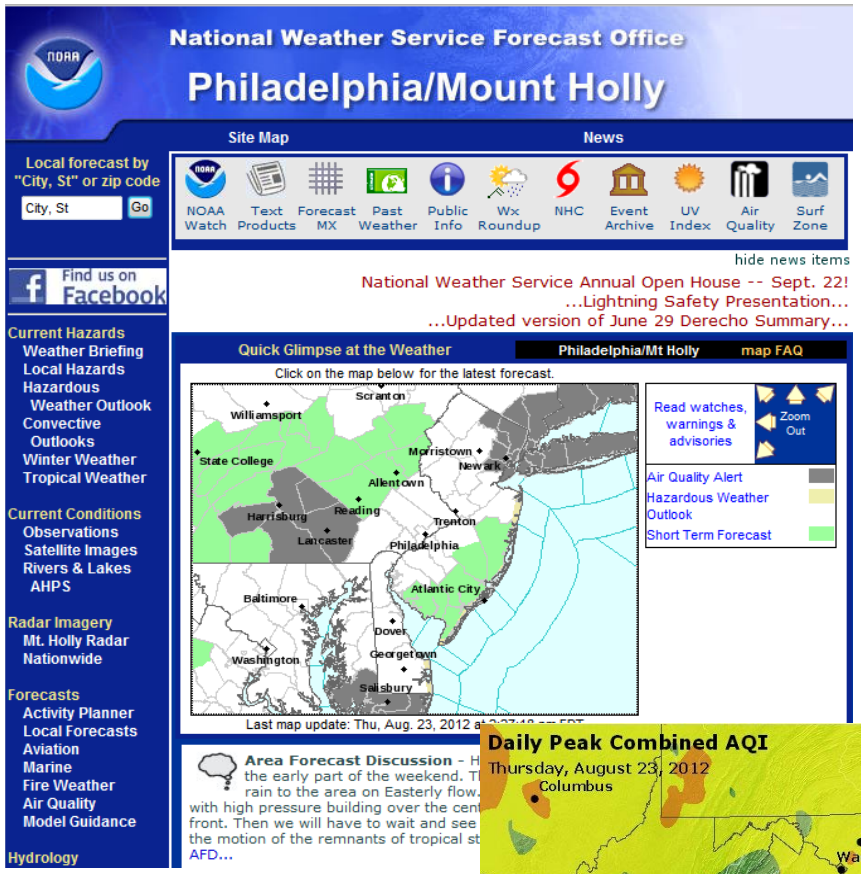
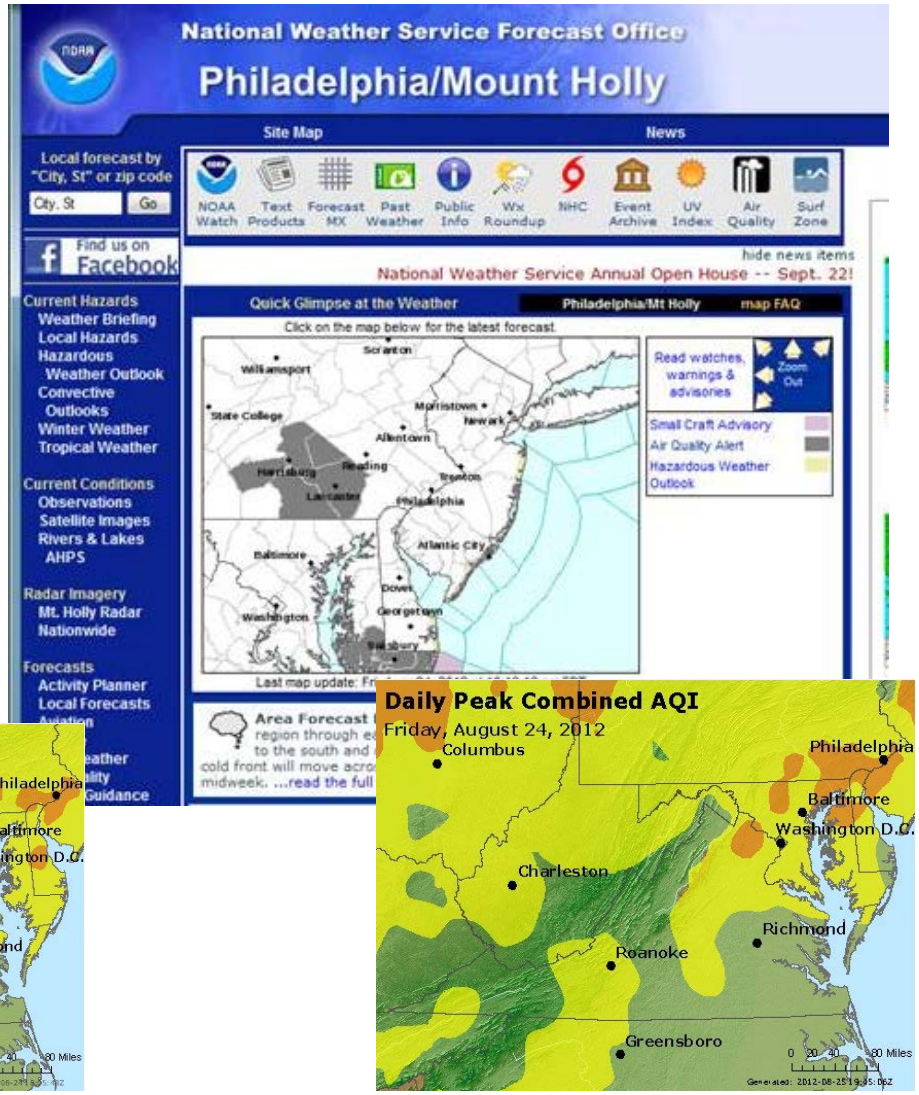
Air Quality Forecasters Focus Group Meeting

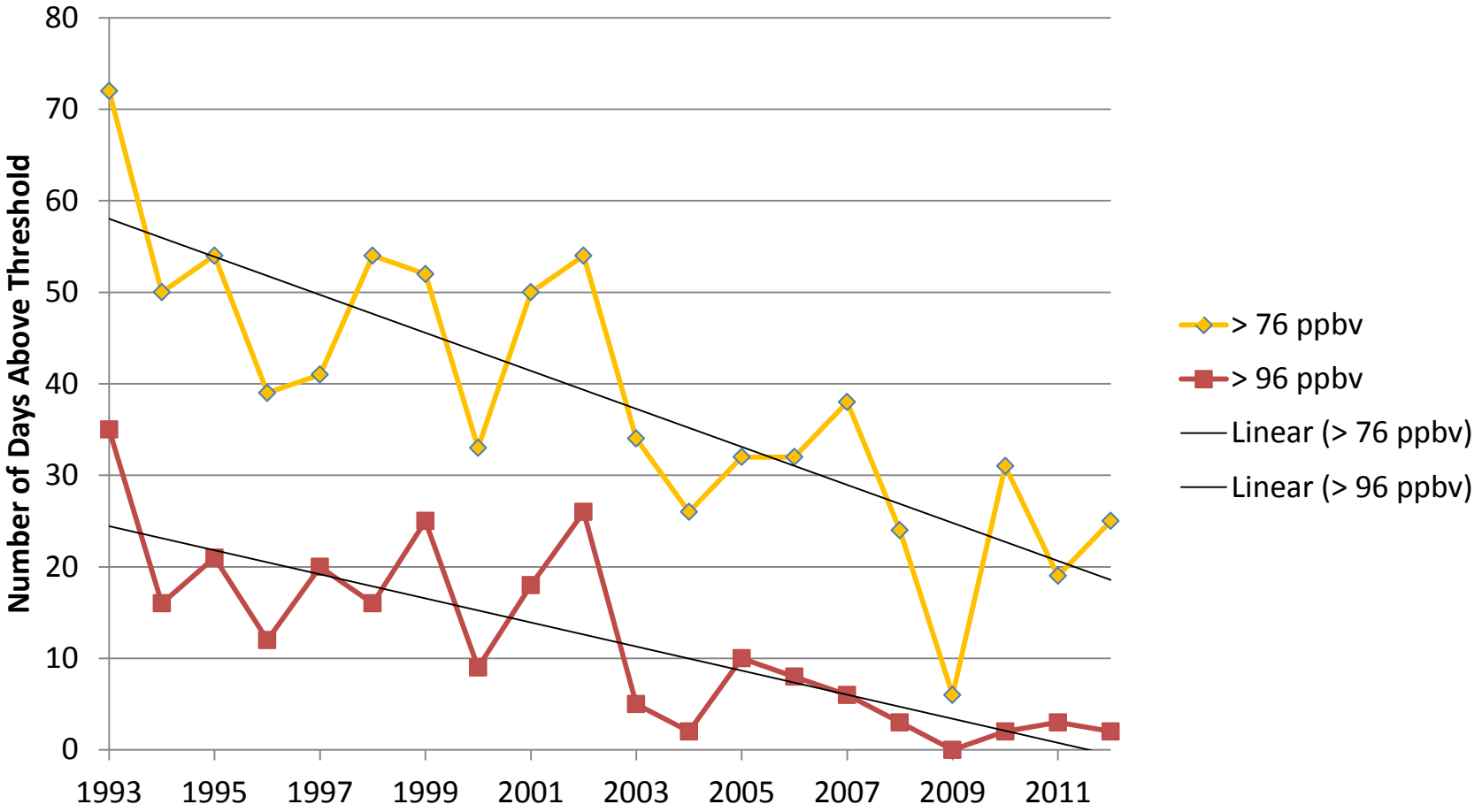
William F. Ryan
Nathan T. Wiles
Department of Meteorology
The Pennsylvania State University
wfr1@psu.edu

Side Swiped By NWS-Sterling and NWS-Mount Holly ("Our Partners")

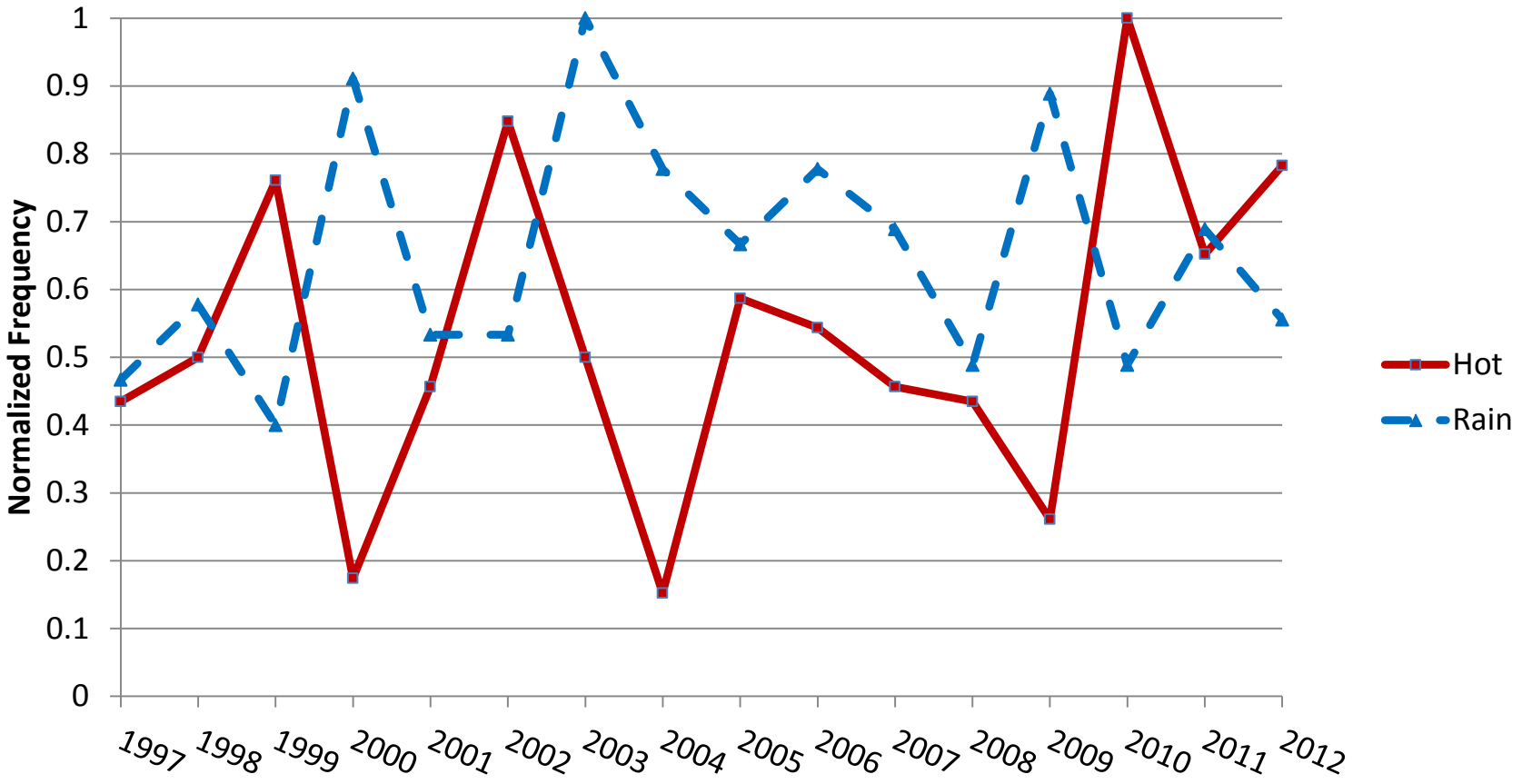




Code Red Cases are Extremely Rare

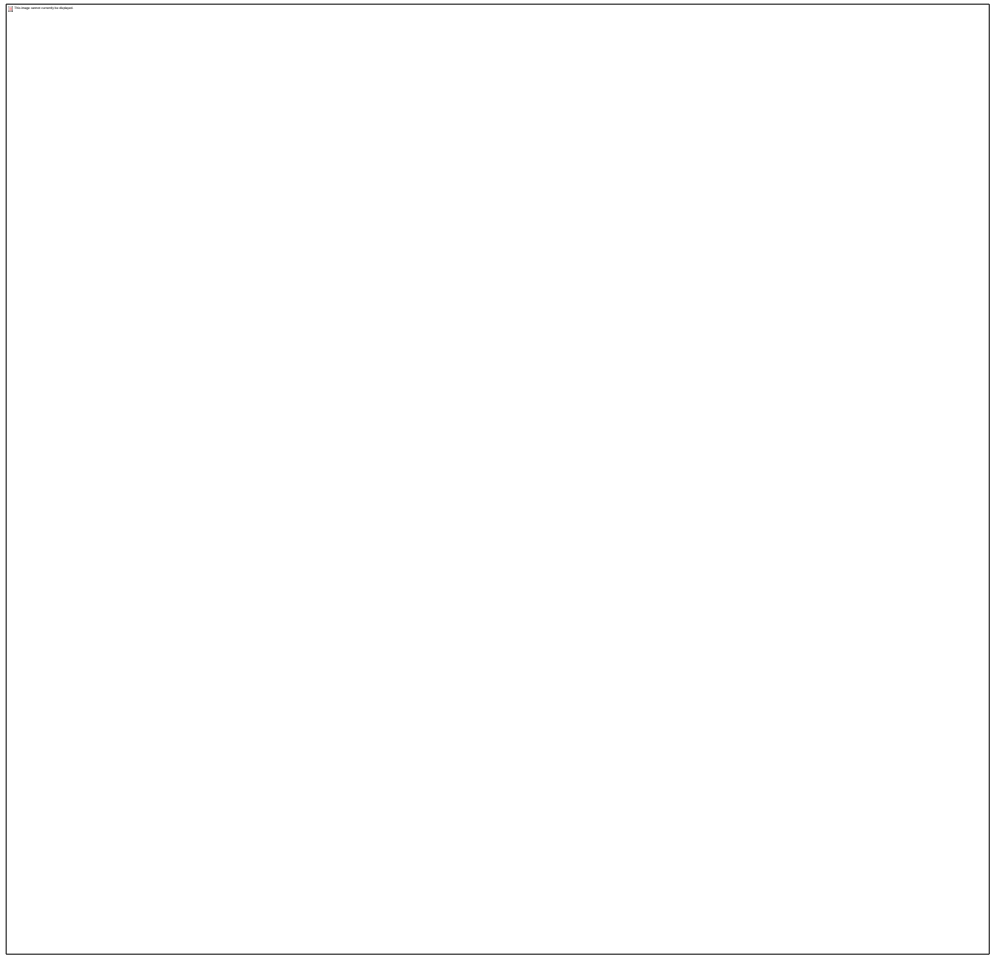


In PHL, as most of the mid-Atlantic, the summer season (JJA) was hot and slightly dry



Normalized frequency of number of days with Tmax > 90 F and number of days With measureable precipitation (. 0.01") at PHL (1997-2012). 2012 was 3rd "hottest" and 7th "driest" over the 16 year period.

Operational NAQFC Forecasts for the Philadelphia Metropolitan Area, 2012



Correlations and Best Fit:

$r = 0.77$

$r^2 = 0.59$

[OBS] = 4.1 + 0.88*[NAQFC]

“Poor Man’s” Ensemble Results (2012)

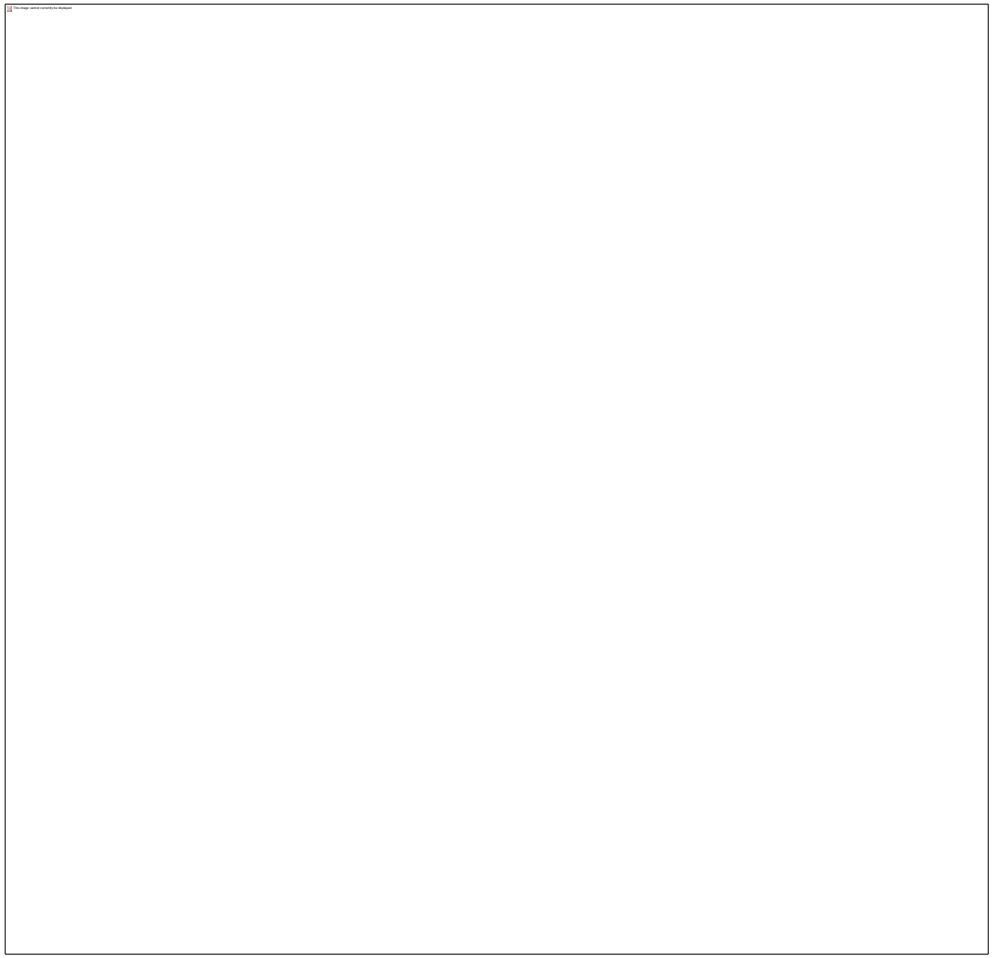
	Mean AE	Median AE	Bias
NAQFC	8.1	6.7	+4.0
SUNY-Albany	8.2	6.0	-2.2
Barons	8.1	7.0	-3.5
ENS1	6.0	5.3	-1.8
ENS11	6.8	5.0	-3.0

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



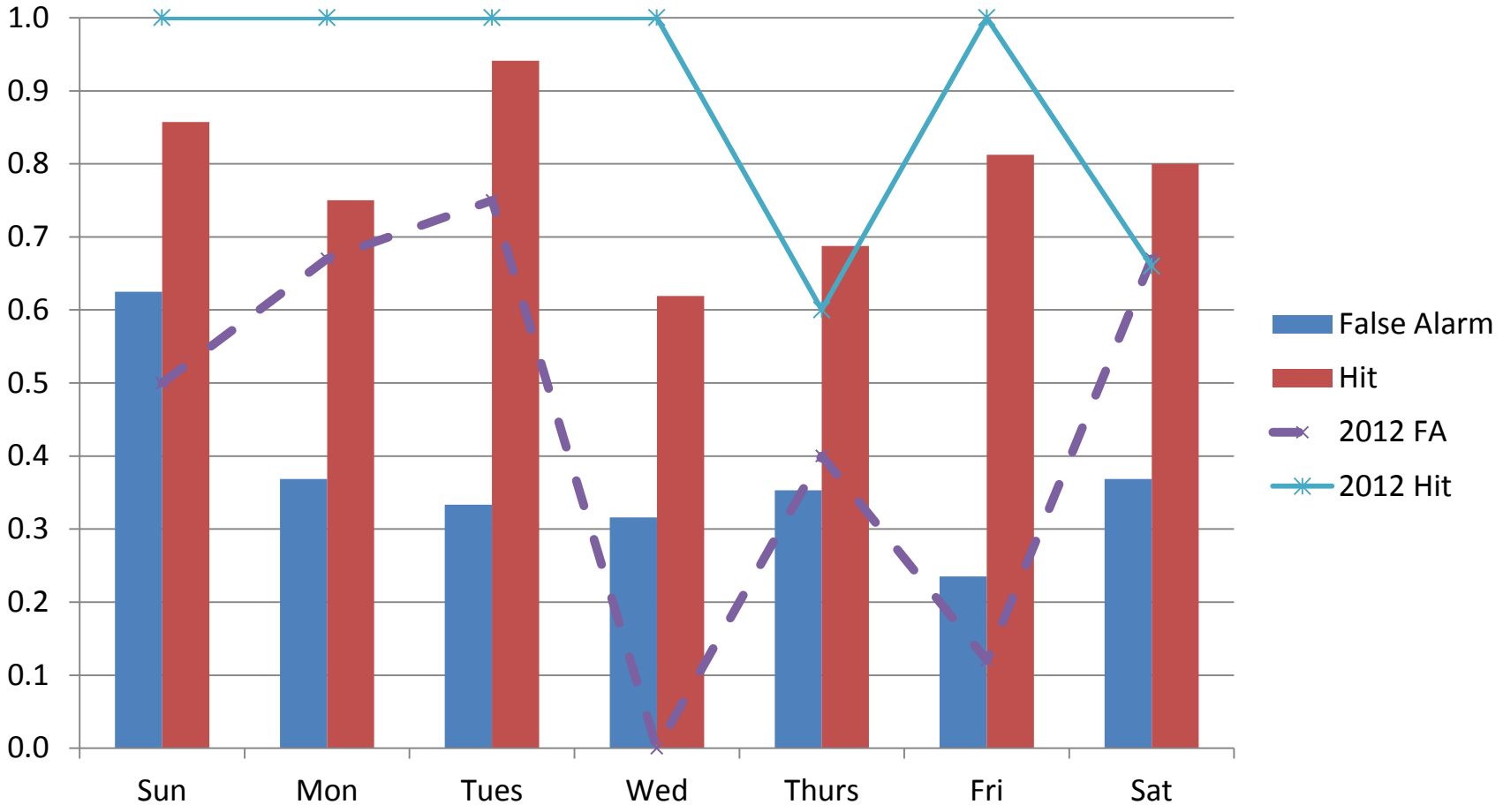
Correlations and Best Fit:

$r = 0.87$

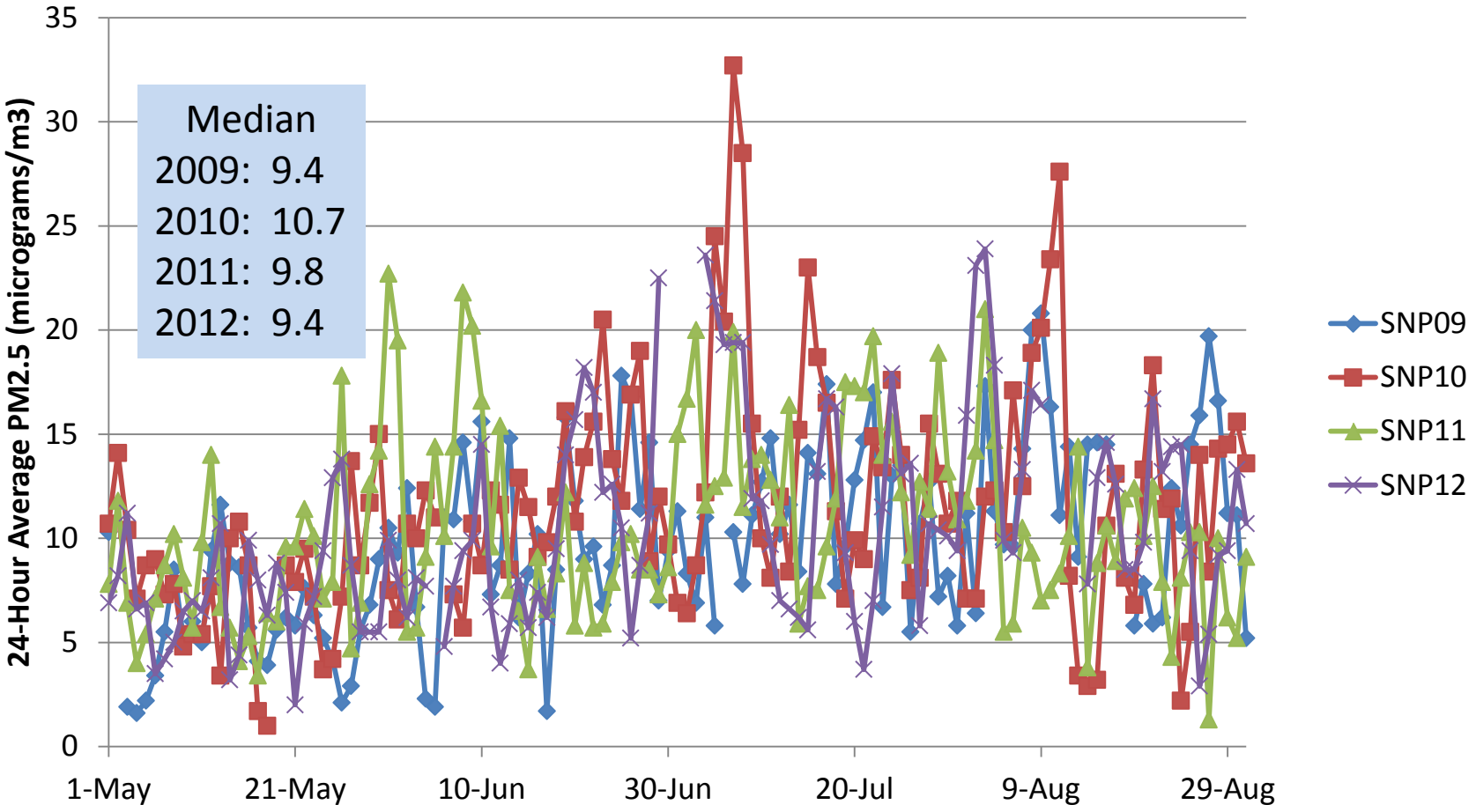
$r^2 = 0.75$

[OBS] = 1.06*[ENS1] – 1.9

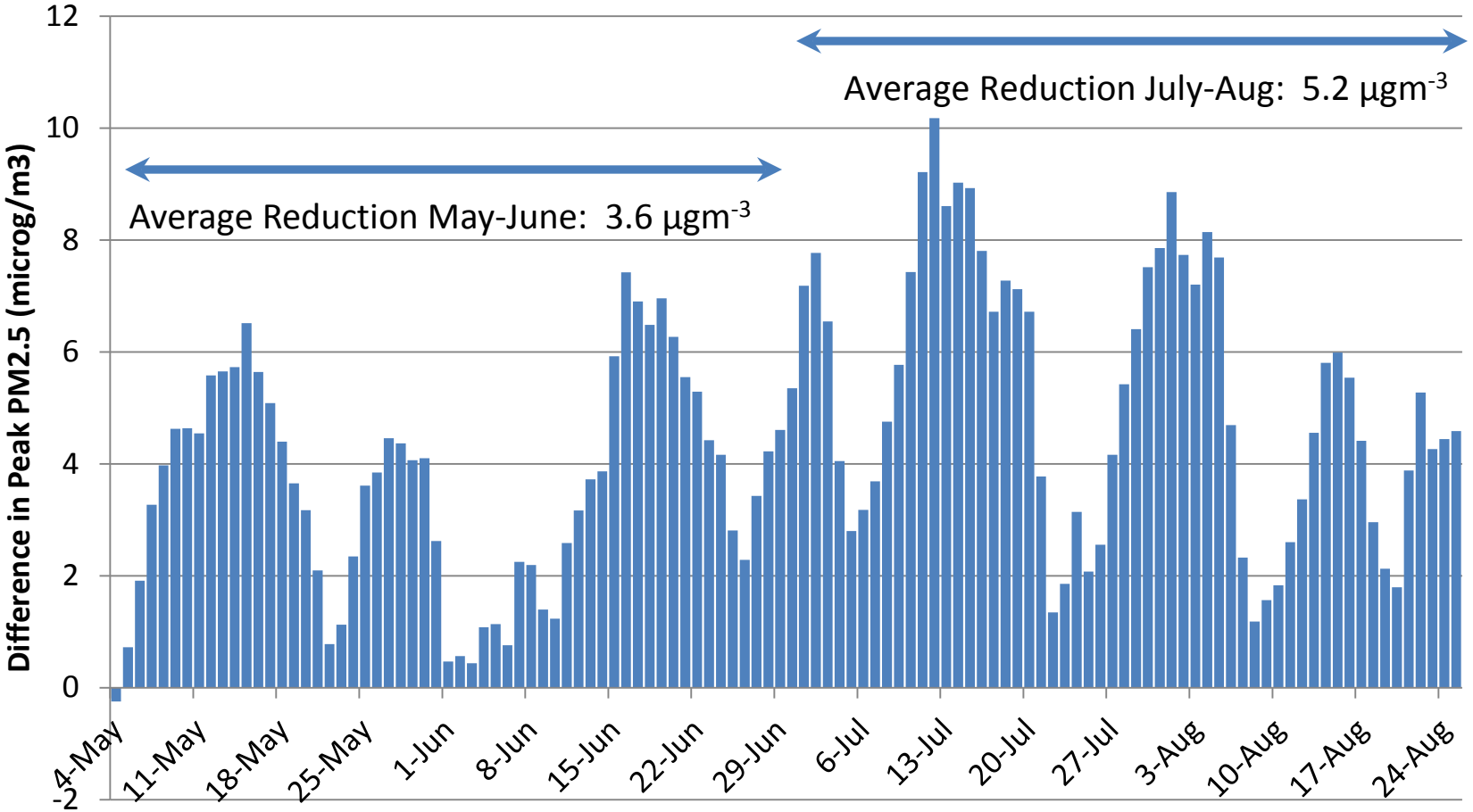
NAQFC Sunday False Alarms (2007-2011 compared to 2012)



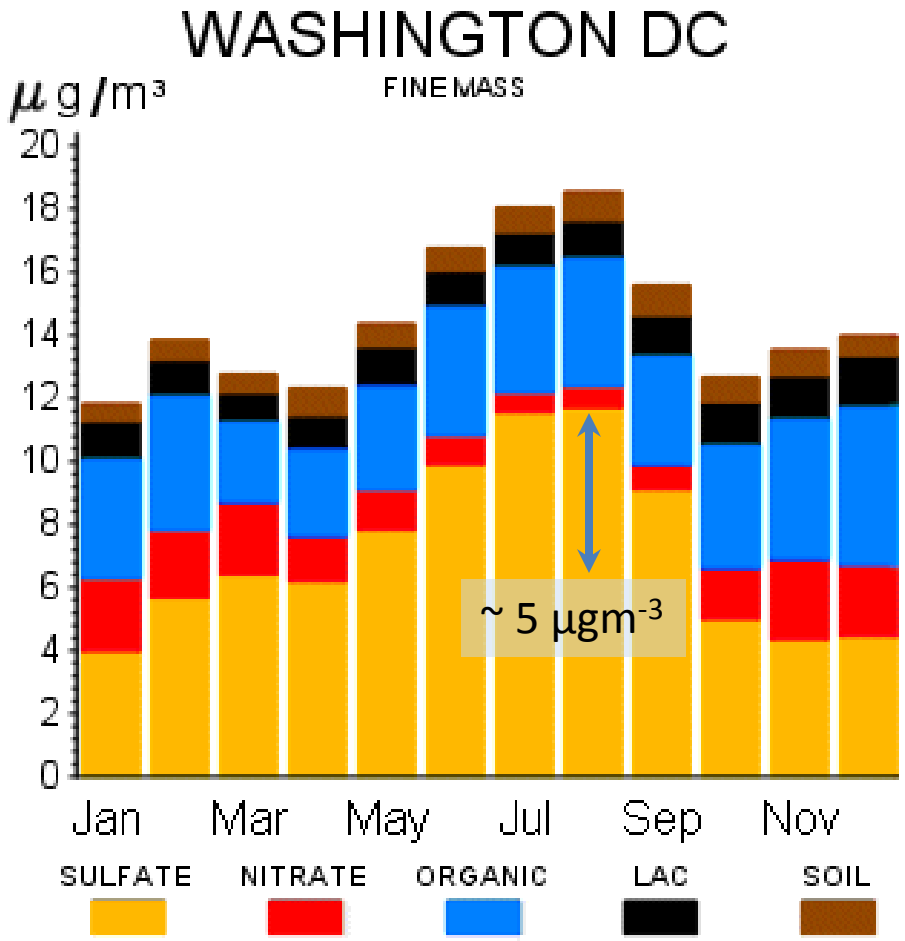
Shenandoah NP (Regional Scale Site) Shows Steady $PM_{2.5}$ Concentrations



Slight Tendency to Larger Reductions in late Summer



Perhaps a Function of Lower Sulfate Emissions?



IMPROVE data, 1996-1998

$PM_{2.5}$ Forecast Summary Statistics

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

NAQFC could not resolve high $PM_{2.5}$ cases, only 2 of 18 cases ≥ 20 μgm^{-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 $PM_{2.5}$ cases in 2012 and those occurred on Code Orange O_3 days.

Conclusions

- The summer of 2012 was conducive to O_3 formation.
- Good performance by NAQFC O_3 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 $PM_{2.5}$ cases.
  - Regional and urban scale $PM_{2.5}$ 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