

# Integrating Communication of Data from Air Quality Monitors, Sensors, and Satellites during Smoke Events

*Susan Lyon Stone, Senior Environmental Health Scientist  
U.S. EPA – Office of Air Quality Planning and Standards*

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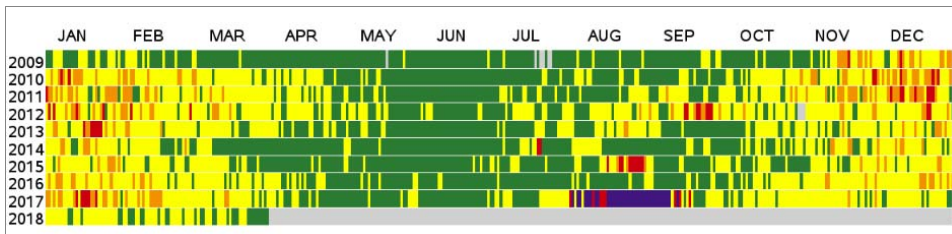
# Communicating Air Quality Information

- Many useful sources of air quality information during smoke events
  - Different purposes
  - Different spatial and temporal scales
- How do sensors fit in?
- Tools to help integrate information of different spatial and temporal scales
- Future opportunities with sensors



# Air Quality Index - Linking Air Quality and Health

- EPA’s color-coded tool for communicating air quality and health information to the public
  - Nationally uniform – used by federal/state/tribal/local agencies
  - Used for all FRM/FEM monitors
  - Updated to reflect the latest standards and science
- The daily Air Quality Index (AQI) for fine particle pollution is a 24-hour index
- AQI is used for
  - Next-day forecasting
  - Current air quality (NowCast)
- Daily AQI reports for particle pollution show previous day’s air quality



PM2.5 Daily AQI Values 2009-2018, Missoula Co, MT  
Data Viz ([www.airnow.gov](http://www.airnow.gov))

The Air Quality Index	
Index Values	AQI Category
0 - 50	Good
51 - 100	Moderate
101 - 150	Unhealthy for Sensitive Groups
151 - 200	Unhealthy
201 - 300	Very Unhealthy
301 - 500	Hazardous

# Air Quality Index

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- Pollutant-specific health effects and cautionary statements address question “who will be affected”
- Based on health information supporting the NAAQS – uses health relevant averaging periods
  - Controlled human exposure, epidemiological studies exposure/risk assessments used to set breakpoints
  - Epidemiological studies useful for identifying risk factors and more serious effects
  - Controlled human exposure studies useful for identifying proportion of healthy population affected, symptoms, mechanisms of effects, genetic variability

*How to use the AQI to lower the dose of inhaled pollution:*

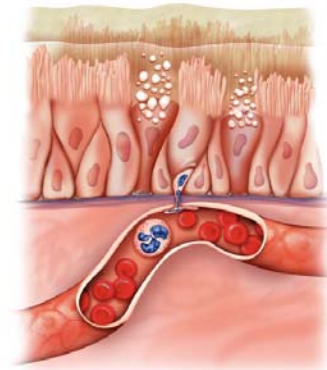
**Dose = Concentration x Ventilation rate x Time**

C - be active outdoors when air quality is better

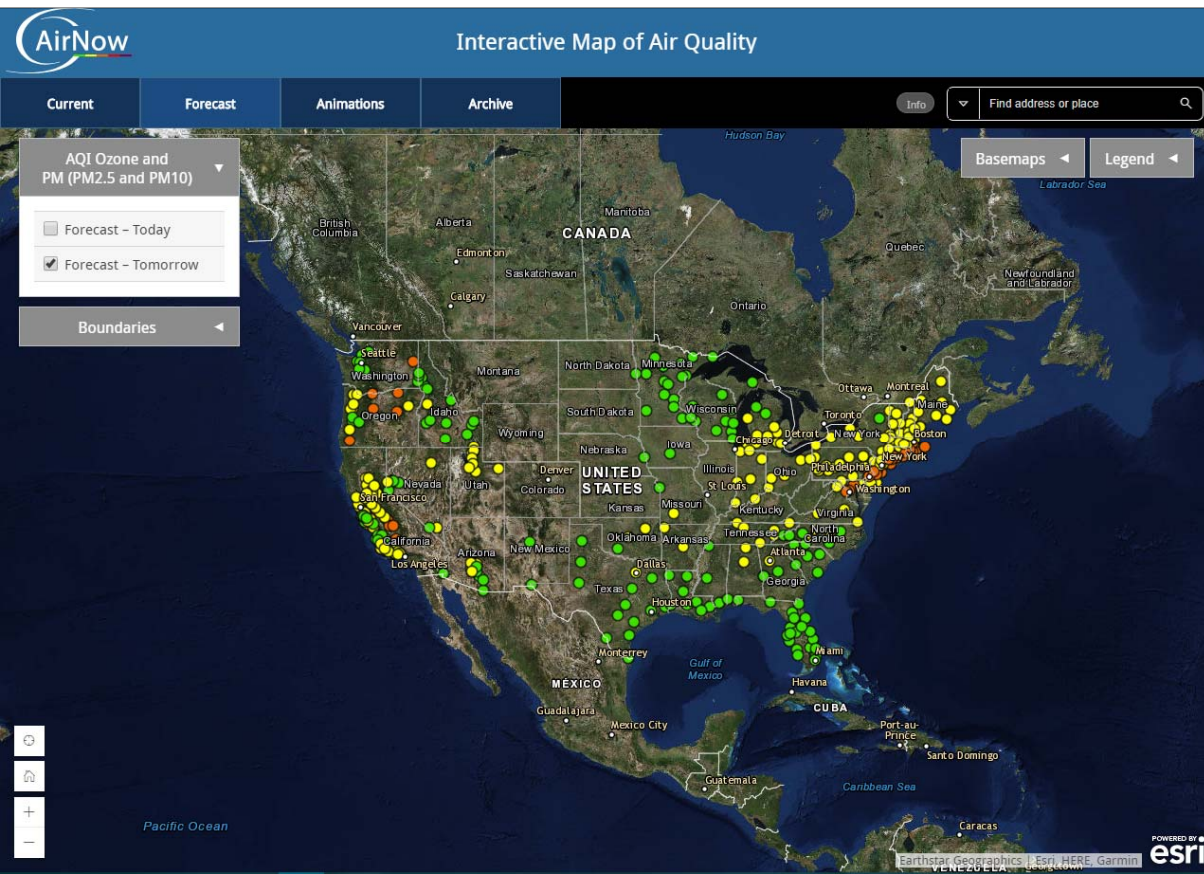
V - take it easier when active outdoors

T - spend less time being active outdoors

**Since people respond differently - PAY ATTENTION TO SYMPTOMS!**



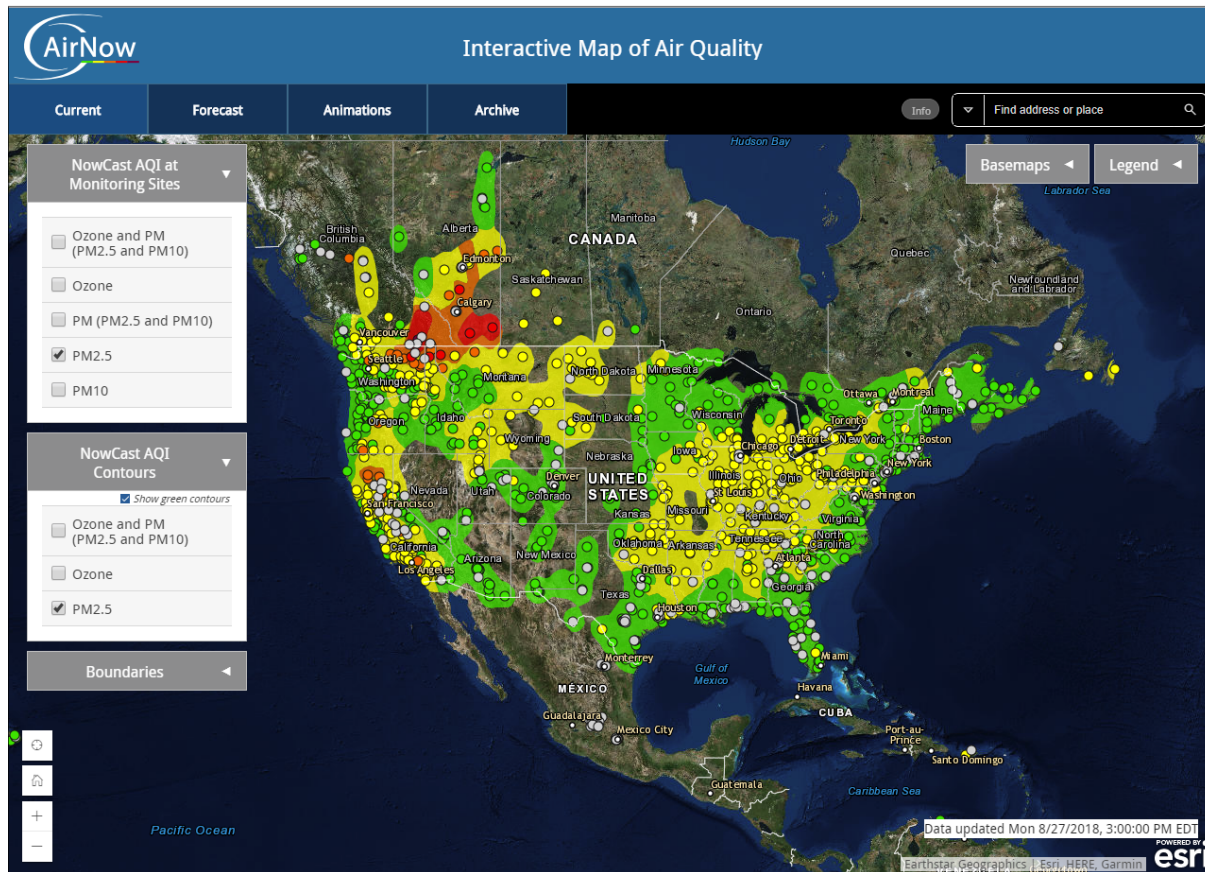
# Forecasted and Real-time AQI



National Map  
Forecasted PM2.5 AQI

[www.airnow.gov](http://www.airnow.gov) , 8/27/18

# Forecasted and Real-time AQI - 2

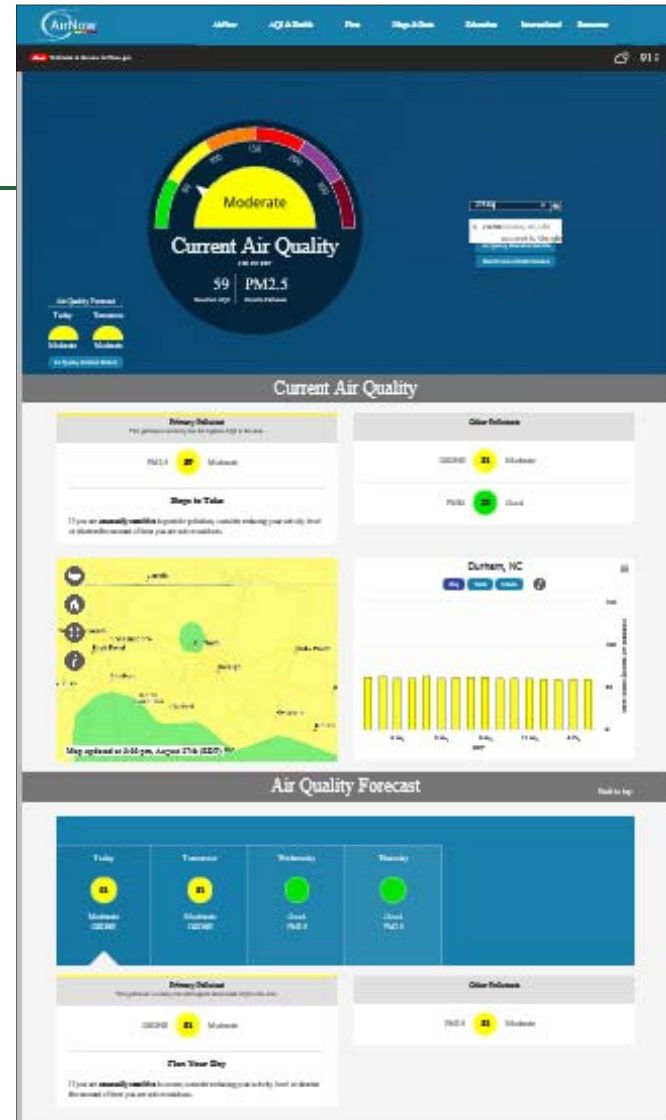


Contour National Map  
Real-time PM2.5 AQI

# Forecasted and Real-time AQI - 3

Real-time AQI Dial  
and Local Map

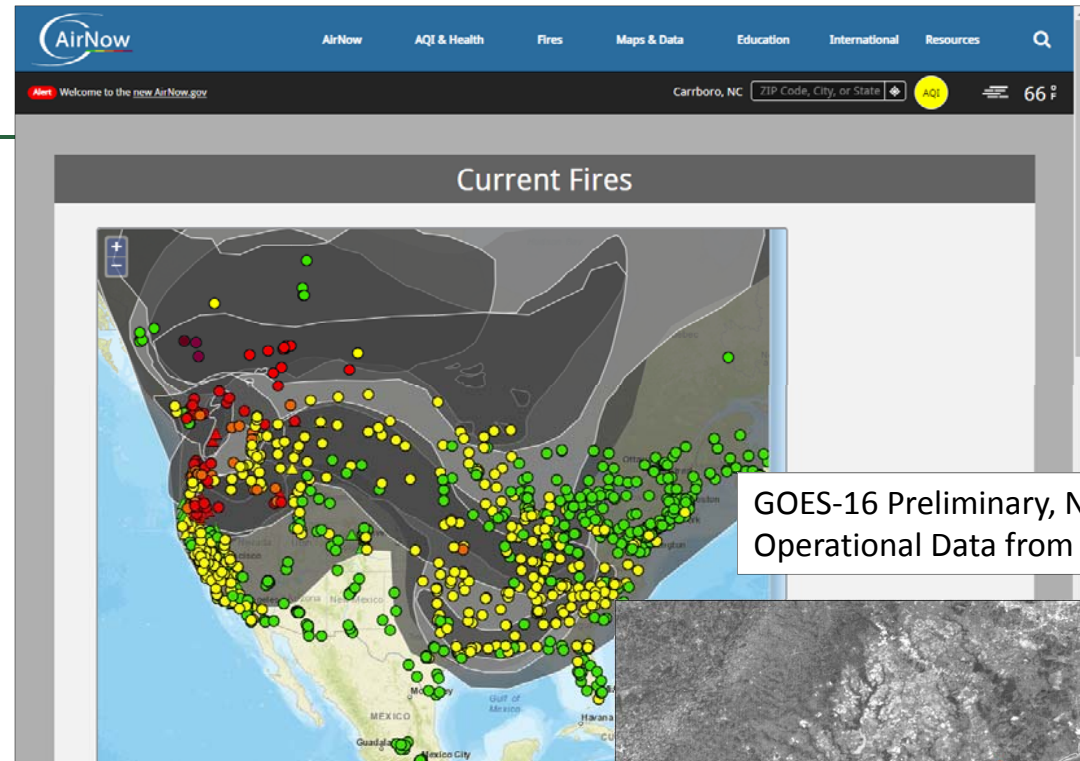
[www.airnow.gov](http://www.airnow.gov) , 8/27/18



# Satellite Data

## NOAA Hazard Mapping System

- 10 satellites send images every 15 minutes
- NOAA analysts work 24/7 to update maps
- Reflects smoke in entire column
- Different temporal and spatial scales than the ambient monitoring network, but the association with the AQI and monitored data is evident
- GOES EAST (formerly GOES-16) provides higher resolution images to detect smoke from most fires
- Satellite imagery may indicate other potential air quality concerns in areas that are unmonitored



GOES-16 Preliminary, Non-Operational Data from 2017

[www.airnow.gov](http://www.airnow.gov) , 8/23/18





## How Do Sensors Fit In?

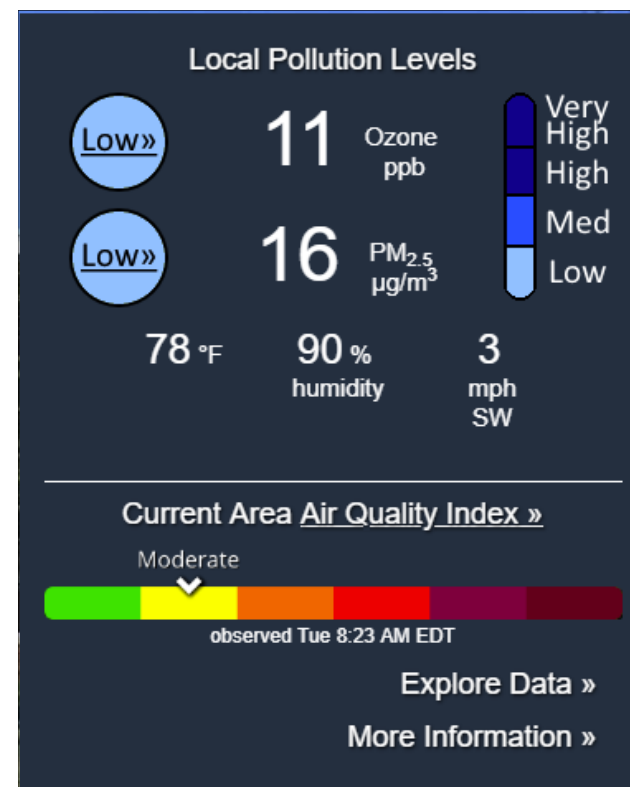
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- Sensors may provide local air quality information at the current moment
- Sensors can provide information about whether air quality is getting better or worse, whether it is better inside or outside
- Sensor readings are associated with behavioral messages using EPA's pilot Sensor Scale

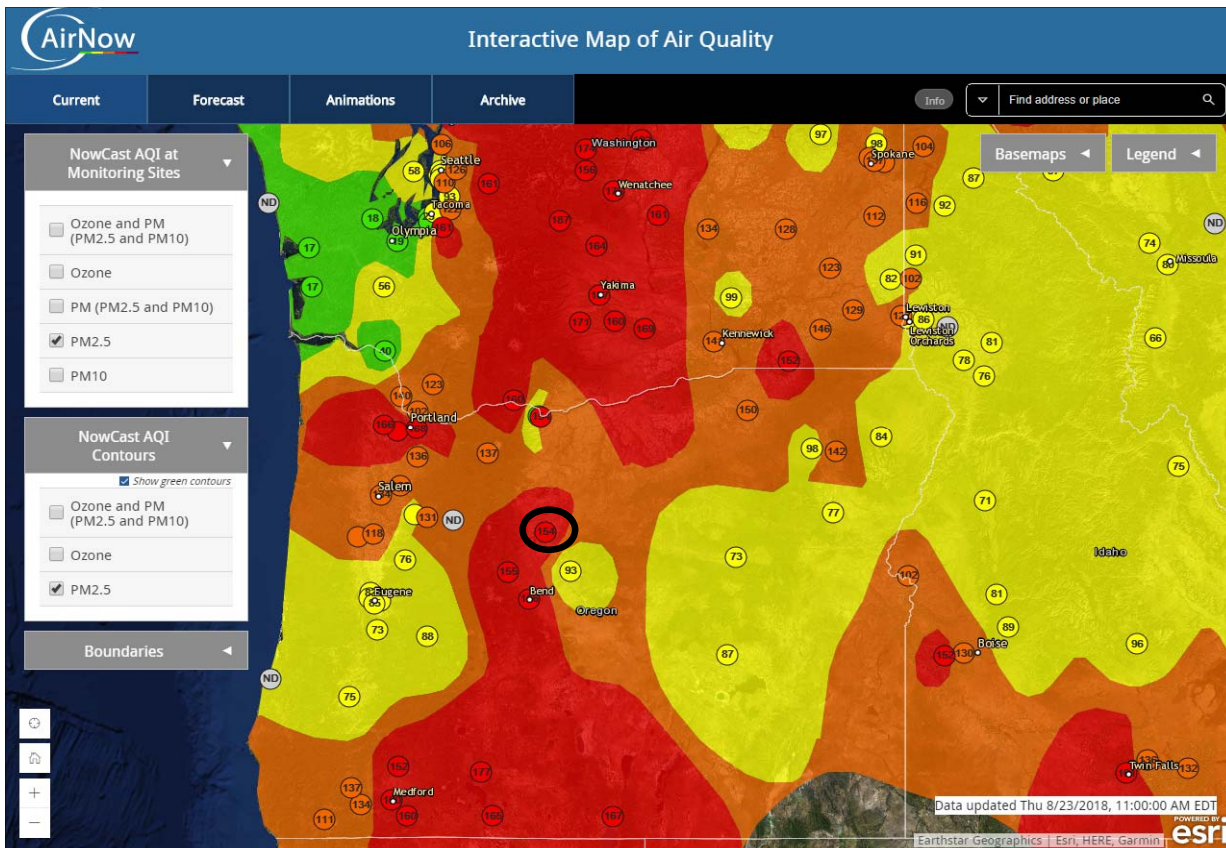
# Pilot Sensor Scale and the AQI

Based on air quality analyses of 1-hr peak to 24-hr mean PM ambient air quality data:

- A “low” sensor reading outdoors corresponds to a 24-hour average concentration below the level of the 24-hour NAAQS and in the “good” or “moderate” AQI categories.  
*Enjoy your outdoor activities.*
- A “medium” sensor reading generally corresponds to the “moderate” or “unhealthy for sensitive groups” AQI categories.  
*If medium readings continue (for an hour or more), use the Air Quality Index to plan outdoor activities.*
- A “high” or “very high” sensor reading corresponds to concentrations that can occur near sources, such as a smoke event.  
*You may be near a source of particle pollution like dust, smoke or exhaust. Check the Air Quality Index to plan outdoor activities.*

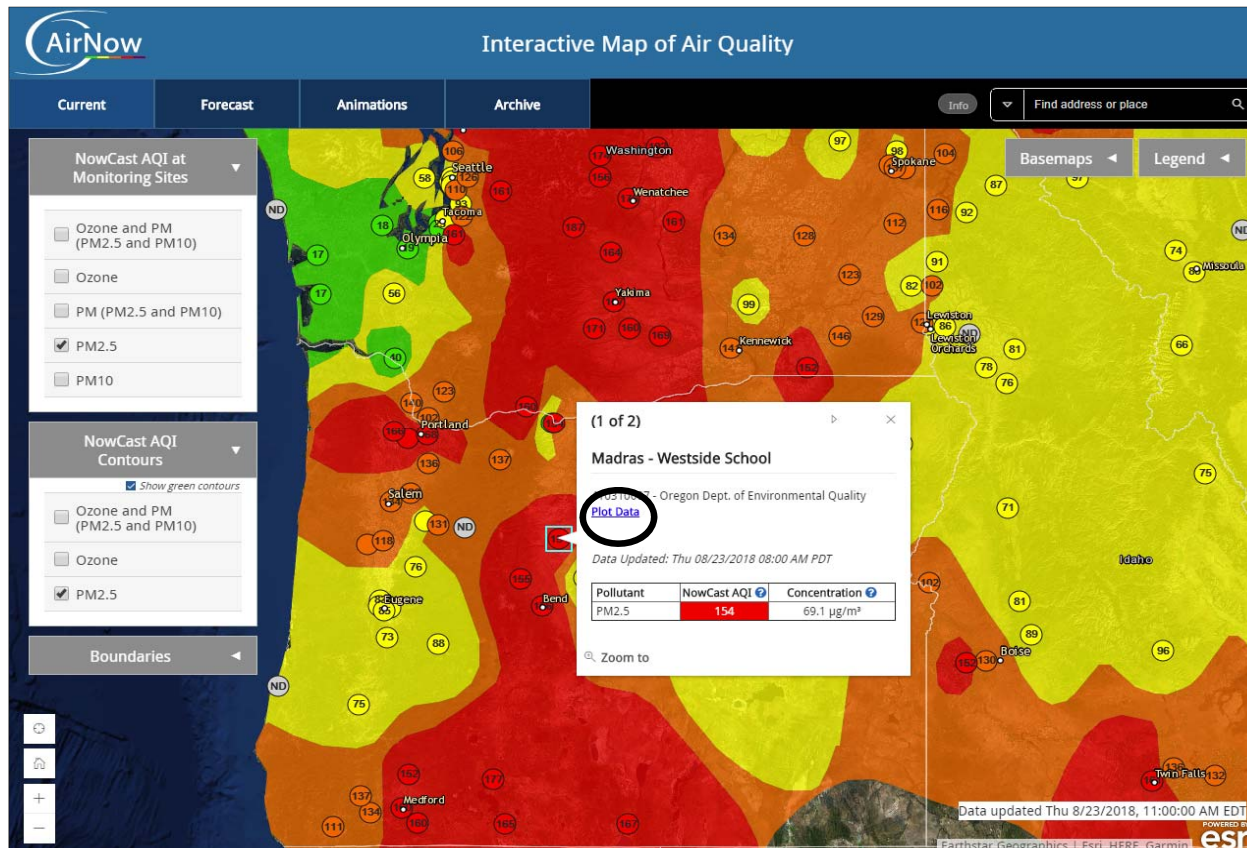


# Tools to Interpret Sensor Data – Spatial Resolution



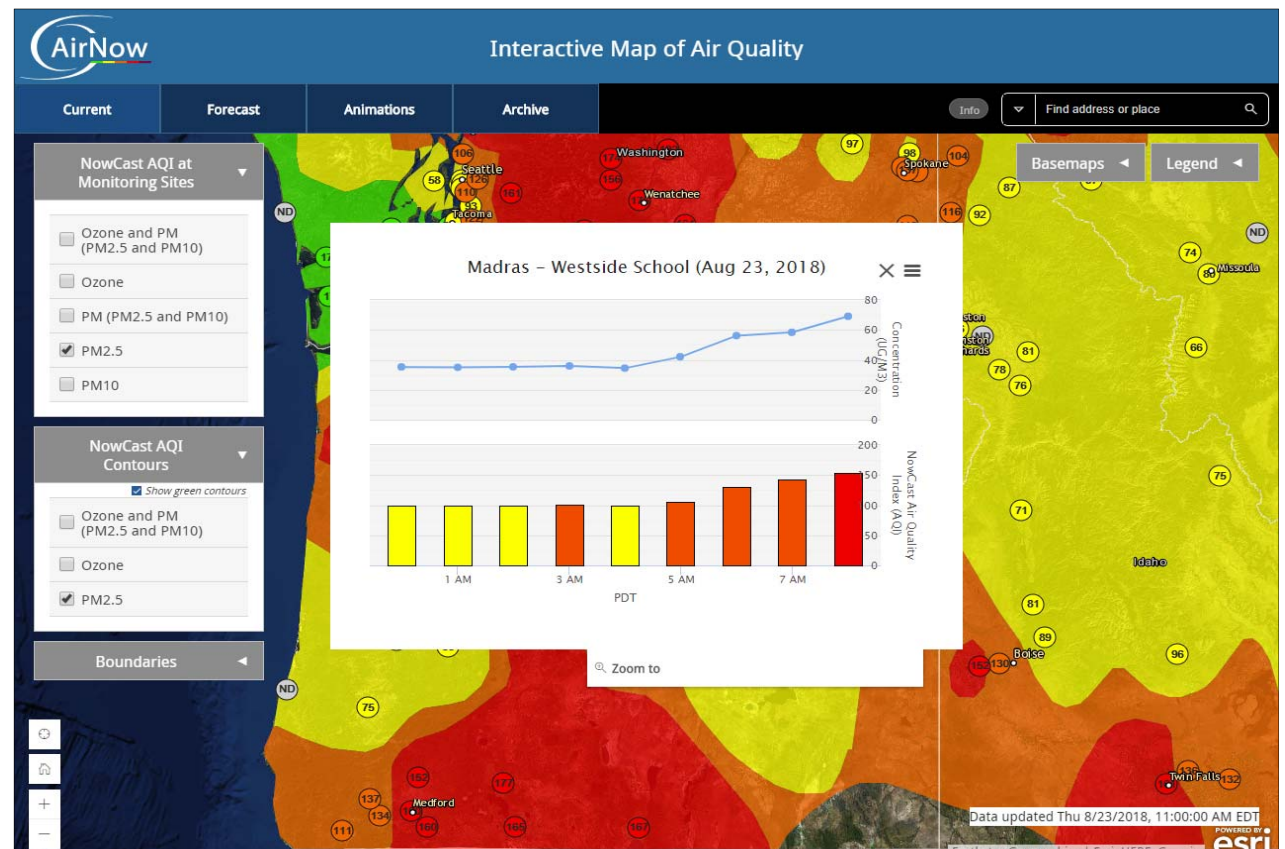
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# Tools to Interpret Sensor Data – Spatial Resolution - 2



[www.airnow.gov](http://www.airnow.gov), 8/23/18

# Tools to Interpret Sensor Data – Spatial Resolution - 3



[www.airnow.gov](http://www.airnow.gov) , 8/23/18

# Tools to Interpret Sensor Data – Temporal Resolution

Smoke Outlook for Southern Oregon and Northern California Border for Saturday and Sunday Aug. 25-26, 2018



**Smoke Outlook for 8/25 - 8/26**  
**California-Oregon Border**  
 Issued at: 2018-08-25 07:38 PDT

Outlook for California-Oregon Border

**Special Statement**

*This air quality forecast predicts potential particulate matter levels, not ozone. Forecast is based on 24 hour average.*

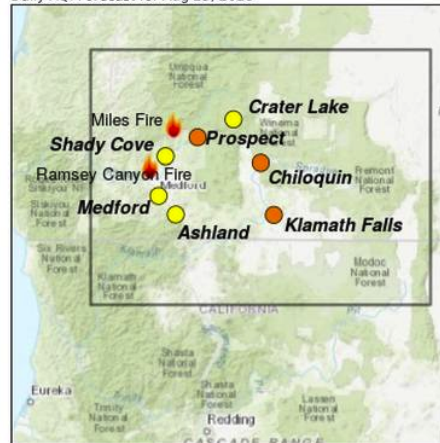
**Fire**

Miles and Columbus fires: 301 acres burned in the last 24 hours. Columbus is burning southern flank and Miles is burning north and northwest of the fire. The crew are working securing the fire perimeter. Ramsey Canyon fire is at 1,329 acres with 17% containment. The fire is burning tall grass, timber, and shrub and burning into 1994 fire scar. Watson Creek fire (not pictured on map) is burning 13 miles west of Paisley, OR. Watson Creek fire is at 46,525 acres with 10% containment. The crew are working on holding the line and conducting firing operation today.

**Smoke**

Air quality has improved significantly yesterday as the cooler temperature and gusty wind pushes the smoke out of the area. Northwest wind will continue today 5-12 mph with gusts up to 18 mph in some area. Watson Creek Fire will experience variable wind with westerly wind becoming north westerly by this evening then shifting to north easterly wind. Paisley will experience more smoke with west winds. Smoke conditions of varying densities are expected to continue for the next few days until the inversion breaks and gusty wind picks up pushing the smoke out.

Daily AQI Forecast for Aug 25, 2018



Air Resource Advisor Smoke Outlook, OR and Northern CA border, 8/25-26/18

ARA Smoke Outlooks

- Issued for smoke from major fires
- Available on AirNow

Station	Yesterday hourly	Fri 8/24	Comment for Today -- Sat, Aug 25
Ashland			Moderate smoke impact continues through Sunday.
Medford			Moderate smoke impact continues through Sunday.
Shady Cove			Air quality has improved in the day.
Prospect			Due to close proximity to the fire, smoke impact will continue.
Crater Lake			Air quality has improved in the day.
Chiloquin			Smoke impact will continue due to northwest winds.
Klamath Falls			Smoke impact will continue due to northwest winds.

Station	Yesterday hourly			Fri 8/24	Comment for Today -- Sat, Aug 25	Forecast	
	6a	noon	6p			Sat 8/25	Sun 8/26
Ashland					Moderate smoke impact continues through Sunday.		
Medford					Moderate smoke impact continues through Sunday.		
Shady Cove					Air quality has improved in the morning and should be moderate for most of the day.		
Prospect					Due to close proximity to the fire, smoke impact will continue.		
Crater Lake					Air quality has improved in the morning and should be moderate for most of the day.		
Chiloquin					Smoke impact will continue due to northwest winds.		
Klamath Falls					Smoke impact will continue due to northwest winds.		

Issued 2018-08-25 07:38 PDT by Nicole Bringolf, Air Resource Advisor, not

## What's Next?

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- To integrate communication of data from different sources during smoke events we need to:
  - Understand what data are available, its intended use, and its spatial/temporal resolution
  - Continue exploring other uses of sensors to:
    - Better characterize rapidly changing air quality
    - Quickly gather and communicate air pollution data
- Other sources of information that may be locally important
  - Visual range metrics (typically reflect “low-medium-high” approach to particle concentrations)
  - Social media
- What can federal agencies do to help?

## Future Opportunities with Sensors

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- Along with rapidly improving air quality sensors, strides are being made in biometric sensors for health parameters
  - For example, sensors for heart rate, blood pressure, temperature, blood oxygen saturation, ECG are readily available
  - NIH – National Institute of Biomedical Imaging and Bioengineering (<https://www.nibib.nih.gov/science-education/science-topics/sensors>)
- Sensor development may allow us to study the health and physiological effects of smoke
  - Brief exposures
  - Prolonged exposures - cumulative effects
  - At-risk populations
  - Effectiveness of interventions at *modifying behaviors*