

# The Rim Fire

August 17<sup>th</sup> to mid September 2013

Third largest fire in California history (400 square miles)

What can satellites tell us about the fire and it's downwind smoke impacts?



REUTERS /MARI WHITTAKER /LANDOV

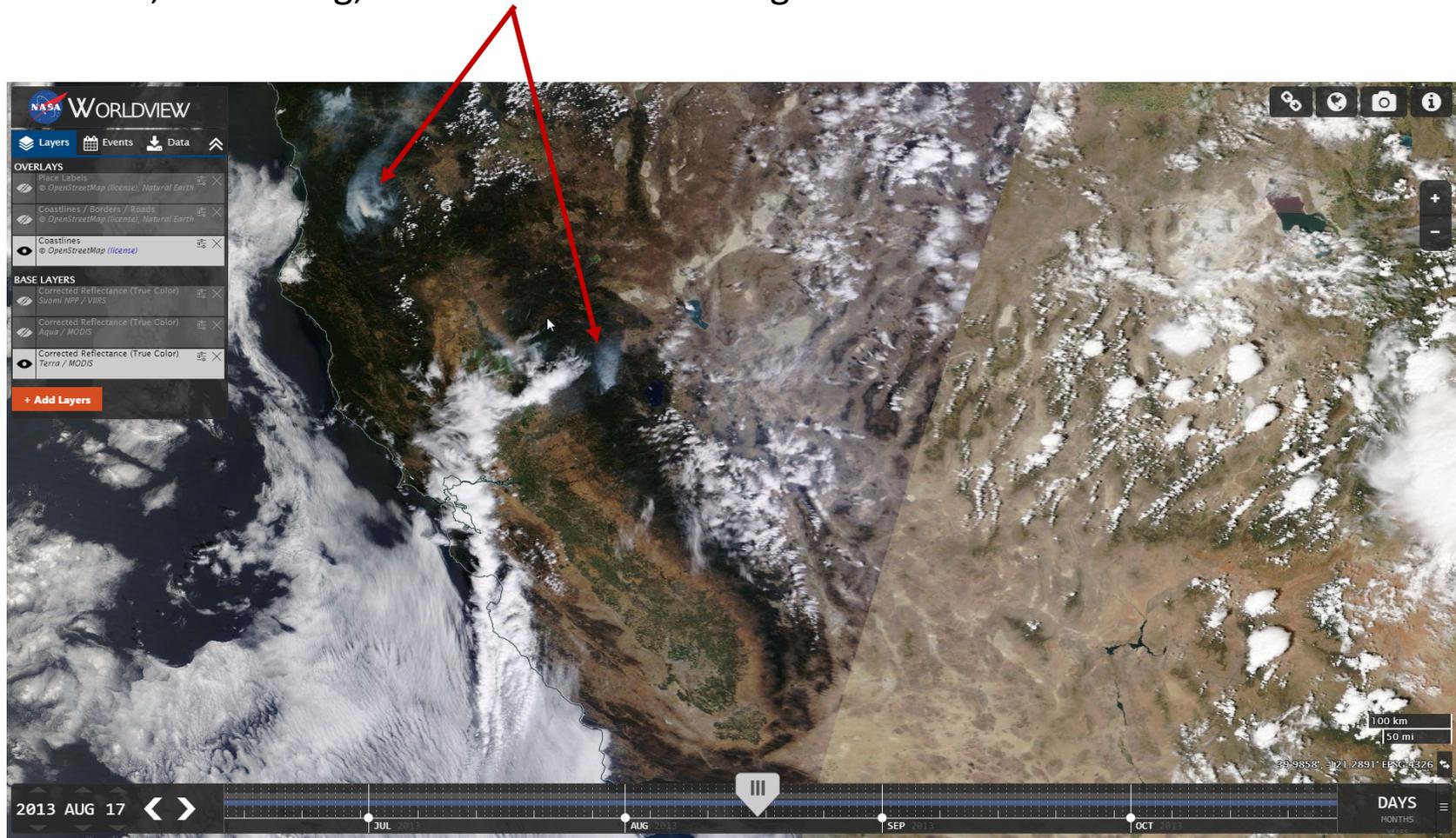
Tools: Worldview, AirNow-Tech Navigator, and CALIPSO browse images

# Browsing in Worldview

Navigate to 2013 AUG 17

Zoom to California

Notice clouds, coastal fog, and smoke from existing fires



# A bit on fire remote sensing

Fires are detected from space in two ways

## 1. Thermal anomalies (“hot spots”)

- Detect heat from actively burning areas by increase in infrared signal compared to surroundings
- Large fires are detected in clusters of many hot spots
- Some small fires are detected, many are missed

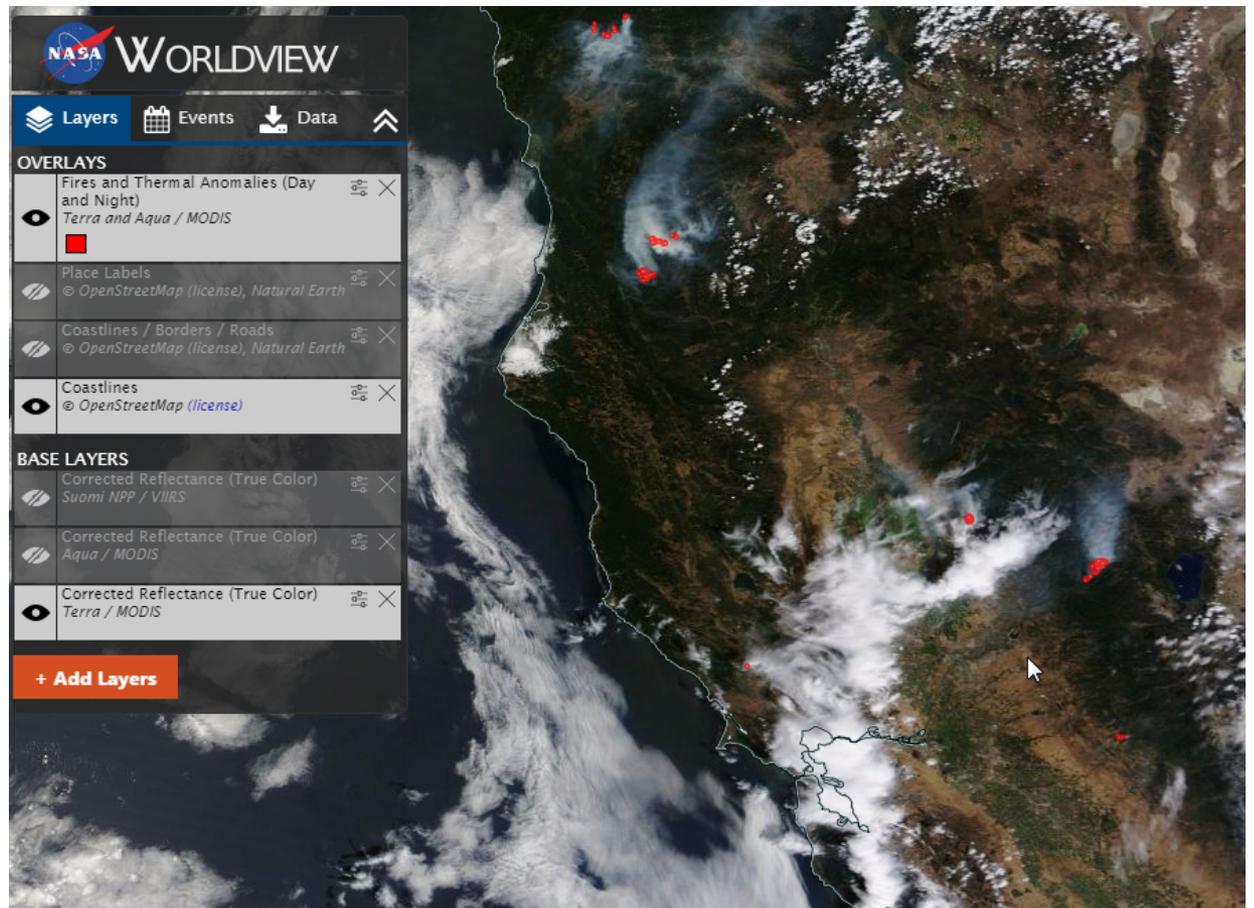
## 2. Change detection (“burn scars”)

- Detect change in vegetation greenness before and after a fire
- Provide good estimates of final fire size and information on the severity of the burn
- Cannot detect burns that occur under the forest canopy

# Overlay Fires

Click Add Layers

Fires → Fires and Thermal Anomalies → Aqua and Terra/MODIS

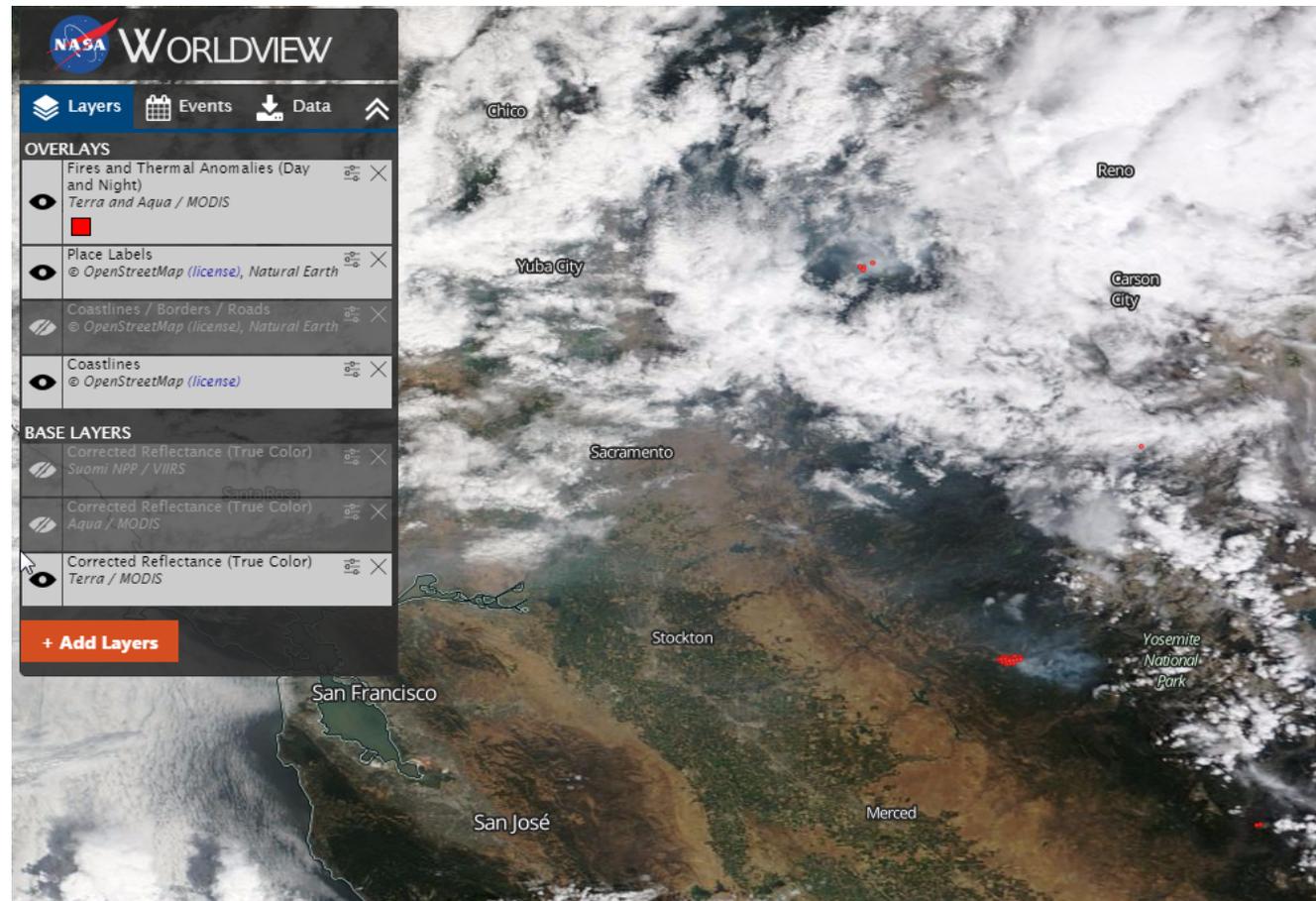


# Look for the start of the Rim Fire

The fire was just west of Yosemite National Park

Display Place Labels to see Yosemite

Navigate forward day-by-day until the fire appears



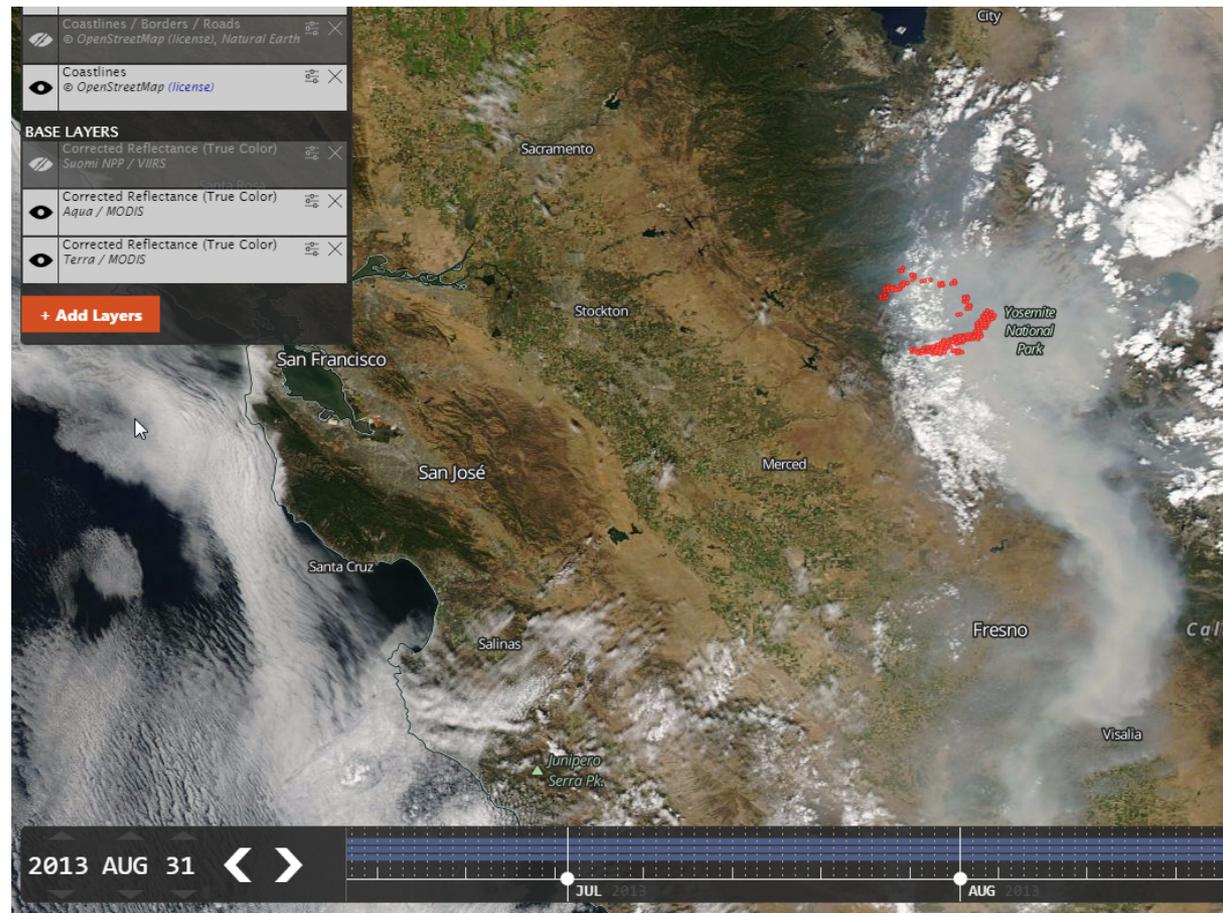
# Watch it Grow

Navigate forward in time through August

Switch between Aqua and Terra base layers to see morning and afternoon

Notice the growth of the fire radially away from the ignition point

Observe the visual difference between clouds and smoke

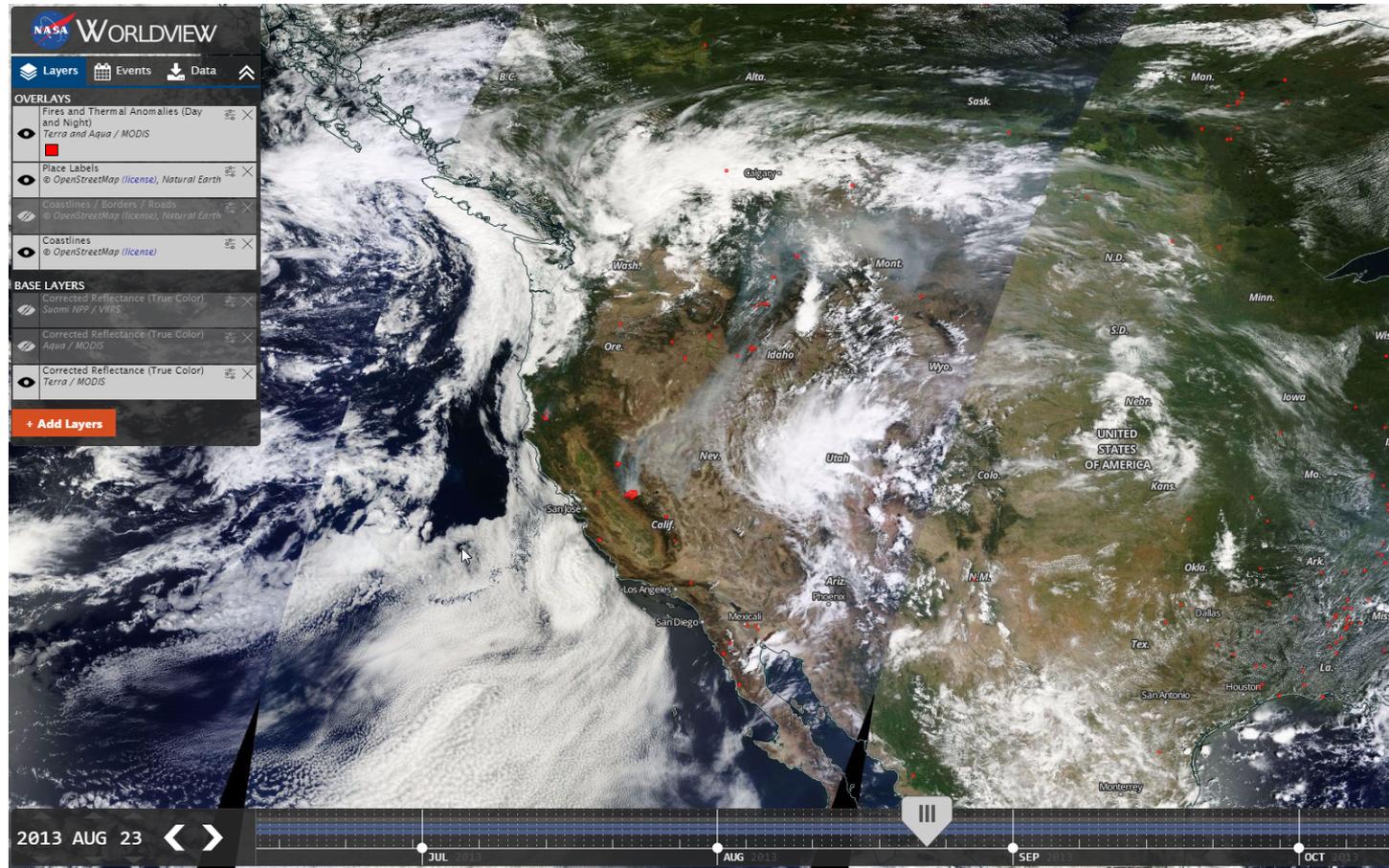


# Long-range Transport

Zoom out so all of the West is visible

Navigate back and forth in time

How far can you detect smoke transport from the Rim fire?

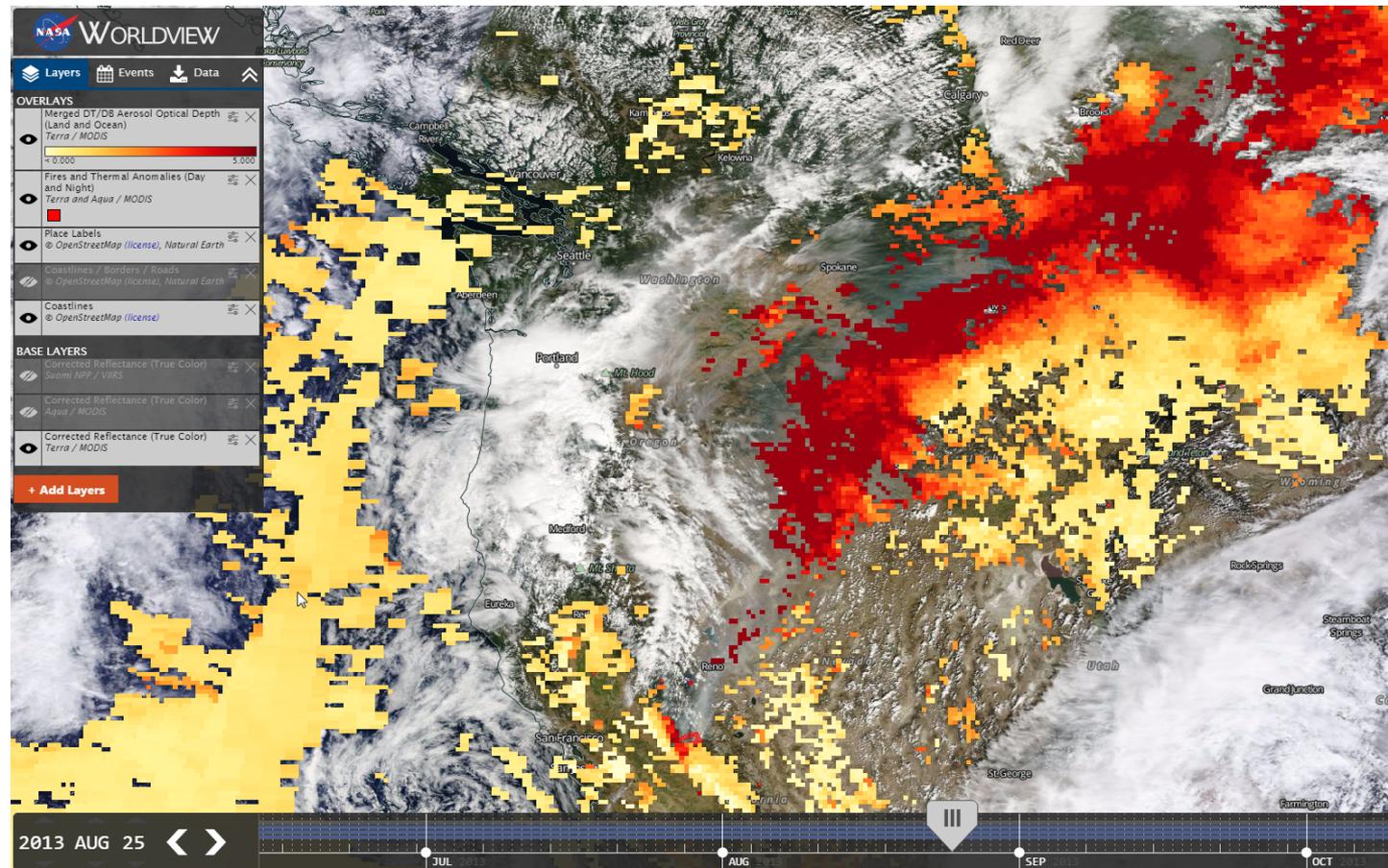


# Aerosol Optical Depth

Add Layers → Fires → Aerosol Optical Depth → Aqua/MODIS → Merged DT/DB Aerosol Optical Depth

Dark red is very high AOD (approaching 1 is “polluted”, roughly)

Notice some issues with AOD in heavy smoke (e.g., AUG 23)

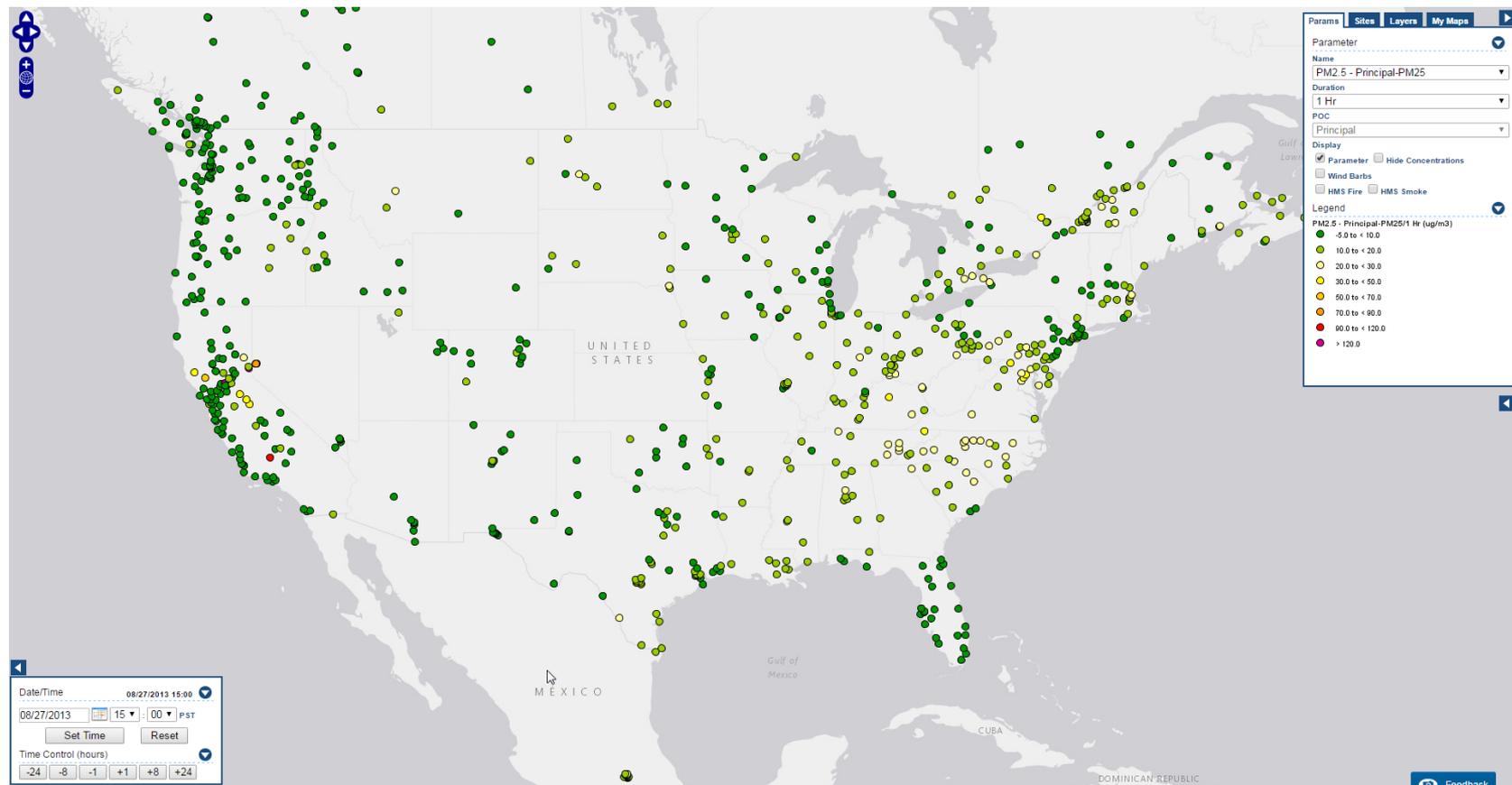


# AirNow-Tech Navigator

A way to explore limited satellite data along with air quality monitoring data

Feel free to follow along if you already have an account

<https://www.airnowtech.org/navigator/index.cfm>



# Late Morning, August 25

2013-08-25 10:00 am local time (near Terra overpass time)

HMS fire detects (combination of MODIS, AVHRR, and GOES detections)

True color image from Terra

PM<sub>2.5</sub> hourly concentrations

## Legend

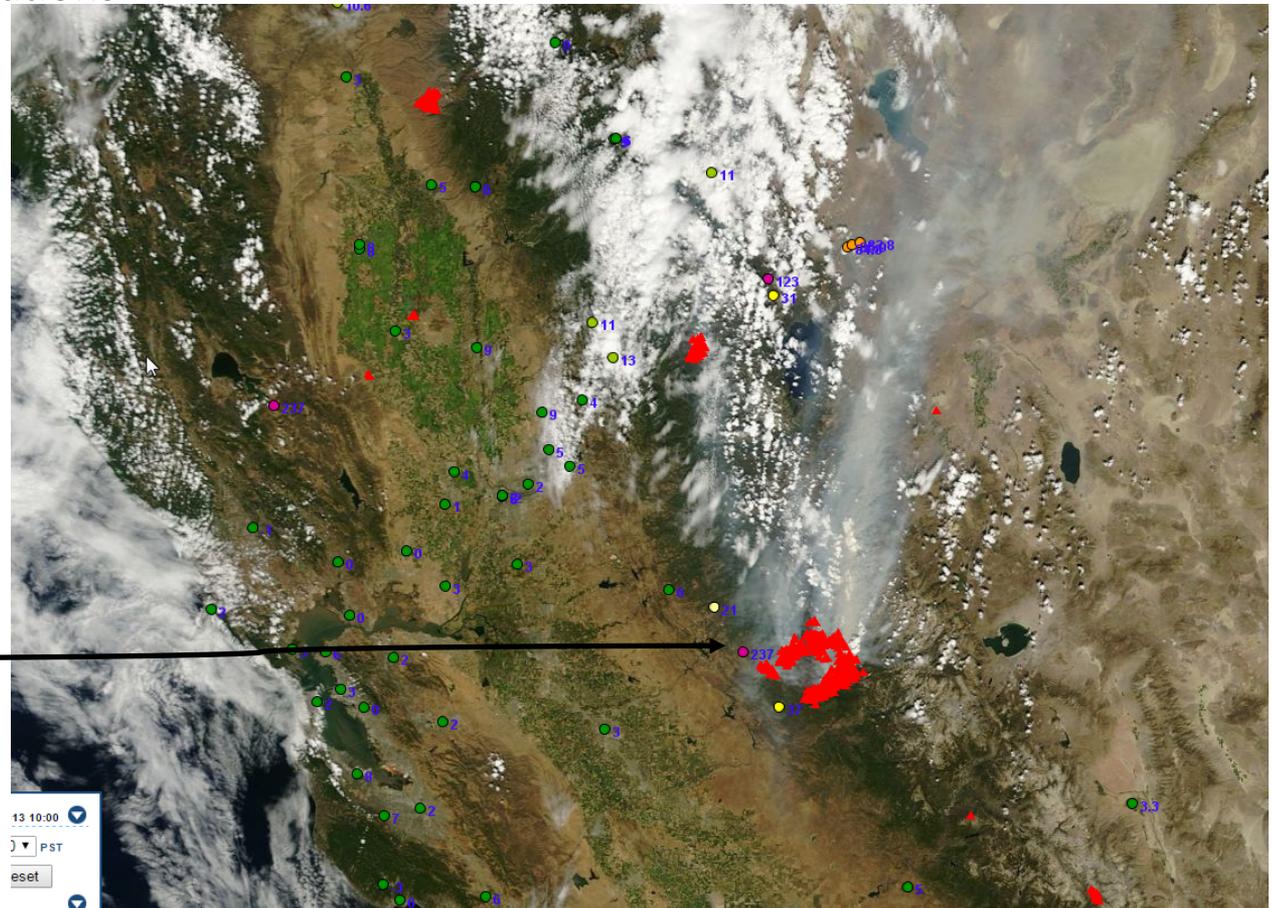
PM2.5 - Principal-PM25/1 Hr (ug/m3)

- -5.0 to < 10.0
- 10.0 to < 20.0
- 20.0 to < 30.0
- 30.0 to < 50.0
- 50.0 to < 70.0
- 70.0 to < 90.0
- 90.0 to < 120.0
- > 120.0

## HMS

- Smoke plume
- ▲ Fire

237  $\mu\text{g}/\text{m}^3$ !



# Afternoon, August 25

2013-08-25 2:00 pm local time (near Aqua overpass time)

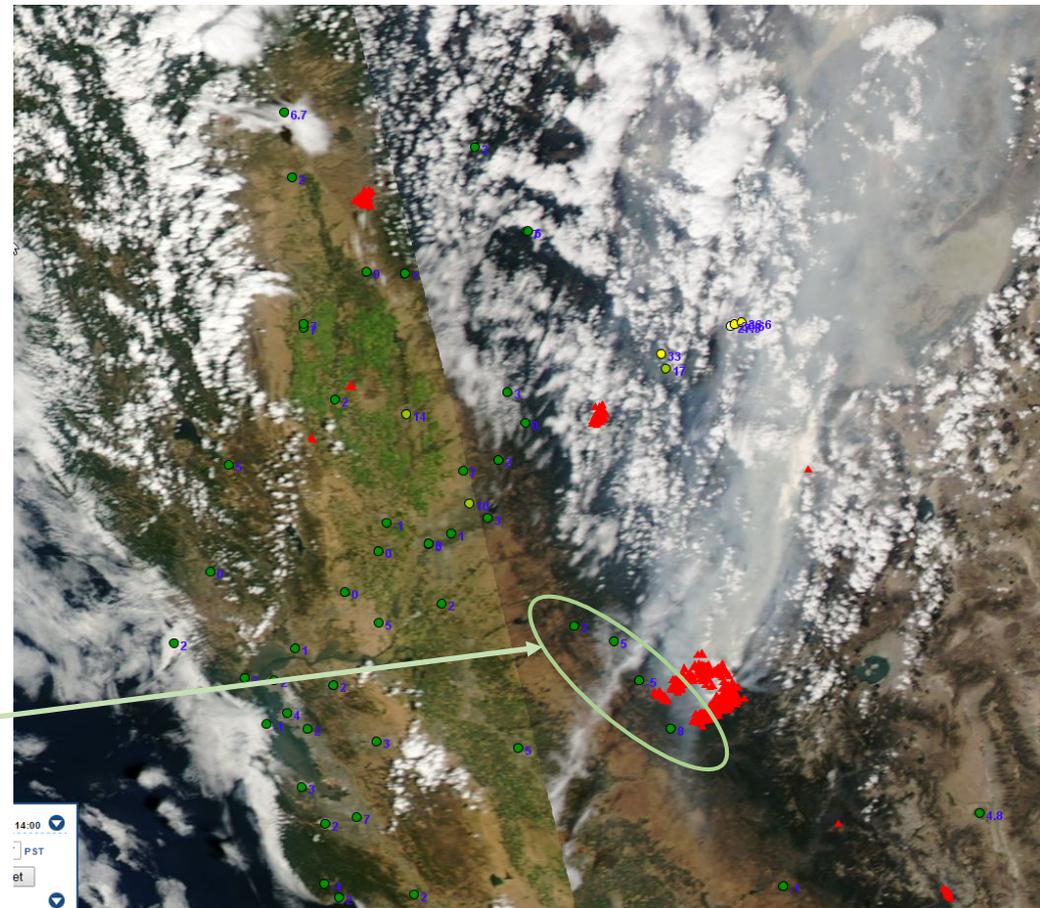
## Legend

PM2.5 - Principal-PM25/1 Hr (ug/m3)

- -5.0 to < 10.0
- 10.0 to < 20.0
- 20.0 to < 30.0
- 30.0 to < 50.0
- 50.0 to < 70.0
- 70.0 to < 90.0
- 90.0 to < 120.0
- > 120.0

## HMS

- Smoke plume
- ▲ Fire



Nearby sites are all clean

# What about downwind?

Low PM2.5 concentrations indicate most of the transport is aloft  
Some modestly elevated values in the Snake River Valley

## Legend

PM2.5 - Principal-PM25/1 Hr (ug/m3)

● -5.0 to < 10.0

● 10.0 to < 20.0

● 20.0 to < 30.0

● 30.0 to < 50.0

● 50.0 to < 70.0

● 70.0 to < 90.0

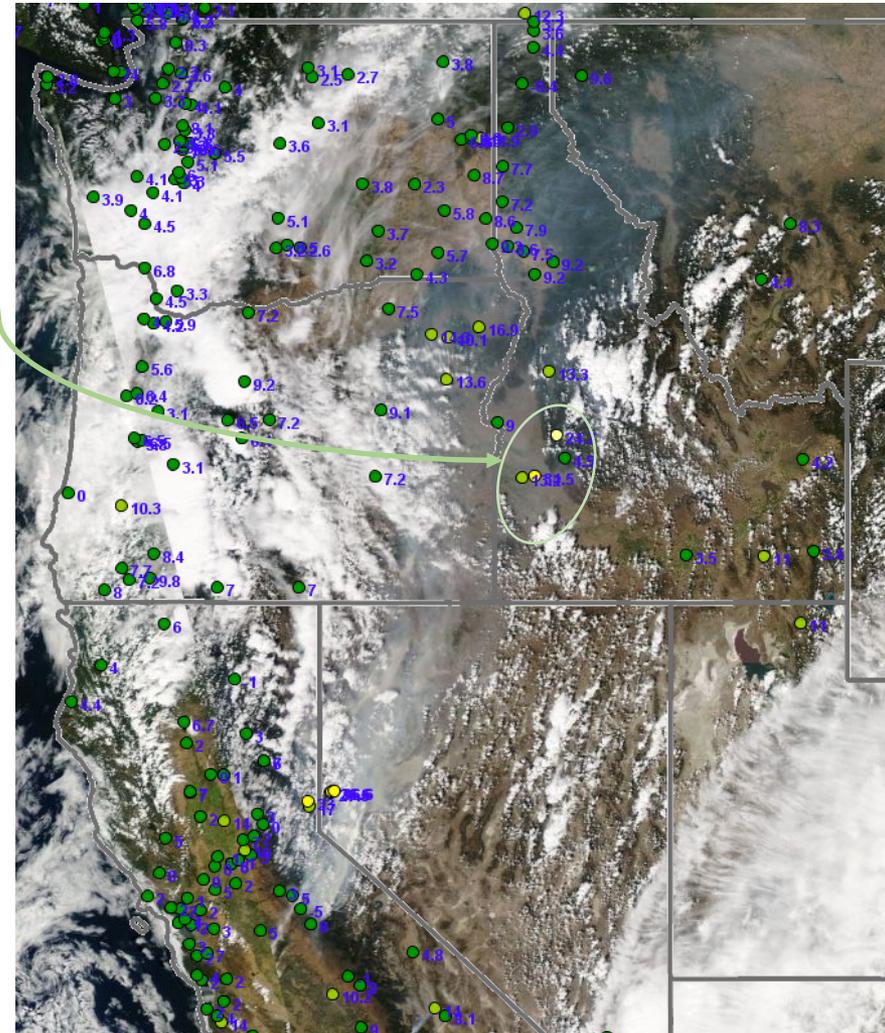
● 90.0 to < 120.0

● > 120.0

## HMS

■ Smoke plume

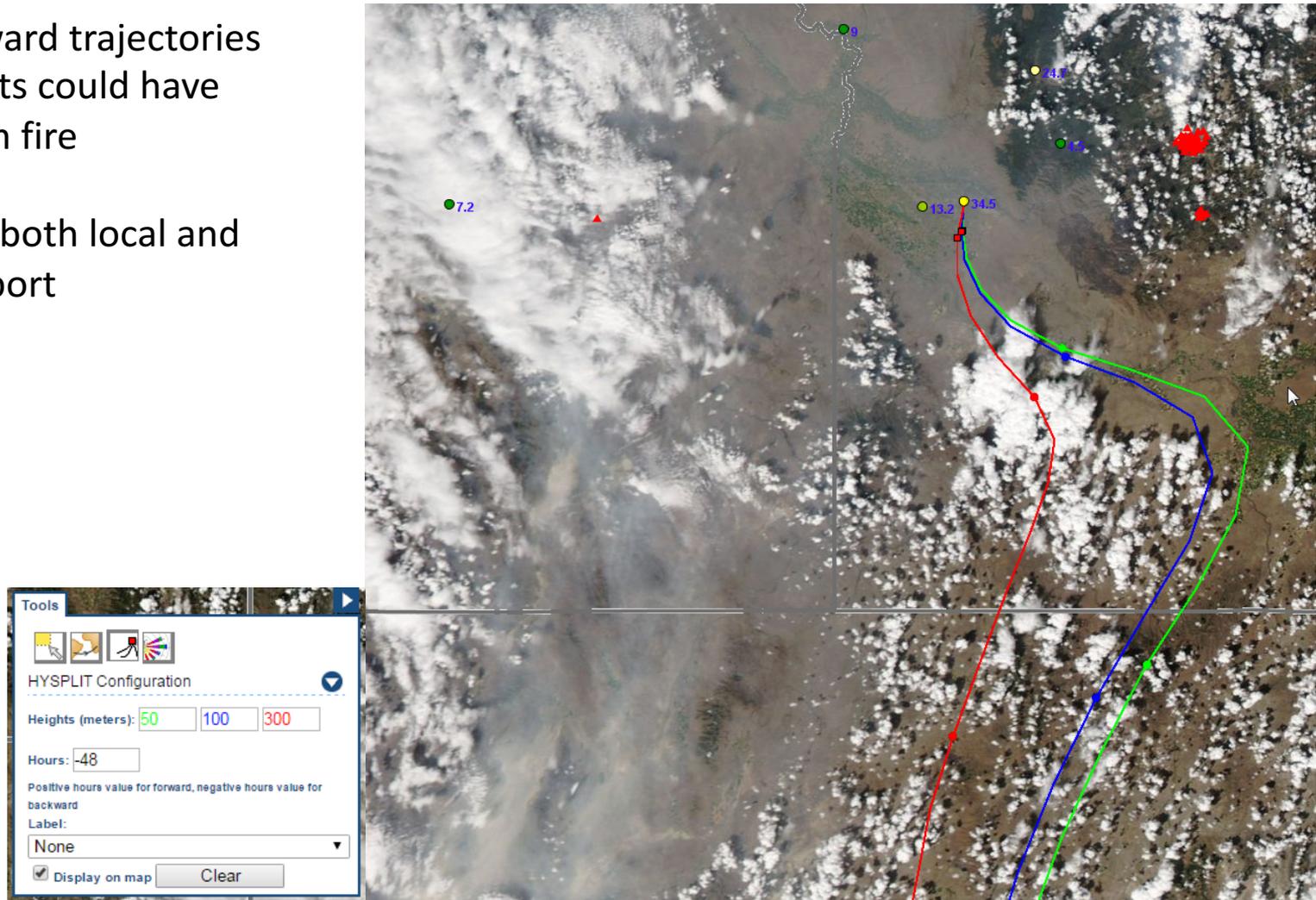
▲ Fire



# Local fires or Rim fire?

HYSPLIT backward trajectories indicate impacts could have come from Rim fire

Likely a mix of both local and regional transport



# Aerosol Optical Depth

AOD shows large slug of dense smoke transport  
Most ground concentrations low

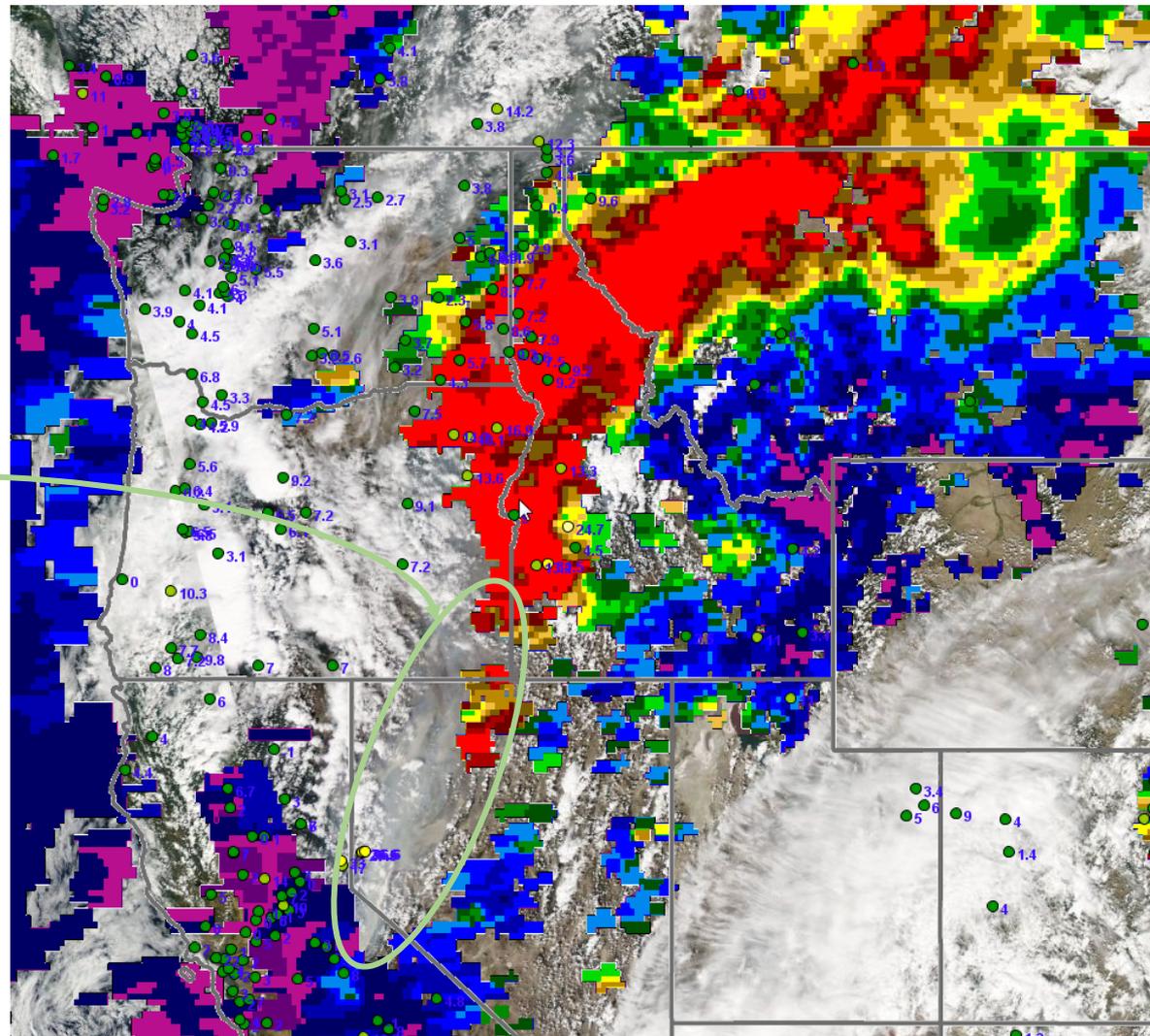
Very dense smoke is often mistaken for clouds in the AOD algorithm

## Legend

PM2.5 - Principal-PM25/1 Hr (ug/m3)

- -5.0 to < 10.0
- 10.0 to < 20.0
- 20.0 to < 30.0
- 30.0 to < 50.0
- 50.0 to < 70.0
- 70.0 to < 90.0
- 90.0 to < 120.0
- > 120.0

NASA GIBS Aerosol  
-0.05 0.70



# CALIPSO Vertical Profiles

CALIPSO lidar can provide a rare glimpse at the vertical profile of large smoke plumes

[http://www-calipso.larc.nasa.gov/products/lidar/browse\\_images/production/](http://www-calipso.larc.nasa.gov/products/lidar/browse_images/production/)  
(or search for calipso browse)

2013-08-23

CALIPSO - Products - The X

← → ↻ 🏠 [www-calipso.larc.nasa.gov/products/lidar/browse\\_images/show\\_date.php?s=production&v=V3-30&browse\\_date=2013-08-23](http://www-calipso.larc.nasa.gov/products/lidar/browse_images/show_date.php?s=production&v=V3-30&browse_date=2013-08-23)

 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

**LIDAR BROWSE IMAGES FOR PRODUCTION RELEASE [V3-30] BROWSE DATE [2013-08-23]**

DATA AVAILABILITY  
100.0%

Displayed on this page are scaled, color-modulated, altitude-time images of CALIPSO attenuated backscatter (1/km/sr) including:

- 532 nm total (parallel + perpendicular) attenuated backscatter
- 532 nm perpendicular attenuated backscatter
- 1064 nm total attenuated backscatter

The orbit track locations for the entire Level 1 .hdf file are in black and the orbit track locations corresponding to this page are color coded.

For the full scale images:

- the color bars for attenuated backscatter show the colors assigned to ranges of attenuated backscatter, 1/km/sr
- the horizontal axes are annotated with latitude (deg) and longitude (deg)
- the vertical axes are annotated to indicate altitude in kilometers
- the date and time of the measurements are listed as UTC time
- the names of the CALIPSO data products for the Lidar Level 1 attenuated backscatter granules are included

The scaled images on this page are organized by CALIPSO data product day and night orbit granules.

The maps with a shaded background indicate nighttime measurements.

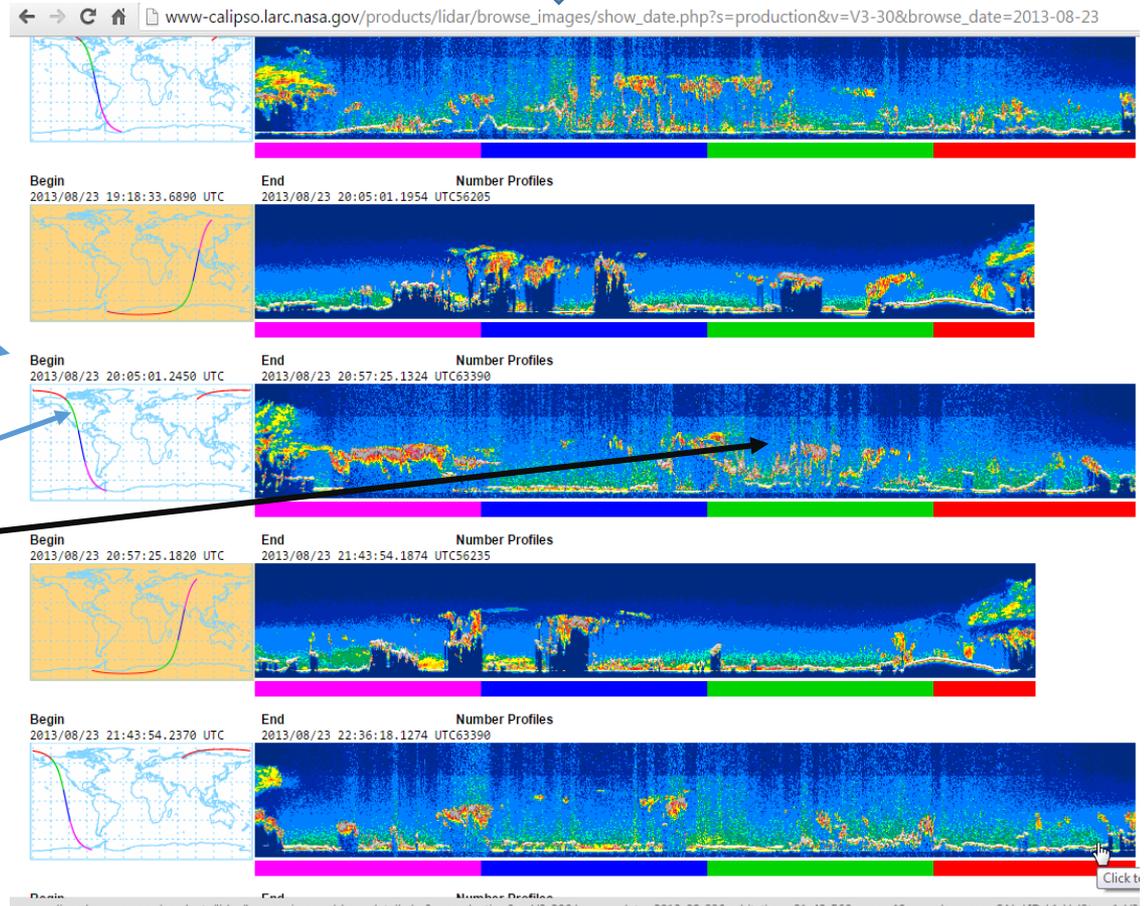
There are a maximum of 4 scaled images per granule.

The orbit tracks plotted on the maps show the measurement locations for each granule.

For each granule, the scaled images are ordered from left to right and their locations along the orbit tracks are color coded as: **image one, image two, image three, image four.**

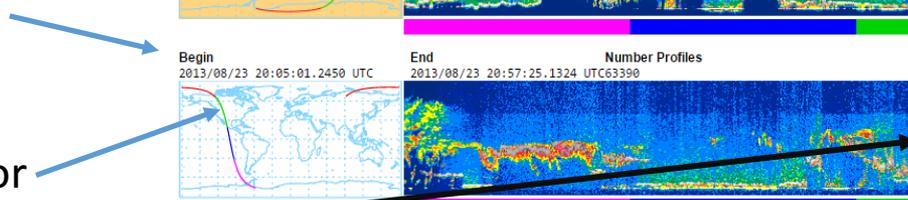
**2013-08-23 Version: 3.30 Nominal Red is Daytime, Blue is Nighttime**

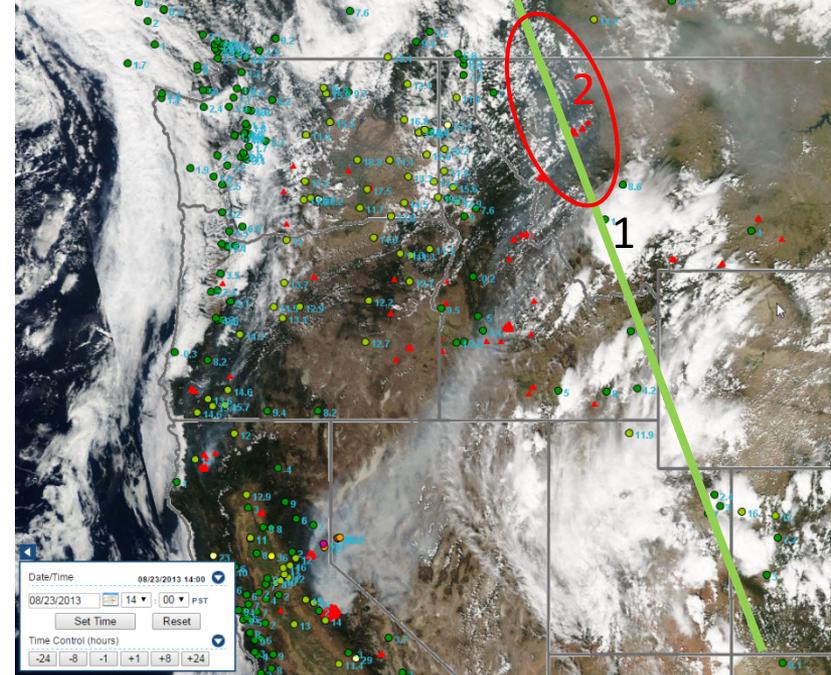
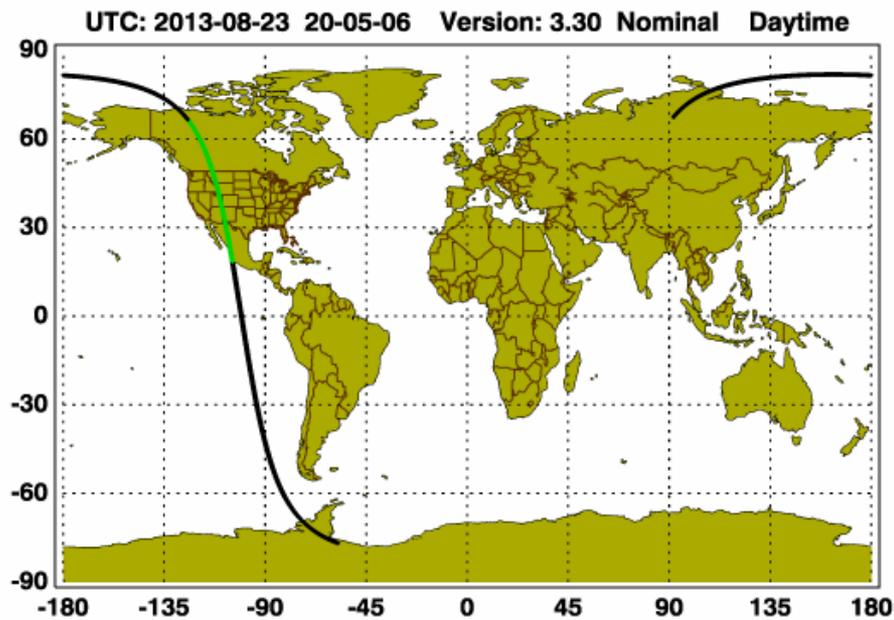
# CALIPSO Vertical Profiles



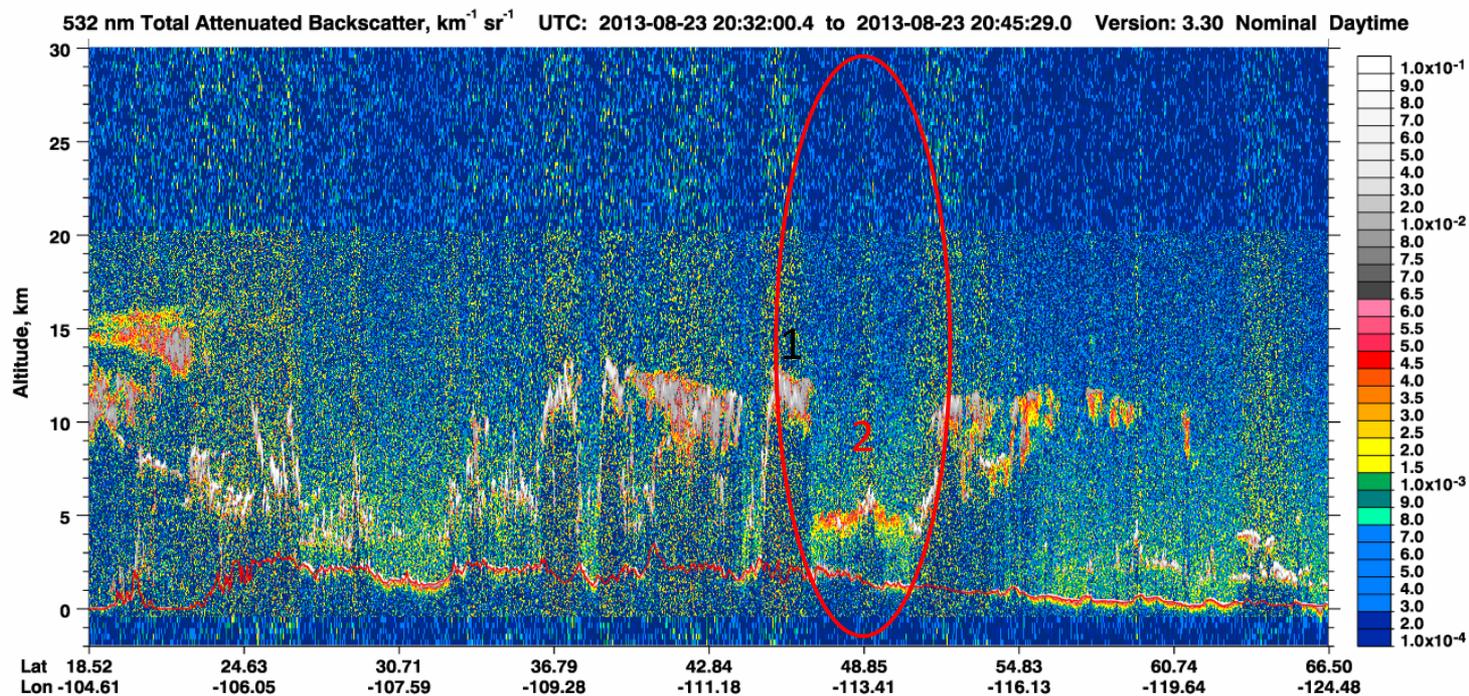
Scroll down the page to find the daytime overpass across the western U.S.

Portions of the orbit are color coded. Click in the green area





Locating the area of interest on the profile can be tricky



# CALIPSO Feature Mask and Aerosol

Feature mask shows a mix of aerosol (orange) and clouds (light blue) over the area of interest

Aerosol is mostly above the surface at about 3 and 5 km above MSL

The aerosol subtype is identified as smoke (black), though misclassification is common

