

Incorporating ASOS Visibility Data in PM_{2.5} Mapping

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Overview

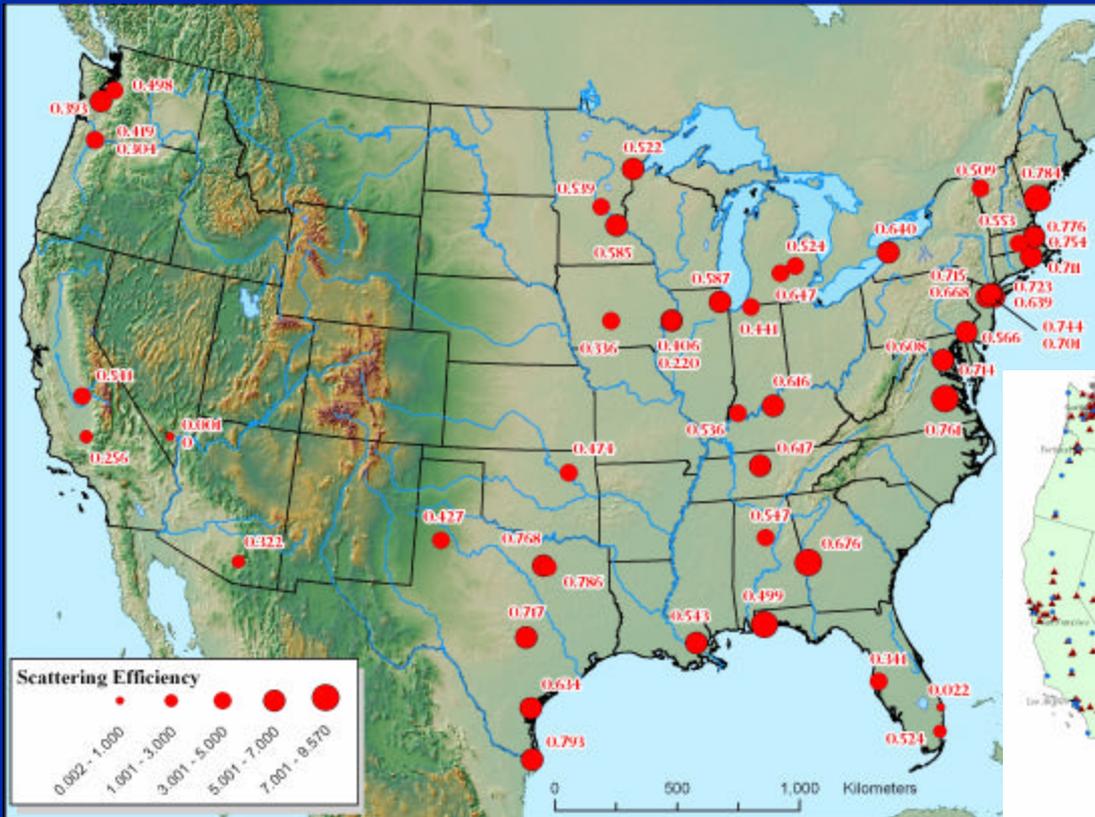
- What is ASOS?
- Introduction
 - Prior work on ASOS-PM_{2.5} relationship
 - PM_{2.5} data on AIRNow
- Case study – incorporating ASOS visibility data in PM_{2.5} mapping
- Conclusions

What Is ASOS?

- Automated Surface Observing System (sponsored by FAA, NOAA, and NWS)
 - provides weather observation data
 - updated observations every minute, 24 hours a day
 - about 900 stations throughout the United States
- Visibility sensors (shown) measure light scattering (b_{scat})
 - possible indicator of $\text{PM}_{2.5}$ mass concentrations



Prior Work on ASOS-PM_{2.5} Relationship (1 of 4)



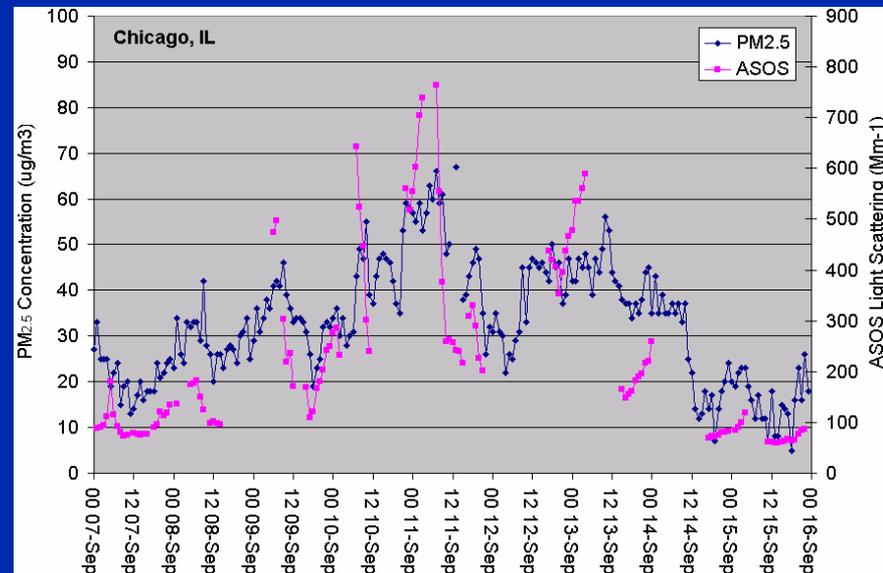
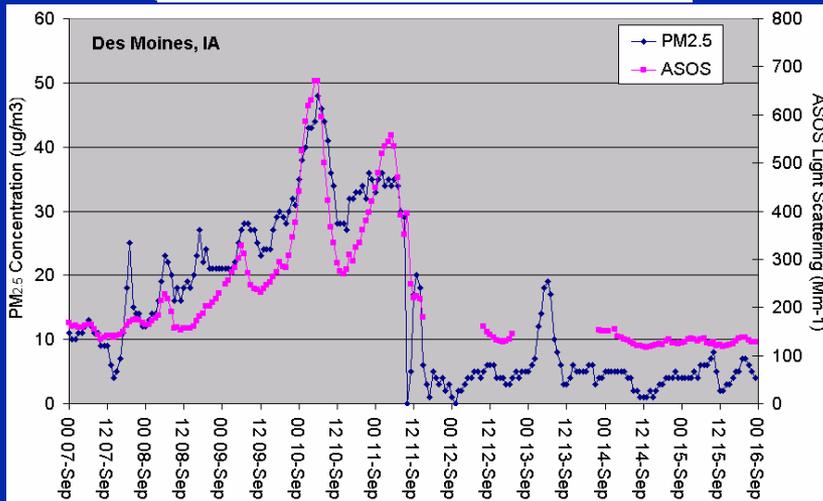
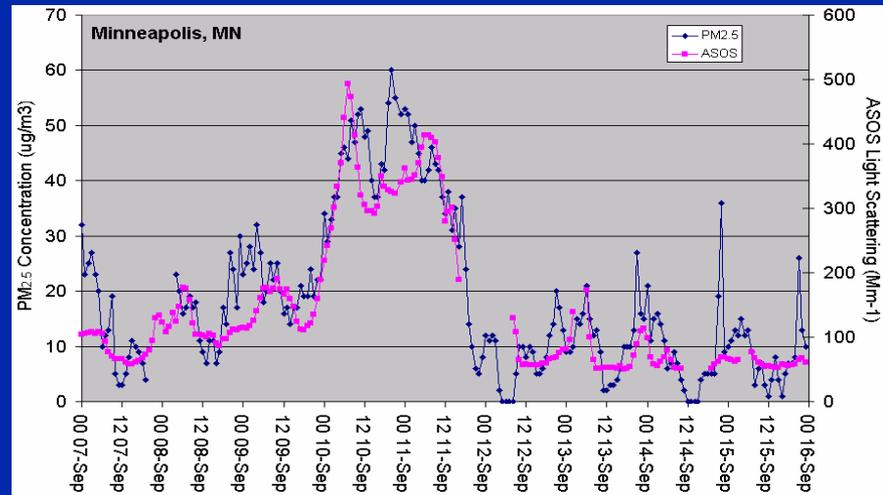
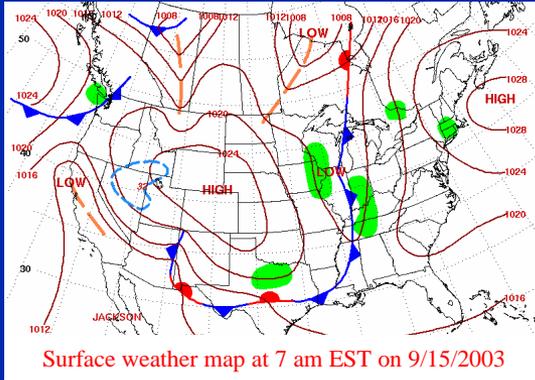
May to September 2003



Variations in ASOS b_{scat} data account for 60-70% of those in PM_{2.5} mass concentrations in the northeastern United States

Prior Work on ASOS-PM_{2.5} Relationship (2 of 4)

Meteorological Analysis



ASOS b_{scat} data correlated well with the large-scale PM_{2.5} increase.

ASOS b_{scat} data captured the lower PM_{2.5} concentrations behind the passage of the cold front.

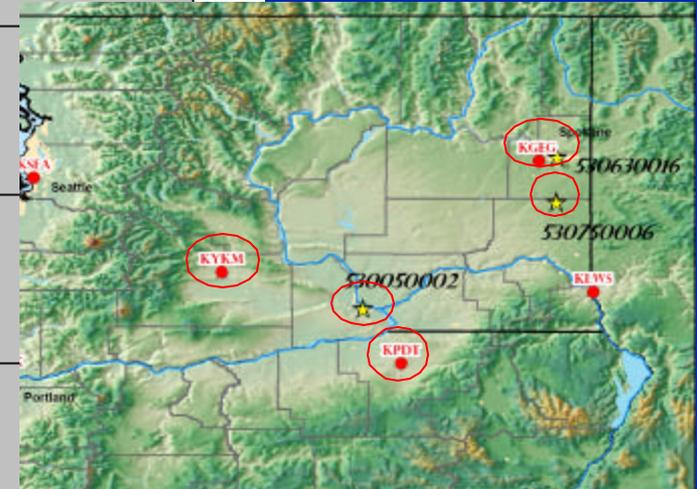
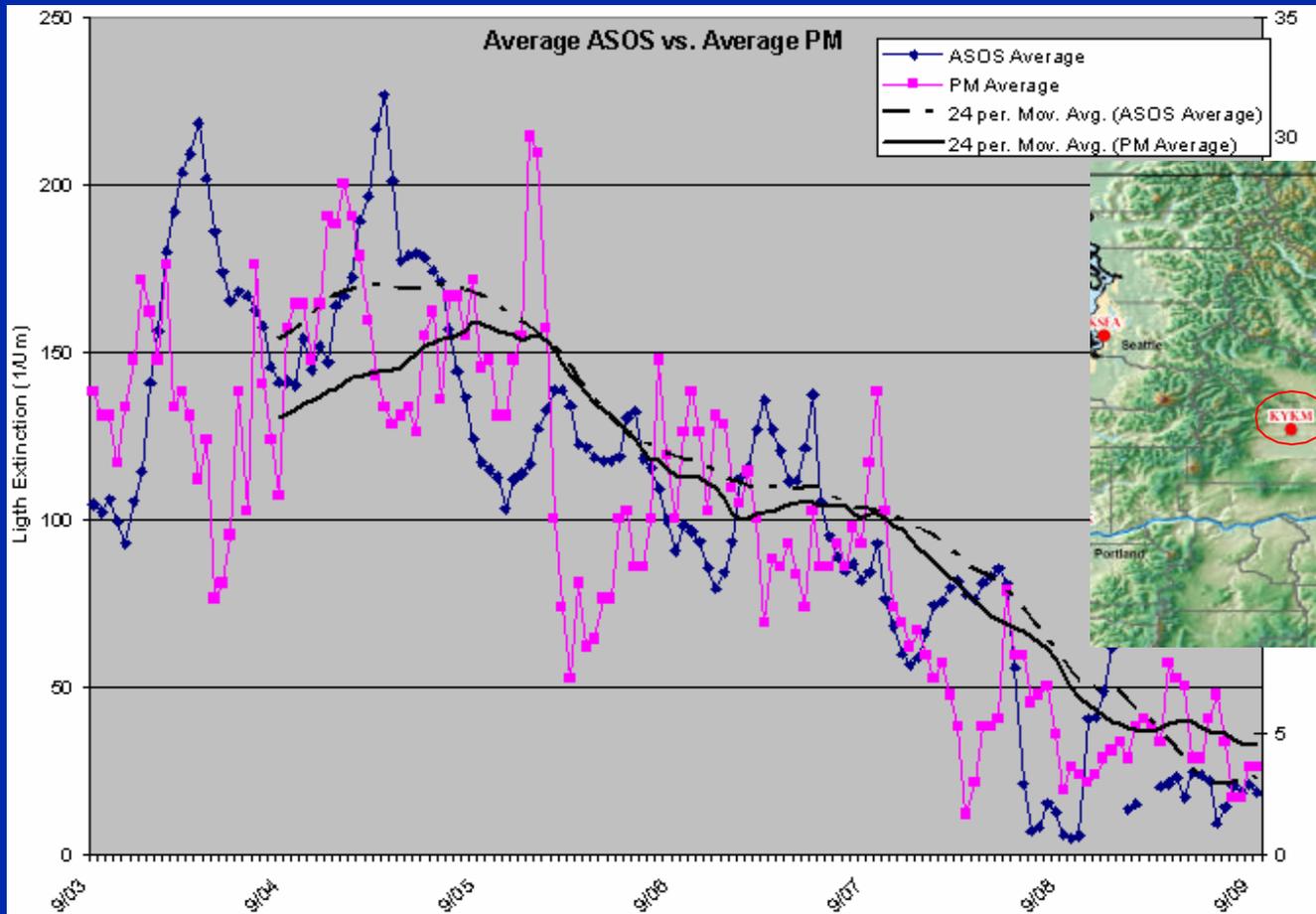
Prior Work on ASOS-PM_{2.5} Relationship (3 of 4)

Wildfire event



MODIS satellite image of a wildfire in Oregon taken at 1200 PST on September 2 (left) and September 4, 2003 (right).

Prior Work on ASOS-PM_{2.5} Relationship (4 of 4)

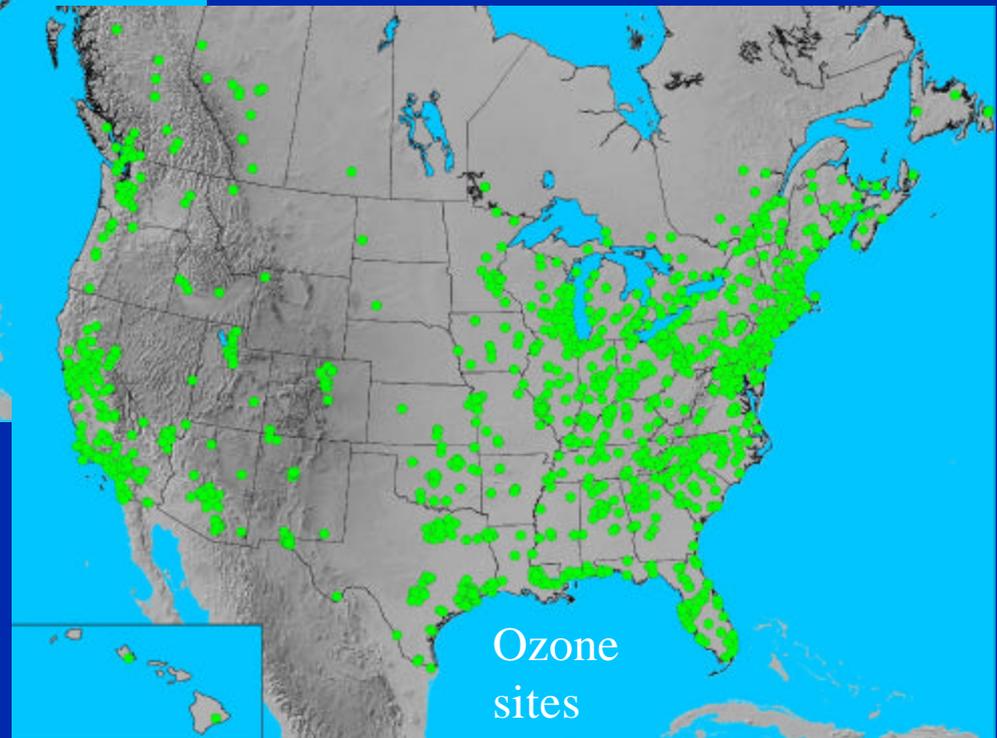
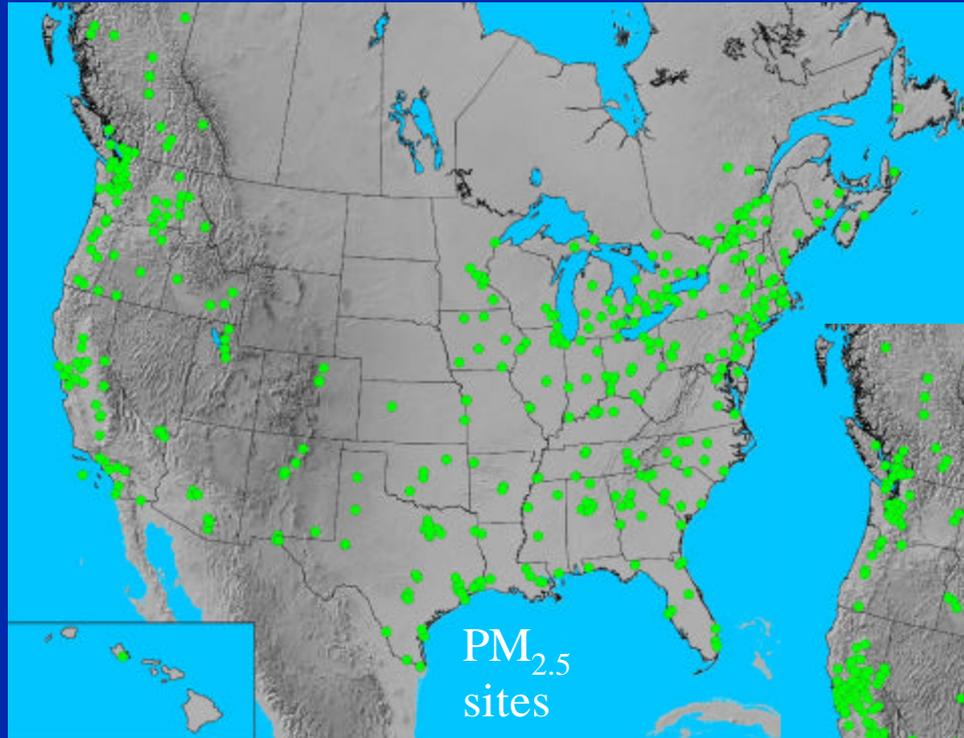


Non-collocated PM_{2.5} and ASOS b_{scat} data in complex terrain agreed well during this fire event.

Summary of Results From Prior Work

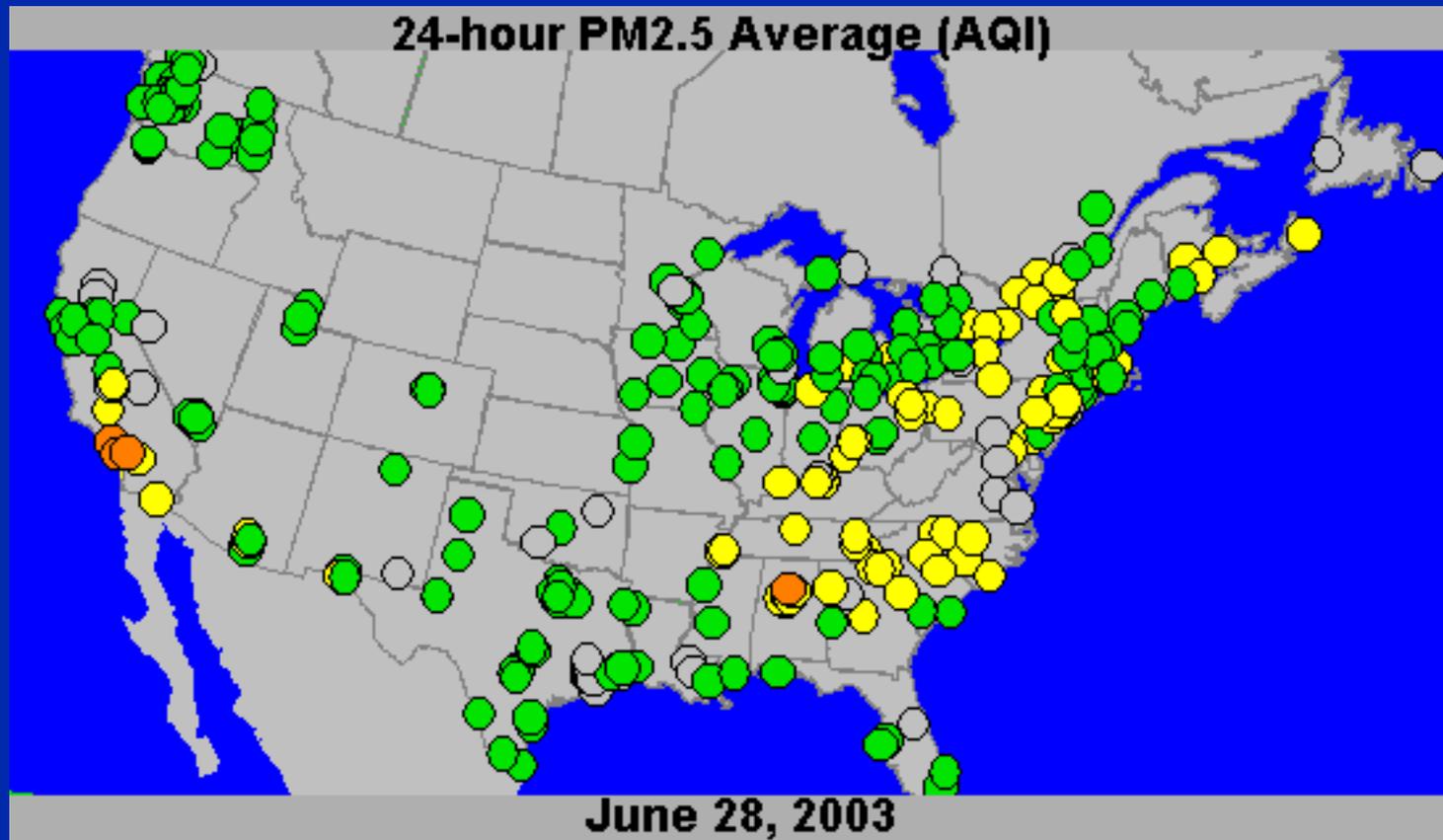
- Variability in the ASOS light-scattering data can predict up to 60-70% of the variance in $PM_{2.5}$ concentrations during summer in regions where aerosols are dominated by sulfate.
- ASOS light-scattering data correlated well with $PM_{2.5}$ concentrations in regional and localized meteorological events.

PM_{2.5} Data on AIRNow



- Limited coverage of PM_{2.5} monitors
- Some agencies are already delivering nephelometer-PM_{2.5} correlated data to AIRNow

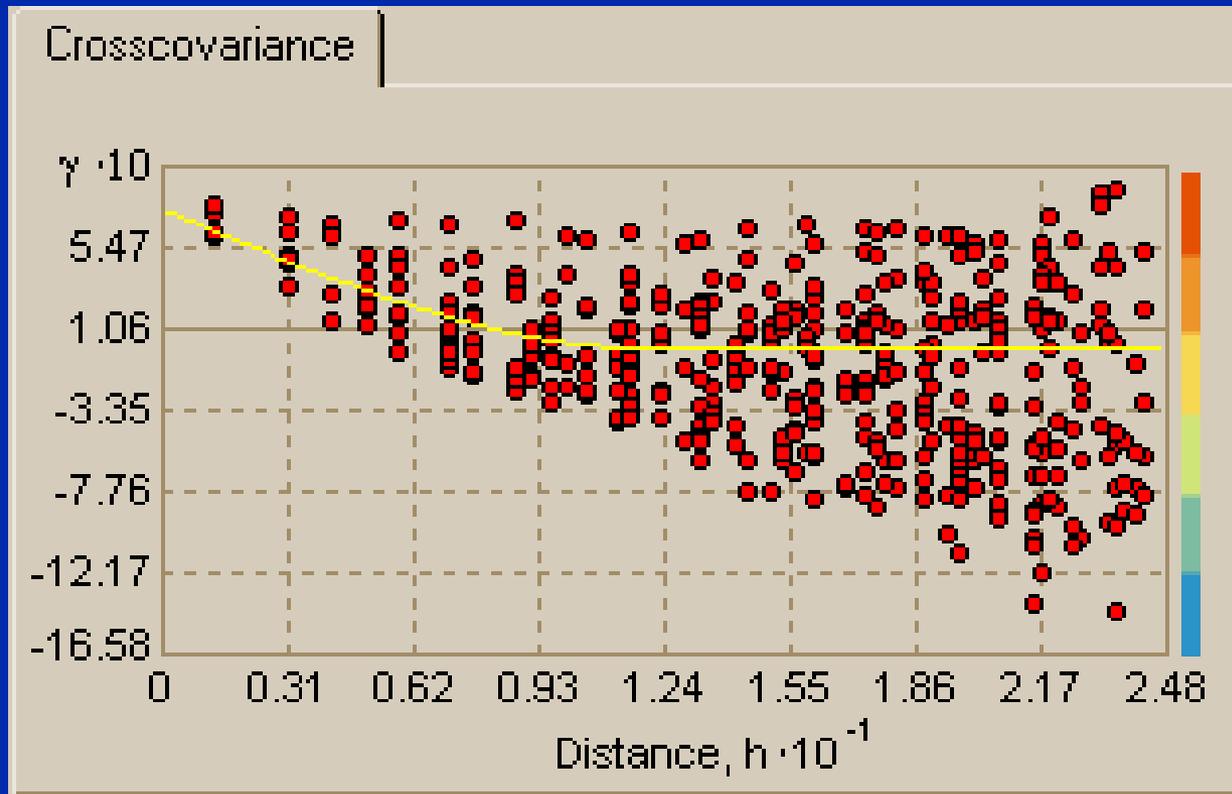
Case Study: June 23 -28 Episode



Comparison of the Geographic Coverage of ASOS and PM_{2.5} Sites



Spatial Correlation of ASOS and PM_{2.5} Data



- Plot shows ASOS/PM pairs
- Crosscovariance is positive when both values vary similarly from their respective means
- At short distances, crosscovariance is high, showing spatial correlation
- As distance increases, crosscovariance spreads, and the data are no longer correlated

Interpolation Methods

- Inverse Distance Weighted (IDW) and Ordinary Kriging (OK)
- For IDW, λ_i determined strictly by distance
- For OK, λ_i determined statistically—depends on distance and direction
- Ordinary Cokriging (CoK) adds information from other spatially correlated variables (ASOS visibility)

$$\hat{Z}(s_0) = \sum I_i Z(s_i)$$

where $\hat{Z}(s_0)$ = prediction value at location s_0

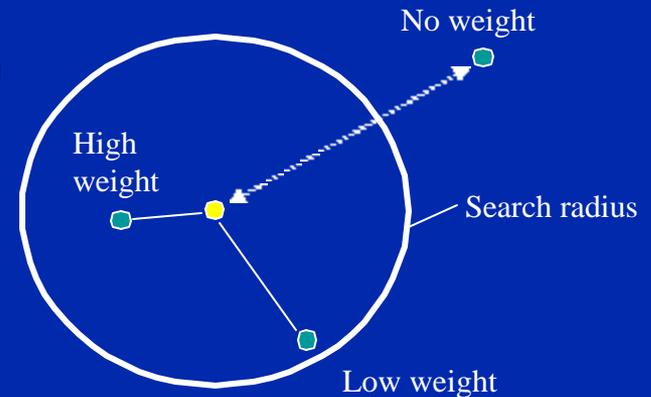
$Z(s_i)$ = measured value at location s_i

I_i = weighting factor at location s_i

$$I_i \propto d_{i-0}^{-p}$$

where d_{i-0} = distance from point i to point 0

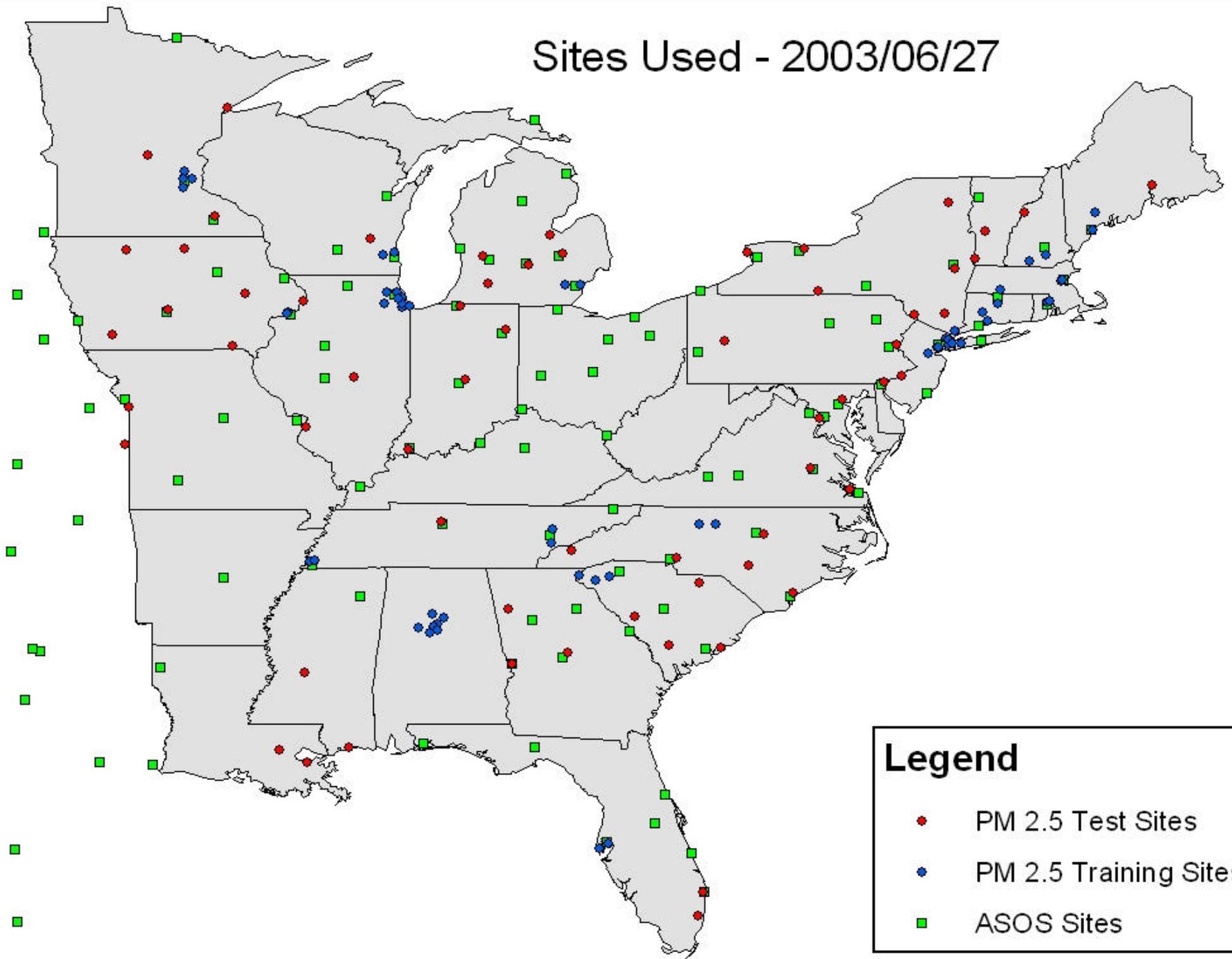
p = power value (e.g. 2)



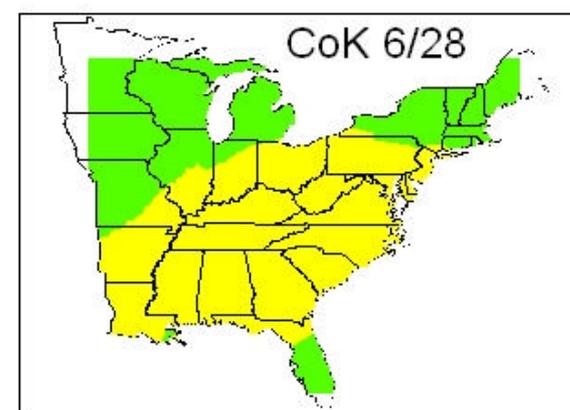
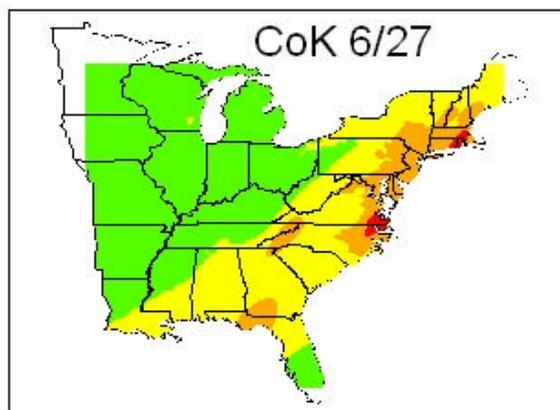
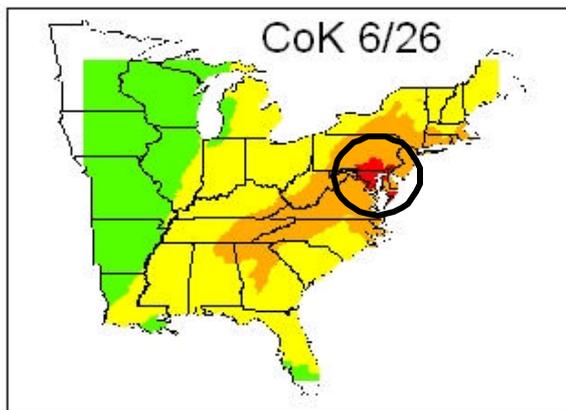
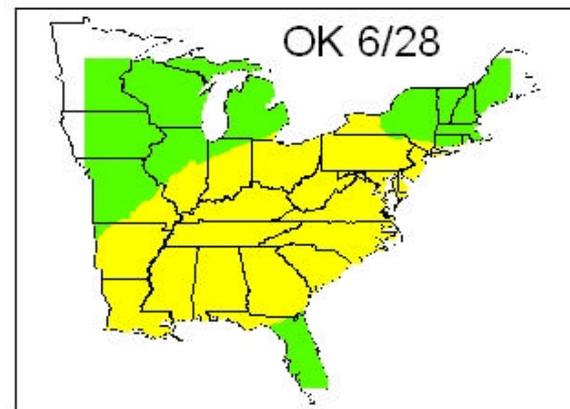
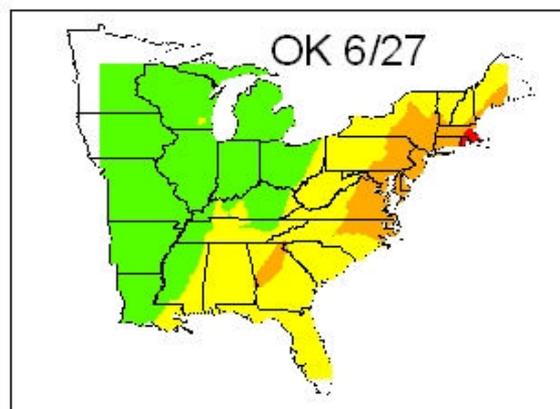
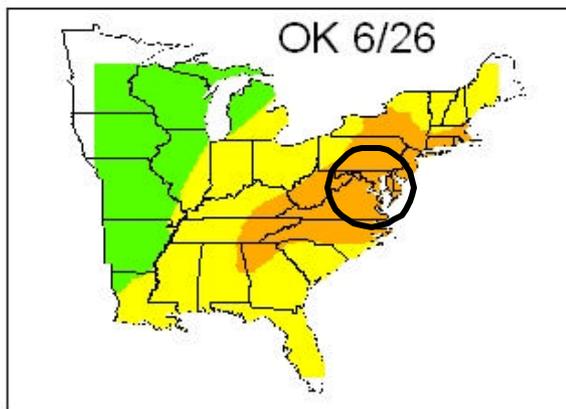
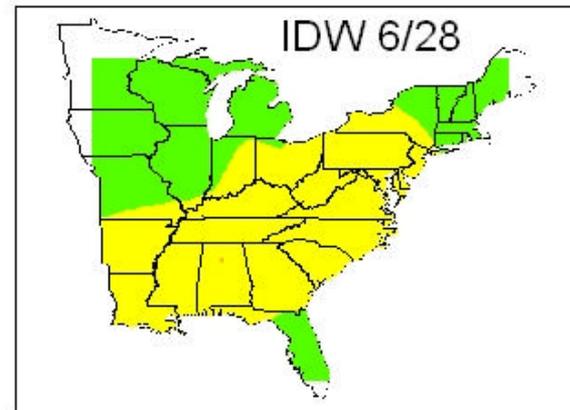
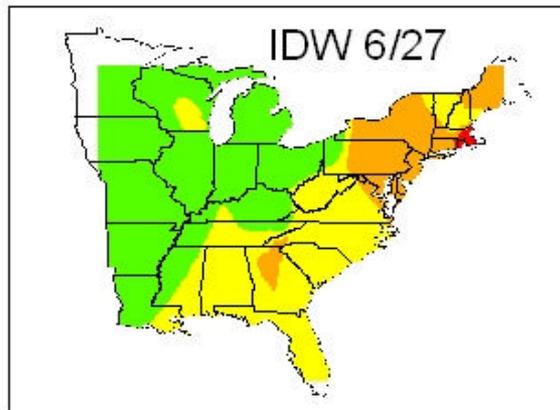
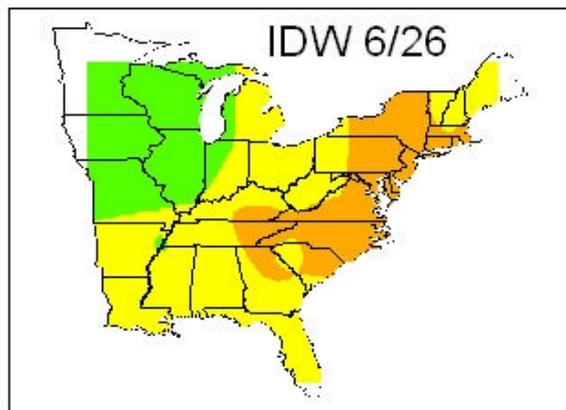
Testing Method

- Divide PM_{2.5} sites into two subsets
 - Training
 - Test
- Perform interpolation calculations using the training data set
 - IDW, OK, CoK
 - For Cokriging, add all available ASOS data
- Test resulting prediction at all test sites

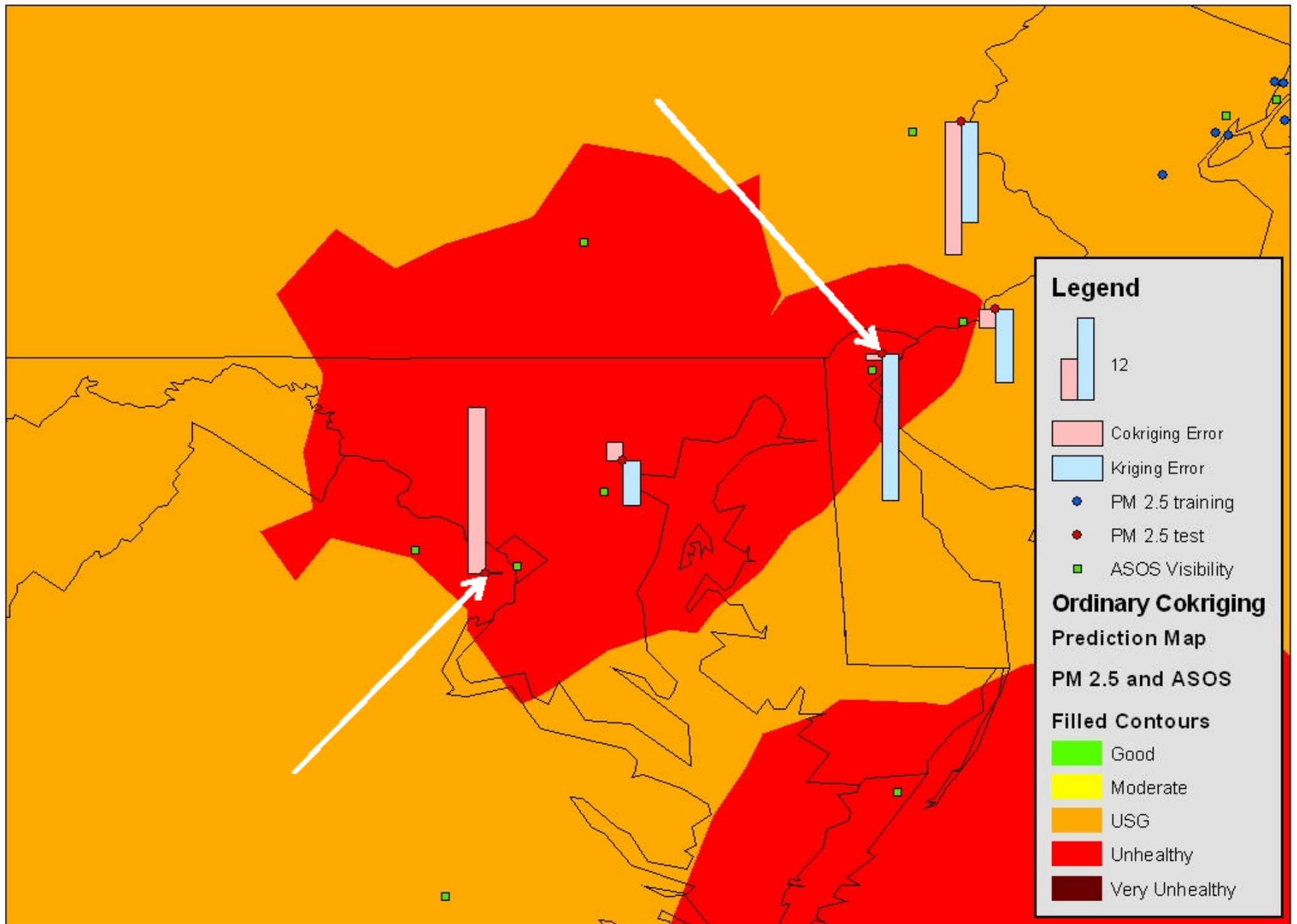
Sites Used - 2003/06/27



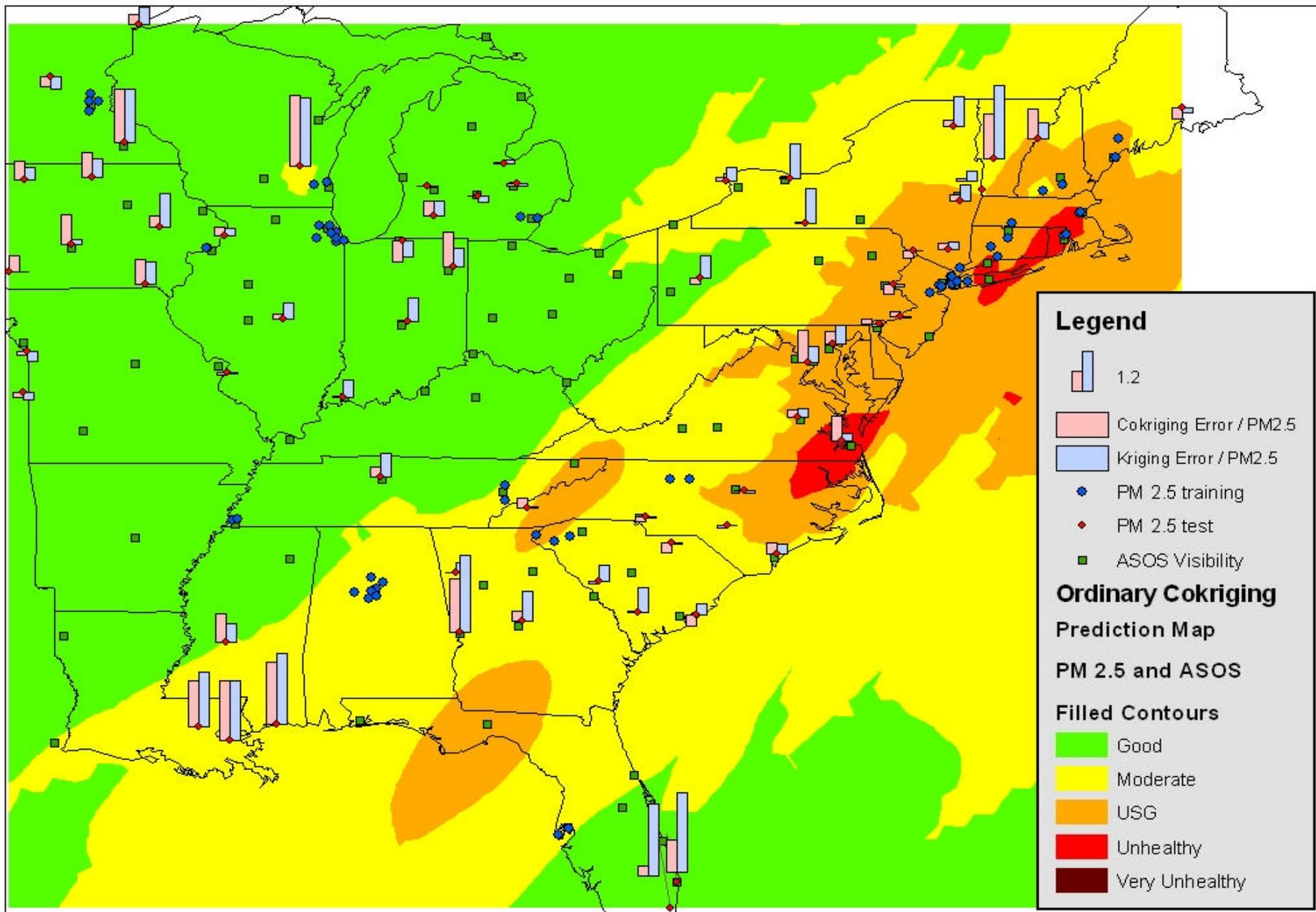
AQI Comparison - 6/26/2003 - 6/28/2003



2003/06/26 - Prediction Error - Kriging vs. Cokriging



2003/06/27 - Relative Prediction Error - Kriging vs. Cokriging



Conclusions (1 of 2)

- ASOS visibility data show potential as a surrogate for $PM_{2.5}$ mapping and can augment the spatial coverage of $PM_{2.5}$ monitors.
- Challenges
 - ASOS data availability
 - ASOS data processing
 - Quality control of data
 - Cokriging a complex algorithm with over 20 adjustable parameters
 - Best when manually tuned
 - Computationally intensive
 - Automation schemes need to be devised
 - $PM_{2.5}$ characteristics vary by region and season

Conclusions (2 of 2)

- What's needed
 - Repeat analyses for different time scales, geographic regions, and episodes
 - Explore different interpolation techniques and schemes that utilize ASOS visibility data
- Implications
 - How does incorporating ASOS visibility data to PM_{2.5} mapping change the AQI maps?

Fast Aerosol Sensing Tools for Natural Event Tracking (FASTNET)

- Inter-RPO (NESCAUM) pilot project for the tracking and detailed analysis of major natural aerosol events
- Goal: characterize the natural haze condition, through the detailed analysis of major natural aerosol events from forest fires, windblown dust and other sources
- Approach: develop data viewing and analysis tools and community website
 - Large number of aerosol-related datasets
 - Analyst Consoles
 - Air Quality Manager's Console (AQMC)

AQMC Conceptual Framework

Analysts' routine observations

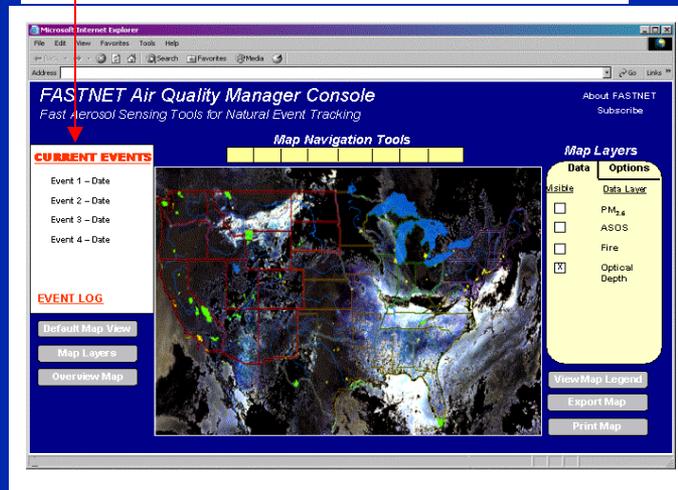
Event Occurs

News peg generated in the form of an e-mail with links to event analyst resources and FASTNET AQMC

Notification

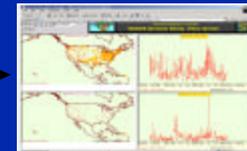
News peg e-mail administered to stakeholders

The FASTNET AQMC homepage will contain information on the current event, pre-defined map renderings and views, and links to analyst resources



The FASTNET AQMC homepage will contain pre-defined map views as well as interactive mapping tools

News peg e-mail contains description of event, links to AQMC, links to the analyst console and other resources

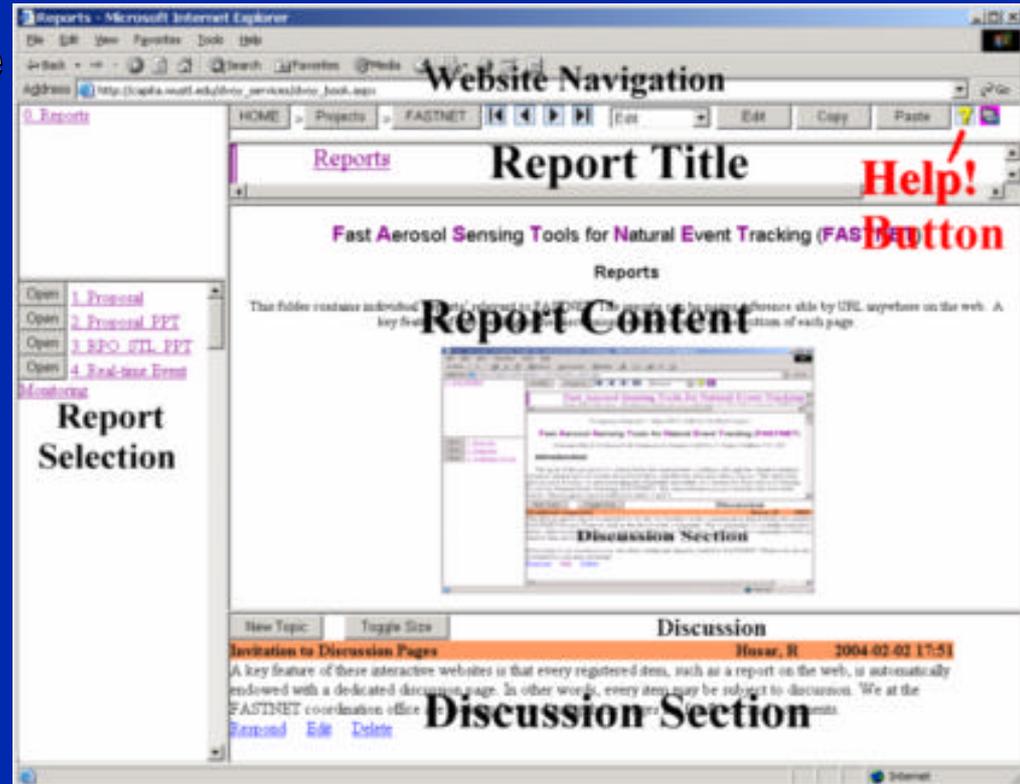


Other relevant information

Get Involved

- FASTNET Community website
 - Explore tools
 - Track progress
 - Participate
- We welcome user input
- Those interested in FASTNET steering committee should contact Tami Funk (that's me), Gary Kleiman or Rich Poirot

Tami@SonomaTech.com

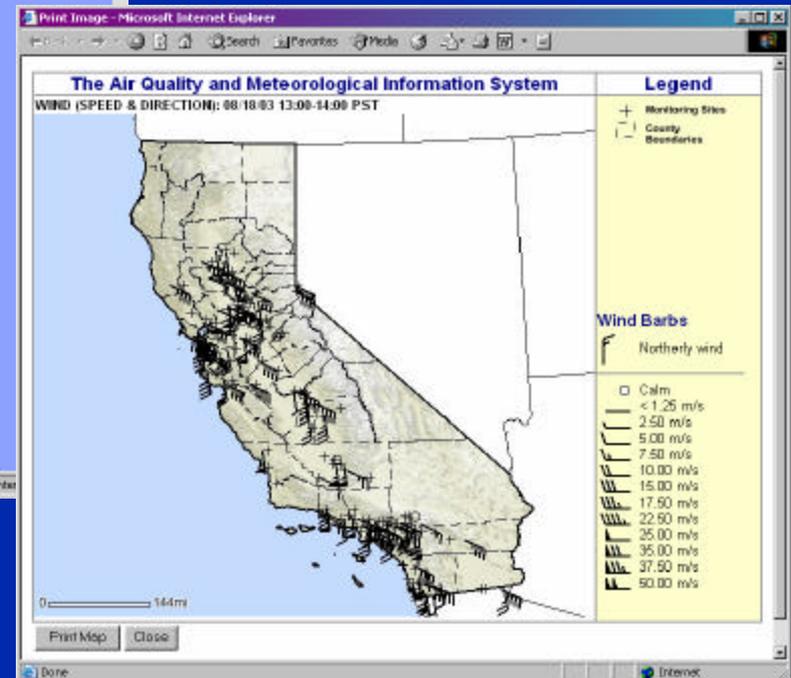
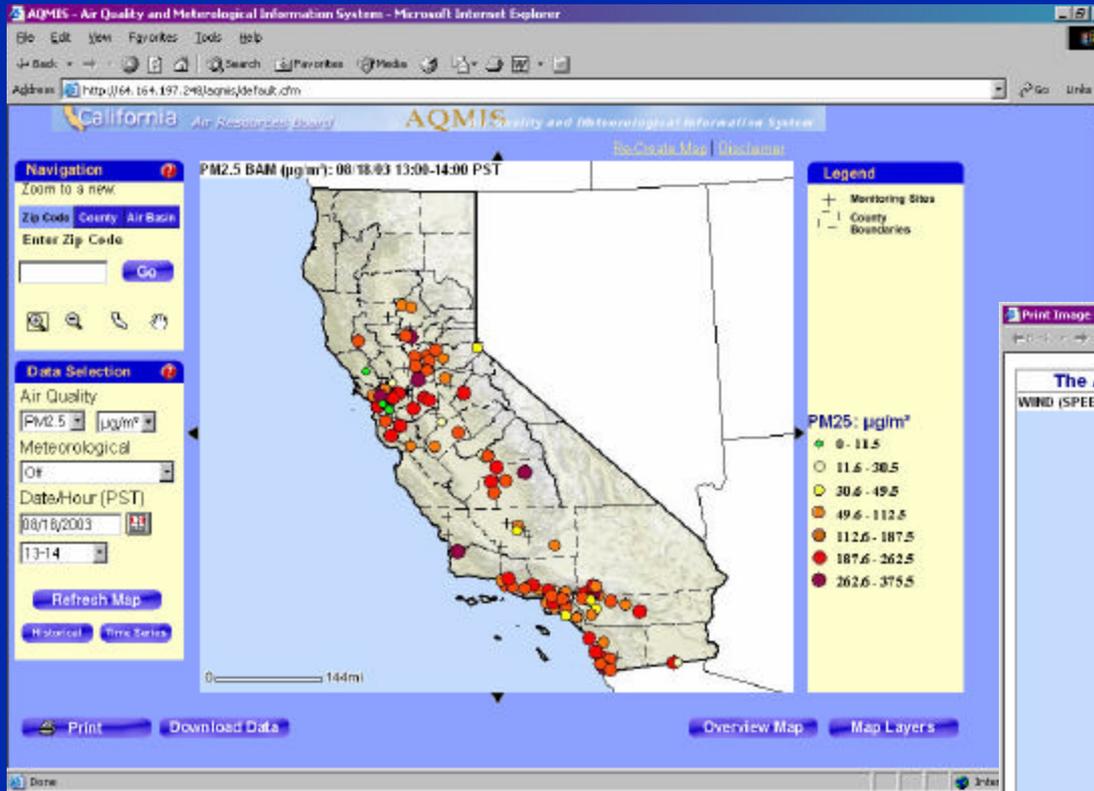


http://capita.wustl.edu/dvoy_services/dvoy_book.aspx?path=HOME/Projects/FASTNET&mode=browse

Air Quality and Meteorological Information System (AQMIS)

The screenshot displays the California Air Resources Board (ARB) website in a Microsoft Internet Explorer browser window. The browser's address bar shows the URL <http://www.arb.ca.gov/aqd/aqinfo.htm>. The website header includes the text "California Air Resources Board" and "Welcome to California" with a banner image of California landmarks. A navigation menu contains links for "ARBHome", "Search", "Site Map", "Software", and "Contact Us". The main content area is titled "Air Quality Information" and features a list of links: "Yesterday's Ozone Air Quality", "Current Years Ozone Air Quality", "Week-at-a-Glance", "Today's Hourly Data", and "Map of Today's Air Quality". To the right of the text is a map of California with numerous colored dots representing air quality monitoring stations. The browser's status bar at the bottom shows "Done" and "Internet".

Near Real-Time Air Quality and Meteorological Data



http://www.arb.ca.gov/gismo/aqmis_v1/