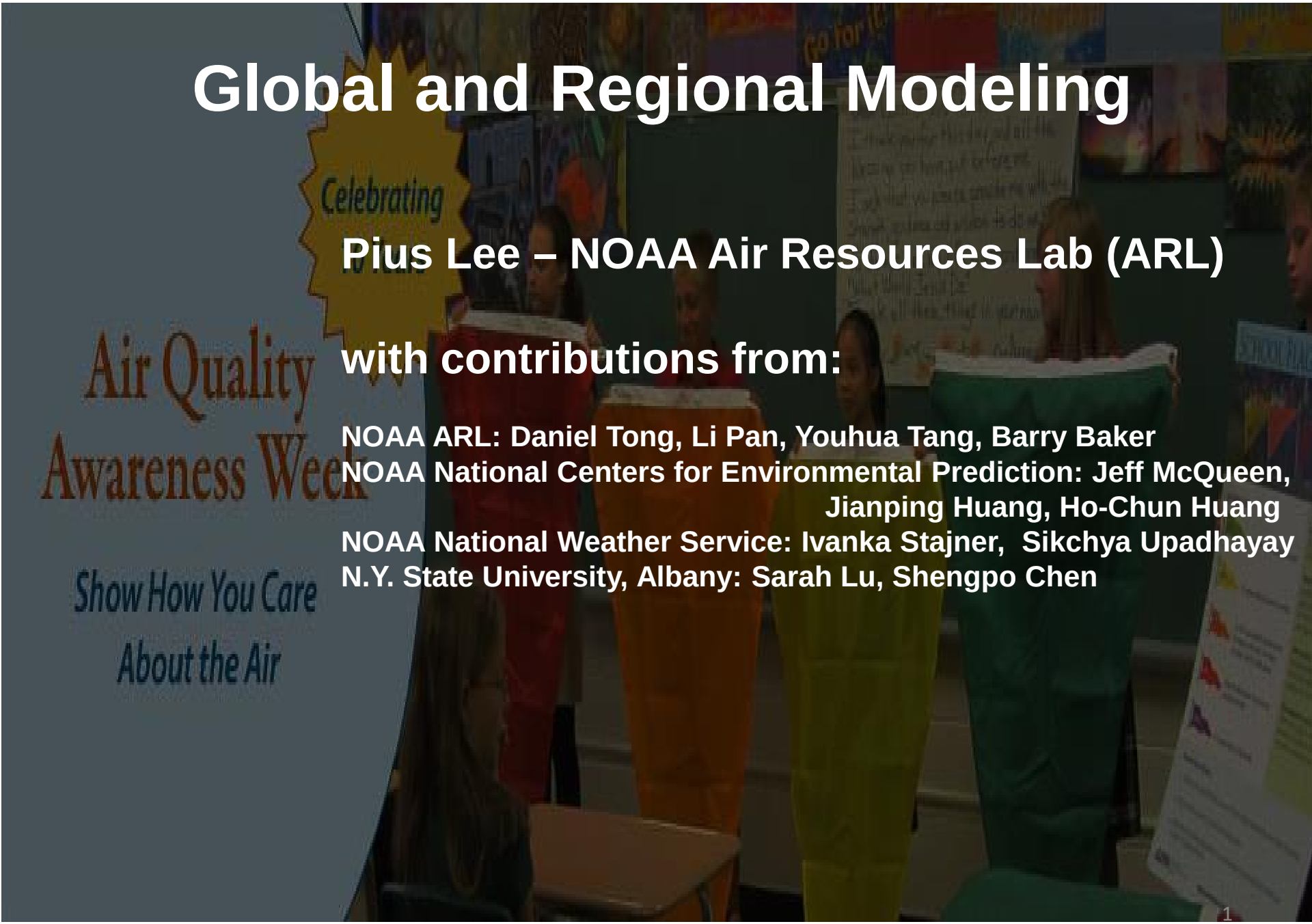
Global and Regional Modeling

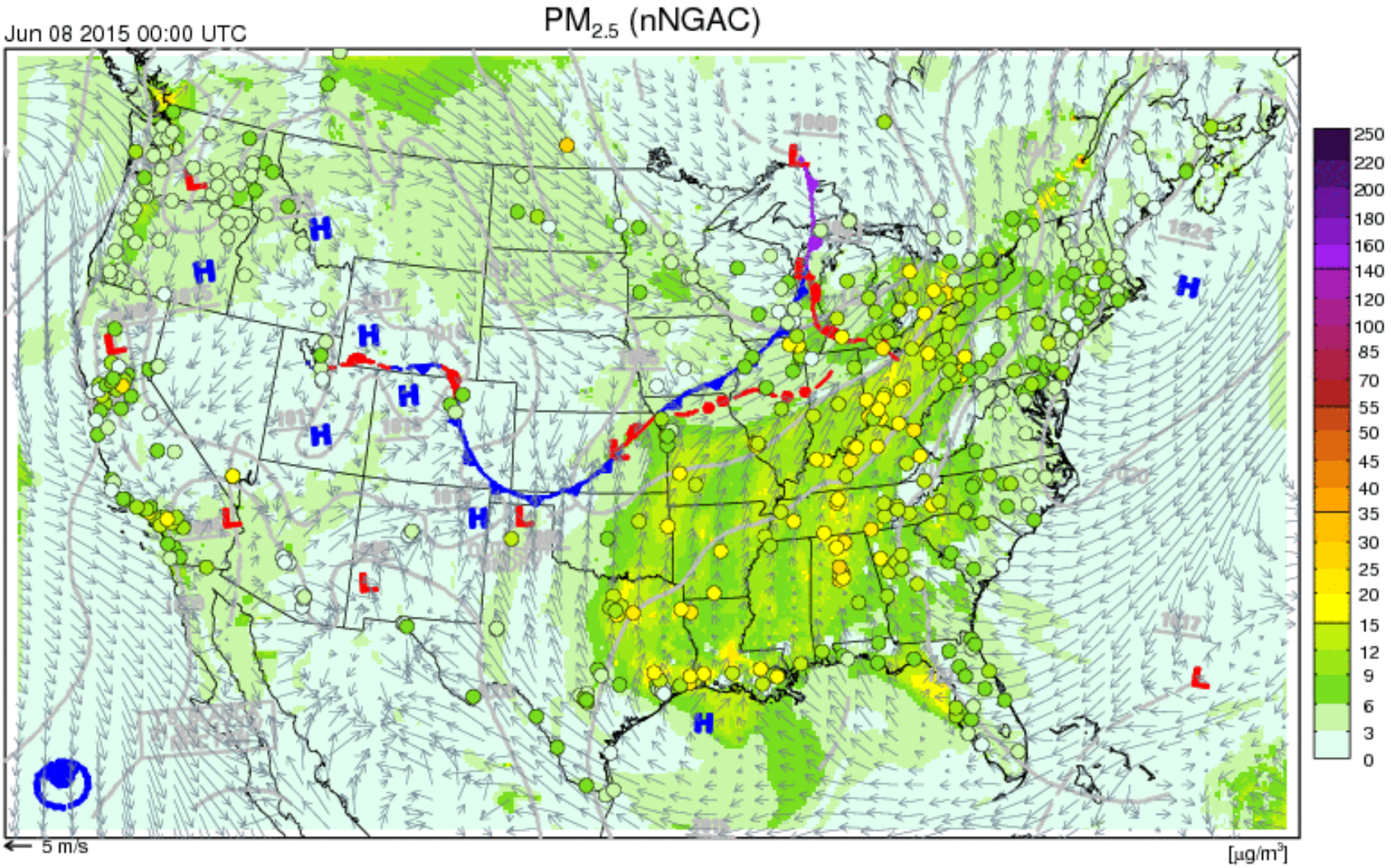


Pius Lee – NOAA Air Resources Lab (ARL)

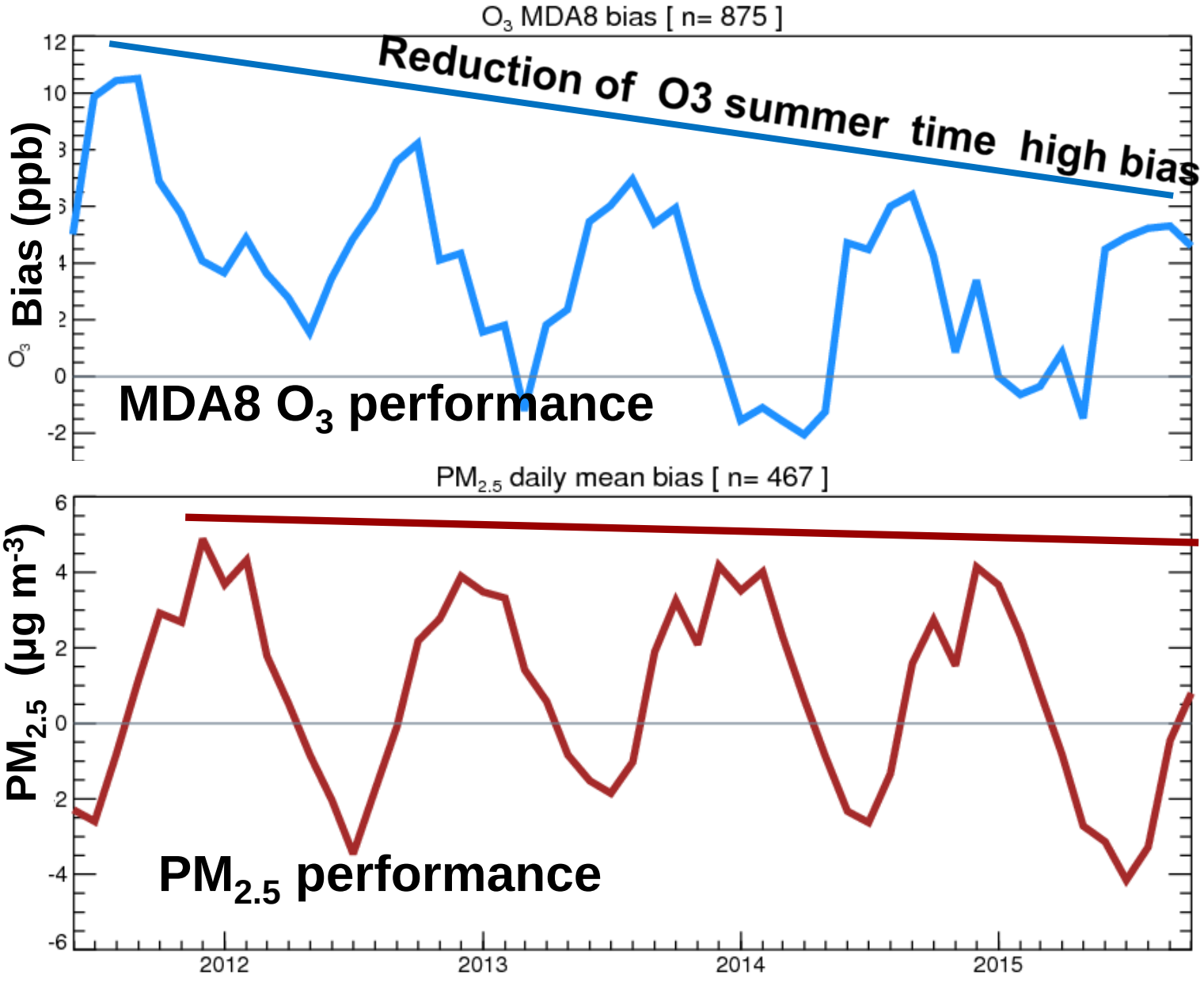
with contributions from:

NOAA ARL: Daniel Tong, Li Pan, Youhua Tang, Barry Baker
NOAA National Centers for Environmental Prediction: Jeff McQueen, Jianping Huang, Ho-Chun Huang
NOAA National Weather Service: Ivanka Stajner, Sikchya Upadhayay
N.Y. State University, Albany: Sarah Lu, Shengpo Chen

Leverage NAQFC daily understanding of the big picture and meteorology

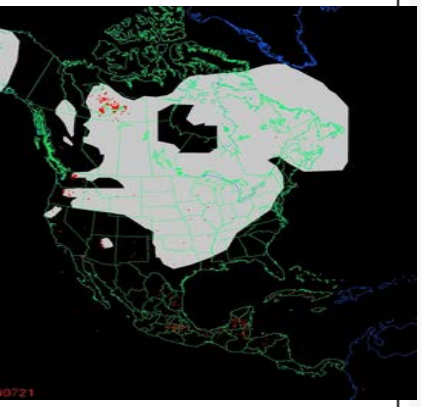


Leverage NAQFC long term record and day-by-day understanding

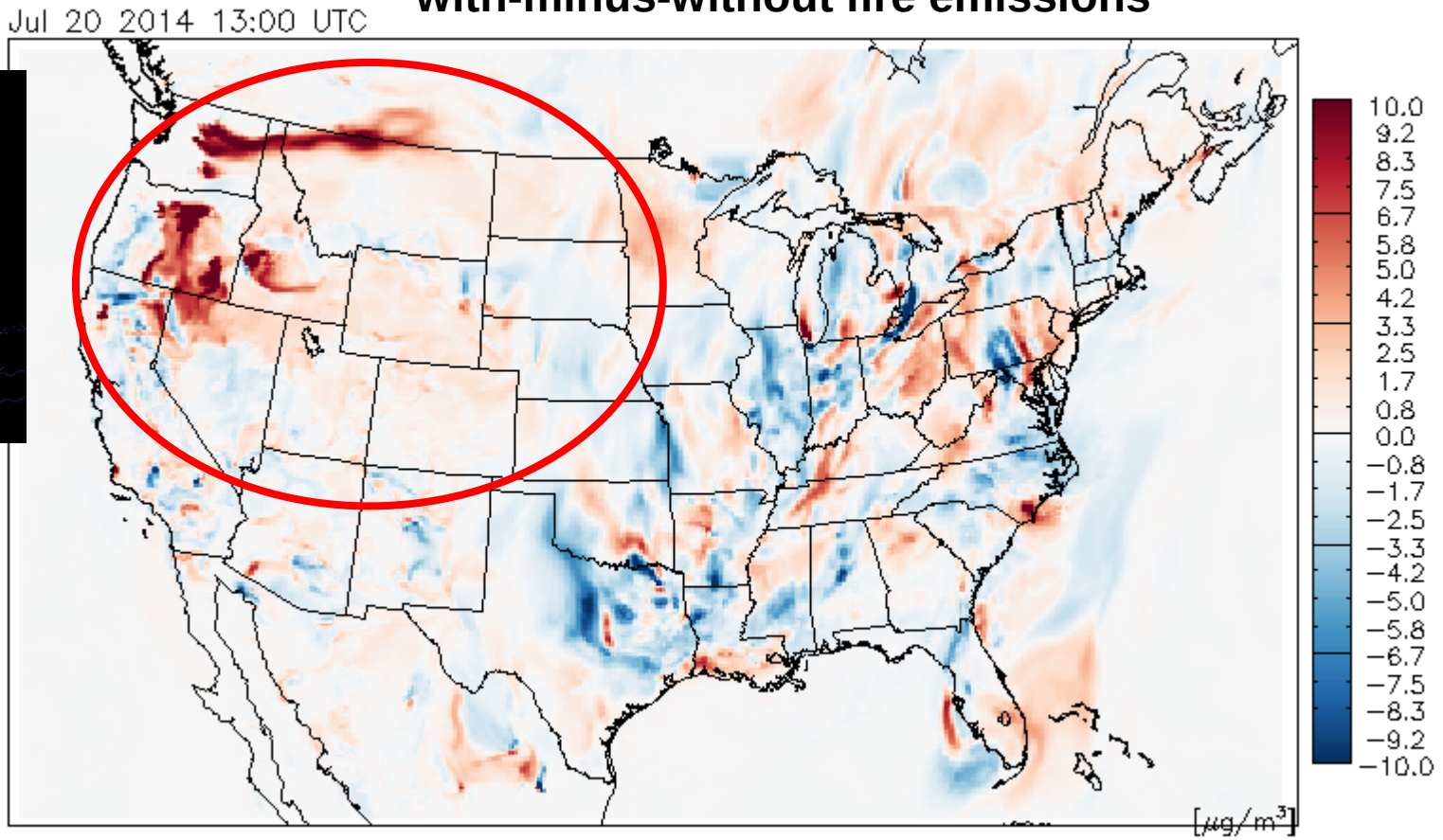


Impact of forest fires in testing of PM2.5 predictions

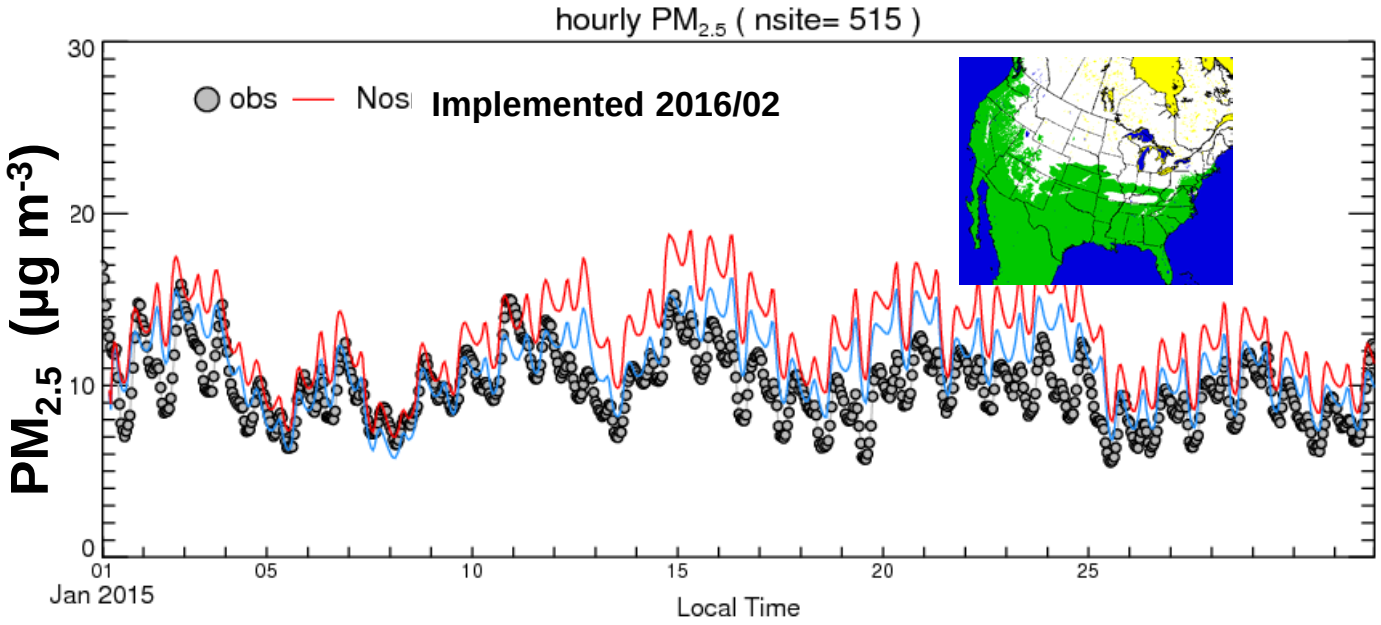
Difference between two PM2.5 predictions: with-minus-without fire emissions

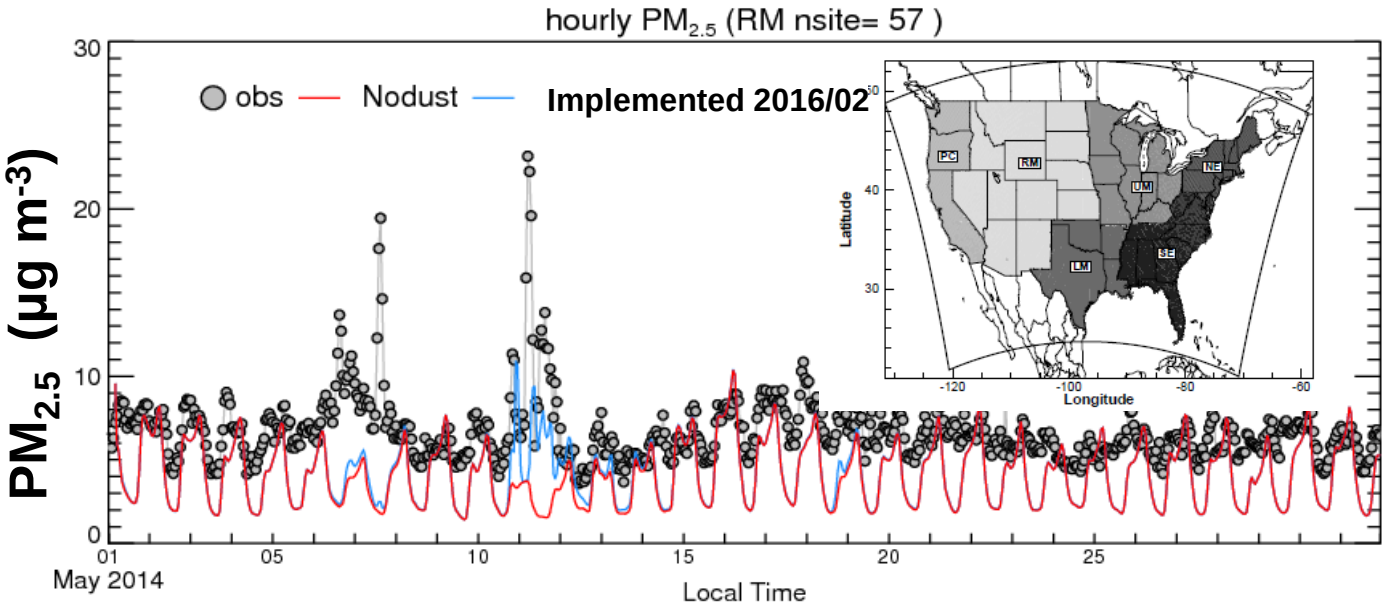


NOAA NESDIS Hazard Mapping System Fire and Smoke Analysis



Impact of fugutive dust on PM2.5 forecast





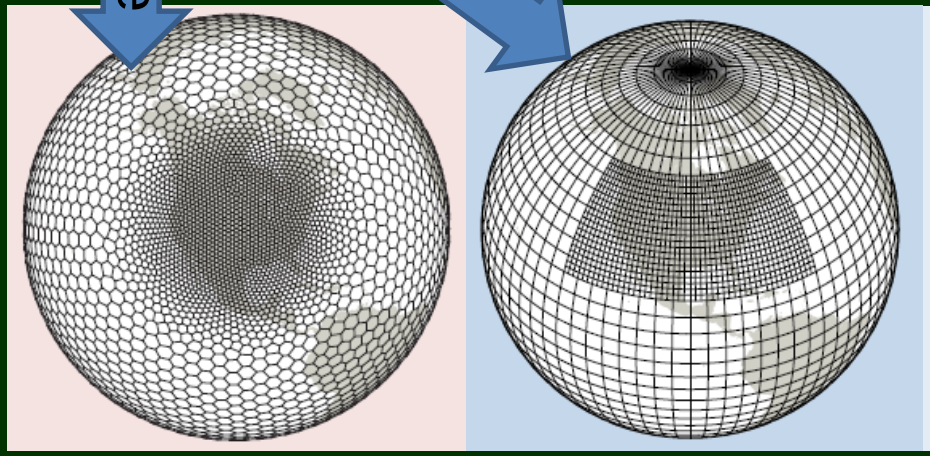
NWS Next Generation Global Forecasting System

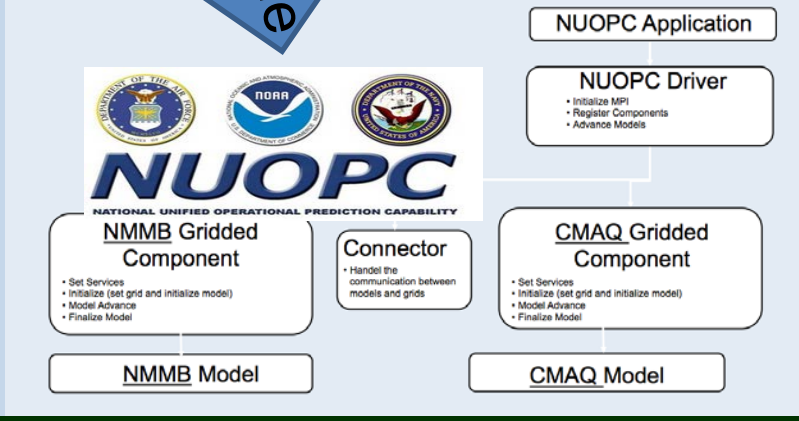
- Chemical Analysis: homogeneously generated fields over multiple years
- NAQFC in finer resolutions: Chemically, spatially and temporally
- Incorporation of air-surface exchange processes in air chemistry
- Air chemistry as one of NWS Earth Modeling System Framework components

example

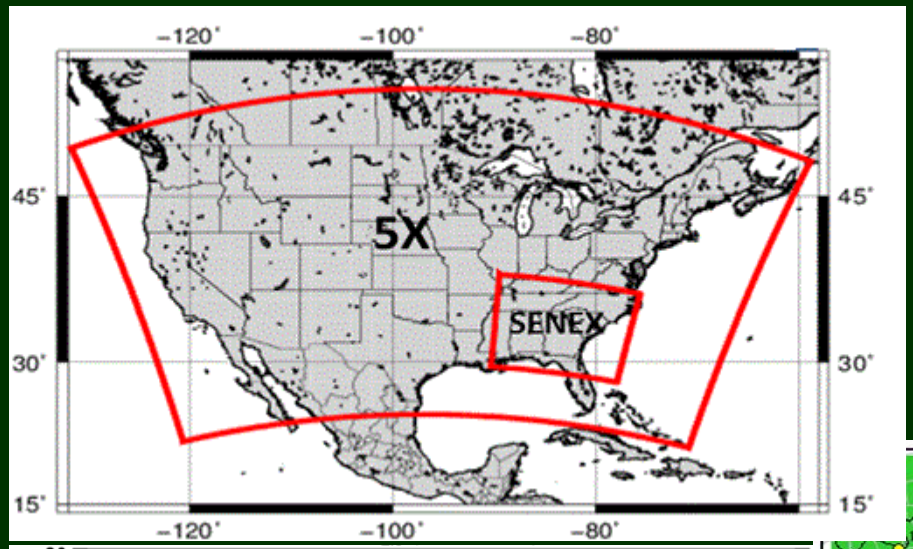
example

example



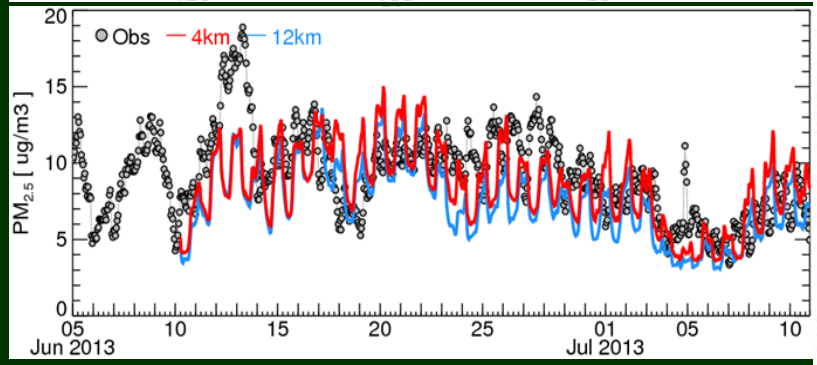


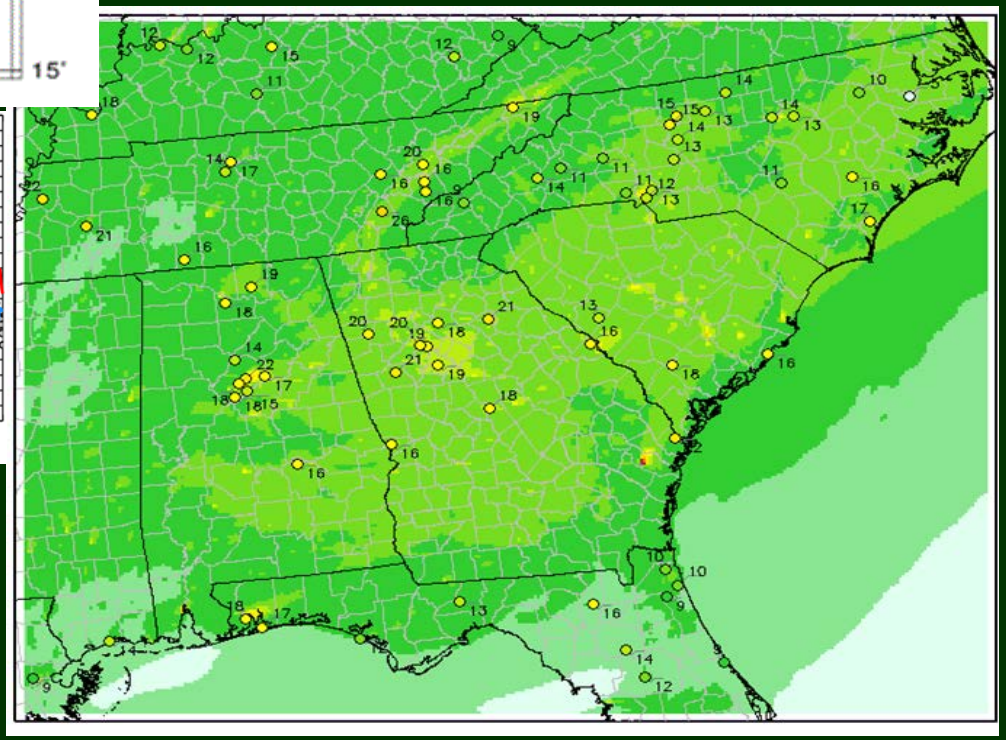
Relevance: Campaign Collaboration AQ Forecasting



NOAA's Southern Oxidant and Aerosol Study (SOAS) - June-July 2013

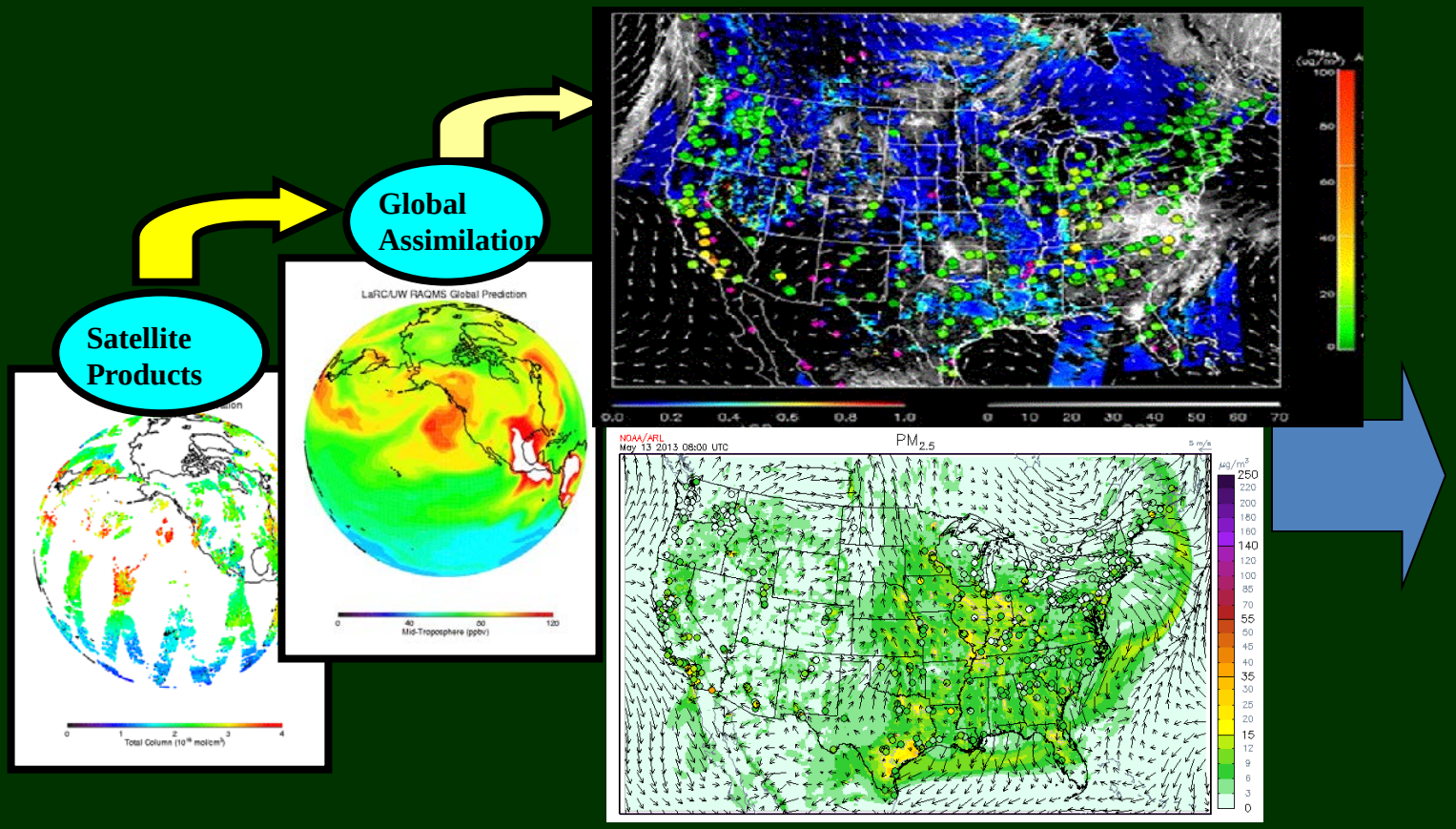
4 km domain nested within the 12 km NAQFC





FY 2013 – 2015 : AQAST Tiger Team: Air Quality Reanalysis

(*Translating Research to Services*)



+ AQ Assessments
+ State Implementation Plan Modeling
+ Rapid deployment of on-demand rapid-response forecasting; e.g., new fuel type,…, etc.
+ Health Impacts assessments
+ Demonstration of the impact of observations on AQ distributions
+ Ingestion of new AQAST products into operations

http://acmg.seas.harvard.edu/aqast/projects.html

2011-2016

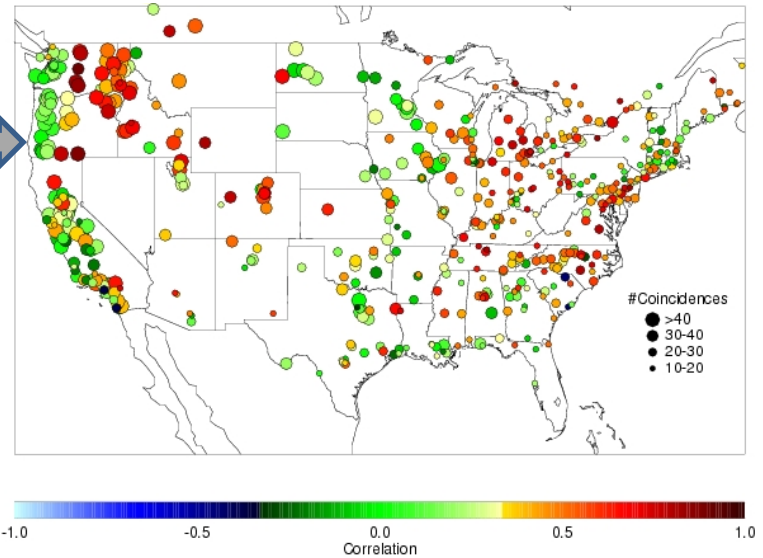
AQAST

NASA Air Quality Applied Sciences Team

Regional Chemical Reanalysis:

National correlation map between AIRNow measurement and MODIS AOD

Typically good correlation between surface $PM_{2.5}$ and AOD retrieved by MODIS



Courtesy :NESDIS

MODIS (Moderate Resolution Imaging Spectroradiometer) AOD

Orbit:	705 km, **10:30 a.m**. descending node (**Terra**) or **1:30 p.m**. ascending node (**Aqua**)
Swath Dimensions:	2330 km (cross track) by 10 km (along track at nadir)
Spatial Resolution:	250 m (bands 1-2) 500 m (bands 3-7) 1000 m (bands 8-36)

http://terra.nasa.gov/About/

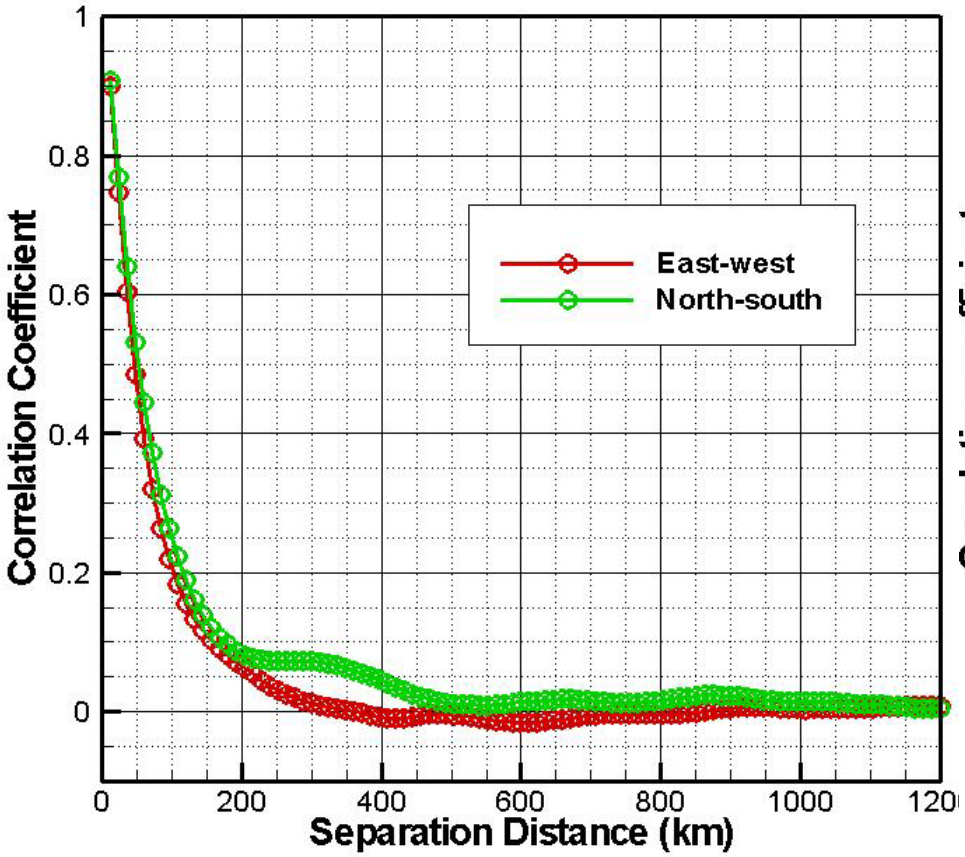
Optimal Interpolation (OI)

- OI formulation (Dee et al. *Q. J. R. Meteor. Soc*. 1998) by limiting the analysis problem to a subset of obs.

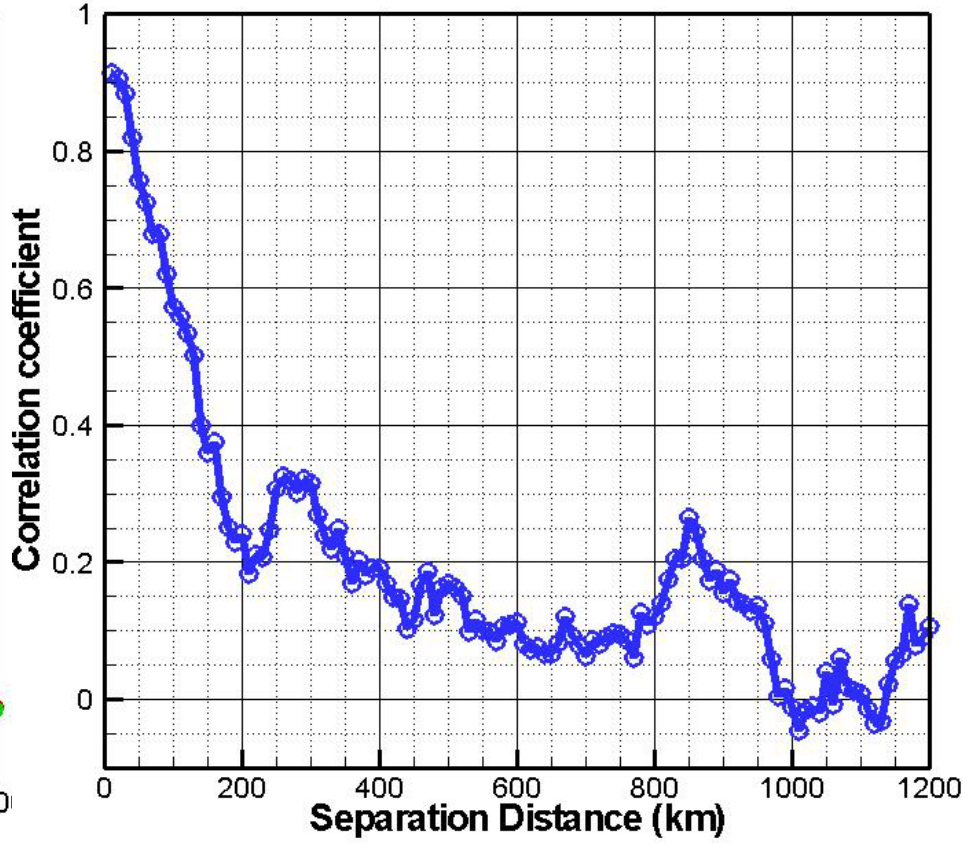
$$X^a = X^b + BH^T(HBH^T + O)^{-1}(Y - HX)$$

- Obs far away (beyond background error correlation length scale) have no effect in the analysis.
- Injection of Obs through OI takes place at 1700 UTC daily.

Horizontal Error Statistics



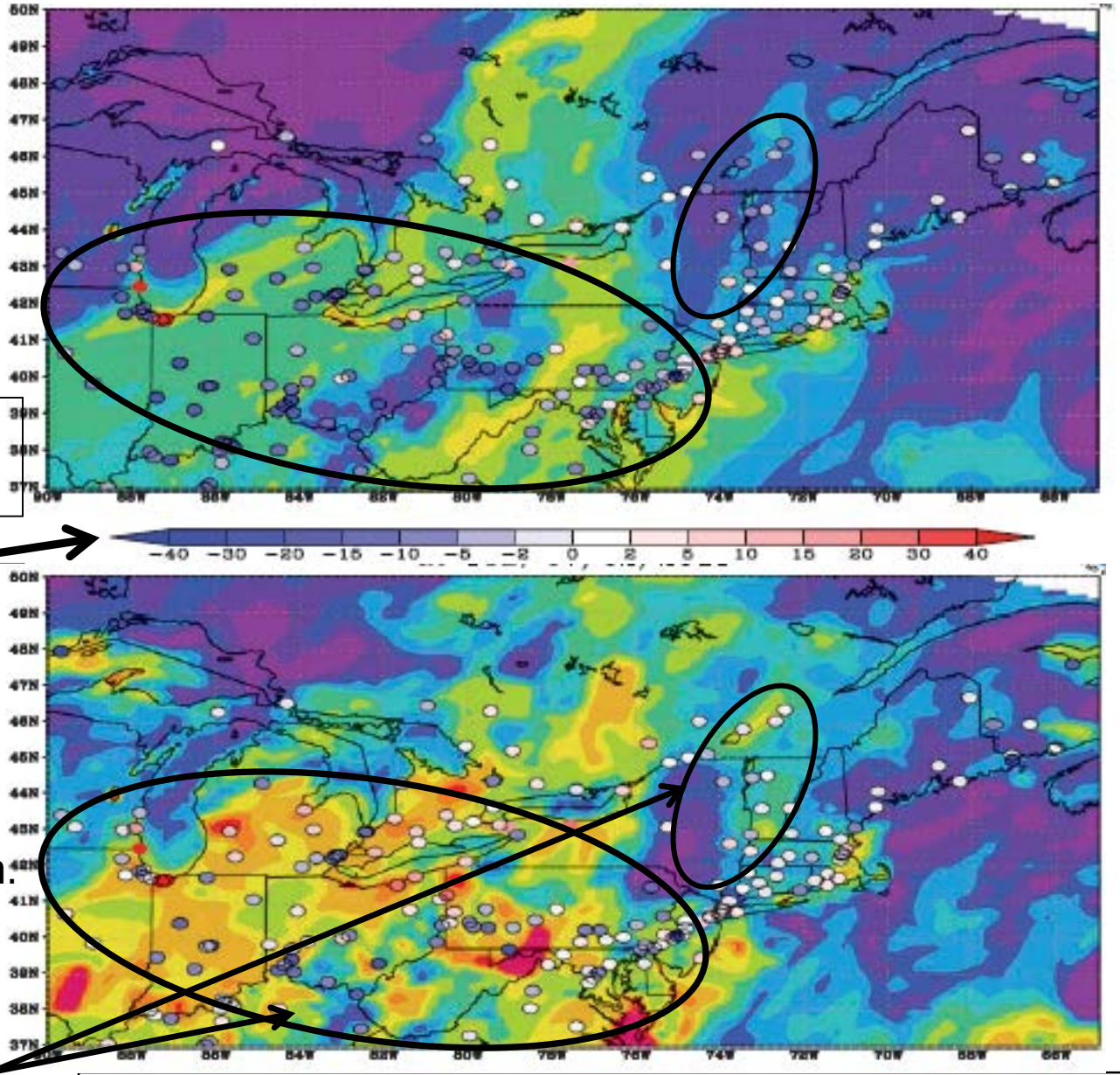
AOD error statistics results w/ NMC



AOD error statistics results through Hollingsworth-Lönnberg approach

a) 12z July 2 2011 forecast valid for 18z on same day: NAQFC setup.

Color-shading for Surface $PM_{2.5}$ ($\mu g\ m^{-3}$)



Color bar for bias w.r.t. AIRNow ($\mu g\ m^{-3}$

b) Same as a) but with data assimilation adjusted Initialization.

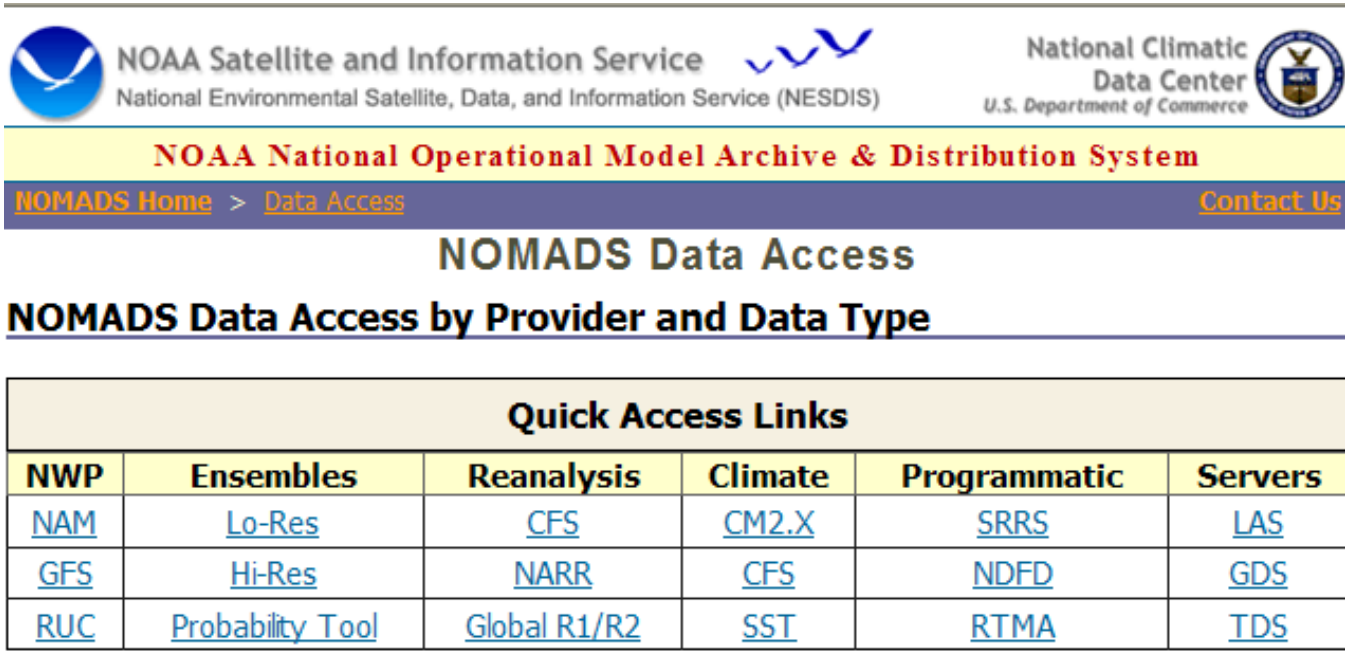
Large reduction in underestimation of PM2.5 w.r.t. a)

Tang et al., 2015: Using optimal interpolation to assimilate **surface measurements** and satellite **AOD** for ozone and PM2.5: A case study for July 2011, *JAWMA, **65,** 1206-1216*

Chemical Reanalyses Product: Friendly downloadable

As reanalysis Meteorological fields For NWP community

Chemical reanalysis Fields for atmospheric Modelers and epidemiologist



NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

National Climatic Data Center
U.S. Department of Commerce

NOAA National Operational Model Archive & Distribution System

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NAM	Lo-Res	CFS	CM2.X	SRRS	LAS
GFS	Hi-Res	NARR	CFS	NDFD	GDS
RUC	Probability Tool	Global R1/R2	SST	RTMA	TDS

Collaborations and data sharing

- Global and Regional AQ modeling National Centers and Institutions:
  - NCEP, and NESDIS
  - EPA, and NASA
  - Other national centers around the world

- Measurement intensive campaigns provide insights:
  - AQ Modeling involves in OSSE
  - AQ Modeling involves in Campaign support

- NGGPS and NUOPC will be the two deafening buzz words:
  - Next Generation Global Forecasting System
  - National Unified Operational Prediction Capability