

# NOAA-EPA's National Air Quality Forecast Capability: Testing Expanded Capabilities

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# Outline



- **Current Capabilities**
  - *NAQFC and Operational Products*
- **2006 Testing:**
  - *Expanded Predictions for Ozone and PM components*
- **Looking Ahead**
  - *2007 and Beyond*

# National Air Quality Forecast Capability

## *End-to-End Operational Capability*

### **Model Components: Linked numerical prediction system**

Operationally integrated on NCEP's supercomputer

- *NCEP mesoscale NWP: WRF-NMM*
- *NOAA/EPA community model for AQ: CMAQ*

Observational Input:

- *NWS weather observations*
- *EPA emissions inventory*

### **Gridded forecast guidance products**

- *On NWS Telecommunications Gateway and EPA servers*
- *Updated 2x daily*

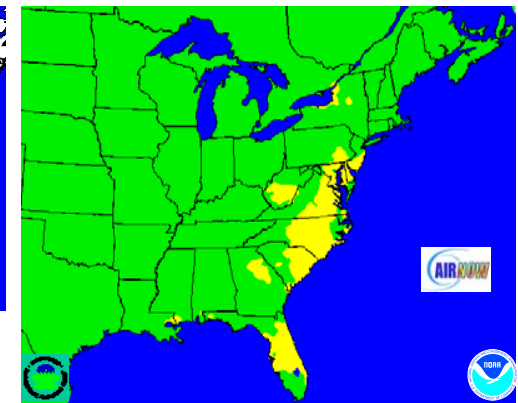
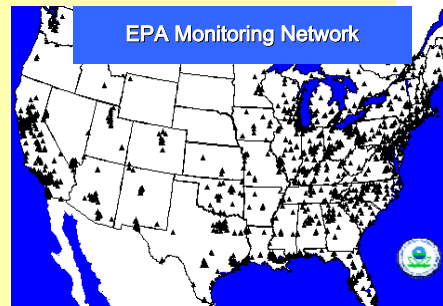
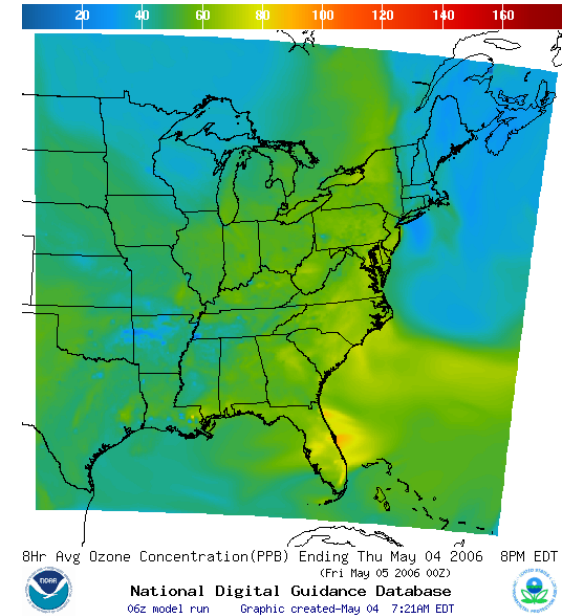
### **Verification basis**

EPA compilation:

- *Ground-level ozone observations*

### **Customer outreach/feedback**

- *State & Local AQ forecasters coordinated with EPA*
- *Public and Private Sector AQ constituents*

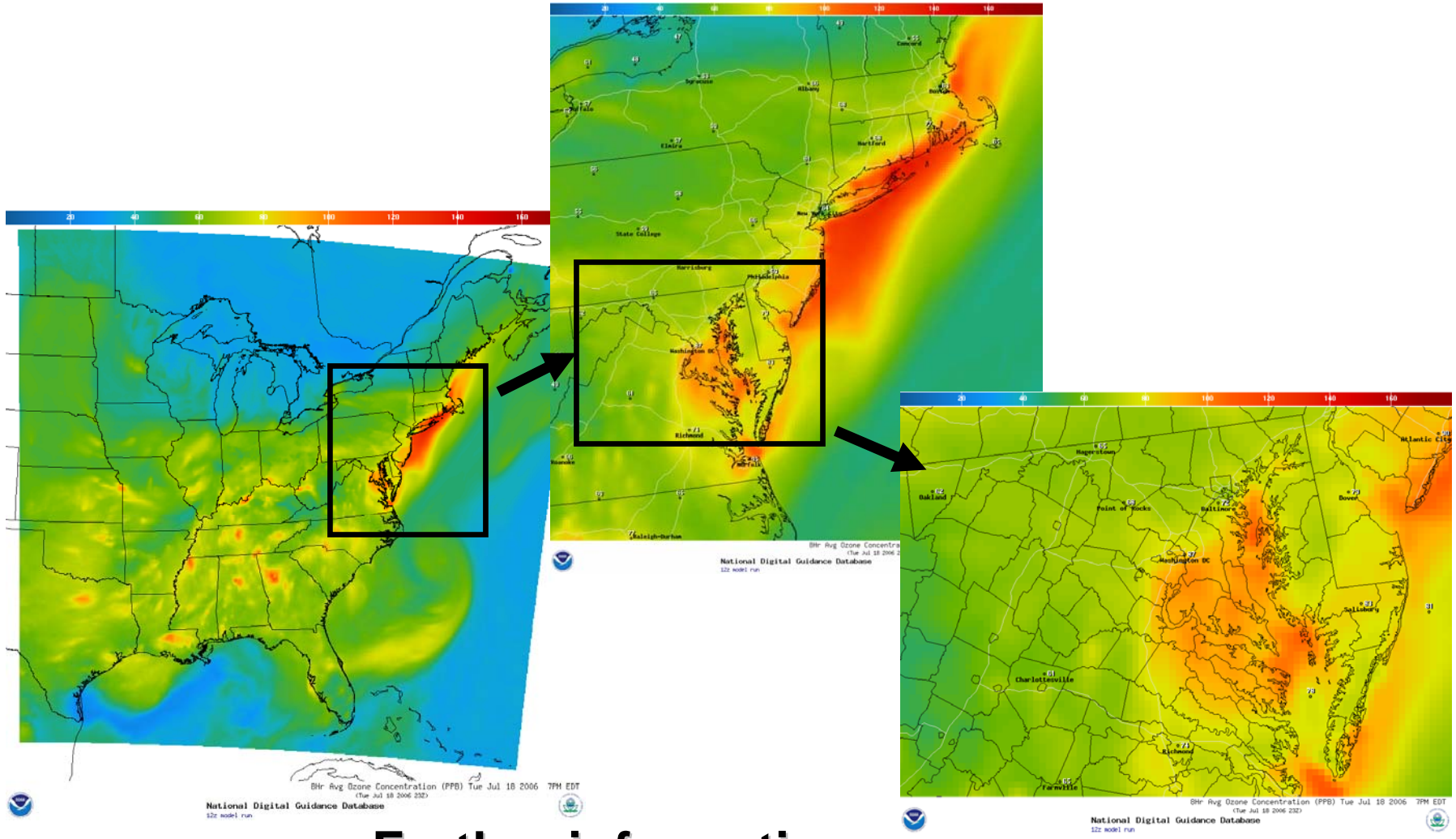


**AQI: Peak May 4**



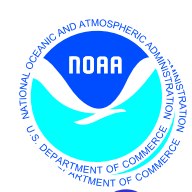
# Operational AQ forecast guidance

[www.weather.gov/aq](http://www.weather.gov/aq)



Further information

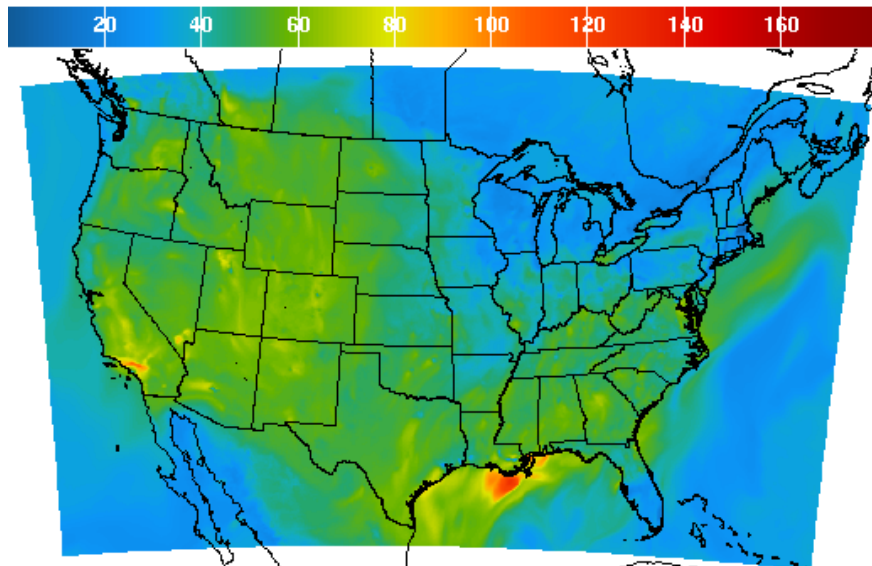
[www.nws.noaaa.gov/ost/air\\_quality](http://www.nws.noaaa.gov/ost/air_quality)



# Experimental Products:



## Coast-to-coast Ozone, Smoke Forecast Guidance



8Hr Avg Ozone Concentration(PPB) Ending Wed Sep 06 2006 10PM EDT

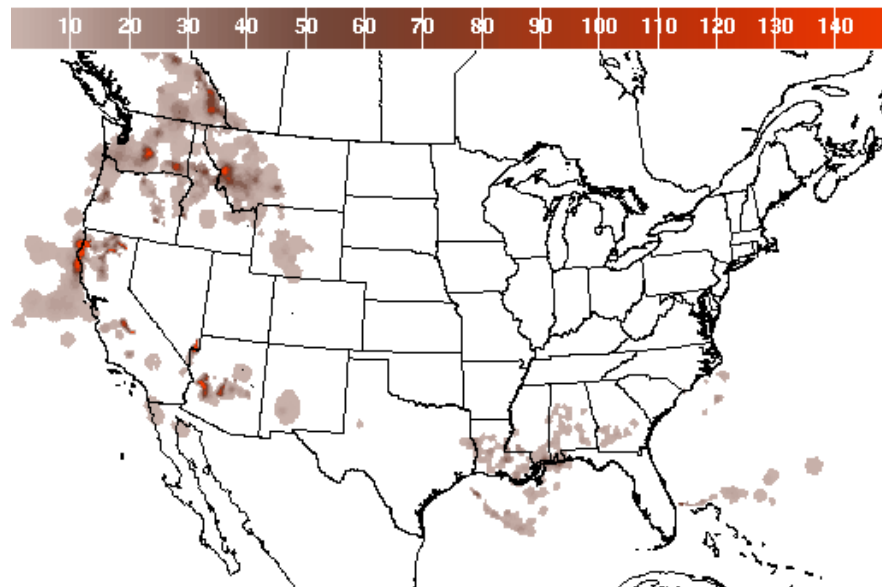
**Experimental** (Thu Sep 07 2006 02Z)

**National Digital Guidance Database**

12z model run Graphic created-Sep 05 2:35PM EDT



[www.weather.gov/aq-expr](http://www.weather.gov/aq-expr)



1Hr Surface Smoke (micrograms/m<sup>3</sup>) Thu Oct 12 2006 12PM EDT

**Experimental** (Thu Oct 12 2006 16Z)

**National Digital Guidance Database**

6z model run Graphic created-Oct 12 9:37AM EDT





# Test Configurations Summary

## Summer, 2006



### **Ozone: Experimental (5X) testing beginning June, 2006**

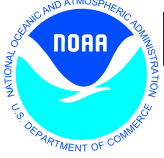
- *New WRF-CMAQ linkage, improved vertical coupling with  $\sigma$ -P adopted in CMAQ/WRF*
- *Updates to emissions (esp mobile and EGU sources)*
- *ACM mixing in clouds*

### **Smoke: Experimental testing beginning March, 2006**

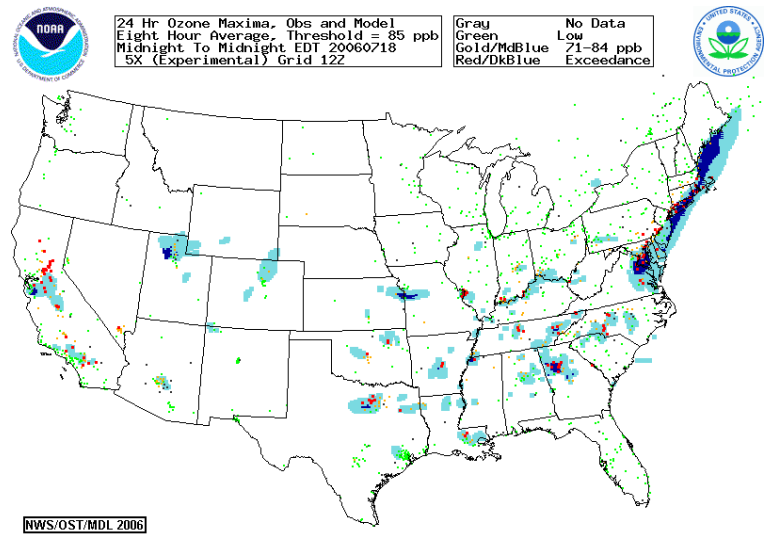
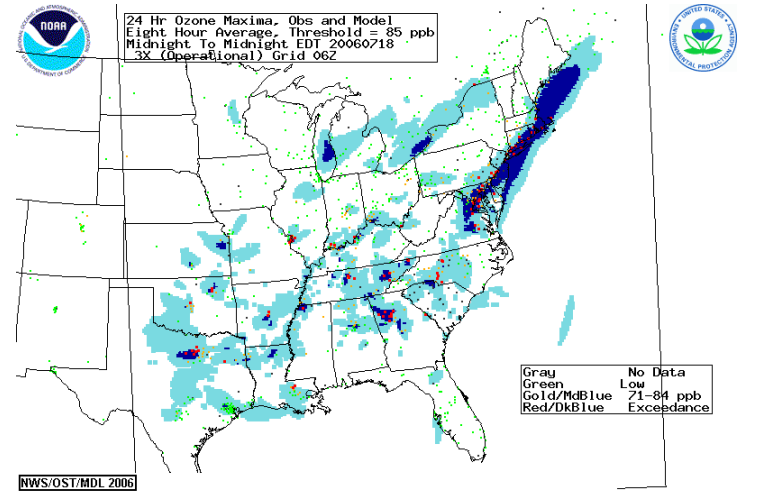
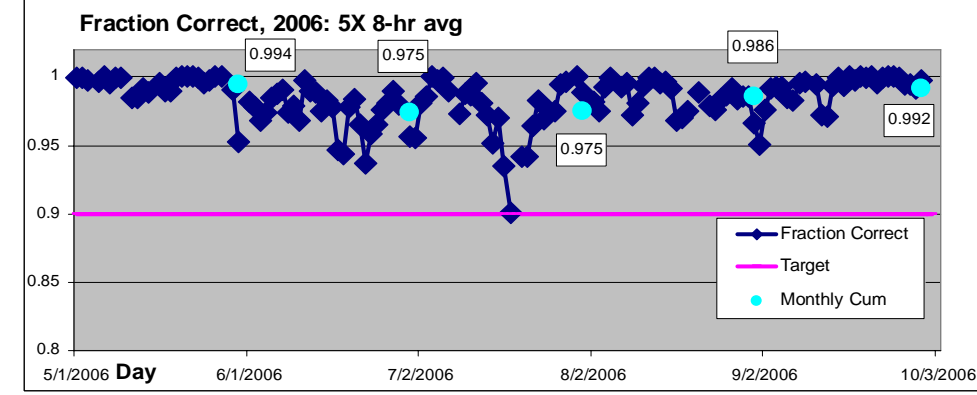
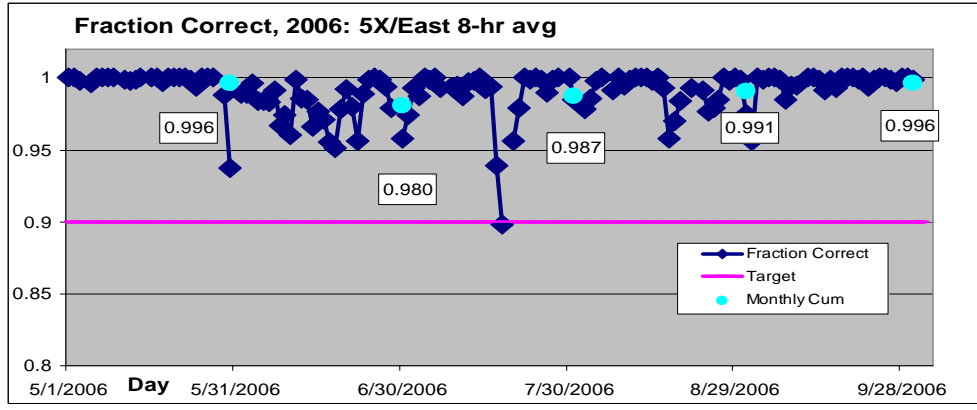
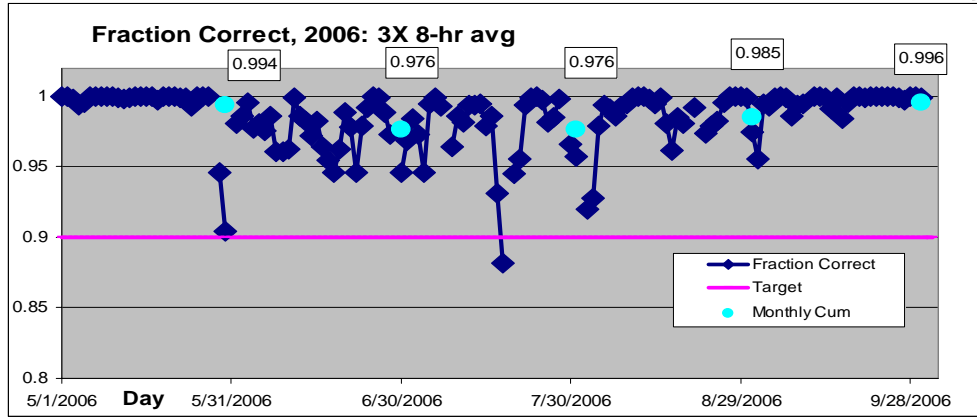
- *Fire Locations and verification based on satellite observations and NESDIS' Hazard Mapping System (HMS) analysis*
- *Fire emissions estimates from USFS (BlueSky)*
- *HYSPLIT/NAM transport*

### **Aerosols: Developmental testing providing comprehensive dataset for diagnostic evaluations**

- *CMAQ (aerosol option)*
- *Qualitative; underprediction consistent with missing source inputs*

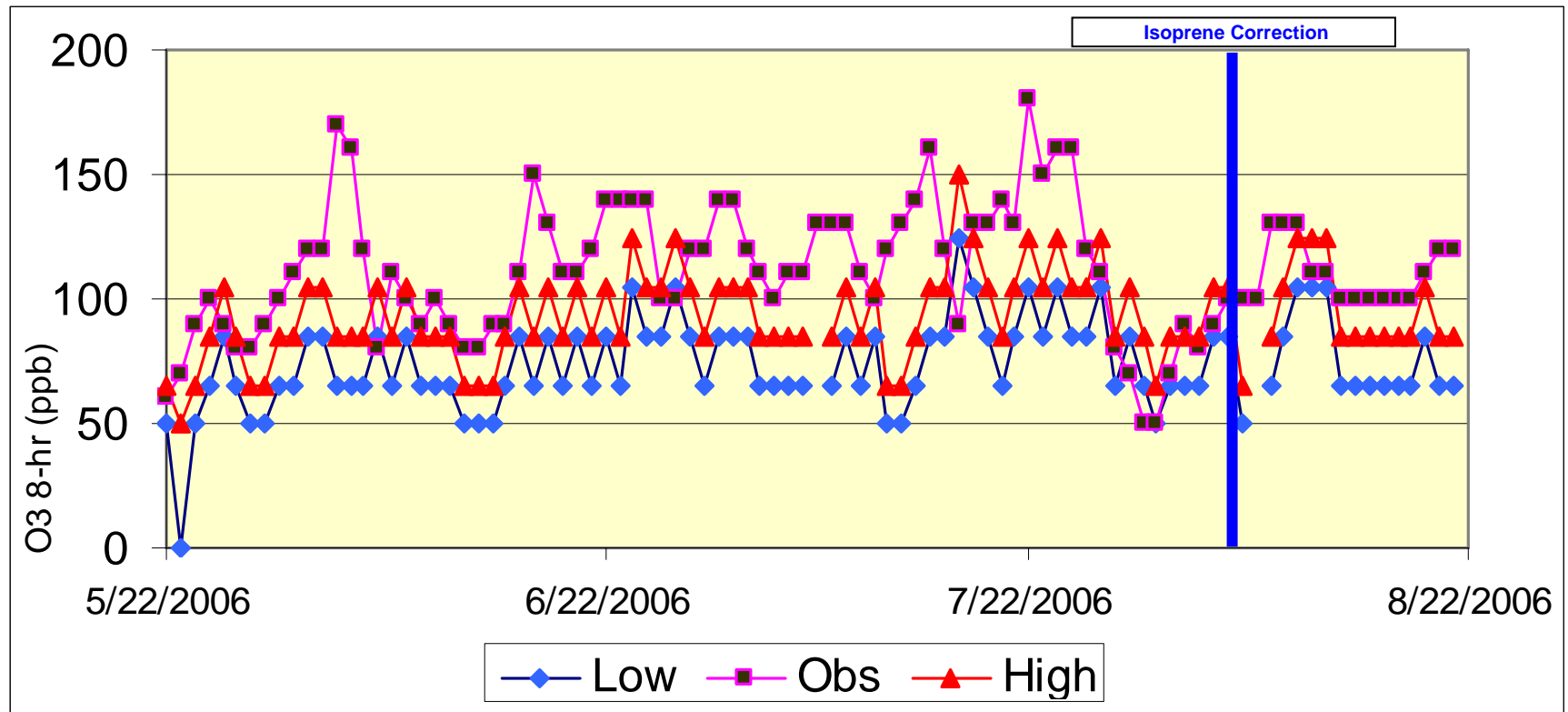


# Preliminary Analysis of Ozone Predictions: Summer, 2006





# A Closer Look at Experimental Testing: *SoCA Under-Prediction (Cassmassi, SCAB)*



Daily (Categorical) Range, Southern California

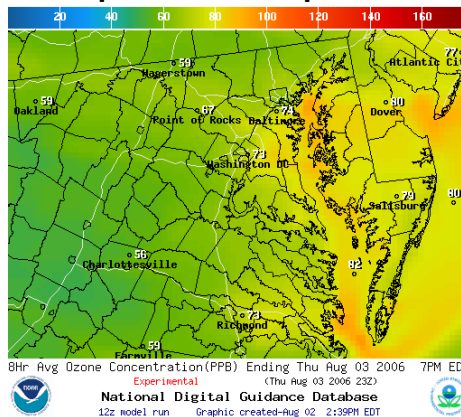
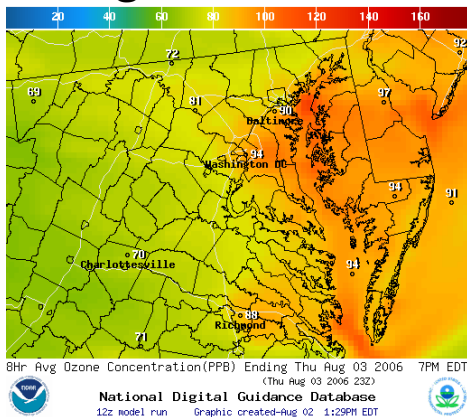


# Testing Challenges: *Summer, 2006*

Comparison of Operational and Experimental testing:

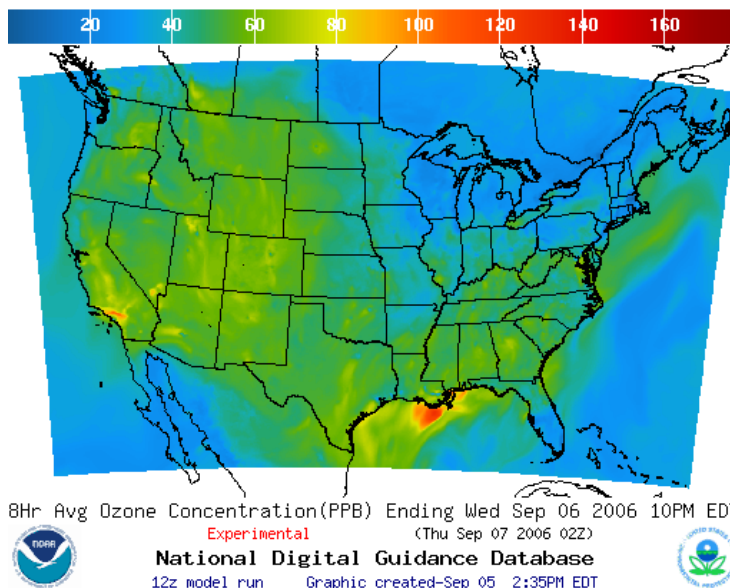
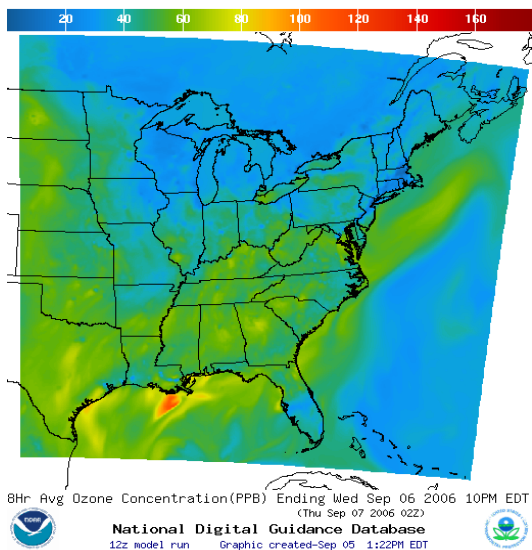
1. **Before Aug 6:** 3X: OK

5X: partial isoprene emissions



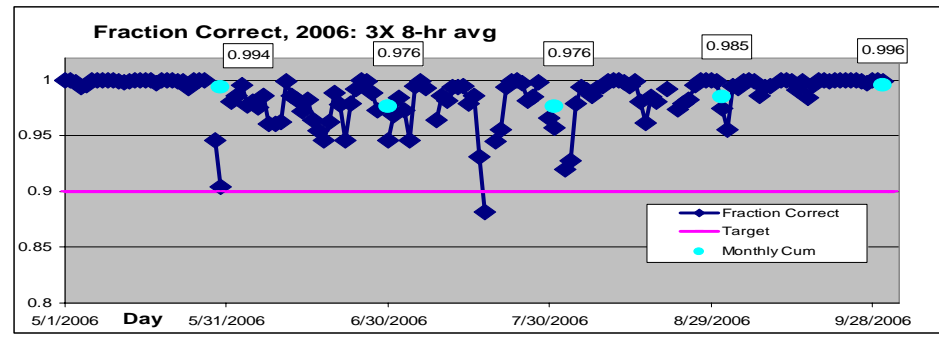
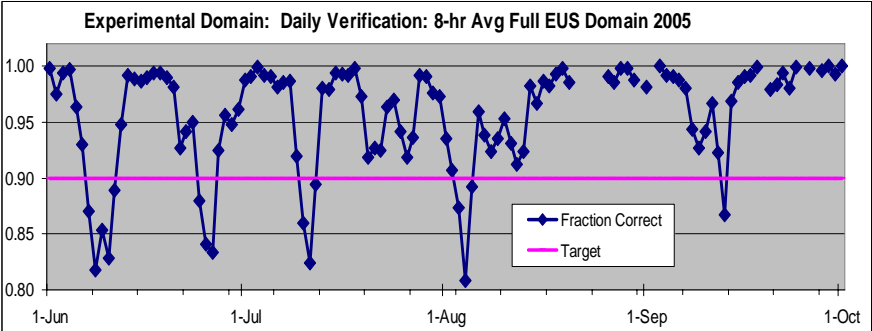
BVOC emissions error produces significantly less ozone in 5X

2. **After Aug 6** Isoprene correction in 5X: 3X and 5X very similar

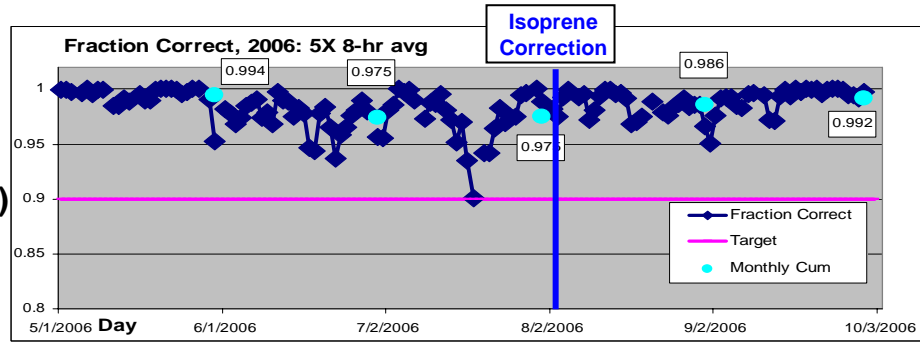
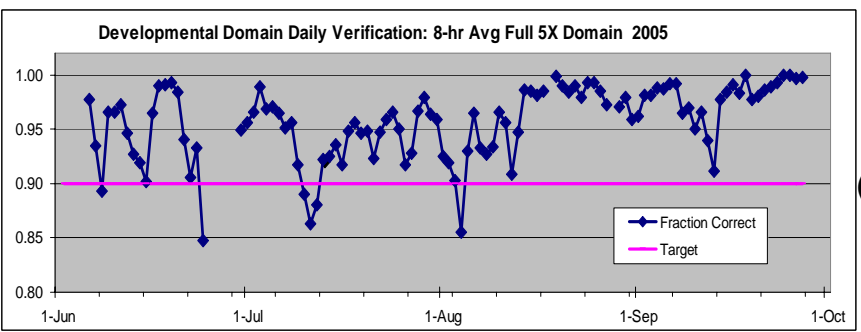




# Progress from 2005 to 2006: Summary Verification for 3X and 5X



**3X  
(EUS)**



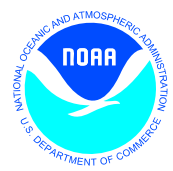
**5X  
(CONUS)**

**2005**

**2006**

**Less overprediction in 2006 led to:**

- Improved accuracy in EUS
- Frequent underprediction in WUS



# Testing Results Summary, Ozone *Summer, 2006*

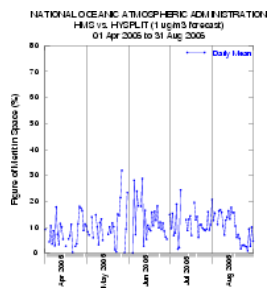
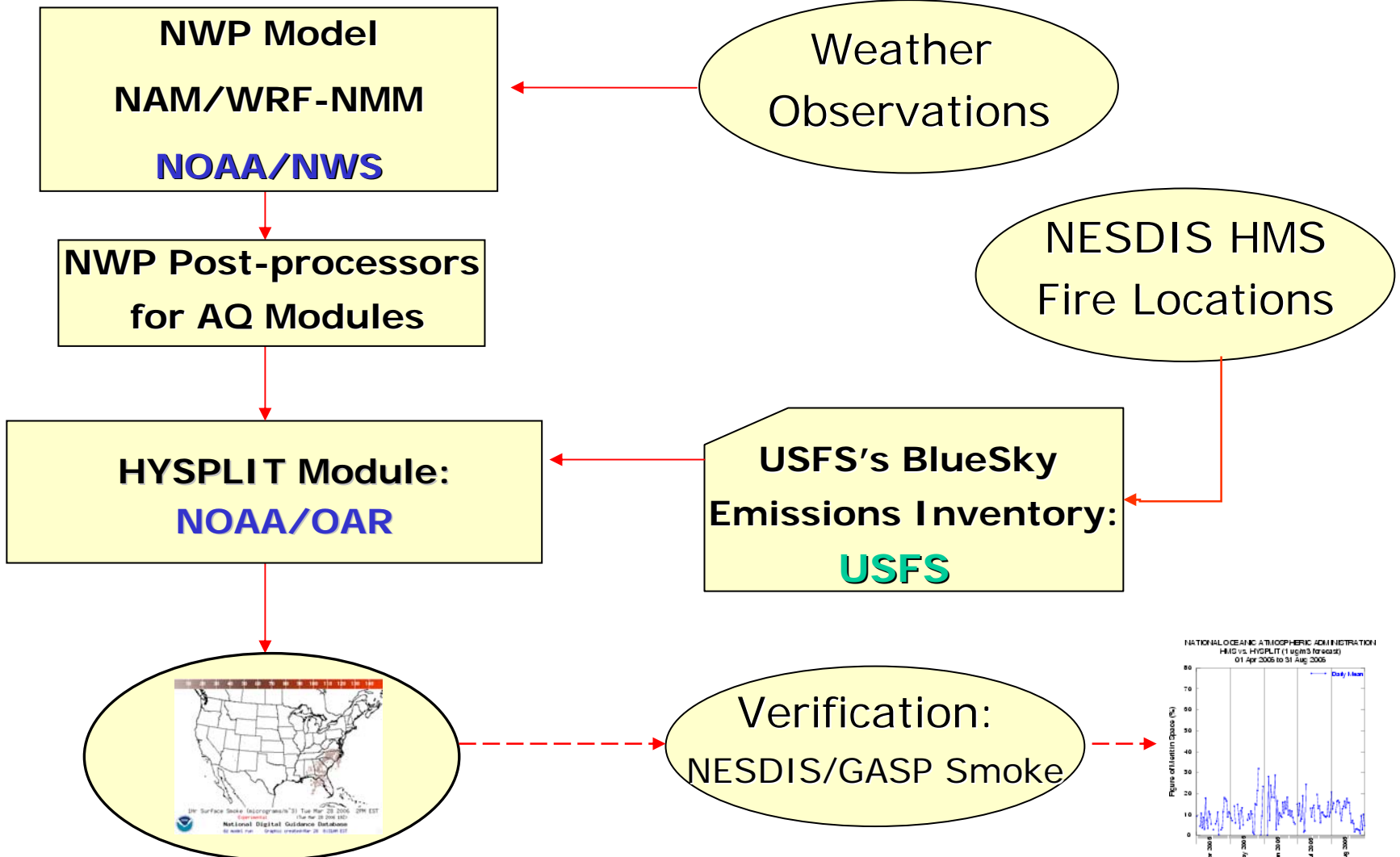


## ***Ozone: Extensive retrospective testing with developmental NAM-CMAQ system during Winter and Spring still left some surprises:***

- **Experimental (5X) ozone:**
  - *Large under-predictions in the west; systematically lower ozone than operational (3X) in East.*
- **Operational (3X) ozone:**
  - *Some over-predictions for cool, cloudy conditions*
- **Despite regional variations, e.g. CA, system-averaged statistics indicate improved accuracy in 2006 vs. 2005**

# Smoke Forecast Tool

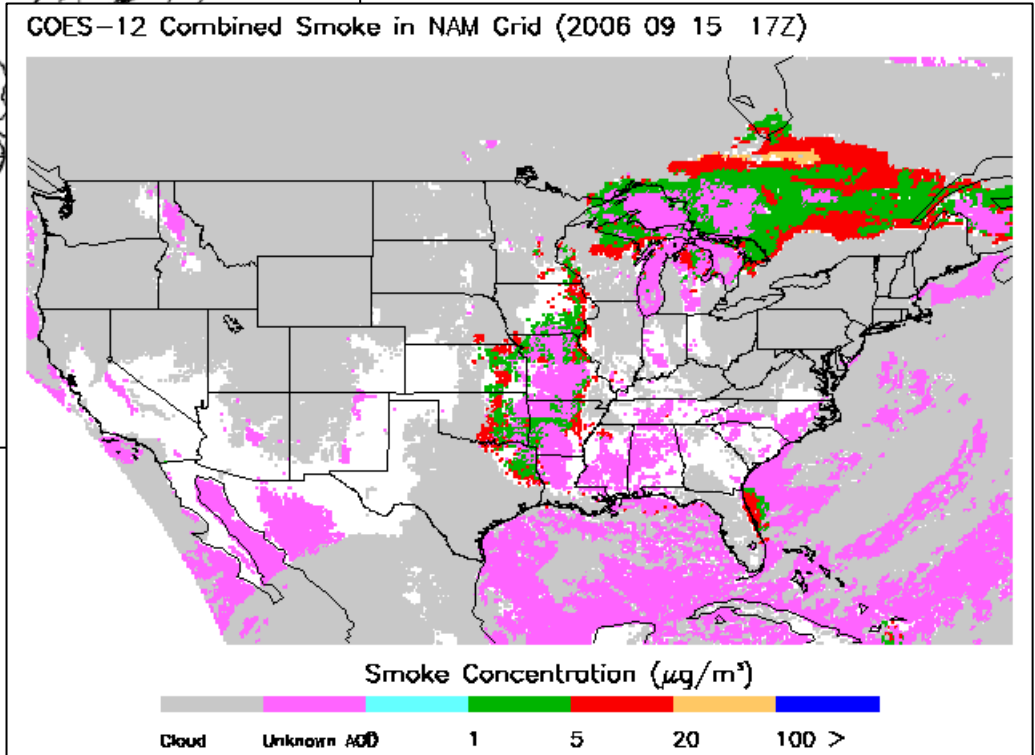
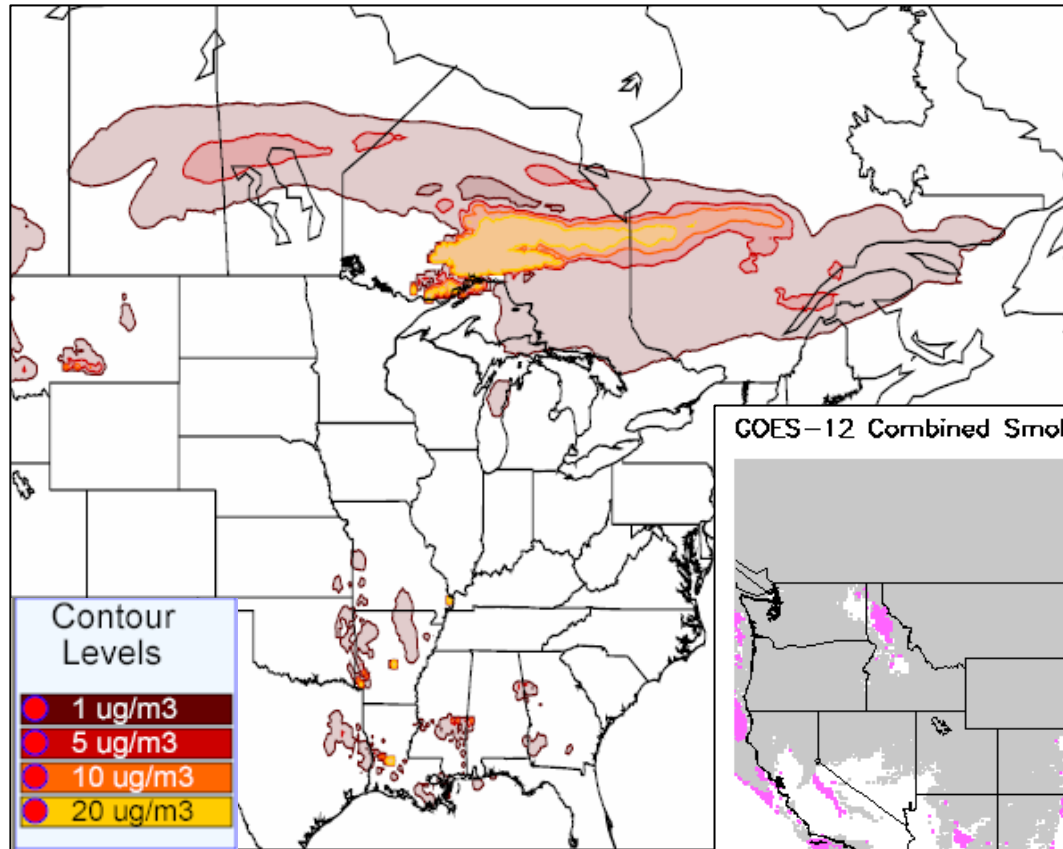
## Major Components



# Sample Smoke Verification: September 15, 2006

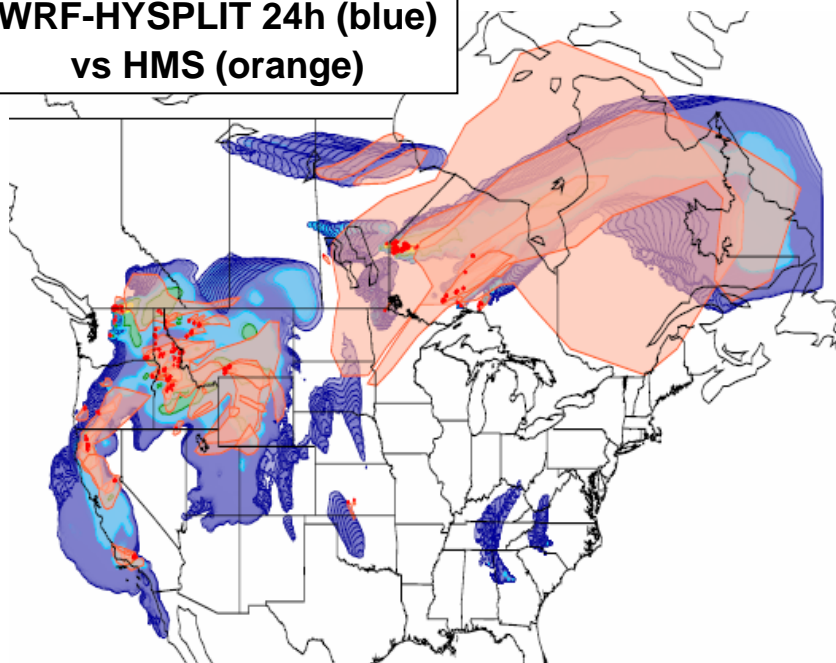
9/15/06, 17Z: high FMS (45%)

- GOES smoke captures peak concentrations identified by HYSPLIT
- Cloud cover limits available observations in northern and western portion of plume

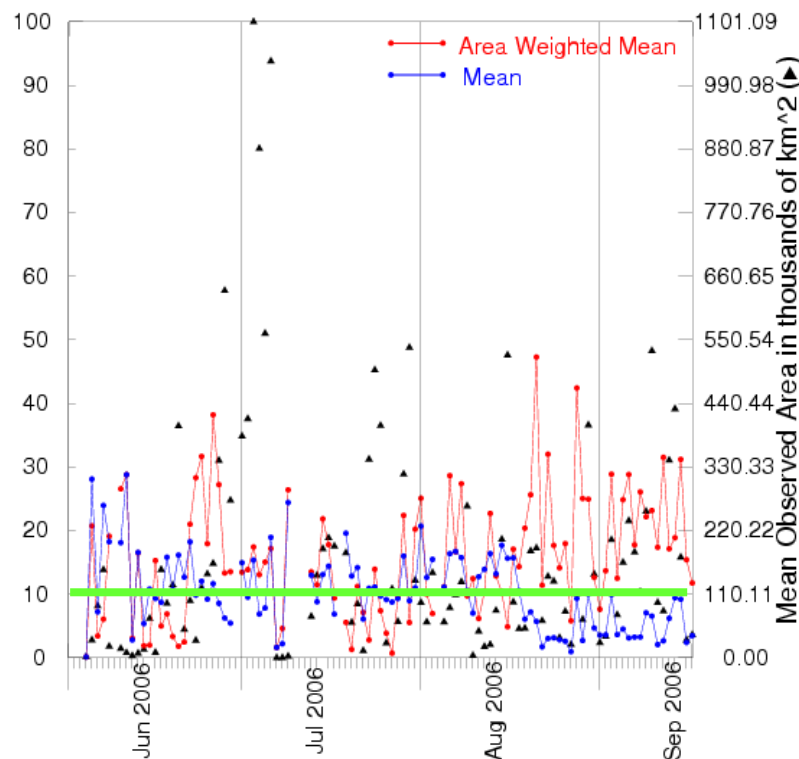


# WRF-HYSPLIT 24-h Smoke Predictions: *Preliminary Evaluation, 2006*

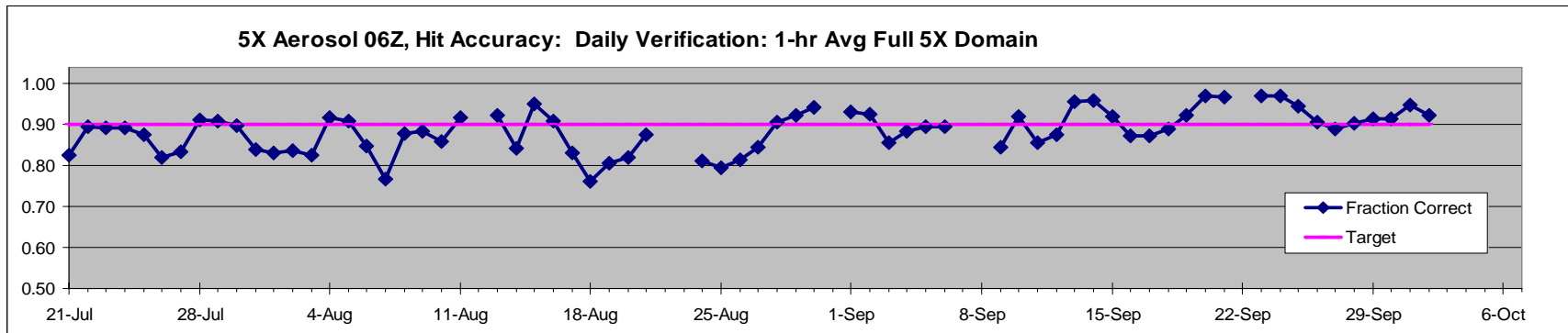
**14 September 2006**  
**WRF-HYSPLIT 24h (blue)**  
**vs HMS (orange)**



**Preliminary Verification statistics: Threat Score**  
**Threshold: 1ug/m3 in Column**  
**Initial target: 10%**

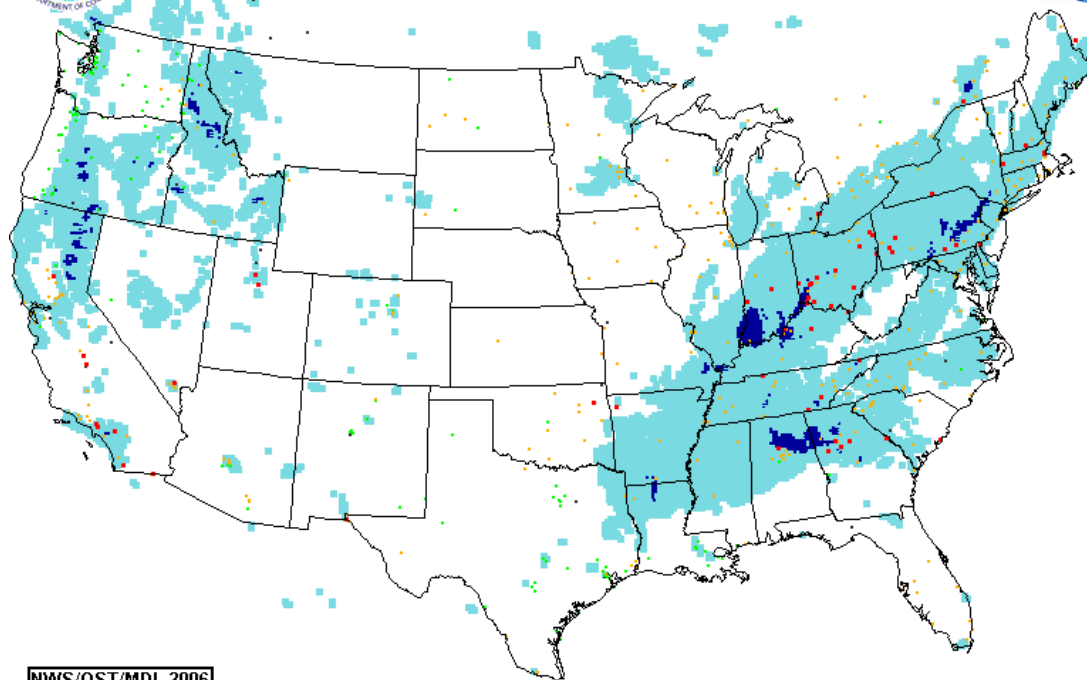


# Preliminary Aerosol Predictions: *Summer, 2006*



24 Hr PM<sub>2.5</sub> Maxima, Obs and Model  
One Hour Average, Threshold=40  $\mu\text{g}/\text{m}^3$   
Midnight To Midnight EDT 20060725  
5X (Developmental) Grid 06Z

Gray	No Data
Green	Low
Gold/MdBlue	15.5–39.9 ppb
Red/DkBlue	Exceedance



July 25, 2006

NWS/OST/MDL 2006



# Testing Results Summary, PM components

## *Summer, 2006*

### ***Smoke: Experimental testing providing basis for systematic near-real time evaluations with satellite observations***

- Results promising for predicted smoke transport, compared to HMS smoke analyses (independent, analyst-prepared)
- Development of objective smoke analyses for near-real time verification providing new baseline for improving predictions

### ***Aerosols: Developmental testing providing comprehensive dataset for diagnostic evaluations***

- Underprediction common; consistent with missing source inputs





# National AQF Capability: *Targets for 2007 and Longer-Term*



## **Ozone forecast guidance (WRF-CMAQ)**

- **Improving day-to-day performance, especially in the west**
- **Transitioning experimental CONUS predictions to operations (2007)**
- **Further development:**
  - *Closer coupling of AQ with WRF prediction; examine impacts of vertical resolution, vertical mixing treatments, horizontal boundary conditions...*
  - *Testing over all 50 states; day 2 and beyond*

## **Particulate matter components:**

- **Smoke from large fires: transition to operations (2007)**
- **Further development:**
  - *Objective satellite products for verification*
  - *Aerosols predictions from anthropogenic source emissions in inventories: continued development/testing/analysis*

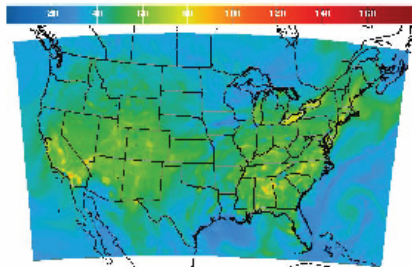


# Coming Soon: *Air Quality Awareness Week*



**Be Air Aware**  
**Keep an Eye on the AQI**

 Air Quality Awareness Week  
April 30 - May 4, 2007  
[www.airnow.gov/airaware/](http://www.airnow.gov/airaware/) 



The Fig. 1299: Green-Health-IMP Living the Air Quality Index (AQI) National Digital Guidance Database

