

# **Analysis of NAQFC Model Predictions for the 2018 Ozone Season in the Philadelphia Metropolitan Area**

**Amy K. Huff**

**William F. Ryan**

**James Enlow**



**PennState**

**Department of Meteorology and Atmospheric  
Science, Penn State University**

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# Overview of Model Analysis for Philadelphia

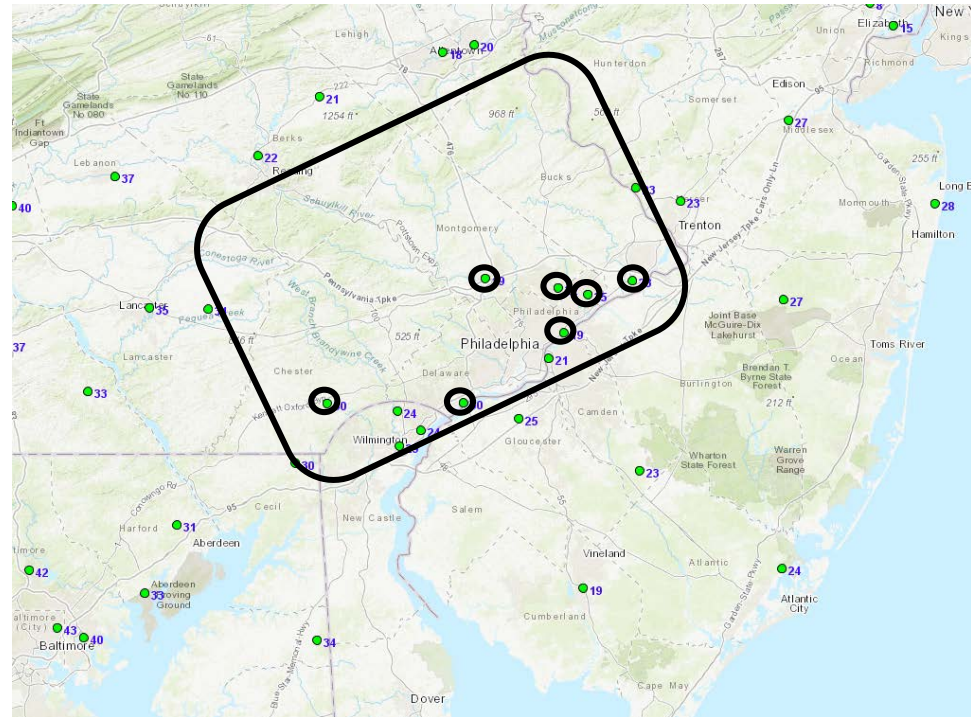
- Philadelphia forecast area includes the following counties in Pennsylvania:

- Bucks
- Chester
- Delaware
- Montgomery
- Philadelphia

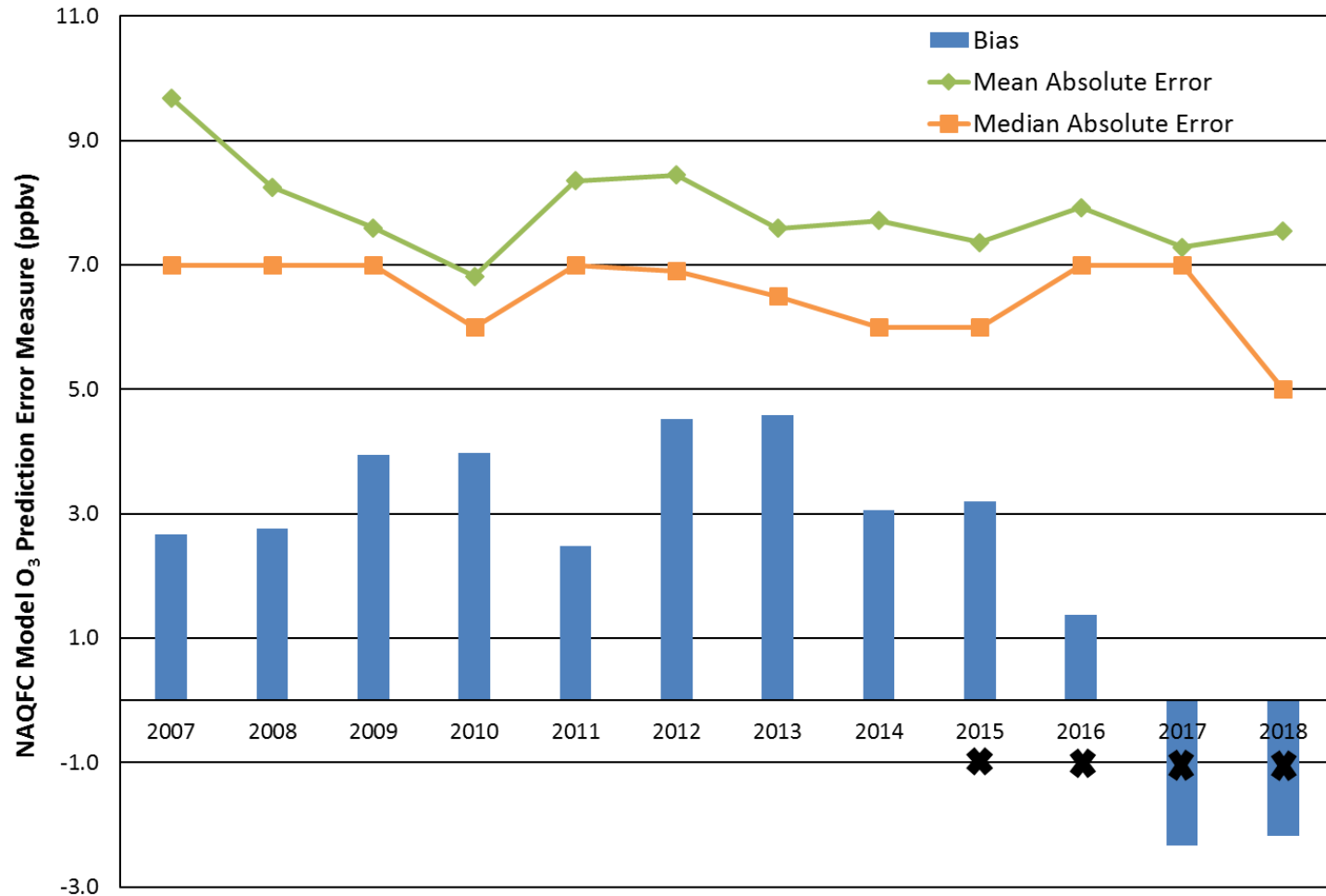
- 7 total O<sub>3</sub> monitors

- NAQFC O<sub>3</sub> (CMAQ V5.02), 12 UTC run, Day 2 output

- Operational NAQFC analysis period: May 1 to Sept 15, 2018 (PROD)
- Experimental NAQFC analysis period: ~July 1 to Aug 15, 2018 (PARA5, PARABC)

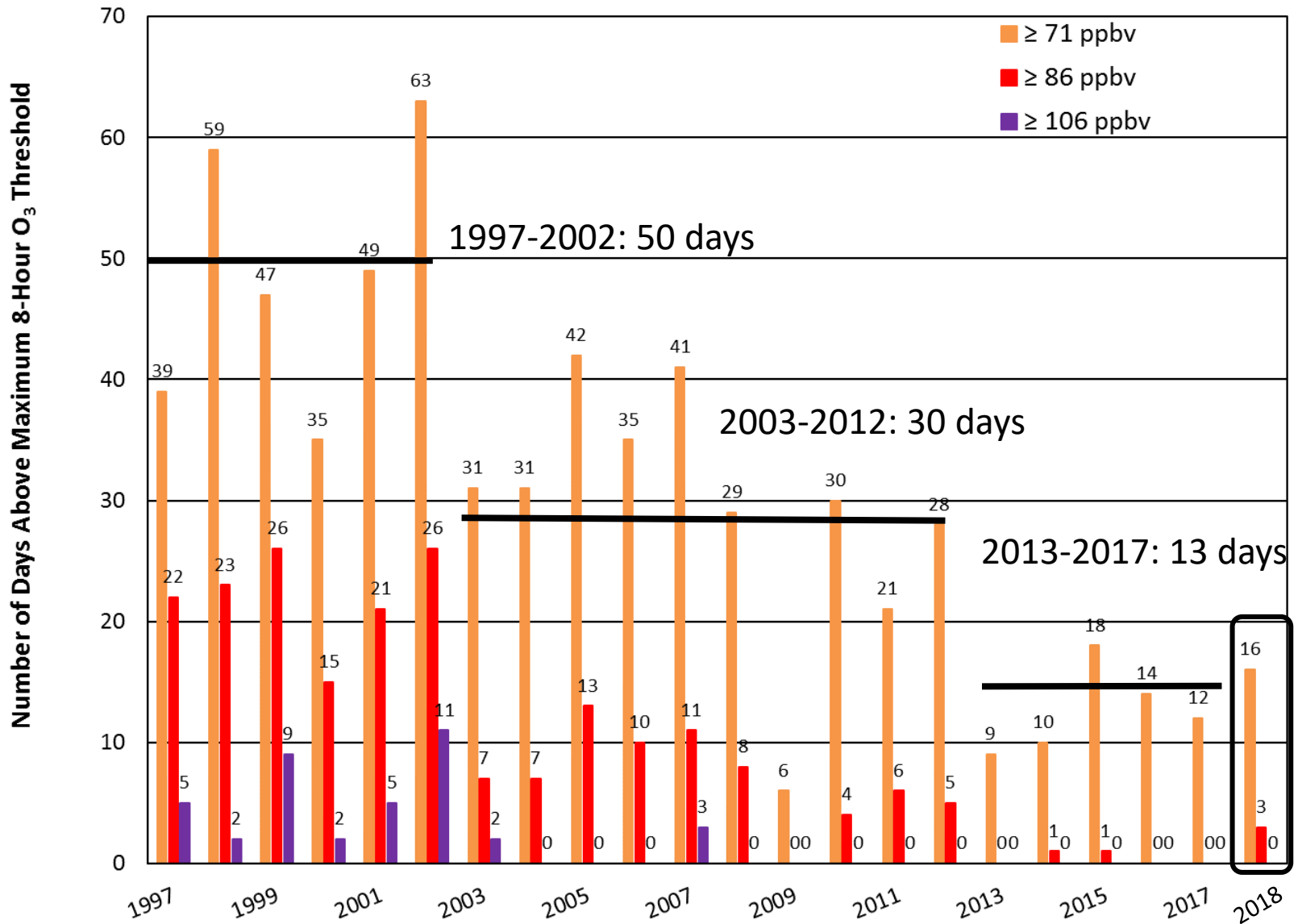


# NAQFC PROD 2018 O<sub>3</sub> Skill, All Days (May 1 to Sept 15)



- NAQFC PROD median absolute error of 5.0 ppbv in 2018 slight improvement in overall accuracy compared to recent years
- NAQFC PROD bias of -2.2 ppbv in 2018 indicated overall under-prediction, consistent with 2017

# 2018 Philadelphia Observed O<sub>3</sub> Exceedance Days: Slightly Higher than 2013-2017 Average

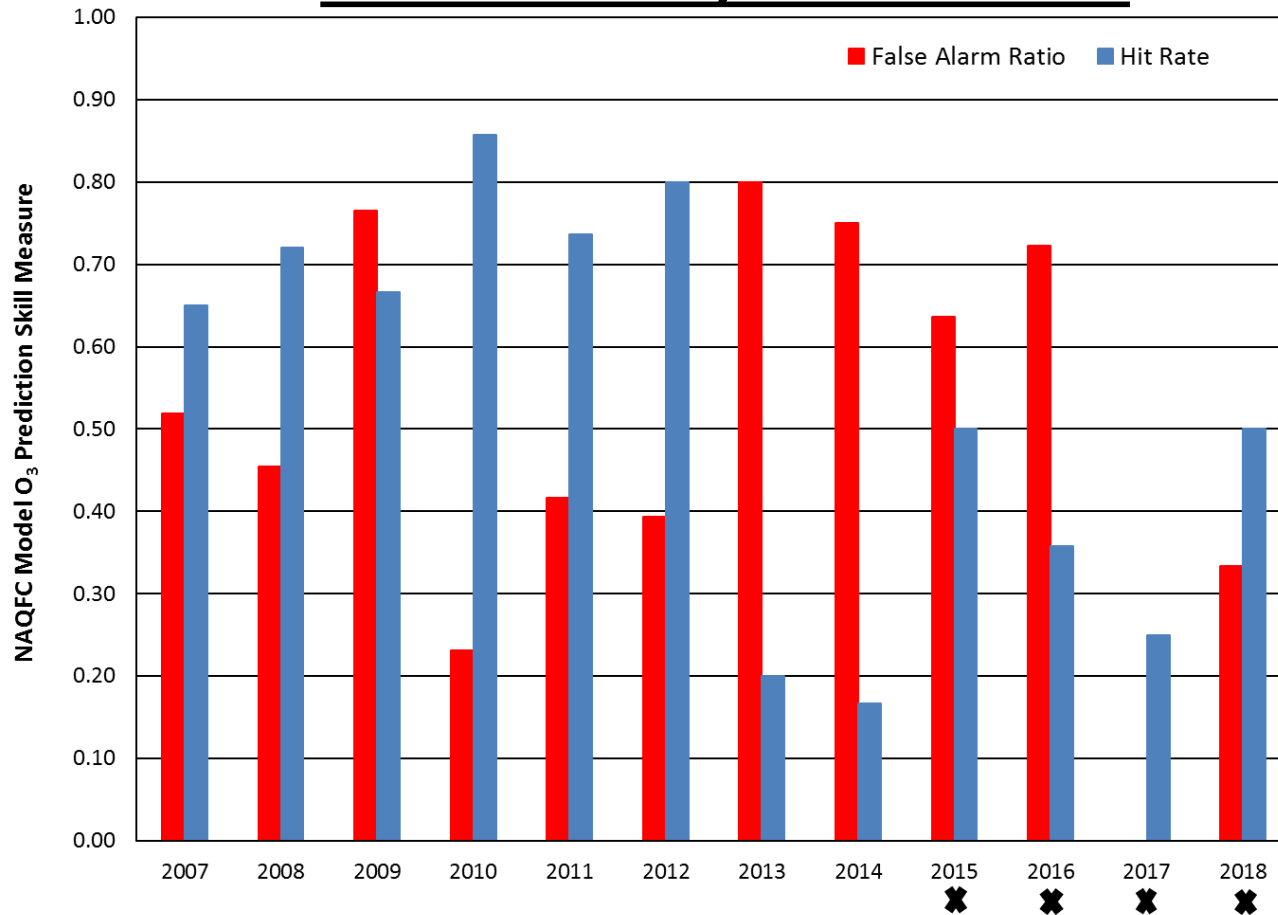


# NAQFC Skill for 2018 O<sub>3</sub> Exceedance Days

8-hr O <sub>3</sub> PHL max (ppb)	May 1	May 2	May 3	May 25	Jun 17	Jun 18	Jun 30	Jul 1	Jul 2	Jul 3	Jul 9	Jul 10	Jul 16	Aug 8	Aug 16	Sep 5
Observed	73	72	72	71	81	81	73	78	91	78	86	84	86	80	71	80
PROD	54	57	55	69	74	74	70	87	107	89	91	68	58	55	73	72
PARA5	-----	-----	-----	-----	-----	-----	-----	-----	108	89	90	71	60	58	73	-----
PARABC	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	82	70	60	53	65	-----

- PROD identified 8 of the 16 exceedance days (hit rate = 0.50)
- PROD had 5 **substantial misses** on May 1-3, July 16, and August 8, when it predicted Good/low Moderate O<sub>3</sub> on exceedance days
- PROD **under-predicted** during episodes in late May, June, late July, August, and September
- PROD **over-predicted** July 1-3 episode
- PARA5 similar to PROD, but caught July 10 exceedance (barely)
- PARABC under-predicted relative to PARA5 (no improvement)

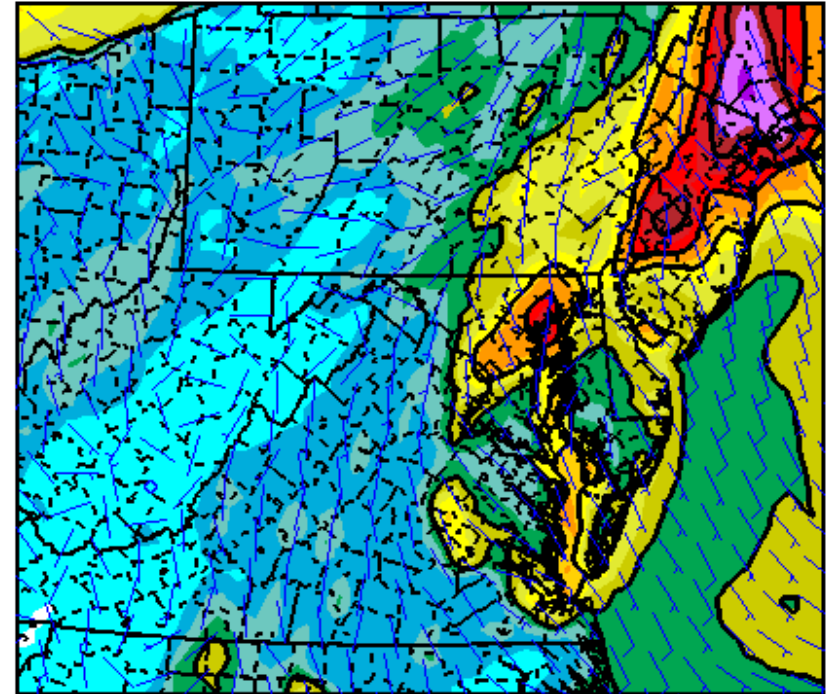
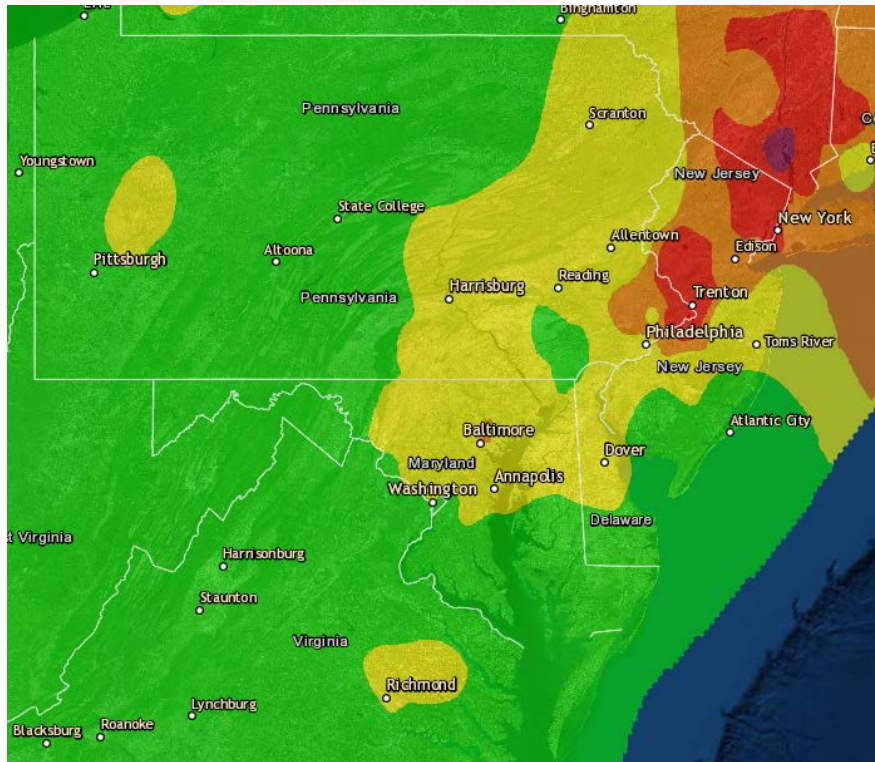
# PROD Skill Scores for O<sub>3</sub> Exceedance Day Predictions, 2007-2018



- NAQFC struggles during years with low overall observed O<sub>3</sub> (2009, 2013-2018)
- NAQFC had a false alarm ratio of 0.33 in 2018, which was a noticeable improvement from 2013-2016 (model did not have any false alarms in 2017)
- NAQFC's 2018 hit rate of 0.50, comparable to 2015, was an increase from 2016-2017

# July 2: Hit for NAQFC, but Over-Prediction

Date	Observed	PROD	PARA5
July 2	91	107	108

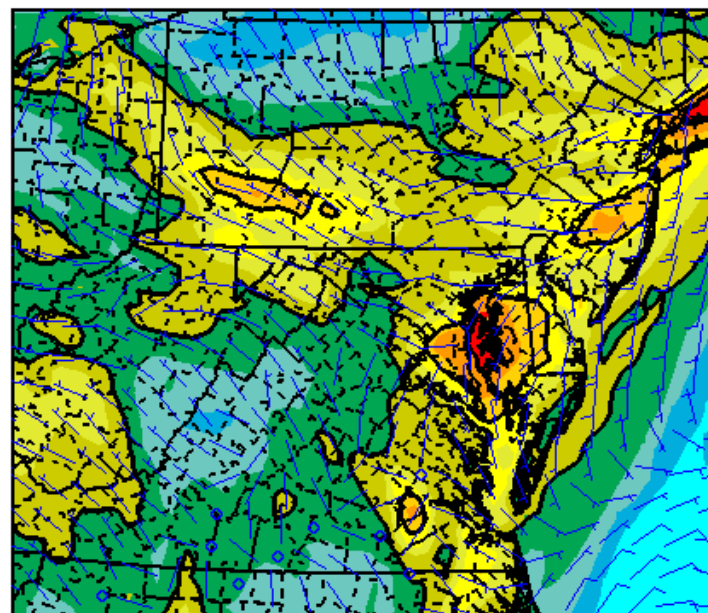
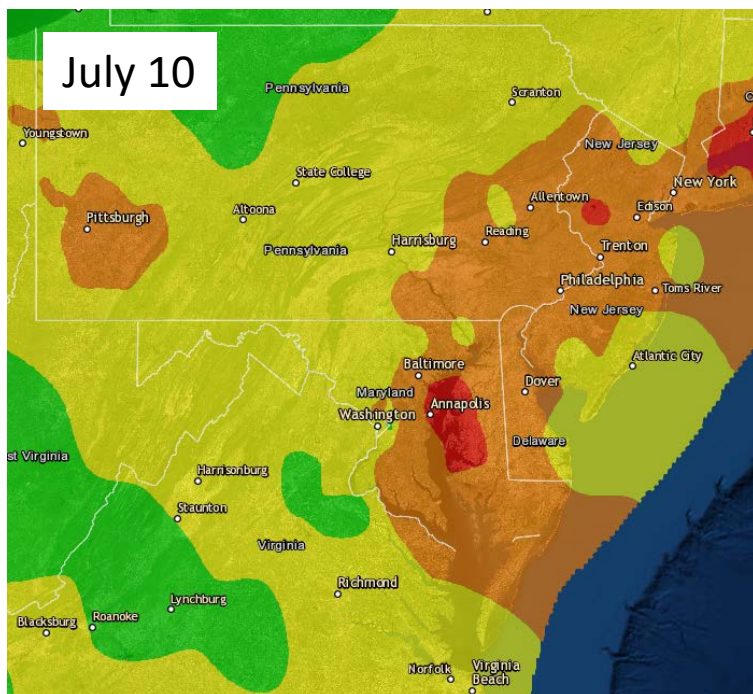


PROD DAY2 OZMX08 (PPB) 20180701 12Z CYC~

- NAQFC PROD and PARA5 accurately predicted geographic extent of exceedances along I-95 Corridor in Philadelphia, NJ, and New York City metro areas, but substantially over-predicted (+16-17 ppb for PHL)
- NAQFC false alarms for Baltimore, Washington, DC, and Wilmington, DE

# July 9-10: Hit and Miss for NAQFC

Date	Observed	PROD	PARA5	PARABC
July 9	86	91	90	82
July 10	84	68	71	70



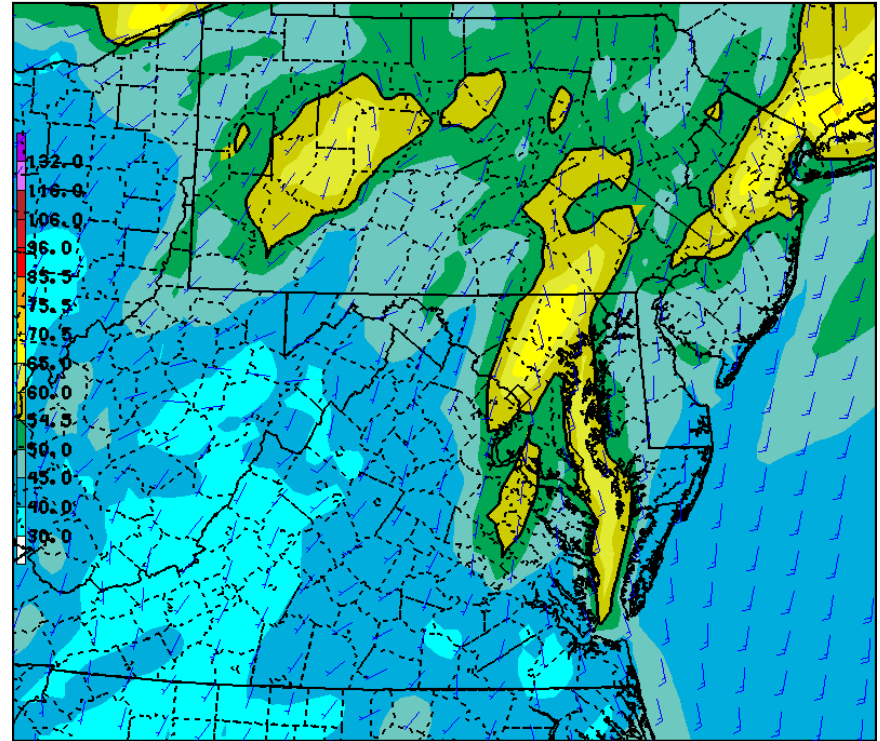
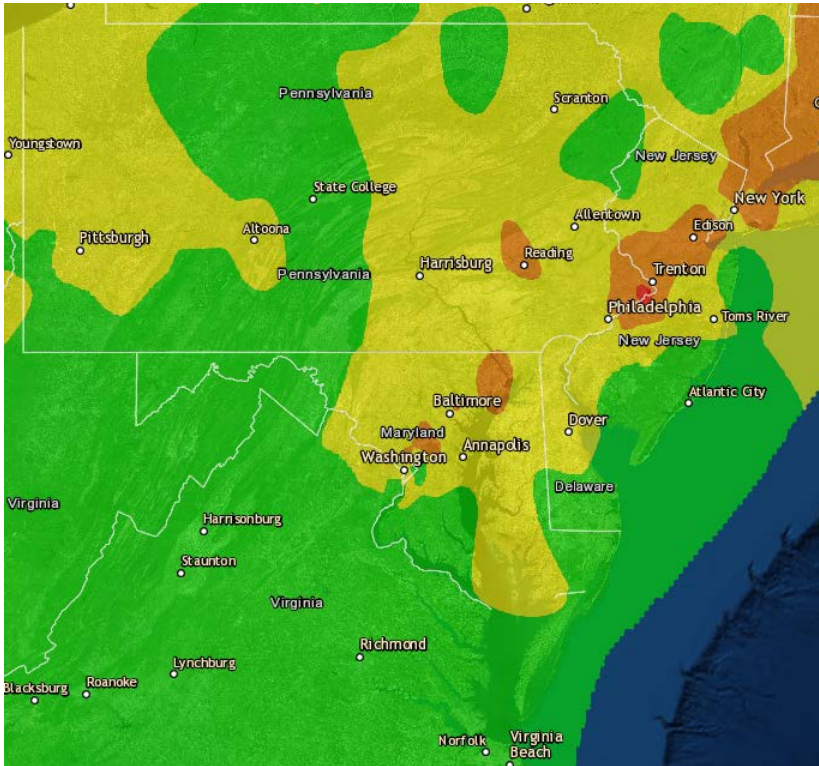
PROD DAY2 OZHX08 (PPB) 20180709 12Z CYC7

- NAQFC PROD and PARA5 correctly predicted Code Red day on July 9; PARABC slightly under-predicted (high Code Orange)
- But NAQFC PROD and PARABC missed more geographically widespread Code Orange exceedances on July 10; PARA5 did (barely) identify Code Orange, but with substantial under-prediction (-13 ppb)



# July 16: Big Miss for NAQFC

Date	Observed	PROD	PARA5	PARABC
July 16	86	58	60	60



PROD DAY2 02HX08 (PBB) 20180715 12Z CYC\*

- NAQFC PROD, PARA5, and PARABC completely missed scattered Code Orange exceedances along I-95 on July 16, including isolated Code Red in Philadelphia

# Summary of 2018 NAFC Performance in PHL

- Skill for all days, May 1 to Sept 15:
  - PROD had **slight improvement in overall accuracy** compared to recent years (median absolute error of 5.0 ppb vs. 6.0-7.0 ppb)
  - PROD **under-predicted**, on average (bias of -2.2 ppb), similar to 2017; previously, PROD tended to over-predict
- Skill in predicting O<sub>3</sub> exceedance days:
  - 16 observed O<sub>3</sub> exceedance days in 2018, slightly above average
  - PROD predicted 8 of 16 days, for **hit rate of 0.50**, comparable to 2015 and improvement on 2016-2017 but still a long way from hit rates of 0.60-0.85 from prior to 2013
  - PROD **false alarm ratio of 0.33** was noticeable improvement from 2013-2016
  - PROD **over-predicted** during early July episode and **under-predicted** for rest of episodes
  - No substantive difference in skill for PARA5 and PARABC:
    - PARA5 similar to PROD but with slight improvement overall (1-3 ppb); caught July 10 exceedance (barely)
    - PARABC under-predicted relative to PARA5 (less skillful)