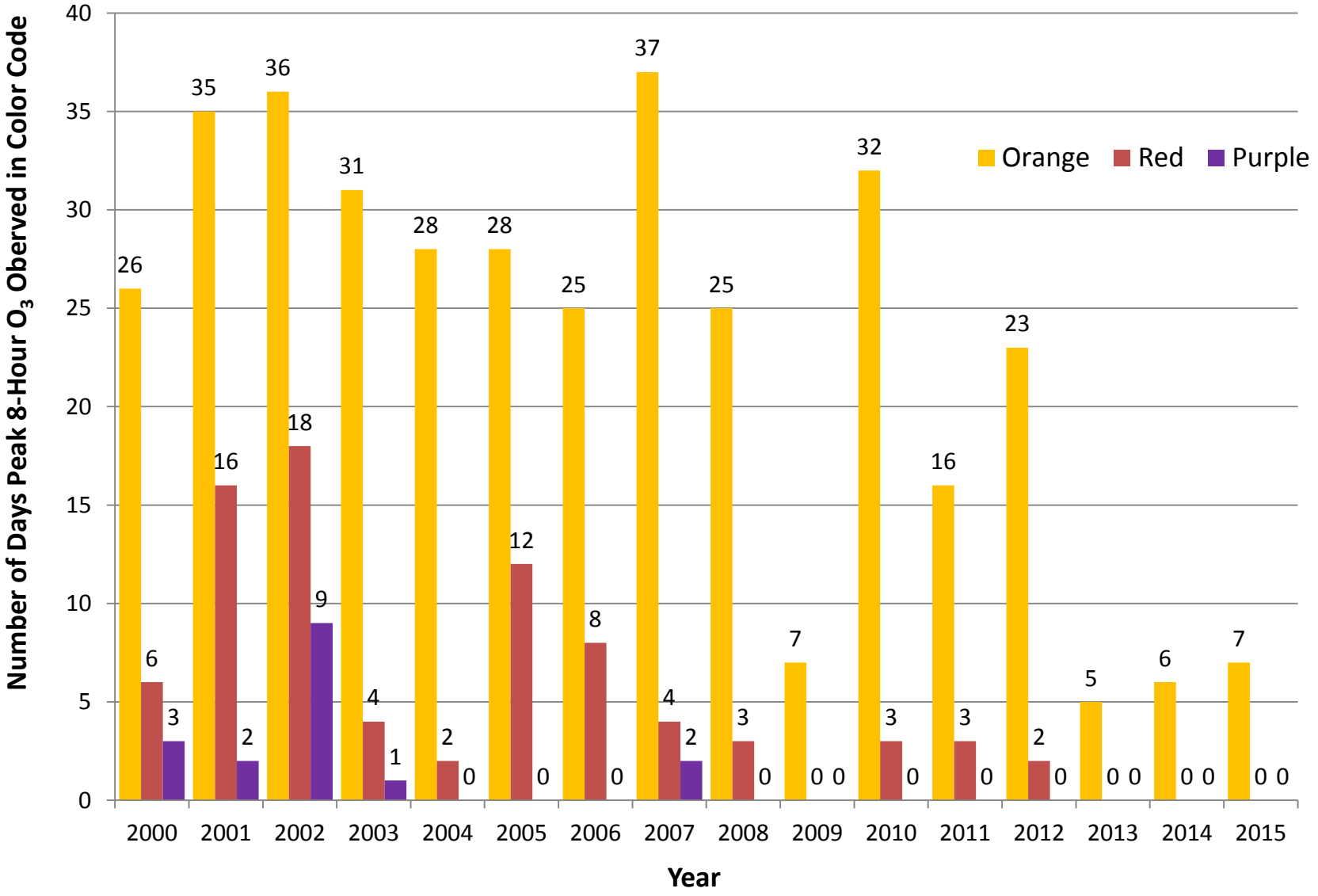
3rd Consecutive Historically Low Ozone Season for PHL

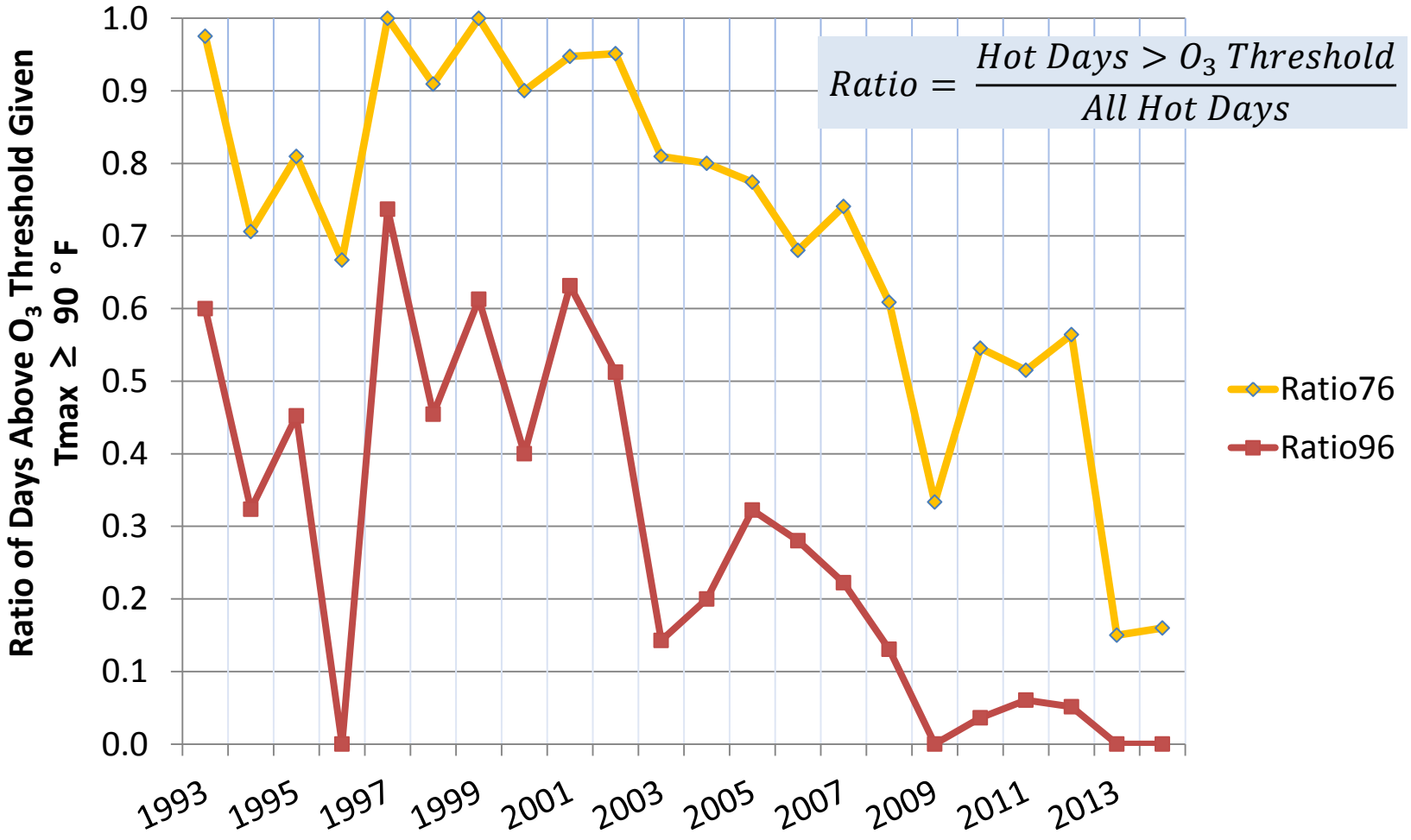


7 Ozone Exceedance Days in PHL in 2015

Date	Max 8-Hr Average O_3 (ppb)	DOW	Number of Exceeding Monitors	Conditions
6/11	92	Thursday	5	Smoke
7/5	76	Sunday	1	July 4th holiday weekend; previous day Code Green
7/28	80	Tuesday	3	7/27 Code Green remnants of weak cold front lingered over PHL, line of converging winds near I-95
7/29	76	Wednesday	1	
8/15	83	Saturday	2	Classic hot and stagnant
8/23	77	Sunday	1	Previous day Code Green
9/2	82	Wednesday	2	Smoke

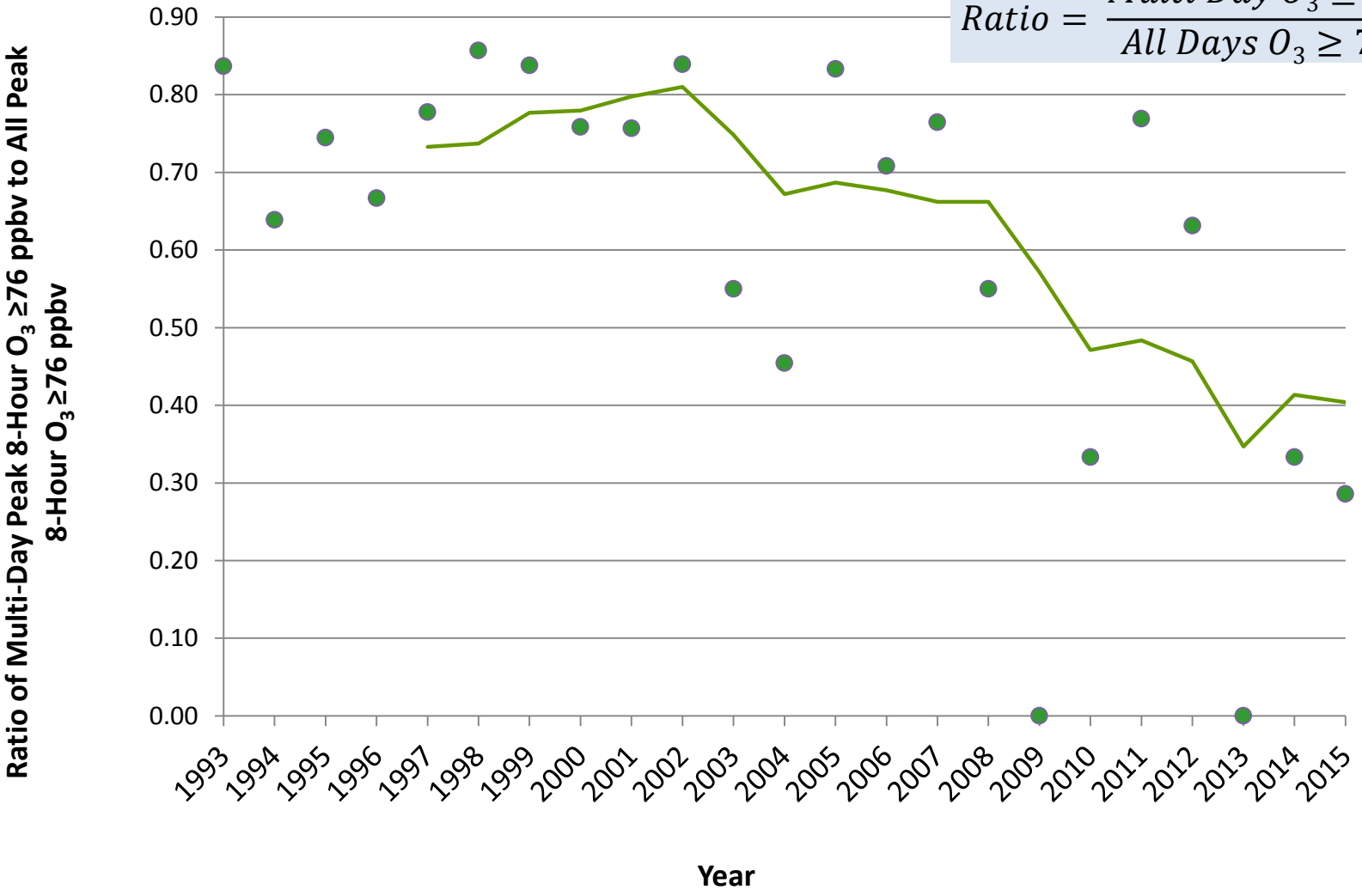
Hot weather and persistence are no longer consistently reliable predictors of high O_3!

Hot Days (T_{max} > 90°F) are Now Much Less Likely To Be High O_3 Days in PHL



High O_3 Now Much Less Likely to Occur in Multi-Day Events in PHL

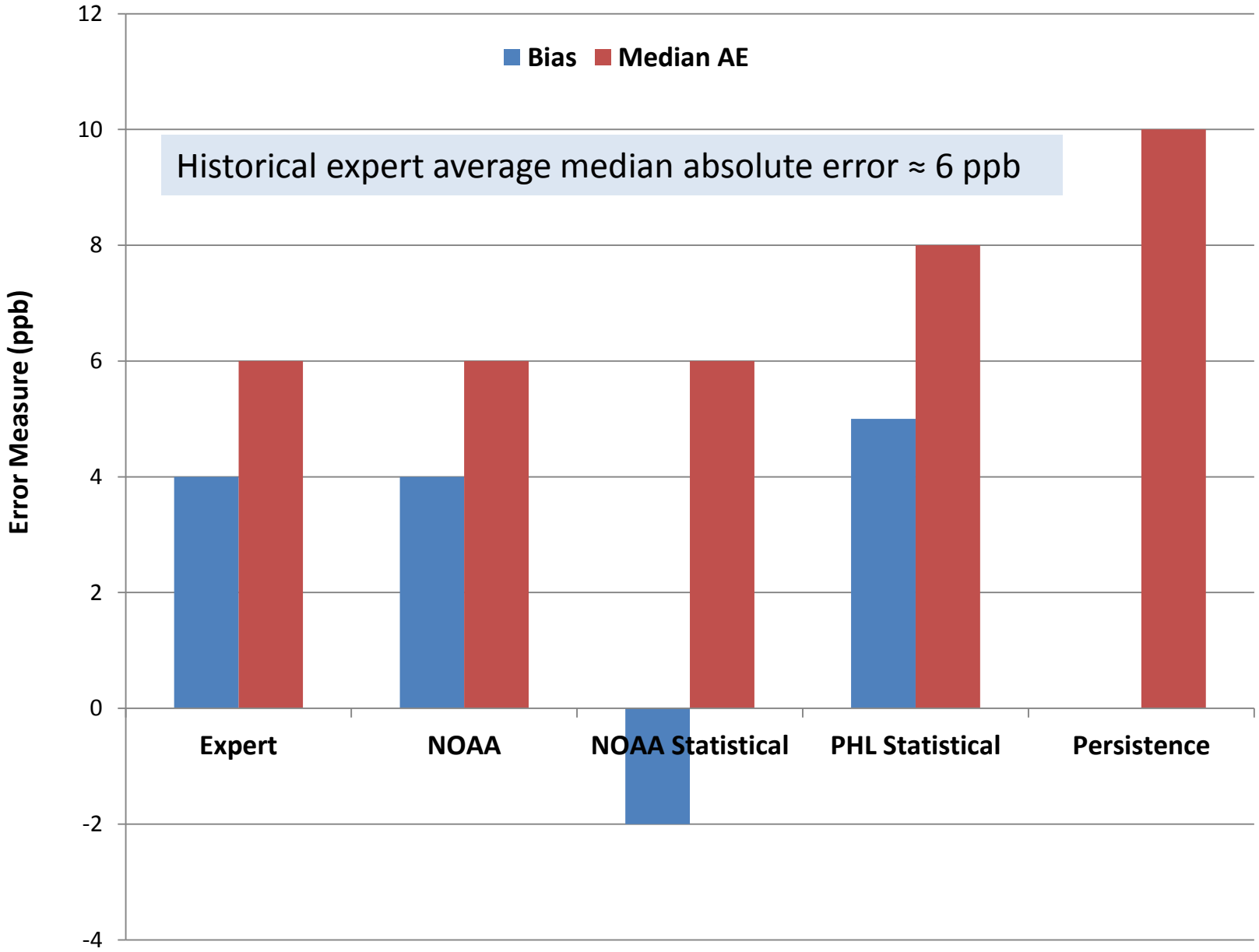
$$Ratio = \frac{Multi\ Day\ O_3 \geq 76ppb}{All\ Days\ O_3 \geq 76ppb}$$



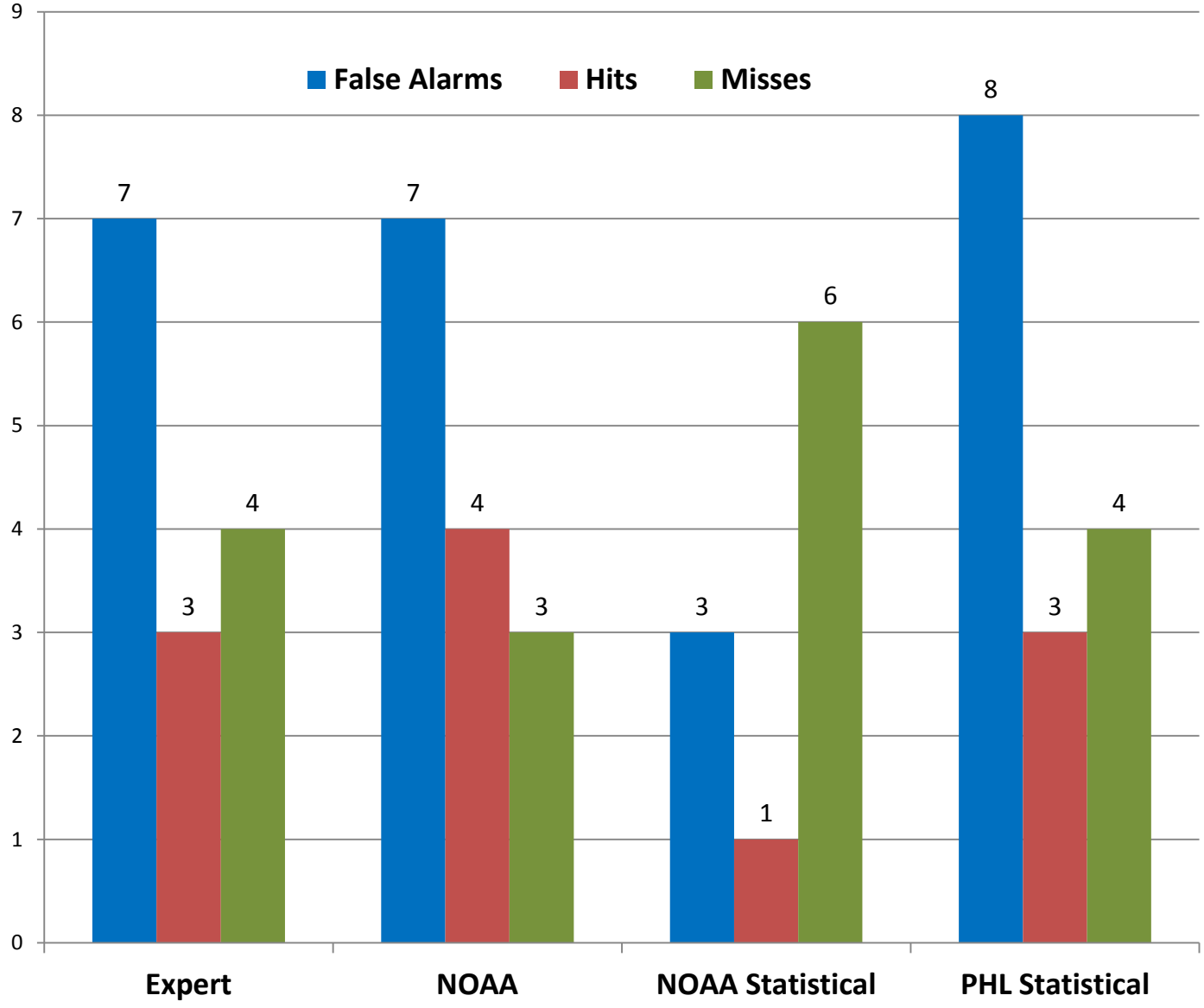
PHL Statistical O_3 Models in 2015

- Lexie Herdt, REU undergraduate student, updated "classic" statistical O_3 model for PHL
  - Historically, very useful guidance due to strong relationship b/w high O_3 and high temperature (hot weather)
  - Discontinued use of statistical models ~ 2008 b/c no longer skillful due to rapidly changing emissions (mostly NOx)
  - Emissions seem to have stabilized, so time to revisit use of statistical guidance
  - Main predictors: persistence, temperature, cloud cover, surface wind speed
- Bill Ryan also developed a statistical model based on NOAA O_3 model guidance
  - Main predictors: persistence, today's NOAA O_3, tomorrow's NOAA O_3

Forecast Results for O_3 Season to Date (5/1-9/4)

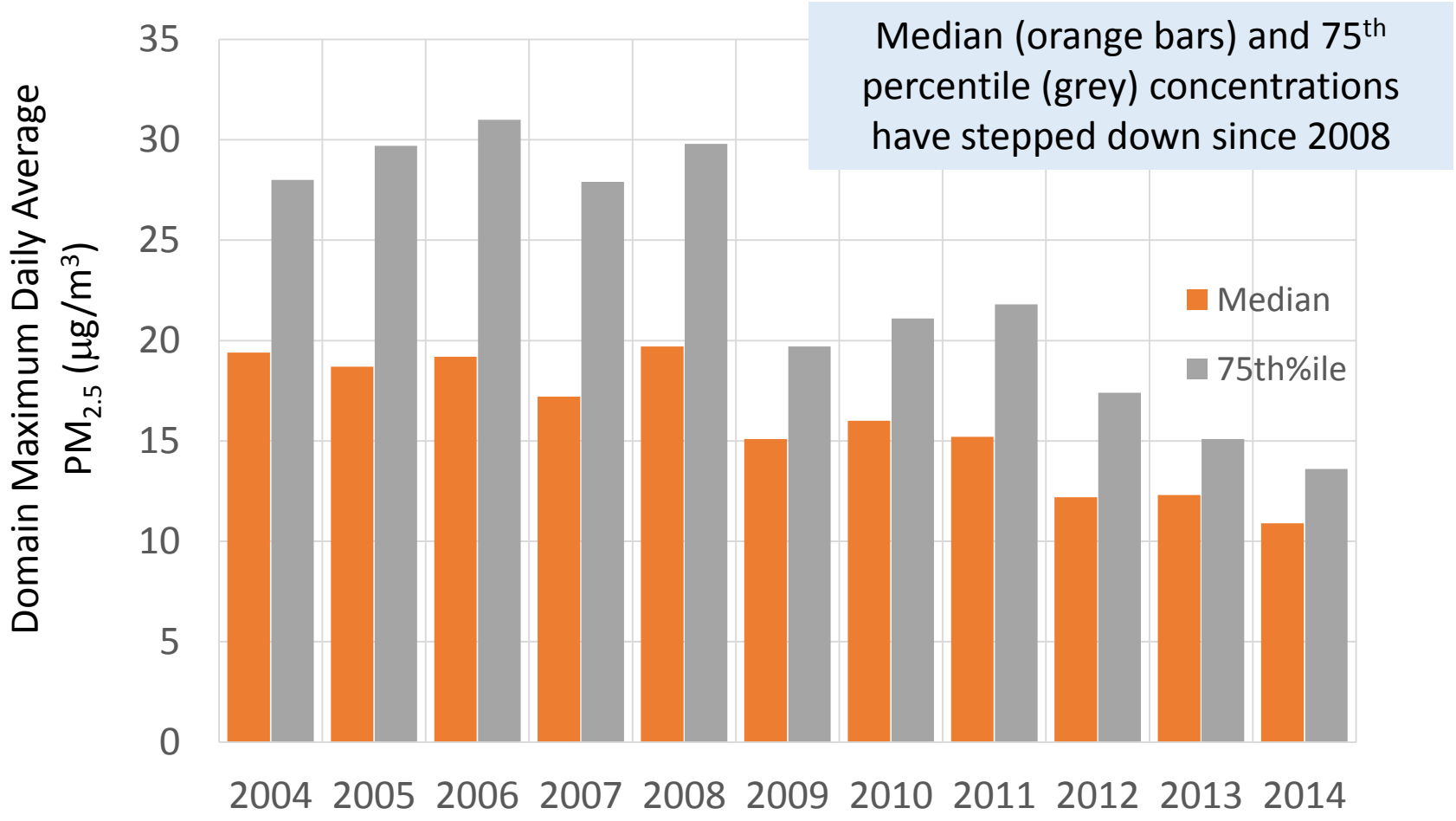


Skill Measures for O_3 Exceedance Days

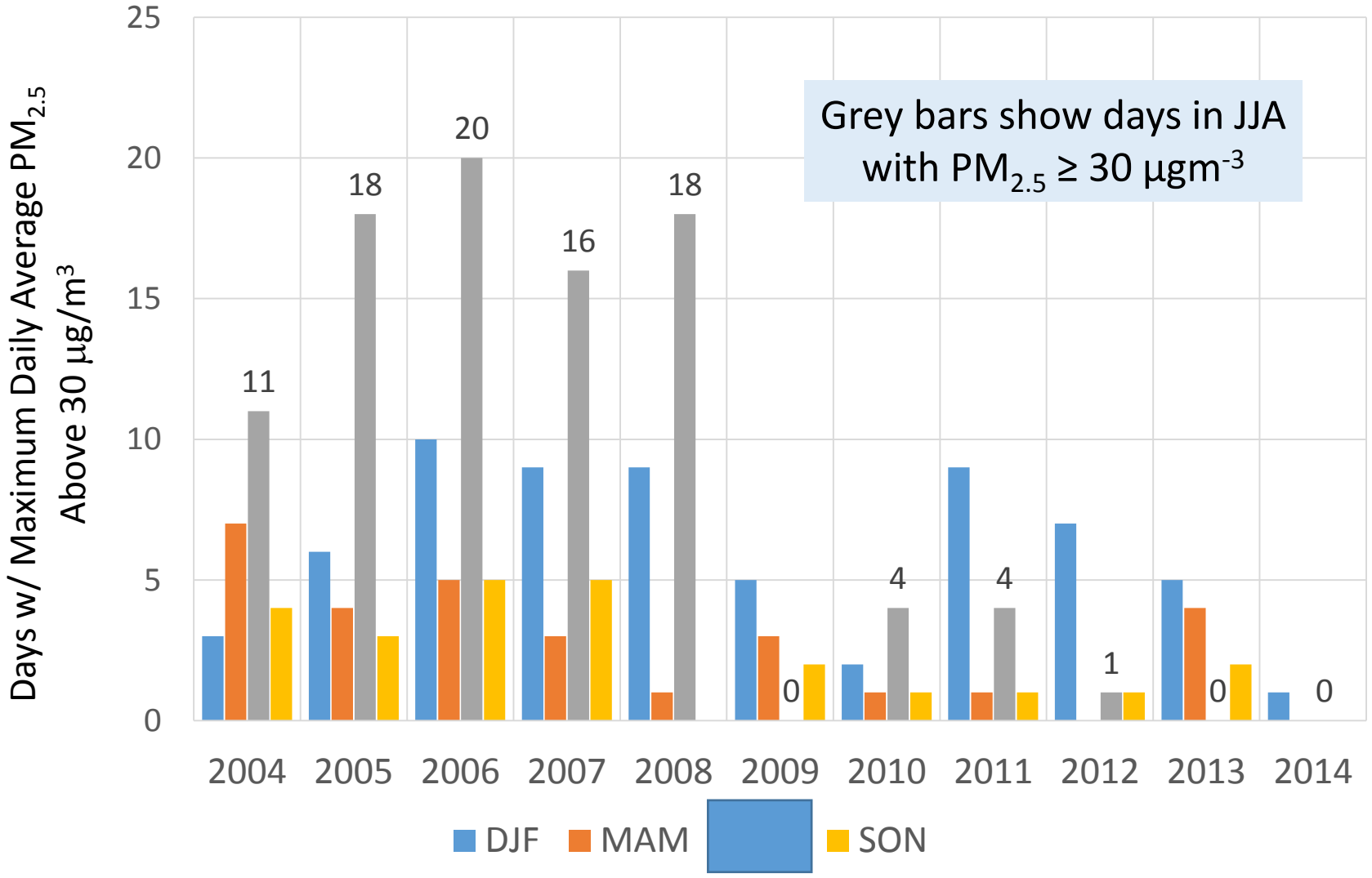


- NOAA model and expert forecasters had same number of false alarms (7) but on different days
- NOAA model got 1 more hit than experts (9/2)
- Statistical models are not helping us identify the high O_3 days

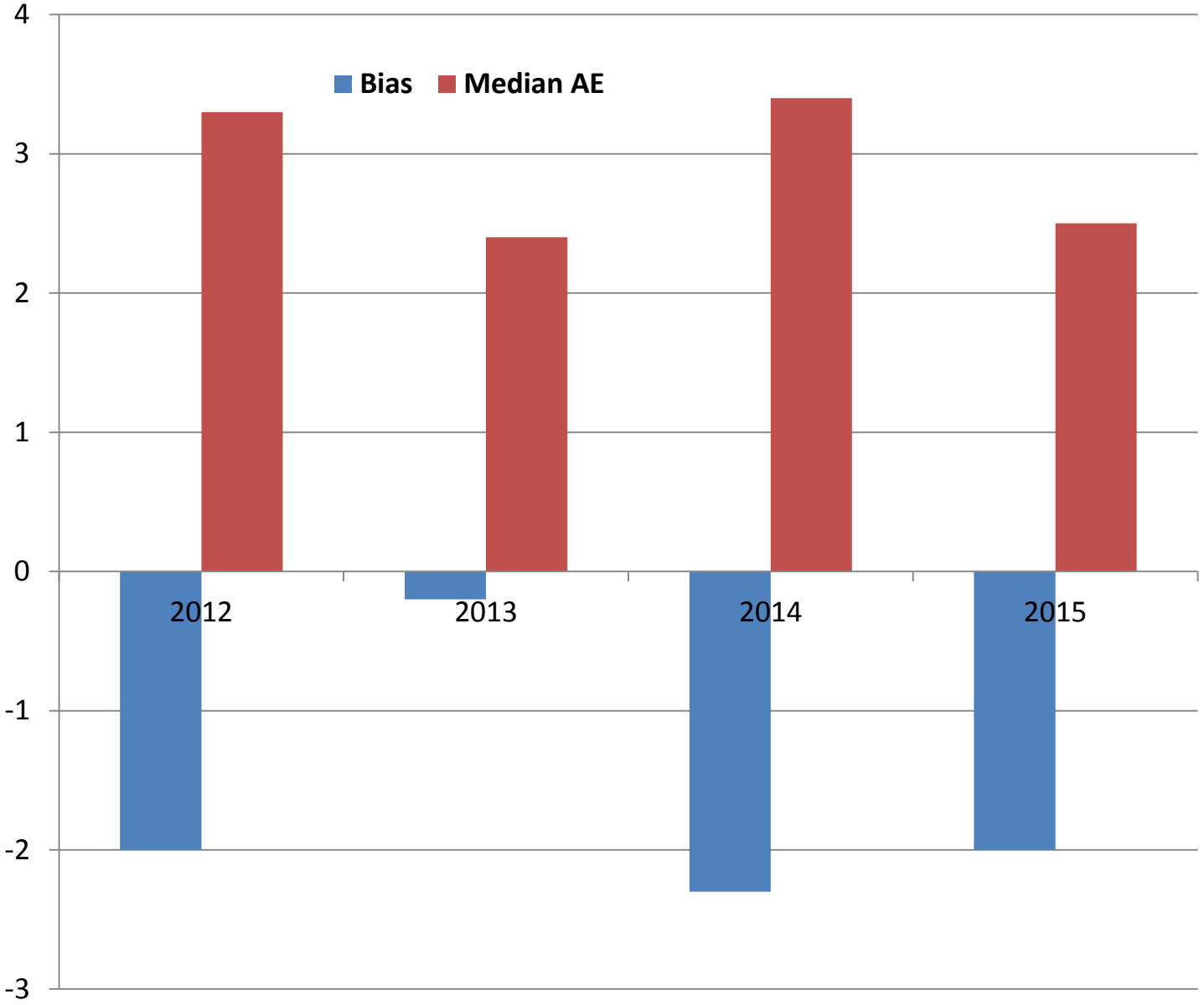
Summer Season $PM_{2.5}$ Maximum Daily Average Concentrations Continue to Fall in PHL



Summer Season $PM_{2.5}$ "Bad Air Days" Are Now Rare in PHL

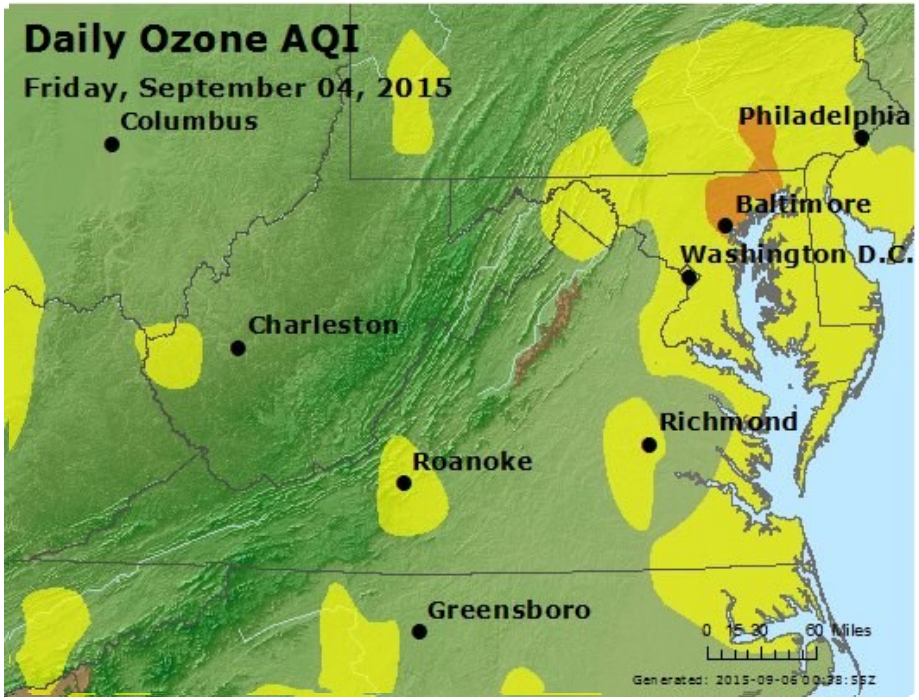


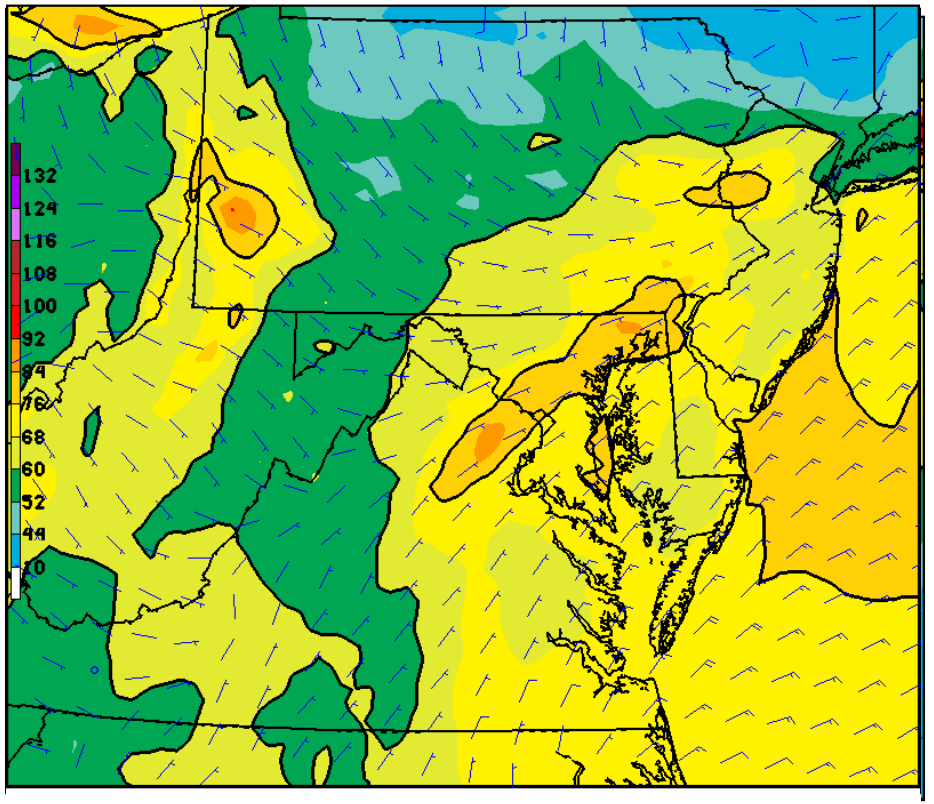
$PM_{2.5}$ NAQFC Summer (JJA) Performance



Aug 29 – Sep 4 Episode: O_3

Max 8-hr O_3 (ppb)	8/29	8/30	8/31	9/1	9/2	9/3	9/4
Observed	71	71	72	74	82	66	69
NOAA	68	72	51	85	86	73	79





Conclusions: O_3

- 2015 was 3rd consecutive historically low O_3 year for PHL
  - Decreases in O_3 precursor emissions
  - Fewer days with favorable synoptic weather pattern
- Association between high O_3 (≥76 ppbv) and high temperature (T_{max} ≥90°F) and persistence (previous day O_3 ≥76 ppbv) continues to weaken for the Mid-Atlantic region
  - Fewer regional events, many more local "spikes"
  - Makes accurate forecasts very challenging, for us and models (numerical and statistical)
  - Mesoscale features much more important (harder to forecast)
  - Smoke made a big difference in 2015 (2 of 7 exceedance days)
- NOAA model captures trends well in O_3
  - Same number of false alarms as expert forecasts (7) but on different days – makes it hard to know when to "trust" model
  - Often difference b/w Moderate and USG is 1-2 ppb at 1 monitor location – very difficult for model to identify

Conclusions: $PM_{2.5}$

- Summer season peak in $PM_{2.5}$ now essentially gone in PHL
  - Code Orange and high Code Yellow days ($PM_{2.5}$ $\geq$30 $\mu g/m^3$) during summer are now very rare; none in 2014 or 2015
  - Only time we see summer $PM_{2.5}$ higher than low Moderate is during smoke events (like last week, low/mid 20s $\mu g/m^3$ for 24-hr average)
  - Winter peak associated with local nitrate remains unchanged
- NOAA model overall bias and absolute error is roughly the same for 2012-2015
  - Slight tendency to under-forecast by ~ 2 $\mu g/m^3$
  - Median absolute error ~2.5-3.5 $\mu g/m^3$
- NOAA model most helpful identifying trends in $PM_{2.5}$
  - Less useful during smoke events since smoke is not part of model boundary conditions

Acknowledgements

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