

# Satellite Data for Air Quality Forecasting and Analysis – A West Coast Perspective

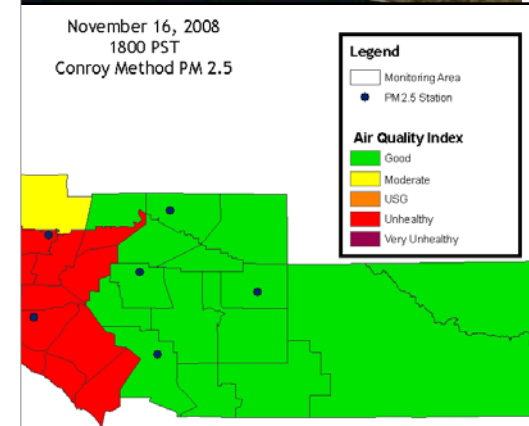
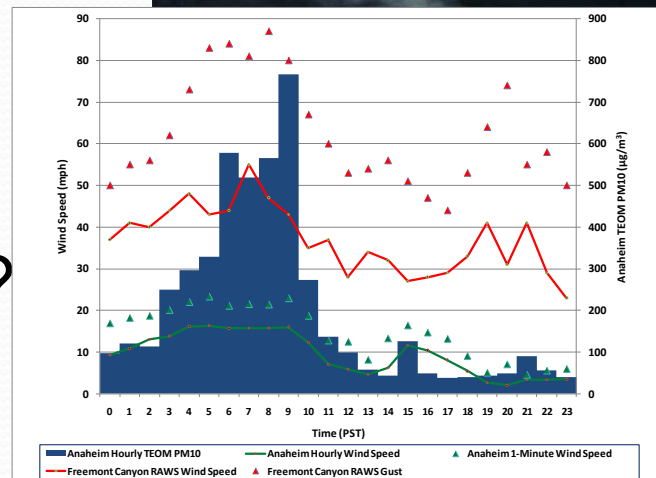
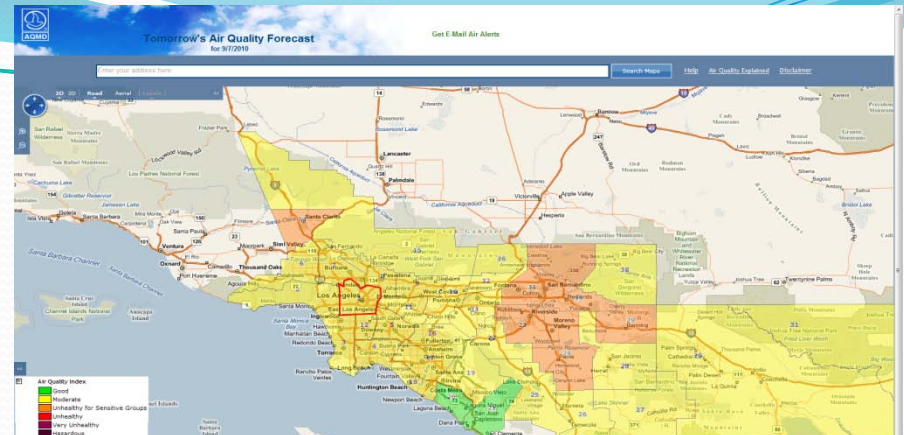


Kevin Durkee & Sang-Mi Lee  
South Coast Air Quality Management District

NOAA GOES-R Air Quality Proving Ground Workshop  
September 14, 2010

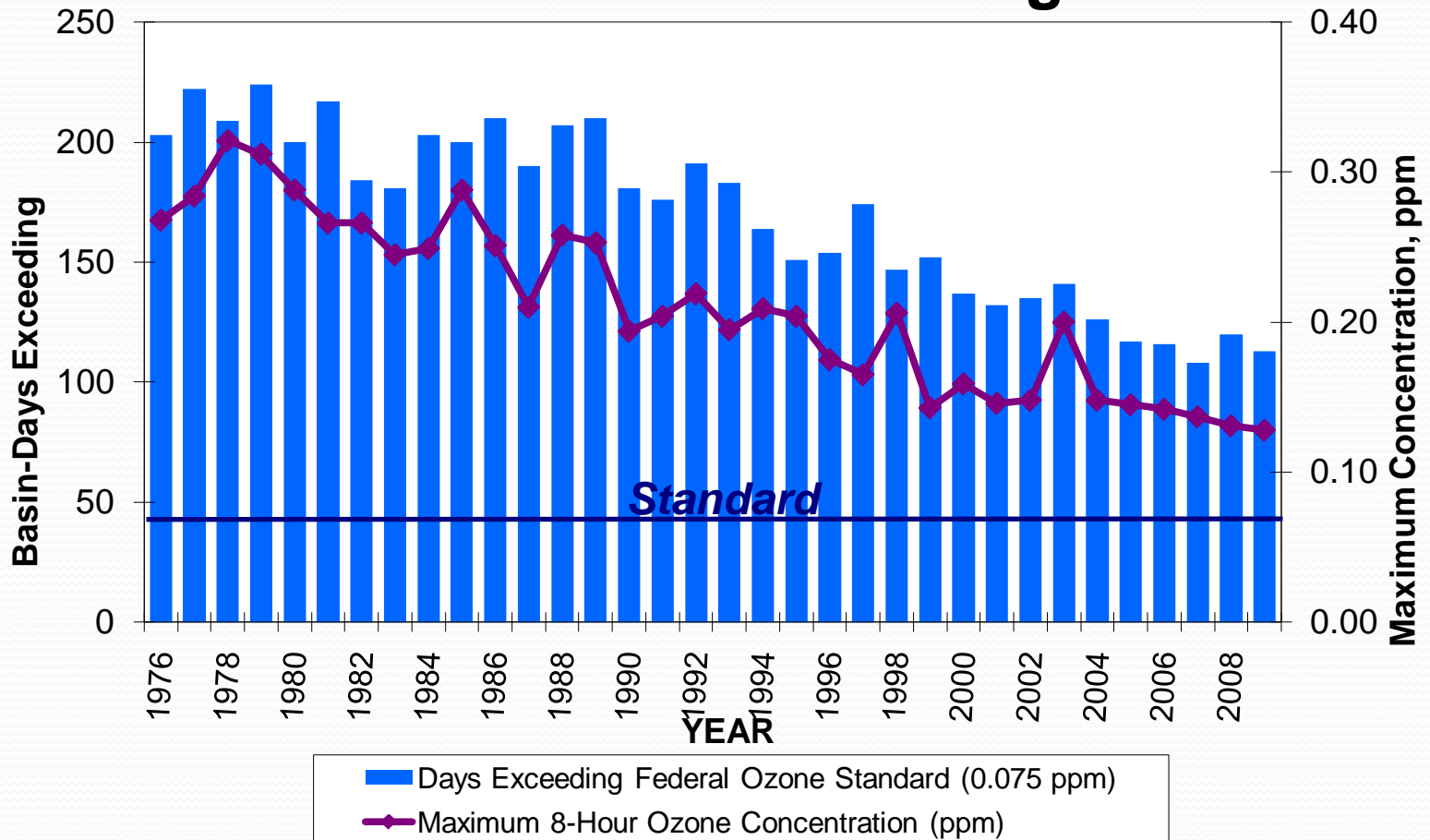
# Overview

- Routine Air Quality Forecasting
- Air Pollution Event Analysis and Alerts
- Post-Event Analyses
- What's Next???

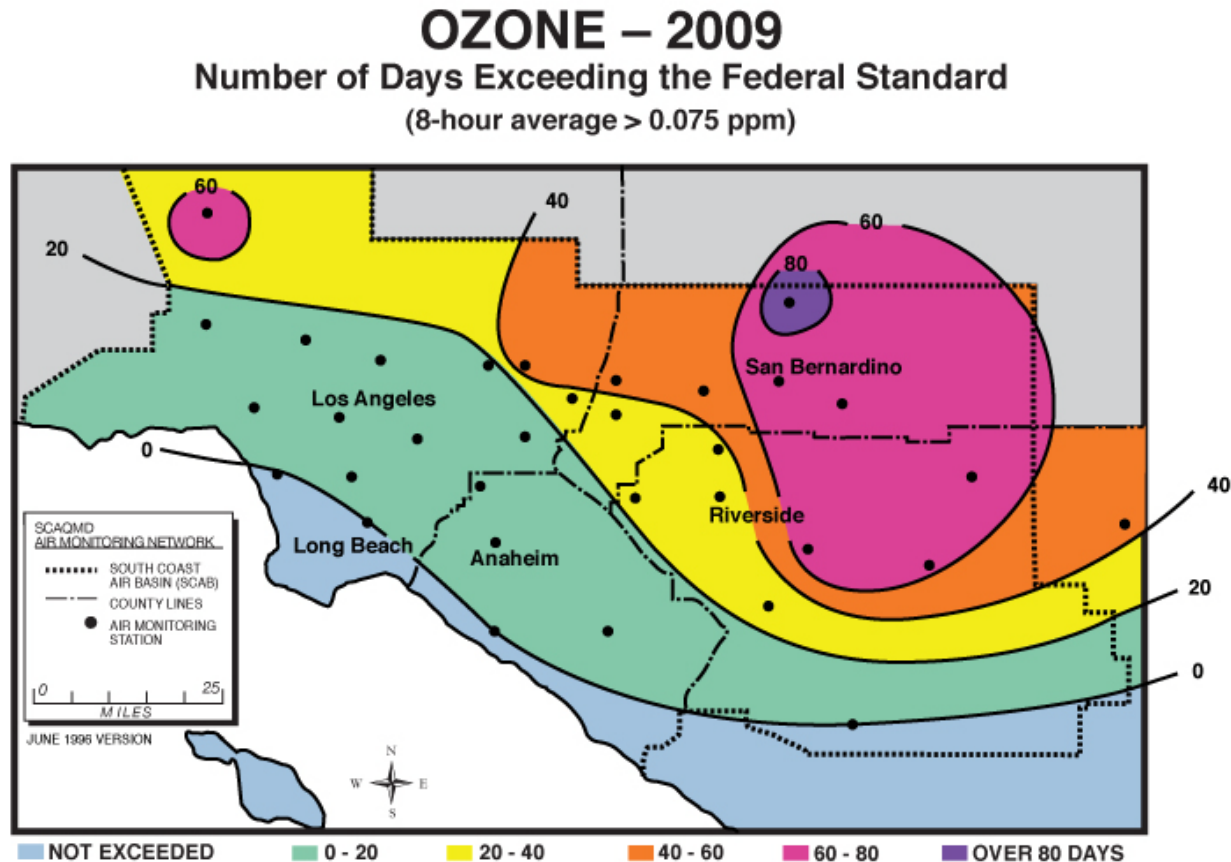


Our success story in southern California has been commendable ...

## South Coast Air Basin Smog Trend

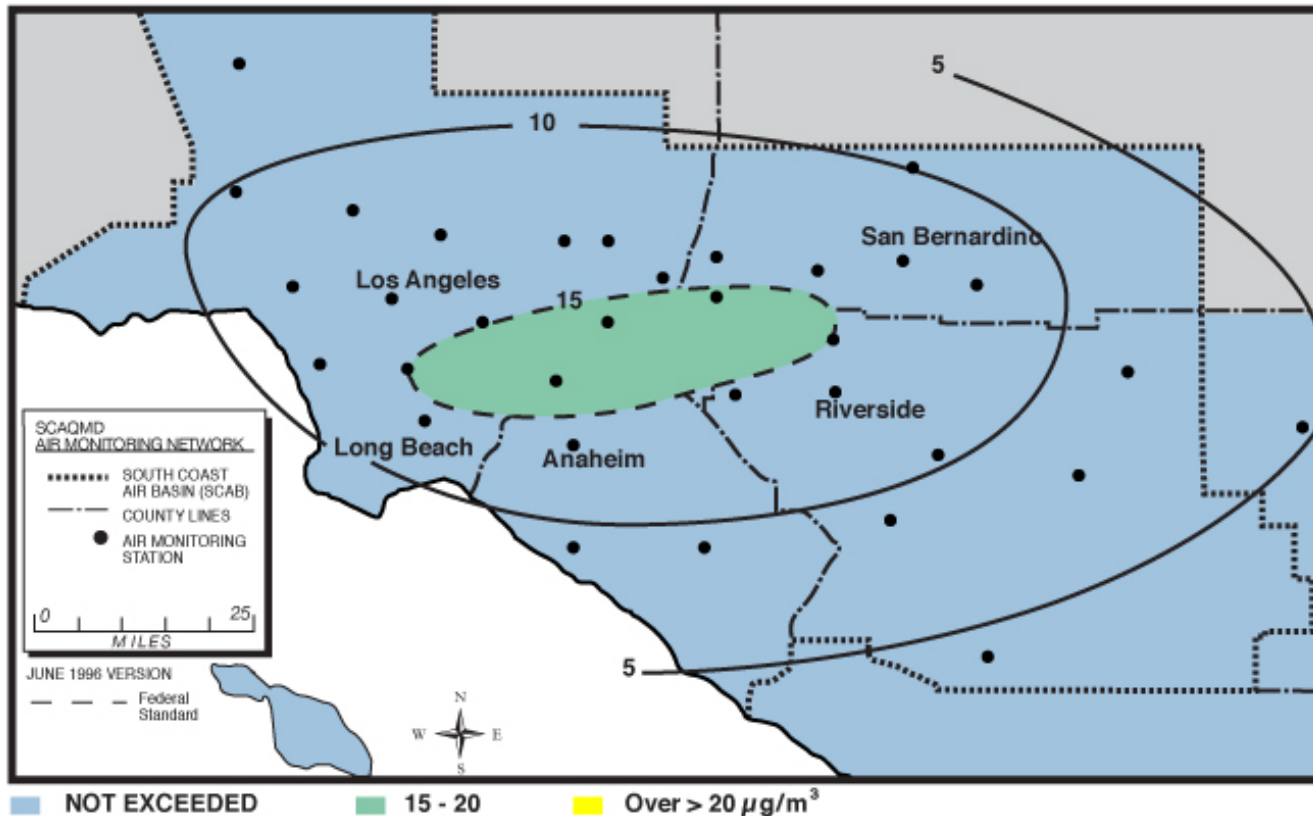


... but we still have some of the worst air quality in the nation...



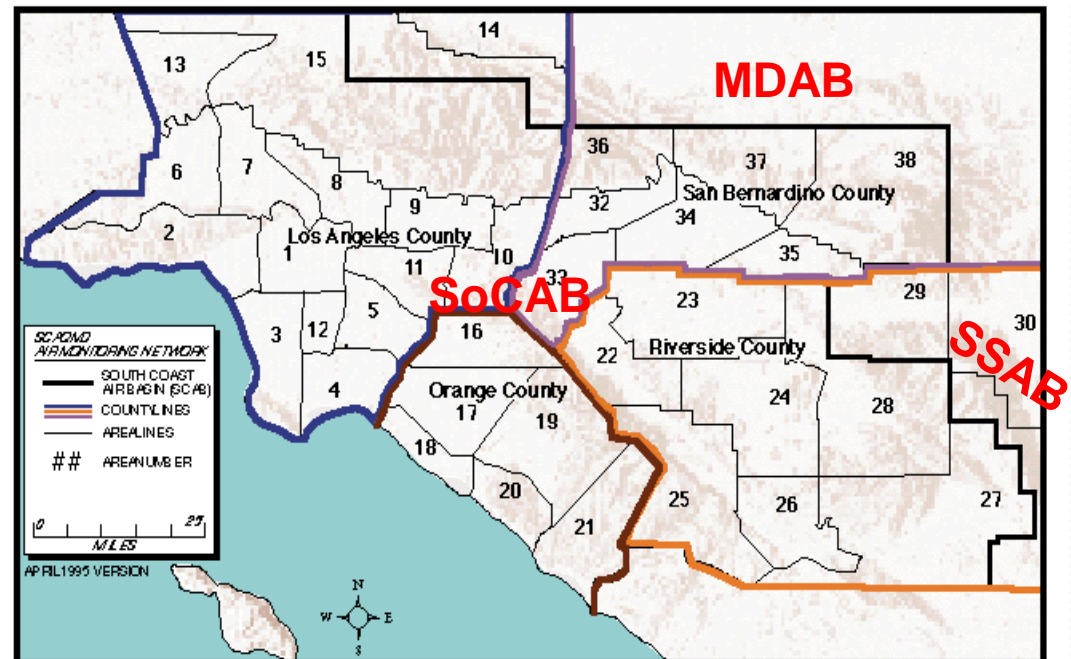
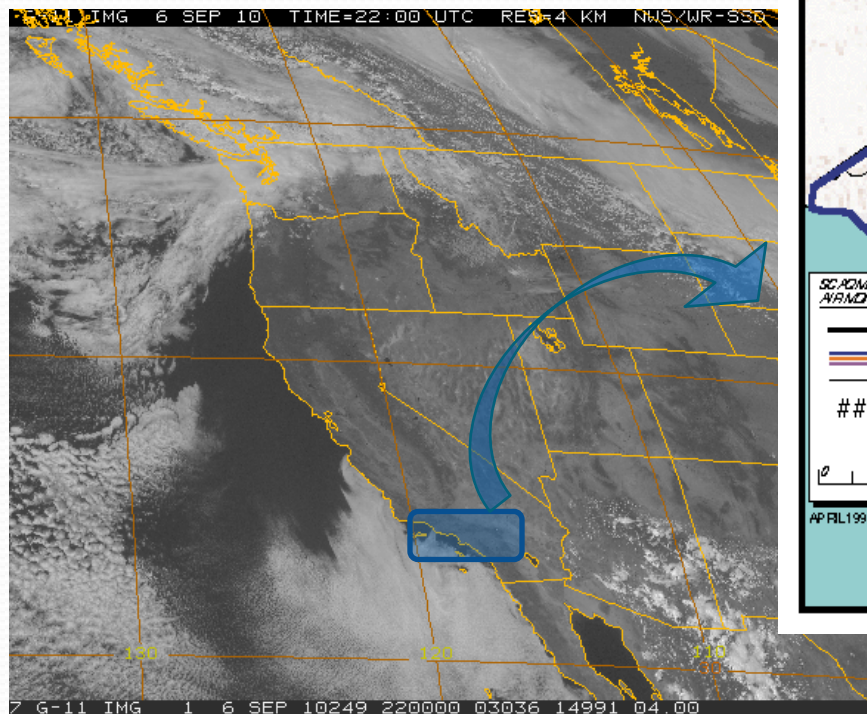
# PM2.5 - 2009

Annual Arithmetic Mean,  $\mu\text{g}/\text{m}^3$   
(Federal Standard =  $15\mu\text{g}/\text{m}^3$ )



# Routine Air Quality Forecasting in the South Coast Air Basin

- 45 Forecast Areas in 4 counties, 3 air basins
- ~16 Million People; 11 Million gasoline & 300,000 Diesel Vehicles



# Routine Air Quality Forecasting in the South Coast Air Basin

- **Daily next-day air quality forecasts:**
  - Ozone, PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub> and CO
    - Concentrations & AQI
  - High wind & PM forecast for fugitive dust rule
  - Burn forecasts for agricultural and prescribed fire
  - Winter wood burning forecasts (coming in November)
- **Forecast methods:**
  - Empirical, regression-based model
  - Additional guidance from prognostic grid models (NOAA, BlueSky, SCAQMD MM5/CAMx)
  - Adjusted with a healthy dose of climatology, persistence and forecaster experience

# SCAQMD Air Quality Forecast

Tomorrow's Air Quality Forecast for 9/7/2010

Get E-Mail Air Alerts

Enter your address here Search Maps Help Air Quality Explained Disclaimer

30:30 Road Aerial Traffic

South Coast AQMD - Windows Intern...  
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http://www.aqmd.gov/  
Favorites Best of the Web  
South Coast Air Quality M...  
Home | Inside AQMD | Community |  
Air Quality Forecast/Advisories  
Current Hourly Air Quality  
Current Advisories

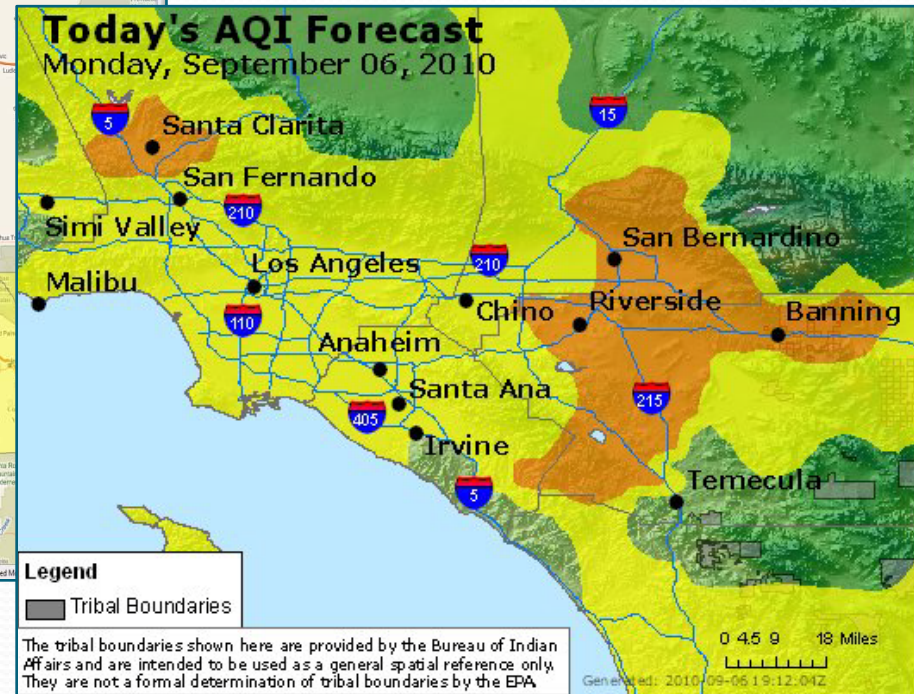
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AQMD News  
AQMD monitors air quality at Rose Bowl prior to UCLA season-opener  
September 3, 2009 - UCLA fans can breathe a sigh of relief: In spite of ongoing wildfires, they will likely still play host to San Diego State on Saturday, Sept. 5 in the Rose Bowl. Based on recent air quality measurements from a monitor stationed at the Rose Bowl

Permit Assistance



<http://airnow.gov/>

**AQMD Air Alerts**

(web, email, fax, IVR, twitter, RSS)

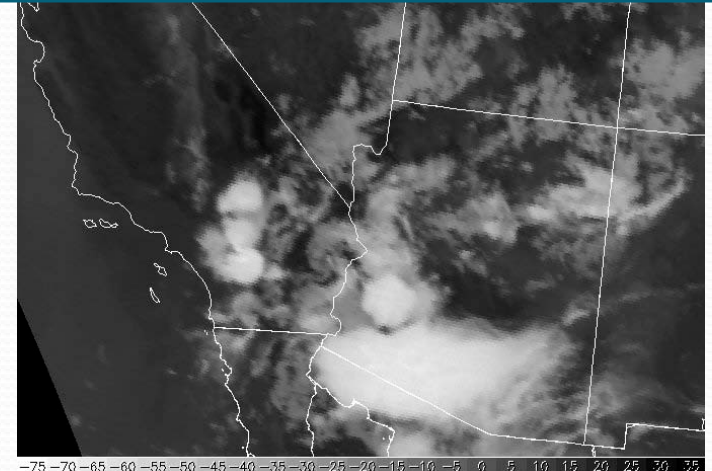
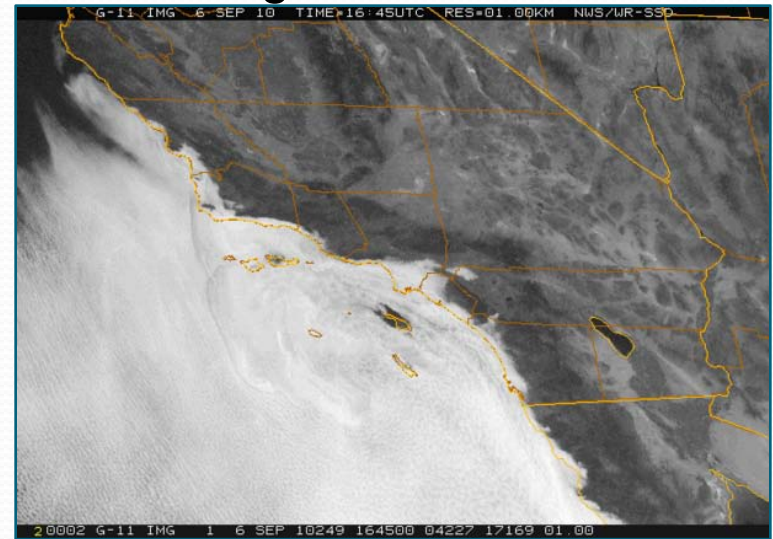
AQMD Website: <http://www.aqmd.gov>





# Satellite Information for Routine Forecasting

- SCAQMD uses satellite images to identify meteorological features that affect air pollutant build-up and transport (mostly GOES VIS, IR & WV)
  - **Stratus/Fog**
    - affects PM monitoring
    - delays ozone reactions
    - affects visibility
  - **Eddy Circulations (e.g. Coastal Eddy)**
    - deepen the marine layer
    - modifies transport pattern
  - **Convection**
    - can improve mixing & ventilation
    - outflows can alter normal transport routes, stagnate the sea breeze, or create windblown dust
    - lightning from thunderstorms can ignite fires
  - **Storm Systems**
    - improve ventilation & mixing
    - create strong winds for windblown dust



# Current Air Pollution Event Analysis, Advisories & Alerts

- Forecasters provide real-time analyses, forecasting and alerts for unhealthy air pollution events:
  - High Ozone or PM2.5 Days
    - stagnant conditions bring worst episodes
    - transport of pollutants and precursors is important
  - Large Wildfire Response
    - mainly affects PM2.5 and often ozone
  - Windblown Dust Notifications
    - mainly PM10
  - Emergency Response
    - spills, explosions, fire – hazardous or toxic releases
  - Support complaint analysis
    - primarily visible emissions and odors

# AQMD Large Fire Smoke Response

- Trigger Supplemental Air Monitoring
- Forecasting
- Advisory Information and Alerts
- Emergency Rule Considerations

**South Coast Air Quality Management District**  
 Home | Inside AQMD | Community | Business | Technology | Health & Edu

**AQMD** is the air pollution control agency for the smoggiest region of the U.S. We advise residents, while remaining sensitive to the needs of our business and industry clients.

**Special Fire**  
 In addition to its ongoing monitoring, AQMD has deployed temporary mobile air quality monitors and public health information.

**SMOKE ADVISORY**  
[Smoke Safety Tips](#)

**SMOKE ADVISORY**  
 MONDAY, AUGUST 31, 2009

Smoke from the Station Fire in the Angeles National Forest has caused **Unhealthy to Hazardous** air quality at times in the San Gabriel Mountains (Area 15) and the West San Gabriel Valley (Area 8). Very high concentrations of fine particulates are occurring in areas of direct smoke impacts near the fire, especially the foothill communities of Altadena, La Canada, Flintridge, La Crescenta, Tujunga, Sunland, Montrose, Altadena and Acton. The Oak Glen and Fendleton Fires near Yucaipa have also caused areas of **Unhealthy** air quality. Everyone should avoid physical activity in areas heavily impacted by smoke.

Smoke has settled into the valleys of Los Angeles County overnight near the fires, as well as in the eastern San Bernardino Valley. Onshore ocean breezes during the afternoon are expected to move smoke into the mountains and inland valleys. Prior to the onshore flow clearing the western Basin, smoke will linger in much of Los Angeles County and in the eastern San Bernardino Valley.

Air quality will reach **Unhealthy** levels, or higher, in smoke impacted areas, especially near the fires. These areas will likely include:

- the San Gabriel Mountains (Area 15);
- the West San Gabriel Valley (Area 8);
- the West San Bernardino Mountains (Area 36);
- the Santa Clarita Valley (Area 13);
- the San Fernando Valley (Areas 6 and 7);
- the East San Gabriel Valley (Area 9);
- East San Bernardino Valley (Area 35);
- East San Bernardino Mountains (Area 38);
- Banning/San Geronimo Pass (Area 29).

*In any area impacted by smoke: Everyone should avoid any vigorous outdoor or indoor exertion; people with respiratory or heart disease, the elderly, and children should remain indoors. Keep windows and doors closed or seek alternate shelter. Run your air conditioner if you have one. Keep the fresh air intake closed and the filter clean to prevent bringing additional smoke inside.*

To view current air quality conditions by region in an interactive map, see [http://www3.aqmd.gov/webapps/120001/12\\_Map3D.aspx](http://www3.aqmd.gov/webapps/120001/12_Map3D.aspx).

For more tips on avoiding health impacts from smoke, see [http://www.aqmd.gov/CA/CivilDisaster/120001/12\\_SmokeSafety.aspx](http://www.aqmd.gov/CA/CivilDisaster/120001/12_SmokeSafety.aspx) on AQMD's website.

Daily Air Quality Forecasts and Advisories by E-mail: [http://www.aqmd.gov/330000/330000\\_email\\_subscribe.htm](http://www.aqmd.gov/330000/330000_email_subscribe.htm)  
 Current AQMD Air Quality Measurements, Forecasts and Advisories can also be obtained from the AQMD Web Site: <http://www.aqmd.gov> or by Telephone with our Interactive Voice Response System: 1-800-CUT-3800 (1-800-232-7644).  
 Central AQMD: 1-800-CUT-3800 or (909) 596-2000

**Enhanced Vapor Recovery for Gas Station**

**Popular "Blowing Away Air Pollution" program sold out!**  
 September 10, 2009 - Gardeners and landscapers across the region did their part for air quality this summer by registering to exchange 1,500 old, highly polluting leaf blowers for new, low-emission models at a deep discount. Registrants will exchange their

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**AQMD News**  
 AQMD approves for curricula; truck s  
 September 11, 2009  
 Advanced Transportation Technol  
 Colleges to design curricula that v  
 install and maintain new low- and  
 also was approved to establish and staff customer service centers at two  
 major truck stops. [More](#)

Done

Local intranet | Prot

AQMD Website: [www.aqmd.gov](http://www.aqmd.gov)

# Satellite Information for Incident Analysis and Forecasting

- Identify meteorological conditions favorable to air pollution episodes
  - Dry conditions and strong winds are conducive to wildfires & windblown dust
    - typical with Santa Ana wind events
  - Shallow stratus layer near the coast allow smog precursors to accumulate then react quickly in clear inland areas
- Identify and evaluate significant air pollution events, like wildfire smoke and windblown dust
  - Locate current events (fire location, windblown dust source)
  - Assess severity of event and track duration
  - Assess transport and temporal extent
  - Provides smoke model inputs

# Satellite Information for Post-Event Analyses

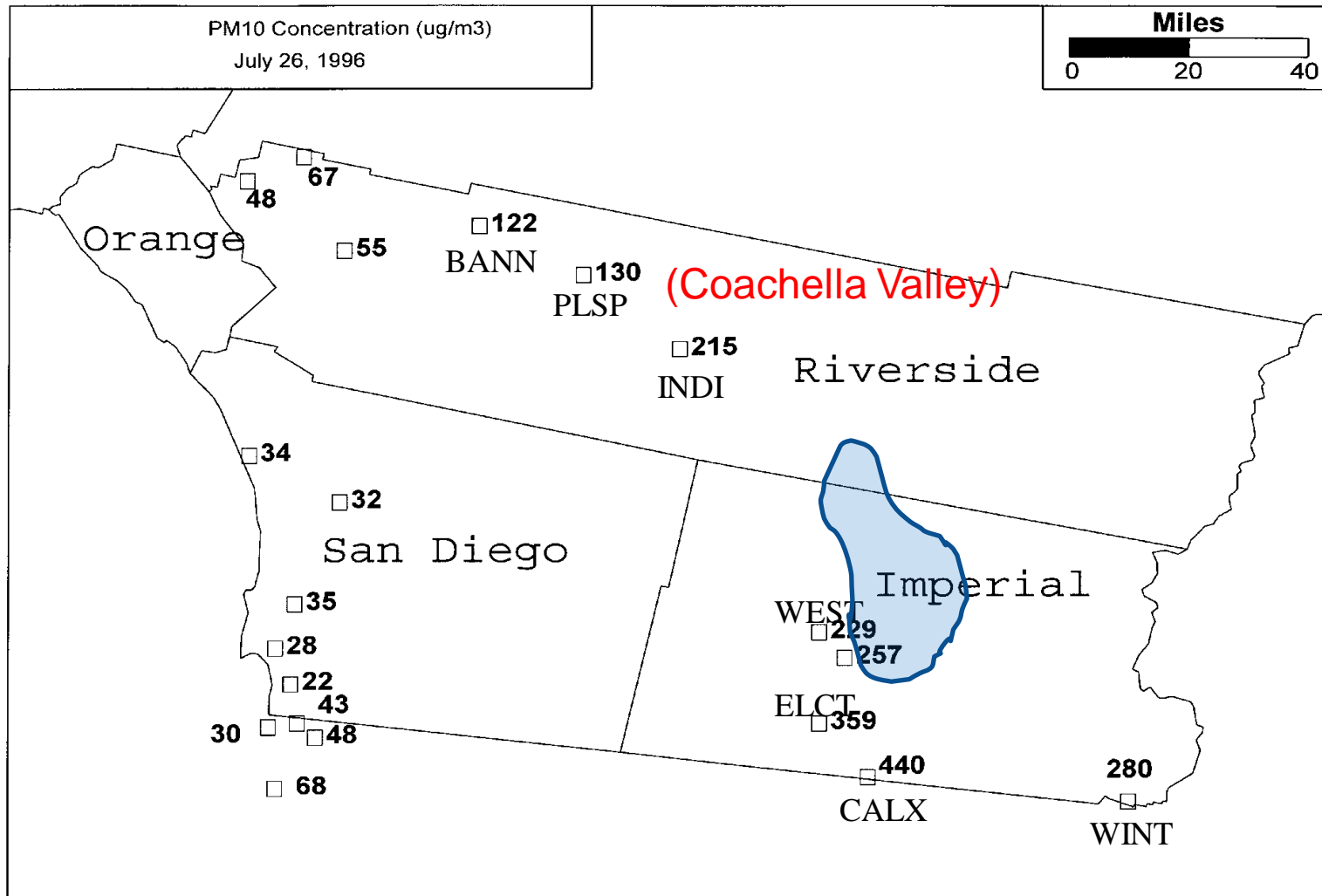
- The U.S. EPA ***Exceptional Events Rule***
  - allows certain air quality events to be flagged and not counted toward attainment status of the National Ambient Air Quality Standard (NAAQS)
- The level of evidence needed for EPA to approve event documentation has increased significantly in recent years, since the *Natural Events Policy* was replaced by the *Exceptional Event Rule*
  - Satellite imagery can provide strong evidence
- In the western US, the Exceptional Event Rule is primarily used for uncontrollable windblown dust and wildfire natural events
- Archived satellite imagery is used to help document -
  - the overall meteorological setting
  - the location, severity, timing, transport and extent of significant air pollution events like fires and high wind PM events
- *One of the most important uses for satellite data for the air quality community is for Exceptional Event Analyses*

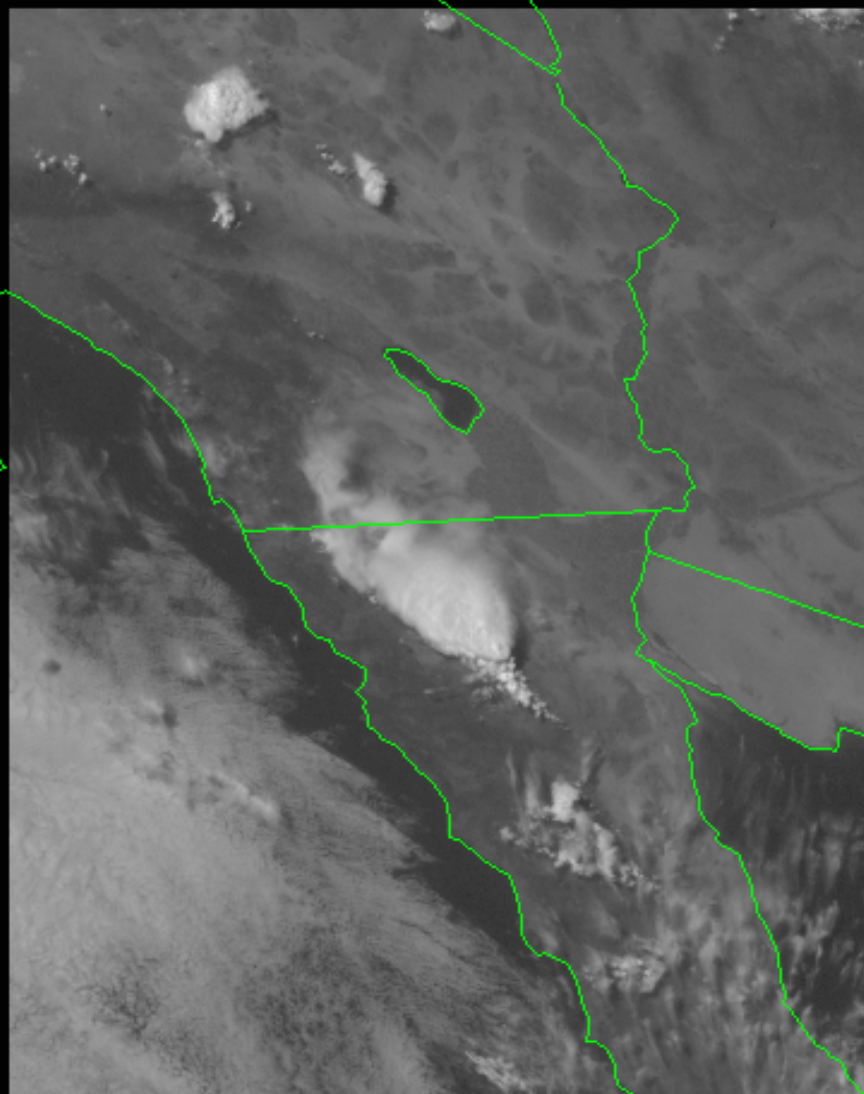
# Some Examples...

# High Wind PM10 Natural Event

## Mexican Thunderstorm Outflow

(winds were light, southeasterly in Coachella Valley)

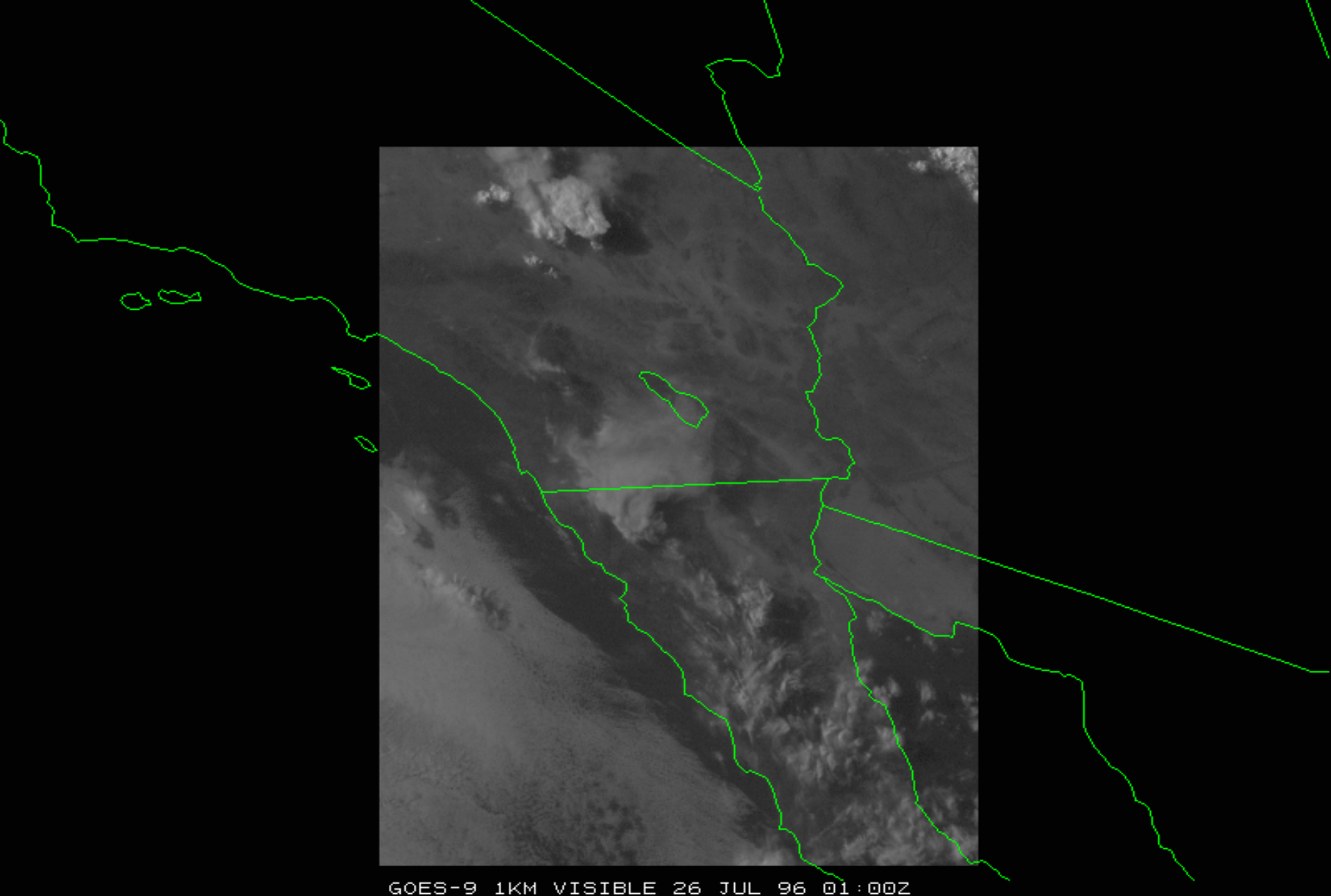




GOES-9 1KM VISIBLE 25 JUL 96 23:00Z

1500 PST July 25, 1996 Visible Satellite Image





1700 PST July 25, 1996 Visible Satellite Image

# Southern California Wildfires October 22, 2007

Strong Offshore Flow (Santa Ana Winds)



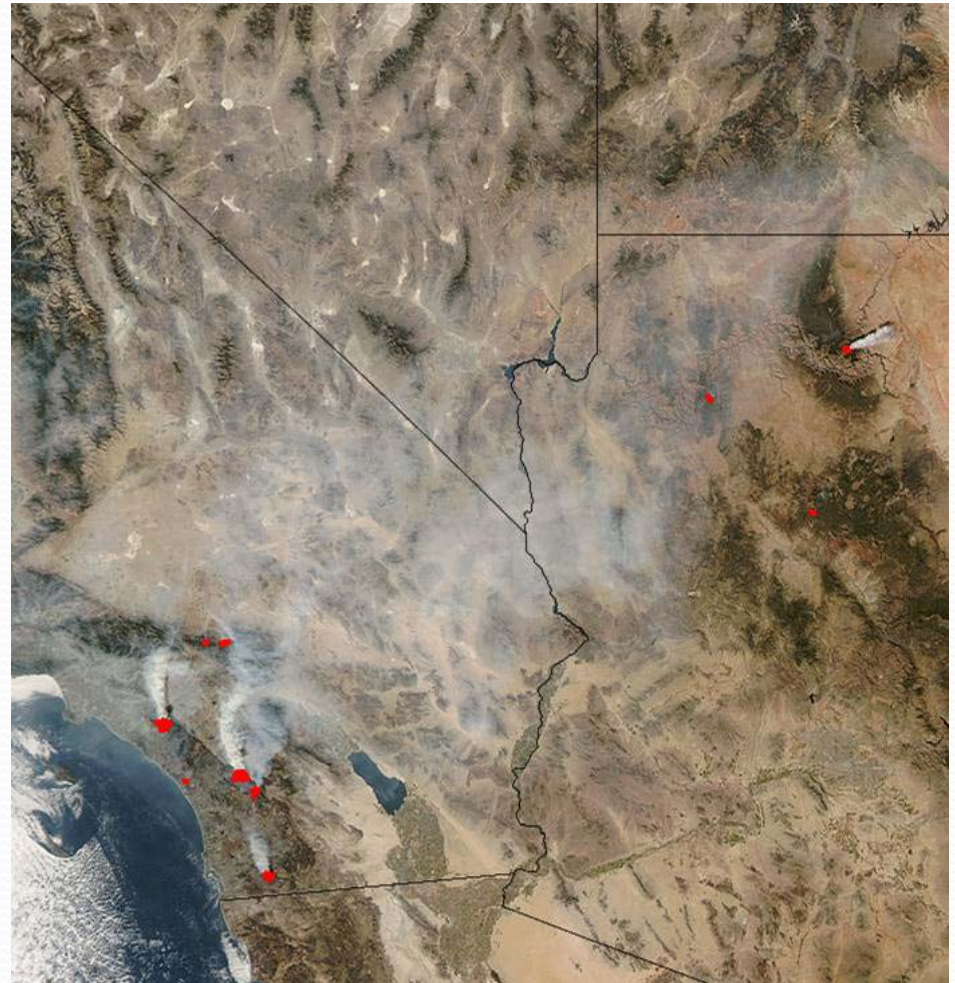
# Southern California Wildfires October 25, 2007

Weak sea breeze returns – smoke fumigates the Basin



# Southern California Wildfires October 26, 2007

- Coastal Eddy brought southerly winds
- San Diego and Orange County fires continued to impact the Basin

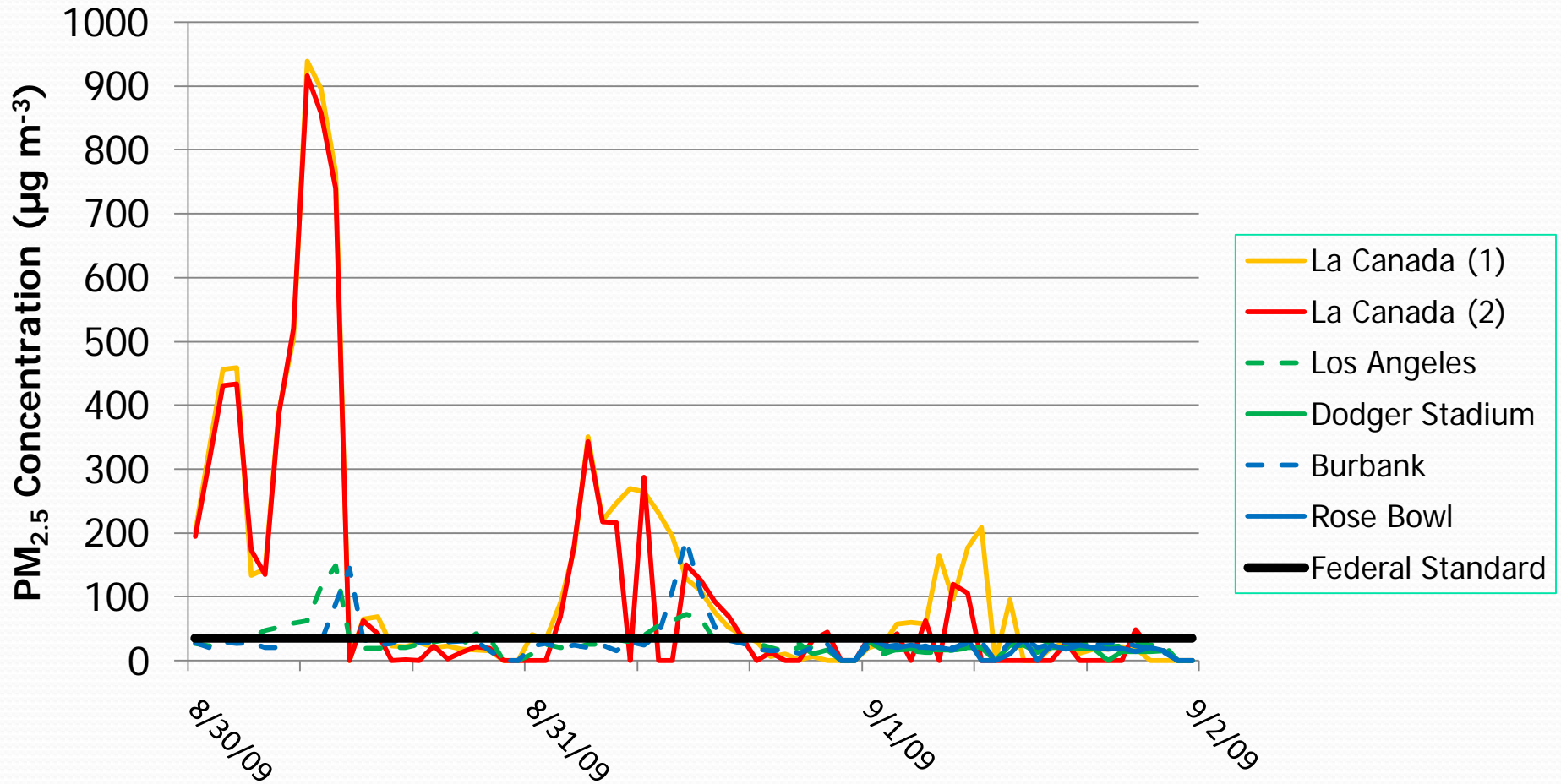


# Station Fire: August – September 2009

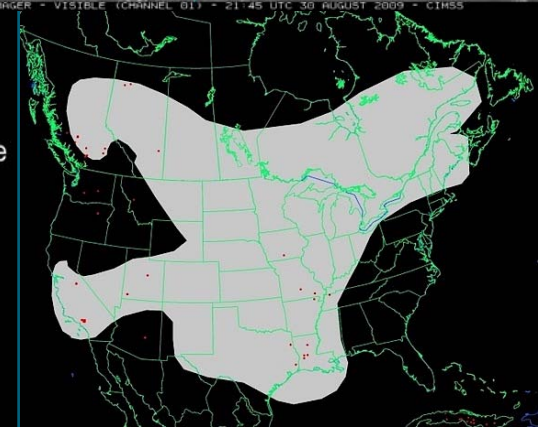
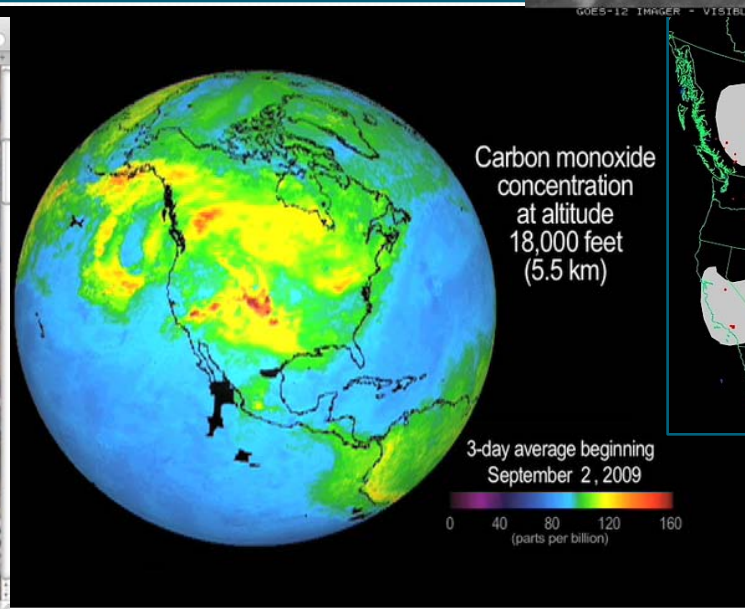
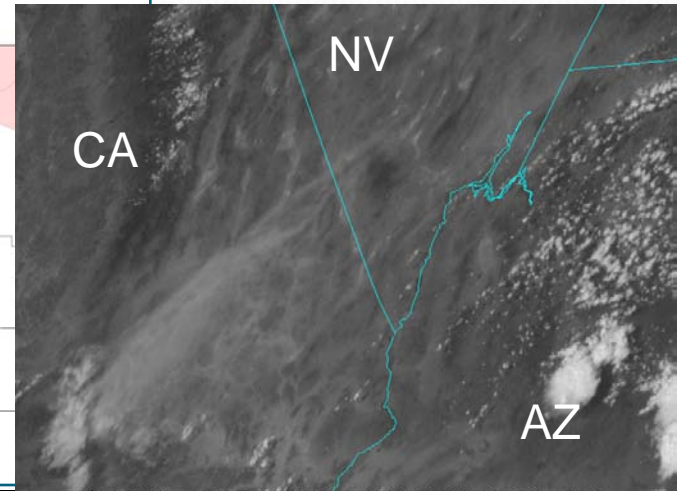
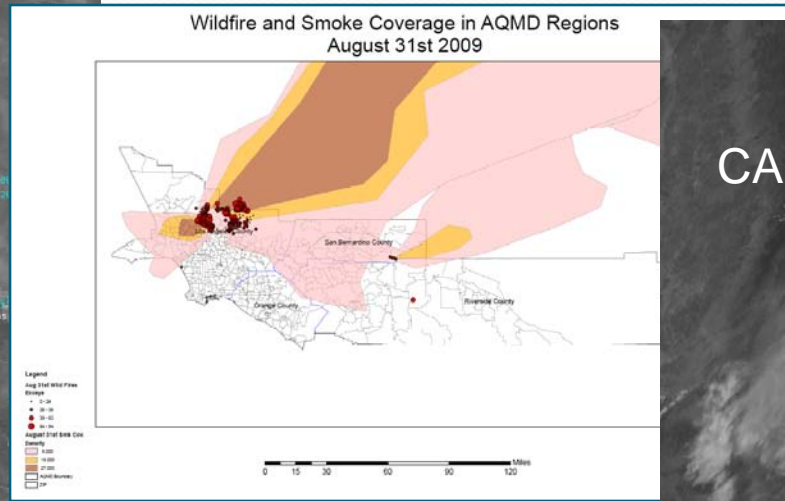
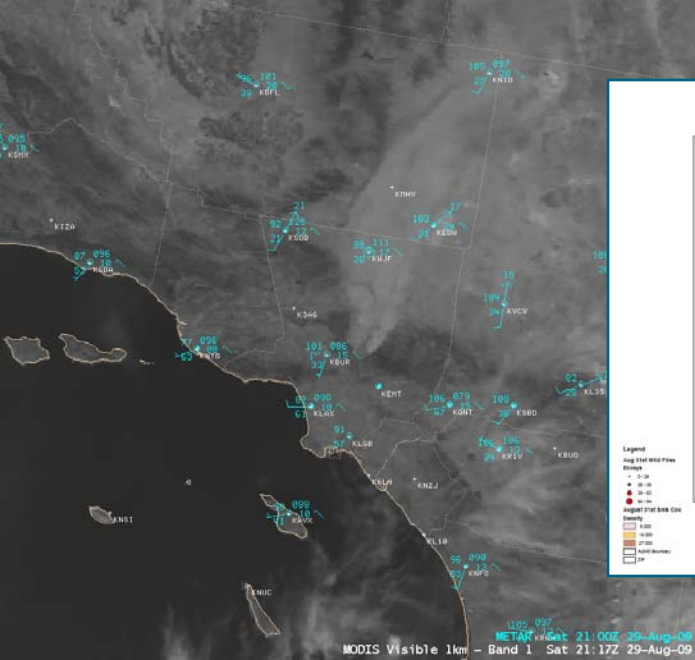


# Station Fire 2009

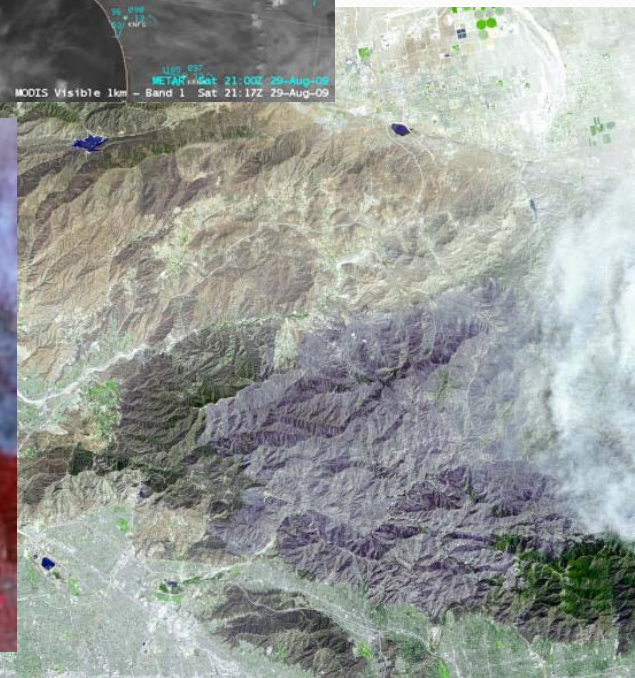
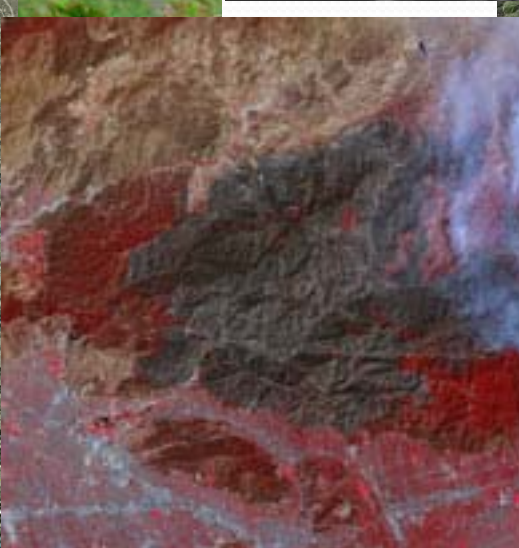
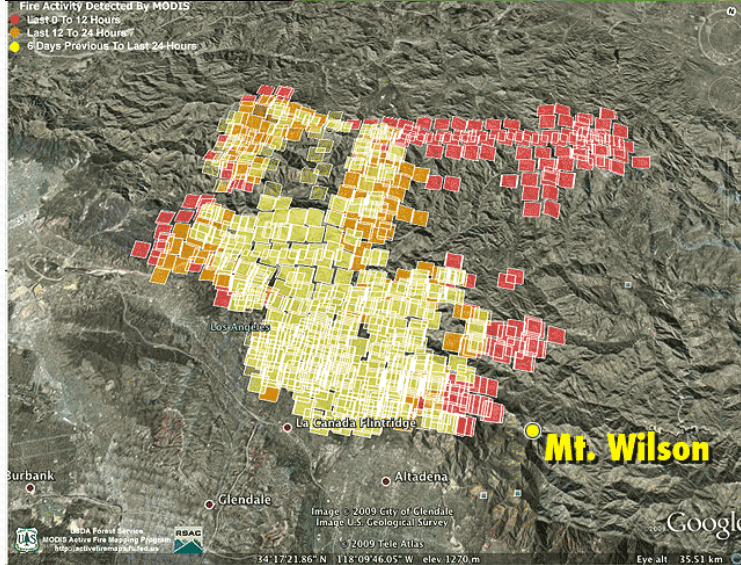
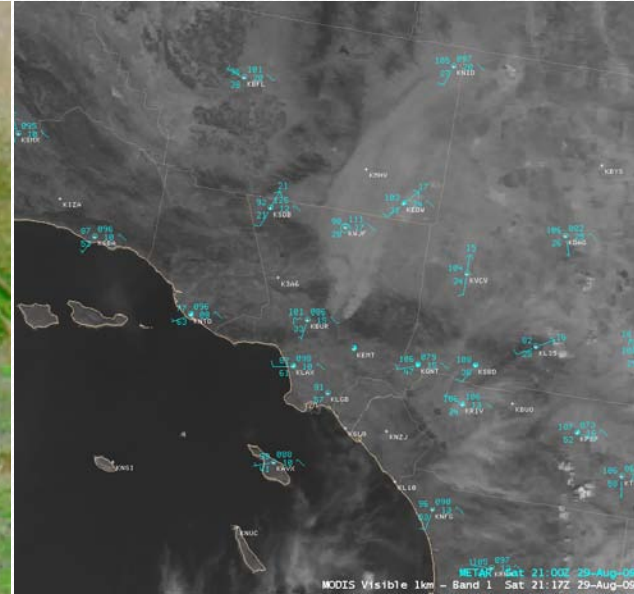
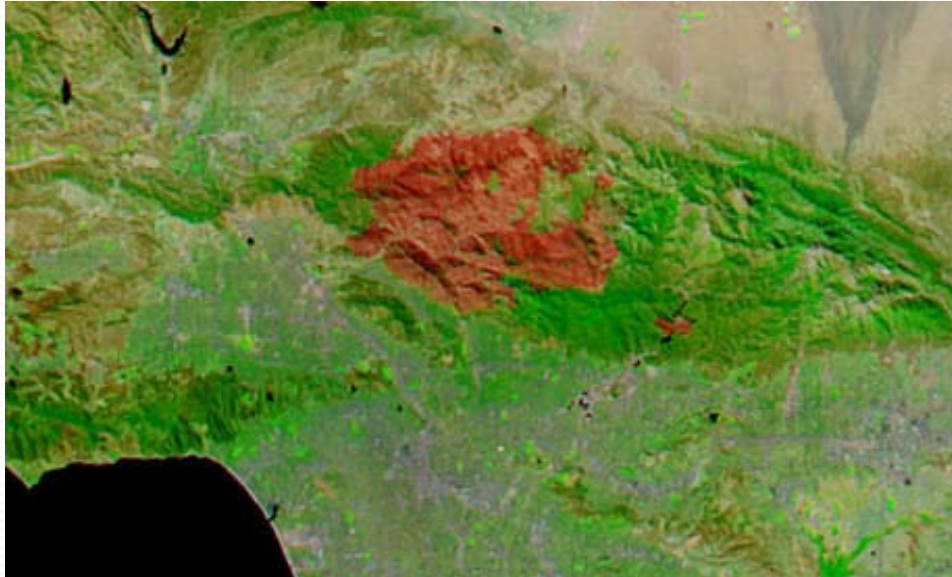
## PM2.5 Monitoring Data: Station Fire



# Smoke Transport Assessment



# Fire Extent and Burn Area Assessment







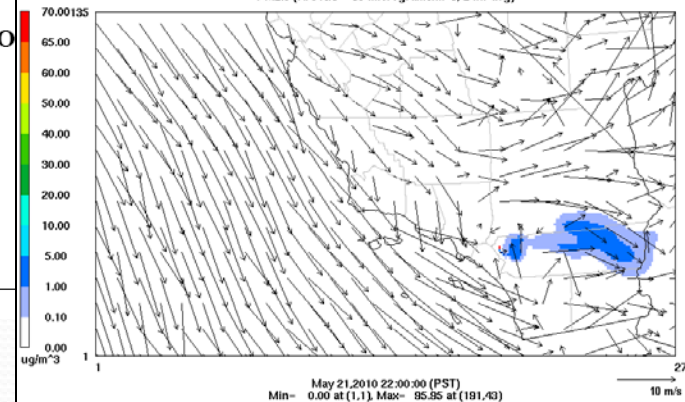
## INCIDENT INFORMATION FACT SHEET

Incident Name Fairview Incident Number CARRU-46366  
 Date Reported 05/26/2010 Time Reported 12:00 PM  
 Type of Incident Vegetation Fire (CONTAINED)  
 Incident Location Fairview Avenue X Whitmer Avenue City East Hemet  
(TB 842-A1)  
 Size/Type of Fuel etc. Cause Equipment  
 Loss:  (STR)  (Content)  Vehicle(s)   
 Save  (STR)  (Content)  Cost to Date   
 Injuries: Fatalities:  Critical:  Moderate:  Minor:  Non-Injury:   
 Transported Ground AMB:  Air AMB:   
 Containment Time 05/26/2010 1630 Control Time

Resources Assigned

### Prescribed Fire & Wildfire Smoke Prediction

MMS Forecast: 2010052100  
PM2.5 (NAAQS - 35 micrograms/m<sup>3</sup>, 24hr avg)



# What's Next???

- Beyond Incident Status Summary (ICS-209) Fire Reports ...
  - Satellites can provide improved fire and smoke detection and better linkages to prognostic smoke and air quality models
- Can new satellites and analysis tools improve our ability to distinguish smoke or dust from ground, clouds and fog?
- Can new GOES satellites provide better spatial resolution with good temporal resolution to resolve smaller fires and smoke and more localized dust events?
- Can satellite-derived air pollutants improve forecasts?

... GOES-R launch scheduled in 2015