

# Air Quality Forecasters Focus Group Meeting

William F. Ryan

Nathan T. Wiles

Department of Meteorology

The Pennsylvania State University

wfr1@psu.edu

# Side Swiped By NWS-Sterling and NWS-Mount Holly (“Our Partners”)

**National Weather Service Forecast Office Philadelphia/Mount Holly**

Local forecast by "City, St" or zip code

Site Map News

NOAA Watch Products MX Forecast Past Weather Public Info Wx Roundup NHC Event Archive UV Index Air Quality Surf Zone

hide news items

National Weather Service Annual Open House -- Sept. 22!  
 ...Lightning Safety Presentation...  
 ...Updated version of June 29 Derecho Summary...

Quick Glimpse at the Weather Philadelphia/Mt Holly map FAQ

Click on the map below for the latest forecast.

Read watches, warnings & advisories  
 Air Quality Alert  
 Hazardous Weather Outlook  
 Short Term Forecast

Zoom Out

Current Hazards  
 Weather Briefing  
 Local Hazards  
 Hazardous  
 Weather Outlook  
 Convective  
 Outlooks  
 Winter Weather  
 Tropical Weather

Current Conditions  
 Observations  
 Satellite Images  
 Rivers & Lakes  
 AHPs

Radar Imagery  
 Mt. Holly Radar  
 Nationwide

Forecasts  
 Activity Planner  
 Local Forecasts  
 Aviation  
 Marine  
 Fire Weather  
 Air Quality  
 Model Guidance

Hydrology

Area Forecast Discussion - H...  
 the early part of the weekend. T...  
 rain to the area on Easterly flow...  
 with high pressure building over the cen...  
 front. Then we will have to wait and see...  
 the motion of the remnants of tropical st...  
 AFD...

**National Weather Service Forecast Office Philadelphia/Mount Holly**

Local forecast by "City, St" or zip code

Site Map News

NOAA Watch Products MX Forecast Past Weather Public Info Wx Roundup NHC Event Archive UV Index Air Quality Surf Zone

hide news items

National Weather Service Annual Open House -- Sept. 22!

Quick Glimpse at the Weather Philadelphia/Mt Holly map FAQ

Click on the map below for the latest forecast.

Read watches, warnings & advisories  
 Air Quality Alert  
 Hazardous Weather Outlook  
 Short Term Forecast

Zoom Out

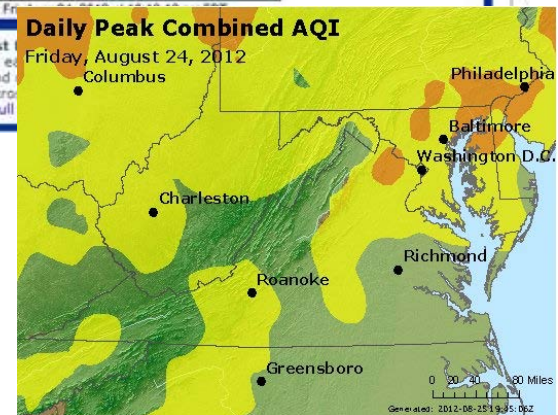
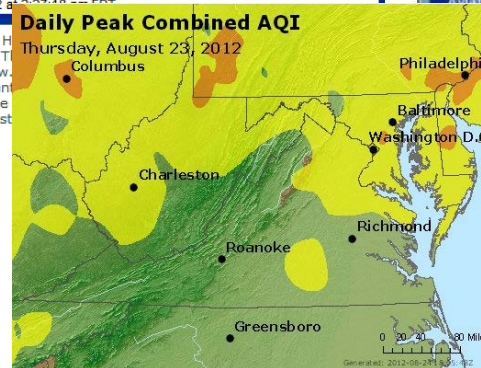
Current Hazards  
 Weather Briefing  
 Local Hazards  
 Hazardous  
 Weather Outlook  
 Convective  
 Outlooks  
 Winter Weather  
 Tropical Weather

Current Conditions  
 Observations  
 Satellite Images  
 Rivers & Lakes  
 AHPs

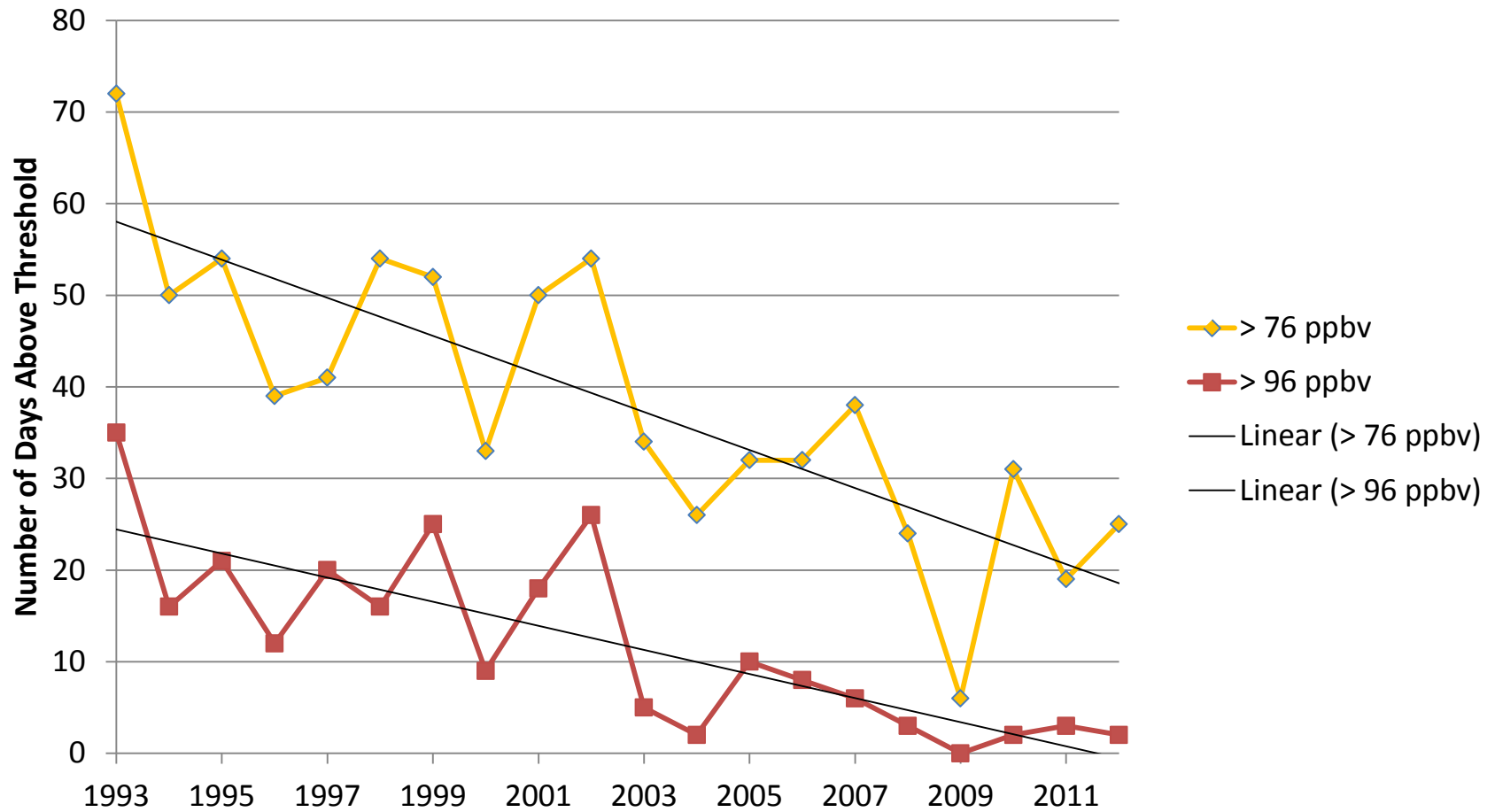
Radar Imagery  
 Mt. Holly Radar  
 Nationwide

Forecasts  
 Activity Planner  
 Local Forecasts  
 Aviation

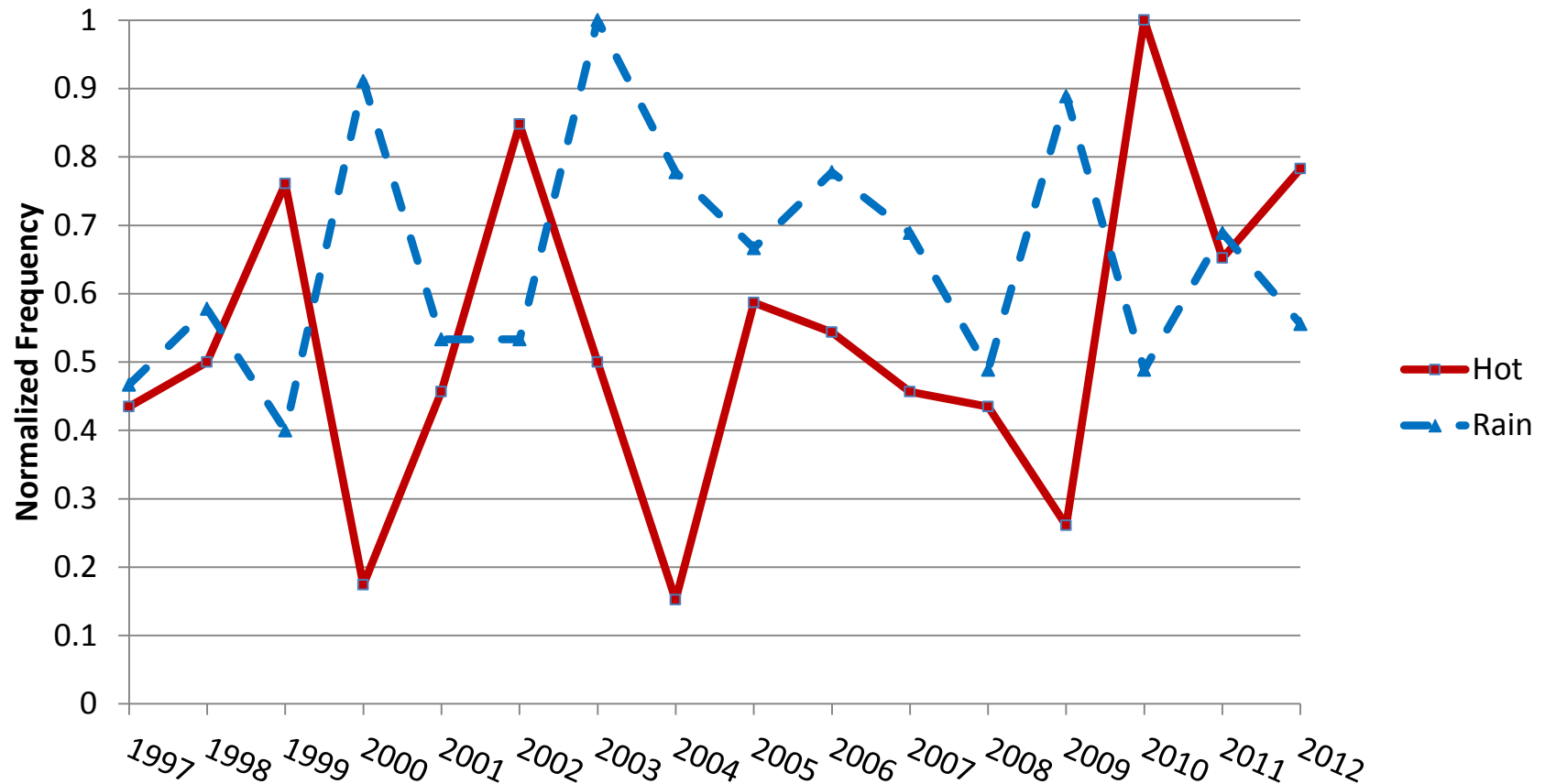
Area Forecast Discussion - H...  
 region through es...  
 to the south and cold front will move acro...  
 midweek. ...read the full...



# Code Red Cases are Extremely Rare

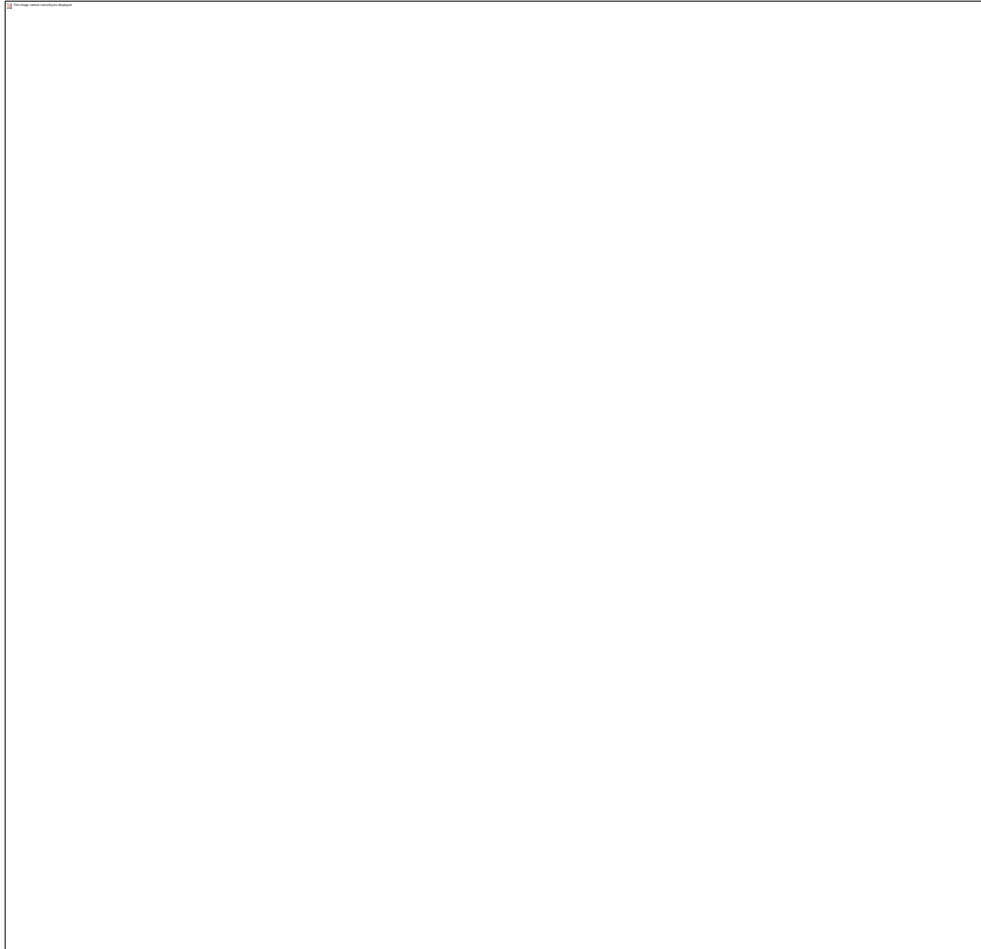


# In PHL, as most of the mid-Atlantic, the summer season (JJA) was hot and slightly dry



Normalized frequency of number of days with  $T_{max} > 90$  F and number of days With measureable precipitation ( $.001$ "") at PHL (1997-2012). 2012 was 3<sup>rd</sup> "hottest" and 7<sup>th</sup> "driest" over the 16 year period.

# Operational NAQFC Forecasts for the Philadelphia Metropolitan Area, 2012



Correlations and Best Fit:

$$r = 0.77$$

$$r^2 = 0.59$$

$$[\text{OBS}] = 4.1 + 0.88 * [\text{NAQFC}]$$



# “Poor Man’s” Ensemble Results (2012)

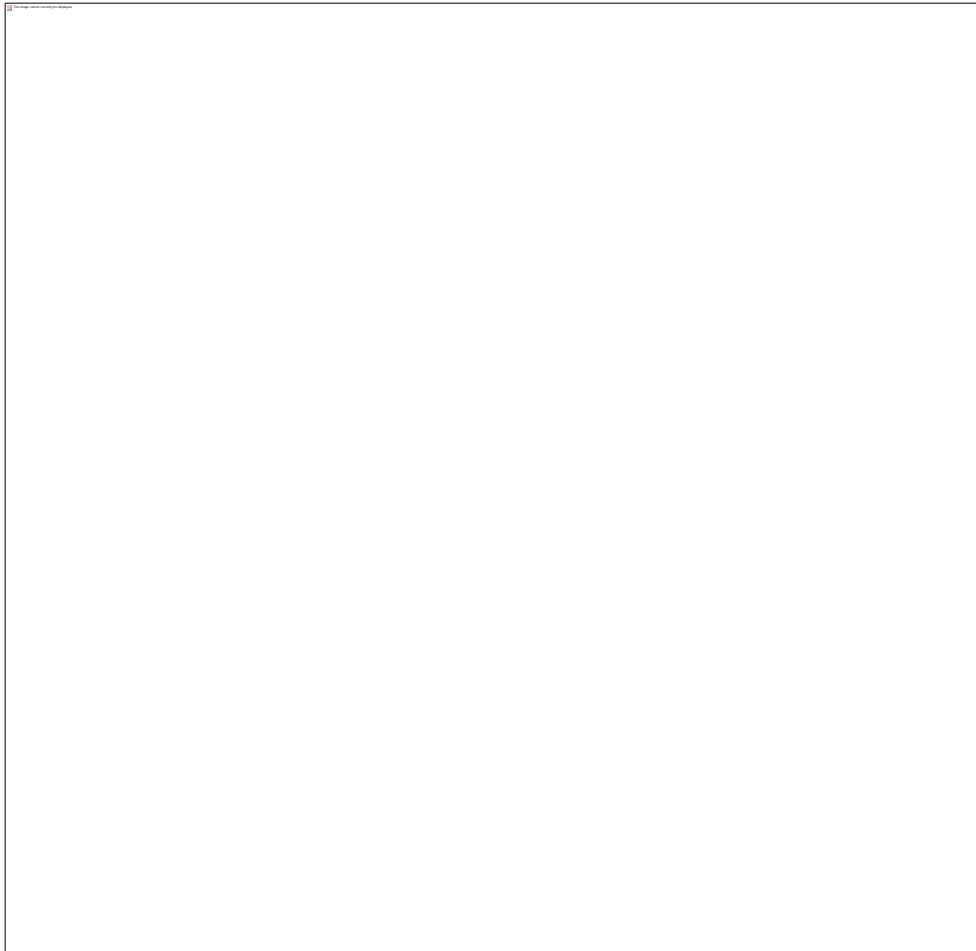
	Mean AE	Median AE	Bias
<b>NAQFC</b>	8.1	6.7	+4.0
<b>SUNY-Albany</b>	8.2	6.0	-2.2
<b>Barons</b>	8.1	7.0	-3.5
<b>ENS1</b>	6.0	5.3	-1.8
<b>ENS11</b>	6.8	5.0	-3.0

A number of ensembles (12) were tested in 2011 and the four best performing were used in 2012. Of these, two ensembles provided the best guidance:

**Ensemble 1 (ENS1):** Even weight of **NAQFC** (12 UTC point forecasts at monitor locations), **SUNY-Albany** (00 UTC, 12 km model, supplemented by 12 UTC, 12 km NCDENR), and **Barons** Met Services (06 UTC, 15 km).

**Ensemble 11 (ENS11):** **SUNY-Albany** and **Barons**.

# ENS1 Forecasts for the Philadelphia Metropolitan Area, 2012



Correlations and Best Fit:

$$r = 0.87$$

$$r^2 = 0.75$$

$$[\text{OBS}] = 1.06 * [\text{ENS1}] - 1.9$$







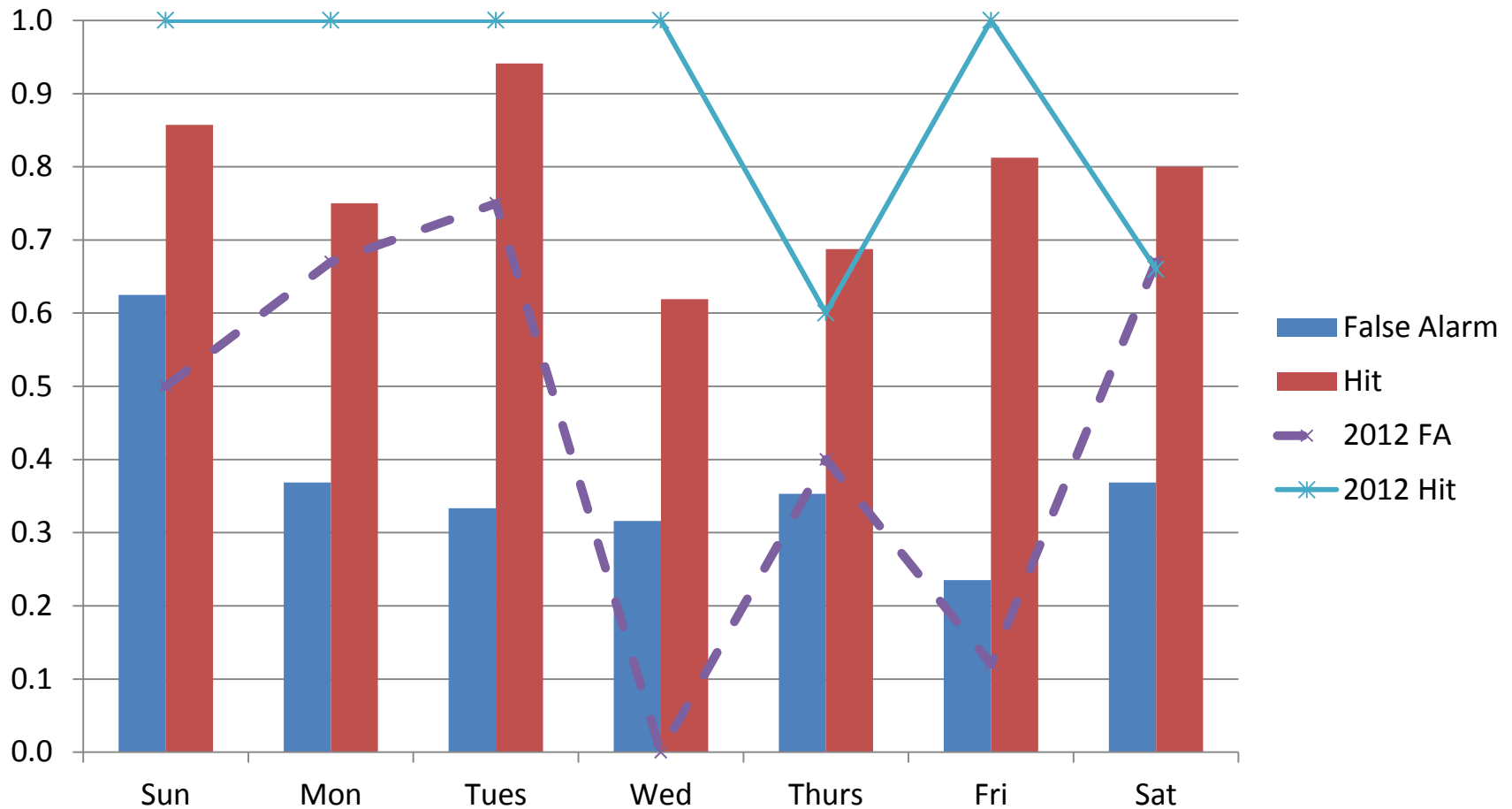








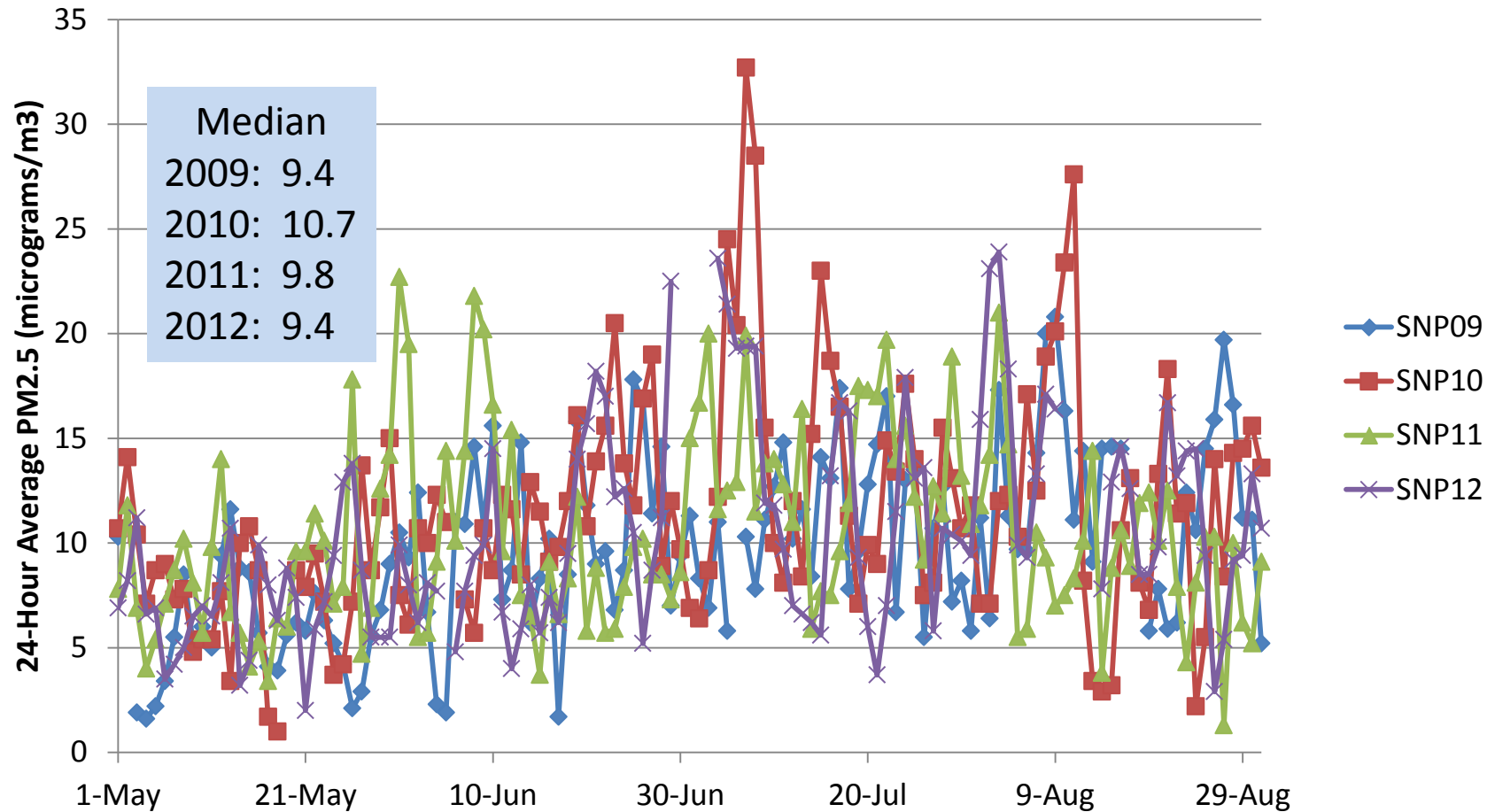
# NAQFC Sunday False Alarms (2007-2011 compared to 2012)





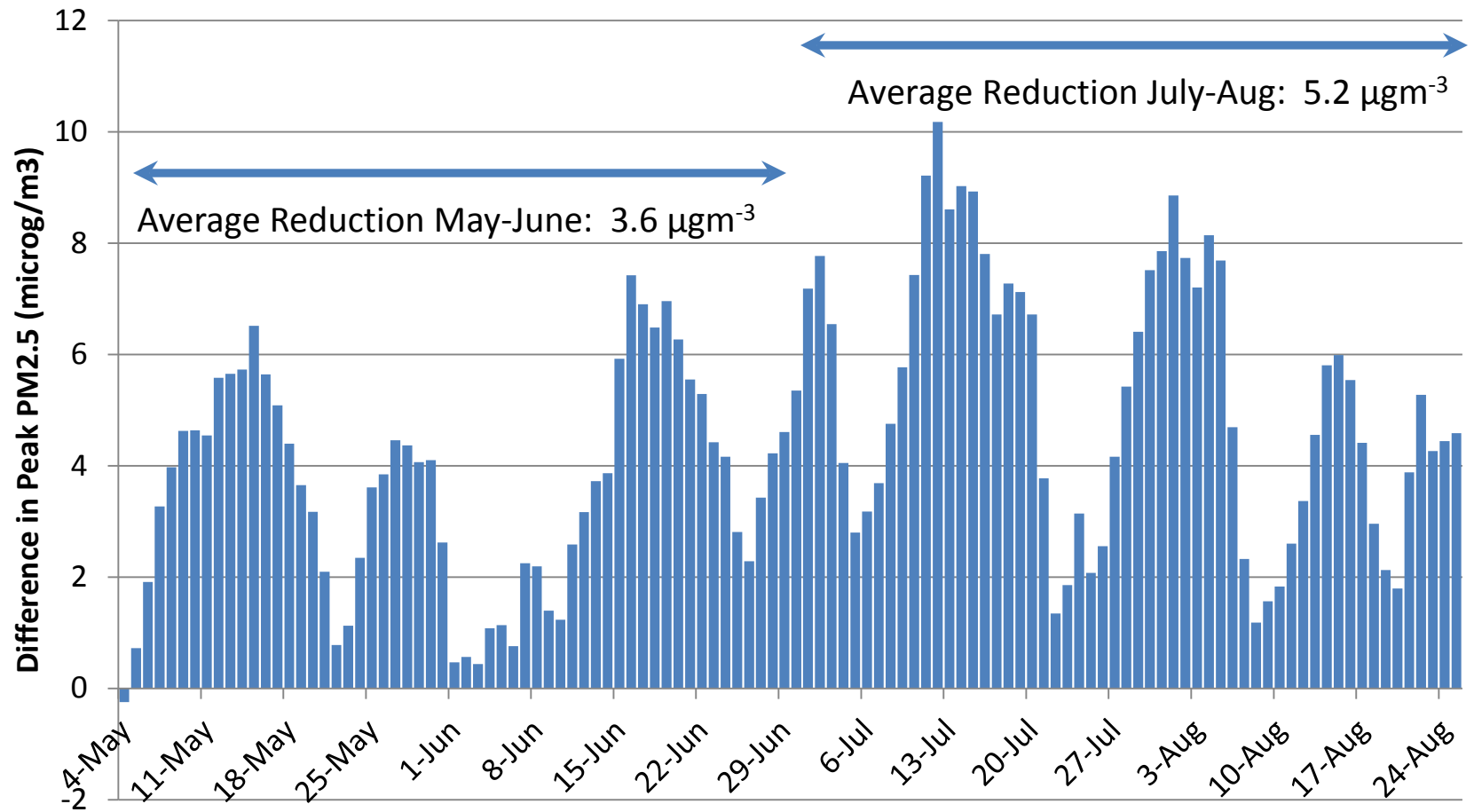


# Shenandoah NP (Regional Scale Site) Shows Steady PM<sub>2.5</sub> Concentrations

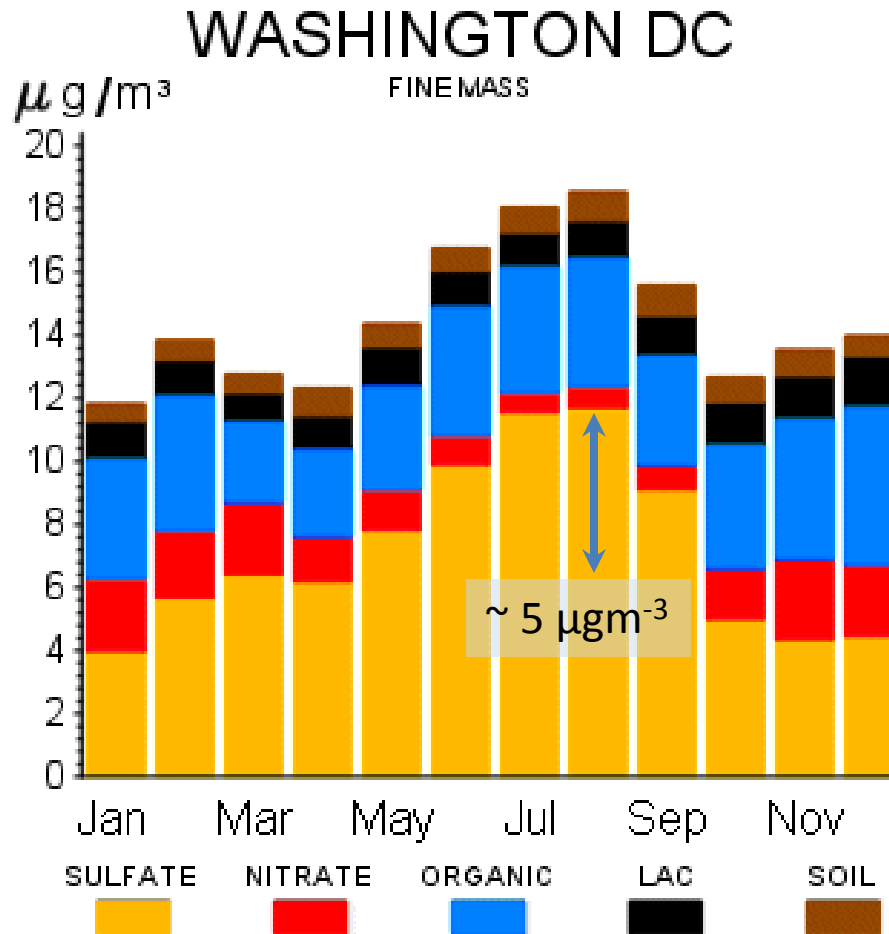




# Slight Tendency to Larger Reductions in late Summer



# Perhaps a Function of Lower Sulfate Emissions?



IMPROVE data, 1996-1998

# PM<sub>2.5</sub> Forecast Summary Statistics

	<b>OBS</b>	<b>NAQFC</b>	<b>Blue Sky</b>	<b>Blue Sky MOS</b>
<b>Median</b>	12.7	11.0	12.9	15.4
<b>Mean (Stdev)</b>	14.0 (± 5.8)	11.7 (± 4.2)	14.5 (± 7.0)	15.9 (± 3.4)
<b>90<sup>th</sup> %ile</b>	20.6	17.0	24.1	20.3
	<b>Forecasts</b>			
<b>Median AE</b>		3.3	3.8	3.4
<b>Mean AE</b>		3.9 (± 3.1)	4.3 (± 3.4)	4.0 (± 3.2)

NAQFC could not resolve high PM<sub>2.5</sub> cases, only 2 of 18 cases  $\geq 20 \mu\text{gm}^{-3}$  correctly forecast compared to 12 of 18 cases for Blue Sky.

Blue Sky had frequent false alarms: 14 cases compared to 3 for the NAQFC.

Luckily, only 2 possible Code Orange PM<sub>2.5</sub> cases in 2012 and those occurred on Code Orange O<sub>3</sub> days.

# Conclusions

- The summer of 2012 was conducive to O<sub>3</sub> formation.
- Good performance by NAQFC O<sub>3</sub> forecast in 2012 in the Philadelphia metropolitan area.
- Skill can be improved by use of “poor man’s” ensemble forecast.
- Seasonal drift issue of less impact in 2012 although False alarms 2x more frequent after mid-July.
- Sunday false alarms not an issue in 2012.
- NAQFC forecast guidance not useful in high PM<sub>2.5</sub> cases.
  - Regional and urban scale PM<sub>2.5</sub> much reduced since 2008, perhaps a function of economic activity and/or reduction in coal burning?

# Acknowledgements

- This work funded in part by:
  - The Delaware Valley Regional Planning Commission
  - The Maryland Department of the Environment
  - The State of Delaware
- The authors are grateful for their support.

# Forecast Models Used in Ensemble

- NAQC (NOAA) – Queried at Monitor Locations
  - 1200 UTC Run valid following day (24-36 h forecast)
  - <http://www.emc.ncep.noaa.gov/mmb/aq/>
- ZIP/NAQC – NOAA Model Queried at all Domain Land Areas
  - Data extracted from AQMOS (Sonoma Tech)
  - <http://aqmos.sonomatech.com/login.cfm>
- AQMOS – NOAA Model with Seasonal Bias Correction
  - <http://aqmos.sonomatech.com/faq/>
- Barons Meteorological Services – MAQSIP RT
  - 0600 UTC Run
  - <http://www.baronams.com/products/>
- SUNY-Albany
  - 1200 UTC Run, “NYSDEC\_3x12z”, CMAQ 4.7.1
  - [http://asrc.albany.edu/research/aqf/aqvis/tomorrowforecast\\_maps.htm](http://asrc.albany.edu/research/aqf/aqvis/tomorrowforecast_maps.htm)



