

Smoke Management Products and Messaging

f
Virtual

Leland Tarnay, Ph.D.

Ecologist/ARA
USDA Forest Service
Region 5 (CA) Remote Sensing Lab

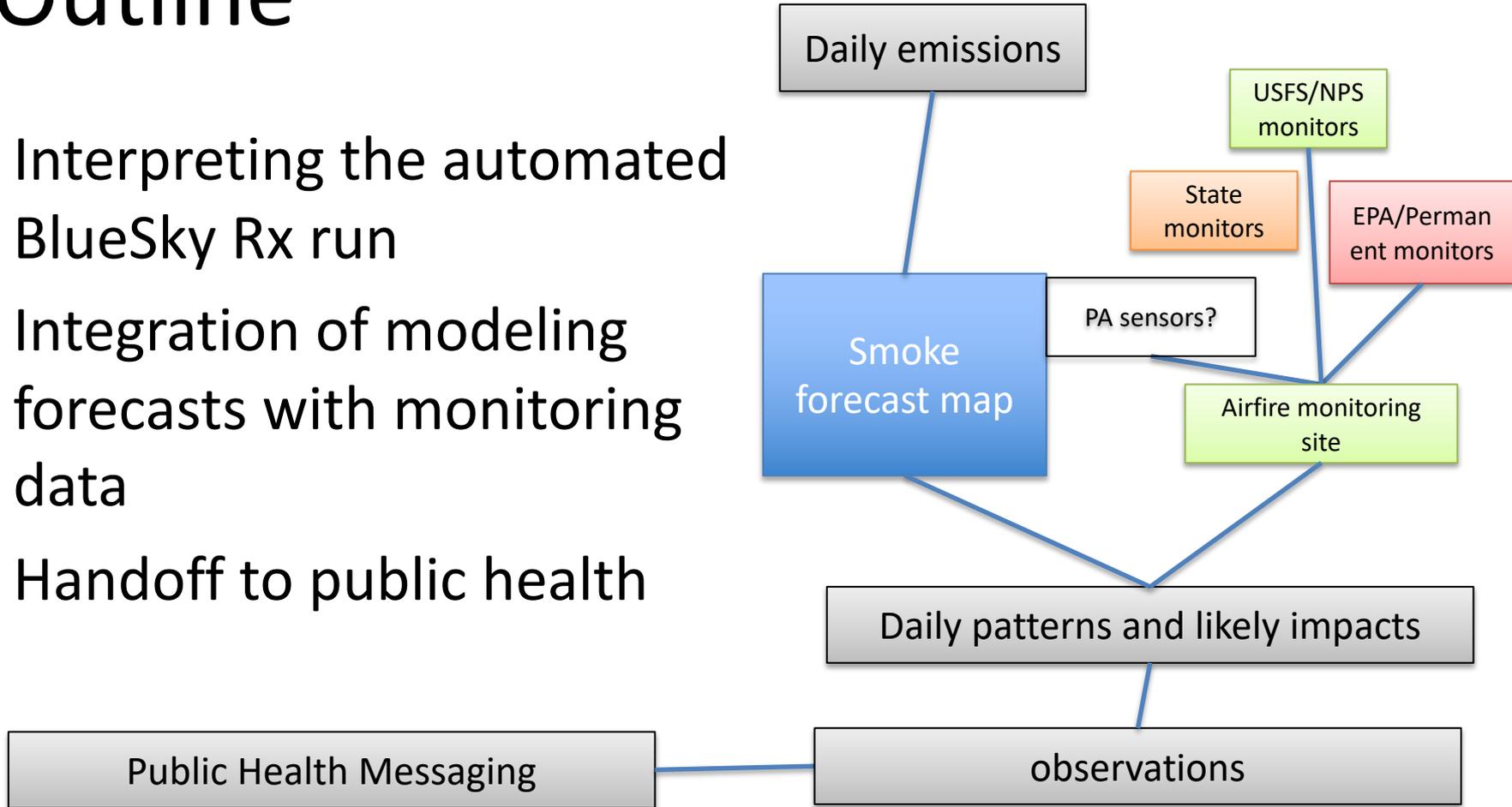
c: 530-227-8811

leland.tarnay@usda.gov

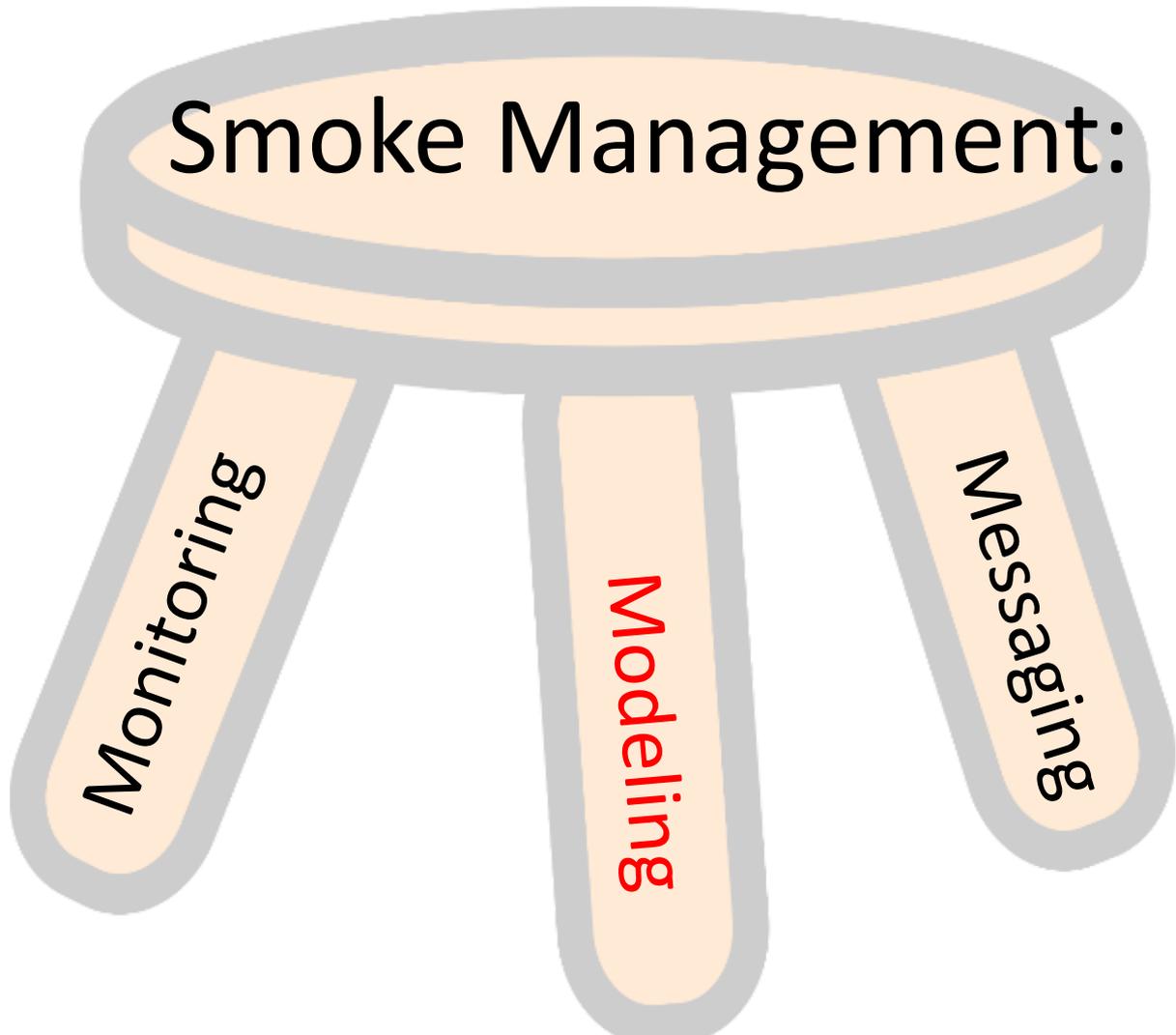


Outline

- Interpreting the automated BlueSky Rx run
- Integration of modeling forecasts with monitoring data
- Handoff to public health



Smoke Management:

A diagram shaped like a stool. The seat is a light orange oval with a grey shadow underneath, containing the text 'Smoke Management:'. Three legs extend downwards from the seat, each a light orange rounded rectangle with a grey shadow. The left leg contains the text 'Monitoring', the middle leg contains 'Modeling' in red, and the right leg contains 'Messaging'. All leg text is rotated 90 degrees counter-clockwise.

Monitoring

Modeling

Messaging

BlueSky Limitations: a Yardstick, Not the Answer



- Bluesky doesn't know any more than you tell it about emissions
- Doesn't know about other sources of PM2.5
- Doesn't carry over smoke from one run to the next
- Doesn't do great with small scale terrain (1.33km is the max resolution)
 - Tends to overestimate vertical mixing from mtn sources to valley receptors
- Operational run uses map based fuels from FCCS (like from our Rx scenarios), along with acres based on MODIS pixels.
 - This is very coarse resolution, and the center of each MODIS pixel count drives the choice of fuels (and can misrepresent each respective pixel)

Checking “under the BlueSky hood”)

CANSAC WRF Realtime: Domain 3 (1.33 km) Init: 1200 UTC Tue 19 Nov 19
 Post: 3.00 h Valid: 1500 UTC Tue 19 Nov 19 (0700 PST Tue 19 Nov 19)
 Mixing Height Horizontal wind vectors at height = 0.01 km sm = 1

https://cansac.dri.edu/cansac_output.php?model=WRF

Air quality products

NAM-Initialized CANSAC WRF Weather Forecasts

CANSAC WRF Realtime results for the current run (starts 2019/11/12 0400 UTC, 0400 PST)

Modeling system [problems](#) (last modified: 2019/11/10) and [changes](#) (last modified: 2019/11/10)

THE WRF PAGES ARE EXPERIMENTAL AND UNDER DEVELOPMENT. THEY CURRENTLY APPEAR PURPLE

If you are having trouble getting the animations to work, [click here](#) for the latest free Java download

Other CANSAC Products and Information

[Archived Runs](#)

[Verification Products](#)

[Air Quality Products](#)

[WRF-GFS \(9 km\)](#)

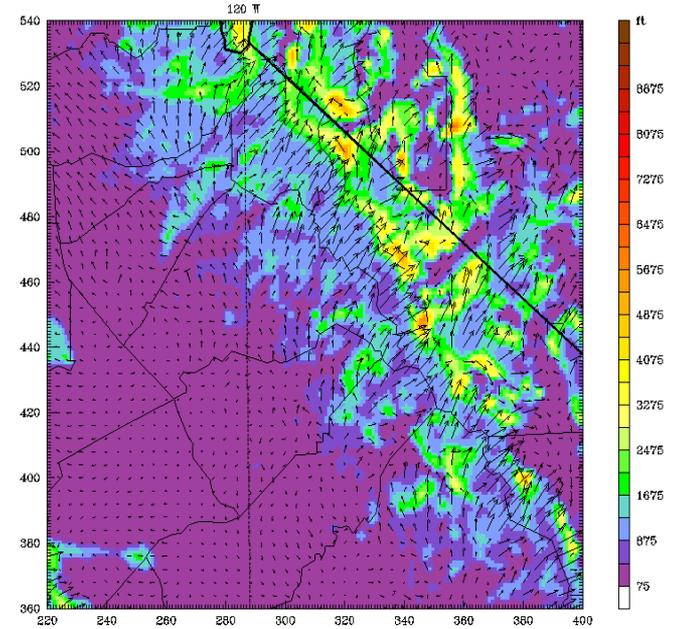
WRF 1.33 km Domain, Initialized 2019-11-12 UTC (19th, 0400 PST)

Product	Forecast Hours
---------	----------------

Product
Mixing Height (WRF) -- 4 km
Mean Transport Winds (4 km)
Mixing Height (WRF) -- 1.33 km
Mixing Height (WRF) -- SW Quadrant
Mixing Height (WRF) -- NW Quadrant
Mixing Height (WRF) -- NE Quadrant
Mixing Height (WRF) -- SE Quadrant
Mixing Height (WRF) -- SJVAPCD
Mixing Height (WRF) -- YOSE

Find Your Mixing height Loop

- Most forecasters in CA know about and use this product, even if you don't!
- Key products are mixing and transport winds



Model Info: V4.1.1 CU: No Cu MP: Liu et al PBL: MYJ SF: Noah LSM 1.3 km 39 levels 3 sec
 LW: RRTM SW: Dudhia DIFF: simple KM: 2D Smagor DAMP: none SFLAY: Eta
 MAXIMUM VECTOR: 20.8 m s⁻¹

Stuff BlueSky IS Good at

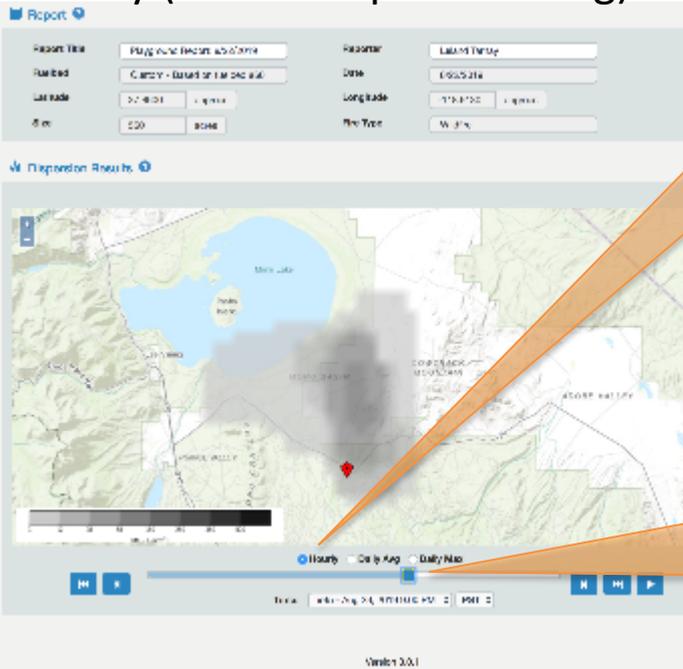
- **Day to day differences:** (24 hr averaging)
 - Also spatial ID of areas most likely to be affected
- **Hourly pattern:**
 - Spatially shows areas that are likely to see the most intense impacts
 - Temporally shows the pattern for a given site



Daily vs. Hourly products

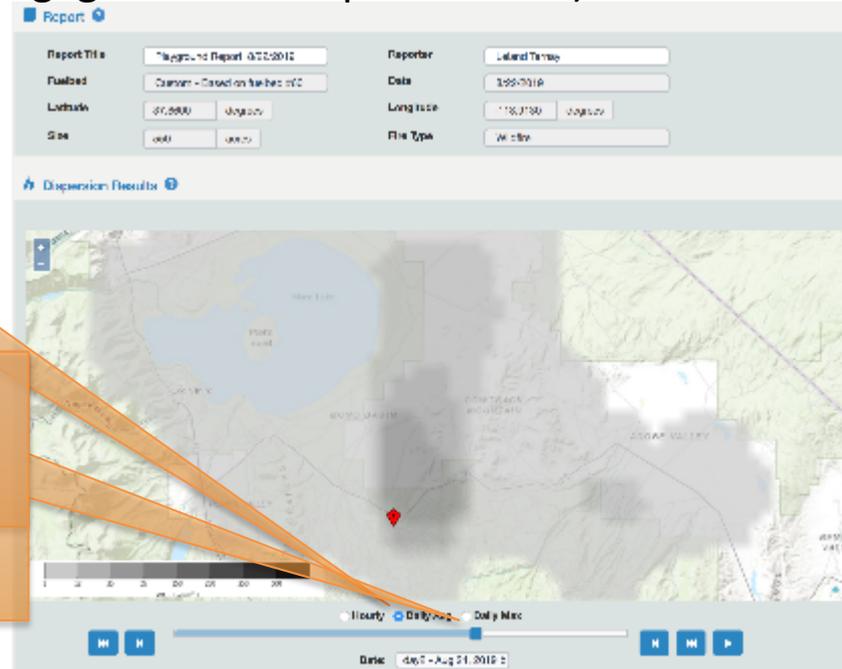
Daily (use to map areas of concern and gage relative impact on AQI)

Hourly (use to map and timing)

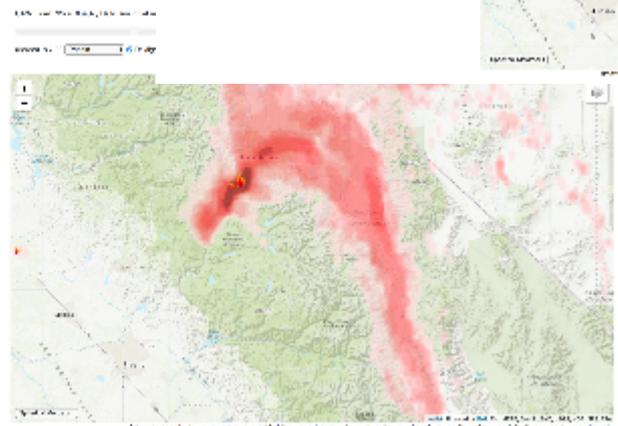
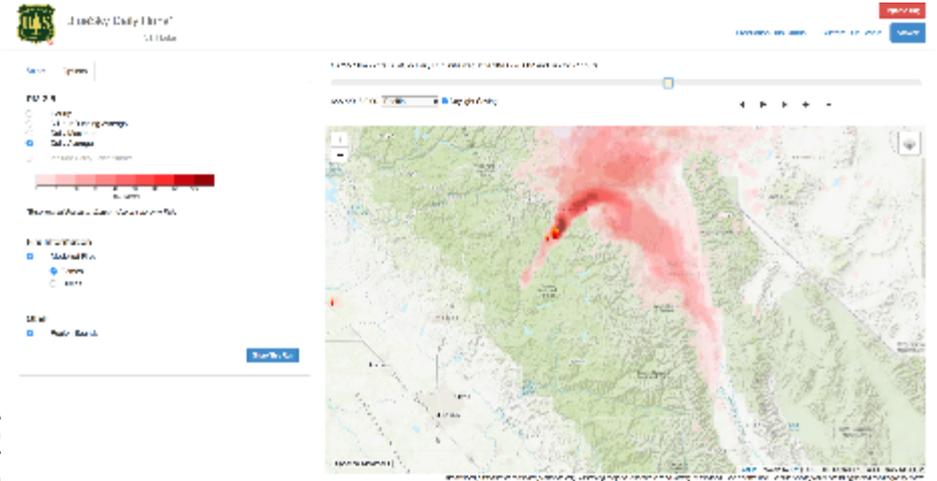
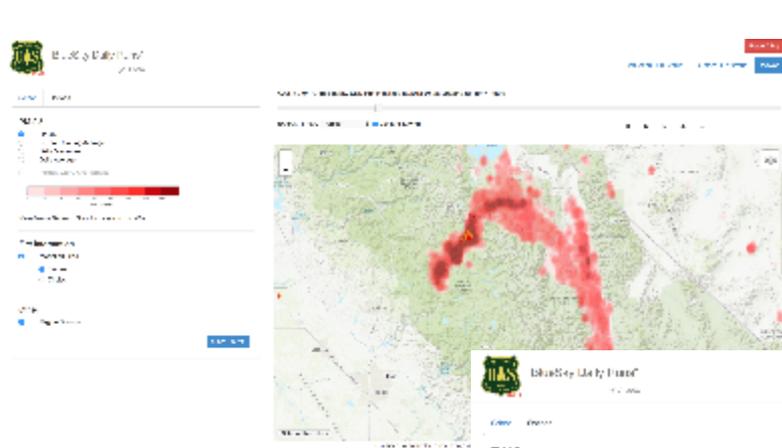


Click the Radio buttons to switch between daily and hourly

Daily Max is less useful for ops: doesn't represent the plume at any one time, but the max for any given pixel during the 24 hr period indicated in the slider



Day to Day: Yesterday, Today, Tomorrow



Scaling CA Smoke Management:

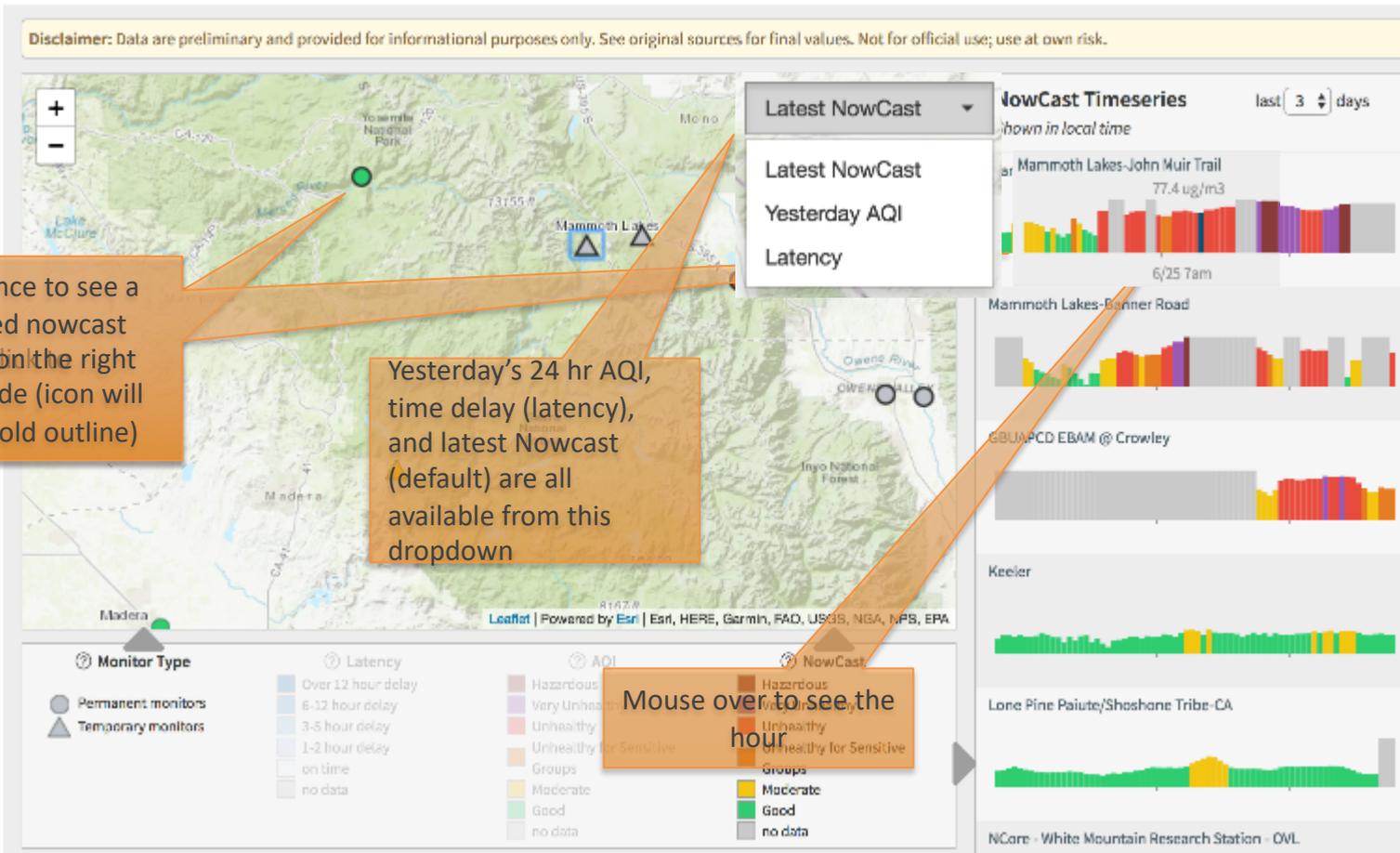
What Air District Staff Should Expect

Monitoring

Modeling

Messaging

Monitoring "v4" site (top)



Click once to see a stacked nowcast graph on the right hand side (icon will get a bold outline)

Yesterday's 24 hr AQI, time delay (latency), and latest Nowcast (default) are all available from this dropdown

Mouse over to see the hour

You can send this URL to anyone (stable), and they can bookmark and refresh to get the latest for the set of selected monitoring sites

Monitoring “v4” site (scroll down)

Selected Monitors: 12 monitors from 1 timezones.

[Data Report](#)

[CSV File](#)

Mammoth Lakes–John Muir Trail

Monitor ID: lon_119.085_lat_37.630_usfa.1027

Source: AIRSIS

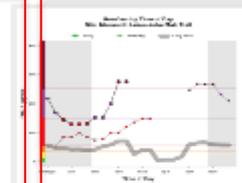
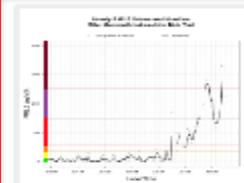
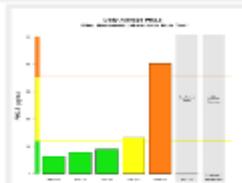
Latest NowCast PM_{2.5}: no data

Last Updated 2018-06-26 20:00:00 UTC

Timezone: America/Los_Angeles

QA/QC: [Report](#)

[Show In Simple Interface](#)



Mammoth Lakes–Banner Road

Monitor ID: lon_119.061_lat_37.647_usfa.1008

Source: AIRSIS

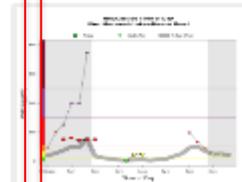
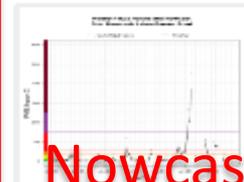
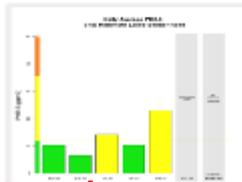
Latest NowCast PM_{2.5}: no data

Last Updated 2018-06-27 00:00:00 UTC

Timezone: America/Los_Angeles

QA/QC: [Report](#)

[Show In Simple Interface](#)



GBUAPCD EBAM @ Crowley

Monitor ID: MMGBU1001_01

Source: AirNow

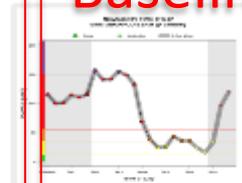
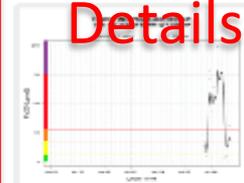
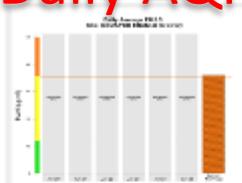
Latest NowCast PM_{2.5}: 36.1 µg/m³

Last Updated 2018-06-27 00:00:00 UTC

Timezone: America/Los_Angeles

QA/QC: by AirNow

[Show In Simple Interface](#)



Keeler

Monitor ID: 060271003_01

Source: AirNow

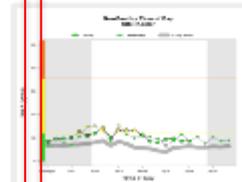
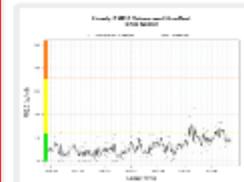
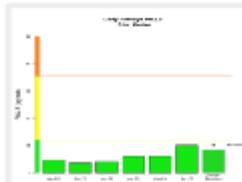
Latest NowCast PM_{2.5}: 8.6 µg/m³

Last Updated 2018-06-27 00:00:00 UTC

Timezone: America/Los_Angeles

QA/QC: by AirNow

[Show In Simple Interface](#)



Daily AQI

Nowcast
Details

Baselines

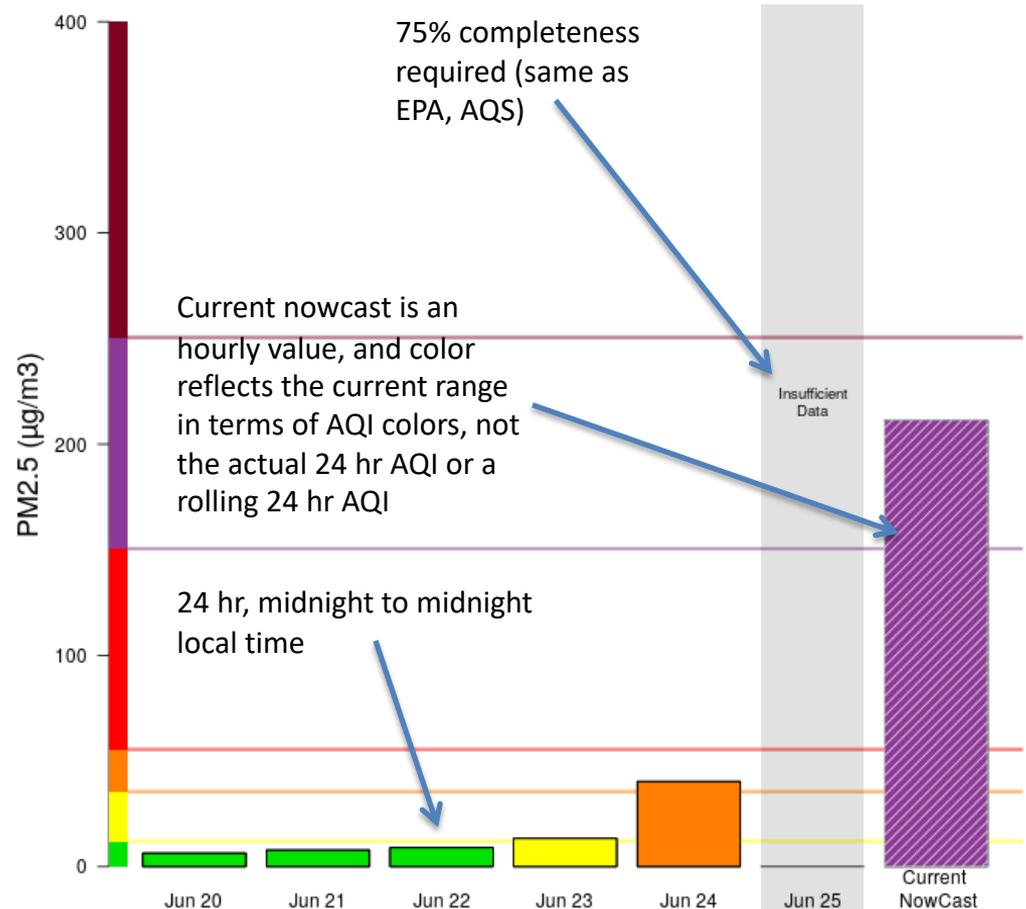
Monitoring “v4” site, 24 hr AQI detail

Air Quality Index

Actions to protect yourself



Daily Average PM2.5
Site: Mammoth Lakes-John Muir Trail



75% completeness required (same as EPA, AQS)

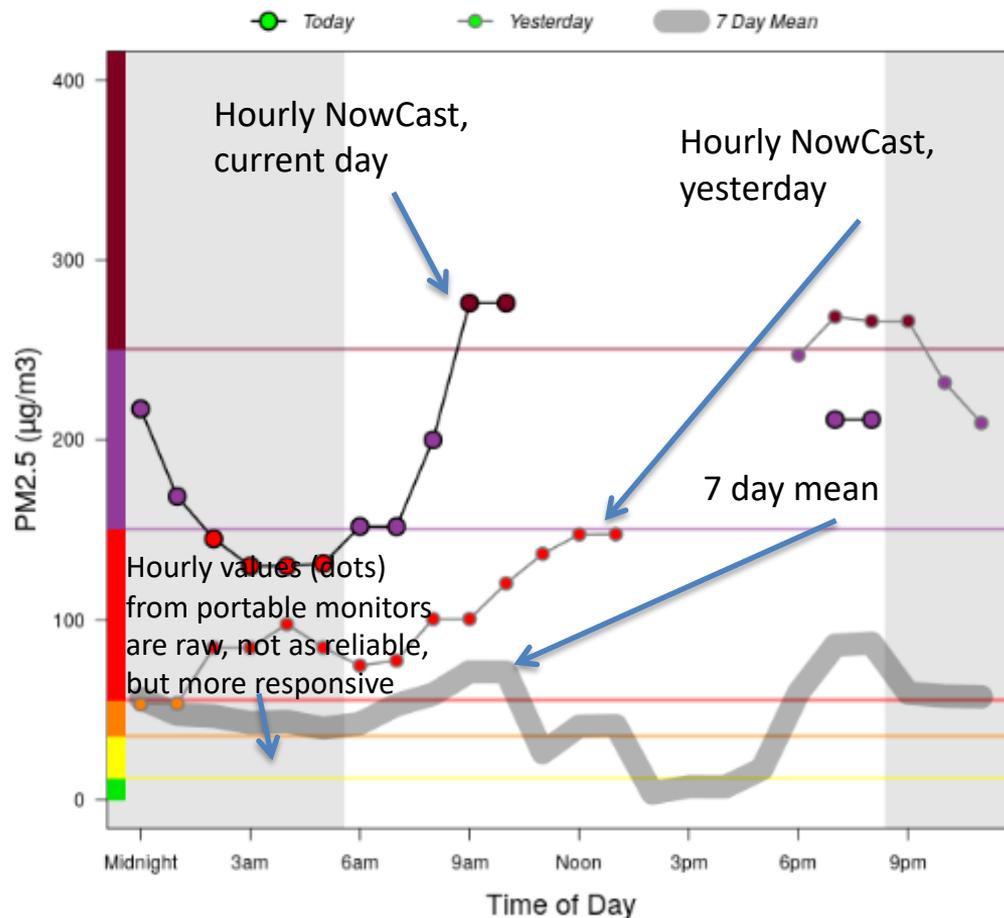
Current nowcast is an hourly value, and color reflects the current range in terms of AQI colors, not the actual 24 hr AQI or a rolling 24 hr AQI

24 hr, midnight to midnight local time

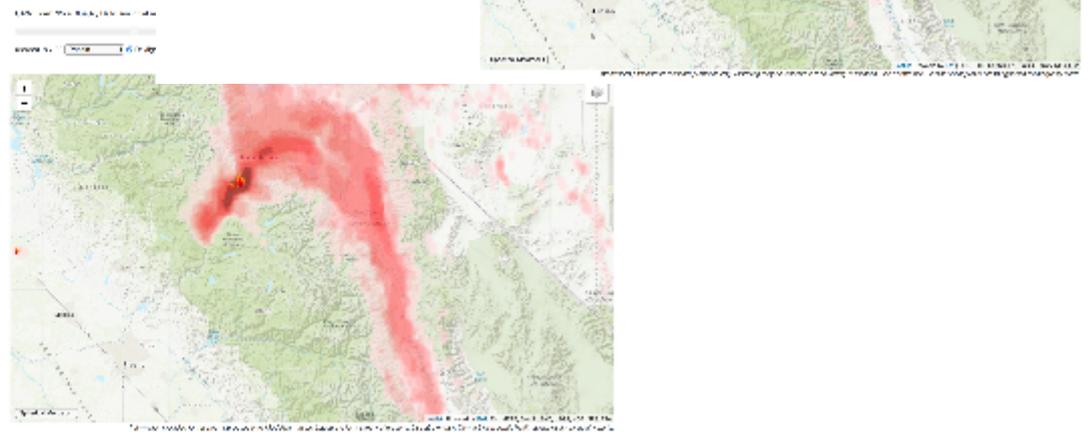
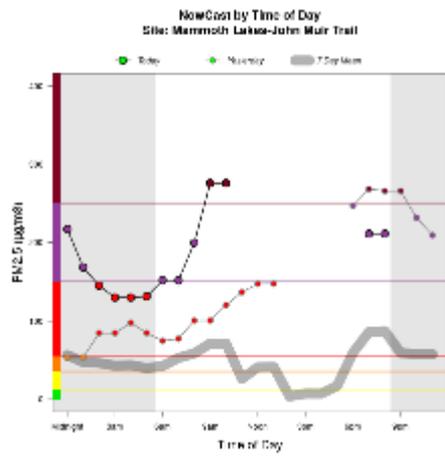
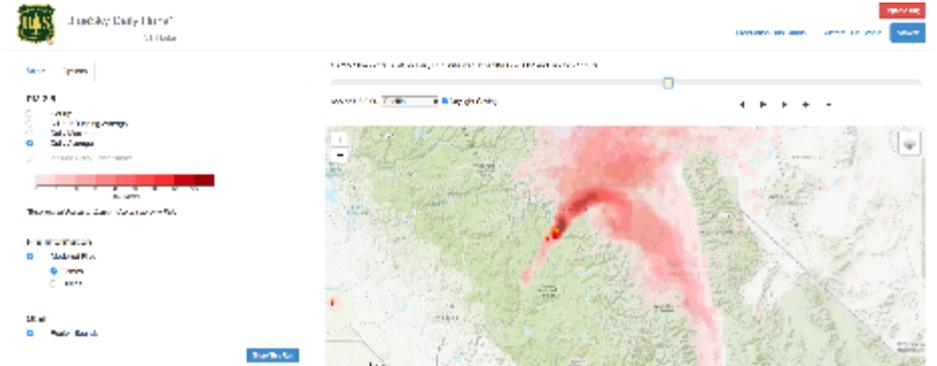
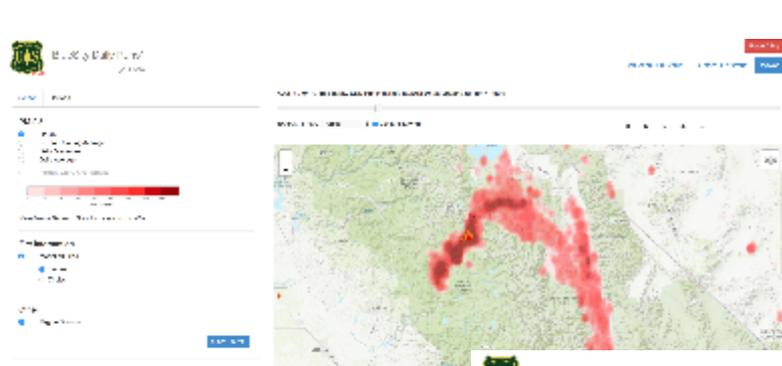
Monitoring “v4” site, Baseline detail



NowCast by Time of Day
Site: Mammoth Lakes-John Muir Trail



Day to Day: Yesterday, Today, Tomorrow



[Handout]

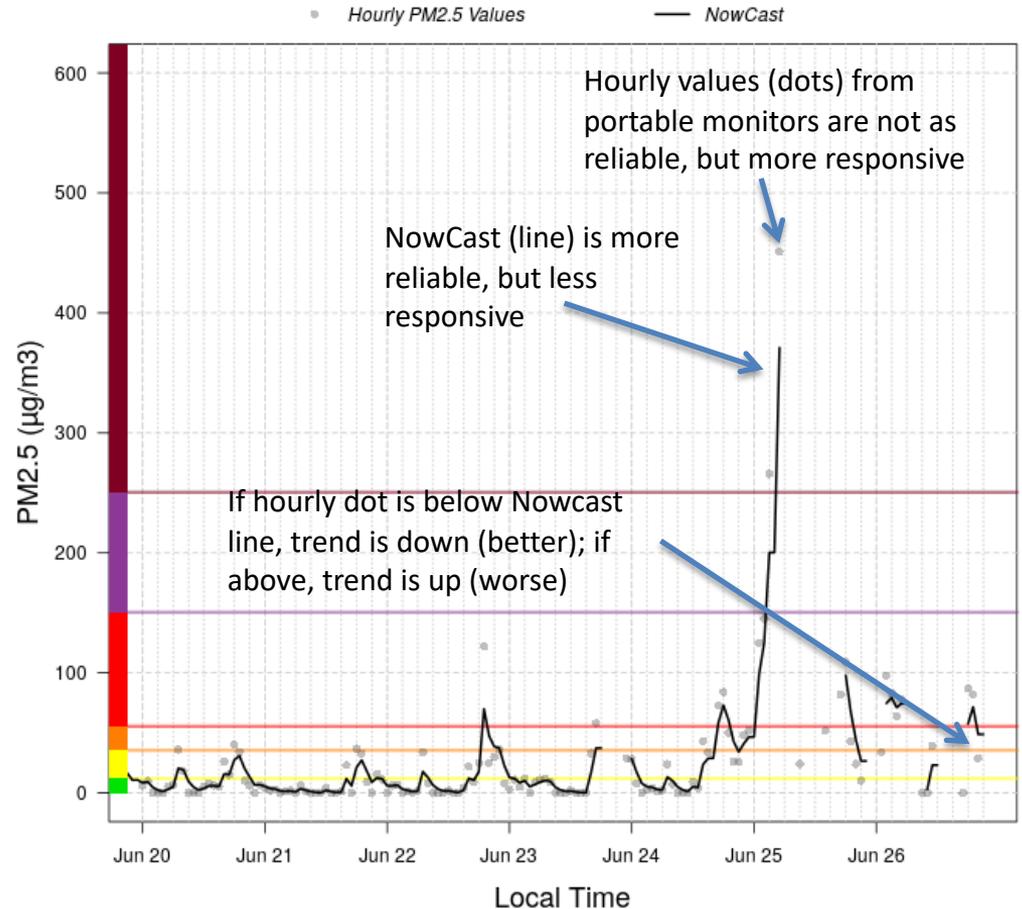
Monitoring “v4” site, hourly detail

Air Quality Index

Actions to protect yourself



Hourly PM2.5 Values and NowCast Site: Mammoth Lakes-Banner Road



Webcams

<http://www.alertwildfire.org/>

Cisco Buttes1

Cisco Buttes2

Cañon Hollow

Cañon Hollow2

Diamond Peak

DL Bliss State Park

Heavenly Ski Area

Hotchkiss Hill

The screenshot displays the ALERT Wildfire website interface. At the top, the logo for ALERT Wildfire is on the left, and the text "Greater Tahoe" is on the right. Below the logo are links for "About", "Partners", "YouTube", and "FAQ". The main content area is titled "Greater Tahoe Cameras" and features a large live webcam feed of a mountain range with snow-capped peaks and a dense forest. To the right of the feed is a map of the Greater Tahoe region with blue arrows indicating the locations of various cameras. A U.S. Forest Service (U.S.) logo is visible in the top right corner of the webcam feed. At the bottom of the webcam feed, there is a small text overlay: "Alert - Heavenly X: -118.71 Y: -39.64 Z: 1.0 NFElderado_svy1re_05-03T09:11 © Juvasec, Setena, Lab 2023/04/08 14:21:57, 01".

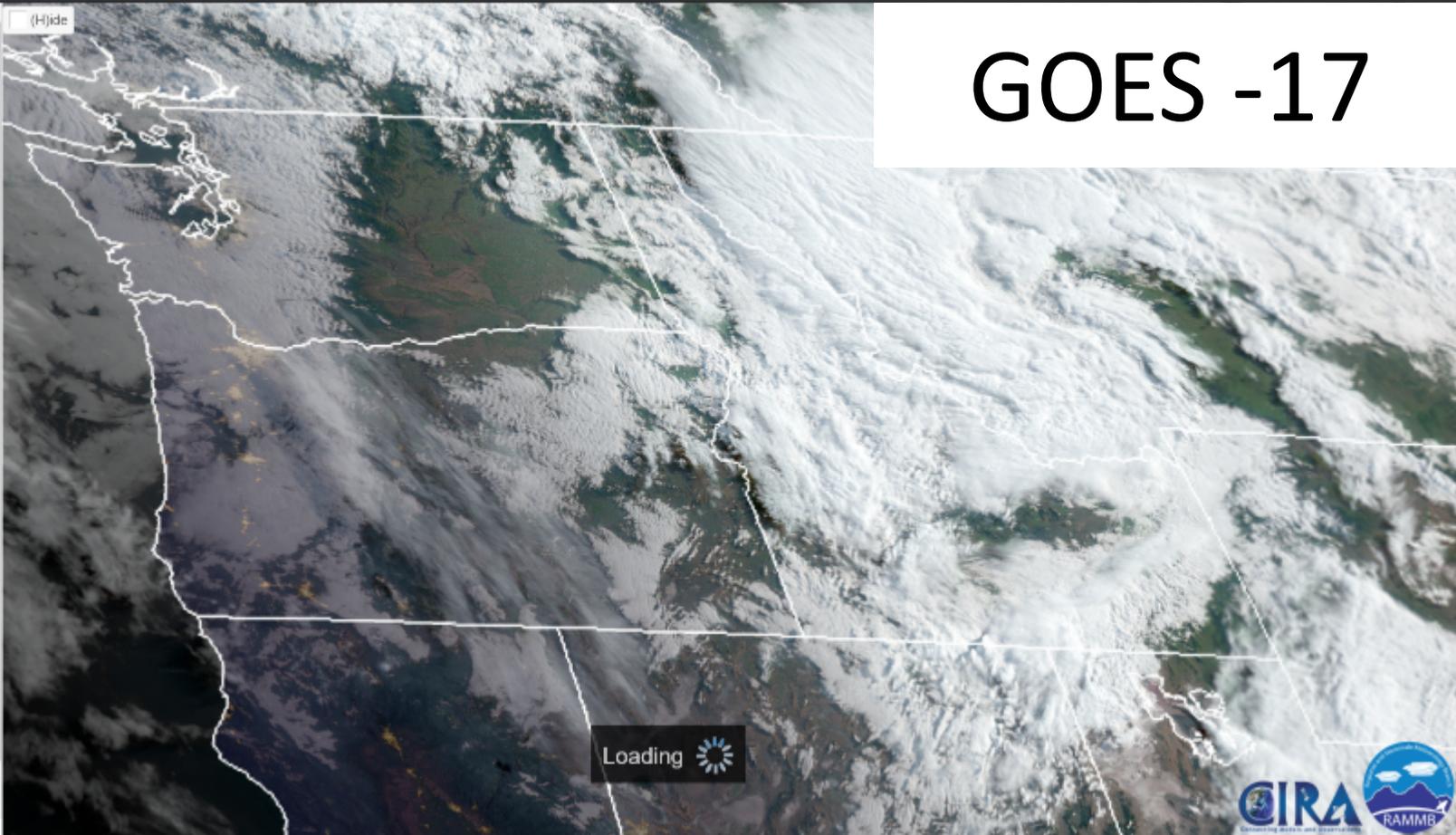
Ione

ki Area 4k

2020-06-08
13:41:17 UTC

(H)ide

GOES -17



(L)oop (R)ock Re(v)

Speed

Zoom (+) Zoom (-) Max (Z)oom

(M)aps Lat/Lo(n) Slid(e)r

(S)atellite GOES 17 (West...)

Se(c)tor CONUS

(P)roduct GeoColor (CIRA)

Add (O)verlay Add (O)verlay

of (I)mages 30

(T)ime Step 5 min

GeoColor (CIRA) Hide Info

(A)rchived Imagery

(B)egin D... B... Begin Ti...
End Date... E... End Tim...

(D)ownload Options

Home (y) Share (U)RL Help (?)

Follow Feature Hide Clear

Mouse Draw(w) Clear Drawin(g)s
2020-06-08 13:41:17 UTC

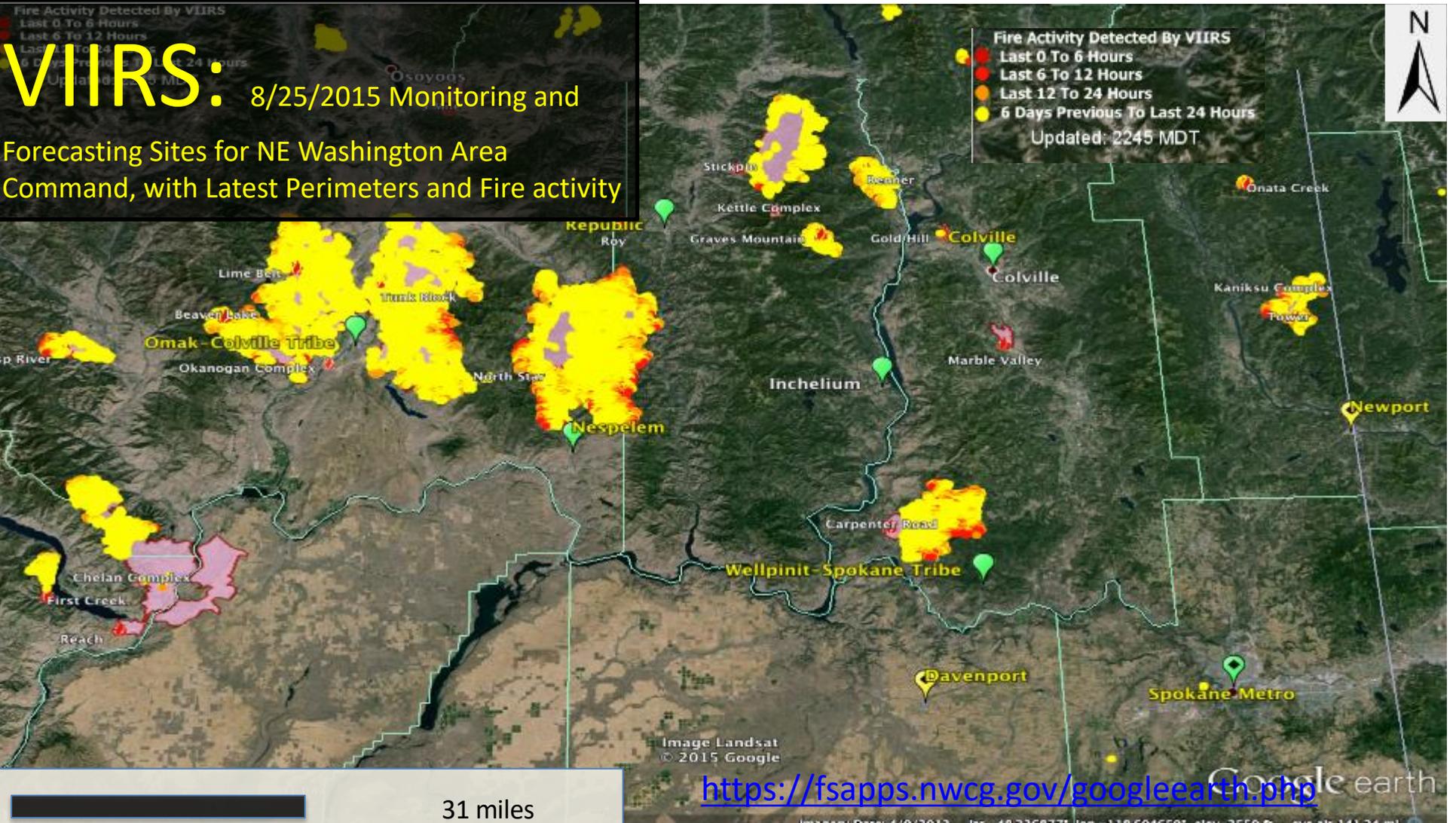
Loading



https://rammb-slider.cira.colostate.edu/?sat=goes-17&z=3&im=30&ts=1&st=0&et=0&speed=130&motion=loop&map=1&lat=0&opacity%5B0%5D=1&hidden%5B0%5D=0&pause=0&slider=-1&hide_controls=0&mouse_draw=0&follow_feature=0&follow_hide=0&s=rammb-slider&sec=conus&p%5B0%5D=geocolor&x=7603&y=3132

Fire Activity Detected By VIIRS
Last 0 To 6 Hours
Last 6 To 12 Hours
Last 12 To 24 Hours
6 Days Previous To Last 24 Hours
Updated: 2245 MDT

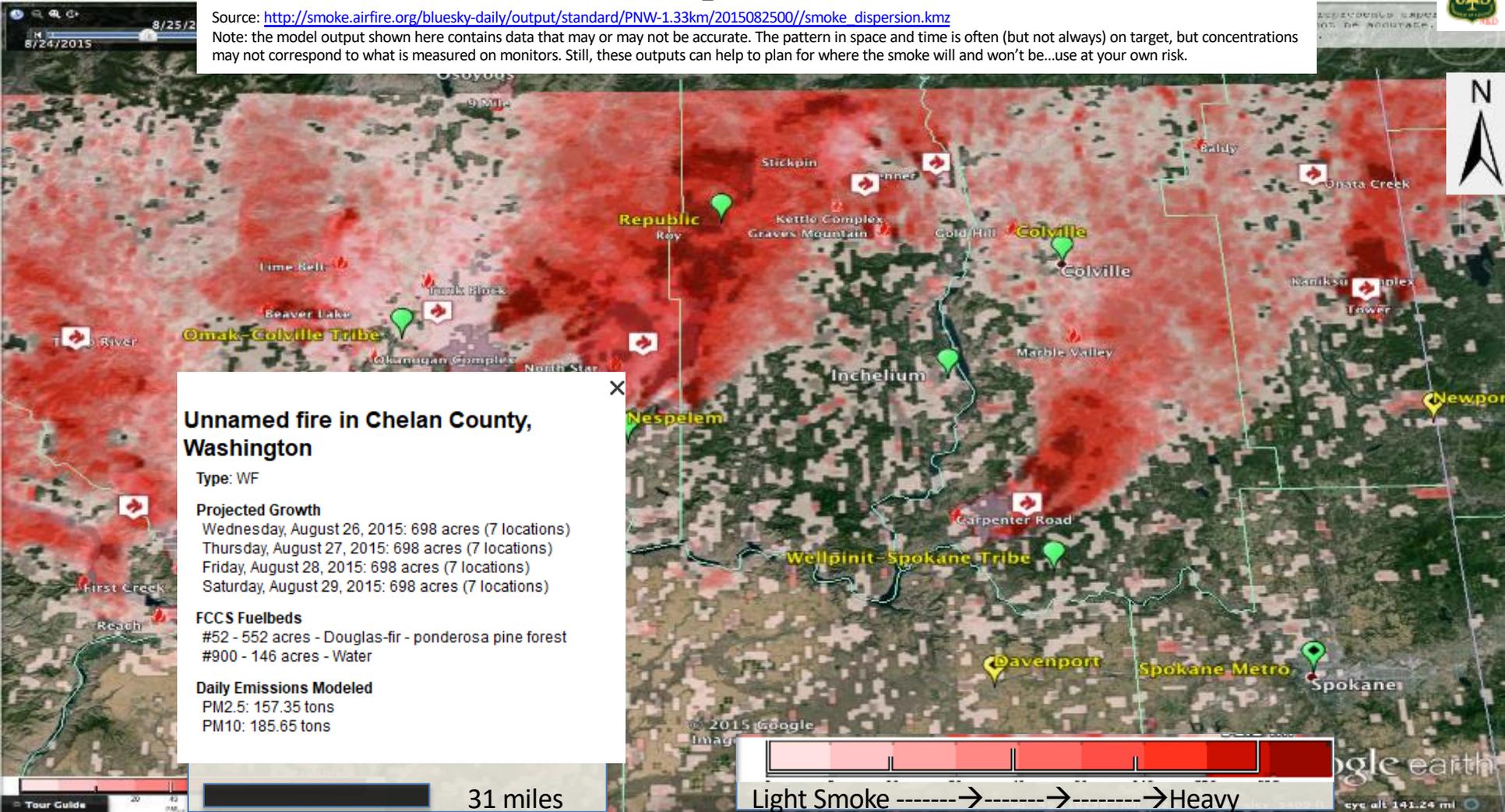
VIIRS: 8/25/2015 Monitoring and Forecasting Sites for NE Washington Area Command, with Latest Perimeters and Fire activity



Modeled Smoke over NE Washington, 5:50 P.M. 8/25

Source: http://smoke.airfire.org/bluesky-daily/output/standard/PNW-1.33km/2015082500//smoke_dispersion.kmz

Note: the model output shown here contains data that may or may not be accurate. The pattern in space and time is often (but not always) on target, but concentrations may not correspond to what is measured on monitors. Still, these outputs can help to plan for where the smoke will and won't be...use at your own risk.



Unnamed fire in Chelan County, Washington

Type: WF

Projected Growth

- Wednesday, August 26, 2015: 698 acres (7 locations)
- Thursday, August 27, 2015: 698 acres (7 locations)
- Friday, August 28, 2015: 698 acres (7 locations)
- Saturday, August 29, 2015: 698 acres (7 locations)

FCCS Fuelbeds

- #52 - 552 acres - Douglas-fir - ponderosa pine forest
- #900 - 146 acres - Water

Daily Emissions Modeled

- PM2.5: 157.35 tons
- PM10: 185.65 tons

31 miles



Integrating the modeling with the monitoring (i.e., do we have “GIGO”?)

IN

- Did the modeled emissions (i.e., what went into the BlueSky match what actually happened?)
 - Timing (e.g., nighttime burning)
 - Amount

OUT

- Did the hourly pattern at the monitor match the hourly pattern in the model?
- Does that model output jibe with other obs



Tweaking emissions and timing THE BLUESKY PLAYGROUND (V3)

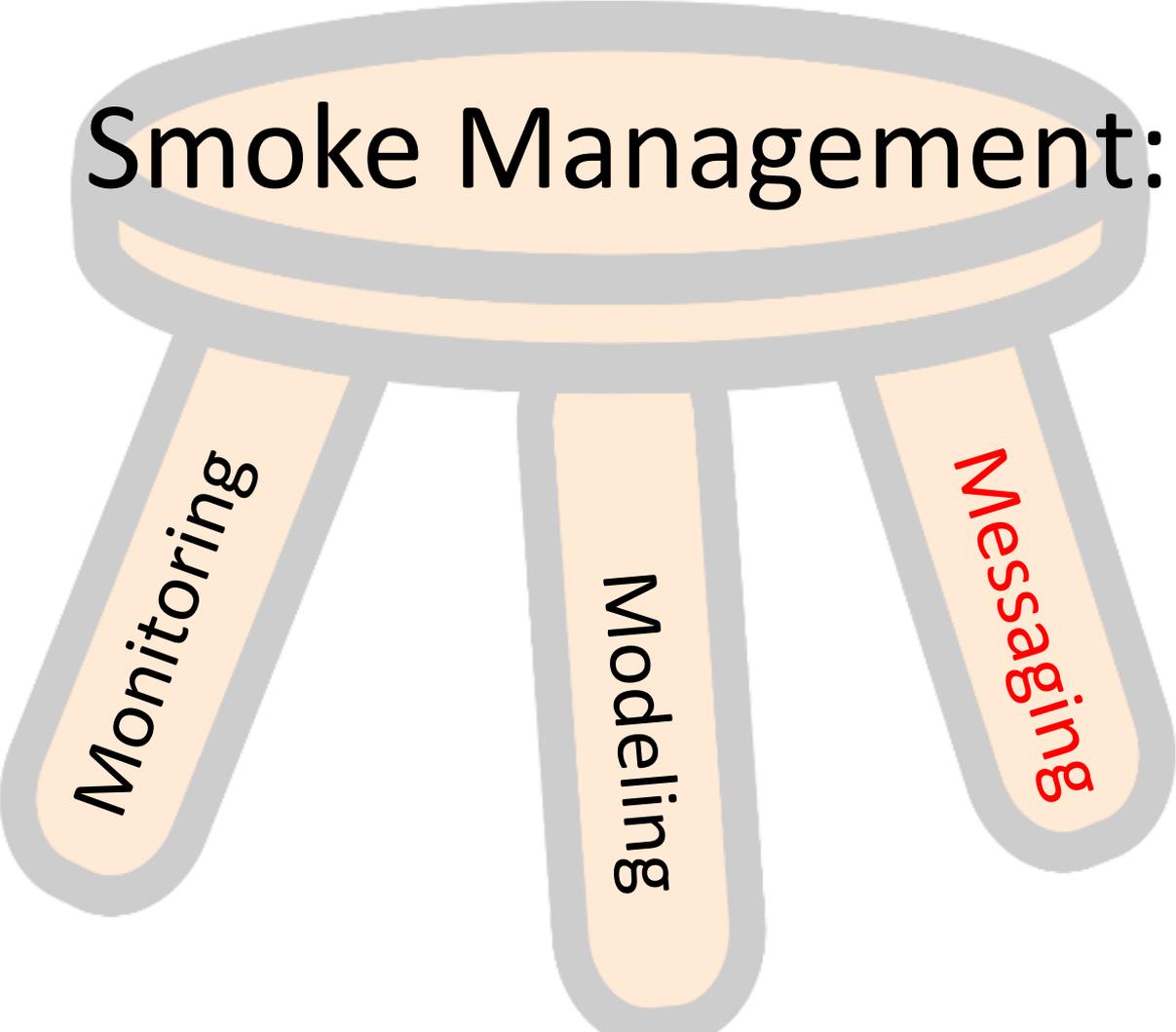
The screenshot displays the BlueSky Playground V3 interface with several key components:

- Navigation Bar:** A top bar with five circular icons labeled "Emissions Inputs", "Emissions Results", "Meteorology Inputs", "Dispersion Inputs", and "Dispersion Results".
- Left Panel:** A sidebar with sections for "Fuel", "Emissions", "Dispersion", and "Weather". Each section contains various input fields and dropdown menus.
- Report Panel:** A central panel titled "Report" with fields for "Fuelbed" (Current - Based on fuel bed: 400), "Date" (8/25/2018), "Latitude" (37.6000 degrees), "Longitude" (-118.2180 degrees), "Size" (500 acres), and "Fire Type" (Wildfire).
- Dispersion Results Panel:** A large map showing a smoke plume over a landscape. The map includes labels for "Moose Lake", "Packer Slides", "COWTRACK MIDWAY", "ADDIE VALLEY", "FRANCE VALLEY", and "BOW VALLEY". A red diamond marker is on the map. Below the map are controls for "Hourly", "Daily Avg", and "Daily Max" views, and a time slider.
- Right Panel:** A "Results" section containing a bar chart with three bars (green, orange, blue) and a line graph showing "Emissions" over time. Below these are two tables of data.
- Bottom Panel:** A "Time" display showing "8:45 - Aug 27, 2018 5:00 PM - PST" and a "Run" button.

Or Call Susan for a Custom Run ☺

<https://tools.airfire.org/playground/v3/>

Smoke Management:

A diagram illustrating the components of smoke management. At the top is a large, light-orange oval with a grey shadow, containing the text "Smoke Management:". Below this oval are three vertical, light-orange rectangular legs, each with a grey shadow. The left leg is labeled "Monitoring", the middle leg is labeled "Modeling", and the right leg is labeled "Messaging". The text on the legs is rotated 90 degrees counter-clockwise. The "Messaging" text is colored red, while the other two are black.

Monitoring

Modeling

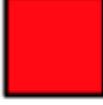
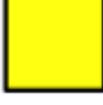
Messaging

Handoff to [data-driven] public health messaging

- This table could be seen as the handoff “baton” between the land manager/air quality side and the public health side

Air Quality Index

Actions to protect yourself

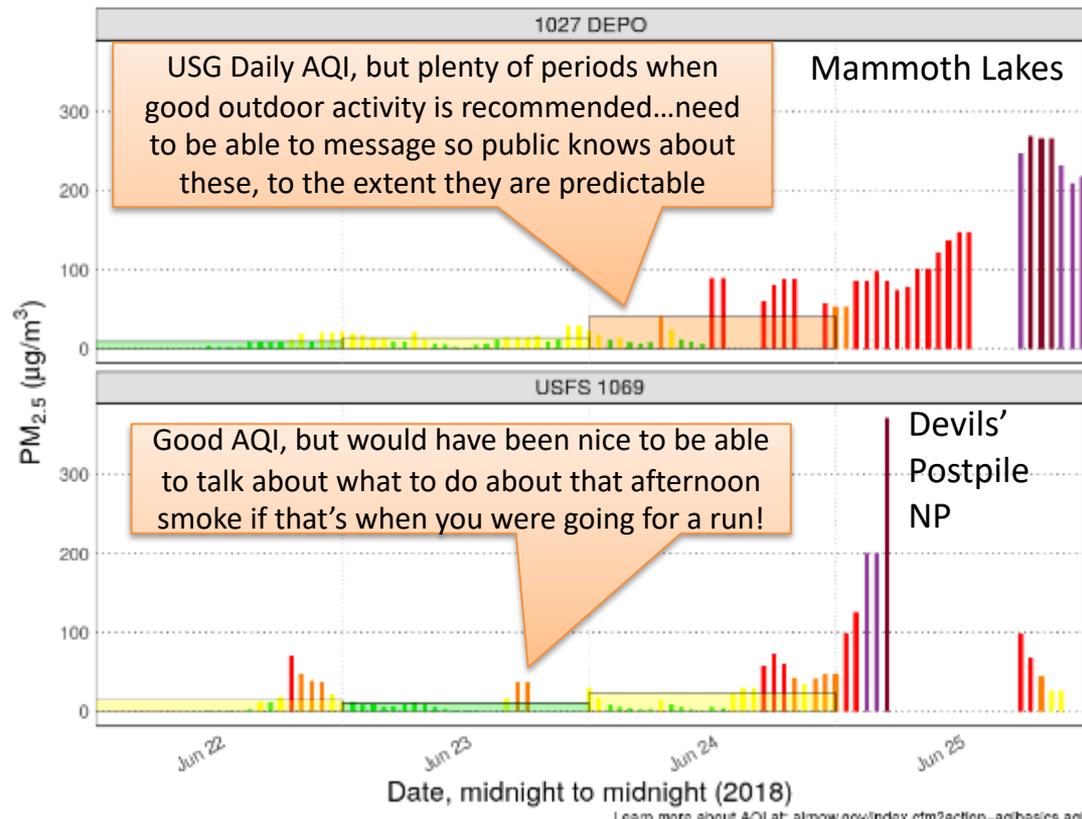
	Hazardous Everyone should avoid any outdoor activity.
	Very Unhealthy Everyone should avoid prolonged or heavy exertion.
	Unhealthy People within Sensitive Groups should avoid all physical outdoor activity.
	Unhealthy for Sensitive Groups People within Sensitive Groups should reduce prolonged or heavy outdoor exertion.
	Moderate Unusually sensitive individuals should consider limiting prolonged or heavy exertion.
	Good None

Explaining Nowcast vs. Daily AQI

Daily (AQI) and Hourly (NowCast) PM_{2.5} Levels

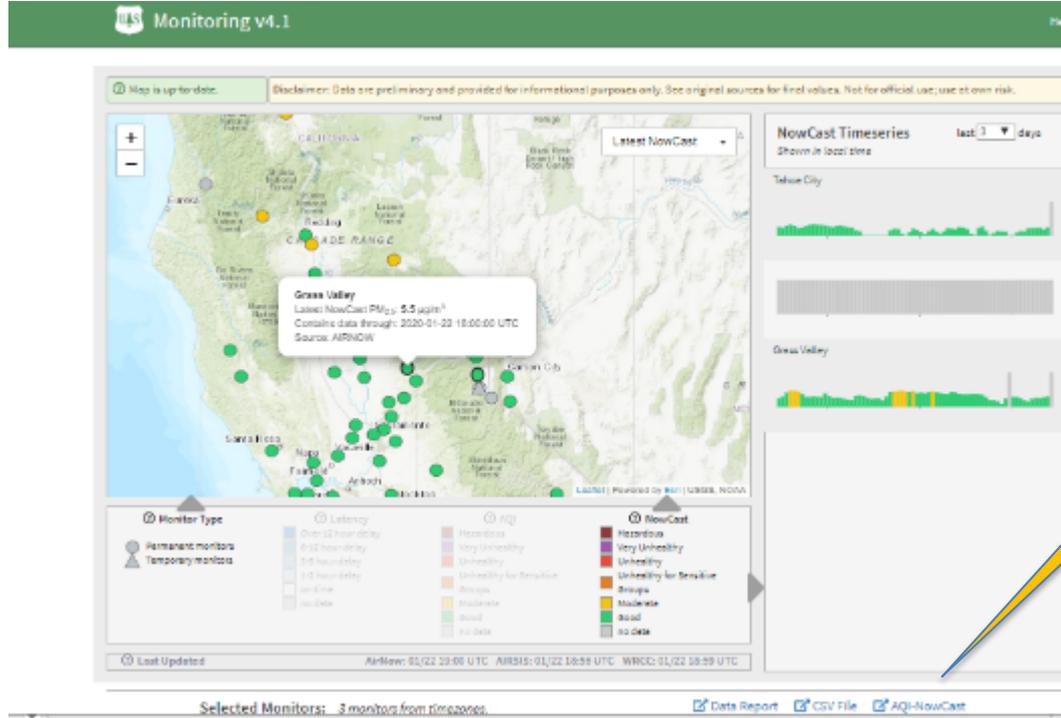
Daily Air Quality Index (24 hr AQI)	Hourly NowCast (actions to protect yourself)
Good	None.
Moderate	Unusually sensitive individuals should consider limiting prolonged or heavy exertion.
USG	People within Sensitive Groups should reduce prolonged or heavy outdoor exertion.
Unhealthy	People within Sensitive Groups should avoid all physical outdoor activity.
Very Unhealthy	Everyone should avoid prolonged or heavy exertion.
Hazardous	Everyone should avoid any outdoor activity.

- Wildfire smoke is too variable for a 24 hr average to be useful for warning/avoiding smoke



https://test-c1.airfire.org/monitor-custom/v1/dailyhourlybarplot?monitors=lon_119.085_lat_37.630_usfs.1027&monitors=lon_118.961_lat_37.647_usfs.1069&outputfiletype=png&lookbackdays=5&width=10&height=7

Where to get the daily/hourly graph:



“AQI-Nowcast”

Make sure you grab them within 45 days of the event, and save them (harder to regenerate them right now)

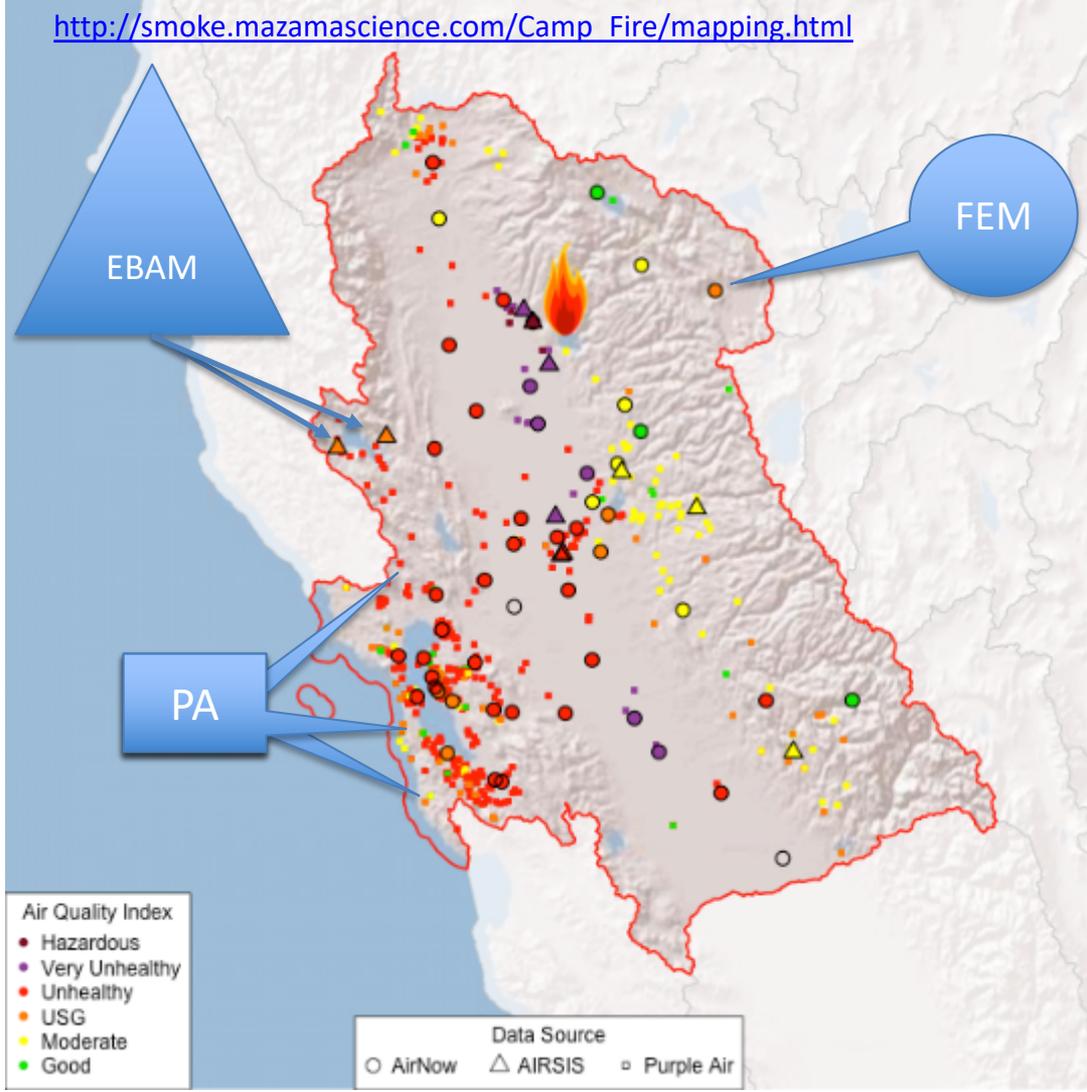
Messaging: ARA Smoke Outlook and site-specific diel patterns

- Yesterday's pattern as a jumping off point for today and tomorrow
- Bubbles forecast the Daily AQI; bar graphs document yesterday's "nowcast" levels
- Text is best guess, based on ARA interp, of the likely pattern tomorrow
- The point is to help people plan activities around smoke

Station	Yesterday	Mon	Forecast	Tue	Wed
	hourly	6/25	Comment for Today -- Tue, Jun 26	6/26	6/27
Mammoth Lake Ranger Station			Unhealthy conditions starting tonight		
GBUAPCD EBAM @ Crowley			Smoke will pool along 885 tonight		
Bishop Paiute Tribe-CA			Evidence of smoke tonight		
Mammoth Lakes-John Muir Trail			Flow rate out of range. Possible bad data.		
Lee Vining			Smoke this evening		
NCore - White Mountain Research Station - OVL			Evidence of smoke tonight		
Merced - S. Coffee Ave					
Tranquillity					
Grass Valley					
Modesto - 14th Street					
Sequoia and Kings Canyon - Ash Mountain					
Keeler					
Auburn					
Tahoe City					
Colfax					
Visalia - N. Church Street					
Fresno - Garland					
Rancho					
CC_Armory					
Turlock - S. Minaret Street					
Lone Pine Paiute/Shoshone Tribe-CA					
Yosemite Village - Visitor Center					
San Andreas					
Madera-City					
NPS SEKI-BAM					
Three Rivers-Sierra Drive					
Sequoia National Park-Generals Highway					
Rancho Murieta-Murieta Drive					
Garden Valley-Marshall Road					
West Point-Salt Springs Road					
Unit 1043 Burn Prog					

New Tools: Purple air

- In the future, it's likely that ebam monitoring will help "anchor" Purple Air monitoring



Minimizing Exposure and Maximizing Health: Balancing Activity with Smoke Avoidance

Activity Timing

Smoke avoidance

moderate



Good

Unhealthy for sensitive groups

Very Unhealthy or worse

Activity Timing

Smoke Avoidance

unhealthy

More new ARA products to come

Tools under rapid development (Contact Pete Lahm) :

- 1) Smoke Ensemble Forecast Tool (SEFT) to improve ARA and partner operational smoke forecasting;
- 2) Smoke Early Warning System (SEWS) that integrates fire outlooks and potential for significant fire growth with emissions to provide extended warnings to communities; and
- 3) Community Assessment of Prescribed fire Smoke Risk (CAPSR) tool for COVID-smoke vulnerability and at-risk populations.

<https://www.nifc.gov/fireInfo/covid-19.htm>

Conclusion: Overall thoughts/experience on how to deal with larger/more burns, statewide

- Models are sometimes wrong, but mostly useful
- Be consistent: use Rx fire AND wildfire to educate public and create “smoke-ready” communities
 - (smoke is smoke, and we now have the tools to use timing and concentration data/forecast to help message/minimize public exposure, no matter what the source)
- Set public expectations for smoke with messaging; builds trust and dialogue