

INTERPRETATION OF SMOKE PLUMES

This is a guide to the interpretation of smoke plumes and the clouds that may form within them. It is intended to assist air and field observers.

Note that complex fires may exhibit more than one of these types at any time.

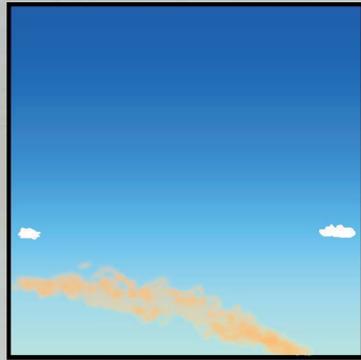
CLEAR SKY:

Of note here is the cloud base at the Lifting Condensation Level (LCL). This is the point where rising surface air would cool to the Dew Point Temperature by cooling at the dry adiabatic lapse rate.

Check the latest Aerological Diagram for data on this.

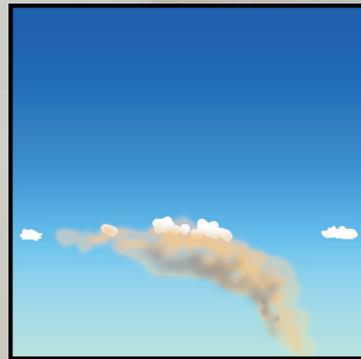
SIMPLE PLUME:

Here with a mild intensity fire there is not enough heat to make the convection column of the fire rise vigorously. It is readily mixing with surrounding air and is thus losing its buoyancy.



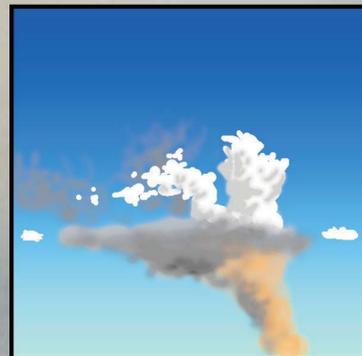
PYRO-CU:

The plume reaches the LCL and cumulus clouds form within the plume where the LCL is reached. These drift downwind with the smoke, away from the fire. These do not indicate any threats to field crews.



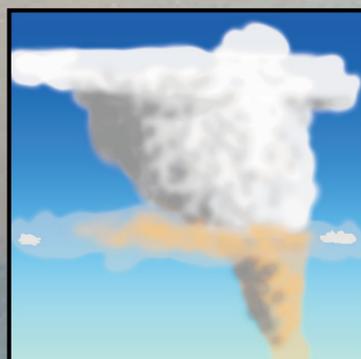
TOWERING PYRO-CU:

Here a hot fire produces towering pyro-Cu. As these are transported downwind they become unstable without their heat source. They then collapse and dissipate. Ultimately the smoke entrained in the clouds is left behind well above the LCL. Watch out for downburst winds due to the collapse.



PYRO-CB (not to scale):

An intense fire with deep flaming can produce a pyro-cumulonimbus or fire thunderstorm. Deep flaming allows the plume to resist mixing up to the LCL, where the latent heat of condensation on moisture in the plume may release more heat than the fire. The fire becomes plume-dominated, or a coupled fire-atmosphere event and is extremely dangerous. The Cb will move with the middle-level winds and will drive fire spread.

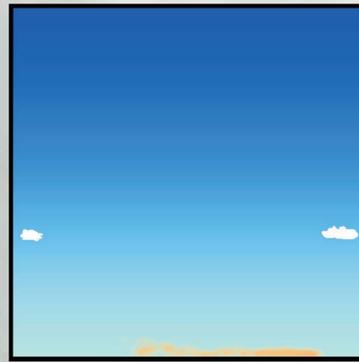


Features: Thunderstorm; anvil; overshooting top; large smoke band at LCL; very dark sky underneath.

PLUME COLOUR:

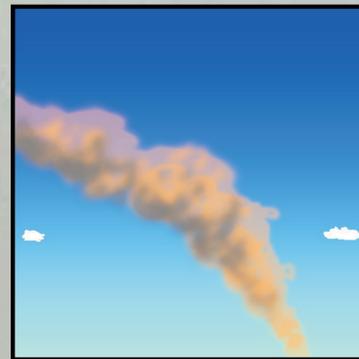
The colour of smoke is useful intelligence:

- White: cool or grassfire;
- Dark or black: hot forest fire;
- Orange: channelling



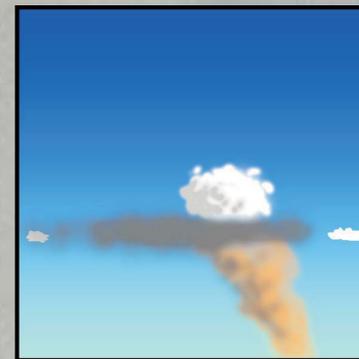
LOW SMOKE:

This can indicate either: (a) little heat release from the fire (especially cooling burnt ground) OR (b) downwards air flow is forcing the smoke to stay low, as may occur in a wind wave or in the inflow into a larger convection system nearby.



DRY PLUME:

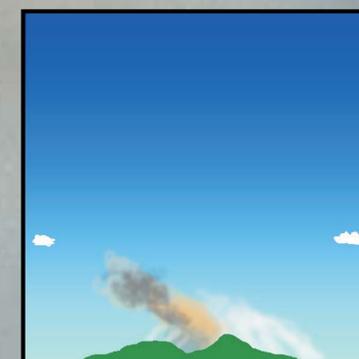
Here there is sufficient heat from the fire to cause the convection column to reach and punch through the LCL, but there is not enough moisture for cloud formation or it has mixed too much with surrounding air for a cloud to form.



ACTIVE PYRO-CU:

When a large pyro-Cu forms it indicates that the ratio of vertical flow in the convection column to lateral transport winds is high, and the cumulus is remaining close to its source - such as over a prescribed slash burn.

Of significance is the separation of a lot of the smoke, which spreads laterally at the LCL as a distinct feature.



CHANNELLING-DRIVEN FIRE:

Unlike "normal" fire behaviour, channelling can make fires extremely dangerous on lee-slopes.

Here an eddy wind forms. If fire is caught in the eddy it both sheds embers up into the overhead winds, and expands laterally. These two processes can ignite large tracts in a short time. Look for a dense orange plume on the windward corner of a fire, coming off a lee slope. The events also form a "dog-leg" in the fire's flank. Numerous merging spotfires will be seen for some kilometres downwind of an event. Elsewhere on the upwind edge wispy, fading smoke (as expected) will be seen.