



National Air Quality Forecasting Capability: Progress and Plans

June 17, 2005

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Outline



- **Background**
- **Current capabilities**
- **Progress and plans for expanded capabilities**



National Air Quality Forecasting *Background*

Congressional Interest

- *H.R. 4 Energy Policy Act of 2002 (Senate Amendment)*

Constituent Interest

- *State and local air quality forecasters: statement of need*
- *AQ managers, public health officials, private weather sector partners urge NOAA to provide AQ forecasts*

NOAA-EPA Agreements

- *DOC Deputy Secretary and EPA Administrator signed MOU/MOA for AQ forecasting May 6, 2003*

Science is Mature

- *Ozone forecast models demonstrated in lab -- others in development*
- *Other nations (Canada, Australia) have existing AQ forecasts; expanding capabilities to include aerosol components*



State and Local AQ forecasters

Statement of Need: NOAA-EPA Capability

Statement of Needs (EPA AIRNOW Workshop Feb. 2004)

Short-Term:

- **Ground-level ozone forecast guidance.**
- **Northeast U.S. domain**
- **Next day guidance available by 1:30 pm EDT; Morning update by 9:00 am**
- **Include 1-hour and 8-hour averages and daily maxima**
- **12km grid resolution**

Long-Term:

- **Additional Pollutants, especially Particulate Matter**
- **Nationwide coverage**
- **Extended at least 2 days**
- **Higher resolution grids to 2.5 km**



National Air Quality Forecasting *Vision and Strategy*

Vision

National Air Quality Forecast Capability which provides the US with ozone, particulate matter and other pollutant forecasts with enough accuracy and advance notice to take action to prevent or reduce adverse effects

Strategy

Work with EPA, State and Local Air Quality agencies and private sector to develop end-to-end air quality forecast capability for the Nation

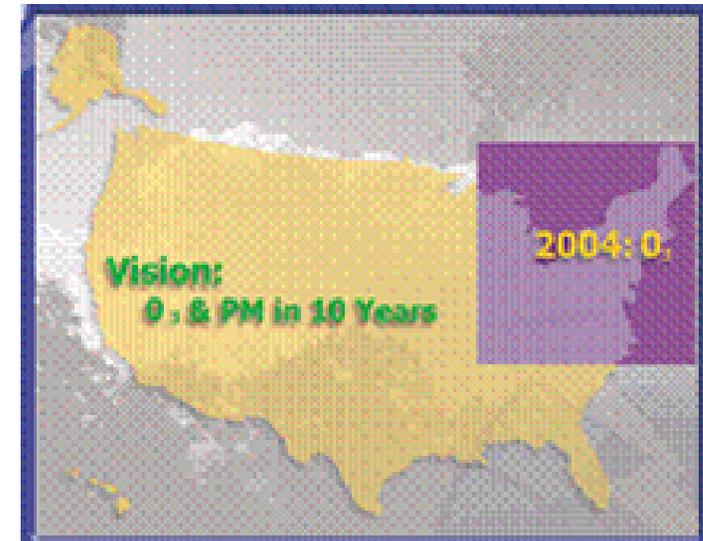


National Air Quality Forecasting *Current and Planned Capabilities*



Current: 1-day forecast guidance for ozone

- Developed and deployed initially for Northeastern US, September 2004
- Deploy Nationwide by 2008



Intermediate (5-7 years):

- Develop and test capability to forecast particulate matter concentration
 - Particulate size ≤ 2.5 microns

Longer range (within 10 years):

- Extend air quality forecast range to 48-72 hours
- Include broader range of significant pollutants



National Air Quality Forecast Capability

Initial Operational Capability (IOC)



Linked numerical prediction system

Operationally integrated on NCEP's supercomputer

- *NCEP mesoscale NWP: Eta-12*
- *NOAA/EPA community model for AQ: CMAQ*

Observational Input:

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

Gridded forecast guidance products

Delivered to NWS Telecommunications Gateway and EPA for users to pull 2x daily

Verification basis

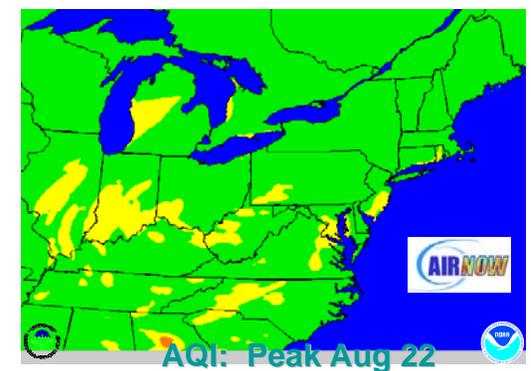
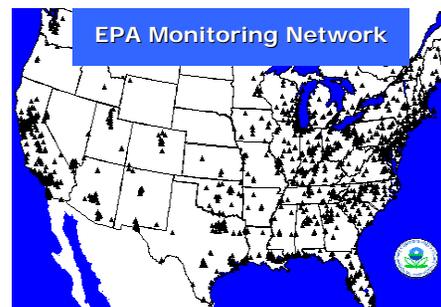
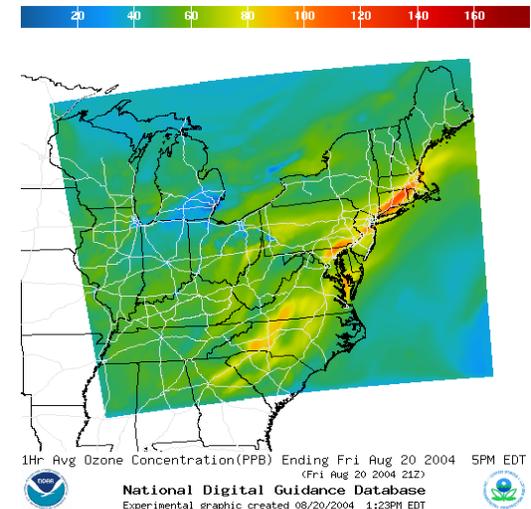
EPA ground-level ozone observations

Customer outreach/feedback

NCEP mesoscale NWP: Eta-12

State & Local AQ forecasters coordinated with EPA

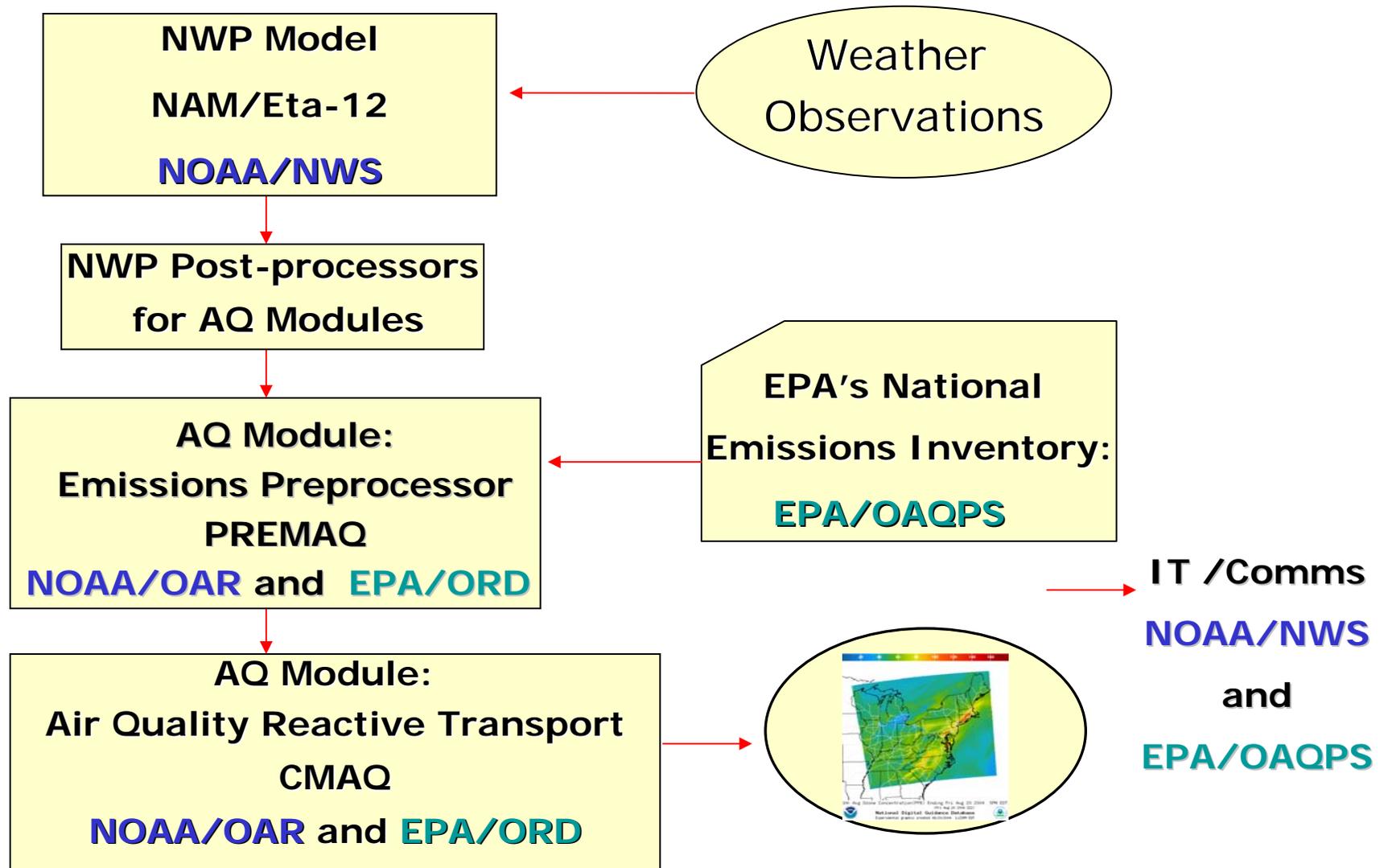
Public and Private Sector AQ constituents





National Air Quality Forecast Capability

Major Components: IOC

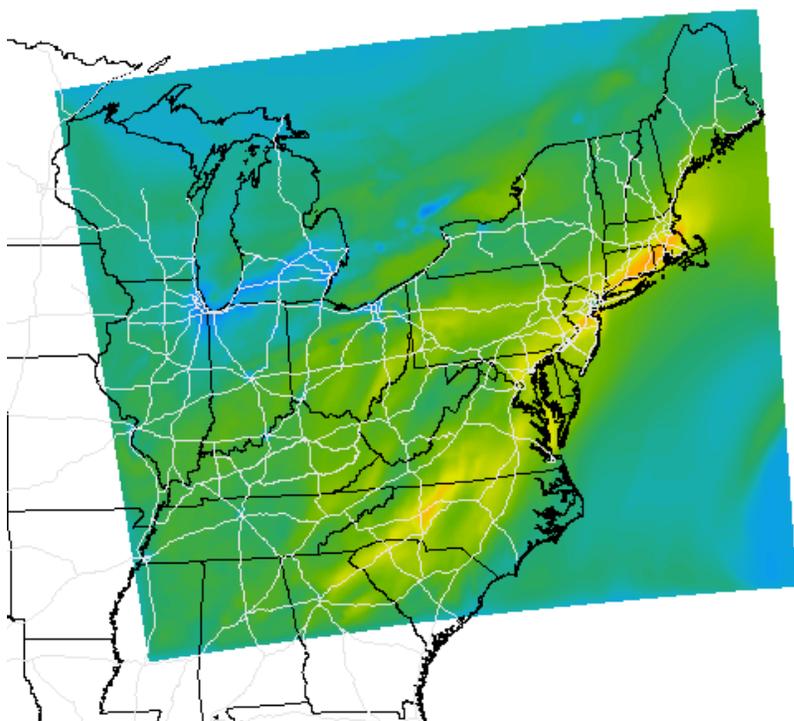




Sample AQ forecast guidance



www.weather.gov/aq

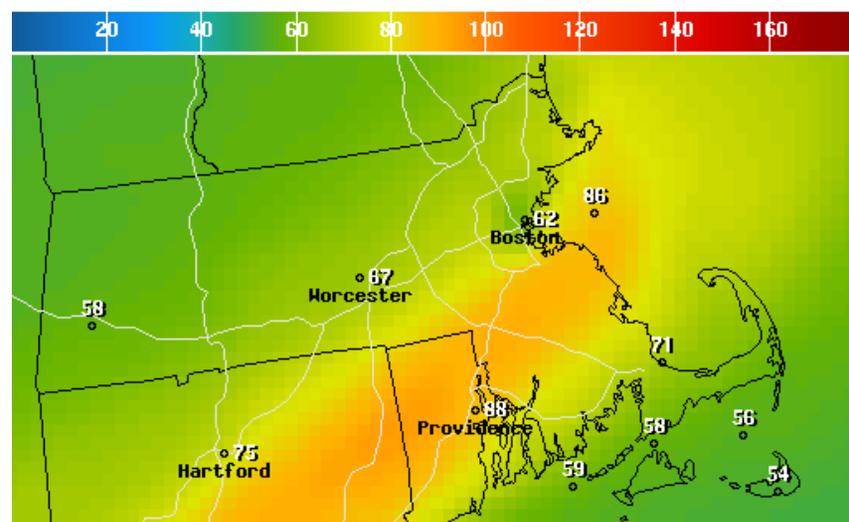


8Hr Avg Ozone Concentration(PPB) Ending Fri Aug 20 2004 7PM EDT
(Fri Aug 20 2004 23Z)



National Digital Guidance Database

graphic created 08/20/2004 6:22AM EDT



8Hr Avg Ozone Concentration(PPB) Ending Fri Aug 20 2004 7PM EDT
(Fri Aug 20 2004 23Z)



National Digital Guidance Database

graphic created 08/20/2004 6:24AM EDT





Initial Operating Capability: Operational Readiness Criteria Summary



Criterion	Lead	Metric	Dates	Status 9/04
Objective Evaluation: Accuracy	NCEP, OAR	> 90 %	6/1/04 – 8/15/04	C
Subjective Feedback	OCWWS	Positive on balance	6/03 – 8/04	C
Production Readiness	OCIO, NCEP			C
On-time delivery		> 95 %	6/1/04 – 8/15/04	C
Back-up		In place	6/1/04	C
Data retention		In place	6/1/04	C
Near-real time verification	NCEP	In place	6/1/04	C
Decision to implement	NWS Director		9/3/04	C

Key	Complete	On schedule	At risk	Remedial Action Required
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Deployment Criteria: Objective Verification (NCEP)

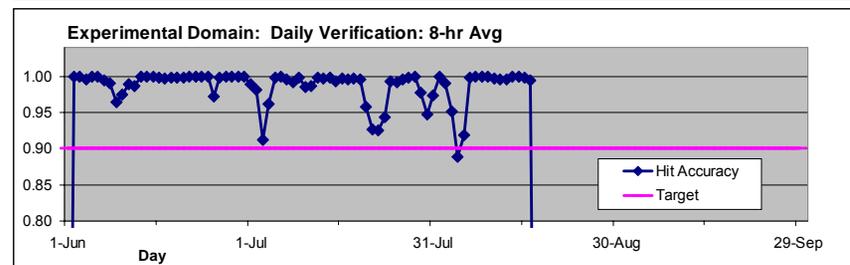
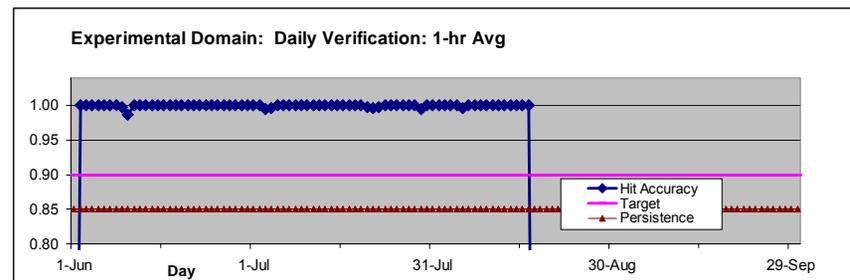


Criterion	Metric	Dates	Status
Objective Evaluation: Accuracy	<p>Correctly predict exceedance and non-exceedance of ozone concentration threshold metrics, during the 24-h valid forecast period, on 90% or more days</p> <p>Threshold metrics:</p> <p>1-hr avg > 124 ppb</p> <p>8-hr avg > 84 ppb</p>	6/1/04 – 8/15/04	C

Summary Performance:

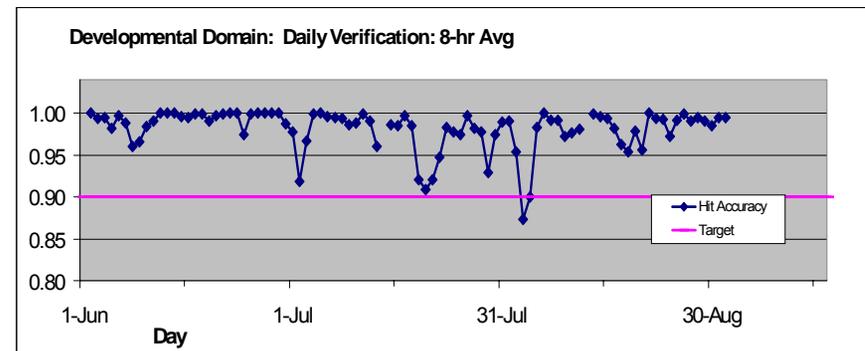
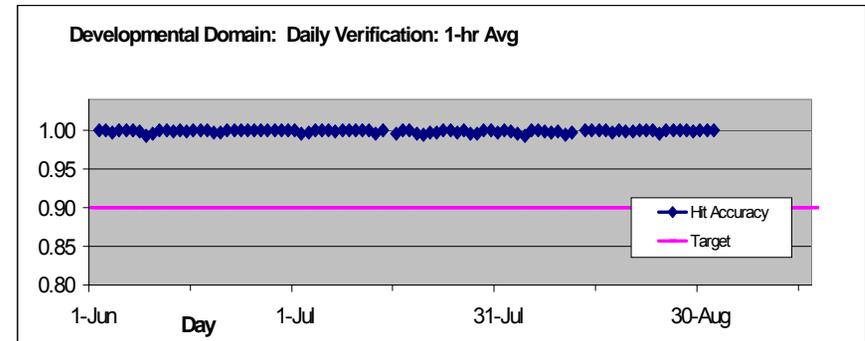
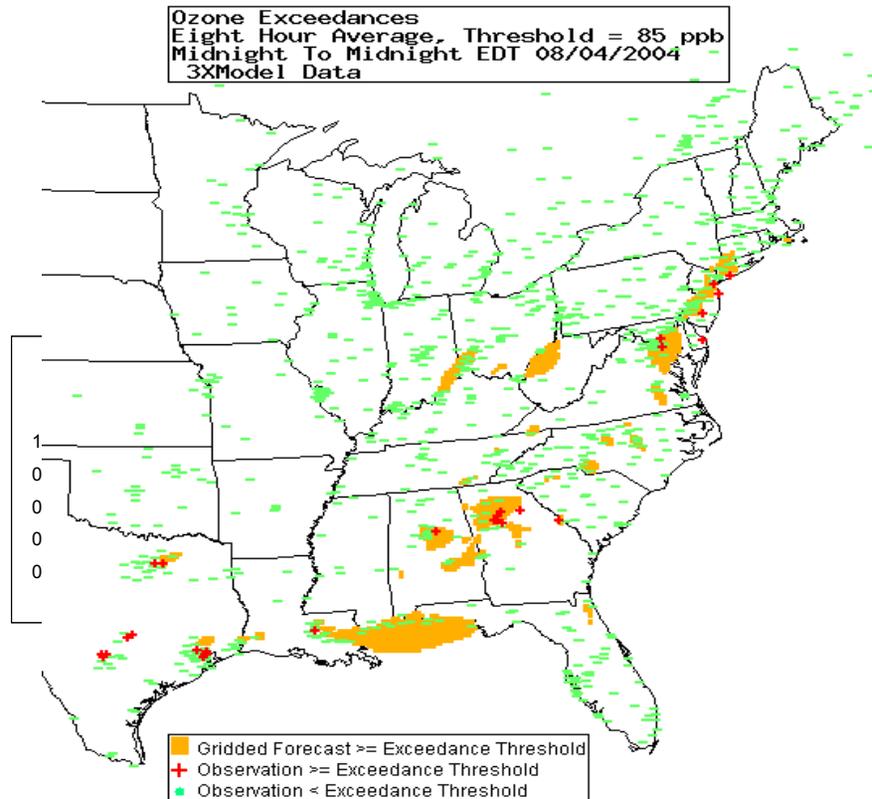
June 1- Aug 15, 2004

- **Exceeds target**
- **Reflects clean conditions**





Expanded Domain, Development Testing: *Sample Verification, 2004*



- Limited test conditions in 2004. Generally good patterns; accuracy lower than NE US (IOC)
- With upgrades in place, experimental (pre-deployment) testing began June, 2005



Expanding the IOC: 2005 Improvements



Ozone testing: *Experimental* **(NAM NWP with Eta)**

Developmental **(NAM moving to WRF)**

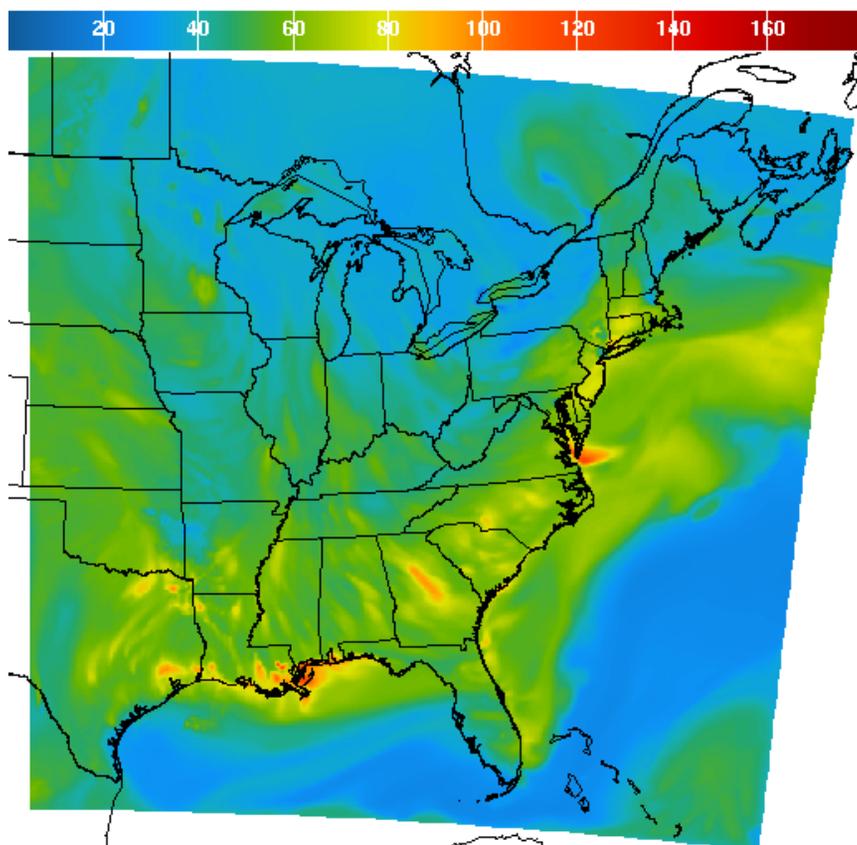
Grid coordinates	<i>interpolate to CMAQ C-grid and CMAQ σ</i>	<i>common E grid; common σ-P</i>
Upgrades to Eta	<i>1 km NOAA landuse</i> <i>2 mb top; improved precip assimilation</i>	
Improved emissions	<i>2005 Updates to mobile and EGU sources</i>	
Photolysis	<i>surface radiative flux scaling</i>	<i>surface and 3-D radiative flux; rates based on NAM radiation fields</i>
PBL	<i>PBL height</i>	<i>Incorporate TKE/Kh</i>
Clouds		
Phases	<i>water</i>	<i>water, graupel & ice</i>
Mixing	<i>Limit chem. mixing from above-clouds</i>	<i>Testing ACM</i>
Lateral BC (ozone)	<i>GFS above 6 km; static below</i>	<i>more vertical resolution near tropopause</i>



June, 2005: Expanded Forecast Guidance



Experimental (EUS)



1Hr Avg Ozone Concentration(PPB) Ending Thu Jun 16 2005 4PM EDT
(Thu Jun 16 2005 20Z)

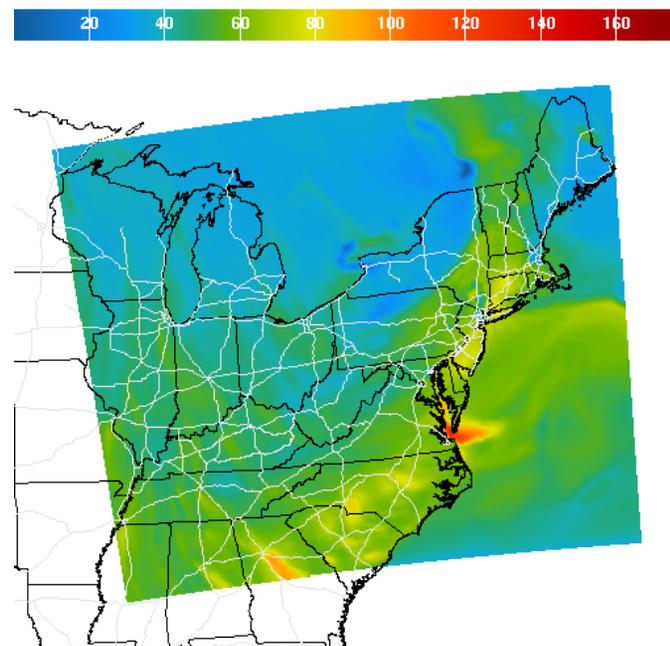


National Digital Guidance Database

Experimental graphic created 06/16/2005 7:34AM EDT



Operational (NE US)



1Hr Avg Ozone Concentration(PPB) Ending Thu Jun 16 2005 4PM EDT
(Thu Jun 16 2005 20Z)



National Digital Guidance Database

Graphic created 06/16/2005 7:24AM EDT



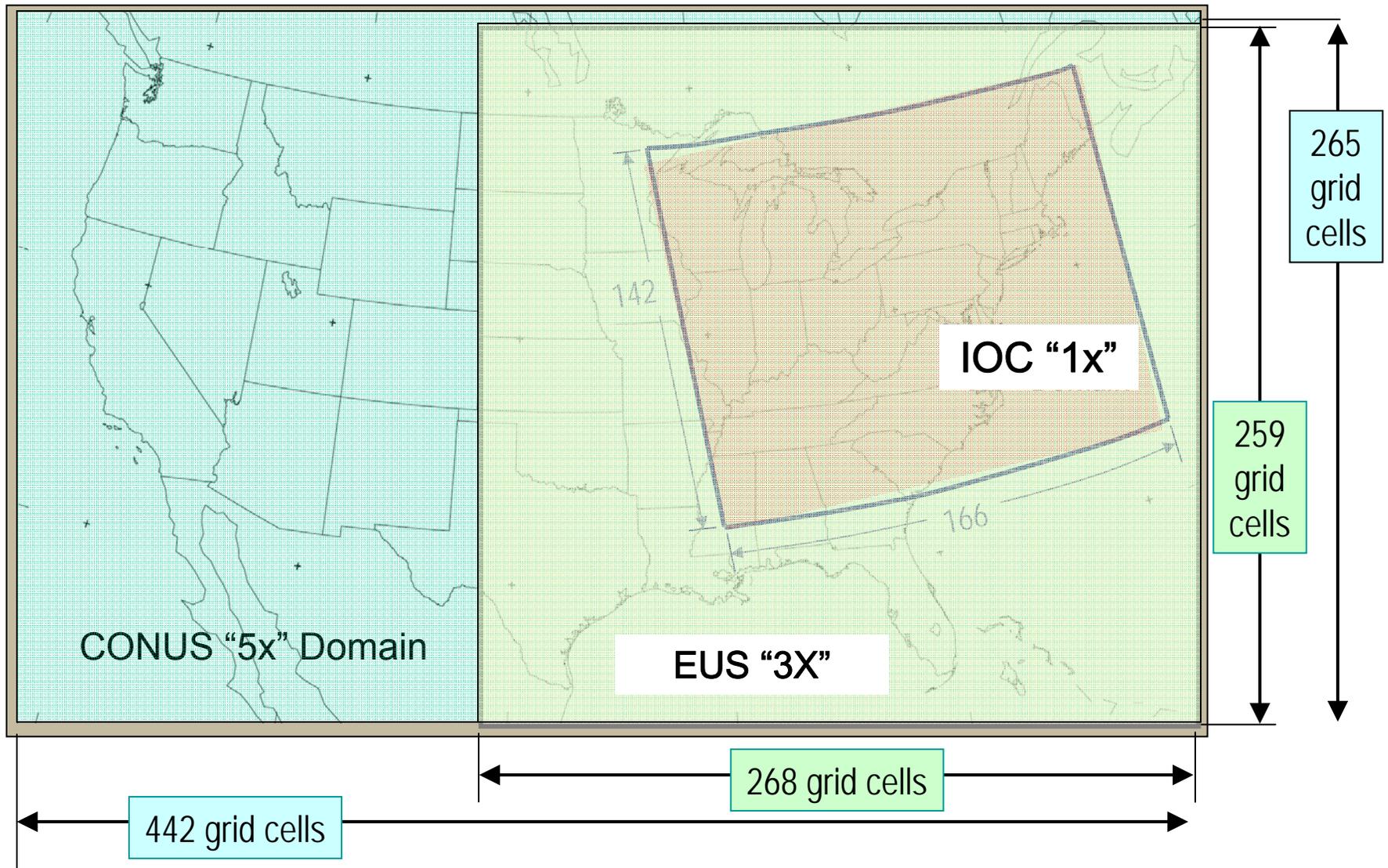


Developmental Testing: Summer 2005



Developmental: CONUS "5X"

Experimental: EUS "3x"





National Air Quality Forecasting

Status: June, 2005. Part 1



Current Operational Capability:

- *NE US (1x) ground-level ozone;*
- *Hour-by-hour concentrations, 12km grid resolution, thru midnight next-day*
- *Demonstrated test guidance accuracy, Summer 2004:*
 - Greater than required 90%; only 7 days below 95%

Current operational capability improves accuracy over developmental test season (2003):

- *Mean daytime bias reduced from ~17 to 5 ppb (2003 vs 2004)*
- *Mean daytime rmse reduced from 22.8 to 14.5 ppb (2003 vs 2004)*
- *Improvements ongoing: still overpredicting in daytime, poorer performance at night*



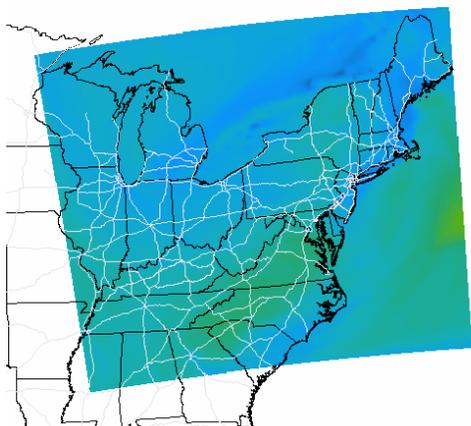
National Air Quality Forecasting

Status: June, 2005. Part 2



Testing Expanded Capability:

- ***Eastern US, ozone: Experimental (pre-deployment) testing underway***
- ***Nationwide deployment, ozone: target now FY08***
 - Developmental testing over CONUS beginning by end of June:
 - OCONUS TBD
- ***Major improvements in testing:***
 - Eta-CMAQ linkage: T-profile; land-use. Moving to WRF (developmental)
 - Emissions updates: Mobile 6; extrapolations to current year emissions
 - Lateral boundary conditions: GFS ozone
 - Improvements in PBL, cloud treatment (ongoing), radiation flux
- ***Testing aerosol components needed for particulate matter capabilities:***
 - Planned testing at risk due to constricted supercomputing capacity
 - Development of nationwide observational plan for PM forecasting urgently needed



1Hr Avg Ozone Concentration(PPB) Ending Mon Dec 13 2004 1PM EST
(Mon Dec 13 2004 18Z)

National Digital Guidance Database
Graphic created 12/13/2004 1:22PM EST

National Air Quality Forecast Capability:

- Improving the Basis for AQ Alerts
- AQ Information for People at Risk



	Current AQ Alerts	NWS Operational Capability		
		Initial Capability	5-Year Vision	10-Year Vision
Purpose: Limit adverse effects from poor AQ, by providing:	Next-day warnings for large cities	State-of-the-science ozone forecast guidance	State-of-the-science ozone forecast guidance	State-of-the-science ozone and particulate matter forecast guidance
Products for Public	Daily AQ alerts; predicted interpretive AQ Index category	Hour-by-hour predictions of air pollutant concentrations in digital & graphical formats	Hour-by-hour predictions of air pollutant concentrations in digital & graphical formats	Hour-by-hour predictions of air pollutant concentrations in state-of-the-art formats
Coverage	Approx 300 cities	Northeast United States	Nationwide	Nationwide
Pollutants Forecasted	AQ Index for ozone; some cities include particulate matter	Ground-level ozone	Ground-level ozone	Ground level ozone, particulate matter, possibly others
Forecast Period	Next-day; also through weekends	Forecast guidance through midnight next day	Forecast guidance through midnight next day	Forecast guidance extended to 2 days or beyond
Spatial Resolution	Alerts are community-wide; little/no other spatial information	12 kilometer grid	5 km grid	2.5 kilometer grid
Temporal Resolution	Daily	1-hr and 8-hr averages each hour		

www.nws.noaa.gov/ost/air_quality