



SFE Fact Sheet 2020-1

Planned Burn (PB)-Piedmont: Predicting overnight smoke conditions in complex terrain

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Planned Burn (PB)-Piedmont model (Achteemeier 2005) is a valuable tool for modeling nighttime and early morning smoke movement in the Piedmont region of the South. PB-Piedmont uses the North American Mesoscale Forecast System model (NAM) for its meteorological file and topographic data to predict patterns of air movement in drainages, such as those that occur in the complex, relatively low-elevation Piedmont topography. Down-drainage flow patterns develop when air at higher elevations in sloped terrain cools and sinks to lower elevations, which usually begins around sunset. Cool, dense air collects close to the surface and travels down the slope of the drainage, often settling in low areas like valleys. When the air is moist, water droplets can also collect around smoke particles and cause fog. For prescribed fires or wildfires burning from the late afternoon through the night, PB-Piedmont helps predict the likelihood of smoke and fog dispersing and settling in drainage pockets that might be close to sensitive areas such as towns, roadways, and hospitals.

PB-Piedmont is a user-friendly online tool:

<https://piedmont.dri.edu>

The following four steps illustrate how to run a model simulation, using Figure 1 as an example.

- 1 Click on map to select location: The above link directs you to a map that operates just like Google Maps (for instance, click and drag to pan the map, click the +/- to zoom). See Figure 1. The first step is to select the location of ignition, which you can do by zooming in and clicking at the location on the map, or by entering coordinates in the latitude and longitude spaces below the map. The time zone will automatically update to the location you

selected. In Figure 1, a location on the Talladega National Forest has been selected.

It is important to note that PB-Piedmont was originally developed for the gently rolling topography of the Piedmont region, although validations have shown it to be reliable in flat or complex terrain.

 A screenshot of the PB-Piedmont web application. At the top, there's a navigation bar with "PB-Piedmont", "Model", "About", and "Contact". To the right are logos for CERA and DRI. Below the navigation bar is a map of the Southeastern United States. A red pin is placed on the Talladega National Forest, with a pop-up box showing "Talladega National Forest", "9901 Alabama 5", "Brent, AL 35034", and a "View on Google Maps" link. Below the map are input fields for "Location of ignition" (latitude: +33.243282, longitude: -86.138306) and "time zone" (America/Chicago (DST)). There are also fields for "Fire start (in fire's time zone) & duration" with confidence ranges and duration options (0-6 hours, 7-12 hours, 13-24 hours, 25-36 hours). Below that are "Local start date" (Aug 10, 2018) and "Local start time" (1800). The "Terrain parameters" section includes "Area burned" (2000 acres), "Grid spacing" (120 meters), and "Sample radius" (10 miles). The "Fuel parameters" section has a "Fuel type" dropdown menu set to "trees". At the bottom, there's a "Run model" button and a note: "After the 'Run Model' button is clicked, progress messages will be displayed below. Results take a few minutes to generate. Links to results".

Figure 1. Screenshot of PB Piedmont's home screen Talladega National Forest selected as an example

- 2** Fire start and duration: Select the fire ignition date and time from the dropdown menus. The date options listed are based on the weather forecast files that are currently available, and include past weather up to 36 hours from the current forecast. Also specify the duration of the planned fire up to 24 hours. It is important to note that the model is designed for burn events that start at least four hours before sunset, and continue for at least six hours after sunset, up to a total time of 24 hours (options exist for longer durations, but run times longer than 24 hours haven't yet been evaluated for accuracy). For example, if sunset is at 8:00 pm, the model will be most accurate for burns starting before 4:00 pm and lasting until at least 2:00 am. **PB-Piedmont also assumes that there are no large-scale weather events (like hurricanes) in the area, and should not be used for forecasting in areas that are normally very windy. In this example, the fire will be ignited at 4:00 pm on August 10, and will continue for 12 hours.**

It is important to note that PB-Piedmont performs best when the modeled duration includes the periods of maximum heating (usually mid-afternoon) and maximum cooling (usually around sunrise). Thus, a normal run duration would be from around 3:00 pm (previous afternoon) to around 9:00 am (the next morning). Model runs with those durations would be for approximately 18 to 19 hours.

- 3** Terrain and fuel parameters: Define how many acres will burn. The model is very sensitive to the size of the area, which is assumed to be a square shape defined by the acreage and sample radius. The sample radius (which you specify) is the distance from the ignition source to the perimeter of the modeled area (the default is 10 miles). When selecting the sample radius, consider that while most motor vehicle accidents associated with wildland smoke have been within 3 miles of the fire site, some accidents have occurred as far as 10 miles from the fire site. Grid spacing options for the model are in 30-meter increments to correspond with the resolution of elevation data. Anticipate that the model will run very slowly with grid spacing set to less than 120 meters. In the example shown here, the burn is planned for 2,000 acres, based on 120 meter grid spacing and a 10 mile radius. Finally, using the dropdown menu, specify whether the fuel is primarily a grassland or savanna ground cover (grass), or forested land (trees).

- 4** Run model and interpret results: Click "Run Model". You can download the results as a KML for Google Earth, or view it on the map. If you view it on the map, you can either click on each hour of the burn independently (hour buttons below the map) to view the smoke (yellow) and fog (red) dispersion patterns (see Figure 2), or you can click on the 'play button' next to 'animation loop' and have it play for you. If you download the kml output, you will get a zipped folder that contains a group of files for each simulation hour that will display in Google Earth as yellow and red circles. Yellow circles indicate smoke surface transport, while red circles indicate smoke transport where there is high relative humidity, natural fog or smoke induced fog. Red circles are an indication that conditions are conducive for the formation of superfog.

Figure 2 shows the expected smoke patterns at 7:00 pm for this example. Light winds appear to be primarily out of the southwest.

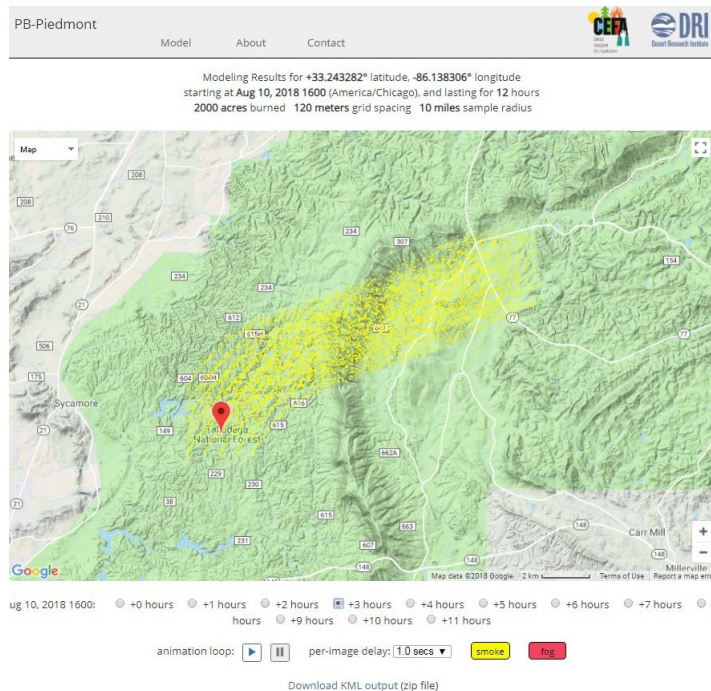


Figure 2. Smoke patterns three hours after ignition (7:00 pm).

By 9:00 pm (Figure 3), the smoke started to settle in the valleys, and a few hours later, fog (red particles) is predicted to form in low lying areas (Figure 4). Note that these areas are close to roads on the eastern side of the mountains. The model predicts the smoke to last at least until 3:00 am, 11 hours after ignition.

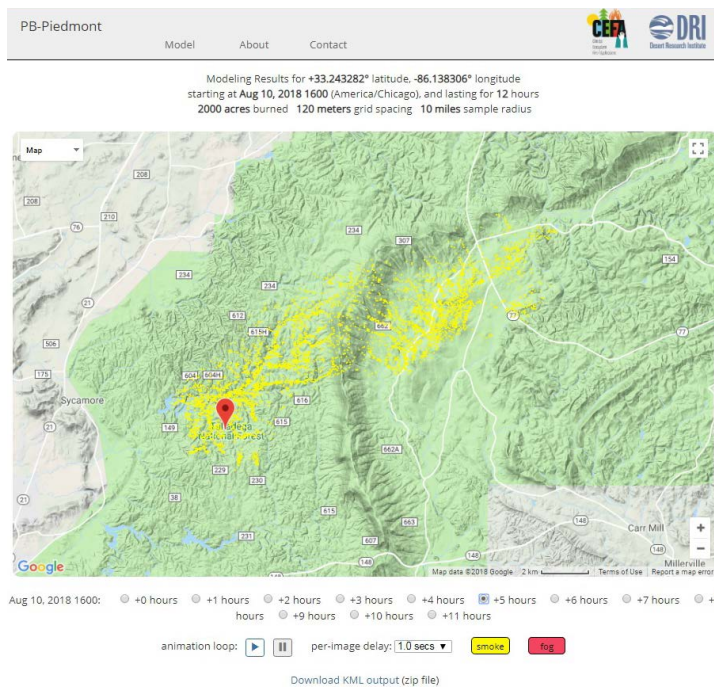


Figure 3. Expected smoke patterns by 9:00 pm.

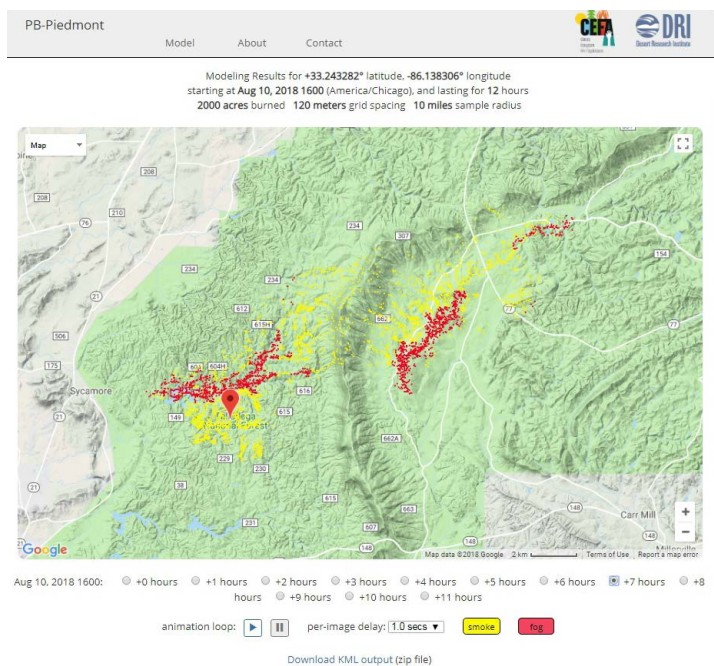


Figure 4. Expected smoke and fog patterns by 11:00 pm.

In Summary

The PB-Piedmont model is one of several tools to use when predicting smoke movement and impacts prior to lighting a prescribed fire. It provides a simple point-and-click interface and results that are clear and easy to interpret. The value of PB-Piedmont is that it combines short-term spatial weather forecast conditions with surface topography and fuels to predict the movement and retention of smoke and fog during evening and morning hours. Given the deadly consequences that can occur when smoke intersects with roadways at night and early morning hours, fire planners should consider including PB-Piedmont as part of their fire preparation process. For additional information, check out this webinar on smoke and fog management, which includes demonstrations of PB-Piedmont:

https://www.frames.gov/documents/smoke/videos/SmoC_webinar_20170629_SuperFog-Part3.mp4

References

Achtemeier, G.L. 2005: Planned Burn-Piedmont. A local operational numerical meteorological model for tracking smoke on the ground at night: Model development and sensitivity tests. *International Journal of Wildland Fire*, 2005, 14, 85-98

Planned Burn (PB)-Piedmont Online Version User Guide
https://piedmont.dri.edu/PB_Piedmont_User_Guide_v4.pdf

Related SFE Fact Sheets

Situational Awareness: Nighttime Smoke and Fog on Prescribed Burns (2011-2)

Predicting Smoke Movement: User-Friendly Computer Models (2011-4)

Smoke Prediction with VSMOKE (2011-6)

Basic Smoke Management Practices for Prescribed Burning (2014-1)

Superfog: State of the Science (2014-2)

Online Tools for Planning Smoke Management (2018-5)

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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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