

SFE Fact Sheet 2018-5

Online Tools for Planning Smoke Management

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SMOKE MANAGEMENT: A BROAD PERSPECTIVE

Mitigating smoke impacts on human health and safety is one of the challenges that landowners and agencies face when conducting prescribed burns. Particulate matter (PM) in smoke, produced by the combustion of fuels during burning, can aggravate respiratory ailments and reduce visibility along roads and near airports. Fine particles that have a diameter less than or equal to 2.5 microns (PM_{2.5}) are one of the primary health hazard concerns from smoke emissions. Predicting how much particulate matter will be produced, where it will travel, and how it might interact with other fires locally and in the region is fundamental for deciding how to mitigate smoke effects from prescribed burns.

A variety of free computer and web-based models have been developed to assist burners with smoke management planning. Reliable smoke forecasting requires information on local conditions such as weather, fuel loads, fuel consumption, and terrain. A number of user-friendly computer models take inputs like the forecast wind speed and direction, mixing height, fuel type, and burn unit size to predict local smoke emissions and dispersion (see SFE Factsheet <u>Predicting Smoke Movement: User-Friendly</u> <u>Computer Models</u>).

Recognizing the need for large-scale planning and communication, the U.S. Forest Service's AirFire Research Team has developed additional tools for monitoring and predicting air quality and smoke movement, available at <u>https://tools.airfire.org</u>. In addition to modeling local smoke dispersion and concentration, these tools display smoke properties and air quality over a broader region. They also make it easy to experiment with inputs from different weather and fuel models. By combining information from different agencies and providing predictions over large regions, AirFire's tools described in this factsheet help promote communication among air regulators, land managers, and agencies.

ACCESS THE TOOLS

For the best results, the most information, and the latest versions of the models, be sure to access the tools described here using this website: https://tools.airfire.org

TOOLS OF THE TRADE INTEGRATING DIFFERENT MODELS

Because regional smoke movement patterns and effects are so complex, the AirFire research team developed a framework called "BlueSky" to link individual models together. This platform integrates information from fuel loading maps and individual models of fuel consumption, fire emissions, plume rise and trajectory, and dispersion. It connects these models together and allows them to run in concert, passing information to each other. Two key tools have been developed within this framework:

BlueSky Daily Run Viewer

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The Daily Run Viewer allows viewers to see current and predicted fire activity and smoke emissions across

the continent. This tool provides twice-daily smoke predictions produced by AirFire using different models (termed 'runs'). These predictions can either be viewed in the online map or downloaded as a KMZ file for Google Earth, and are forecast for different time spans and spatial resolutions, depending on the run. The map display shows active fires from prescribed burn and wildfire reporting systems and the modeled smoke plume predictions from these fires. Users can click on active fires and see the location, fuel type, and projected size of the fire, as well as the modeled PM_{2.5} and PM₁₀ values. The help pages and FAQ can help you determine which runs might be appropriate for your needs (see the "More Info" links).

BlueSky Playground

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Playground is a web-based application that allows users to customize inputs to models within BlueSky to get detailed

fuels, fire, and emissions information. The current version is 3.0 but the older 2.0 and next 3.5 versions are also available. Users can look up fuels information, and calculate fuel consumption, emissions, plume profiles, and predicted plume trajectories and smoke concentrations. Users can choose which models they would like to estimate a given parameter, such as VSMOKE for smoke dispersion (see SFE Factsheet <u>Smoke Prediction with VSMOKE</u>). The results can be output as detailed pdfs with information such as fuel loading and emissions per acre, hourly fuel emissions estimates, and maps of dispersion and PM_{2.5} concentrations. Users need to



BlueSky Daily Run Viewer

BlueSky Playground

TOOLS OF THE TRADE **CURRENT SITUATION AND CONTEXT**

create an account with a login and password on the website to access this tool.

Monitoring PM_{2.5}

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Monitoring PM_{2.5} is a simple and

useful graphical tool that allows users to see current and concentrations across the United States previous PM_{2.5} and parts of Canada. This tool aggregates monitoring data from individual ground monitors and displays it as points on a map. The user can click on any ground monitor and obtain hourly estimates of $PM_{2.5}$ levels from up to ten days prior. Hourly data are color-coded by Air Quality Index categories

TOOLS OF THE TRADE

OUICK ASSESSMENT OF SMOKE TRANSPORT

according to PM_{2.5} levels.

In addition to models at the local scale, The AirFire team also provides tools for understanding how the atmosphere carries smoke across a region.

Ensemble Trajectories

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This simple tool for calculating and visualizing smoke transport at a regional scale provides a choice of

numerical weather models to predict the smoke trajectory over twelve hours from the user-specified location and display it on **REFERENCE** a map. The weather model predictions are combined with the HYSPLIT trajectory model to display hourly locations of the smoke plume at various heights. The tool is currently being modified to use a variety of regional and national weather

model predictions as input.

ADDITIONAL AIRFIRE RESOURCES

Finally, there are several additional weather-based models to assist understanding climate influences on smoke transport. The Ventilation Climate Information System is useful for visualizing maps and graphs of monthly or annual patterns of mixing height, ventilation index, and surface wind speed. The Arctic Transport Potential Climatology map displays data from a 30-year climatology of meteorological conditions that allow transport of emissions to the Arctic. The map shows the percent of days within the selected time frame and at the selected heights that emissions were likely carried to the Arctic. Finally, the *Climatology of Convective Instability* displays maps of monthly and seasonal variability in atmospheric instability. Instability supports greater updrafts

FIND MORE DETAILED INFORMATION ON **USING THESE AND OTHER SMOKE TOOLS**

All the tools in this factsheet are free and are routinely updated to provide the most accurate and reliable forecasts. They should help you predict and understand how the smoke from a fire might affect air quality in your area and the region. More detailed information on how to use these models is available by clicking on the "More info/help" links below each tool on the tools page https://tools.airfire.org.

and turbulence associated with erratic fire behavior.

Pacific Northwest Research Station. 2006. A clear picture of smoke: BlueSky Smoke Forecasting. Science Update, 14. https:// www.fs.fed.us/pnw/pubs/science-update-14.pdf

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> For more information on the Southern Fire Exchange, visit www.southernfireexchange.org or email contactus@southernfireexchange.org.



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Ensemble Trajectories