

Overview of smoke forecast map

Last updated: 6/20/2025

The smoke forecast map provides a prediction of fine particulate matter, shown as a PM2.5 Air Quality Index (AQI) category. Health warnings linked to each air quality category are available in the <u>What Is</u> <u>AQI PDF</u>. Forecasts can be used to plan outdoor activities and reduce exposure to air pollution.

A five-day forecast is issued from June through October, when wildfire smoke is of concern, while a twoday forecast is issued for the rest of the year. The forecast map is broken into many zones, based on Ecology's network of air quality monitors and some local Clean Air Agency (CAA) management regions. The size of the zones are smaller in the cold months, because smoke impacts are localized.

The smoke forecast is based on:

- Forecasts issued by local clean air agencies and Ecology staff, based on professional judgment.
- Forecasts produced by the Idaho Department of Environmental Quality (IDEQ) Machine Learning (ML) model (an update to the WSU version formally used).
- Forecasts produced by the Ecology HYSPLIT model (wildfire season only)

Forecasts issued by local CAAs are retrieved from AirNow and assigned to the appropriate zones on the map. All forecasts issued by a local CAA or Ecology staff are shown unaltered on the map.

The IDEQ ML model uses previously monitored PM2.5 and the University of Washington (UW) Weather Research and Forecasting (WRF) model to produce a two-day forecast. The average of Ecology's eight HYSPLIT forecast simulations is used to produce a five-day forecast. The automated forecast shown on the map uses an average of IDEQ's ML model and Ecology's HYSPLIT ensemble for days 1-2, and Ecology's HYSPLIT ensemble for days 3-5 or when the ML forecast is unavailable.

Two-day forecasts from IDEQ Machine Learning (ML) model

WSU developed site-specific PM_{2.5} versus meteorology relationships using 4-kilometer UW WRF forecasts archived since 2017. These relationships show how PM2.5 has changed in recent years during different meteorological conditions. The relationships are used in combination with the UW WRF ensemble forecast average to construct a two-day forecast. More information is provided in <u>Fan et al.</u>, <u>2023</u>. IDEQ updated the ML model to include bias correction and site characteristic inputs to capture regional effects. IDEQ also retrains the model with recent monitoring data every year.

Five-day forecasts from Ecology HYSPLIT ensemble model

Eight simulations of wildfire smoke are performed using the NOAA <u>HYSPLIT</u> model as implemented by Ecology. Each scenario has a unique method for calculating emissions, as listed in the Table on the following page. Meteorology is obtained from the UW WRF 12km extended forecast. Anthropogenic sources, boundary conditions, initial conditions, chemical reactions, and deposition are not included. Fire locations are from NOAA's Hazard Mapping System (HMS). Daily processes include:

- 1. Download NOAA HMS file for recent fire locations and remove duplicate locations
- 2. Assign 194 acres to each location and merge clusters (sum acres; max FRP)
- 3. Apply FRP modification formula (scenario-specific) for emissions; keep original FRP for heat
- 4. Assign daily emissions basis (66.1 Kg PM2.5 / MW)
- 5. Apply fire potential (USA) and fire danger (Canada) and vegetation factors
- 6. Apply hourly diurnal profile for heat and emissions (scenario-specific)
- 7. Create HYSPLIT input files (hourly emissions with heat and area for plume rise) sounds
- 8. Run all 8 HYSPLIT scenarios and report the average PM2.5 within each zone on the forecast map

HYSPLIT Emissions Scenarios

	S1	S2	S3	S4	S5	S6	S7	S8
First Hour Kept	Noon	Noon	2 a.m.	2 a.m.	Noon	Noon	Midnight	Midnight
from HMS	(-1 Day)	(-1 Day)	(-1 Day)	(-1 Day)	(-1 Day)	(-1 Day)	(-3 Days)	(-3 Days)
Duplicate Dist.	10m	10m	10m	10m	10m	10m	50m	50m
FRP	FRP	1.25 FRP	2 sqrt FRP	2 sqrt FRP	4 sqrt FRP	4 sqrt FRP	2 sqrt FRP	3 sqrt FRP
Modification	max = 100	max = 100	max = N/A					
Formula	min = 0.3	min = 0.3	min = 0.3	min = 0.3	min = 0.3	min = 0.3	min = 0.3	min = 0.3
Awaa wax Dataat	194 Acres	194 Acres	194 Acres	194 Acres	194 Acres	194 Acres	194 Acres	194 Acres
Area per Detect	(r = 500m)	(r = 500m)	(r = 500m)	(r = 500m)	(r = 500m)	(r = 500m)	(r = 500m)	(r = 500m)
Merge	FRP = Max	FRP = Max	FRP = Max	FRP = Max	FRP = Max	FRP = Max	FRP = Max	FRP = Max
Aggregation	Area = Sum	Area = Sum	Area = Sum	Area = Sum	Area = Sum	Area = Sum	Area = Sum	Area = Sum
Merge Distance	1000m	1000m	1000m	1000m	1000m	1000m	1000m	1000m
USA Fire		Moist = 0.25						
		Dry = 1.00						
		Lightning = 1.00						
	None	Very Dry = 1.25						
Fotential		Hot = 1.25						
Tactors		Burn Env. = 1.25						
		Windy = 1.25						
		Hot & Dry = 1.50						
		Low = 0.25						
CAN Fire		Moderate = 0.50						
Danger Rating	None	High = 0.75						
Factors		Very High = 1.00						
		Extreme = 1.25						
	Barren = 0.01	Barren = 0.01	Barren = 0.01	Barren = 0.01	Barren = 0.01	Barren = 0.01	Barren = 0.01	Barren = 0.01
Vegetation	Scrub = 0.40	Scrub = 0.40	Scrub = 0.40	Scrub = 0.40	Scrub = 0.40	Scrub = 0.40	Scrub = 0.40	Scrub = 0.40
Factors	Forest = 1.00	Forest = 1.00	Forest = 1.00	Forest = 1.00	Forest = 1.00	Forest = 1.00	Forest = 1.00	Forest = 1.00
	Crops = 0.20	Crops = 0.20	Crops = 0.20	Crops = 0.20	Crops = 0.20	Crops = 0.20	Crops = 0.20	Crops = 0.20
Diurnal Profile	BlueSky	WRF-CHEM	BlueSky	WRF-CHEM	BlueSky	WRF-CHEM	BlueSky	WRF-CHEM

Diurnal Profile Hourly Factors

Hour (PST)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Emis. (BlueSky)	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.28	0.55	0.97	1.39	1.80	2.22	2.36	1.66	0.97	0.55	0.14	0.14	0.14	0.14
Heat (BlueSky)	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.65	2.04	5.52	8.95	12.21	15.43	16.47	11.13	5.52	2.04	0.29	0.29	0.29	0.29
Emis. (WRF-CHEM)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.6	0.8	1	1.2	1.5	1.7	1.5	1.2	1	0.8	0.5	0.2	0.2	0.2	0.2
Heat (WRF-CHEM)	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.75	0.83	1.41	2.91	5.65	8.81	12.3	13.46	12.13	8.81	5.65	2.74	1.25	0.66	0.66	0.66	0.66