



EPA's Advanced Monitoring Initiative



Application of satellite data for monitoring of $PM_{2.5}$ formation and transport in San Joaquin Valley

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Presented by Jay Al-Saadi

Objective: Assess capabilities of NASA satellite data for improved monitoring and prediction of air quality associated with fine particulates

Goals

- Test understanding of $PM_{2.5}$ in San Joaquin Valley (SJV)
 - Sources
 - Effectiveness of control measures
- Evaluate adequacy of ground network
- Incorporate results in $PM_{2.5}$ State Implementation Plan mid course review
- Identify possible alternative for future intensive (expensive!) field studies

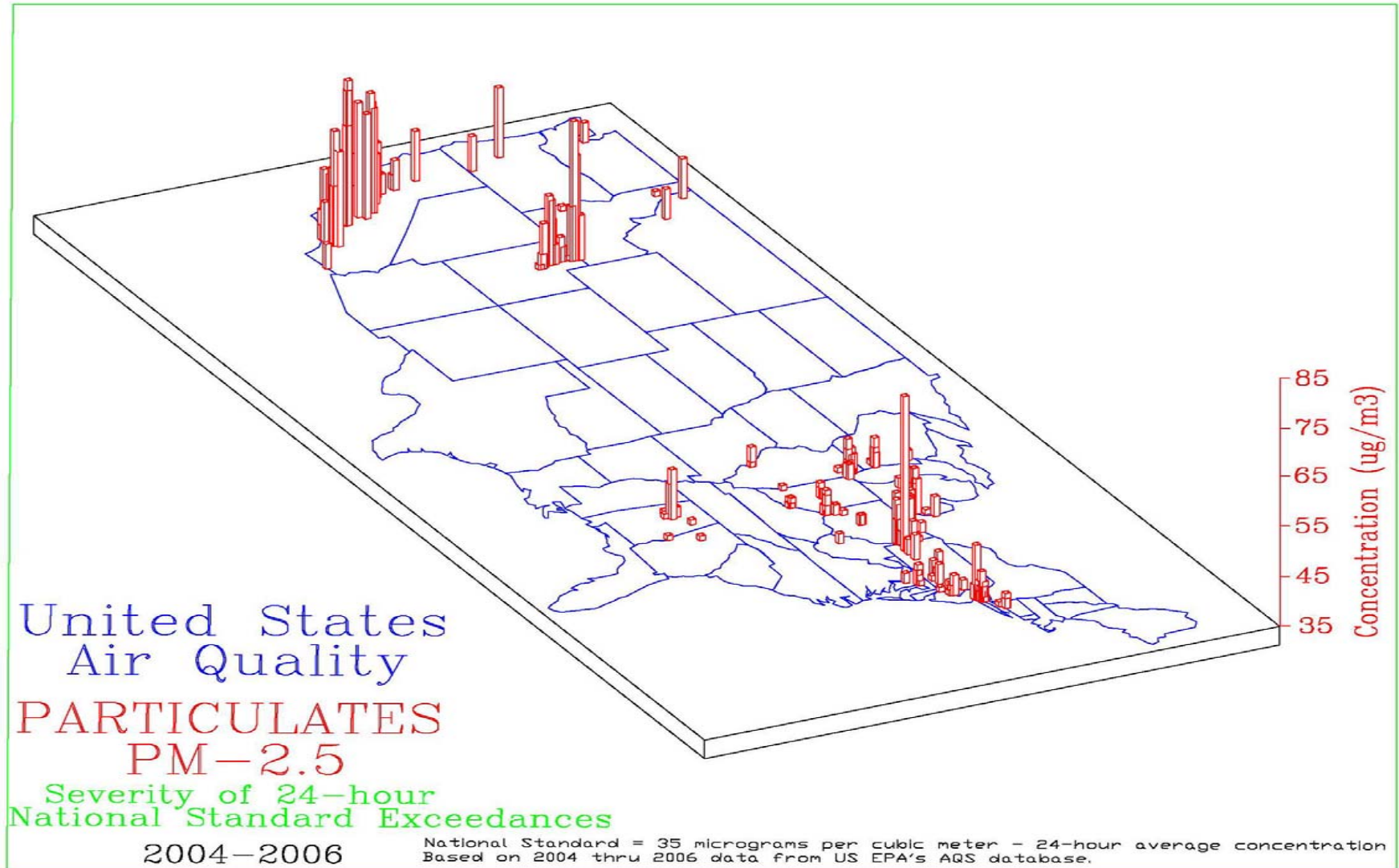
Benefits expressed in NASA AQ Apps Framework

- Benefit to partner(s)
 - Assessment of NASA satellite data capabilities for improved monitoring and prediction of air quality associated with fine particulates
 - Assessment of airborne HSRL capabilities for supporting SIP-related requirements for aerosol
 - Data set for evaluation of pre-operational NOAA/NCEP NMM/CMAQ aerosol forecasts over western US

- Benefit to NASA Earth science
 - Improved MODIS retrievals over a challenging region
 - Contribution to CALIPSO validation by expanding HSRL-based aerosol sub-typing database

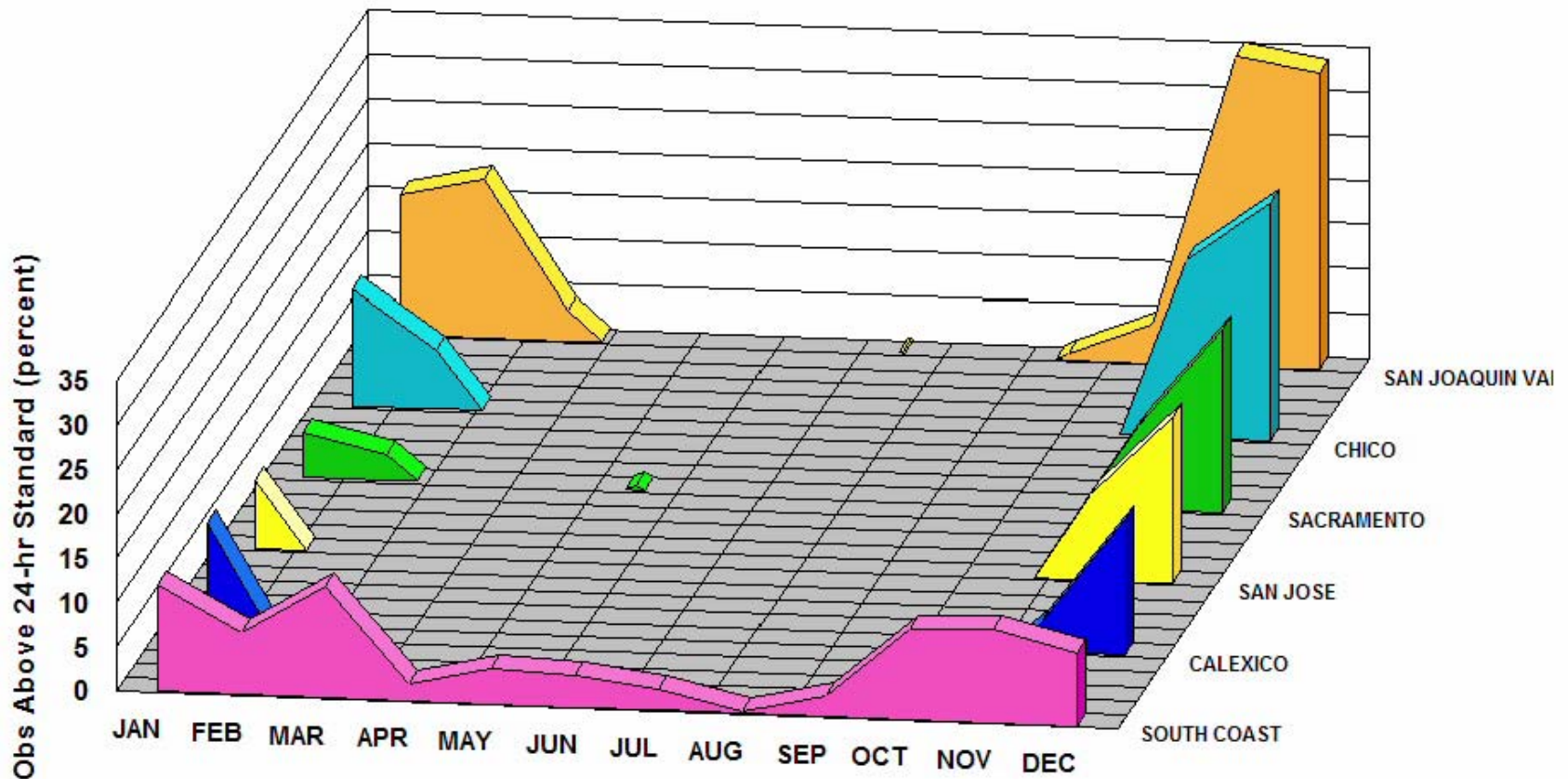
- Benefit to NASA Applied science
 - Benchmark for application of MODIS for particulate monitoring in California
 - Can be considered a demonstration of GEO/GEOSS

High PM_{2.5} Concentrations



SJV high PM_{2.5} concentrations and seasonal variation

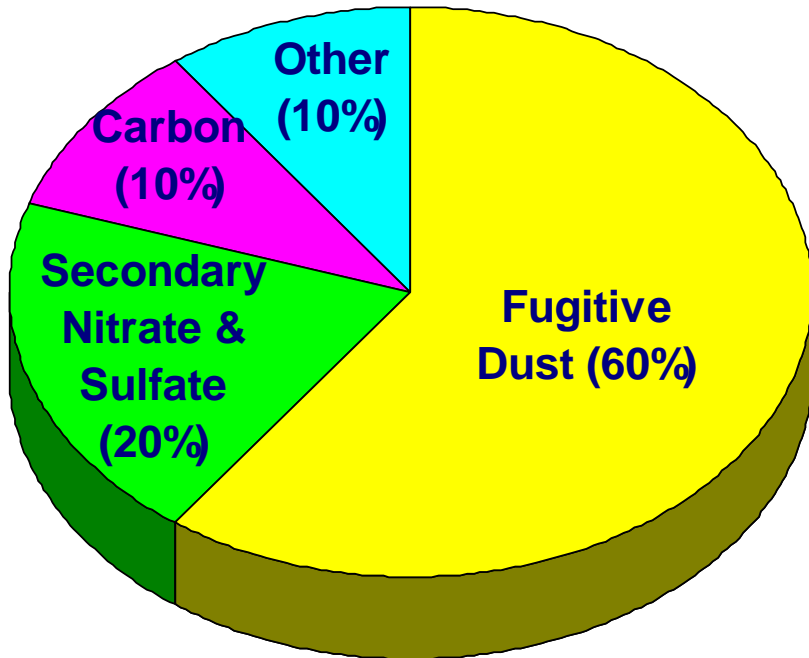
U.S. EPA Region 9 Air Quality PARTICULATE MATTER - PM-2.5 Monthly Variation of 24-hour Exceedances 2004-2006



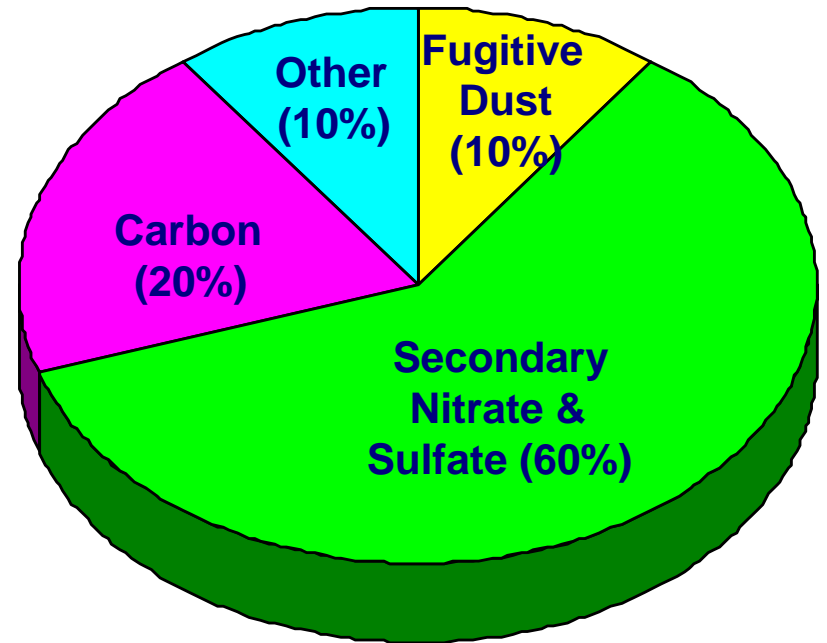
National PM-2.5 24-hour standard is 35 micrograms per cubic meter.
Based on data in AQS as of 3/5/07.

Seasonal Variation in PM_{2.5} Composition

Fall Composition



Winter Composition



Provided by CARB

Approach

- Obtain airborne LIDAR measurements co-located with surface monitor locations and co-timed with satellite overpasses to link satellite observations with surface measurements
- Use detailed aerosol vertical and size information from LIDAR measurements to interpret/link satellite and surface observations
- Evaluate targeted improvements to MODIS Aerosol Optical Depth (AOD) retrieval algorithm
 - Horizontal resolution
 - Humidity/reflectance parameters

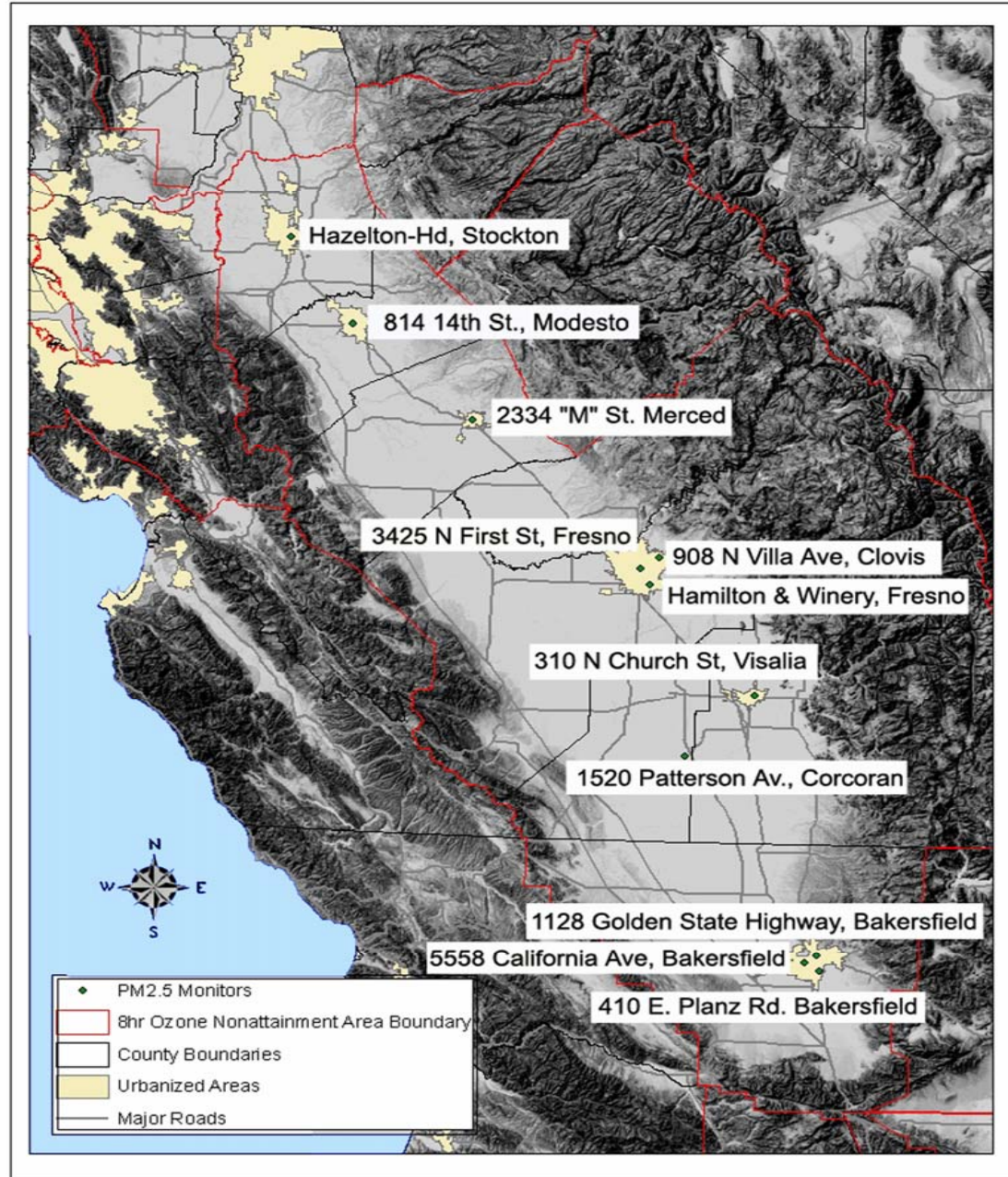


February 2007 Intensive Measurement Campaign in SJV

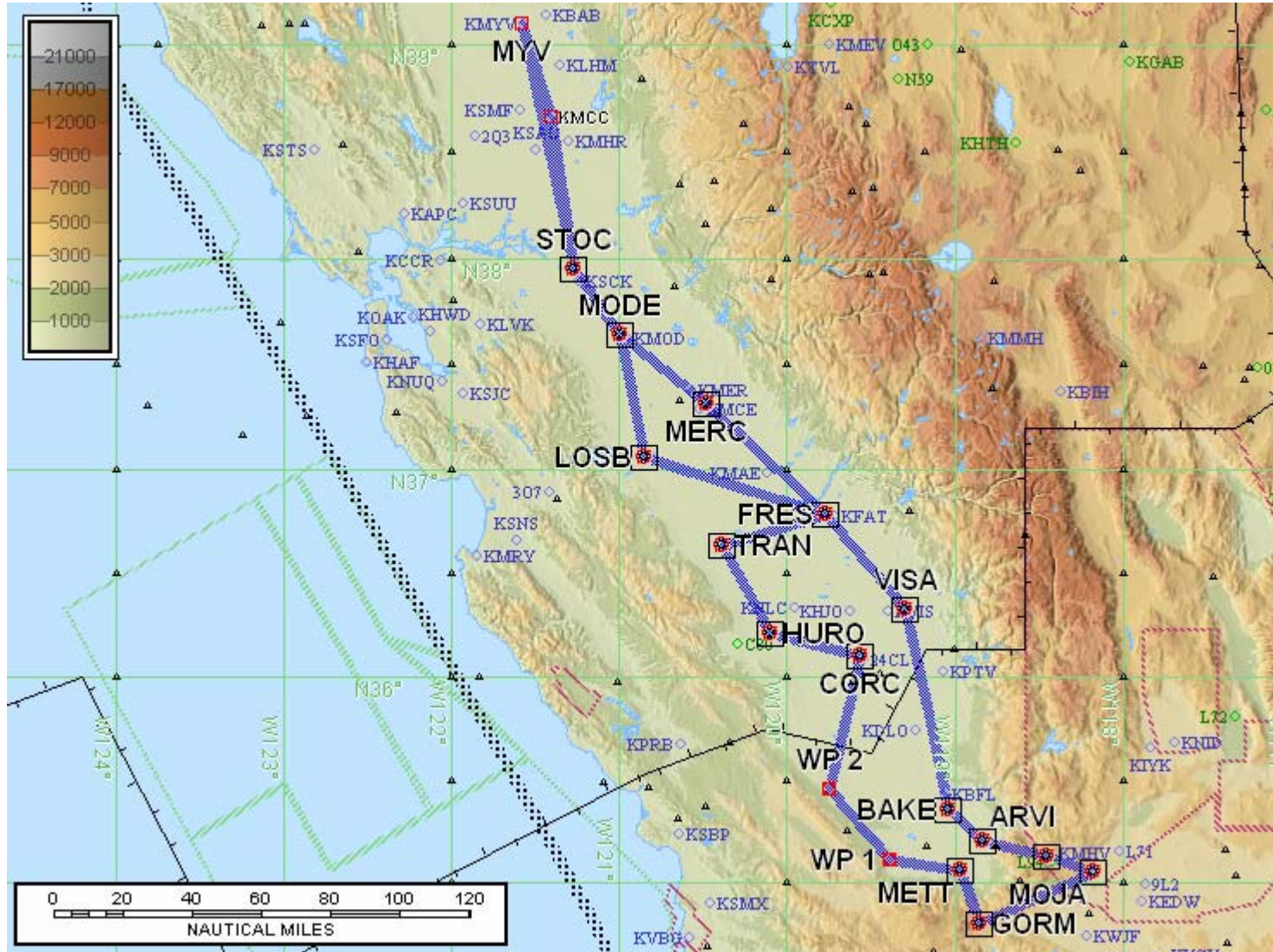
Measurements/Inputs during February 2007 Intensive:

- NASA-Langley Research Center Airborne High Spectral Resolution Lidar (HSRL) aboard NASA B200 King Air (28000ft)
- MODIS (Terra and Aqua), GOES, MISR satellite aerosol measurements
- Ground-based measurements: CARB/SJV APCD surface PM_{2.5} and aerosol speciation, NASA Aeronet, US Forest Service portable aerosol monitors
- Forecast guidance: SJV APCD AQ forecasts, NOAA/NWS/NCEP pre-operational CONUS numerical guidance

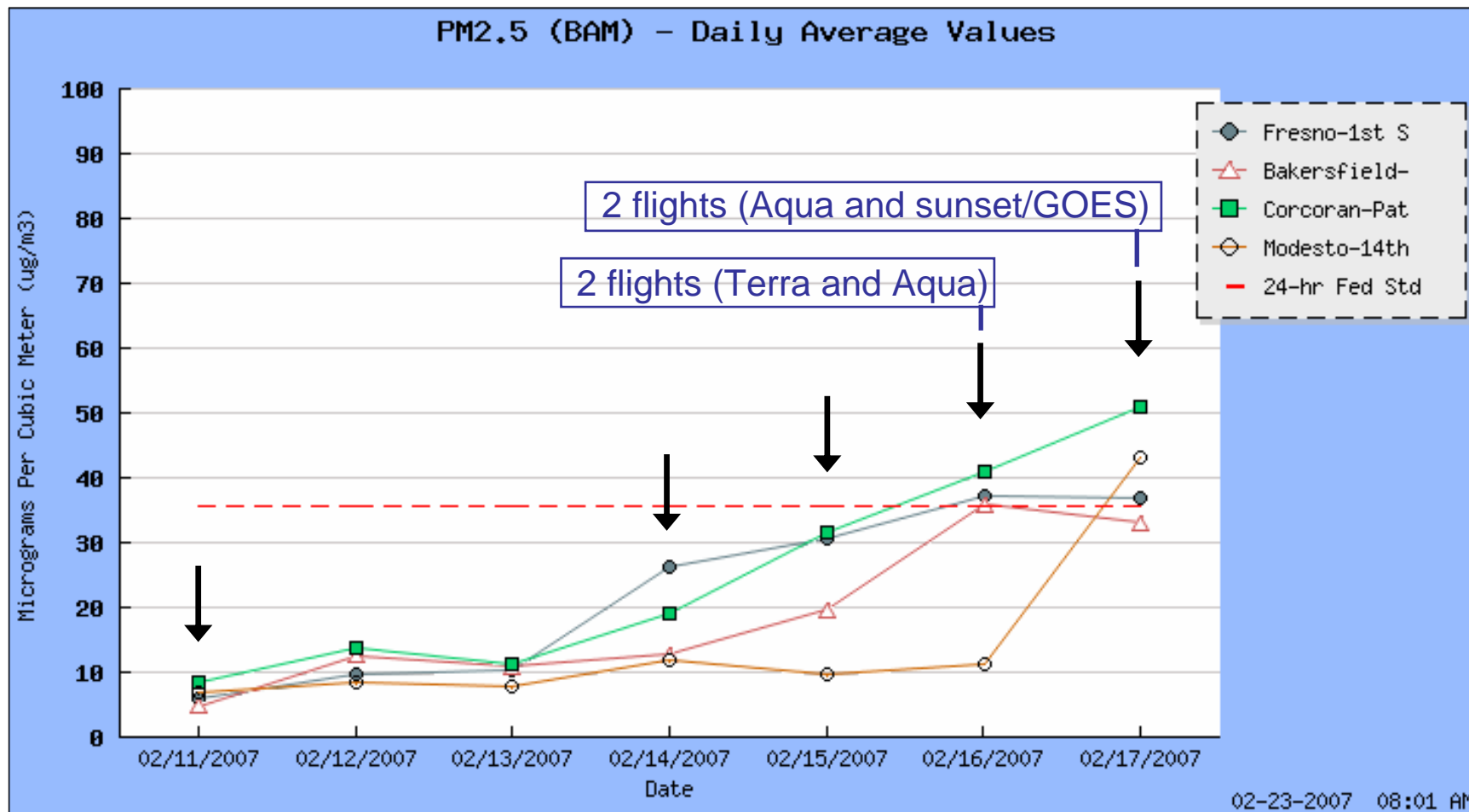
Ground-based monitoring network in SJV for PM_{2.5}



NASA King Air Flight Track in SJV for February 2007 Intensive



PM_{2.5} Concentrations in SJV (February 8-17, 2007)



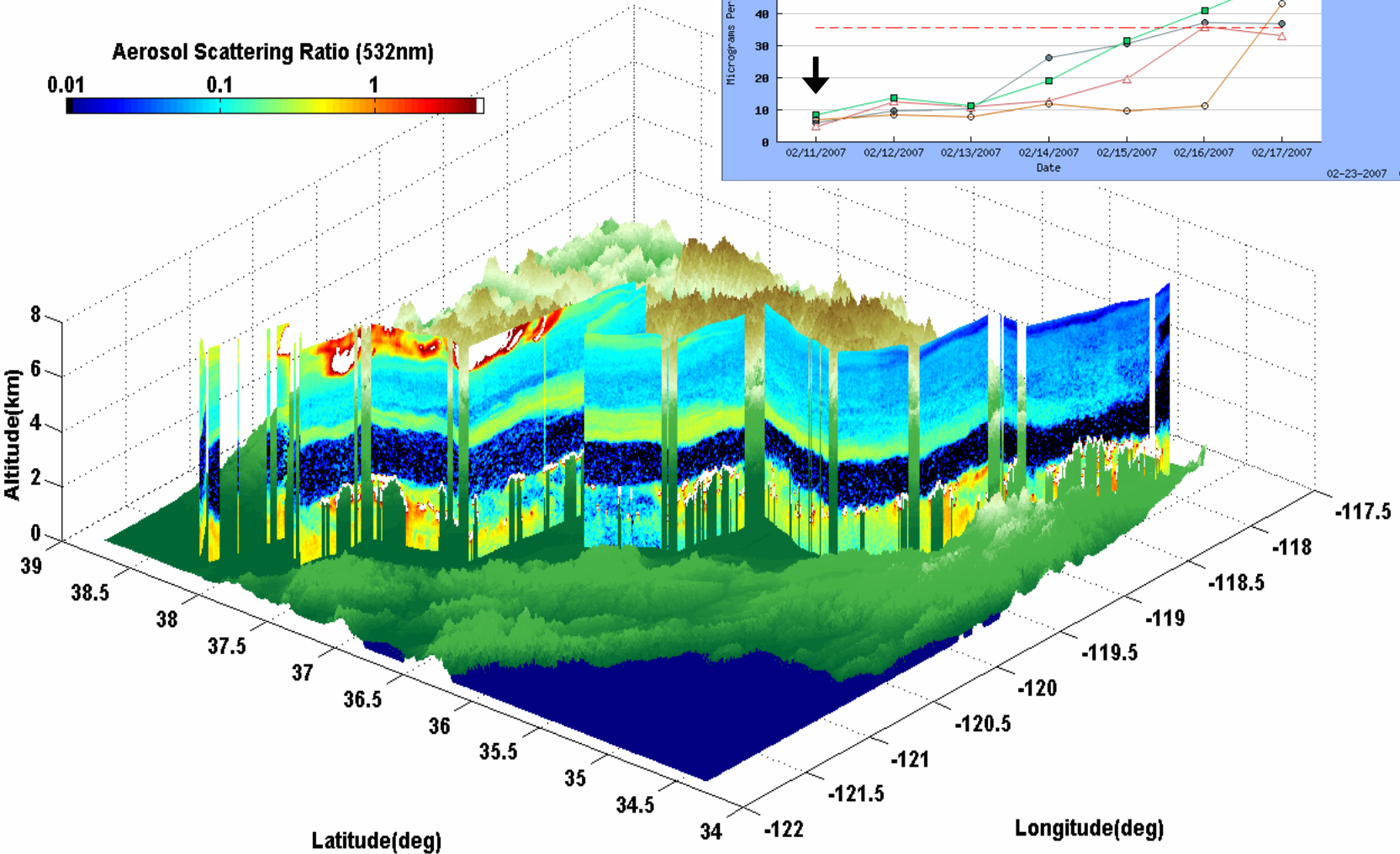
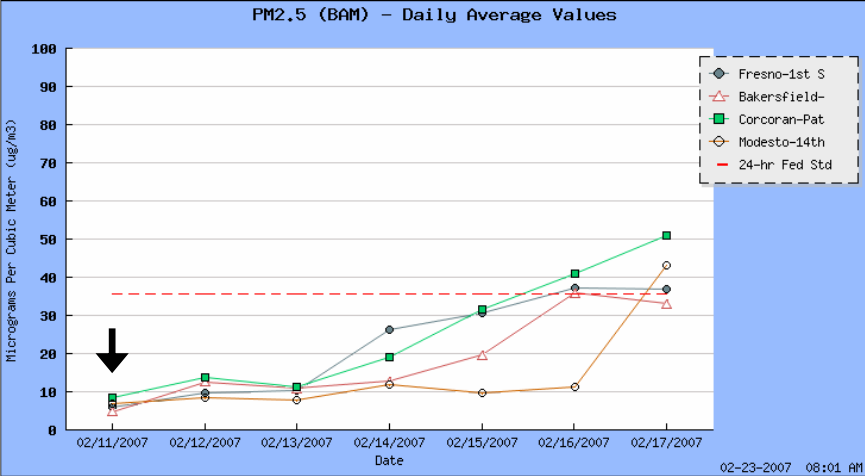
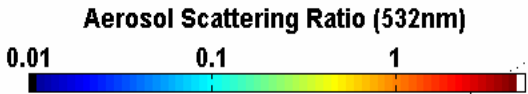
Arrows indicate aircraft flight days

February 11, 2007: Elevated haze layer over SJV



11 8:44PM

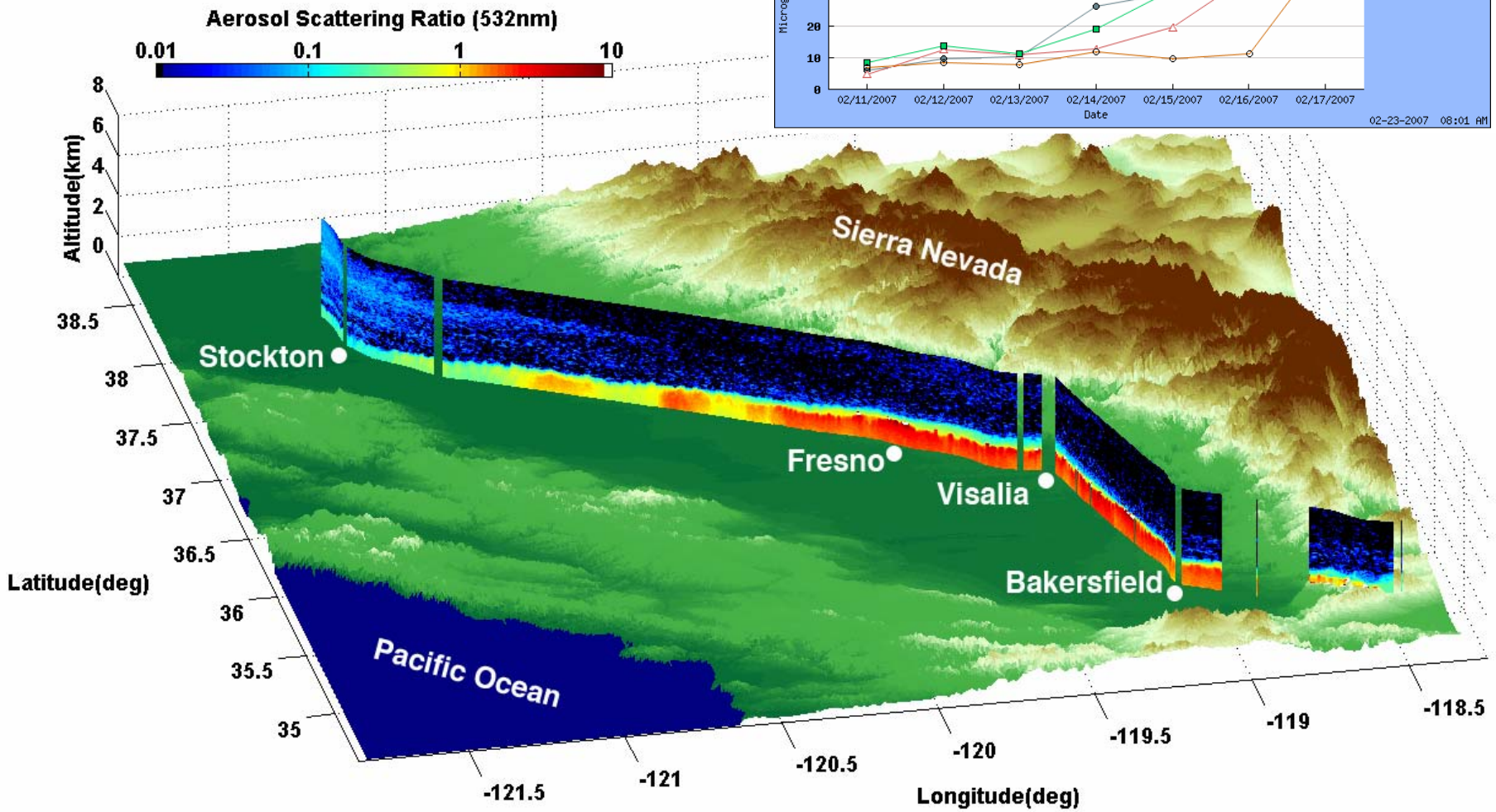
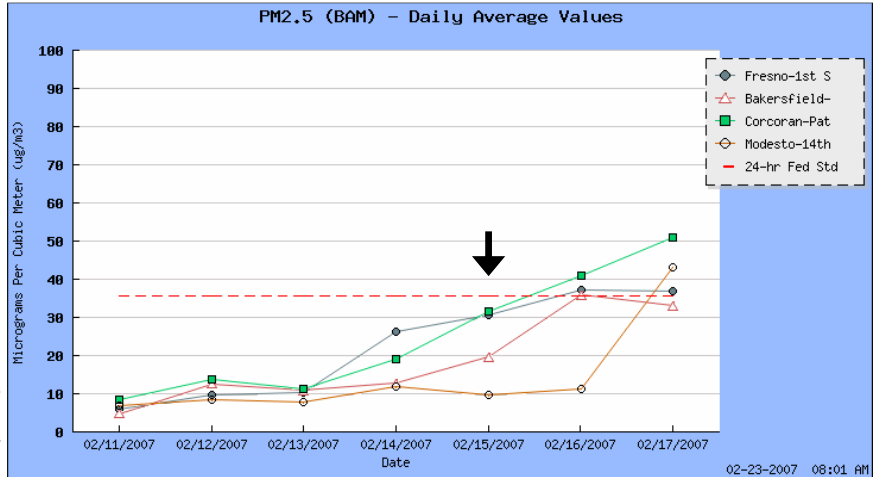
February 11, 2007: Aerosol measurements in SJV (preliminary data)



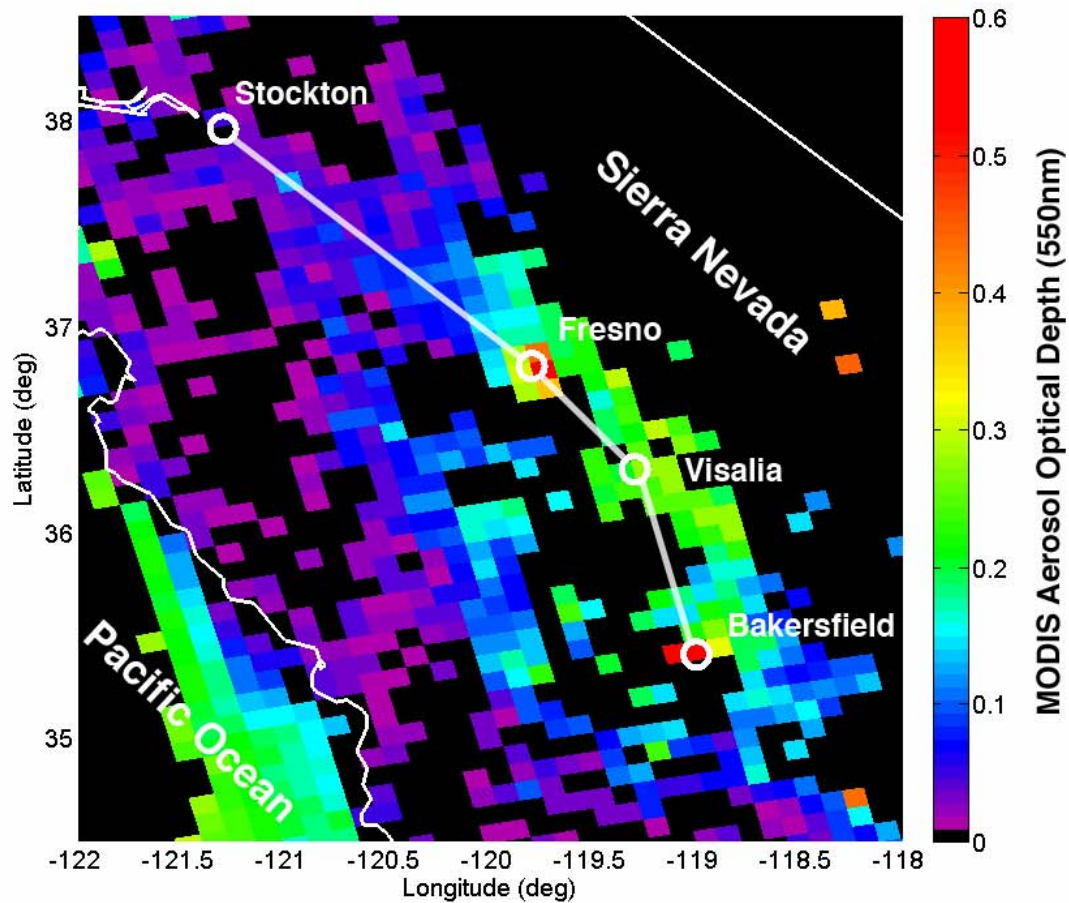
February 15, 2007: MODIS True Color Image



February 15, 2007: Aerosol measurements in SJV (preliminary data)



February 15, 2007: MODIS Aerosol measurements in SJV (preliminary data)



Outreach/Communication

- EPA Region 9 hosted a media day during the campaign, included researcher interviews and “tours” of the aircraft
 - 3 major networks and ~7 local newspaper reporters attended
 - 3 minute feature on local ABC evening news
- Feature articles on home pages of EPA Region 9 (including short EPA-produced video) and NASA

<http://www.epa.gov/region09/air/features/nasa-air-sampling.html>

<http://www.nasa.gov/vision/earth/environment/SanJoaquin.html>

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Using Technology to Assess Air Quality in the San Joaquin Valley


It may sound like fiction - NASA pilots, EPA scientists, lidar instruments, and an airplane flying back and forth over the San Joaquin Valley - but it is a fact.

Last week, in an effort to better understand how particulate matter pollution is formed, EPA teamed up with NASA scientists to bring advanced monitoring technology to the valley.


Air pollution is easily trapped inside a valley and the San Joaquin Valley is long, low, and surrounded by mountains on three sides. The recent population boom, busy highways, and other sources of pollution have combined with the natural topography to create some of the highest concentrations of fine particulate pollution in the country. Improving the valley's air for the 3.3 million people who live there is a priority for EPA.

The plane that flew over the valley was equipped with lidar, an advanced monitoring instrument from NASA that makes unique aerosol (particulate matter) measurements. These measurements give a downward snapshot of the entire aerosol that is in the atmosphere. (See the graphic below.) The measurements are useful for assessing the sources and transport of the aerosol.


The data gathered during the flights can help us better understand the underlying science of particulate matter pollution and help the San Joaquin Valley Air Resources Board and the SJV APCD develop more informed air quality plans. EPA will continue to work with the California Air Resources Board and the SJV APCD same goal - cleaner air for the valley residents.



Particulate pollution in the San Joaquin Valley




Air monitoring equipment (lidar) aboard the NASA Study plane



Aerial photo of San Joaquin Valley, from NASA study plane

How NASA's Satellites Helped with Air Sampling

Graphic courtesy of NASA; Visit [NASA's A-Train site](#) for more information



NASA - Clearing the Air: NASA and the EPA Work to Understand the Quality of the Air We Breathe

http://www.nasa.gov/vision/earth/environment/SanJoaquin.html

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Clearing the Air: NASA and the EPA Work to Understand the Quality of the Air We Breathe

03.19.07

A warm and cozy fireplace is the perfect setting on a cold winter night. As you curl up in front of your fire however, you probably aren't thinking about asthma, heart attacks, or even cancer. But, the Environmental Protection Agency (EPA) warns that wood-burning appliances and fireplaces generate smoke and may emit large quantities of air pollutants containing hundreds of harmful chemical compounds.

The EPA is working with NASA to improve what we know about the air we breathe.

The two agencies recently completed a short but intense field campaign to study air quality in the San Joaquin Valley in central California. Using instruments on aircraft, satellites, and at ground sites, scientists are working to improve observations and understanding of air quality in this region, an area that is plagued with air pollution.



Image right: The flight track for the campaign. The EPA and NASA researchers flew this same path each day of their mission. Click on the image to see a larger format version. Credit: NASA

"The San Joaquin Valley has some of the highest concentrations of fine particulates in the nation," said Jim Szykman, an EPA research scientist working at NASA Langley Research Center in Hampton, Va. "The wintertime is when these concentrations, or poor air quality days, can be really bad because of a lot of factors, including, we believe, wood burning for heat, as well as meteorological processes like temperature inversions."

A temperature inversion means there is a cooler air mass near the ground and warmer air at higher altitudes. This atmospheric condition is usually caused by a passing cold front or from the invasion of sea air by a cooler onshore breeze, which is typical of the wintertime conditions in central California. Because of central California's location - the ocean to the west and mountains to the east - wintertime temperature inversions can cause pollutants to get trapped because lower level cool air does not rise and then disperse like warm air.

Szykman and Rebecca Rosen, also from the EPA, are the co-principal investigators for the San Joaquin Valley Advanced Monitoring Initiative. Together the EPA and NASA are using a suite of instruments to study atmospheric particles, called aerosols, which come from many sources: burning wood; vehicles; construction and agricultural activities; and stationary sources such as refineries.

During the campaign, researchers flew an advanced laser instrument called the HSRL (High Spectral Resolution Lidar) on a NASA King Air B200 aircraft, based at NASA Langley. The lidar instrument is an innovative technology that is similar to radar. Instead of the radio waves that radar uses to determine and map locations, directions and speeds, lidar uses laser light.



Image left: Inside the King Air B200, Dave Harper from NASA Langley monitors the instrument as it makes measurements of the air above the San Joaquin Valley in central California. Credit: EPA

The King Air is specially equipped so that the researchers can transmit the laser out of a window in the bottom of the airplane and use a telescope to measure the

Next Steps

- Analysis of HSRL, satellite, and ground-based aerosol measurements from February intensive
- Satellite/surface comparison for other periods
- Regional air quality modeling analysis (CARB)