

Post-Processing of Air Quality Forecasts for the AIRNow Forecaster Community



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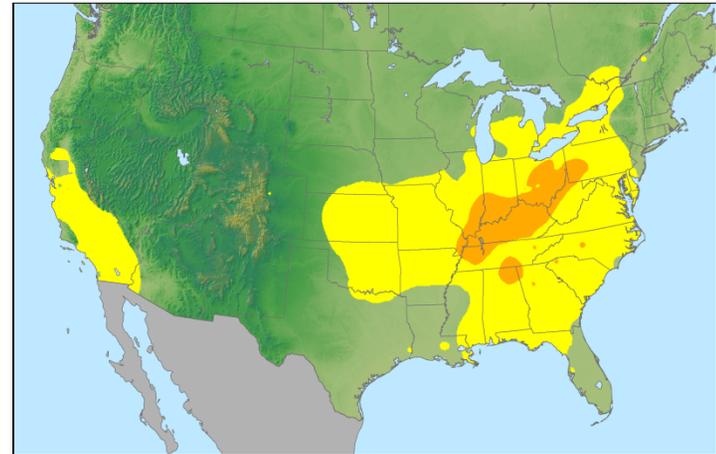
Topics

- AIRNow Program Overview
- AIRNow use of NOAA AQ Forecast Guidance
 - Integration into AIRNow-Tech Decision Support Tool
 - Model Verification
 - Treatment of Land/Water Interface
 - Public Display
- Bias-Correcting NOAA Model Data in Real Time: AQMOS
- Supporting the Research Community
 - Existing Services
 - Emerging Services

AIRNow Program Overview

AIRNow provides a common framework for acquiring and distributing air quality information that

- Fosters community effort among federal, state, local, and tribal air quality agencies (130+)
- Collects, quality assures, and transfers real-time and forecasted air quality information to the public
- Communicates air quality via the Air Quality Index (AQI)
- Issues weather/air quality news stories
- Enables partnerships with national media
- Provides air quality education and outreach



AIRNow Program Overview

Data/Info



Access



Who

Real-time AQ Data

*US, Canada, Mexico
2000 sites
Hourly data*

Forecasts

*300 cities
Current and next day
Some multi-day*

Maps

*Static GIFS
Animated GIFS
100s of types*

Information

*News stories
Graphical outlooks*

Air Quality Index



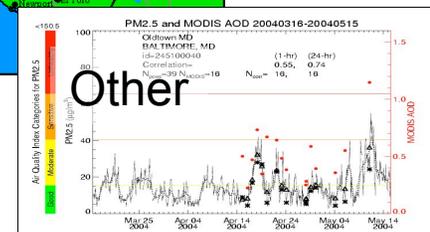
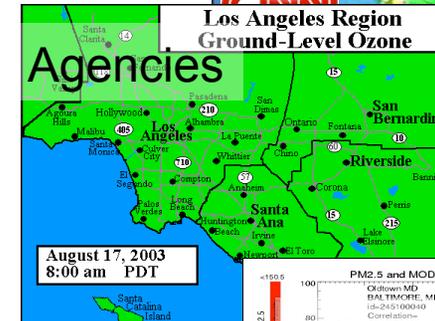
Files

FTP

Web services

Websites

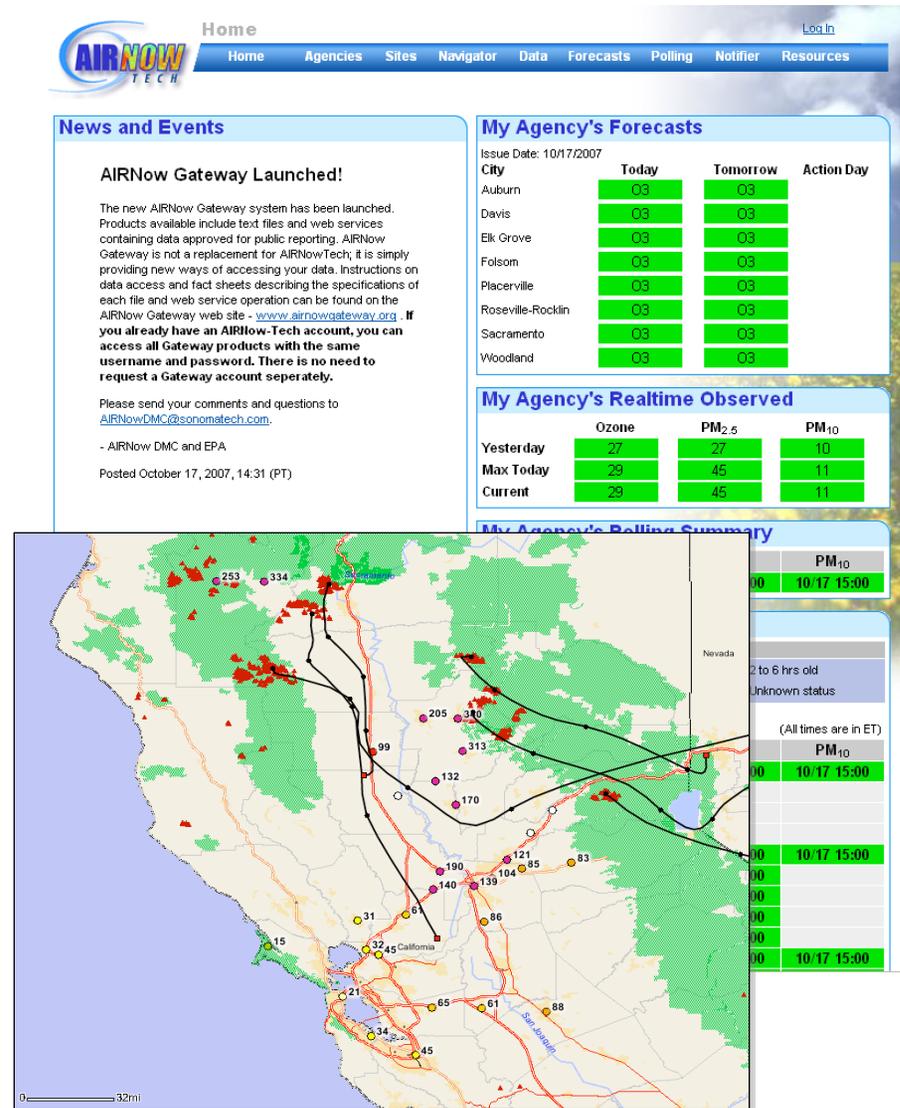
Weather providers



AIRNow-Tech

AIRNowTech.org

- Decision Support System – for AQ community
- Functions
 - Data administration
 - Data queries
 - Mapping
 - Forecasting
 - Education
- AQ and Meteorological data



AIRNow-Tech - Forecast Submittal System

AIRNow-Tech

- Used by state/local agencies to submit forecasts.
- Provides NOAA model output for their forecast area.
- Also contains HYSPLIT trajectories and other analytical tools.

Standard Forecast Welcome, Chris Reith! | [My Account](#) | [Sign Out](#)

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Choose an Existing Form

Phoenix Metro Forecast (Default)

For categorical forecasts, enter:

g	for	Good
m	for	Moderate
usg	for	Unhealthy for Sensitive Groups
u	for	Unhealthy
vu	for	Very Unhealthy
h	for	Hazardous

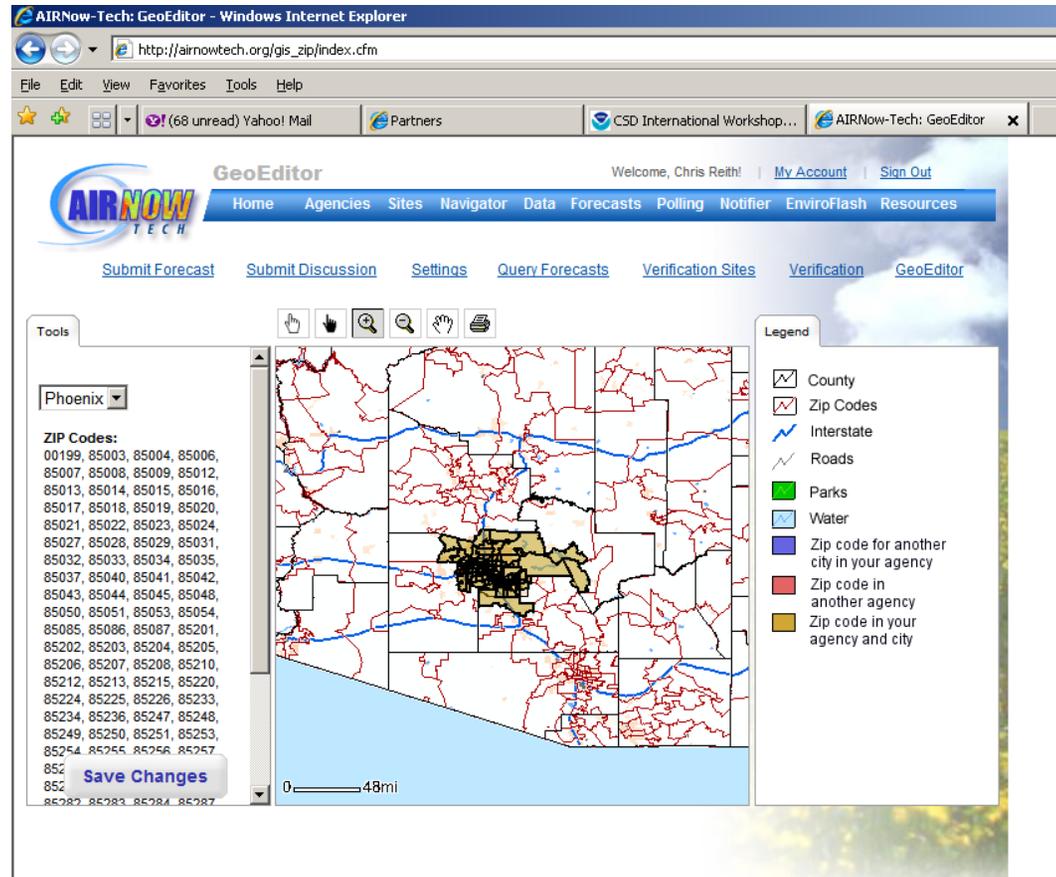
Phoenix Last Submitted Tue, 11/24

Pollutant	Yest. Obs Mon, 11/23	Today Tue, 11/24	Tomorrow Wed, 11/25	Day 2 Thu, 11/26	Day 3 Fri, 11/27	Day 4 Sat, 11/28	Day 5 Sun, 11/29	Delete Forecast
Ozone Forecast	41	38	38	39				<input type="checkbox"/>
NOAA		46	47					
Action Day	<input type="checkbox"/>							
PM _{2.5} Forecast	65	81	90	82				<input type="checkbox"/>
Action Day	<input type="checkbox"/>							
PM ₁₀ Forecast	64	76	74	64				<input type="checkbox"/>
Action Day	<input type="checkbox"/>							
CO Forecast		35	37	40				<input type="checkbox"/>
Action Day	<input type="checkbox"/>							

AIRNow-Tech - Forecast Submittal System

Method for extracting NOAA model output:

- Forecaster defines zip codes.
- Value of model grid cell at the lat/long of zip codes' centroid is extracted.
- Takes max of all centroids in the zip code-defined area.
- Will not return results for NOAA model in areas that do not have zip code defined forecast areas.



Model Verification

Verification

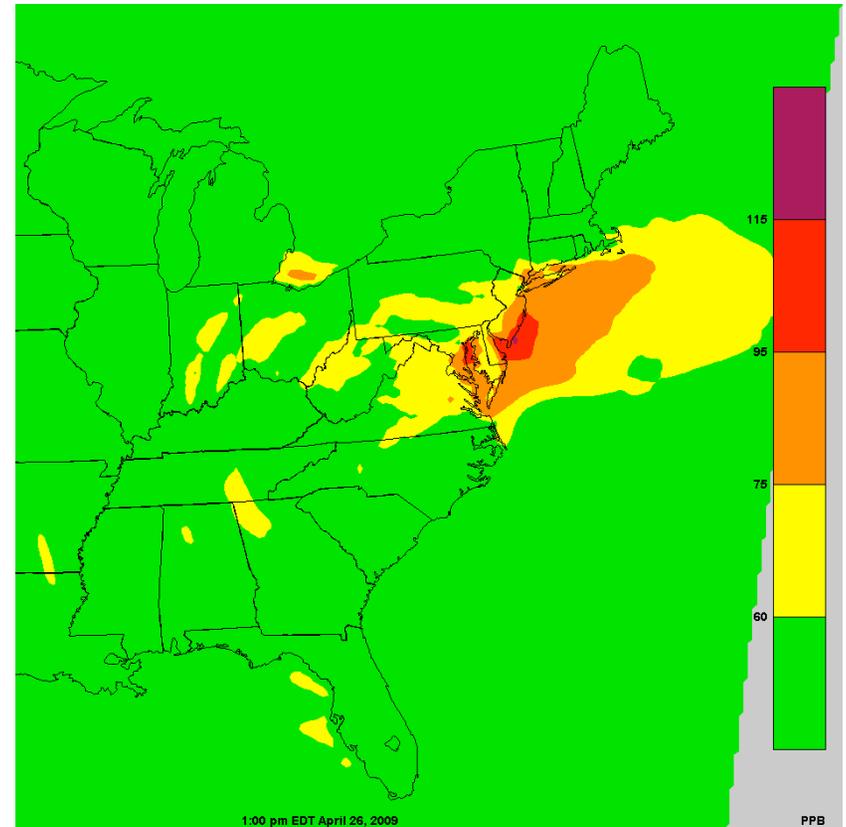
- NOAA model verification is available in AIRNow-Tech since 6/4/08.
- Uses model grid cell at the lat/long of zip codes' centroid.
- Takes max of all centroids in the zip code-defined area.
- Verification will not return results for NOAA model in areas that do not have zip code defined forecast areas.

Click on the column heading to sort

Agency	City	Forecasts	Percent Correct	Bias	FAR	CSI	POD	Skill	Matrix
North Carolina DENR - Divison of Air Quality	Fayetteville	68	91	0	0	0	0	-4	62 0 6 0
North Carolina DENR - Divison of Air Quality	Charlotte	68	75	0.95	38	43	59	38	38 8 9 13
North Carolina DENR - Divison of Air Quality	Hickory	68	91	1.33	50	40	67	7	58 4 2 4
North Carolina DENR - Divison of Air Quality	Raleigh-Durham-Chapel Hill	68	76	1.43	55	36	64	33	43 11 5 9
North Carolina DENR - Divison of Air Quality	Asheville Valleys (below 4000 feet)	68	97		100	0		0	66 2 0 0
North Carolina DENR - Divison of Air Quality	Rocky Mount	68	90	2.5	100	0	0	-1	61 5 2 0

Issues with Land/Water Interface

- AIRNow-Tech NOAA results often high for areas near water
- Cause:
 - NOAA model predictions over water often higher than land values
 - Model predictions based on lat/long of zip codes' centroid
 - Zip code centroids sometimes located near or over water for certain forecast cities
 - AIRNow-Tech displays max value of all centroids.



Issues with Land/Water Interface

Solution:

- Used GIS-based filter to remove water-adjacent zip code centroids
- Manually adjusted zip code centroid list further to add near-water zip codes that weren't in the water-adjacent list
- Applied to Mid-Atlantic to Northeast States, Great Lakes region, and Texas

City	Before Filter (8-hr ozone in ppb)	After Filter (8-hr ozone in ppb)
Atlantic City	115.4	83.0
Baltimore	114.7	96.8
Millington	115.4	85.8
Riverhead	97.1	89.0

Public Display

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AIRNOW LOCAL AIR QUALITY CONDITIONS AND FORECASTS

Zip Code: Go State: Go

[National Air Quality Summary \(text\)](#)

NOAA-EPA Forecast Guidance

[Today's Forecast Guidance Maps](#) | [Tomorrow's Forecast Guidance Maps](#) | [Today's National Forecast](#)

NOAA-EPA Model Predicted Ozone (AQI)

Good	NOAA Peak 8-hr O₃ AQI guidance Today, November 29, 2009	NOAA Peak 8-hr O₃ AQI guidance Tomorrow, November 30, 2009
Moderate		
Unhealthy for Sensitive Groups		
Unhealthy		
Very Unhealthy		
Hazardous		
-More-		

Ozone Graphical Predictions
This map shows predictions of ground level hourly Ozone (O₃) concentrations for the northeastern US, based on a photochemical model. This is a joint NOAA-EPA product of the [Air Quality Forecast System](#) [EXIT AIRNOW](#) by the National Weather Service. This guidance product is for state and local air quality forecasters, but does not constitute an official air quality warning or alert from the National Weather Service. Please refer to your official current air quality forecast which is available at the [EPA AIRNow](#) web site.

This page was last updated on Monday, October 05, 2009

QUICK LINKS

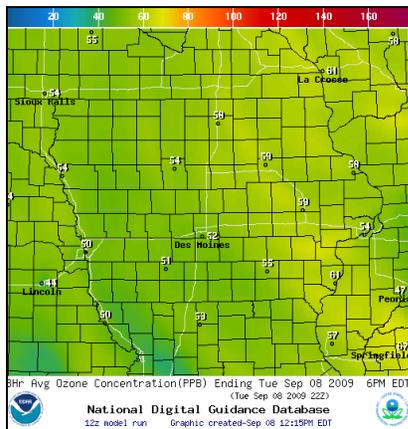
Air Quality Action Days / Alerts	International	Publications
AirCompare	Kids	Publicaciones (En Español)
Air Quality Index (AQI)	Movies	

Internet

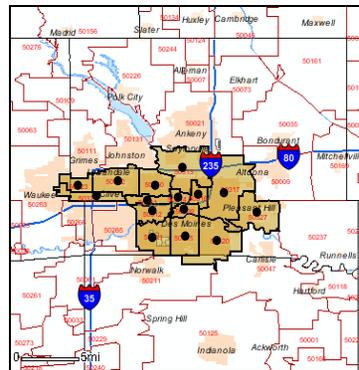
Bias-Correcting NOAA Model Data in Real Time: AQMOS - Introduction

- All models have some bias.
- Similar to model output statistics (MOS) for weather models, air quality MOS (AQMOS) corrects for air quality model bias.
- AQMOS is
 - Automated,
 - Dynamically updated each model run, and
 - City-, pollutant-, and model-specific.

How It Works – Acquire Data



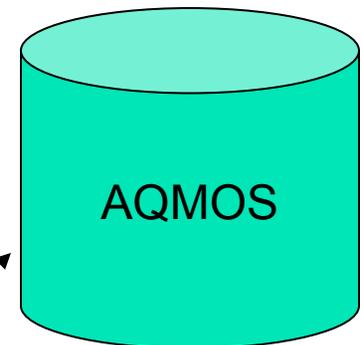
Calculate peak current-day and next-day 8-hr ozone forecast from hourly NOAA grib data.



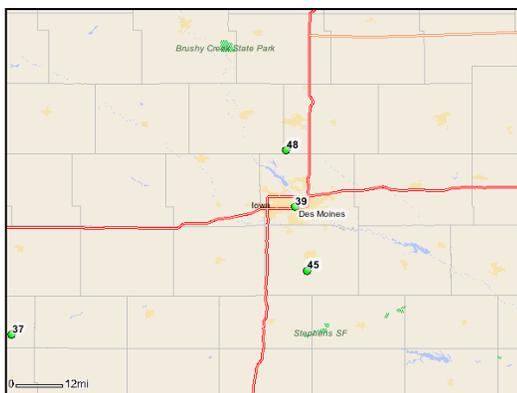
Extract concentration at the geographic centroid of each zip code.

Calculate maximum concentration in area: 53 ppb for Des Moines in this example.

Store daily predictions for each area and model run in database.



Store daily peak concentration data in database.



AIRNow Gateway

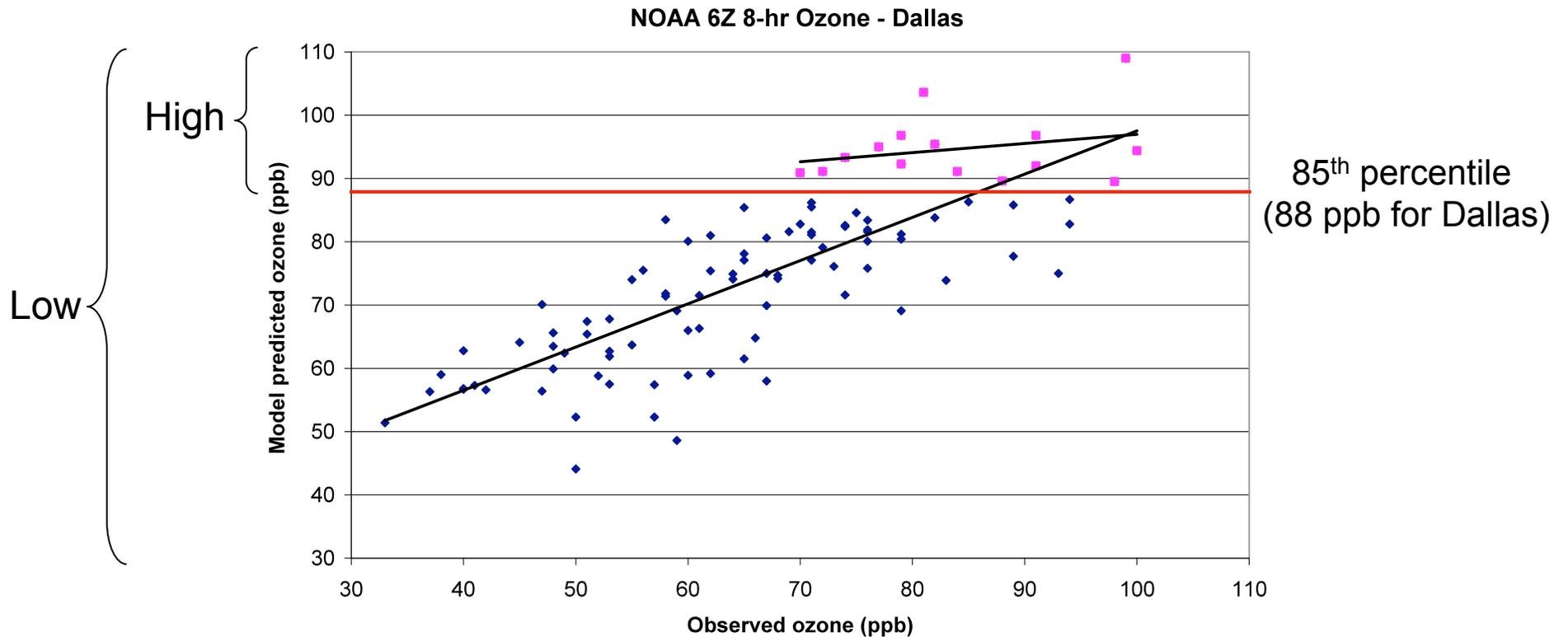


Acquire peak 8-hr ozone concentrations for each forecast area from AIRNow Gateway.

How It Works – Calculate Regression

Match historic forecasts with observations.

Calculate regression for each city using up to six months of data.



$$\text{AQMOS} = \text{model prediction} \times \text{correlation factor} + \text{constant}$$

AQMOS Website

[Home](#) [Verification](#) [Contact Us](#) [FAQ](#) [Sign out](#) [Edit Users](#)

NOAA [09/04/2009] AL Area [Pollutant] Go

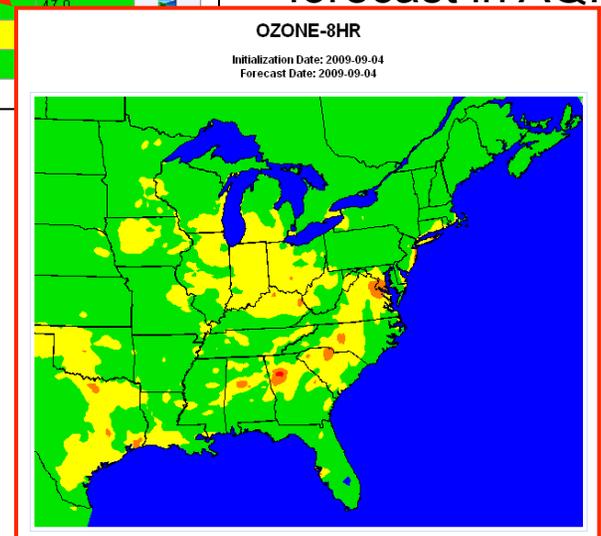
Model	Model Initialization	Forecast Area	Pollutant	09/04/2009				09/05/2009			
				Model	Model Corrected	Observed	Image	Model	Model Corrected	Observed	Image
NOAA	2009-09-04 6Z	Birmingham, AL	OZONE-8HR	89.0	62.8	60.0		87.0	60.3	31.0	
NOAA	2009-09-04 6Z	Columbus-Phenix City - GA/AL, AL	OZONE-8HR	67.7	56.4	44.0		59.3	47.9	47.0	
NOAA	2009-09-04 6Z	Huntsville, AL	OZONE-8HR	62.4	53.8	58.0		68.9	58.0	41.0	
NOAA	2009-09-04 6Z	Mobile, AL	OZONE-8HR	56.8	44.2	28.0		38.4	30.8	33.0	
NOAA	2009-09-04 12Z	Birmingham, AL	OZONE-8HR	90.9	65.6	60.0		68.0	49.9	31.0	
NOAA	2009-09-04 12Z	Columbus-Phenix City - GA/AL, AL	OZONE-8HR	60.0	50.5	44.0		57.2	47.3	47.0	
NOAA	2009-09-04 12Z	Huntsville, AL	OZONE-8HR	62.8	54.6	58.0		73.5	62.0	47.0	
NOAA	2009-09-04 12Z	Mobile, AL	OZONE-8HR	51.6	40.7	28.0		42.3	33.9	28.0	

Original NOAA forecast in AQI

$$\text{AQMOS} = \text{model} \times \text{slope} + \text{constant}$$

$$62.8 \text{ ppb} = 89.0 \text{ ppb} \times 0.73 + (-2.36 \text{ ppb})$$

NOAA prediction: 89.0 ppb
 AQMOS prediction: 62.8 ppb
 Verification: 60.0 ppb

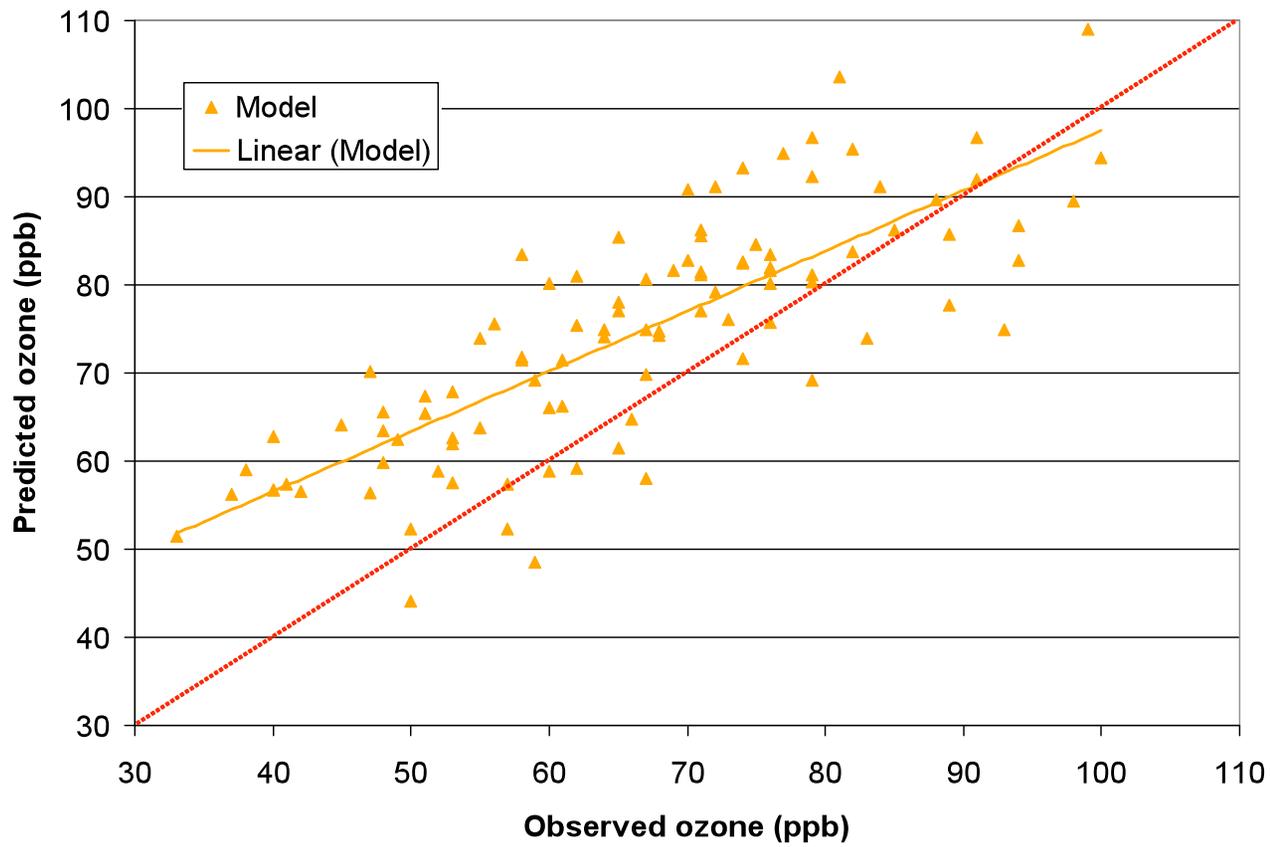


Verification (1 of 2)



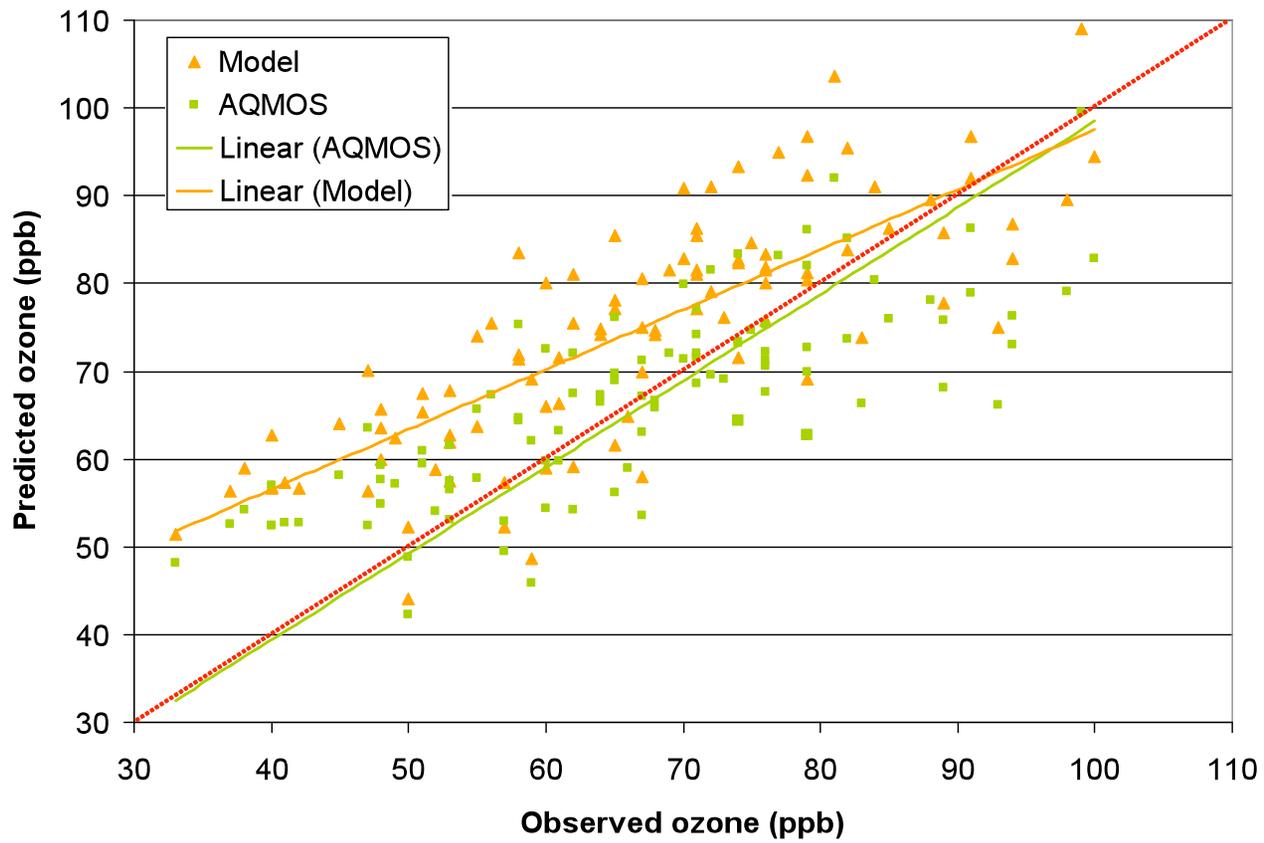
Verification (2 of 2)

AQMOS performance



Verification (2 of 2)

AQMOS performance



AIRNow Support of Research Community

- Existing services
 - Access to AIRNowTech
 - Access to FTP data feeds via AIRNow Gateway
 - Feedback from forecasters to modelers

- Emerging Services
 - Feeds
 - RSS/CAP/Atom
 - Feeds are available to the public on www.enviroflash.info
 - Web Services
 - URL based
 - Produces both XML and CSV payloads
 - Geo-spatial Web Coverage Service
 - Produces KML and CSV payloads

AIRNow Feeds & Web Services

Web [Images](#) [Videos](#) [Maps](#) [News](#) [Shopping](#) [Gmail](#) [more](#) ▼ scottjackson5@gmail.com | [Classic Hor](#)

 [Advanced Search](#)
[Search Preferences](#)
[Language Tools](#)

New! [Add social gadgets](#) to post updates and play games with friends. [Change theme](#)

Home

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- Weather
- How to of the Day
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- Gmail
- Pogue's Posts
- Current Moon Phase
- Raleigh-Durham-Ch...

Updates
Friends

Chat

Search, add, or invite

- Scott Jackson

Set status here ▼

Lawton, OK - forecast alert notification

[Lawton, OK - forecast alert notification](#)

Location: Lawton, OK

Forecast: Moderate - 70 AQI

Pollutant: Ozone

Health Tip: Unusually sensitive people should consider reducing prolonged or heavy exertion outdoors

Agency: Oklahoma Department of Environmental Quality

Last Update: 08/26/2009 10:10:00

Weather

Top Stories

- [Residents at Hyannis Port mourn death of their neighbor, Ted Kennedy](#)
New York Daily News - [all 9395 related >](#)
- [Tropical storm Danny heads for Bahamas](#)
AFP - [all 977 related >](#)
- [SC Lt. Gov. Calls on Gov. Sanford to Resign](#)
FOXNews - [all 593 related >](#)
- [Israel PM: progress made with US on settlements](#)
The Associated Press - [all 2504 related >](#)
- [The American Way Of Torture](#)
Atlantic Online - [all 4797 related >](#)

Gmail

Date & Time



How to of the Day

- [How to Make a Marshmallow Gun](#)
- [Sun Tea: The best way to make iced tea on a hot day](#)

Raleigh-Durham-Chapel Hill, NC - forecast alert notification

[Raleigh-Durham-Chapel Hill, NC - forecast alert notification](#)

Pogue's Posts

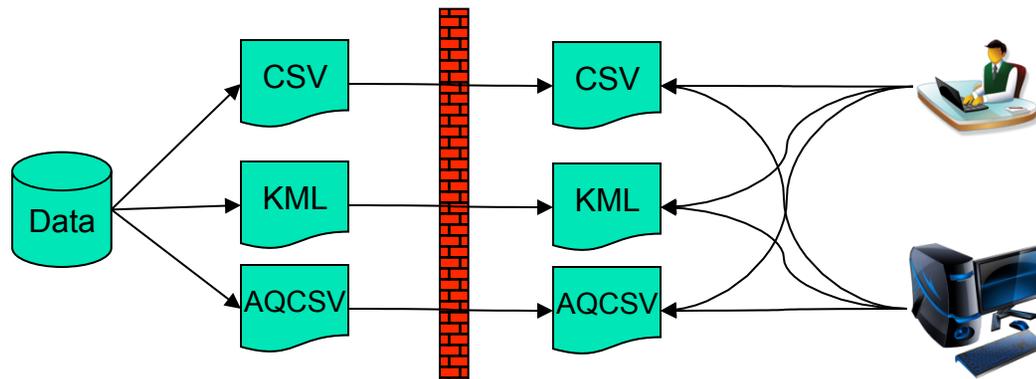
- [A Better Way to Manage Receipts for Business Travel](#)
- ['Take Back the Beep' Campaign: An Update](#)
- [Is Google Voice a Threat to AT&T?](#)

AIRNow Feeds & Web Services

Web service operations

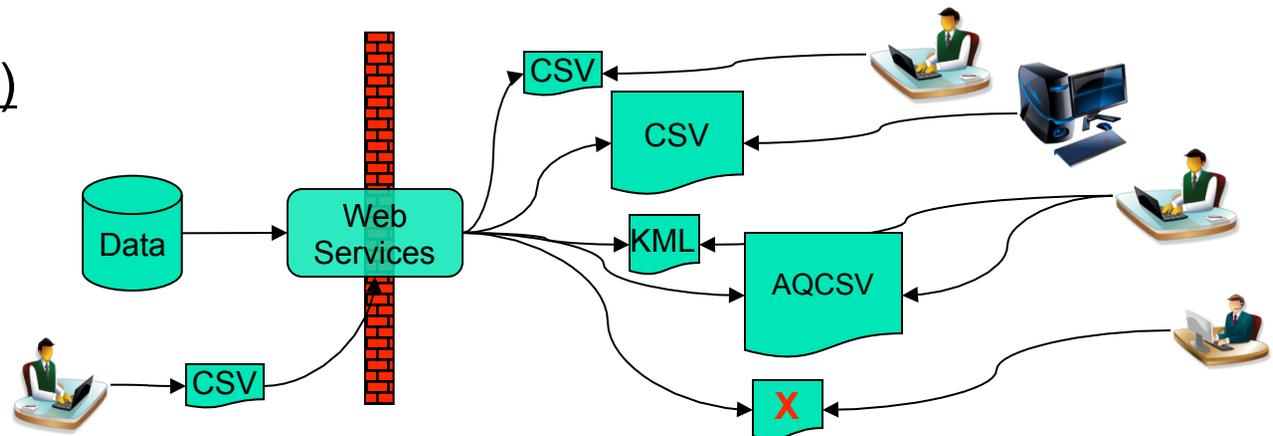
Traditional (FTP)

- Uncontrolled access
- Data version problems
- More software required
- Difficult to maintain
- Semi-automated



New (Web Services)

- On demand (as needed)
- Automated
- Controlled access
- Always deliver "best" data
- Less software required
- Monitoring access is easy



Types of Web Services

Web Service	Description	Outputs
WCS_Point	Extraction of data points	CSV, AQCSV, KML, NetCDF
WCS_TimePoint	Extraction of a time series for a specific parameter, site, and time range	CSV, AQCSV, KML, NetCDF
WCS_Grid	Extraction of a grid data subset	NetCDF, KML

“Restful” – called via URL

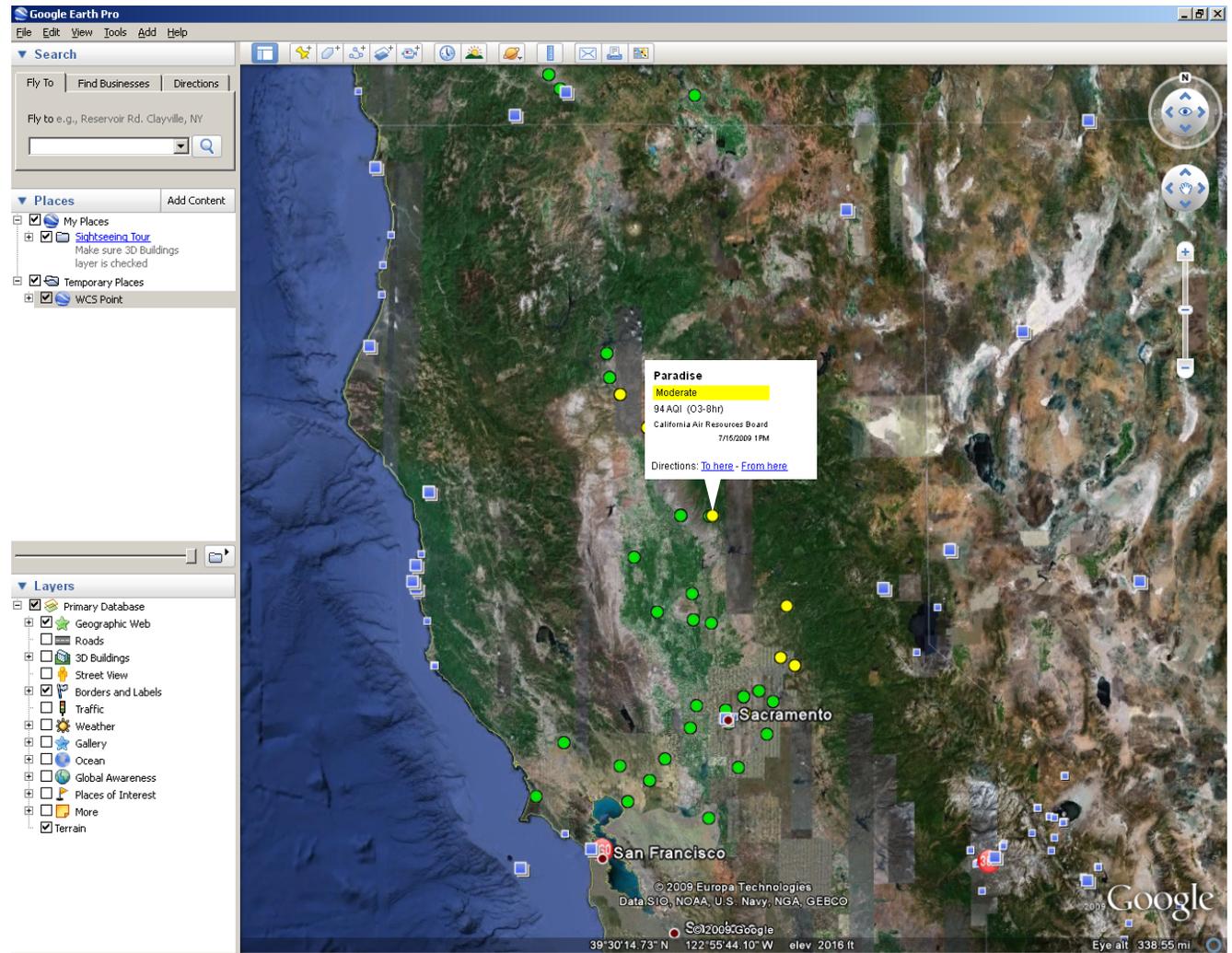
[http://staging.sonomatech.com/wcs/wcs.asmx/wcs?service=wcs&Request=GetCoverage&identifier=timepoint&aqssitecode=040131004&aqsparamcode=44201&aqsdurationcode=1&poc=1&begin_timesequence=2009-05-26 0:0:0&end_timesequence=2009-05-26 23:59:59&format=csv&username=IMS_Username&password=IMS_Password](http://staging.sonomatech.com/wcs/wcs.asmx/wcs?service=wcs&Request=GetCoverage&identifier=timepoint&aqssitecode=040131004&aqsparamcode=44201&aqsdurationcode=1&poc=1&begin_timesequence=2009-05-26%200:0:0&end_timesequence=2009-05-26%2023:59:59&format=csv&username=IMS_Username&password=IMS_Password)

Potential Products

- Output gridded data
 - Observations
 - Agency forecasts (contoured)
 - NOAA model forecasts
- View in geo browsers
 - Google Earth and Google Maps
 - Display in AIRNow-Tech
 - Display in GIS

Potential Products

https://ws.airnowgateway.org/wcs/wcs.asmx/wcs?service=wcs&Request=GetCoverage&identifier=point&db=dmc&durationcode=150¶meterid=1002&poc=1&time_sequence=2009-07-1519:0:0&bbox=38,-123,43,-121&aggregateid=0&metricid=0&statistic=0&exceedence=0&format=kml&username=PLACE USERNAME HERE&password=PLACE PASSWORD HERE



Summary

- AIRNow-Tech is an air quality decision support system that uses the NOAA model in a variety of ways.
- Bias correcting the NOAA model in real-time can improve performance.
- The research community can benefit from AIRNow's web services. Visit www.airnowgateway.org

Contact Information

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