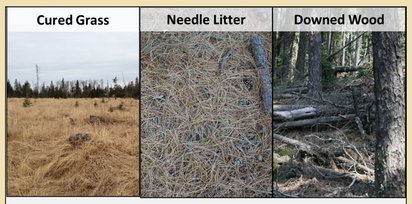
NWCG Fire Environment Poster

Factors That Influence Fire Behavior

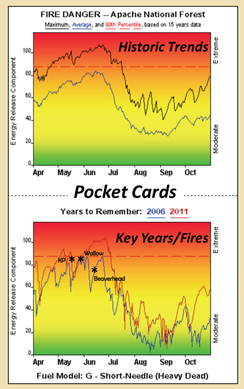
Sun, Heat, Humidity, and Rain

The sun's radiation heats fuels and lowers humidity. It creates a more unstable atmosphere. Bright, ***sunny days*** with above normal temperatures, increased instability, and below normal humidity are characteristic of active fire days. ***Clouds and shade*** from trees and terrain reduce the sun's influence on flammability. ***Persistence*** of these conditions, if the forecast or observation is similar to yesterday, can help predict today's fire behavior.

Dead Fuel Moisture



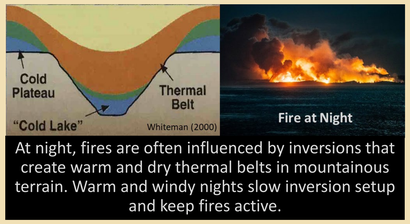
Moisture and flammability of ***dead fuels*** is governed by the weather conditions around them. ***Fine dead fuels***, like grass and litter, gain and lose moisture from hour to hour as the sun rises and sets, the temperature rises and falls, and moisture moves between the fuel and the air. Peak burning conditions typically occur late in the afternoon. Larger ***dead woody fuels*** dry more slowly and usually burn most readily during the peak season.



Pocket cards are a quick and easy way to learn about the ***fire season*** in an area and to interpret today's burning conditions. They show:

- Historic trends in top graph,
- Key years and fires in lower graph,
- Important indices and thresholds for the area, and
- Fire behavior safety concerns.

These allow you to plot current conditions on graphs to see how important and unusual they are.

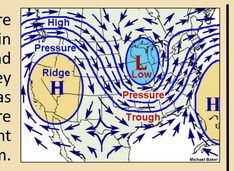


At night, fires are often influenced by inversions that create warm and dry thermal belts in mountainous terrain. Warm and windy nights slow inversion setup and keep fires active.

In the fire environment, ***drought*** develops over weeks, months, or years. It increases the fuel load by stressing and curing live fuels and drying large woody fuels so that they burn readily. Look for signs of drought.

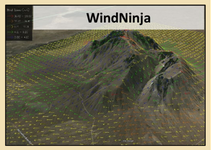
Wind Speed and Wind Direction

Wind is the primary threat to safety on wildfires. Changes in windspeed and direction occur throughout the day based on the the forces outlined here. Fire weather forecasts cannot provide enough detail about the effects of terrain, instability, and the fuelbed on winds at your location. Factor in the ***general wind forecast***, ***effects of local winds***, and threat of ***critical winds*** to determine how the result will affect your fire today.

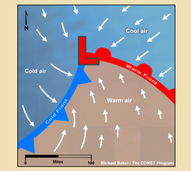


General winds are felt most clearly in flatter, open areas and on mountain ridges. They are strongest when areas of high and low pressure produce a strong gradient between them.

Critical winds arise quickly, usually as strong, gusty winds with sudden changes in direction. Look for warnings of them in the forecast.

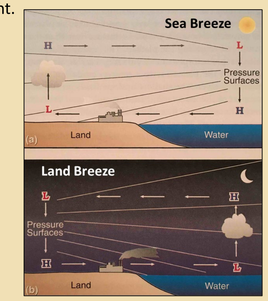


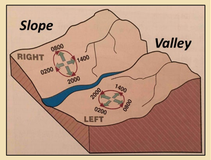
Local winds usually combine with general winds, producing varying directions and speeds in terrain, and near lakes and basins. In most cases, they transition in the morning and evening and are strongest during the peak burn period. Use ***WindNinja*** to see local winds on your fire.



Dry cold fronts have increasing winds ahead, gusty winds that change direction during passage, and strong winds that continue for hours after. Beware of thunderstorms with the front.

Sea breezes (10 - 20 mph) blow onshore during the day; ***land breezes*** *(3 - 10mph) blow* off-shore at night.

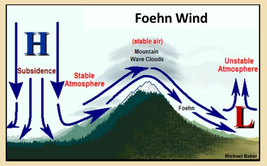




Slope and ***valley*** winds depend on surface heating during the day and cooling at night. ***Upslope*** (3 - 8 mph) and ***upvalley*** (10 - 15 mph) are stronger than ***downslope*** (2- 5 mph) and ***downvalley*** (5 - 10 mph).

Thunderstorms make lightning and produce strong outflow winds. They can change the spread direction and behavior of the fire.

Foehn winds are among the strongest you can face. Hot and dry, they can produce extreme fire behavior.



Cloud and Plume Indicators

Clouds foretell concerns about lightning and changing winds.

Fire Weather Cloud Chart, PMS 438

Smoke columns point out key concerns about ***atmospheric instability***, as well as ***windspeed and direction***. To the left, onshore breeze at surface and general wind above can be seen, suggesting ***wind shear***. On the right, weak inversion aloft cannot cap heat from intense fire. Cloud cap shows instability above and warns of outflow winds around it.

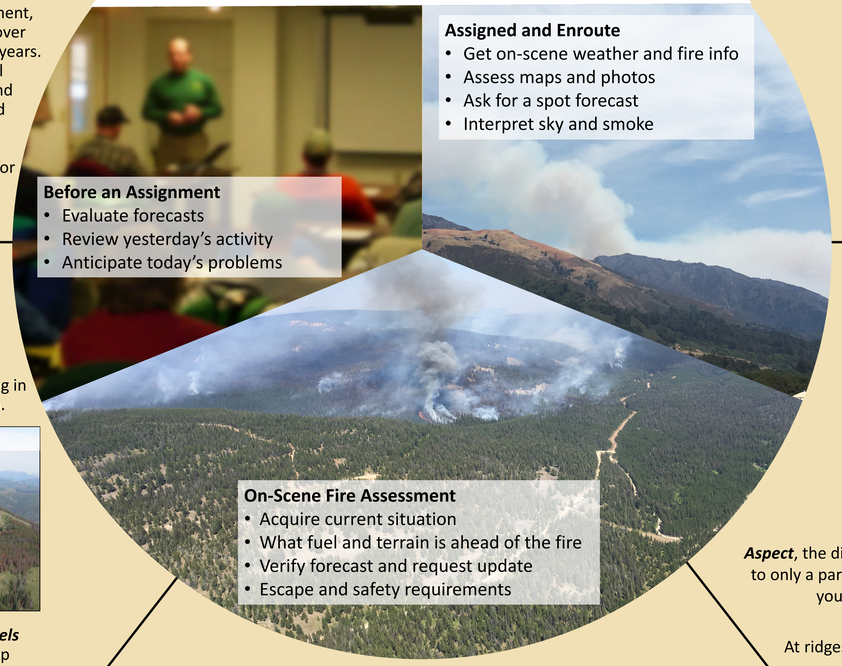
Poor air quality is a concern for firefighters and public. It decreases visibility of fire too.

Stability and Inversions cap fire activity but can bake fuels. Beware when the air clears.

Increasing ***dust devil*** and ***fire whirl*** development indicates increased instability and thus a changing atmosphere. They can also threaten your position on the fireline by throwing embers into unburned fuels.

Smoke color can indicate what is burning, amount of unburned chemicals, particulates, and suggests health hazards for firefighters working there. ***White smoke*** is from light fuels and release of moisture. ***Black smoke*** is from heavy fuels. ***Gray smoke*** can mean fire is slowing.

Identify the Next Big Changes



Before an Assignment

- Evaluate forecasts
- Review yesterday's activity
- Anticipate today's problems

Assigned and Enroute

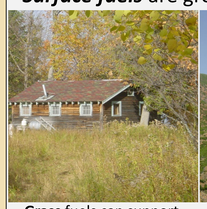
- Get on-scene weather and fire info
- Assess maps and photos
- Ask for a spot forecast
- Interpret sky and smoke

On-Scene Fire Assessment

- Acquire current situation
- What fuel and terrain is ahead of the fire
- Verify forecast and request update
- Escape and safety requirements

Fuel Characteristics

Surface fuels are grouped into 6 classes to aid identification:



<u>Grass</u> fuels can support very fast spread, increasing with wind and slope.

<u>Grass/Shrub</u> fuels spread slower than grass but can be more difficult to control.

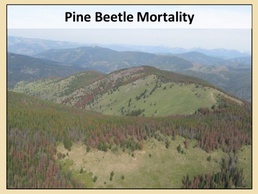
<u>Shrub/Brush</u> fuels often require more wind for fire spread, like crown fires.

<u>Timber Understory</u> has live and dead ladder fuels that can cause crown fire.

<u>Timber Litter</u> fuels are not influenced by living plants. Burn intensity varies by load.

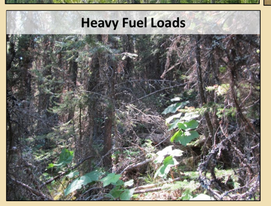
<u>Slash</u> fuels have heavy dead loads. They burn intensely but spread more slowly.

Live green vegetation is usually present during some part of the season, increasing in spring and declining later on.



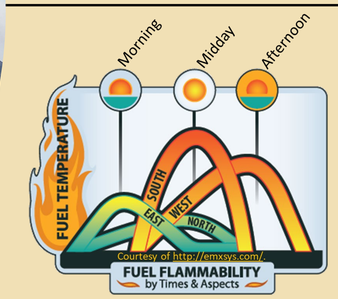
In many cases, green ***live fuels*** slow fire spread and can stop it completely. However, as the fire season progresses, normal curing converts them to dead fuels. Insect and disease damage can injure or kill vegetation, leaving dead needles to burn more readily.

Crown fire potential is governed by the characteristics of the tree canopy fuels over the surface fuels. If trees are ***widely spaced***, torching and spotting is the primary. ***Dense stands*** of conifers with flammable needles can more easily support active crown fire.



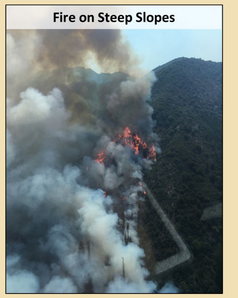
Heavy surface fuel loads and vertical continuity of ***ladder fuels*** are important factors in assessing crown fire potential. Shading and wind sheltering by overstory trees reduces potential, requiring these fuels to be very dry.

Topography



Aspect, the direction the slope faces, limits the sun's heating to only a part of the day. Knowing where you are and when you will be there can be critical safety information.

The ***topography*** of the landscape surrounding your fire affects each of the other fire environment factors. ***Slope, aspect, and elevation*** all influence the vegetation and fuels in an area. They affect the amount of sun and heating that can dry the fuels and increase the winds as the day progresses. A ridge can lift air and reinforce instability. ***Gaps and channels*** can cause winds forced through them to speed up with turbulence for greater problems.



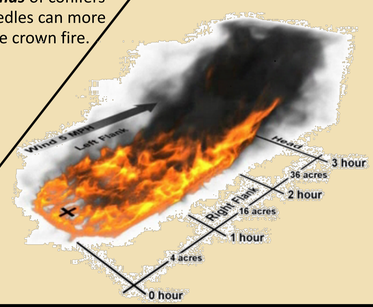
Anticipate, Observe, and Report Rapid Changes in Fire Behavior

Well-developed ***vertical columns*** suggest potential outflow winds that can change direction. ***Leaning columns*** lead to long-range spotting.

- When and where do you see ***smoldering and creeping fires?*** Look for increasing activity as the day warms and winds pick up.
- Is the frequency and number of ***torching trees*** increasing? Anticipate spotting spread and active crown fire.

The kind of fire you see and report is a result of all the factors in the fire environment. Fire behavior changes as the fire environment changes.

Can you see the head, flanking, or backing fire? Say so.



What will the next big change look like? Where and how fast will it come?

Good fire observations are key to anticipating change in the coming minutes, hours, and days.

Be precise. Use the right terminology. Describe type of fire, estimated spread rate, and flame length. Identify changes.

Surface Fire — When fire is on the ground

Crown Fire — When trees and shrubs burn

Smoldering	Creeping and Spreading	Running	Torching and Spotting	Crowning	Erratic and Extreme
					
Little fire spread • Minimal flaming, less than 1' • White smoke • Combustion of ground fuels	**Intermittent surface fire** • Slow spread • Visible open flames 1' - 4' • Little torching • Generally white smoke	**Vigorous surface fire** • Flames 4' - 8' • Flammable canopy can ignite • Moderate to fast (grasses) spread	**Single tree to group tree torching** • Surface flames 8' - 12' • Moderate to fast spread • Gray to black smoke	**Crown fire front at head** • Fast spread rates • Black to copper smoke • Long-range spotting	**Extreme fire environment** • Extreme intensity • Turbulent fire • Chaotic spread • Interface fuel involvement

Remember, you can see the flame length, but you must estimate the spread rate.

At ridges and in valley bottoms, fires often stop or slow down due to barriers and backing spread. But beware of ***slope reversal*** to upslope. ***Rollout on steep slopes*** is a danger like spotting.

Barriers include water and bare rock. Partial barriers, like high ***elevation*** green fuel, can be breached by upslope runs and spotting. They can cure. Be vigilant.

Narrow canyons are choked with fuel at the bottom, and sidewalls are subject to very intense heating from active fire. Beware of aligning winds.

Winds through ***gaps*** are gusty. ***Saddles*** and ***passes*** in ridgelines can cause wind to reverse behind you.

Chutes and chimneys can be death traps with fire below. They focus heating and winds up the draw. Expect extreme spread and flames.

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https://www.nwcg.gov/publications/439