

# Tools and Information for Smoke Forecasting

Susan O'Neill, USDA Forest Service  
NW-AIRQUEST Annual Meeting  
June 2020



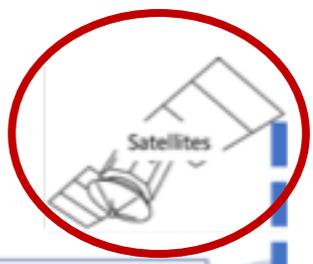
*Photo – Greg Johnson*

# Overview

- **AirFire Tools**
  - Daily Smoke Forecasting Runs
  - Do your own Smoke Forecasting (Playground V3)
  - Smoke Monitoring Tool
- **PB-Piedmont (fog/superfog)**
- **Satellite Data/Tools**
- **Smoke Emissions Reference Application (SERA)**
- **Interagency Wildland Fire Air Quality Response Program**

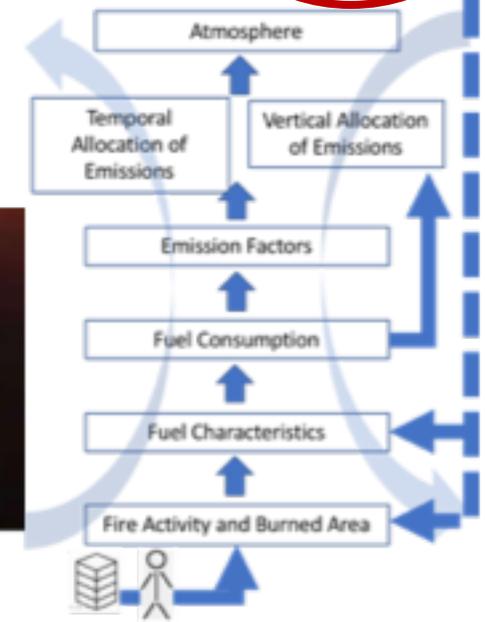
# Tools for Wildfire and Rx Fire Smoke

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



**Wildland Fire / Air Quality Tools**

This page provides links to the most recent versions of tools produced by the U.S. Forest Service PNW Research Station's Pacific Wildland Fire Sciences Laboratory in support of wildland fire operations.

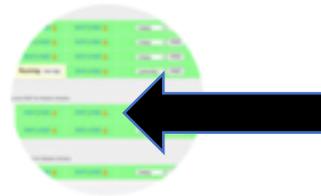


## REAL TIME SMOKE TOOLS



### PM2.5 Monitoring

Aggregated ground monitoring information [More info](#)



### BlueSky Daily Run Viewer

Visualize daily smoke forecasts [More info](#)



### BlueSky Playground

Customized emissions and dispersion modeling [More info](#)

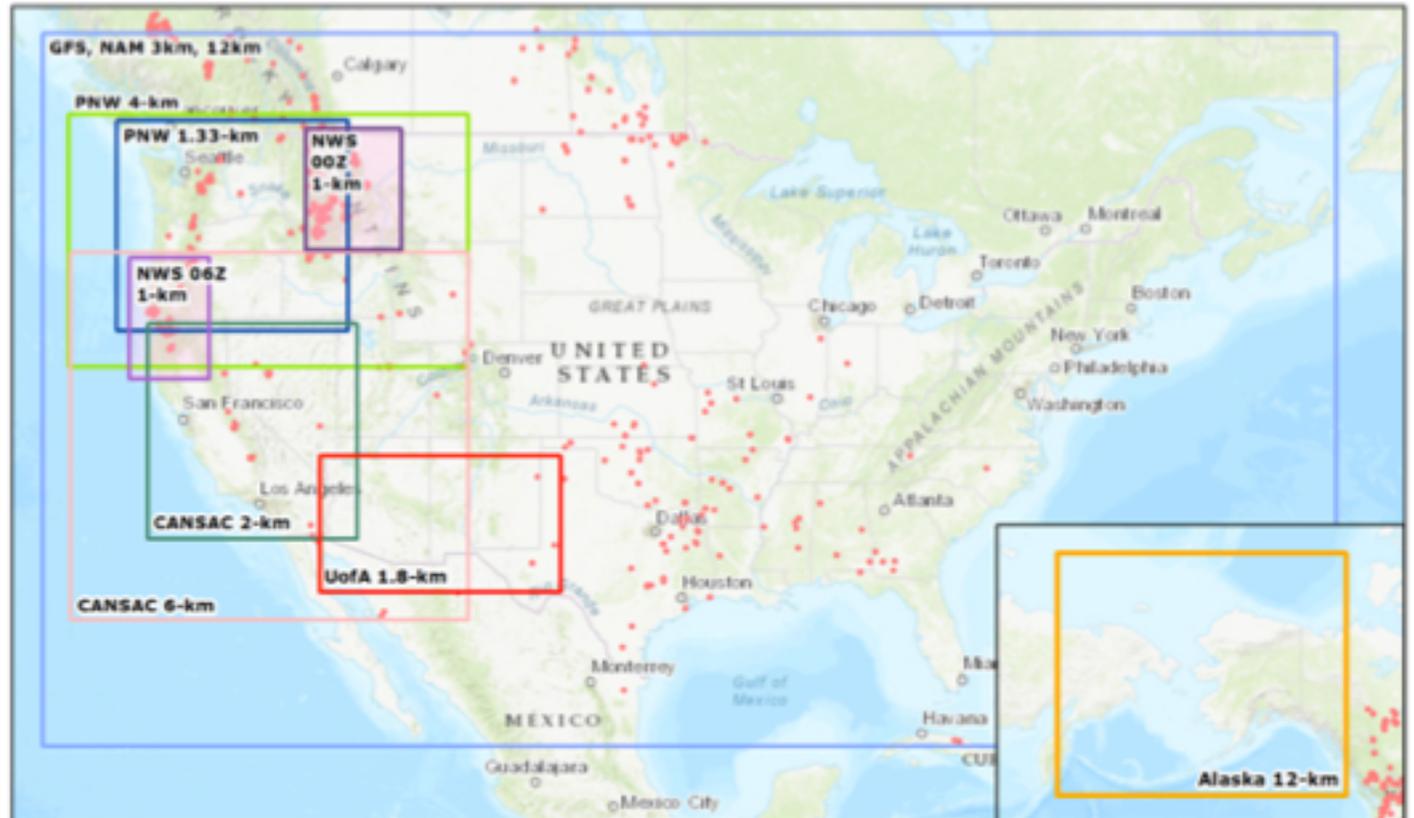


# Tailored Smoke Predictions Delivered to Incident Management Teams

- Domains

- 1.33-km PNW
- 4-km PNW
- 1.33-km CA/NV
- 4-km Western US
- 12-km CONUS
- 3-km CONUS
- 12-km Alaska
- 1.8-km AZ/NM
- 1.27-km FW (moveable)

- Meteorology from: NWS, UW, DRI, UofA



- HYSPLIT – Primary near-surface 1-hr PM<sub>2.5</sub>

### Northwest:

Uses meteorological forecast data from the NWRMC regional model runs and NWS Fire Weather Domains

PNW 4-km 72-hr forecast, NWRMC 4-km met	00Z	MAP   KMZ 🔥	MAP   KMZ 🔥	(today) ↕ KMZ
PNW 1.33-km 60-hr forecast, NWRMC 1.33-km met	00Z	MAP   KMZ 🔥	MAP   KMZ 🔥	(today) ↕ KMZ

### West/Southwest:

Uses meteorological forecast data from the CANSAC regional model runs and NWS Fire Weather Domains

Southwest 6-km 72 hr forecast, CANSAC 6-km met	00Z	MAP   KMZ 🔥	MAP   KMZ	(today) ↕ KMZ
	12Z	Running <a href="#">view logs</a>	MAP   KMZ 🔥	(yesterday) ↕ KMZ
CA/NV 2-km 72 hr forecast, CANSAC 2-km met	00Z	MAP   KMZ 🔥	Error	(today) ↕ KMZ
	12Z	Running <a href="#">view logs</a>	MAP   KMZ 🔥	(yesterday) ↕ KMZ

Running (click on "view logs" for run progress)

### Alaska:

Uses meteorological forecast data from the National Weather Service model runs and NWS Fire Weather Domains

Alaska 12-km	00Z	(no fires)	MAP   KMZ	(today) ↕ KMZ
	06Z	(no fires)	(no fires)	(today) ↕ KMZ

Number of Fires

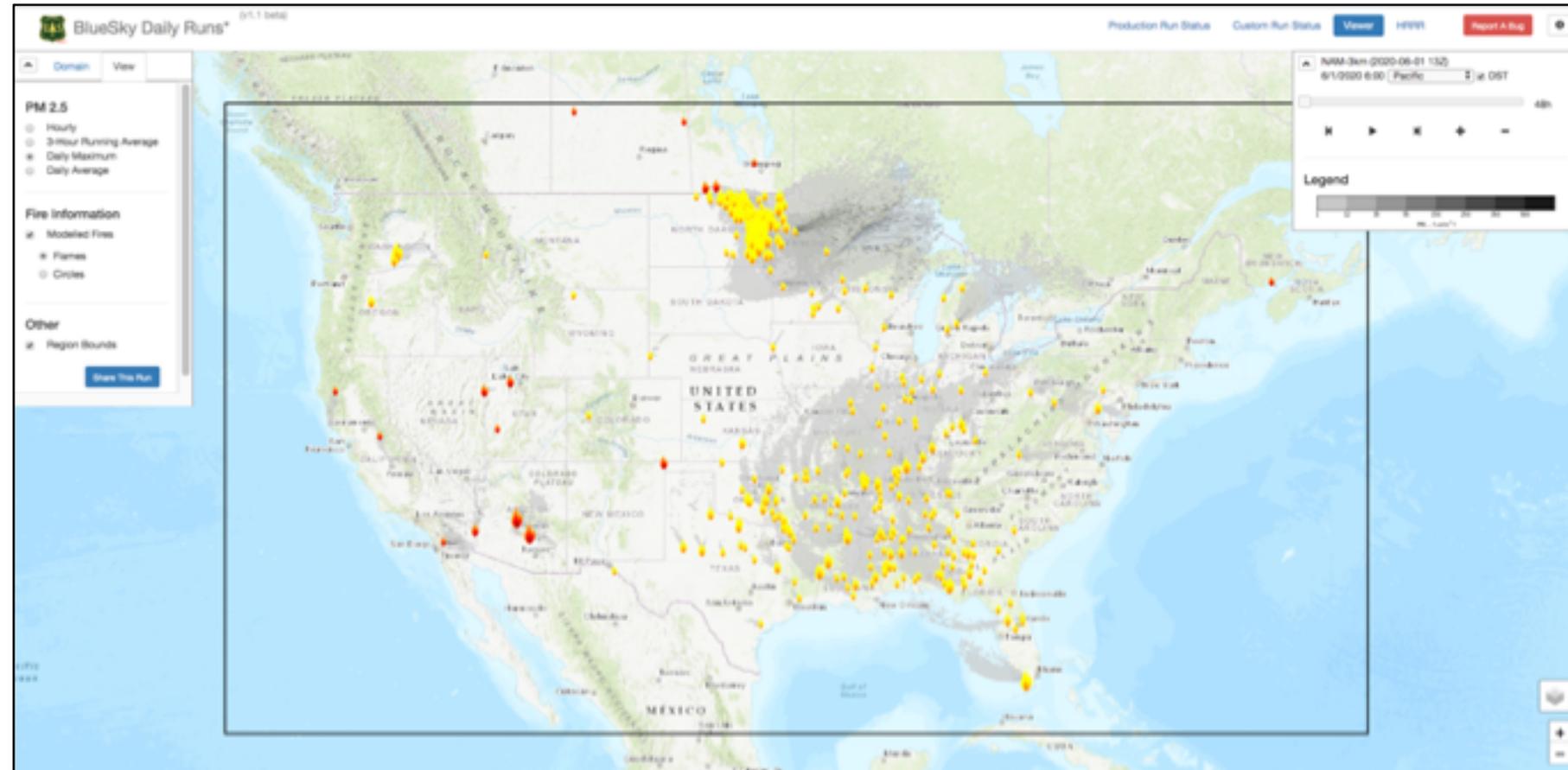
Successful!

Failures show up in red.

Website shows status of current runs

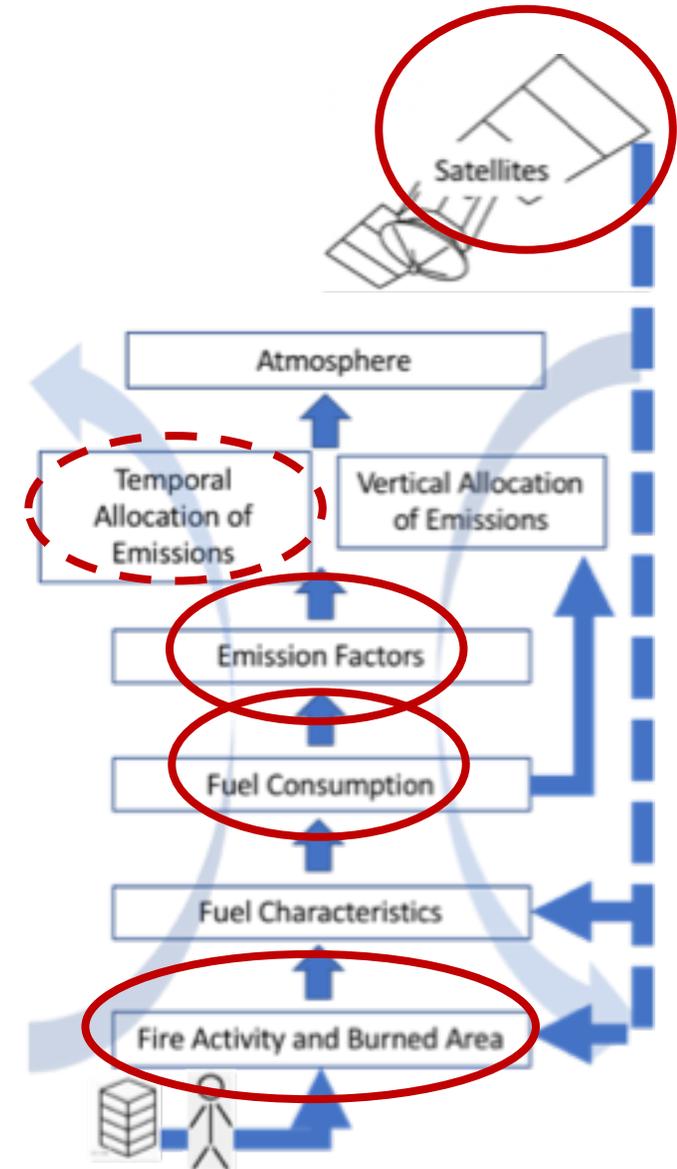
# Tailored Smoke Predictions Delivered to Incident Management Teams

- Fire Activity Information
- NOAA Hazard Mapping System (HMS) Satellite Fire Detections
- Example: 3-km NAM meteorology 6/1/2020



# Recent Updates

- Satellite and Ground-Based Fire Activity Information
- Major revision of underlying code
- CONSUME V5
  - *S.J. Prichard, M.C. Kennedy, C.S. Wright, J.B. Cronan, R.D. Ottmar. 2017. Predicting forest floor and woody fuel consumption from prescribed burns in southern and western pine ecosystems of the United States. Forest Ecology and Management, Volume 405, Pages 328-338, ISSN 0378-1127, <https://doi.org/10.1016/j.foreco.2017.09.025>.*
- Emission Factors
  - *Prichard, O'Neill, Eagle, Andreu, Drye, Dubowy, Urbanski, Strand. 2020. Wildland fire emission factors in North America: synthesis of existing data, measurement needs and management applications. IJWF <https://doi.org/10.1071/WF19066>*
- Current Research – Diurnal Profile(s)
  - *GOES-16: Custom profiles for Wildfires (O'Neill and Raffuse. 2020. High Temporal Resolution Satellite Fire Detection Data Provide Important Improvements in Smoke Forecasting for Large Wildfires. Eos. Submitted)*
  - *Li, F., X. Zhang, D. P. Roy, S. Kondragunta. 2019. Estimation of biomass-burning emissions by fusing the fire radiative power retrievals from polar-orbiting and geostationary satellites across the conterminous United States. Atmospheric Environment, Volume 211, Pages 274-287, ISSN 1352-2310. <https://doi.org/10.1016/j.atmosenv.2019.05.017>.*



# Fire Information System (FIS) - Spider

- Fire Information System

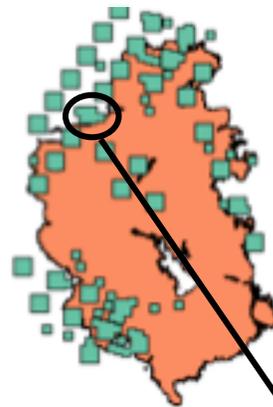
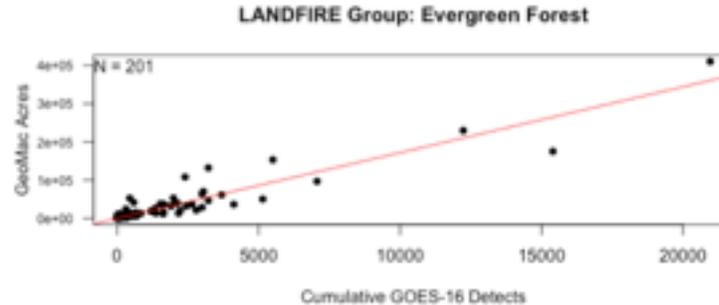
- Aggregation of multiple satellite detection sources and fire information (perimeters)
- Association of satellite data to known fires
- Estimation of active burning area via statistical relationship per detection source and vegetation type

- Spider

- GOES-16
- Max area of other two options (VIIRS, MODIS-nominally)

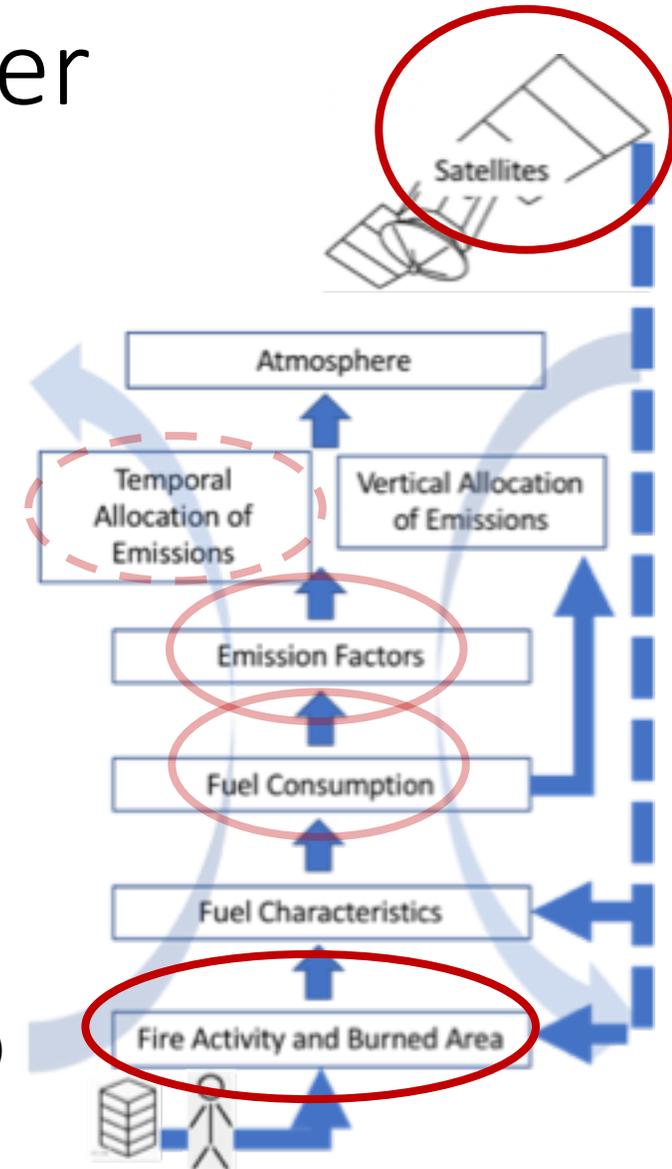
- Using HMS

- Direct datafeeds of GOES-16/17, MODIS, VIIRS



*Carr Fire, 8/4/2018*  
*Clustered detects from 8/4/2018*

**Landfire Vegetation Group: 7 (Evergreen Tree)**  
**Number of GOES-16 detects: 23**  
**Number of HMS detects: 8**  
**Estimated area from GOES-16: 391 acres**  
**Estimated area from HMS: 320 acres**



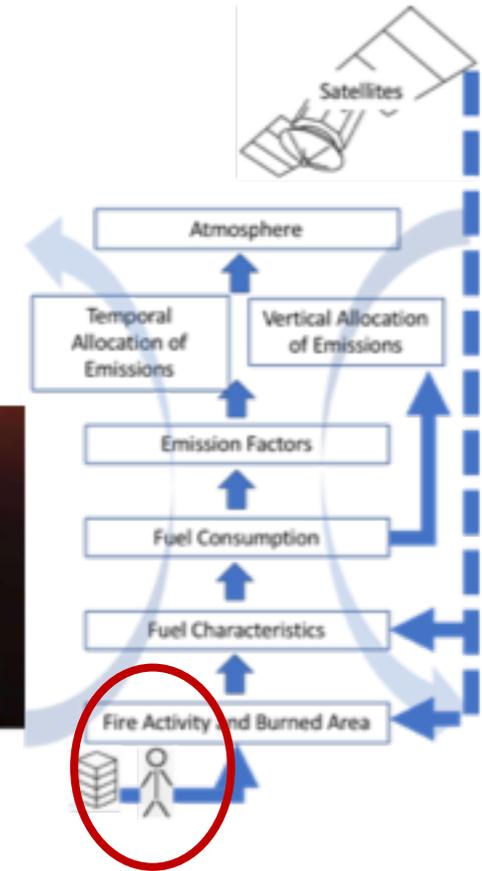
# Tools for Wildfire and Rx Fire Smoke

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



**Wildland Fire / Air Quality Tools**

This page provides links to the most recent versions of tools produced by the U.S. Forest Service PNW Research Station's Pacific Wildland Fire Sciences Laboratory in support of wildland fire operations.



## REAL TIME SMOKE TOOLS



### PM2.5 Monitoring

Aggregated ground monitoring information [More info](#)



### BlueSky Daily Run Viewer

Visualize daily smoke forecasts [More info](#)



### BlueSky Playground

Customized emissions and dispersion modeling [More info](#)



# BlueSky Playground V3 (PGV3)

 BlueSky Playground  
3.0 Alpha

**Emissions Inputs** | Emissions Results | Meteorology Inputs | Dispersion Inputs | Dispersion Results

New Run

---

**Fire Information** [?](#) Standard Advanced

> Fire Type  Size (acres)  Latitude  degrees Longitude  degrees

---

**Fuels** [?](#) Standard Advanced

> Fuelbed   Update From Map Fuel Type

---

**Fuel Moisture** [?](#) Standard Advanced

> Moisture Level

---

**Consumption** [?](#) Standard Advanced

>  Use Defaults

---

**Timing** [?](#) Standard Advanced

> Number of Days

---

I'm not a robot  reCAPTCHA  
Privacy - Terms

**Run**

# PGV3 – Fire Location



BlueSky Playground  
3.0 Alpha



New Run

## Fire Information ⓘ

Standard   Advanced

Fire Type    Size (acres)    Latitude  degrees   Longitude  degrees



# PGV3 – Fuels Inputs

BlueSky Playground  
3.0 Alpha

Emissions Inputs   Emissions Results   Meteorology Inputs   Dispersion Inputs   Dispersion Results

New Run

Fire Information

Fire Type: Prescribed   Size (acres): 500   Latitude: 44 degrees   Longitude: -121.4 degrees

Fuels

Fuelbed: 24 - Pacific ponderosa pine-Douglas-fir forest   Update From Map:    Fuel Type: Natural

		Loading (tons/acre)	
		Total	24.8
Tree crowns <small>Show</small>	Loading (tons/acre)	Snags / ladder fuels <small>Show</small>	
Shrubs/Herbs	Loading (tons/acre)	% Live	Sound wood
Primary	0.5	75	1hr
Secondary	0	0	10hr
			100hr
			1000hr
			10,000hr
			>10,000hr
Litter-Lichen Moss	Loading (tons/acre)	Depth (inches)	Rotten wood
Litter	1.78	0.7	1000hr
Ground lichen	0	0	10,000hr
Moss	0	0.2	>10,000hr

# PGV3 – Fuelbed Selection

**Fuels** ?

Standard Advanced

Update From Map Fuel Type Natural

er fuels Show Loading (tons/acre)

Loading (tons/acre)
0.1
0.2
0.75
-

**Common Fuelbeds From Fire Location**

- ✓ 24 - Pacific ponderosa pine-Douglas-fir forest
- 28 - Ponderosa pine savanna
- 238 - Pacific silver fir-mountain hemlock forest
- 55 - Western juniper/sagebrush savanna
- 52 - Douglas-fir-Pacific ponderosa pine/oceanspray forest

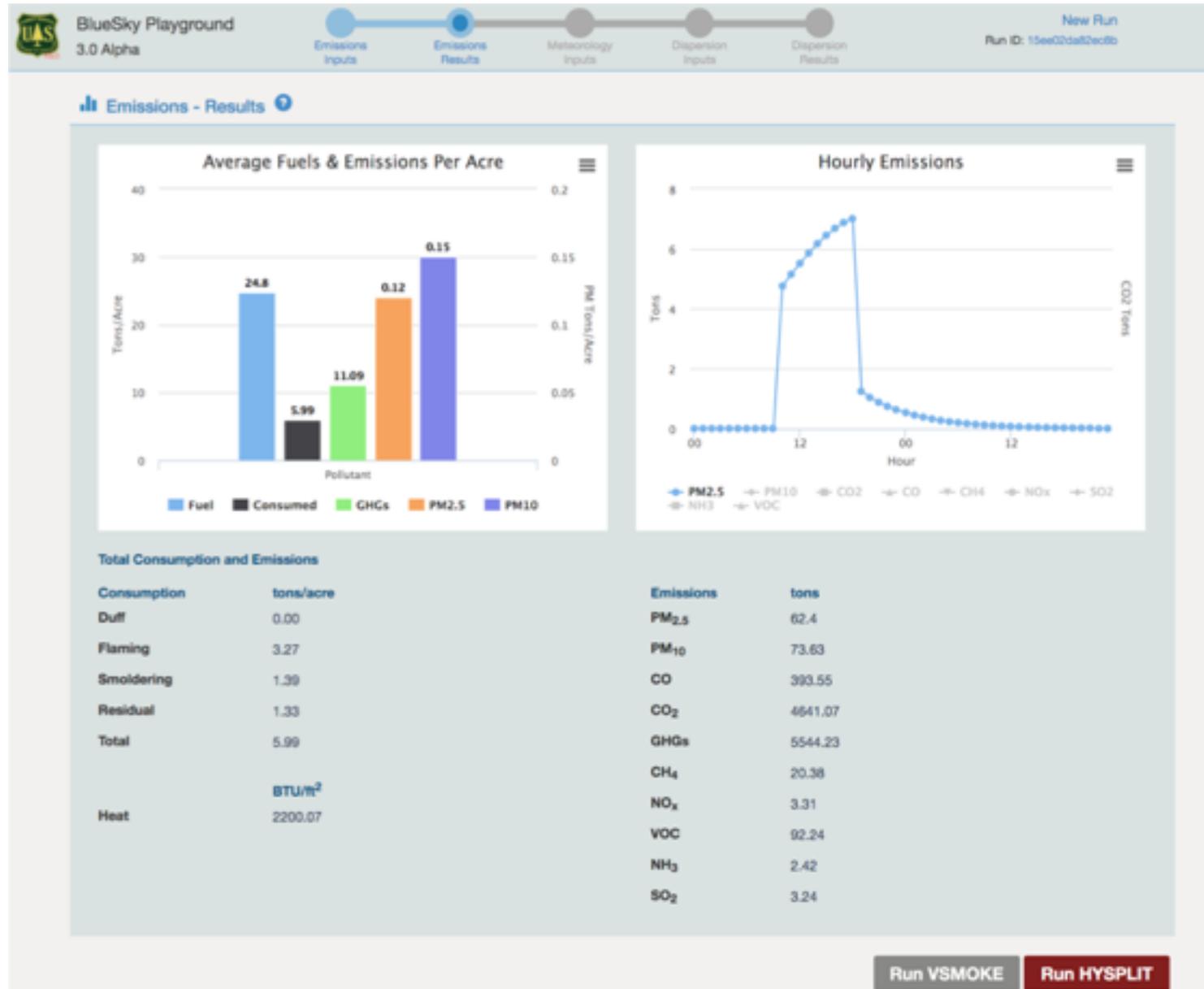
**OR/WA Smoke Management Fuelbeds**

- 1 - Black cottonwood-Douglas-fir-quaking aspen forest
- 2 - Western hemlock-western redcedar-Douglas-fir forest
- 3 - Douglas-fir forest
- 4 - Douglas-fir/ceanothus forest
- 5 - Douglas-fir-white fir forest

**All Fuelbeds**

- 0 - Bare Ground
- 1 - Black cottonwood-Douglas-fir-quaking aspen forest
- 2 - Western hemlock-western redcedar-Douglas-fir forest
- 3 - Douglas-fir forest
- 4 - Douglas-fir/ceanothus forest
- 5 - Douglas-fir-white fir forest

# PGV3 – Emissions and Consumption Summary



# PGV3 – Meteorology Selection

 BlueSky Playground  
3.0 Alpha

Emissions Inputs   Emissions Results   **Meteorology Inputs**   Dispersion Inputs   Dispersion Results

New Run  
Run ID: 15ee02da82ec8b

If you are not able to edit fuels in the Advanced tab, then clear browsing cache. To do this in chrome, clear "Cached images and files" for time range of "all time". [\(more info\)](#)

**Meteorology** ?

> **Meteorology** ✓

- Standard Archives
  - Pacific Northwest 1.33-km
  - AZ/NM 1.8-km
  - CA/NV 4-km
  - CA/NV 1.33-km
  - National 3-km
  - Pacific Northwest 4-km
  - National 12-km
  - Alaska 12-km
- Special Archives
  - Bend, OR 333m 2015
  - Rough Fire

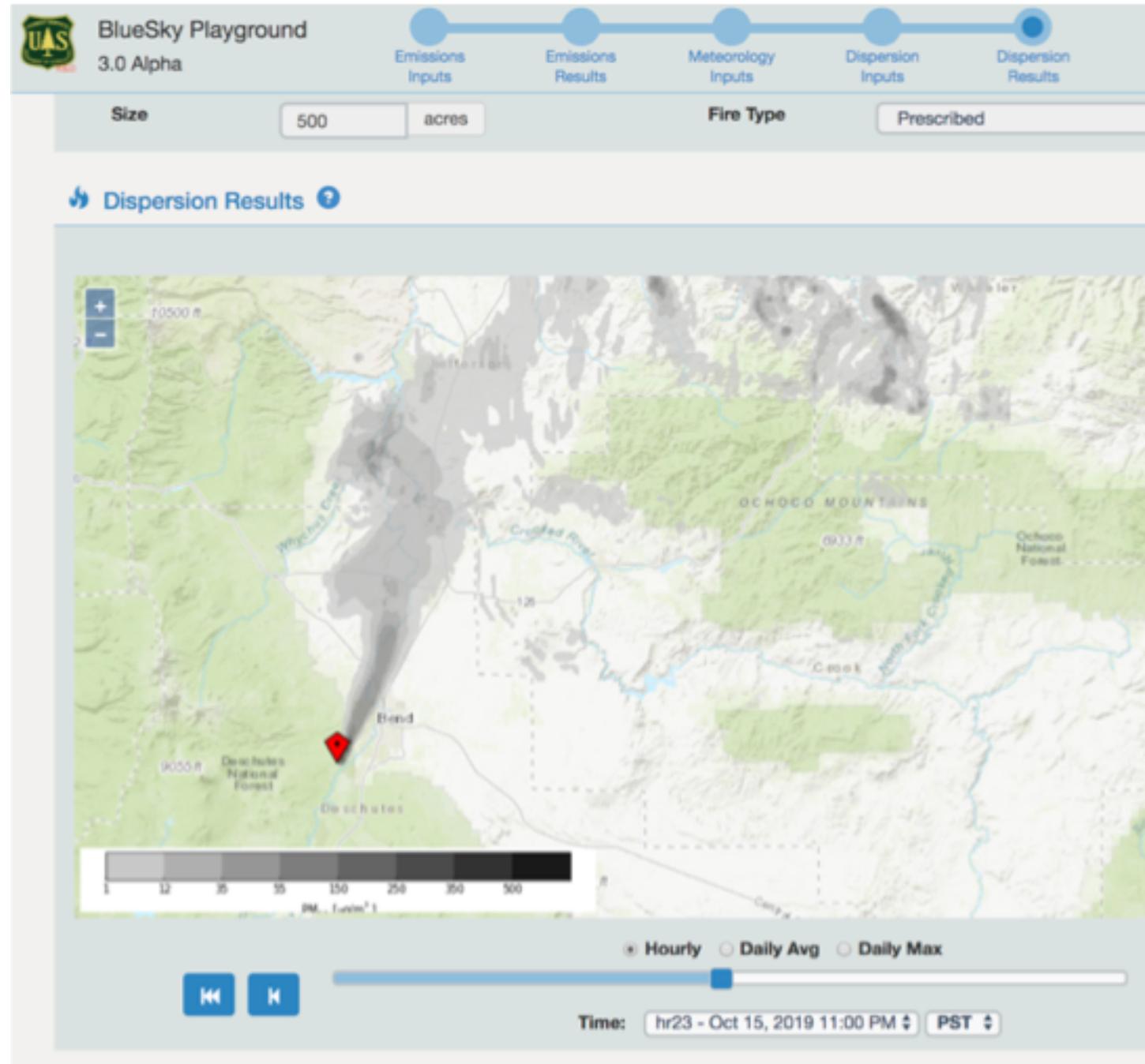
Date: 2020-06-09   Length of Run: 48 hours

**Continue**

Version 3.0.1

# BlueSky Playground V3 Do-your-own-smoke-modeling

- Near surface 1-hr average PM2.5 Concentrations
- HYSPLIT Dispersion Model



# Smoke Monitoring Tool (Permanent and Temporary Monitors)



WFAQRP-AirFire Tools

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



**Wildland Fire / Air Quality Tools**

This page provides links to the most recent versions of tools produced by the U.S. Forest Service PNW Research Station's Pacific Wildland Fire Sciences Laboratory in support of wildland fire operations.

## REAL TIME SMOKE TOOLS



### PM2.5 Monitoring

Aggregated ground monitoring information [More info](#)



### BlueSky Daily Run Viewer

Visualize daily smoke forecasts [More info](#)

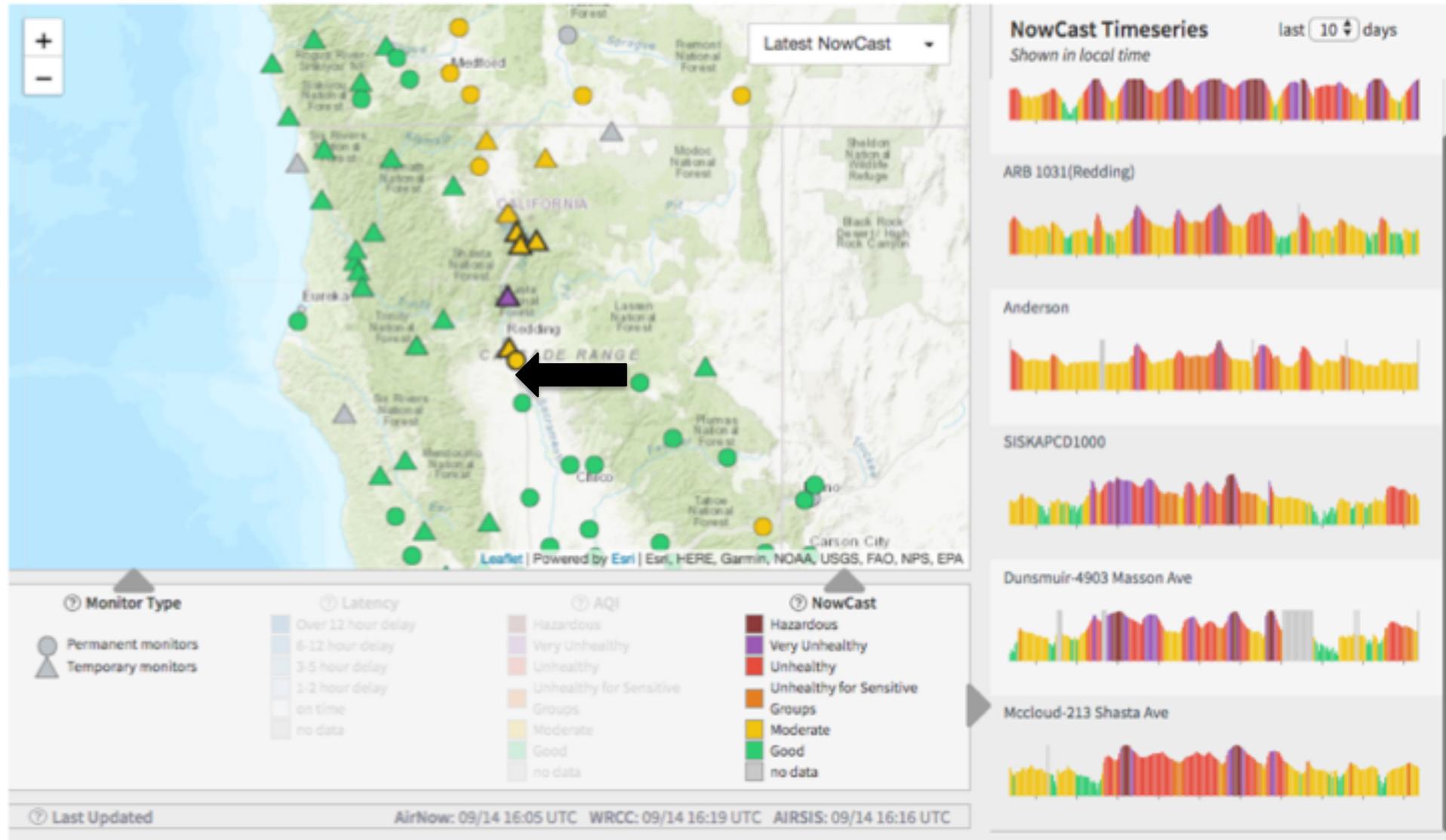


### BlueSky Playground

Customized emissions and dispersion modeling [More info](#)

# Monitoring V4

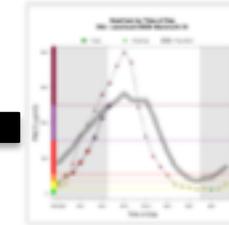
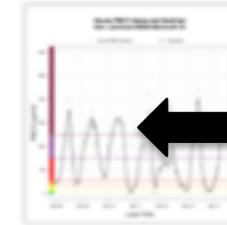
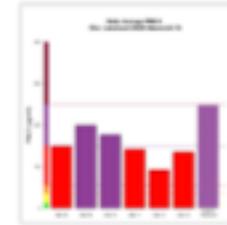
Circles - Permanent Monitors  
Triangles - Temporary Monitors



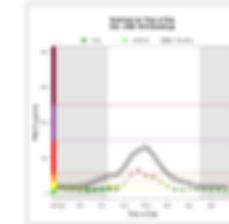
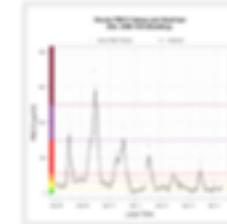
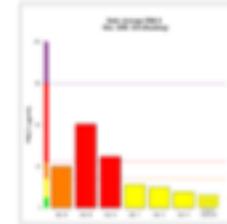
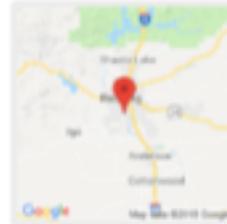
# Measured PM<sub>2.5</sub>

- Meta Data
- Map location
- 24-hr Average
- 10-day 1-hr & 3-hr
- Diurnal Profile

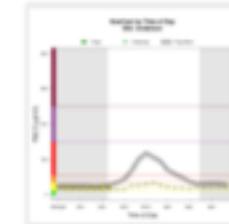
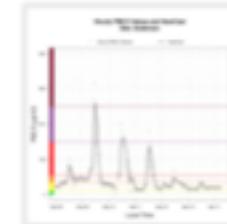
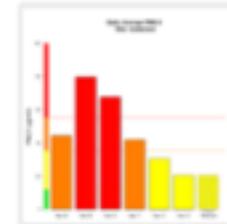
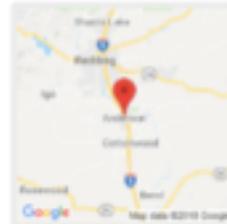
**Lakehead-20808 Mammoth Dr**  
 Monitor ID: lon\_122.385\_lat\_40.890\_arb2.1009  
 Source: AIRSIS  
 Latest NowCast PM<sub>2.5</sub>: 247.5 µg/m<sup>3</sup>  
 Contains data through 2018-09-14 15:00:00 UTC  
 Timezone: America/Los\_Angeles  
 QA/QC: [Report](#)  
[Show in Simple Interface](#)



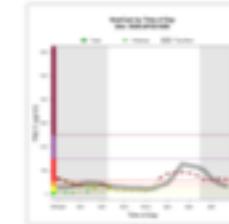
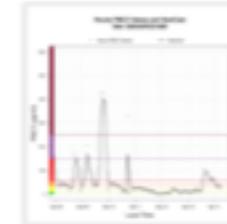
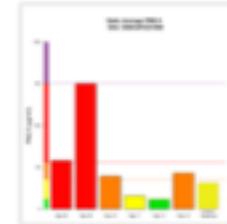
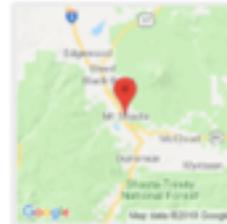
**ARB 1031(Redding)**  
 Monitor ID: lon\_122.380\_lat\_40.550\_arb2.1031  
 Source: AIRSIS  
 Latest NowCast PM<sub>2.5</sub>: 16.8 µg/m<sup>3</sup>  
 Contains data through 2018-09-14 15:00:00 UTC  
 Timezone: America/Los\_Angeles  
 QA/QC: [Report](#)  
[Show in Simple Interface](#)



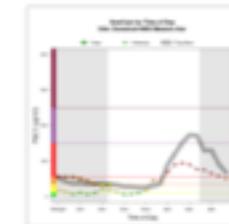
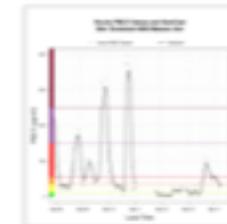
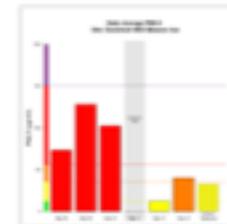
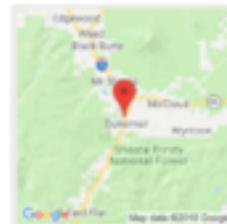
**Anderson**  
 Monitor ID: 060890007\_01  
 Source: AirNow  
 Latest NowCast PM<sub>2.5</sub>: 20.6 µg/m<sup>3</sup>  
 Contains data through 2018-09-14 15:00:00 UTC  
 Timezone: America/Los\_Angeles  
 QA/QC: by Airflow  
[Show in Simple Interface](#)



**SISKAPCD1000**  
 Monitor ID: lon\_122.313\_lat\_41.313\_apod.1014  
 Source: AIRSIS  
 Latest NowCast PM<sub>2.5</sub>: 31.5 µg/m<sup>3</sup>  
 Contains data through 2018-09-14 15:00:00 UTC  
 Timezone: America/Los\_Angeles  
 QA/QC: [Report](#)  
[Show in Simple Interface](#)

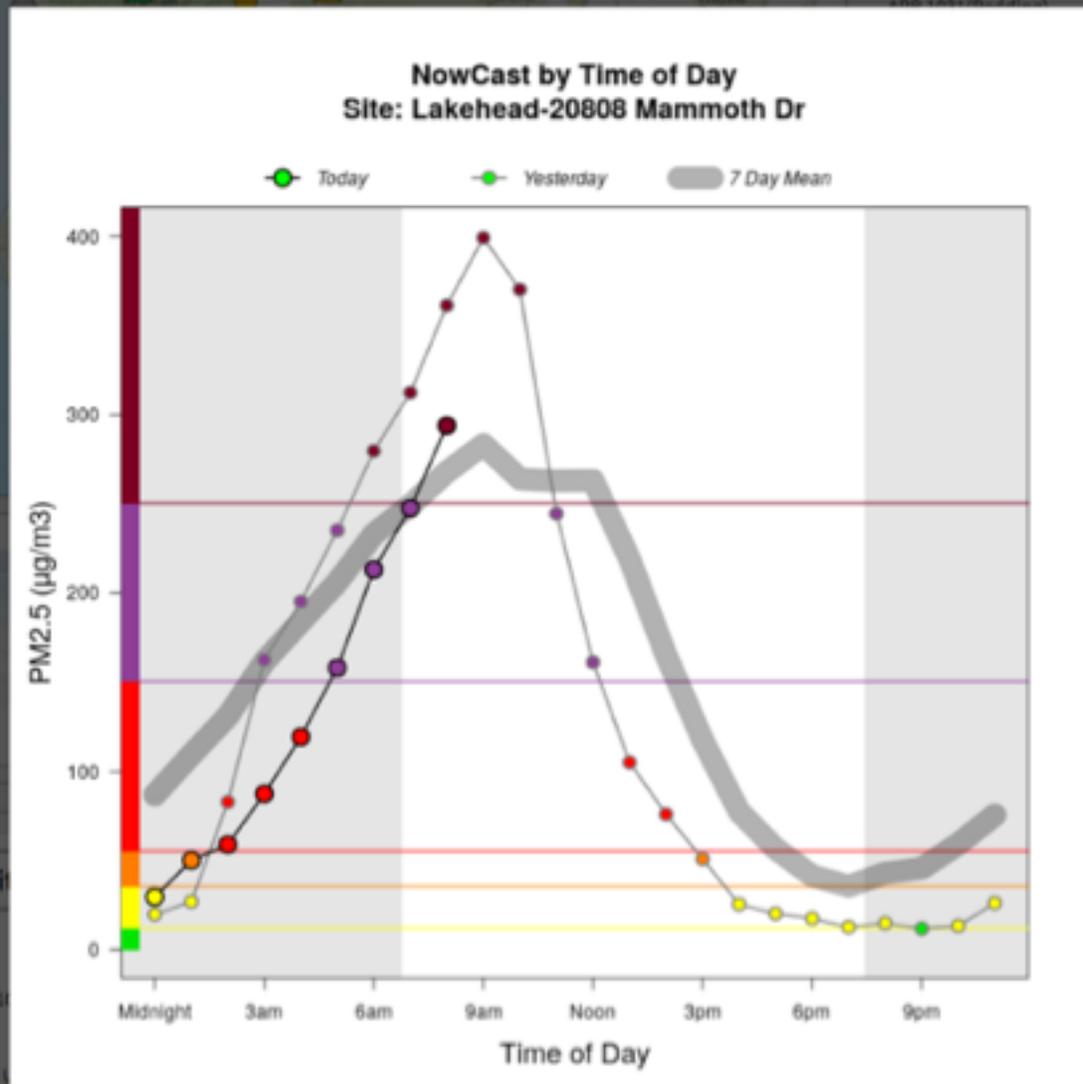


**Dunsmuir-4903 Masson Ave**  
 Monitor ID: lon\_122.278\_lat\_41.224\_arb2.1044  
 Source: AIRSIS  
 Latest NowCast PM<sub>2.5</sub>: 32.6 µg/m<sup>3</sup>  
 Contains data through 2018-09-14 15:00:00 UTC  
 Timezone: America/Los\_Angeles  
 QA/QC: [Report](#)  
[Show in Simple Interface](#)



# Mazama Science R Package

- [MazamaCoreUtils](#) -- Utilities to help write production R code
- [MazamaSpatialUtils](#) -- Harmonized spatial datasets and spatial search functions
- [MazamaLocationUtils](#) -- A system for managing spatial metadata associated with known locations
- [PWFLSmoke](#) -- Utilities for working with federal air quality monitoring data
- [AirMonitorPlots](#) -- Plotting functions for the PWFLSmoke package
- [AirSensor](#) -- Utilities for working with data from air quality sensors (e.g. Purple Air)



# Smoke Modeling Superfog – PB-Piedmont



Click on map above to select location of ignition

Location of ignition:  latitude  longitude

Time zone:

Fire start (in fire's time zone) & duration

confidence ranges (relative to latest available NAM forecasts): past data  0-6 hours  7-12 hours  13-24 hours  25-36 hours

Local start date:

Local start time:

Duration:  hours

Terrain parameters

Area burned:  acres

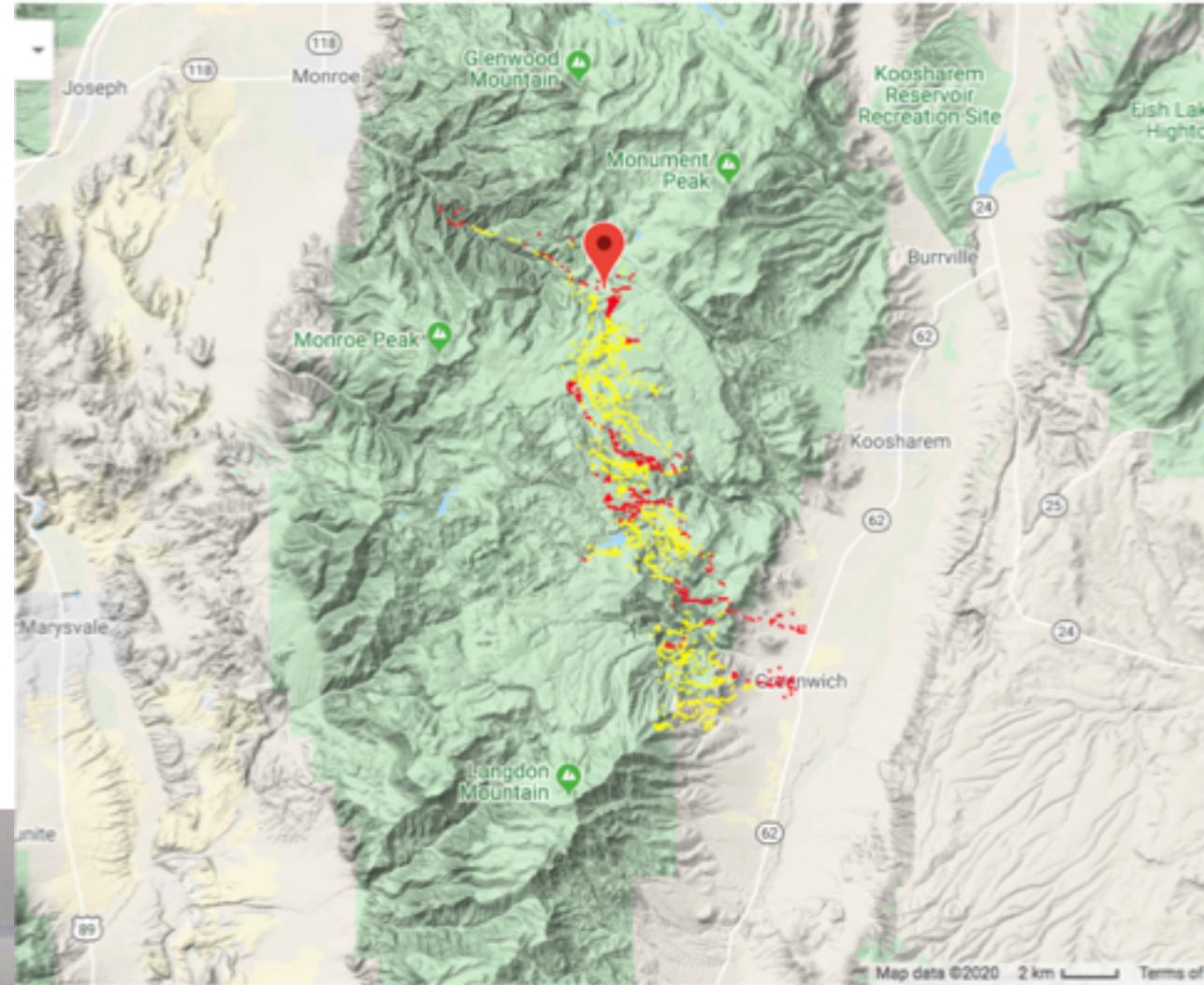
Grid spacing:  meters

Sample radius:  miles

Fuel parameters

Fuel type:

Modeling Results for +38.559303° latitude, -112.004372° longitude  
starting at Feb 5, 2020 1400 (America/Denver), and lasting for 6 hours  
400 acres burned 120 meters grid spacing 10 miles sample radius



Feb 5, 2020 1400:  +0 hours  +1 hours  +2 hours  +3 hours  +4 hours  +5 hours

animation loop:

per-image delay:

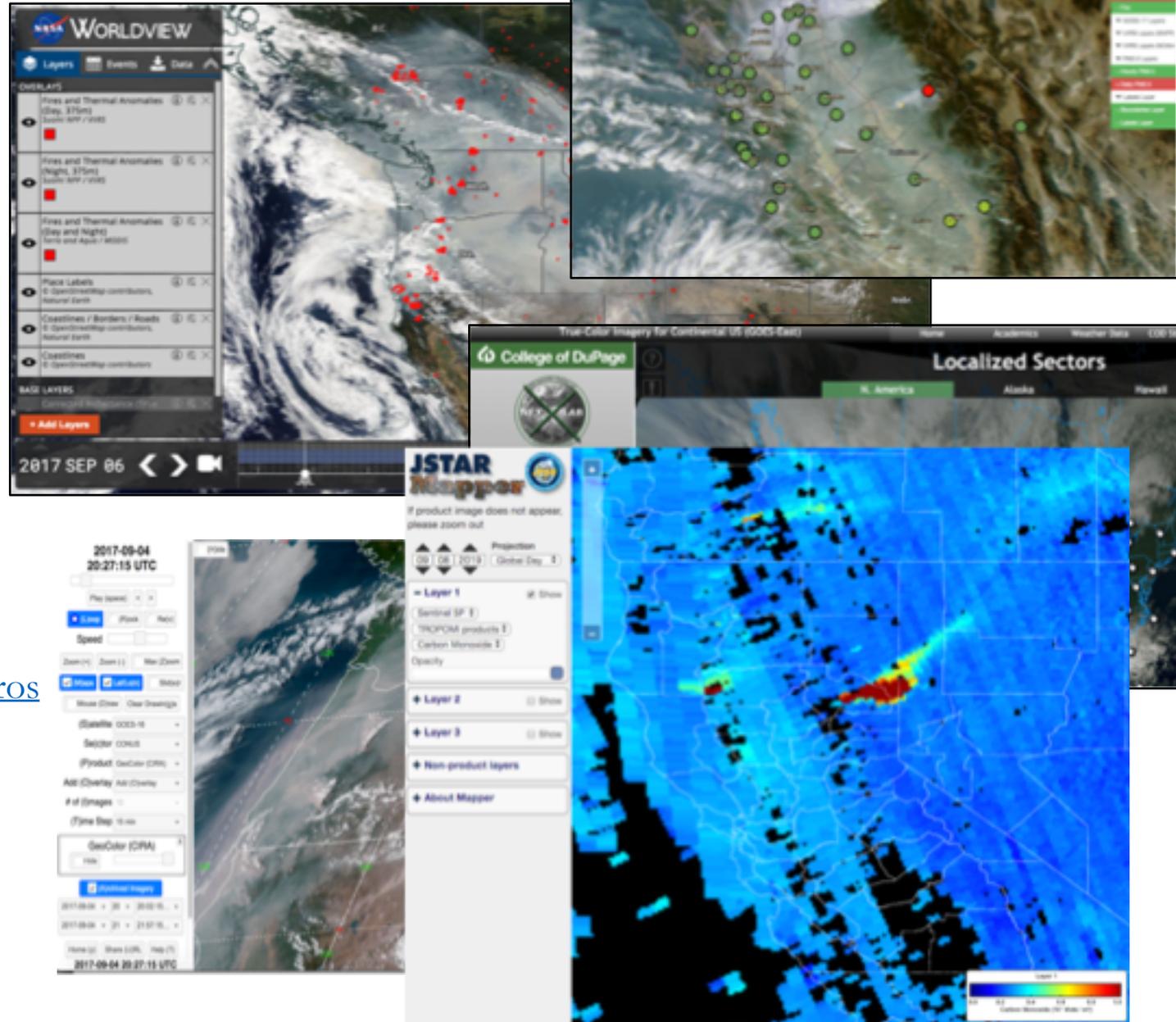
[Download KML output \(zip file\)](#)

<https://piedmont.dri.edu//>



# Satellite Information for Smoke

- NASA Worldview  
<https://worldview.earthdata.nasa.gov/>
  - VIIRS, MODIS
  - Visible smoke imagery, AOD, Fire Detections
  - Easy to add many layers
  - LOTS more
- College of Dupage <https://weather.cod.edu/satrad/>
  - GOES-16 (fast)
- CSU CIRA <http://rammb-slider.cira.colostate.edu/>
  - GOES-16, GOES-17 (be patient)
- NOAA AerosolWatch  
<https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch/>
  - GOES-16/17, VIIRS
  - AOD, Fire Detections, Surface Monitors
- JPSS JSTAR Mapper  
<https://www.star.nesdis.noaa.gov/jpss/mapper>
  - Suomi NPP, NOAA-20, Sentinel 5P (CO, NO2)



# The Basics of Satellite Data for Smoke and Fire Online Training (15 min)

Part 1: The Basics of Satellite Data for Smoke and Fire



Part 2: The Basics of Satellite Data for Smoke and Fire



Summary Table of Satellites, Satellite Instruments, and Products for Smoke and Fire

(discussed at the end of video Part 2)

Name	Instrument	Products	Orbital Revolution, Orbital Time	Orbital Resolution	Filter/View	Launch Date	Expiration Date
GOES-16	ABI	Visible, PFR, ARES, Fire Hot Spot, Smoke Mask	1.5 hrs (101.5 min), 90 min PFR Orb	1.0 - 2.0 km	Color	November 2016	November 2021
GOES-17	ABI	Visible, PFR, ARES, Fire Hot Spot, Smoke Mask	1.5 hrs (101.5 min), 90 min PFR Orb	1.0 - 2.0 km	Color	November 2016	November 2021
Travis	MODIS	Visible, PFR, ARES, Fire Hot Spot	Equator Crossing 10:30 AM EST	1000m, 1000m	False	November 1999	November 2008
Aqua	MODIS	Visible, PFR, ARES, Fire Hot Spot	Equator Crossing 1:30 PM EST	1000m	False	Mar 2002	Mar 2015
Satellite PFP	VIIRS	Visible, PFR, ARES, Fire Hot Spot, Smoke Mask	Equator Crossing 10:30 PM EST	1.0 - 1.0 km	False	October 2011	November 2013
NPP-VIIRS	VIIRS	Visible, PFR, ARES, Fire Hot Spot, Smoke Mask	Equator Crossing 10:45 PM EST	1.0 - 1.0 km, 1000m	False	November 2011	Mar 2018
Leaflet (with: Boreas, Sentinel-1, Sentinel-2, Sentinel-3, Sentinel-6, Sentinel-5P, Sentinel-6, Sentinel-6, Sentinel-6)	Various, depending on satellite. For Leaflet 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	Visible, various flags	Equator Crossing 10:30 AM EST	1000m	False	Feb. 2013	April 2013



- What is a polar orbiting versus geostationary satellite?
- What are the instruments on commonly used satellites?
- What are the products from these instruments?

The 15 minute online training is at:  
<https://sites.google.com/firenet.gov/wfaqrp-airfire/projects/haqast/2017NorthernCAWildfiresTT/training>

# Wildland Fire Emissions Factors in North America

## The new Smoke Emissions Reference Application (SERA)

**SMOKE EMISSIONS REFERENCE APPLICATION (SERA)**

Emissions Factors by Pollutant: Smoke Emissions Reference

Filter summaries by:

- Combustion Phase:
  - Flaming
  - Smoldering
  - Unspecified
  - Residual smoldering
- Burn Type:
  - Fast fire - Aerial
  - Fast fire - Airborne
  - Fast fire - Ground
  - Fast fire - Tower
  - Fast fire - Airborne
  - Lab
- Region:
  - North
  - Southeast
  - West
- Vegetation Type:
  - Conifer forest
  - Grassland
  - Hardwood forest
  - Mixedwood forest
  - Organic soil
  - Other
  - Shrubland
- EPA Pollutant Category:
  - Air Toxin (ATC)
  - Critical Air Pollutant (CAP)
  - Greenhouse Gas (GHG)
  - Hazardous Air Pollutant (HAP)
  - Ozone Depleting Substance (ODS)
  - Ozone Precursor (OP)
  - Persistent Bioaccumulative Toxin (PBT)
- Stack:
  - Include stack (default)
  - Include stack
  - Stack only

Advanced search: Use checkboxes in the table below to further limit output to selected pollutants.

Download this summary table | Download source EPA for this summary table

Emissions Factor Summaries: Showing all 276 pollutants, across all categories (excluding outliers and stack)

Pollutant	Formula	Pollutant Category	Molecular Wt	Count	EF (g/kg)		WCE (g/h)	
					Mean	SD	Mean	SD
<input type="checkbox"/> ammonia	NH <sub>3</sub>	inorganic gases	17.031	100	1.380	1.440	0.010	0.008
<input type="checkbox"/> carbon dioxide	CO <sub>2</sub>	inorganic gases	44.009	400	1,390,004	168,218	0.010	0.040
<input type="checkbox"/> carbon monoxide	CO	inorganic gases	28.01	400	90,042	49,433	0.008	0.005
<input type="checkbox"/> methane	CH <sub>4</sub>		16.043	304	4,204	3,367	0.014	0.040
<input type="checkbox"/> nitric oxide	NO	nitrogen oxides	30.006	170	2,100	1,600	0.000	0.007
<input type="checkbox"/> nitrogen dioxide	NO <sub>2</sub>	nitrogen oxides	46.005	140	1,170	0.874	0.000	0.007
<input type="checkbox"/> nitrogen oxides	NOx	nitrogen oxides		97	3,001	2,110	0.001	0.000
<input type="checkbox"/> particulate matter 2.5µm	PM2.5	particulate matter		200	20,400	18,804	0.010	0.044
<input type="checkbox"/> sulfur dioxide	SO <sub>2</sub>	inorganic gases	64.064	100	1,110	0.700	0.007	0.000

Pollutant	Formula	Pollutant Category	Molecular Wt	Count	EF (g/kg)		WCE (g/h)	
					Mean	SD	Mean	SD
<input type="checkbox"/> 1,1,2,2-tetrachloroethane	C <sub>2</sub> H <sub>2</sub> Cl <sub>4</sub>	halocarbons	167.836	1	0.000	0.000	0.000	0.000
<input type="checkbox"/> 1,1-dichloro-1-fluoroethane	CH <sub>2</sub> ClCF <sub>2</sub>	halocarbons	116.944	2	0.200	1.800	0.000	0.000

<https://depts.washington.edu/nwfire/sera/index.php>

Susan O'Neill, USDA Forest Service

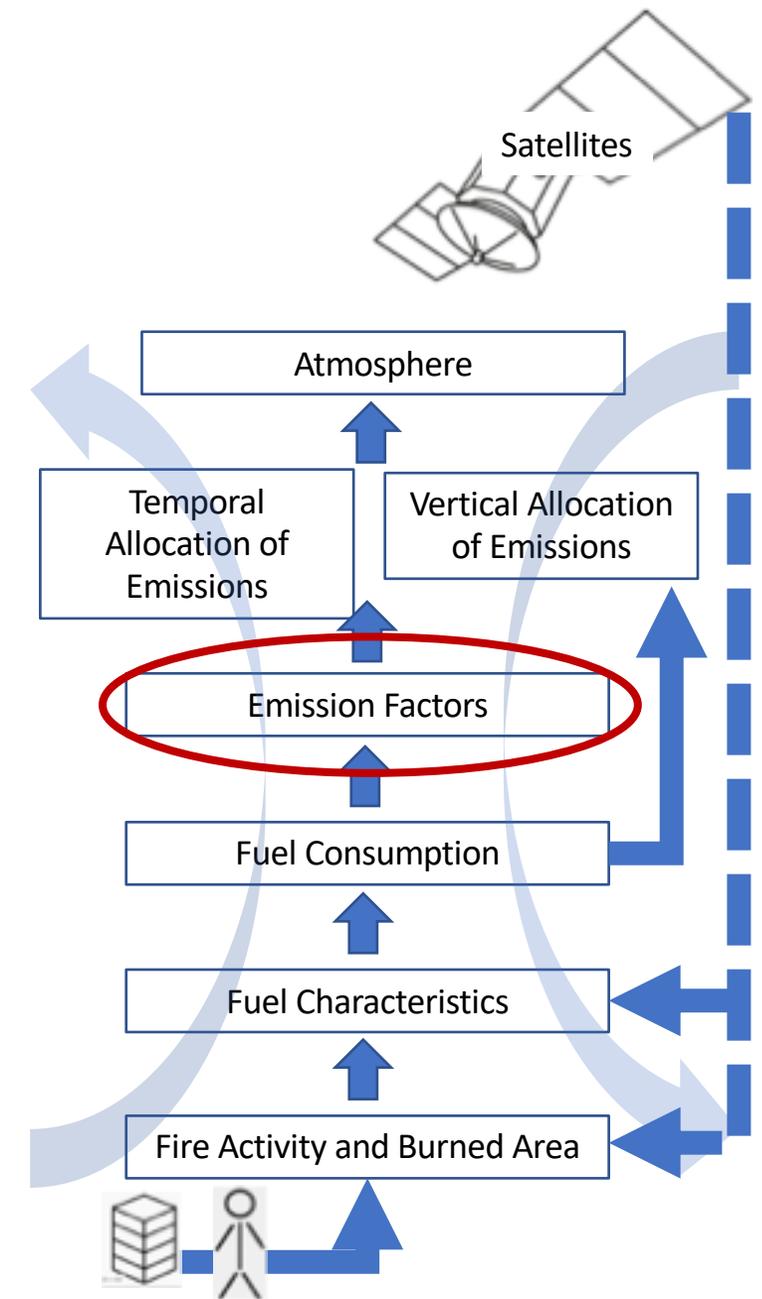
Susan Prichard, University of Washington

EPA Wildland Fire Research Focus Group, April 2020



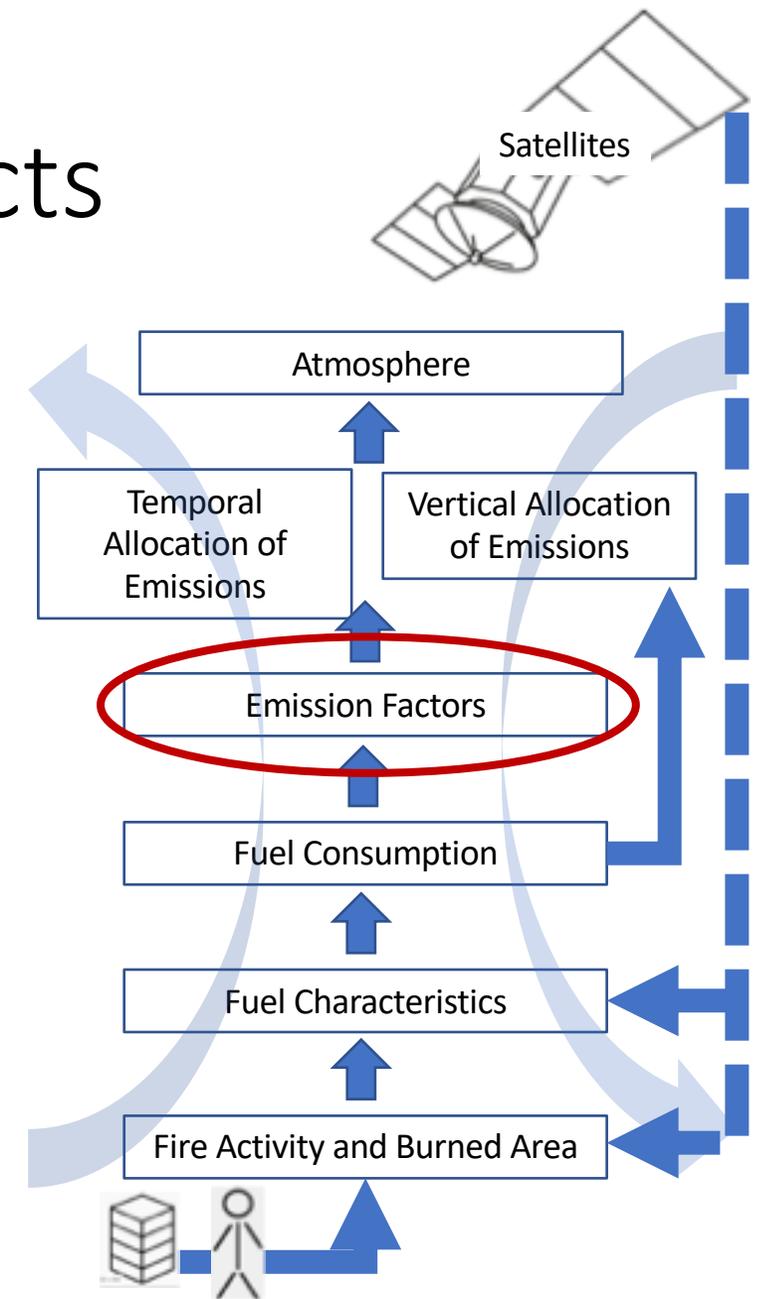
# Emission Factors

- Emission Factor (EF): mass pollutant released per mass fuel consumed (e.g. g/kg)
- Represents the chemical & physical processes of the air sample from the combustion release point to sampling point
- Important component in many fire emission calculation systems (e.g. BlueSky, CONSUME, FOFEM, FFT, NEI)
- Many years of research



# Emission Factor Synthesis Projects

- Department of Defense Strategic Environmental Research and Development Program
    - Extensive literature review through 2010
    - Spreadsheet compilation of EF data
    - Lincoln et al. 2014. <https://www.fs.usda.gov/rds/archive/Product/RDS-2014-0012>
  - National Wildfire Coordinating Group (NWCG) Smoke Committee (SmoC)
    - Update the SERDP work (add data since 2010)
    - Purpose: Update CONSUME, FOFEM, BlueSky models
    - Create a web interface and database
    - Prichard, O'Neill, Eagle, Andreu, Drye, Dubowy, Urbanski, Strand. 2020. IJWF <https://doi.org/10.1071/WF19066>
- ➔ The Smoke Emissions Reference Application (SERA)



# SMOKE EMISSIONS REFERENCE APPLICATION (SERA)

## SERA

- 276 Trace gases & aerosol
- 12,533 records
- Filter by:
  - Combustion Phase
  - Burn Type
  - Region
  - Vegetation Type
  - Pollutant Category
  - Logging Slash
- Mean, Std Dev
- Download the underlying data
- Fast!
- Simple to Use

### Emissions Factors by Pollutant | Smoke Emissions References

Filter summaries by:  Include outliers

**Combustion Phase**

 Flaming  
 Smoldering  
 Unspecified  
 Residual smoldering

**Burn Type**

 Field: Rx - Aerostat  
 Field: Rx - Airborne  
 Field: Rx - Ground  
 Field: Rx - Tower  
 Field: Wild - Airborne  
 Lab

**Region**

 North  
 Southeast  
 West

**Vegetation Type**

 Conifer forest  
 Grassland  
 Hardwood forest  
 Mixedwood forest  
 Organic soil  
 Other  
 Shrubland

**EPA Pollutant Category**

 Air Toxin (TOX)  
 Critical Air Pollutant (CAP)  
 Greenhouse Gas (GHG)  
 Hazardous Air Pollutant (HAP)  
 Ozone Depleting Substance (ODS)  
 Ozone Precursor (OP)  
 Persistent Bioaccumulative Toxic (PBT)

**Slash**

 Exclude slash (default)  
 Include slash  
 Slash only

▶ Advanced search

Use checkboxes in the table below to further limit output to selected pollutants.

[Download this summary table](#) | [Download source EFs for this summary table](#)

**Emissions Factor Summaries: Showing all 276 pollutants, across all categories (excluding outliers and slash)**

Primary Gases/Aerosols						EF (g/kg)		MCE (0-1)	
	Pollutant	Formula	Pollutant Category	Molecular Wt	Count	Mean	SD	Mean	SD
<input type="checkbox"/>	ammonia	NH <sub>3</sub>	inorganic gases	17.031	199	1.386	1.445	0.910	0.059
<input type="checkbox"/>	carbon dioxide	CO <sub>2</sub>	inorganic gases	44.009	435	1,595.634	166.218	0.915	0.040
<input type="checkbox"/>	carbon monoxide	CO	inorganic gases	28.01	493	99.042	49.433	0.908	0.055
<input type="checkbox"/>	methane	CH <sub>4</sub>		16.043	324	4.294	3.387	0.914	0.040
<input type="checkbox"/>	nitric oxide	NO	nitrogen oxides	30.006	175	2.159	1.632	0.929	0.037
<input type="checkbox"/>	nitrogen dioxide	NO <sub>2</sub>	nitrogen oxides	46.005	146	1.175	0.874	0.935	0.027
<input type="checkbox"/>	nitrogen oxides	NO <sub>x</sub>	nitrogen oxides		97	3.021	2.110	0.891	0.090
<input type="checkbox"/>	particulate matter 2.5µm	PM2.5	particulate matter		252	22.456	16.954	0.919	0.044
<input type="checkbox"/>	sulfur dioxide	SO <sub>2</sub>	inorganic gases	64.058	123	1.113	0.723	0.927	0.033
Other Gases/Aerosols						EF (g/kg)		MCE (0-1)	
	Pollutant	Formula	Pollutant Category	Molecular Wt	Count	Mean	SD	Mean	SD
<input type="checkbox"/>	1,1,2,2-tetrachloroethane	C <sub>2</sub> H <sub>2</sub> Cl <sub>4</sub>	haloalkanes	167.838	1	0.005	0.000	0.886	0.000
<input type="checkbox"/>	1,1-dichloro-1-fluoroethane	CH <sub>3</sub> CClF <sub>2</sub>	haloalkanes	116.944	2	3.250	1.850	0.900	0.023

<https://depts.washington.edu/nwfire/sera/index.php>



# Interagency Wildland Fire Air Quality Response Program (IWFAQRP)

Smoke Forecast Outlook issued September 15, 2017 at 10:45 AM EDT

**Outlook for UmpquaNorthHighCascades**

**Smoke:** Air quality is improving overall in the area as fire activity lessens somewhat thanks to cooler temperatures and high humidities but areas close to fires remain at risk of smoke. Views and air quality at Crater Lake National Park are expected to be much better than yesterday with smoke increasing late in the day and evening.

**Fires:** Umpqua N. complex grew 585 acres to 41,441 acres with 38% containment and is burning actively. High Cascades complex is reported as 14,475 acres smaller than yesterday due to removal of the Spruce Lake fire from the complex and is at 60,393 acres with 18% containment. Spruce Lake fire in Crater Lake NP is 15,660 acres with 0 growth and 27% containment.

**Other:** Rain is expected to begin in the area late on Sunday and could significantly dampen and suppress fires in the area.

**Daily AQI Forecast for Sep 15, 2017**

Station	Yesterday hourly	Thu 9/14	Forecast Comment for Today -- Fri, Sep 15	Fri 9/15	Sat 9/16
Roseburg	Good	Good	Mostly Good air quality, may see some light smoke mid-day with easterly wind flows.	Good	Good
Glide	Good	Good	Mostly Good air quality, may see some smoke mid-day with easterly wind flows.	Good	Good
Tokatee	No hourly data	Unhealthy	Proximity to fires means smoke remains significant. The monitor in the area has failed.	Unhealthy	Unhealthy
Diamond Lake	No hourly data	Unhealthy	Should see periods of clearing during the day followed by smoke in the afternoon and evening.	Unhealthy	Unhealthy
Prospect	No hourly data	Unhealthy	Morning clearing followed by smoke accumulations in the afternoons.	Unhealthy	Unhealthy
Shady Cove	Unhealthy	Unhealthy	Smoke impacts relatively light unless fires become more active.	Unhealthy	Unhealthy
Crater Lake	Unhealthy	Unhealthy	Air quality conditions improving from yesterday. Smoke increasing in late afternoon and evenings.	Unhealthy	Unhealthy
Chiloquin	Unhealthy	Unhealthy	Smoke light during the day, increasing late in the evening.	Unhealthy	Unhealthy
Klamath Falls	Unhealthy	Unhealthy	Impacts lightening overall as long as fires stay somewhat quiet. Worst time overnight.	Unhealthy	Unhealthy

Issued Sep 15, 2017 by Janice Peterson, Air Resource Advisor, jpeterson@fs.fed.us

Air Quality Index (AQI)	Actions to Protect Yourself
Good	None
Moderate	Unusually sensitive individuals should consider limiting prolonged or heavy exertion.
Unhealthy	People within Sensitive Groups should reduce prolonged or heavy outdoor exertion.
Very Unhealthy	People within Sensitive Groups should avoid all physical outdoor activity.
Hazardous	Everyone should avoid prolonged or heavy exertion.

**Additional Links**

- Oregon Smoke Blog
- Crater Lake announcements and Webcam
- Umpqua North Complex Fire Information
- Oregon DEQ air quality
- High Cascades Complex Fire Information

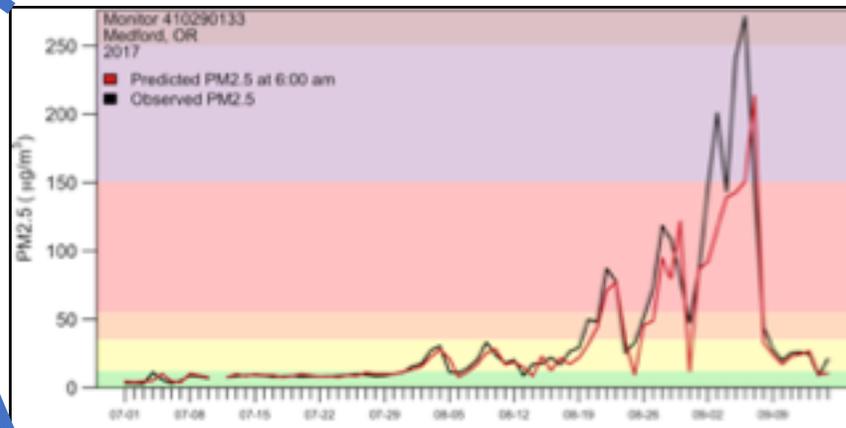
<http://wildlandfiresmoke.net/outlooks/2017/UmpquaNorthComplex#NE>

CONGRESS.GOV

**S.47 - John D. Dingell, Jr. Conservation, Management, and Recreation Act**

116th Congress (2019-2020) | [Get alerts](#)

- Deployment of Air Resource Advisors (ARA) with Incident Management Teams (IMT) or Geographic Area Coordination Centers (GACC)
- Provide: Modeling, Monitoring, Messaging



Marsha, A., and N.K. Larkin (2019) A statistical model for predicting PM<sub>2.5</sub> for the Western United States. J. Air Waste Manage. 69(10): 1215-1229

# Thank you!

- AirFire Team
- Mazama Science
- US Forest Service – F&AM, FERA, R6
- National Park Service
- National Weather Service, NOAA
- Environmental Protection Agency
- Joint Fire Science Program
- NASA
- Environment and Climate Change Canada
- Natural Resources Canada
- University of Washington
- Desert Research Institute
- University of Arizona
- *many others*

*Susan O'Neill*

[susan.oneill@usda.gov](mailto:susan.oneill@usda.gov)

