

# **EPA AIRNow Program**

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## ***Air Quality Index Reporting and Forecasts***

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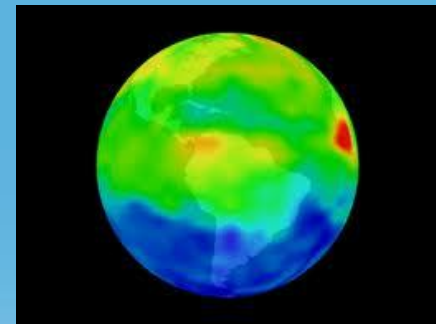
***1st Workshop on Satellite Observations for Air Quality Management***

***May 9th, 2011***



# Outline

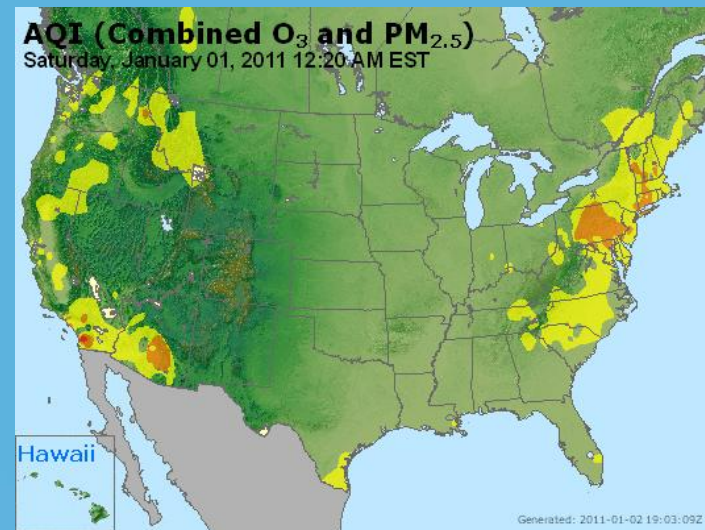
- **AIRNow Program Overview**
- **Air Quality Forecasting in the U.S.**
  - How is it done?
  - Challenges of Forecasting Agencies
  - The Forecasting Process
  - Role of AIRNow
- **AIRNow and Satellite Information**
  - Possibilities
  - Current NASA ROSES project
  - Data Fusion
- **Challenges We Face**



# AIRNow Program Overview (1 of 2)

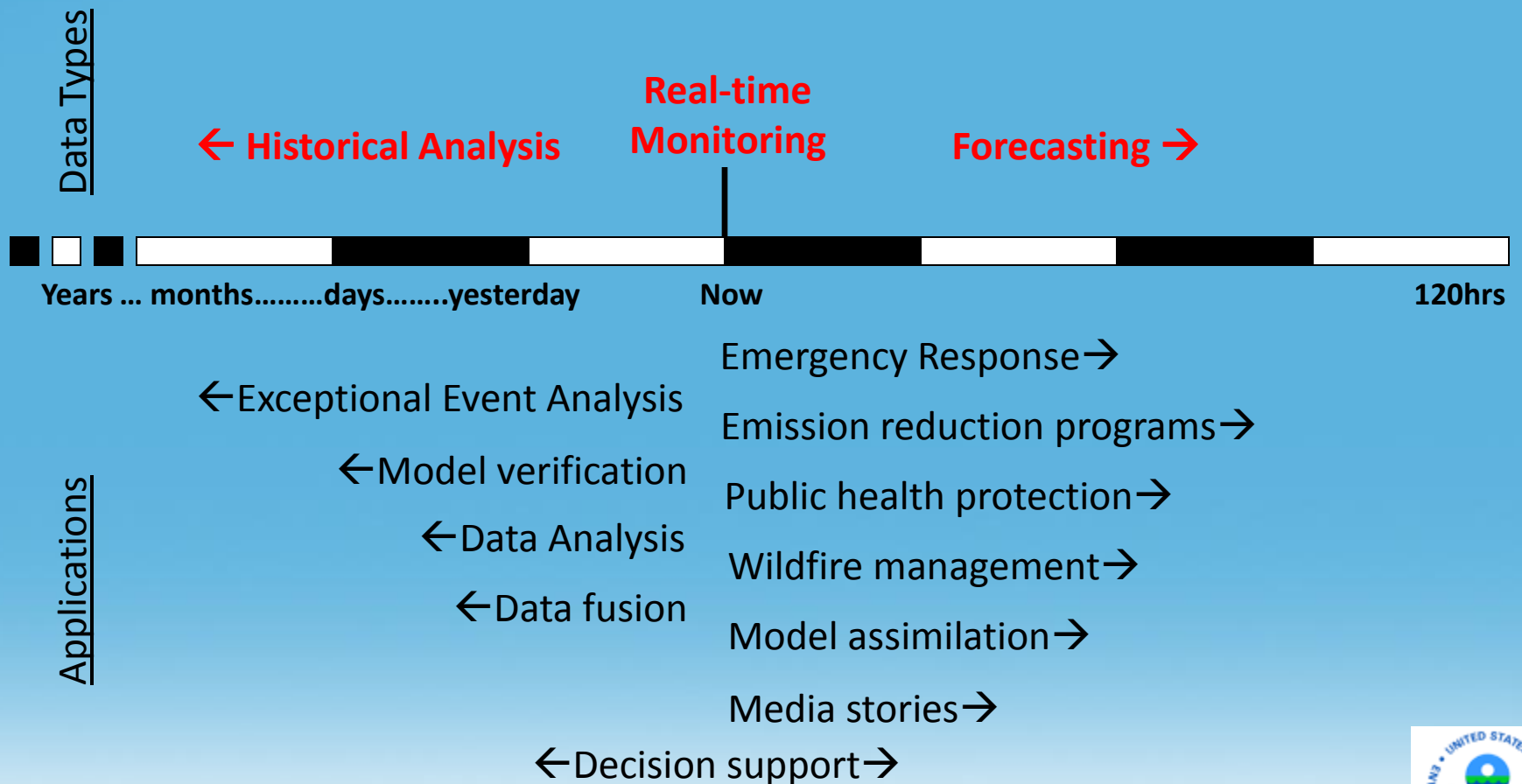
**AIRNow is the National system for acquiring and distributing air quality observations and forecasts to the public**

- Non-regulatory program
- Multi-agency effort (130 federal, state, local, and tribal air quality agencies)
- Voluntary participation
- Standardized Air Quality Index (AQI)
- Partnerships with national media
- Air quality education and outreach
- Emergency response (e.g., wildfires)
- Produces national and local maps, forecasts, other products on an hourly basis



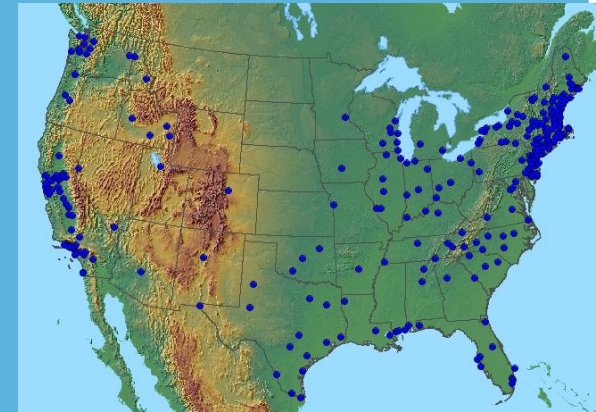
# AIRNow Program Overview (2 of 2)

## Applications of AIRNow



# Air Quality Forecasting in the U.S.

- **Distributed network of agencies**
  - 80+ forecasting agencies
  - All VOLUNTARY—No Federal law for forecasting or real-time reporting
  - AIRNow —> provides centralized organization
  - EPA and NOAA do NOT issue forecasts
- **Various forecasting methods!**
  - Criteria (rule of thumb)
  - Statistical
  - Photochemical models
  - Experience
  - Numerical (NOAA, BlueSky, private sector, in-house)
- **Educational Materials**
  - Guidance documents
  - Air quality short courses (National Air Quality Conference)
- **Air Quality Forecasts**
  - 300 cities forecasting for ozone
  - 150+ cities forecasting for PM<sub>2.5</sub>
  - Air quality action days



# Forecasting Process – Typical Agency

- It takes time, experience and understanding to develop air quality forecasting expertise
- Start with ozone and/or PM “climatology”
- Complete weather analysis and a solid weather forecast
- Assess the current pollutant scenario in concert with the weather conditions
- Utilize various tools (numerical and statistical models, datasets, programs)
- Apply knowledge of the pollutant behavior under the expected weather conditions
- Issue and disseminate forecast (EPA AIRNow, local media/groups)



# Forecasting Agency Challenges (1 of 2)

- **Type of forecast staff:**

- Range from all meteorologists to technical staff (w/ met. training and/or experience)

- **Staff time for forecasting:**

- Varies by region (function of area size, severity of AQ problem, other duties)
- Ranges from as low as 5-10 hours per week to as high as 20-25 hours per week

- **Forecast program resources**

- Some groups use little beyond continuous monitors and the Internet (weather pages, AIRNow-Tech, NOAA model)
- Other agencies have their own:
  - Meteorological towers
  - Visibility cameras
  - Classification schemes
  - Simplified decision aid tools
  - Radar profilers
  - GOES satellite processing tools, etc.



# Forecasting Agency Challenges (2 of 2)

- **Time constraints**

- Forecast deadlines - early afternoon for media (range from 1pm to 4pm Eastern)
- Most all 00Z model products are available at the beginning of the workday for morning discussions and current day forecast updates
- 12Z ETA / NGM / RUC model products downloaded/printed just after 12:00 EDT. Some reanalysis products, BUFKIT, take longer
- Around 13:00 - 12Z AVN and many 12Z MM5 products are starting to appear
- This leaves about two hours of intense informational analysis before forecast discussion production
- Continual communication/analysis with the air quality monitors occurs up to forecast submission

- **Budget constraints**

- More monitoring requirements, less EPA support/funding, overall budget issues!

- **Changing Federal Air Quality standards...**

- **Changing chemistry/meteorological processes...**



# Role of EPA AIRNow in Forecasting

- **Provides centralized organization to 80+ forecasting agencies**
  - Communication and standardized products
- **AIRNow-Tech Decision Support Tool**
  - Forecast Submittal System
  - Geo-Editor (assign zip codes to forecast areas)
  - HYSPLIT, ASOS and Fire Detect data
- **NOAA model guidance integration**
  - AIRNow displays model predictions on city level to aid in forecasting
  - AQI conversion
- **AIRNow Gateway (web services/flat files)**
  - Media distribution (USAToday oversight)
  - Researchers/agencies
- **Forecasting Training (workshops, courses, videos, guidance docs)**
  - Not so much in recent years due to lack of funding



# AIRNow-Tech

[AIRNowTech.org](http://AIRNowTech.org)

- **Decision Support System – for AQ community**
- **Functions**
  - Data administration
  - Data queries
  - Mapping
  - Forecasting
  - Education
- **AQ and Meteorological data**
  - Includes HYSPLIT trajectories
- **Survey Says...**
  - State/locals want satellite data in AIRNow-Tech

The screenshot shows the AIRNow-Tech website interface. At the top, there is a navigation bar with links for Home, Agencies, Sites, Navigator, Data, Forecasts, Polling, Notifier, and Resources. The main content area is divided into several sections:

- News and Events:** A section titled "AIRNow Gateway Launched!" with a detailed announcement about the new system and contact information for AIRNow DMC.
- My Agency's Forecasts:** A table showing forecast data for various cities, including Auburn, Davis, Elk Grove, Folsom, Placerville, Roseville-Rocklin, Sacramento, and Woodland. The table has columns for Today, Tomorrow, and Action Day.
- My Agency's Realtime Observed:** A table showing real-time observed data for Ozone, PM<sub>2.5</sub>, and PM<sub>10</sub> for Yesterday, Max Today, and Current.
- My Agency's Polling Summary:** A table showing polling summary data for Ozone, PM<sub>2.5</sub>, and PM<sub>10</sub> for various agencies.

At the bottom of the screenshot is a map of California showing monitoring stations and HYSPLIT trajectories. The map includes a scale bar (0 to 32 miles) and a legend for the data series.

# AIRNow-Tech - Forecast Submittal System

## Forecast Submittal System

- Used by state/local agencies to submit forecasts and action day notifications
- Provides NOAA model output for their forecast area
- Provides forecast statistics and NOAA model verification

Standard Forecast

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

Home Agencies Sites Navigator Data Forecasts Polling Notifier EnviroFlash Resources

[Submit Forecast](#) [Submit Discussion](#) [Settings](#) [Query Forecasts](#) [Verification Sites](#) [Verification](#) [GeoEditor](#)

Choose an Existing Form

Phoenix Metro Forecast (Default)

For categorical forecasts, enter:

g	for	Good
m	for	Moderate
usq	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"/>
	<a href="#">NOAA</a>		46	47					
	Action Day	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
PM <sub>2.5</sub>	Forecast	65	81	90	82				<input type="checkbox"/>
	Action Day	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
PM <sub>10</sub>	Forecast	64	76	74	64				<input type="checkbox"/>
	Action Day	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO	Forecast		35	37	40				<input type="checkbox"/>
	Action Day	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

# AIRNow and Satellite Information

## The Possibilities...

### Real-time Air Quality Satellite Product Usage

- Focus seems to have been on forecasting – great!...but
  - ✓ Satellite product timing/availability/accuracy
  - ✓ These workshops will help ascertain needs of forecasting community
  - ✓ Satellite products needs to be fast, reliable and easy to assimilate/understand
  - ✓ AIRNow can serve that role to forecasters

### Historic Air Quality Satellite Product Usage

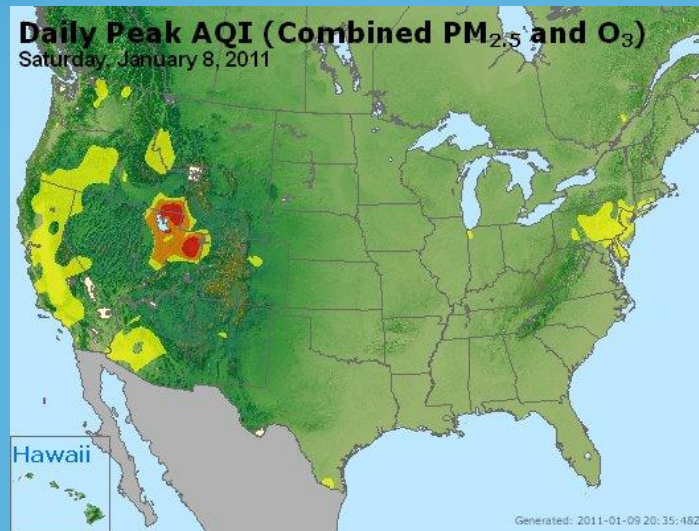
- Underutilized by Air Quality Community?
  - ✓ Case studies – advance the science/understanding of air quality
  - ✓ Exceptional Event Analyses – AIRNow can help facilitate this via AIRNow-Tech?
  - ✓ More accurate historical air quality maps – satellite/model information used to fill in monitoring gaps?

**EPA AIRNow can/should help with all of this...**



# AIRNow and Satellite Information

## NASA ROSES Project - Objectives



Operational map

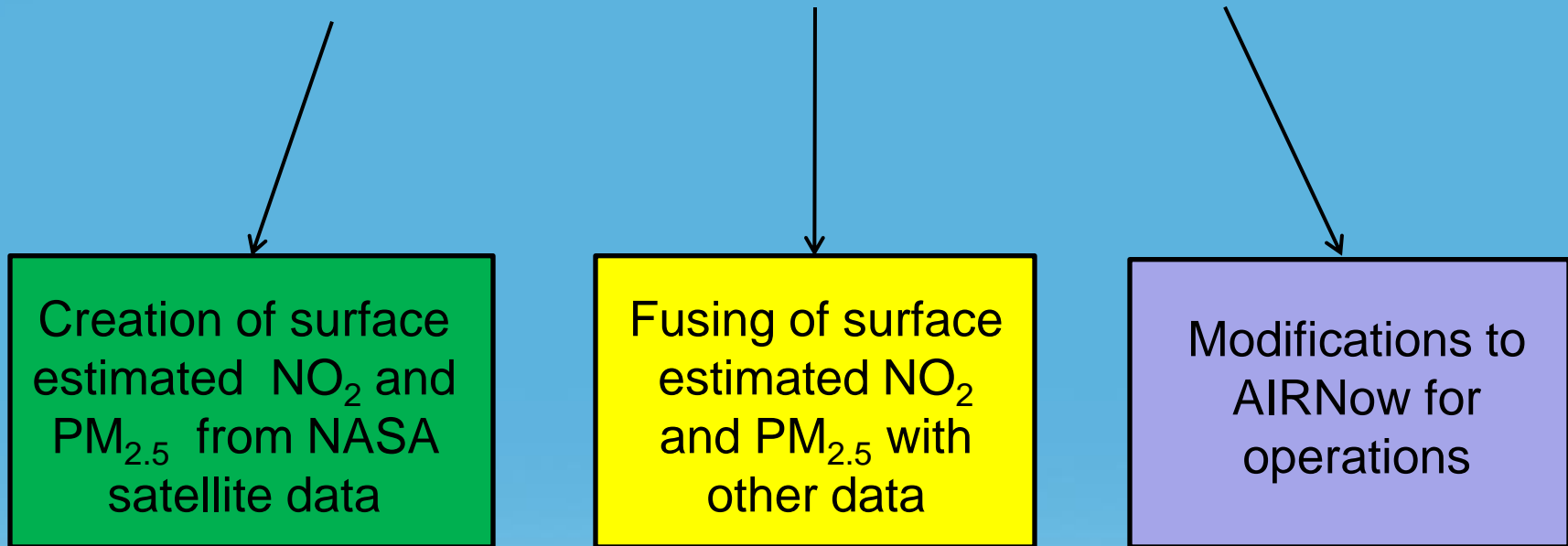


Without satellite data, no contouring is possible in the hatched areas

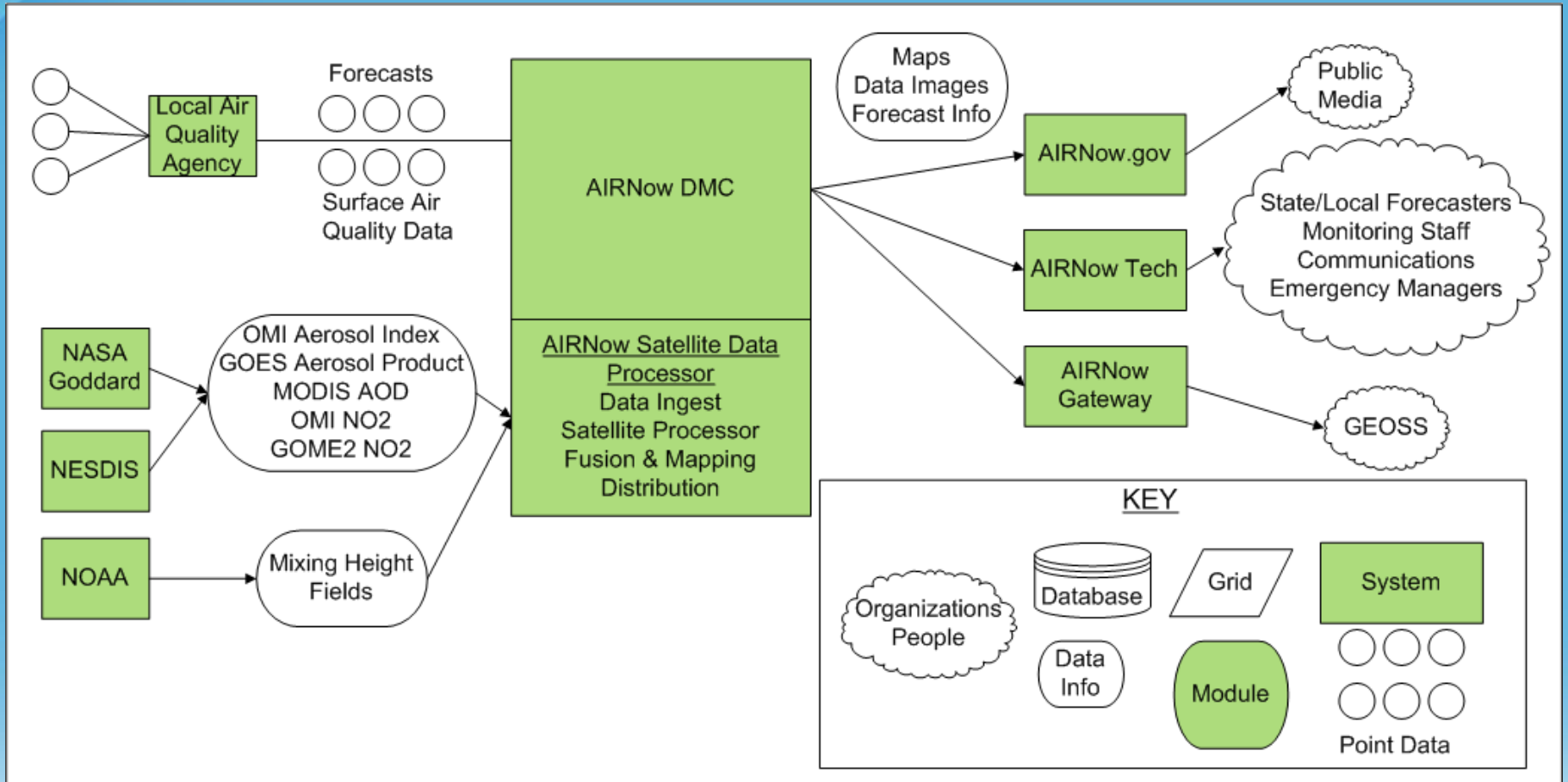
- **Improve operational air quality maps currently in AIRNow using satellite data**
- **Provide satellite data products in AIRNow-Tech**
- **Improve tools for air quality forecasting**

# NASA ROSES Project General Overview (1 of 2)

## Three Key Components



# NASA ROSES Project General Overview (2 of 2)



# NASA ROSES Project General Considerations

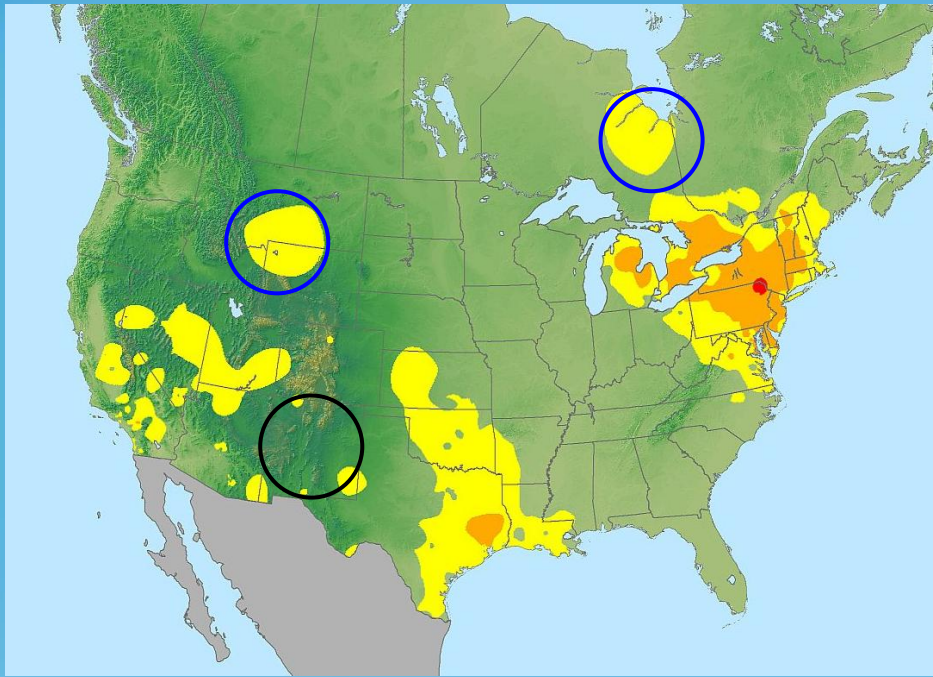
- **Operational feasibility**
  - Balance between science and operations
- **Treatment of uncertainty**
  - Different uncertainty structures for each dataset (satellite and ground observations)
  - Relative weighting of observation and satellite data will depend on uncertainties
  - Changes in data availability (e.g., missing data) will alter the uncertainty structure
- **Use of the final fused product (maps, forecasting, etc.)**
- **Long-term sustainability**

# AIRNow and Satellite Information

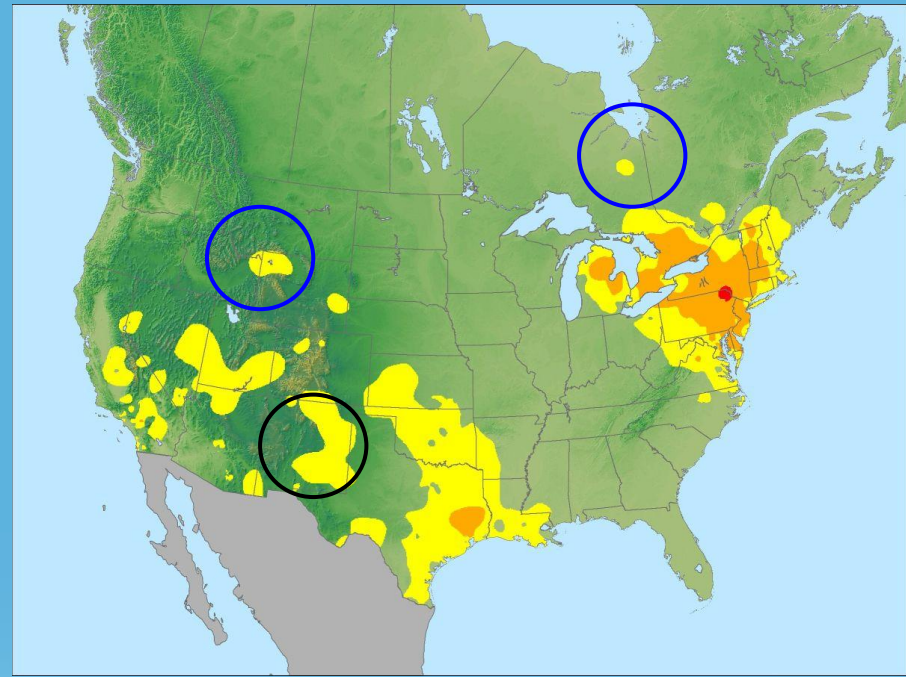
## Data Fusion Methods: Background

- **Several data fusion techniques have been tested in previous work: weighted average, cokriging, bias-adjusted, Hierarchical Bayesian Modeling (HBM)**
- **Bottom line from previous studies: no single technique stands out as a top-performer for data fusion**
- **We have begun testing the weighted average and cokriging techniques with NOAA model data**
  - NOAA model and air quality observations
  - NOAA model and air quality forecasts issued by agencies
  - Need to test fusion techniques and build capability before satellite surfaces are ready

# Results for Fusion of Ozone Observations and NOAA Ozone Model Data

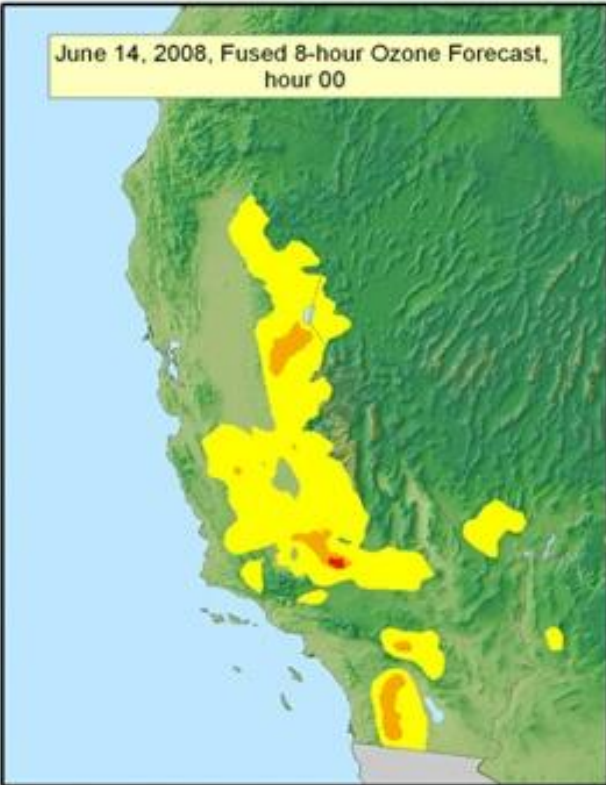


**Interpolation without fusion  
(observations only)**



**Interpolation with fusion  
(observations and NOAA model)**

# Results for Fusion Agency Ozone Forecasts and NOAA Ozone Model Predictions



Fused model and agency forecasts



NOAA model data



Agency forecasts available by zip code

# NASA ROSES Project

## Next Steps

- **Year 2 of 5 year project – Work Assignment to be issued soon! (had a delay in funding/interagency agreement)**
- **Complete testing of the weighted average and cokriging techniques using 9 months of data**
- **Test the HBM technique for the same period**
- **Develop a prototype data fusion application which can run in real time**

# Challenges We Face...

- **Overall EPA Funding**

- AIRNow Operations
- New development/products – how to integrate/manage operational costs

- **Data Access and Applications**

- Access to satellite data (easier and quicker)
- Real-time vs. archive (availability and use)
- Integration of satellite data with existing tools (AIRNow-Tech)
- Additional tools for AQ agencies (forecasting, retrospectives)
- Understanding the limitations of satellite data
- Working together to develop applications beyond images and derived fields (AOD)
- Training on these topics (NAQC or web-based)

**Believe we  
Can WIN**



# Thanks!

John E. White

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