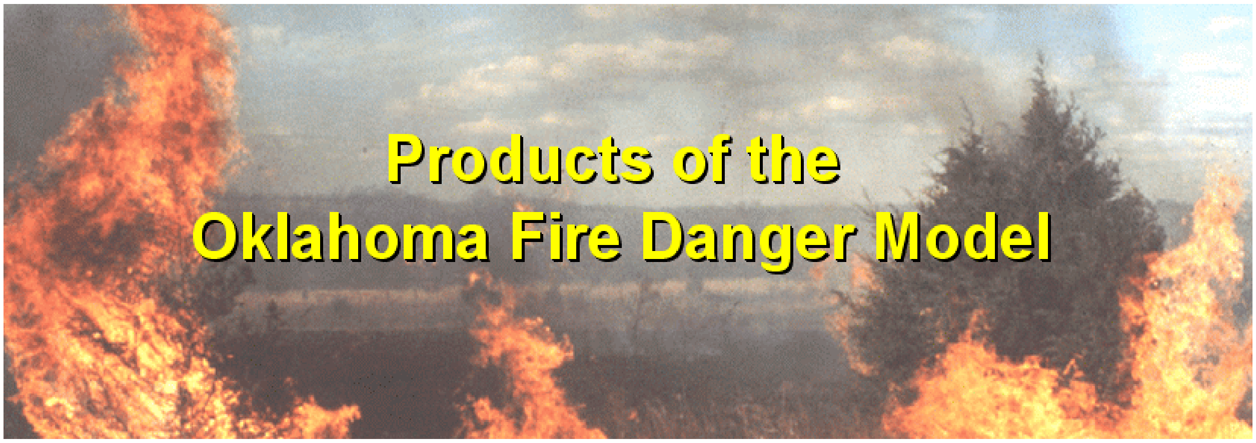


Products of the Oklahoma Fire Danger Model

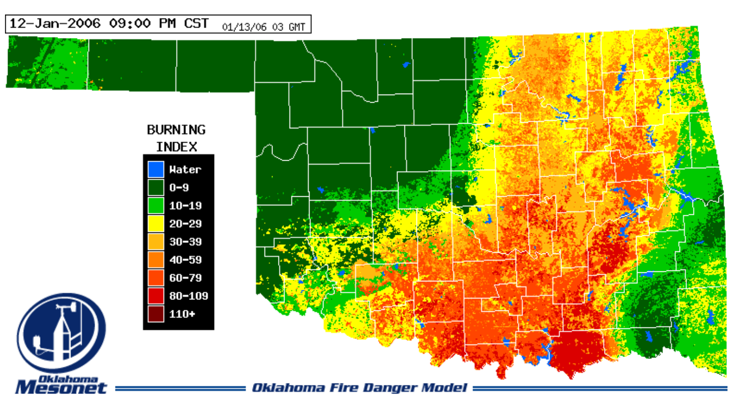
The Oklahoma Fire Danger Model is run hourly using weather data from the Oklahoma Mesonet of 120 stations and weekly satellite imagery for assessment of live fuel moisture and loads. In addition, 84-hour weather forecasts from the National Weather Service's NAM model are integrated into the model. Model output can be assessed via the OK-FIRE web site at:

http://okfire.mesonet.org

In the FIRE section of the web site, click on "CURRENT Fire Danger" or "RECENT Fire Danger" for model output based on the Oklahoma Mesonet (for current and past fire danger conditions up to 30 days ago). There are a variety of products available, including dynamic maps, site-specific charts, and site-specific tables. For model output based on the 84-h NAM forecast, click on "FORECAST Fire Danger". Here as well, dynamic maps, site-specific charts, and site-specific tables are available. Consult *The Oklahoma Fire Danger Model* for more details on the model and its limitations.

Burning Index (BI)

This is probably the most useful index since it directly relates to the intensity of the fire (and thus is related to the difficulty of containment) and is scaled such that BI/10 is equal to the flame length (FL) in feet at the head of the fire. It is an index which integrates both the spread component (SC) and energy release component (ERC). An example of a BI map from 9 p.m. CST Jan. 12, 2006 is shown below. A cold front was progressing across the state, resulting in greatly decreased fire danger behind the front.



The traditional U.S. Forest Service interpretation of Burning Index (BI) with respect to fire behavior and suppression is listed below.

BI < 40 (FL < 4 ft)	Fires can generally be attacked at the head or flanks by persons using handtools. Hand line should hold the fire.
BI = 40-80 (FL = 4-8 ft)	Fires are too intense for direct attack on the head by persons using handtools. Hand line cannot be relied on to hold fire. Equipment such as dozers, pumpers, and retardant aircraft can be effective.
BI = 80-110 (FL = 8-11 ft)	Fires may present serious control problems - torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.
BI > 110 (FL > 11 ft)	Crowning, spotting, and major fire runs are probable. Control efforts at the head of the fire are ineffective.

Spread Component (SC)

The SC is numerically equal to the forward speed of the headfire in feet/minute. It is the most variable of the indices, with variations being caused by changes in wind speed and in moisture content of the live and dead fuels.

Energy Release Component (ERC)

ERC is a measure of the heat released per unit area in the flaming zone at the head of the fire. It is the least variable of the indices on a day-to-day basis, being a function solely of the fuels (and their moisture content).

Ignition Component (IC)

The IC is equal to the probability (0-100%) of a firebrand producing a fire that will require suppression action. It says nothing about the intensity of the fire.

Dead Fuel Moisture

In addition to the above maps which are produced hourly, statewide maps of 1-, 10-, 100-, and 1000-hour dead fuel moisture (DFM) are also available on an hourly basis. Based on calculations from the next-generation Nelson dead fuel moisture model, these color-coded maps are created by interpolating DFM values from all Mesonet sites. For 1- and 10-h DFM, an inverse distance weighting scheme is used. Consult the document entitled *Dead Fuel Moisture* for more details about the Nelson model, the four timelag categories of dead fuel, their behavior, and for examples of available products at the OK-FIRE site.

Keetch-Byram Drought Index (KBDI)

The Oklahoma Fire Danger (OKFD) model also calculates a drought index which is used to increase the amount of dead fuel available for consumption. This index, the Keetch-Byram Drought Index (KBDI), was included in the 1988 revisions to the national system (NFDRS). A statewide color-coded map of KDBI is updated once daily at 4 p.m. CST.

Drought, as defined by KBDI, is a condition of dryness in the litter, duff, and upper soil layers that progresses from saturation to an absence of available moisture. The KBDI is based on an arbitrary 8 inches of water in the litter/duff/soil column. When the column is completely saturated, KBDI = 0. As water is removed from the column by evapotranspiration, the KBDI increases in value. When KBDI reaches 800 (its max), all the water has been removed. In the NFDRS and OKFD model, as KBDI increases above a value of 100, increasing amounts of dead fuel are provided for burning. During combustion some of this fuel contributes directly to fireline intensity (BI), but most increases total heat release (ERC) and contributes to burn severity through smoldering combustion.

In Oklahoma, the KBDI has shown itself to be more useful during the growing season than during the dormant season. Also, as it was developed mainly for forested landscapes, its usefulness for grassy landscapes is somewhat questionable. The interpretations below are based on experience within forested areas in the southeastern United States.

KBDI Value	Interpretations
0-200	Nearly all soil organic matter, duff and litter are left intact after a burn. Once the fire passes, remaining embers extinguish quickly and within a few minutes, the area is extinguished and smoke free.
200-400	Litter and duff layers begin to contribute to fire intensity. Heavier fuel classes can become involved. Soil exposure is minimal. Smoke management can become a real hazard, especially if there are larger fuels available. Smoldering with resulting smoke can continue into the night.
400-600	These levels represent the upper range at which most understory type burning should be conducted. Most of the duff and organic layers will ignite and actively burn. Considerable soil exposure occurs. The intensity can be expected to increase almost exponentially from the lower to upper ends of this range. Complete consumption of all but the largest dead fuels can be expected, and larger fuels not consumed may smolder for several days, leading to smoke and possible fire control problems.
600-800	These levels represent the most severe drought conditions, and many states issue burn bans at these levels. Prescribed fires should not be conducted at levels over 700. Fires that do occur will be intense and deep-burning. Live understory vegetation (2-3" range) should be considered part of the fuel complex due to its low fuel moisture. Most subsurface soil organic matter will be consumed, and great soil exposure will occur with great future erosion potential. Smoldering may occur for many days, with smoke and fire control problems.

Satellite-Derived Greenness Maps

The OKFD model utilizes weekly composites of satellite-derived 1-km resolution NDVI (Normalized Difference Vegetation Index) for the estimation of live fuel moisture. For each 1-km pixel, the NDVI value is converted to “visual greenness” and “relative greenness”. Visual greenness (0-100%) is similar to the degree of “greenness” one would see as one flies over the landscape in a high-altitude aircraft. Relative greenness (0-100%), on the other hand, is based on the historical maximum and minimum NDVI values for a given 1-km pixel. It is relative greenness that is used in the OKFD model to calculate live fuel moisture and partition live and 1-h dead fuel loads. For more details, consult *Use of Satellite Data to Assess Vegetation Greenness*.

Live Fuel Moisture

Using relative greenness from the weekly NDVI data, 1-km resolution maps for live herbaceous and live woody moisture are also created. Refer to *Live Fuel Moisture* for many more details.

Fire Behavior and the Weather

In Oklahoma the OKFD model uses one of five NFDRS fuel models (click on “Default Fuel Models Map” in the FIRE section of the web site). Model A is used for shortgrass prairie; Model L for mixed prairie and western cropland; Model T for tallgrass prairie/eastern redcedar landscapes and central/eastern cropland; Model R for deciduous forests; and Model P for pine forests. Models A and L have only 1-hour (fine) dead fuels and herbaceous fuels. Model T has both 1- and 10-hour dead fuels, as well as herbaceous and woody fuels. Models R and P have all of the above plus some 100-hour dead fuels. In addition, Models T, R, and P each have a “drought” fuel load that becomes increasingly available as KBDI increases over 100.

It is important to realize that fire initiation and behavior are primarily determined by the current weather conditions, of which relative humidity, wind speed, temperature, and solar radiation are most important. While precipitation is important when it’s occurring (fuel surfaces covered with water/snow/ice have minimal fire danger, and precipitation raises relative humidity), it can also have long-term effects in raising fuel moisture of larger size dead fuels, decreasing the KBDI value, and providing soil moisture to increase live fuel moisture.

Fine fuels (1-hour dead fuels) respond quickly to changing weather conditions; the subsurface can be completely saturated by recent rains, but the surface 1-hour fuels (e.g., grasses) can still dry out and carry a fire if weather conditions are suitable. The burning index (BI), spread component (SC), and ignition component (IC) are primarily a function of current weather conditions, and thus are the best indicators of fire danger and behavior. With respect to KBDI, increasing values add extra amounts of fuel to the fuel load, but the moisture content of dead fuels is still determined by weather conditions, not KBDI. Thus, even with very high KBDI values, if wind speeds are low and relative humidities are high, there will be low fire danger. Conversely, with very low KBDI values, if wind speeds are high and relative humidities low, fire danger will be high.