

Weather & The Fire Environment



**For
Firefighters and Dispatchers**

Revised March 2010

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Errors and omission:

Great effort has been made to ensure that the material contained within the S-212 *Weather and the Fire Environment* course is complete and factual, however errors may still exist. Please email any comments to Forests.ProtectionBranchOffice@gov.bc.ca.

Introduction

Anyone whose work involves wildland fire needs to be acutely aware of the weather and its influence upon fire behaviour. Within a short period of time weather conditions can change dramatically, and consequently the way a fire behaves can also change dramatically. Wildland fire is also capable of creating its own weather conditions. Without a rudimentary knowledge of weather processes, fire behaviour and the relationship between them the wildland fire fighter will find himself or herself at a disadvantage in their work.

How a wildland fire burns is dependent upon three variables: topography, fuel and weather. These three variables together form the wildland fire triangle. Topography normally only changes over periods of thousands of years; for wildland fire fighting purposes it does not change at all. The fuel type will change, often over a period of months or years, but not quickly enough to affect current fire fighting operations. Fuel condition may change more rapidly as a result of changes in the weather, which may occur within hours or minutes. Because weather conditions can change rapidly, the worker needs to know not only what the current weather conditions are, but also what weather conditions are likely to occur in the immediate future, so that he or she is able to predict how a fire will behave and act accordingly.

The weather will not only affect how a fire behaves, but it also affects the safety and comfort of personnel fighting the fire.

This course is designed to give the student some basic weather knowledge, explain the relationship between weather and fire behaviour, and explain the relationship between weather and crew comfort and safety. It is by no means comprehensive, but will give some insight into the relationship between weather and wildland fire fighting. An optional section about weather instruments may be more relevant to field personnel; dispatchers may wish to omit this section. A fire weather case study is included at the end of the course for those interested in a more rigorous application of the concepts contained within the course material.



Upon completion of this unit the student will be able to:

- Understand the relationship between weather and fire behaviour
- Understand the relationship between weather and crew safety and comfort
- Be able to observe and report weather conditions
- Understand the use and limitations of the Fire Weather Forecast
- Understand and use weather instruments & Belt Weather Kits (optional section)



Several weather elements directly affect the dryness of forest fuels, and, by affecting their dryness, also affect the ignition potential of these fuels and their behaviour when they burn. The weather elements also affect Firefighter safety and comfort. These weather elements are temperature, relative humidity, wind speed and direction and precipitation. Although these elements can individually cause a change in conditions, their combined effect will produce the greatest change.

Temperature

- Is the hotness or coldness of the atmosphere. Most of the heating of the atmosphere is indirect; radiation from the sun first heats the Earth's surface which then heats the atmosphere.
- Fuel is preheated in warmer temperatures making it more likely to ignite.
- Warmer temperatures dry the fuels faster because of faster evaporation of fuel moisture.
- Directly affects the firefighters comfort. Cooler temperatures may lead to hypothermia and dehydration may occur with hotter temperatures.
- Has a daily variation, coolest near daybreak and warmest during the late afternoon and early evening. Higher temperatures and lower relative humidities during the late afternoon and evening mean fire is more active at this time of day.
- Has a seasonal variation, coolest in winter when daylight is limited and warmest during summer when daylight hours are longest. The sun's rays arrive at the Earth's surface at a more direct angle in summer than in winter, rendering them more effective at heating the Earth's surface in the summer. Warmer temperatures result in a longer burning period during summer days.
- Varies with altitude, forest cover, terrain aspect. Warmest in the valley bottoms and on south facing slopes. Coolest in the mountains and on north facing slopes. Cooler under the closed forest canopy.
- Normally decreases with altitude, although in an inversion temperature increases with altitude. A thermal layer caused by an inversion in a valley can allow a fire to remain active through the night.

Relative Humidity

- Is a ratio expressing the relative saturation of the airmass. With no moisture in the airmass the RH is zero; when the airmass is fully saturated the RH is 100 percent. The absolute amount of moisture an airmass can hold varies with temperature. A colder airmass can hold less moisture, while a warmer airmass can hold more moisture.
- Affects the moisture content of fine and medium fuels. RH below the moisture content of the fuels will dry the fuel and RH above the moisture content of the fuels will add moisture to the fuel. The tendency is for the moisture in the air and in the fuel to equalize.
- Affects fire behaviour. The lower the relative humidity the more active the fire behaviour.
- Has a daily variation, lowest in the late afternoon and early evening, and highest near daybreak. This produces the most active fire behaviour during the late afternoons and early evenings.
- Has a seasonal variation, tending to be higher during the winter months and lower during the summer months.
- Varies with altitude, forest cover, terrain aspect. Lowest in the valley bottoms and on south facing slopes. Highest in the mountains and on north facing slopes. Higher under the closed forest canopy.
- Normally increases with altitude, although it can decrease with altitude in a nighttime inversion in a thermal layer near the top of the inversion in the valley, where fire behaviour can remain active through the night.

Wind Speed

- Affects the drying of the fine and medium fuels by transporting moisture away from the fuels. Strong wind produces increased drying.
- Affects fire spread rates and fire behaviour by producing longer flames, which are tilted toward unburned fuel in advance of the flame front, preheating the fuel. The higher the wind speeds the greater the spread rates and more active fire behaviour.
- Affects fire behaviour by replacing oxygen used in the combustion process leading to more active fire behaviour.

- Affects firefighter safety. Strong winds cause blow-down of snags and trees and produce flying debris, including the embers that cause spot fires. Fires in strong or increasing winds may overrun firefighters.
- Affects firefighter comfort. Strong winds and cool temperatures can lead to hypothermia. Strong winds and hot temperatures can lead to dehydration.
- Has a daily variation. Calmest near daybreak and strongest during the late afternoon and early evening. Heating of the Earth's surface mixes stronger winds aloft down to the surface which in turn cause gusty late afternoon and early evening winds that lead to erratic spread rates and directions and spotting.
- Normally increases with height.
- Will increase with valley narrowing.

Wind Direction

- Blows from high pressure to low pressure.
- Blows from cold to hot.
- Affects fire spread direction.
- Affects firefighter safety. Changing wind direction can lead to trapped firefighters.
- Veers during the day and backs at night.
- Is upvalley/upslope during daylight hours and downvalley/ downslope at night
- Tends to follow the valleys.
- Is onshore during the day (seabreeze) and offshore at night (landbreeze).
- Veers with height.

Precipitation

- Has several states which depend on temperature and the stability of the atmosphere. Rain, drizzle, snow, ice pellets, snow pellets, hail, showers can all occur during the fire season.

- Affects fire starts. Lack of precipitation over an extended period leads to drier fuels and an increased chance of ignition while moderate to heavy precipitation and extended precipitation will limit the chance of ignition.
- Affects fire behaviour. An extended period of no precipitation will lead to active fire behaviour. Moderate to heavy precipitation and extended precipitation will decrease fire behaviour.
- Affects firefighter safety. Moderate to heavy precipitation and extended periods of precipitation will lead to lower temperatures and an increased chance of hypothermia. It will also lead to poor footing.
- Has seasonal variations. Precipitation producing storms are more active in the spring and fall.
- Has diurnal variations. During summer months afternoon and evening showers are most common.

Airmass Stability and Instability

Stability of the airmass refers to the tendency of a parcel of air when it is lifted to either continue rising or sink back to its original level. Although airmass stability is not a primary element of fire weather, knowledge of cloud formation and weather as well as knowledge of fire behaviour rely on an understanding of the concept.

A parcel of air can be lifted in several ways:

- Heating from below making the parcel more buoyant
- Cooling from above making the parcel more buoyant
- Air converging in a low pressure system forcing air upward
- Forced upward by topographic features such as mountains
- Advancing front pushing cooler air under warmer air lifting the warmer air

A lifted parcel of air may

- Continue rising, or
- Sink back to its original level

A parcel that continues rising is called unstable

- Is warmer than the surrounding air
- Fire behaviour is more intense in an unstable airmass

A parcel that sinks back to its original level is called stable

- Is cooler than the surrounding air
- Fire behaviour is less intense in a stable airmass
- The airmass in a high pressure system is generally stable and the airmass in a low pressure system tends to be unstable

OBSERVING THE WEATHER



CLOUDS

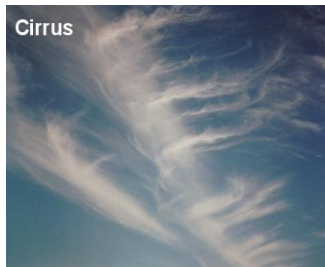
Types and associated weather

Formation and Classification of Clouds

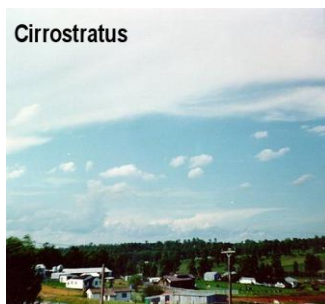
Clouds are formed by certain processes which lift a parcel of air. We noted these lifting processes in the previous section on airmass stability. As the parcel is lifted the air in the parcel cools to the point where the moisture in the parcel condenses and forms a visible cloud. At this point precipitation may start falling from the saturated cloud.

Classification of clouds can be by the height above ground at which they form, the levels being high, middle and low, and by whether they are cumuloform or stratoform. Cumuloform clouds normally have vertical development greater than the horizontal area, whereas stratoform clouds have little vertical development compared to the horizontal area. Some clouds may exhibit characteristics of both forms. The type of cloud can give an indication of atmospheric processes at work and therefore what weather conditions to expect in the near future. A stratoform cloud is formed by lifting stable air, and cumuloform cloud is formed by lifting unstable air.

High cloud - Bases 6,000 metres (20,000 feet) and higher. Consist of ice crystals. No precipitation.

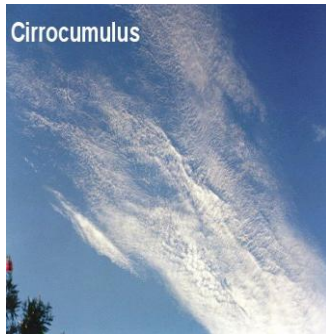


Wispy thin clouds often called mare's tails. Usually fair weather but can be indicative of an approaching warm front a couple of days off or a jet stream overhead.



Thin blanket of cloud with the sun visible and often a halo around the sun. First indication of an approaching warm front, forerunner of precipitation in the next 18 to 30 hours.





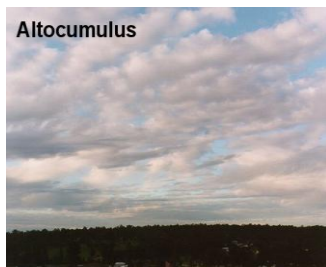
Sheets or bands of small white flakes or very small globular masses, may look like ripples in the sand on the seashore. Unstable air, often a forerunner of thunderstorms later in the day. Virga possible.

Middle cloud -

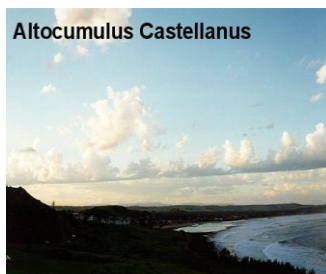
Bases 2,000 to 6,000 metres (6,500 to 20,000 feet). Consist of water droplets, super cooled water droplets and ice crystals. Light rain or showers possible, no appreciable precipitation.



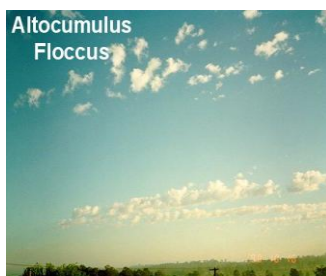
Grayish sheet or blanket of cloud with the sun dimly visible or invisible, no halo. Stable air, pre warm front with light rain or virga associated.



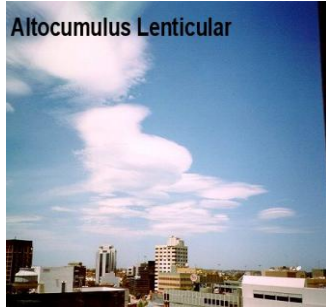
Patches, bands or sheets with a rounded or rolled shape appearance, globular masses. Unstable air with very light showers or virga possible. May be frontal, pre or post frontal or associated with an upper trough.



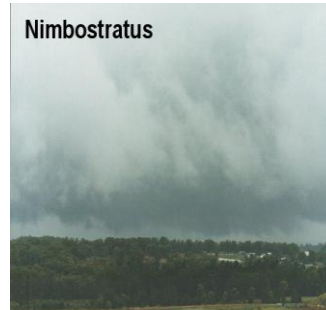
Individual tower like cells. Unstable airmass, thunderstorms often develop later in the day. May be frontal, pre or post frontal, associated with an upper trough or unstable airmass. Light rain shower or virga possible.



Puffy white clouds looking like cotton balls. Unstable airmass, thunderstorms often develop later in the day.



Lens or almond shaped cloud generally on the lee side of mountain ranges. Indicator of strong high level winds. No precipitation.

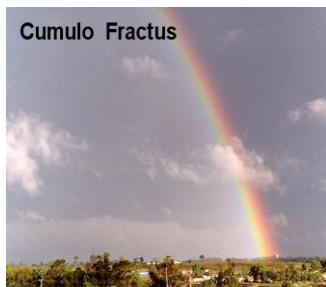


Dark gray cloud covers the entire sky and blocks out the sun. Stable air. Warm frontal cloud with continuous rain, which may be light, moderate or heavy in intensity. Thunderstorms are sometimes embedded if airmass unstable.

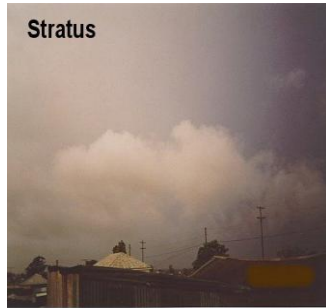
Low cloud - Bases usually from the surface to 2,000 metres (6,500 feet), consist of water droplets or super cooled water droplets and ice crystals in the towering clouds. During the summer months cumulus cloud bases may range as high as 4,500 metres (15,000 feet). Cumulus clouds are also referred to as clouds of vertical development.



Fragmented wispy clouds, form in precipitation. Stable air.



Fragmented wispy clouds, form in precipitation. Unstable air.



Stratus

Low, uniform layer of cloud. Stable airmass, may produce drizzle with no appreciable accumulation.



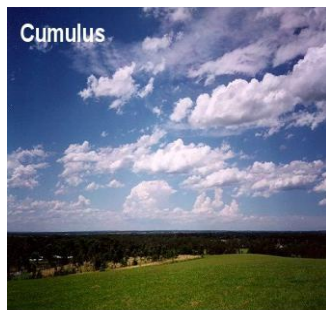
Fog

Thin, gray layer of cloud whose base is touching the ground. Stable airmass, may produce drizzle with no appreciable accumulation.



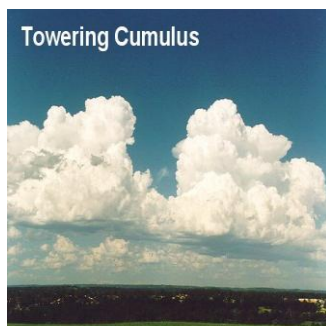
Stratocumulus

Bands, sheets or patches of cloud with a rounded or rolled shaped appearance. May be frontal, pre or post frontal or associated with an upper trough. May produce light rain or light drizzle.



Cumulus

Puffy white clouds with flat bases. Unstable air. Usually fair weather but if observed during the morning hours may grow to towering cumulus or cumulonimbus during the afternoons in the summer months. No precipitation.

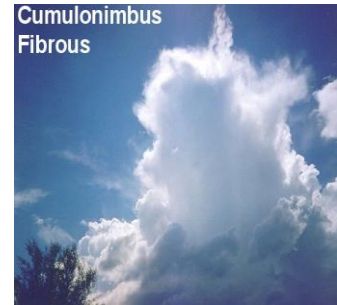


Towering Cumulus

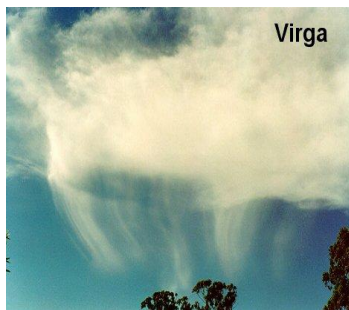
Tall cumulus clouds which may be growing, well-rounded, cauliflower-like tops and flat bases. Unstable air. May be frontal, pre or post frontal, with an upper trough or general airmass. Light occasionally moderate showers possible and virga. Downdrafts with gusty erratic winds. May grow into cumulonimbus.



Huge cumulus cloud with flat base and an anvil top. The top may also be in the form of towering cumulus but the edges are becoming fibrous. Very unstable air. Forms along cold fronts, in squall lines preceding a cold front, embedded in warm frontal cloud if the airmass is unstable, with an upper



trough or general airmass thunderstorms when enough heating and moisture is available. Showers of light, moderate, heavy or very heavy intensity. Virga, hail, lightning and tornadoes possible. Downdrafts will produce strong, gusty winds from 50 to 90 km/h while microbursts can produce winds gusts as high as 150 km/h. These clouds may develop as individual cells, clumps of cells or a line of cells.



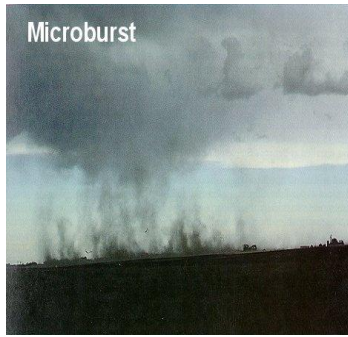
Precipitation falling from cloud but not reaching the ground, it evaporates as it falls. Indicative of very dry air below the cloud.



A violently rotating column of air extending downward from the base of a cumulonimbus cloud and touching the ground. This column is an extremely powerful updraft into the cloud. Wind speeds can be as strong as 116 km/h (f0 tornado) to over 420 km/h (f5 tornado). Updraft wind speeds can reach 300 km/h. Extremely unstable air.



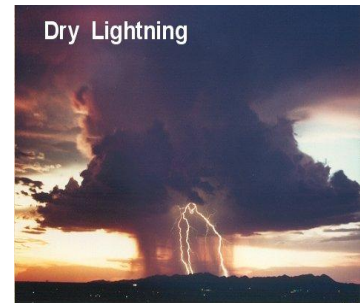
A violently rotating column of air extending downward from the base of a cumulonimbus cloud, not in contact with the Earth. This is an extremely powerful updraft into the cloud. Can become a tornado.



A very intense downdraft out of a cumulonimbus cloud which spreads out in all directions as it hits the ground. Wind speeds of 100 km/h to greater than 200 km/h can be experienced.



Can be cloud to cloud, inside cloud and cloud to ground. We are interested in cloud to ground which is a discharge of static electricity from the cloud to the ground. Can be positive or negative. Negative is from near the base of the cloud and positive



is from the top of the cloud. Although both types of lightning start fires, positive strikes are generally considered to be more dangerous due to the longer duration of the stroke and it is more likely to strike outside the rain area.

Dry lightning occurs when there is little or no precipitation from the cloud, or strikes outside the precipitation area.

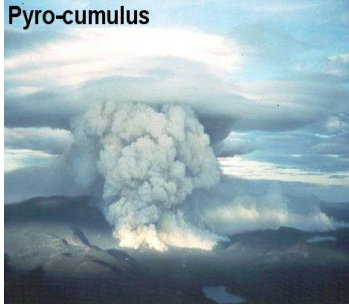


Rounded globular masses hanging from the bases of cumulonimbus cloud. The mechanism for their formation is not well known and as been poorly studied. Generally occur during the dissipating stage and is a sign of cool moist air sinking out of the cloud with very dry air beneath. Very unstable air.



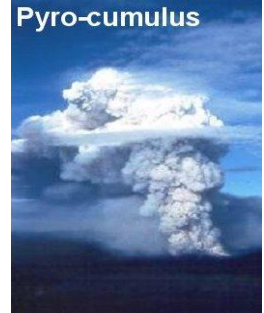
Precipitation in the form of ice falling from cumulonimbus cloud. Indicative of strong updrafts in the cloud. Very unstable air.

Pyro-cumulus



Cumulus clouds forming over a large fire, may grow into cumulonimbus and produce lightning. Caused by the extreme heat of the fire and very unstable air.

Pyro-cumulus

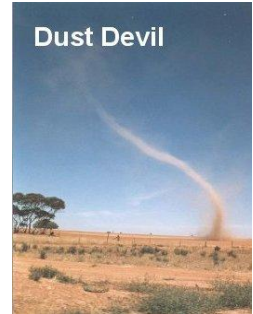


Fire Whirl



Indicators of intense local heating and very unstable air. Updrafts of 40 to 60 km/h can develop with whirlwind speeds of 40 to 90 km/h.

Dust Devil



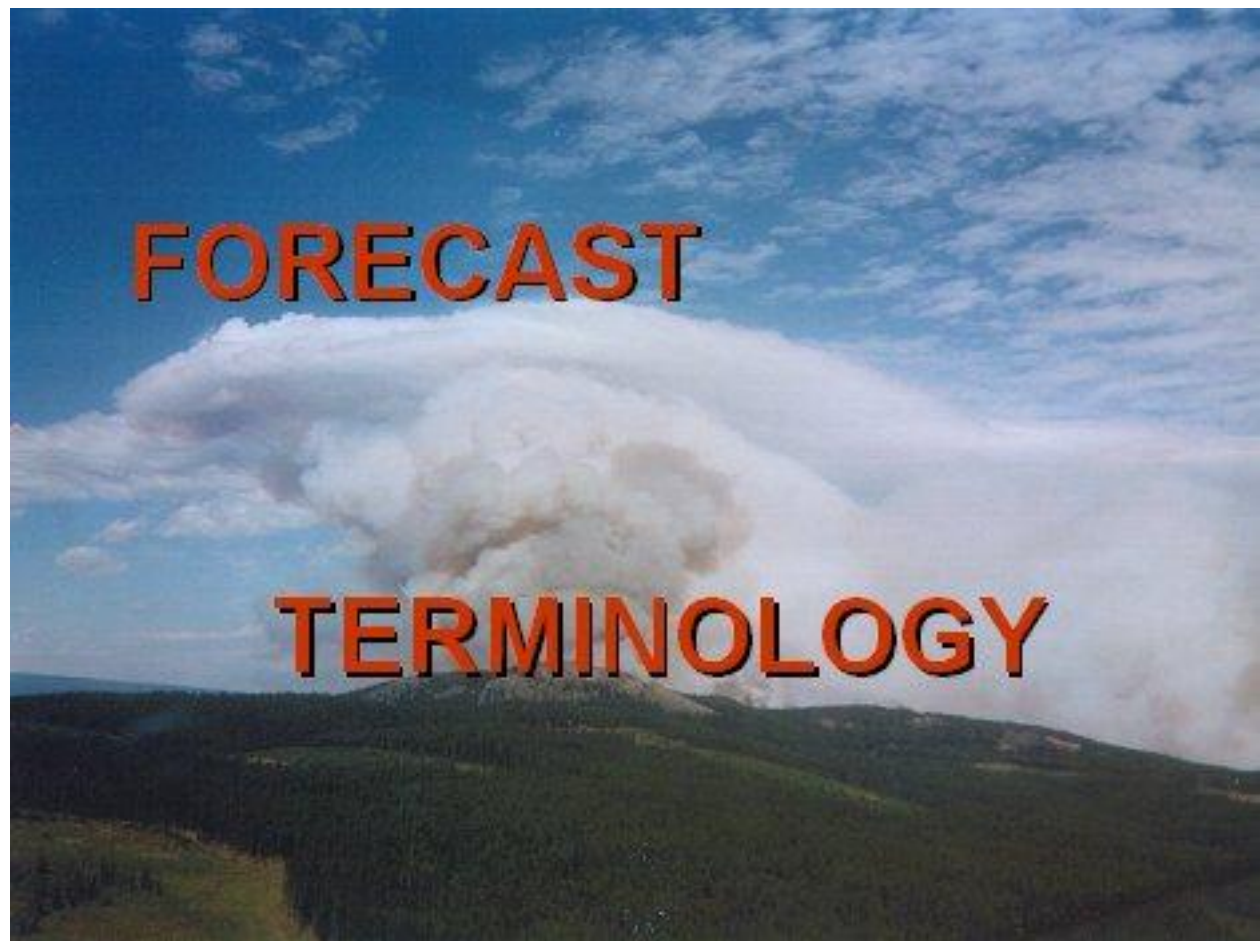
Inversion



Warm air over cooler or cold air, traps smoke and pollutants below the inversion. A nocturnal inversion forms due to radiation cooling under clear or mostly clear skies and calm or light winds.

Inversion





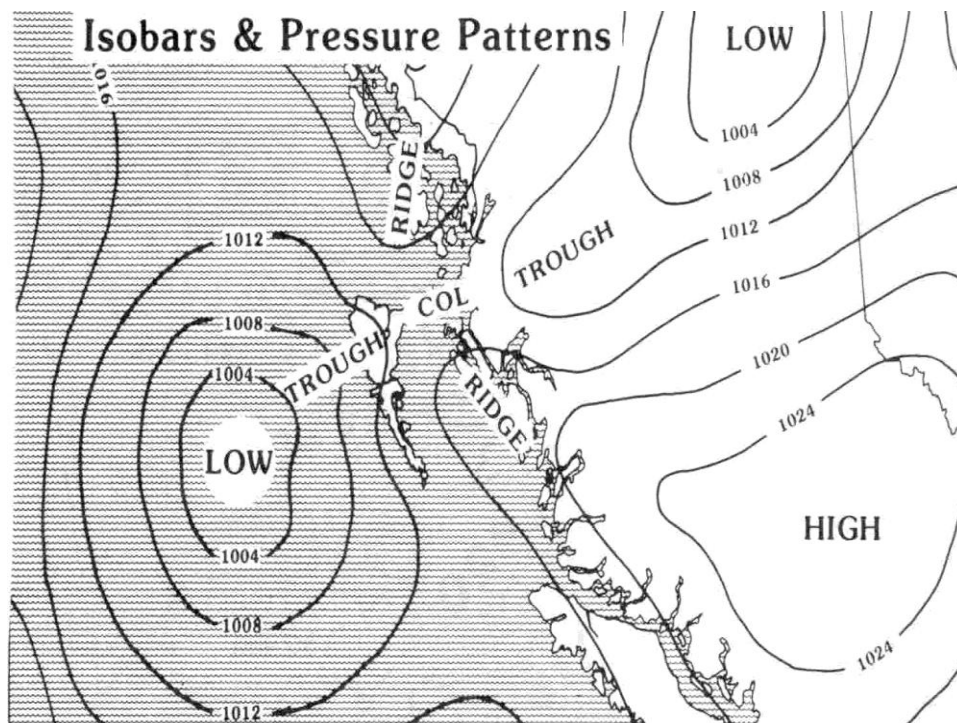
LOW PRESSURE AND TROUGH OF LOW PRESSURE

- Cloudy, cool, windy, rain or showers, thunderstorm
- On the surface chart wind blows counterclockwise around the low and inwards at a slight angle towards the centre
- The trough is an elongation of the low

HIGH PRESSURE AND RIDGE OF HIGH PRESSURE

- Sunny, warm, dry, light winds
- On a surface chart wind blows clockwise around the high and outwards at a slight angle towards a low
- The ridge is an elongation of the high

Surface Chart

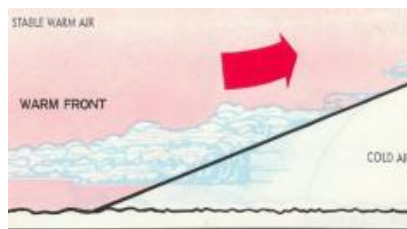


COLD FRONT



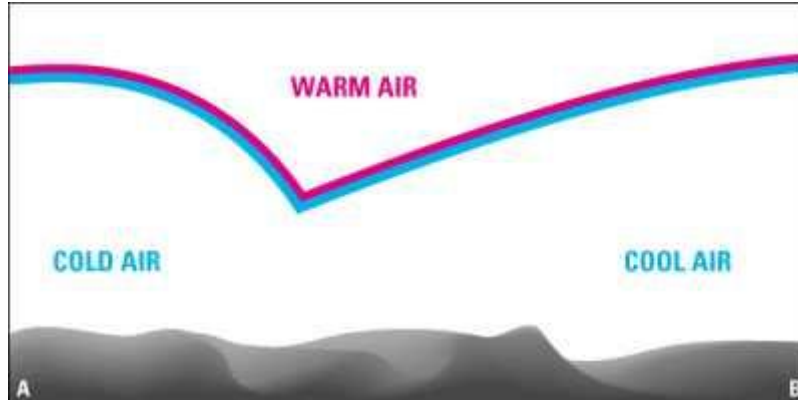
- Border between advancing cold air and warm air 45 to 90 km wide
- Cloudy and windy with showers or thundershowers
- Abrupt wind shift as the front passes, often to the west or northwest
- Temperature and relative humidity decrease with the frontal passage

WARM FRONT



- Border between retreating cold air and warm air
- 150 to 300 km wide
- Cloudy and windy with rain
- Wind shift as the front passes, often to the south or southwest
- Temperature and relative humidity increase with the frontal passage

TROWAL



- Trough of warm air aloft.
- Occurs when a cold front overtakes a warm front
- Conditions will be a combination of the weather associated with both a cold front and a warm front.

UPSLOPE/SUBSIDENCE

A predominately westerly flow of air over B.C. with several mountain ranges between the coast and Alberta produces 2 significant weather features in our province, upslope and subsidence. These two conditions affect the amount of cloud and rainfall accumulation, in many areas of B.C.



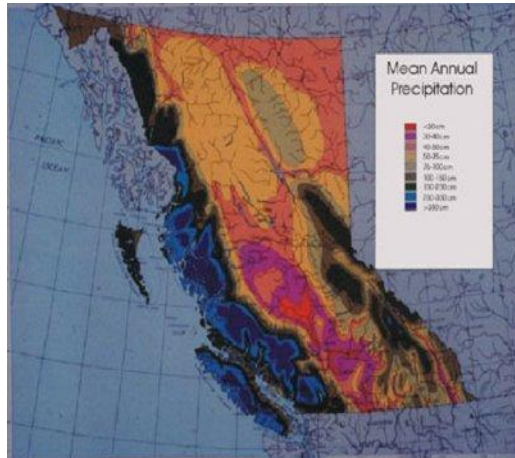
Windward side of all mountain ranges in BC. Produces large rainfall events as weather systems move across the area. Rainfalls of 20 to 30 mm are common in these areas with 50 to 100 mm rainfalls occurring a few times per season, generally in the spring and fall. The air in the westerly flow is forced upward by the mountain range. As the air is forced up it cools and moisture contained in the airmass is condensed and falls out as precipitation when the airmass is cooled enough to reach saturation. The most notable areas in the province are the Vancouver Island Mountains, Coast Mountains, Cariboo Mountains, Monashee Mountains, Selkirk Mountains, Columbia Mountains and the Rocky Mountains.



Leeward side of all mountain ranges in BC. Dries out weather systems as they move across the area with little or no rainfall experienced, warmer temperatures and more sun than surrounding areas.

The most notable areas in the province are east of the Coast Mountains from the Southern Okanagan into the Chilcotin, east of the Vancouver Island Mountains, east of the Coast Mountains in northwestern BC, east of the Rockies in northeastern BC and east of the Columbia Mountains in southeastern BC.

Upslope and subsident areas become reversed when a cold low passes to the south of the area or a surface high moves through the southern NWT or northern Alberta. This gives the wind an easterly component, changing upslope areas from western slopes to eastern slopes and subsident areas from eastern slopes to western slopes.



Looking at the annual average precipitation map for BC we see the upslope and subsident areas well delineated.

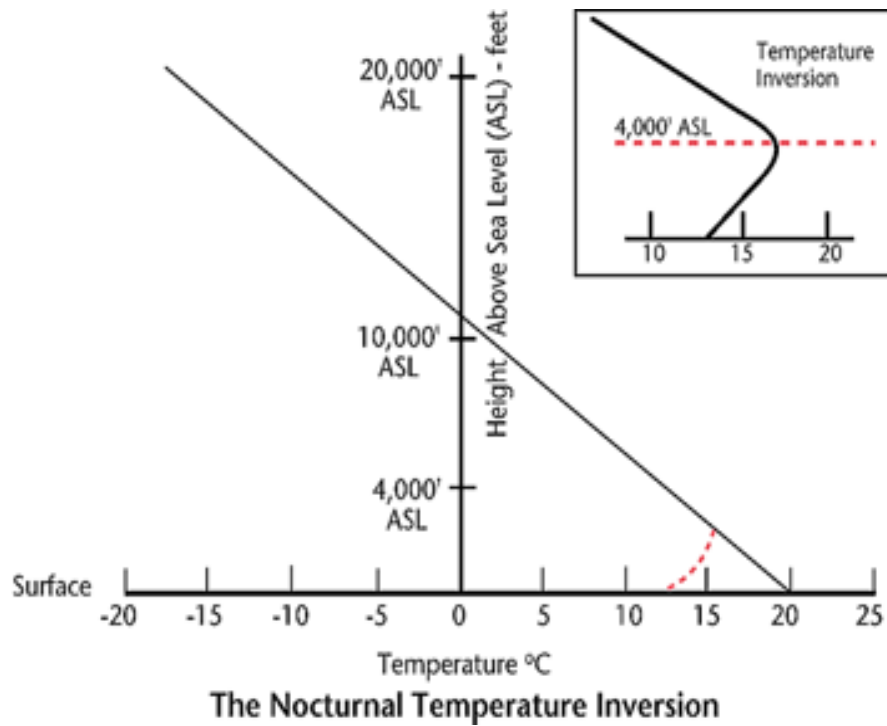
TEMPERATURE INVERSIONS

Temperature normally decreases with height at 1 C per 100 metres. In a temperature inversion, temperature increases with height.

Types of Inversions

Nocturnal

- Forms at night, due to the settling of the atmosphere.
- Readily forms on CLEAR and CALM nights.



- Fire Behaviour becomes more active and erratic once a nocturnal inversion breaks!



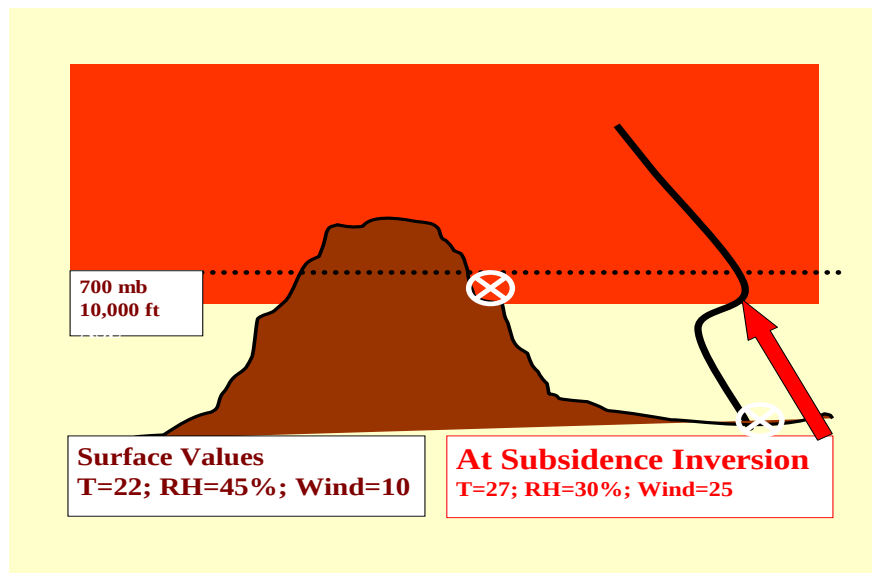
Marine

- Forms when cooler, marine air moves over the land

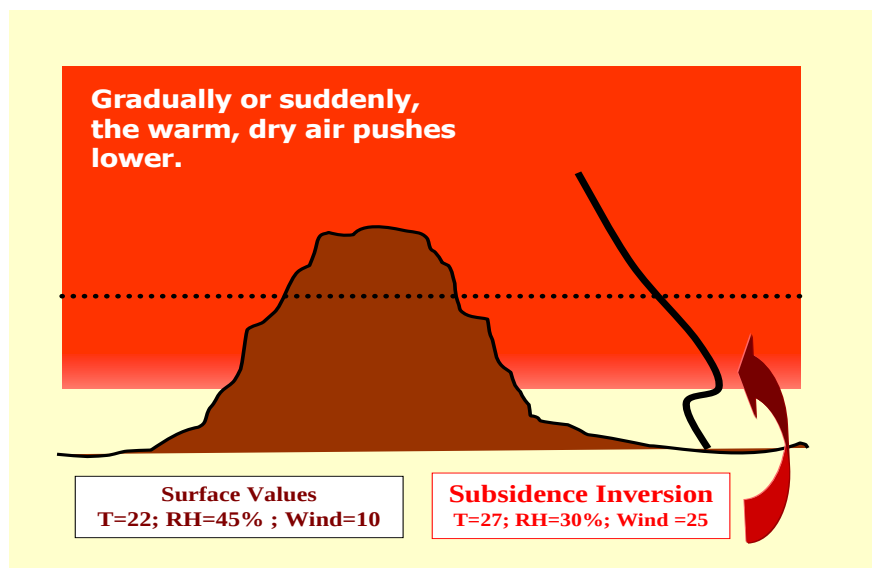
Subsidence

- Forms when a large blocking ridge of high pressure develops over an area, usually during the first several days. Subsidence progresses downward from its origins in the upper atmosphere. As a result, it takes time for the warmest and driest air to reach the surface.

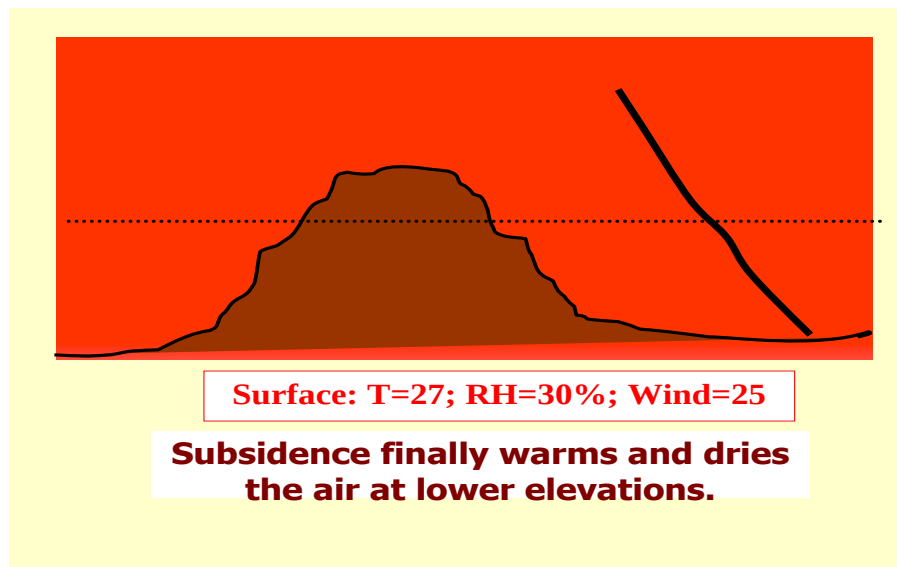
Day 3



Day 5

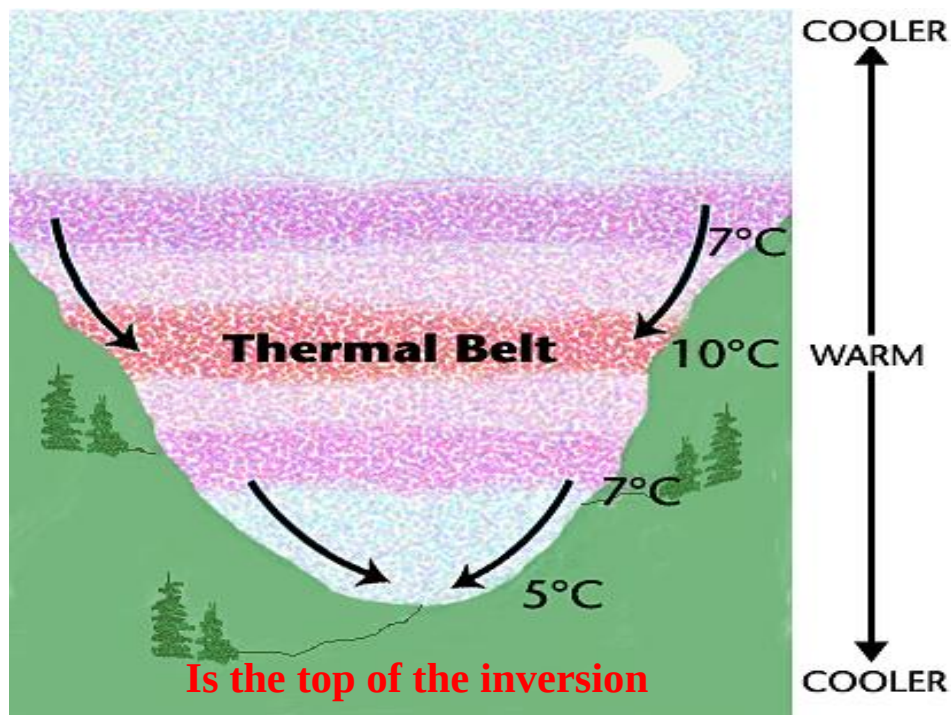


Day 7



Thermal Belt

- Has the highest overnight temperature, the lowest overnight relative humidity and stronger overnight winds.
- **Fires burning in the thermal belt remain more active overnight!**



Below the thermal belt:

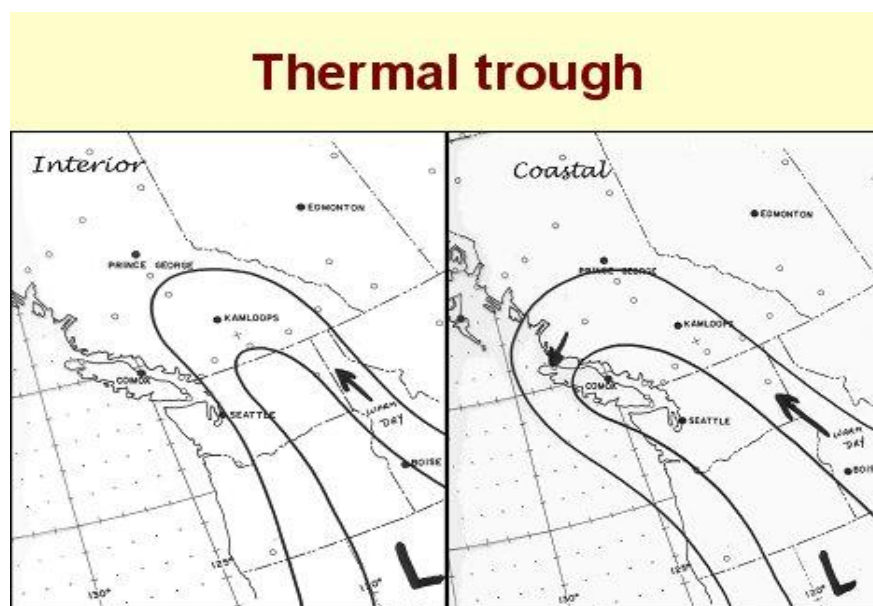
- Conditions are “stable”.
- Lighter winds, lower temperatures, higher RH values.
- Predictable fire behaviour.

At the thermal belt:

- Conditions abruptly change from stable to unstable; from cooler to warmer; from higher RH to lower; from light winds to gustier.
- Promotes a change in fire behaviour.

Above the thermal belt:

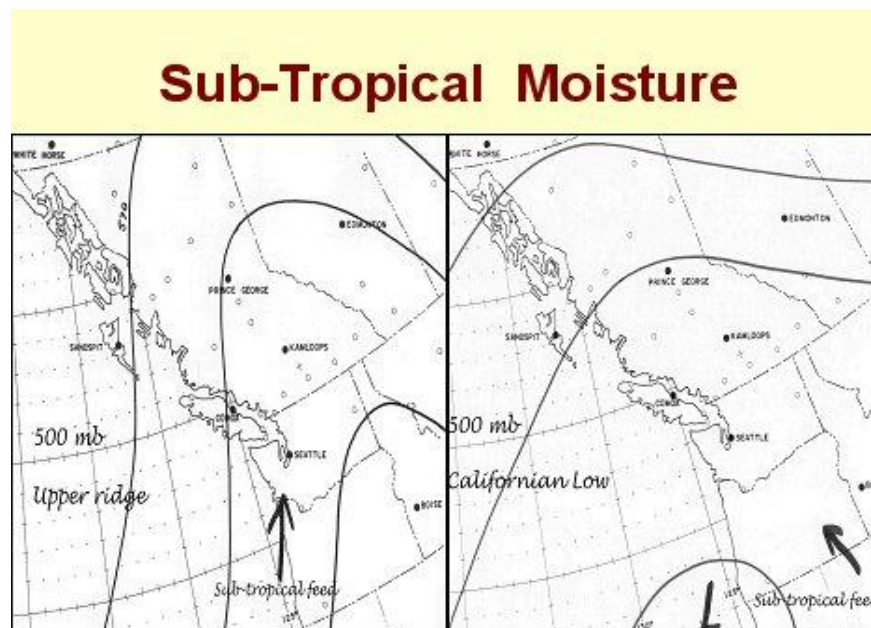
- Air mass more unstable.
- Lower temperatures, higher RH.
- Often stronger (or erratic) winds.
- Fire behaviour sometimes less predictable.



Strong heating in the southwestern US will develop a thermal trough northwards into southern BC either into the south interior or along or off the coast. The thermal trough enhances warming and drying. Effects developed by this trough include warmer temperatures (2 to 8 degrees Celsius depending on the time of year), lower humidities (10 to 20%) and inflow or outflow winds.

A trough into the interior produces light inflows overnight until mid morning, then moderate to very strong inflows from mid mornings through mid evenings as temperatures increase in the interior.

A trough along or off the coast produces moderate to strong outflows overnight and in the early morning hours then reverses to light to moderate inflows from late mornings through early evenings with strong heating from the Interior.



Sub-tropical moisture (sometimes referred to as monsoonal moisture) approaches BC from the southwest, south or southeast and has a source region of the South Pacific or Mexico. This air is very moist, usually in the mid to high levels and approaches in bands or patches. With strong daytime heating in southern BC sub-tropical moisture can explode into moderate to severe dry lightning storms, developing from mid afternoons onwards and occasionally persisting through the overnight period.

Two patterns signal the possible approach of sub-tropical moisture. The first sees a strong upper ridge over eastern BC or Alberta with a deep upper trough off the BC/US coast producing a southwest to south flow of air into southern BC. The second sees a strong upper level ridge of high pressure over the province with a cold low off the

California coast (High/Low Block) producing a south to southeast flow of air into southern BC.

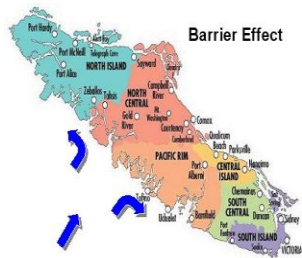
The southwest to south flow of air usually confines dry lightning outbreaks to the south interior while a south to southeast flow of air will also see dry lightning develop over south coastal areas.

COLD LOW

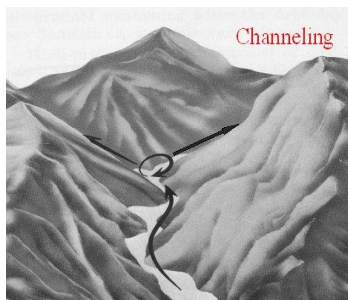
- Generally cloudy, unseasonably cool, windy and very wet.
- Timing and intensity and movement of these systems are variable and unpredictable.



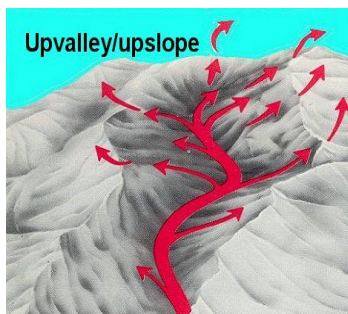
Wind, although often driven by large scale synoptic high and low pressure systems, in British Columbia is significantly affected by local effects, such as mountainous terrain, and in some areas synoptic winds may never be experienced. Some of the many variables we have to take into consideration when determining wind speed and direction are the coastline, mountain ranges, valleys, heating and cooling in addition to pressure gradient and frontal systems. The coastline, mountain ranges and valleys control wind direction in BC while the pressure gradient, temperature differential and valley shape control the wind speed.



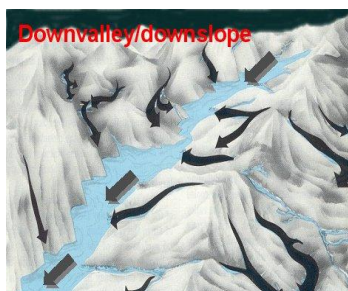
Wind, with a barrier in its path, will alter direction and flow parallel to the barrier unless the flow is strong enough to force the air over the barrier.



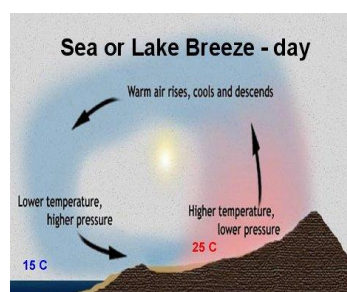
Wind direction follows the shape of the valley



Develop during the morning hours and last through early to mid evening, strongest during the afternoon and early evening. Upslope winds begin on eastern slopes first as temperatures rise, up-valley winds begin later in the morning to early afternoon as the whole volume of air in the valley is warmed. Winds can reach speeds of 20 to 30 km/h.

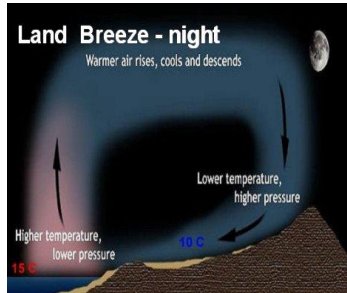


Develop during the evening and last into the morning as temperatures decrease and cold air begins draining into the valleys, usually a light wind of 5 to 15 km/h.

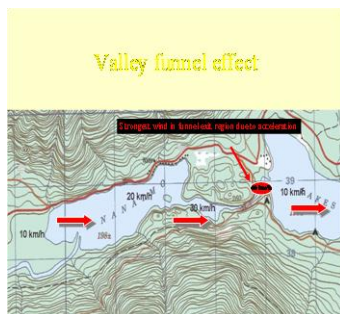


Water temperature varies little from night to day while land

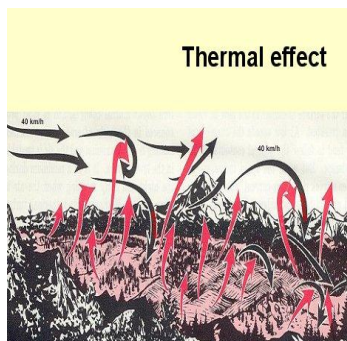
temperatures see significant diurnal changes. During the day the land temperature will be many degrees warmer than nearby water temperatures of the ocean or large lakes, this will develop an onshore flow of air which can reach speeds of 10 to 20 km/h during the late afternoons with local gusts to 30 km/h. Air over the land is heated faster than air over the water and as it rises the air over the water moves onshore to fill the void left by the rising air.



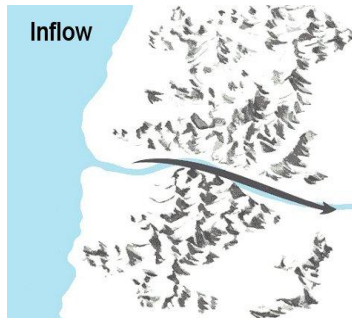
Land temperatures cool significantly overnight and can end up lower than nearby ocean or large lake water temperatures, developing an offshore flow of air in the 5 to 10 km/h range. This is the reverse process of the daytime sea breeze.



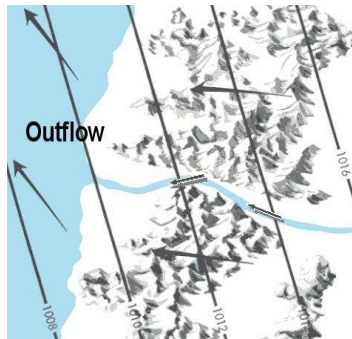
Winds increase as they are forced into narrow areas of valleys and decrease as they flow into wider areas. Wind speeds can double or triple in speed under these conditions.



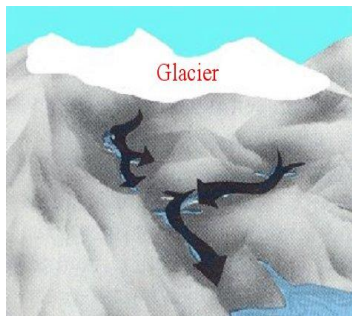
Intense heating in the interior of BC will see a deep mixing layer develop, which will bring high level winds to the surface as gusts during the afternoons. In mountainous terrain winds from 3,000 metres will reach the surface on a strong convective day.



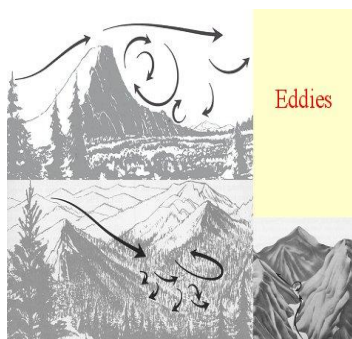
Through inlets and valleys, develops with a ridge of high pressure along the coast and a trough of low pressure or low in the interior. The wind speed is dependent on the pressure gradient and temperature. Overnight inflows tend to be light, 5 to 10 km/h, strengthening through the day as temperatures increase with speeds from 10 to 20 km/h common and 20 to 30 km/h not unusual. Local valleys, i.e. Fraser Canyon near Lytton, will see 30 to 40 km/h winds with gusts from 50 to 60 km/h.



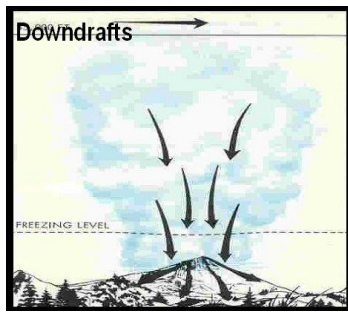
Through inlets and valleys, develops with a trough of low pressure or low along or off the coast and a ridge of high pressure or a high over the Interior. The wind speed is dependent on pressure gradient and temperature. During the day winds will tend to be light, 5 to 10 km/h, increasing to moderate outflows, 20 to 30 km/h by late evening into the early to mid morning when they will again become light. A deep low pressure system approaching the coast can produce outflow gusts from 60 to 100 km/h through some valleys and inlets. Strong heating in the interior will shift outflow winds to light to moderate inflows during the afternoon. Outflow winds will also develop warmer than normal temperatures and lower relative humidities in mainland inlets and valleys.



Downslope day and night, undercuts the up-valley/upslope wind. Speeds of 10 to 20 km/h are common with stronger gusts associated. Bursts from 60 to 100 km/h are possible in the deeper and narrower ravines and canyons.

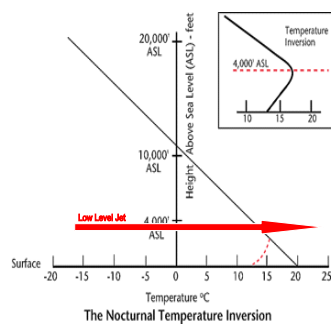


Over hills and mountains and at valley intersections and bends. They cause erratic directional and speed changes.



Downdrafts develop beneath the bases of towering cumulus clouds and cumulonimbus clouds. Gusts from 40 to 60 km/h can be experienced near towering cumulus clouds while gusts from 60 to 80 km/h can be experienced near cumulonimbus clouds.

LOW LEVEL JET



A narrow band or stream (sometimes called a tube) of strong, low level winds. These winds can vary from 40 to over 100 km/h. Two types of low level jets occur. The first is a night-time phenomena and occurs near the top of an inversion. It forms near or shortly after sunset and breaks up when the inversion dissipates. The second occurs between 1500 and 4000 metres associated with upper troughs and cold fronts.



FIRE WEATHER FORECAST

The Fire Weather forecast is an extremely valuable decision planning aid used by the BC Forest Service. The forecast consists of several sections:

Synopsis -	short description of weather systems affecting the area of interest, their strength, track and speed. Airmass descriptors will also be included in this section.
Today -	detailed forecast of clouds, wind, temperature, humidity and precipitation.
Tonight -	as above.
Tomorrow -	as above.
3 to 5 day -	forecast of weather systems, cloud, wind, temperature, humidity and precipitation, although not as detailed as the today, tonight and tomorrow section.
6 to 10 day -	general forecast of weather systems and trends.
Venting -	detailed forecast for today indicating the venting conditions. To include the top of the inversion, if any, the inversion breakthrough temperature and the timing of this breakthrough. Plume drift characteristics.
4 day venting -	a more general forecast for day 2 through day 5.
Winds aloft -	upper level wind speeds and directions for 3 general levels - below 1000 metres, above 1000 metres and above 2500 metres.
Confidence -	Good/poor/fair - how the forecaster feels about the forecast, confidence in the computer analyses and prognoses. This could be a simple or detailed statement.

Example:

FIRE WEATHER FORECAST FOR THE KAMLOOPS FIRE CENTRE

MORNING ISSUE

Wednesday, May 16, 2012

SYNOPSIS: Ridge of high pressure over the South Interior moving into Alberta this morning. Strong Southwesterly flow of mild and moist Pacific air developing. A Frontal system embedded in the flow is moving over the South Coast this morning then through the Interior overnight and Saturday.

TODAY: Mainly cloudy except cloudy with sunny periods in subsident areas. Showers developing this afternoon, scattered in subsident areas. Flurries higher levels. Wind Southeasterly 20 to 30 km/h except Southerly 30 to 40 km/h through the Fraser Canyon with gusts from 40 to 70 km/h. Minimum humidities 40 to 55%. Highs 7 to 12.

TONIGHT: Mainly cloudy, clear breaks in subsident areas. Periods of rain in the North Thompson, Monashees and Fraser Canyon, showers elsewhere, scattered in subsident areas. Snow or flurries higher levels. Wind Southeasterly 20 to 30 km/h except Southerly 30 to 40 km/h through the Fraser Canyon with gusts from 40 to 60 km/h. Overnight recoveries 80 to 100%. Lows 1 to 8.

TMRRW: Mainly cloudy, clear periods in subsident areas. Periods of rain or showers in the North Thompson and Monashees, scattered showers elsewhere. Snow or flurries higher levels. Wind decreasing to light except Southerly 20 to 30 km/h through the Fraser Canyon. Minimum humidities 40 to 55%. Highs 7 to 12.

3 TO 5 DAY OUTLOOK: Strong West to Southwest flow of air across the Region Sunday. A weak ridge of high pressure begins building over the area Monday then moves Eastward Tuesday. A strong Southwesterly flow of mild and moist Pacific air redevelops Tuesday with a series of frontal systems embedded. Variable cloudiness Sunday except mainly cloudy in the North Thompson and Monashees. Scattered showers or flurries in the North Thompson and Monashees. Windy at times. Highs 6 to 12. Variable cloudiness Monday. Windy at times. Highs 5 to 10. Cloudy with sunny periods Tuesday except mainly cloudy in the North Thompson and Monashees. Scattered showers or flurries in the North Thompson and Monashees. Windy at times. Highs 6 to 10.

6 TO 10 DAY OUTLOOK: Northwesterly flow of cooler air still forecast to develop near mid week but is forecast to collapse quickly returning a strong Westerly flow of mild and moist air across the Region. Look for mild and unsettled conditions to continue.

VENTING: Poor venting below 500 metres till mid to late morning then good. Breakthrough temperature 10 C. Good venting above 500 metres. Plume drift Northeast 30 km/h.

4 DAY VENTING OUTLK: Poor venting in the valleys during the mornings otherwise good.

WINDS ALOFT: South to Southwest 10 to 20 km/h below 1000 metres. Southwest 20 to 40 km/h above 1000 metres increasing to 30 to 60 km/h this afternoon. West to Southwest 50 to 60 km/h above 2500 metres increasing to 70 to 90 km/h this afternoon.

CONFIDENCE: Fair. Mild, unsettled, blustery pattern seems well established. Variables will be timing and intensity of each disturbance, so far these systems are moving in and through quicker than forecast. Subsidence will weaken each system to the lee of the coast mountains. Poor confidence longer term.

Paul Robertson - Fire Weather - Kamloops fire Centre
Phone - 554 5517 Fax - 376-3485 Email - kfirewx@pop.gov.bc.ca

SPOT FORECAST

The spot forecast is a more detailed site-specific forecast for decision planning on active fires and for planned burns. This forecast can be tailored to the requirements of the person requesting the forecast. The forecaster will need information from the crew on site or on the planned site to prepare this forecast. This information includes the fire name and number, location (lat./long.), elevation, aspect, slope, valley orientation and the latest weather readings from on site or from a representative site. As it is not always possible to provide all this information immediately, **the minimum required information** from the site would be the fire name and number, location and the elevation. The remainder of the information will be forwarded to the forecaster as soon as possible.

The following example indicates the forecast would be for 1 PM and would include the maximum temperature, wind and minimum relative humidity. However, this is only a basic template and if forecast data were required for other time periods or 2 or 3 elevations it would also be included in the spot forecast. A section would also be added if any significant weather were expected to develop.

A final area of the form is left for feedback and comments from the crew, this will enable the forecaster to fine tune the forecast for your site.

Example 1: basic form

SPOT FORECAST

1. REQUEST

ZONE:		DATE:	May. 16, 12
NAME OF PERSON MAKING REQUEST:			

LOCATION NAME:	
LOCATION CO-ORDINATES	

FORECAST REQUESTED FOR DATE:	Today	TIME:	1300
------------------------------	-------	-------	------

ELEVATION:		<u>LATEST WX READING</u>	
ASPECT		NAME OF REPRESENTATIVE STN:	
SLOPE:		DATE - TIME:	
VALLEY ORIENTATION:		TEMPERATURE	
		RELATIVE HUMIDITY:	
		WIND:	
		PRECIPITATION:	

2. SPOT FORECAST:

DATE: May 16, 2012

1 PM TEMP:		RH:		WIND:		% CHANCE RAIN:	
------------	--	-----	--	-------	--	----------------	--

MAX TEMP:		MIN RH:		MAX WIND:	
-----------	--	---------	--	-----------	--

OUTLOOK:

Signature: PBR

3. FEEDBACK & COMMENTS

ACTUAL OBSERVATIONS

DATE-TIME:		WIND:	
TEMP:		PCPN:	
RH:			

GENERAL COMMENTS:

Example 2:

SPOT FORECAST

1. REQUEST

ZONE:		Date requested:	May. 16, 12
NAME OR PERSON MAKING REQUEST:			

LOCATION NAME:	
LOCATION CO-ORDINATES	

FORECAST REQUESTED FOR DATE:	Today	TIME:	1300
------------------------------	-------	-------	------

ELEVATION:		<u>LATEST WX READING</u>	
ASPECT		NAME OF REPRESENTATIVE STN:	
SLOPE:		DATE - TIME:	
VALLEY ORIENTATION:		TEMPERATURE	
		RELATIVE HUMIDITY:	
		WIND:	
		PRECIPITATION:	

2. SPOT FORECAST: Issued: Wednesday, May 16, 2012 8:42 AM Valid:

10 AM TEMP		RH:		WIND:	
------------	--	-----	--	-------	--

1 PM TEMP:		RH:		WIND:		% CHANCE RAIN:	
------------	--	-----	--	-------	--	----------------	--

5 PM TEMP:		RH:		WIND:	
------------	--	-----	--	-------	--

OUTLOOK:

Signature: PBR

3. FEEDBACK & COMMENTS

ACTUAL OBSERVATIONS

DATE-TIME:		WIND:	
TEMP:		PCPN:	
RH:			

GENERAL COMMENTS:

Example 3:

SPOT FORECAST

1. REQUEST

ZONE:		Date requested:	May. 16, 12
NAME OR PERSON MAKING REQUEST:			

LOCATION NAME:	
LOCATION CO-ORDINATES	

FORECAST REQUESTED FOR DATE:	Today	TIME:	1300
------------------------------	-------	-------	------

ELEVATION:		<u>LATEST WX READING</u>	
ASPECT		NAME OF REPRESENTATIVE STN:	
SLOPE:		DATE - TIME:	
VALLEY ORIENTATION:		TEMPERATURE	
		RELATIVE HUMIDITY:	
		WIND:	
		PRECIPITATION:	

2. SPOT FORECAST: Issued: Wednesday, May 16, 2012 8:42 AM Valid:

800 metres

10 AM TEMP:		RH:		WIND:	
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1 PM TEMP:		RH:		WIND:		% CHANCE RAIN:	
------------	--	-----	--	-------	--	----------------	--

5 PM TEMP:		RH:		WIND:	
------------	--	-----	--	-------	--

1200 metres

10 AM TEMP:		RH:		WIND:	
-------------	--	-----	--	-------	--

1 PM TEMP:		RH:		WIND:		% CHANCE RAIN:	
------------	--	-----	--	-------	--	----------------	--

5 PM TEMP:		RH:		WIND:	
------------	--	-----	--	-------	--

OUTLOOK:

Signature: PBR

3. FEEDBACK & COMMENTS

ACTUAL OBSERVATIONS

DATE-TIME:		WIND:	
TEMP:		PCPN:	
RH:			

GENERAL COMMENTS:

WEATHER WARNINGS AND ADVISORIES

- Are sent out when significant changes to the weather forecast are indicated. They would include thunderstorms, lightning, wind, heavy precipitation and hail, conditions which would pose a serious threat to life and/or property.
- Advisories are issued when conditions indicate the potential for a significant weather event.
- Warnings are issued when a definite severe weather event is forecast to take place.
- Weather warnings and advisories are very detailed forecasts indicating the intensity and timing of the severe weather event.

W I N D / T H U N D E R S T O R M A D V I S O R Y

Ministry of Forests – Kamloops Fire Centre

Wednesday, May 16, 2012 8:42 AM

PLEASE ENSURE ALL LINE STAFF RECEIVE THIS INFORMATION

Cold front North/South along the Fraser River moving Eastward across the area this afternoon with a band of thunderstorms forecast to develop along the front. The front is forecast to move East of the Fire Centre area by late afternoon.

A band of thunderstorms accompanying the cold front will be locally intense at times with moderate to heavy thundershowers. Gusts from 40 to 70 km/h with the thunderstorms with locally 80 to 100 km/h microbursts possible.

“ALL STATIONS IN THE FIELD PLEASE CONFIRM YOU HAVE RECEIVED & UNDERSTOOD THIS MESSAGE. Kamloops Fire Centre, Standing By.”

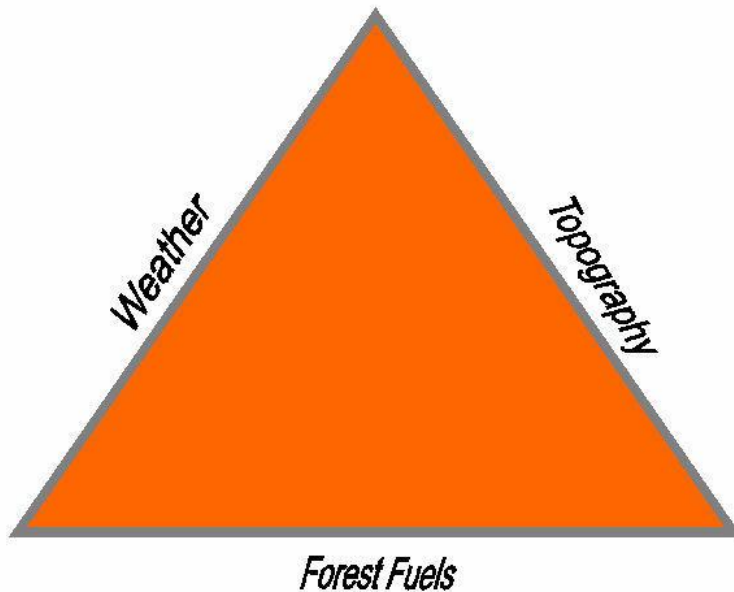
FIRE WEATHER (554 5517) FAX (376-3485)
KAMLOOPS FIRE CENTRE

- 1) CFCO Signature: _____
- 2) CFCO Specifies Zones for broadcast of message. Please circle choices:
K1 K2 K3 K4 K5 K6 K7
- 3) Dispatch: Broadcast a 1-minute warning & then transmit to all crews on fire and in the field, on channels selected above by the CFCO.
Time of broadcast: _____ Name of Dispatcher: _____
- 4) Dispatch: Must confirm message has been received & understood from all personnel & aircraft in the area of concern. List below & check mark those confirmed. File: Weather/Weather Advisories

Fax to: PFCO, Nearby FCtrs: _____, All Zones & Crews, Kam. Region & Districts, Rap Base, PATC, PFFRC, Fire# _____
Copies to: CFCO, All Disp Workstations, Tactics Officers, Plans, BB, & File



Fire Behavior Triangle



Firefighting is normally a challenging but reasonably safe occupation. However, problems do occur and most of these can be linked to changes in the Fire Environment.

These changes include:

- Fuel type changes - predictable
- Topography changes - predictable
- Weather changes - predictable but also variable - hourly, daily, weekly and seasonally

Wind shifts - cause the fire to run back towards the firefighters on the flanks and in the rear of the fire.

- Upslope/downslope winds shift 180 degrees as the atmosphere warms up or cools down.

- Upslope winds develop from mid morning through to early afternoon.
- Downslope winds develop from early to late evening.
- Subsidence will shift winds 180 degrees to downslope winds during the day when upslope winds normally occur.
- Sea or lake breezes, onshore or offshore shift 180 degrees as the atmosphere warms up or cools down.
 - Onshore breezes develop as the land becomes warmer than the water during the late morning and early afternoon.
 - Offshore breezes develop as the land cools during the evening.
- Frontal passages cause abrupt wind shifts from 45 to 180 degrees as they move through an area. The degree of shift depends on your location. In open areas wind shifts tend to be 45 to 90 degrees. In valleys wind shifts tend to be 180 degrees.
- A trough of low pressure will cause winds to shift through 180 degrees as it crosses the area.
- Thunderstorms moving across an area will produce erratic wind shifts.

Wind increases - causes the fire to overrun the firefighters near the head of the fire.

- Daytime heating will cause winds to increase in strength as a deep mixing layer develops and higher levels winds are forced to the surface. These winds will tend to be gusty and erratic in nature.
- Subsidence will cause light to moderate and occasionally strong downslope winds to develop.
- Frontal systems and troughs of low pressure bring increasing winds to the area as they approach.
- Thunderstorms bring strong and erratic wind increases.

Temperature changes - These occur as weather systems change and through normal diurnal heating and cooling. They are a cause of hypothermia and dehydration. Systems which will bring about these changes include:

- Cold frontal passages will normally develop a sudden drop in temperatures, as much as 10 degrees.
- Cold lows will develop a gradual to fast cooling of the atmosphere as it approaches, as much as 15 to 20 degrees.
- Thermal troughs will increase temperatures by as much as 8 degrees.
- Thunderstorms can bring significant localized cooling with their downdrafts as they move through an area. This cooling tends to be short-lived unless associated with a frontal passage or cold low or late in the day.
- A temperature inversion will produce a thermal layer on the slopes above the valley floor where temperatures will remain warm through the night and fire can remain active .
- Subsidence will produce several degrees of warming which will last through the night.

Relative humidity changes - These occur as weather systems change and through normal diurnal heating and cooling. Low relative humidities are a cause of aggressive fire behaviour while higher relative humidities will bring a decrease in fire activity. Systems which will develop these changes include:

- Subsidence will bring a decrease in the relative humidity during the day when low humidities are common and at night when we would normally expect a significant increase in the relative humidity.
- A thermal trough will bring decreasing relative humidities, as much as 10 to 20%.
- A temperature inversion will produce a thermal layer on the slopes above the valley floor where relative humidities will remain low through the night and fire can remain active.
- Warm fronts, cold lows and troughs of low pressure normally bring increasing relative humidities.
- Cold fronts normally bring lower relative humidities.

Thunderstorms develop - These changes can be brief or prolonged depending on the weather system the thunderstorm is associated with. Thunderstorm changes tend to be very abrupt and significant.

- Abrupt and erratic wind shifts. The wind flows outward from the thunderstorm cell.
- Sudden and strong increase in wind speed. Winds will have strong gusts associated. Speeds from 40 to 80 km/h are common.
- Potential for microbursts, a sudden and extremely strong downdraft from the thunderstorm cell with speeds in excess of 100 km/h.
- Strong cooling.
- Significant increase in relative humidity.
- Moderate to heavy rain or snow, hail.
- Lightning.

SIGNALS OF IMPENDING CHANGE

There are many tools and indicators available to the Firefighter to enable the prediction of change in the fire environment.

- The forecast will mention approaching frontal systems, troughs, subtropical moisture, potential for thunderstorm development, formation of low level jets, thermal troughs, etc.
- Forecast updates, amendments, advisories and warnings will keep you up-to-date on any significant systems that may be changing in intensity or developing.
- Cloud types and cloud changes will signal approaching frontal systems, troughs, cold lows and will also alert you to the development of thunderstorms.
- Smoke plumes will give an indication of the high level winds and with the right environment the lowering of these winds to the surface.
- Change in fuel type can effect a change in fire spread rate and the fire intensity.
- Change in topography can effect a change in the fire spread rate and the fire intensity.

WEATHER INSTRUMENTS (optional section)

THERMOMETERS - Sling psychrometer

Wet Bulb

Measures the evaporative air temperature in degrees and tenths of degrees Celsius



Dry Bulb

Measures air temperature in degrees and tenths of degrees Celsius

The difference between the dry bulb and wet bulb thermometers is used to calculate the relative humidity.

WIND GAUGE

Measures the wind speed in kilometres per hour. May read in other units but must be converted back to km/h.



RAIN GAUGES

Measures rainfall in millimetres and tenths of millimetres



AUTOMATIC WEATHER STATION

Automatically measures temperature, relative humidity, wind speed and direction and rainfall accumulation hourly and stores the data. The station can be called by radio or telephone and the data downloaded to a central computer.

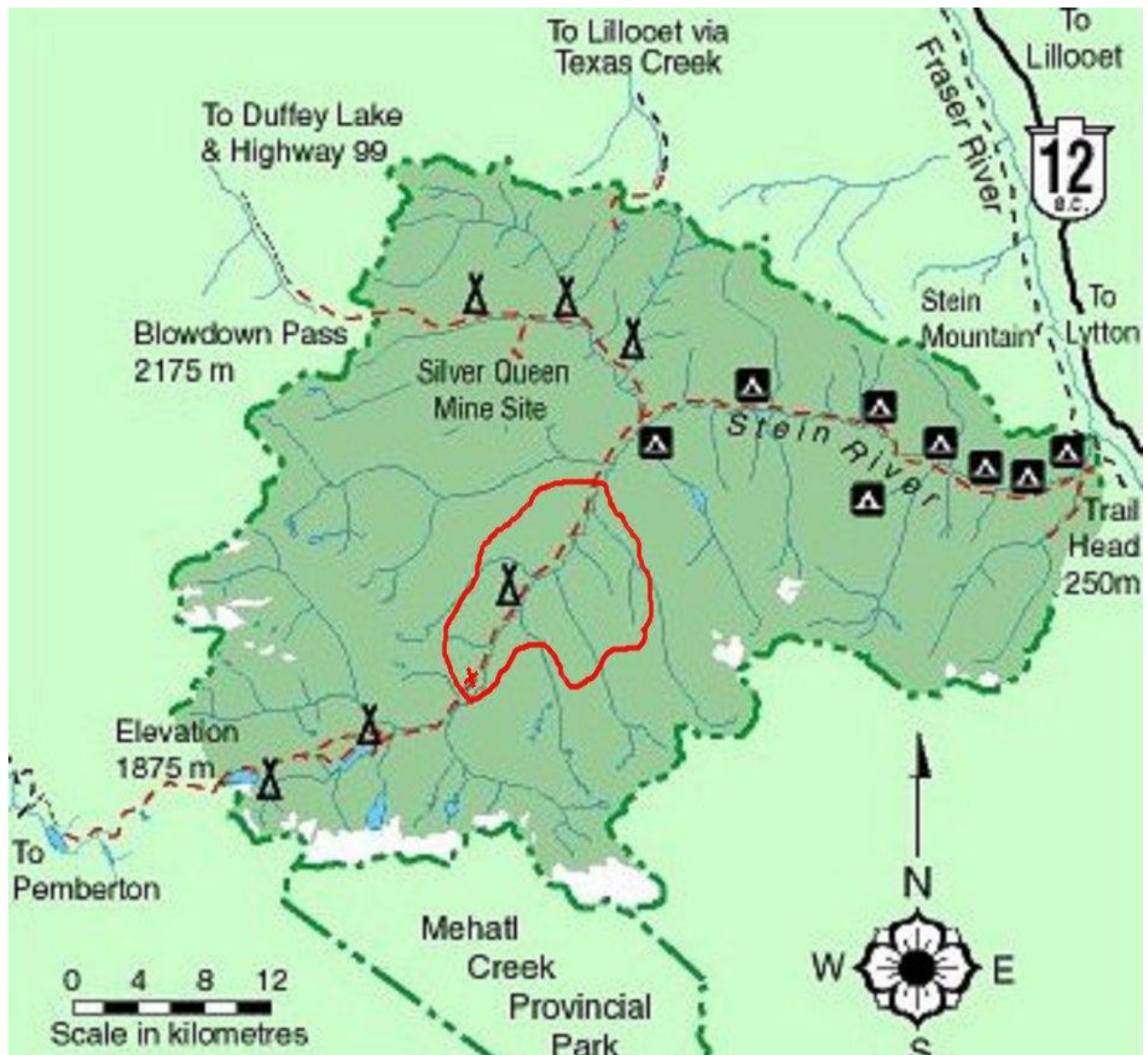


THE BELT WEATHER KIT

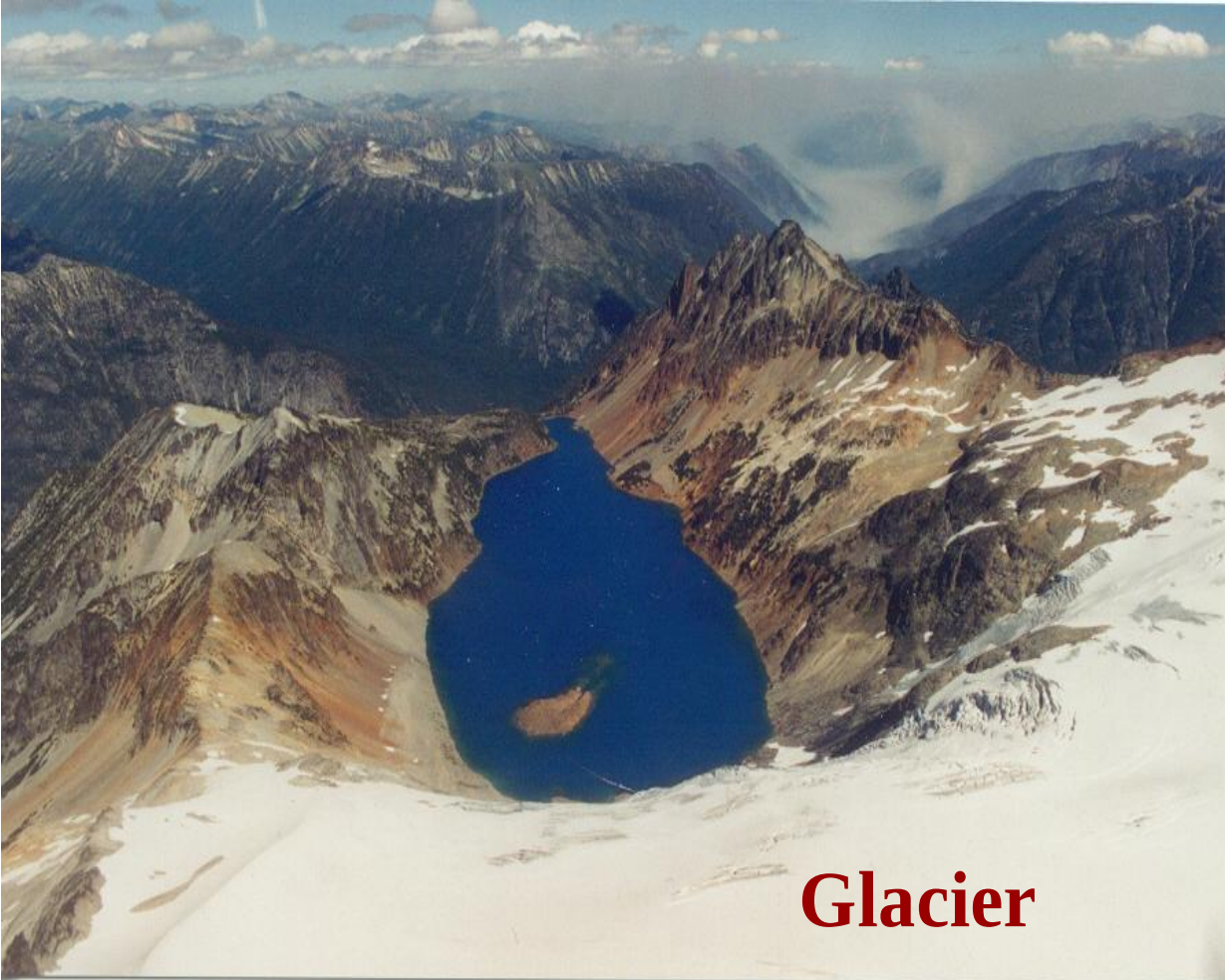
Student exercise - understanding and use (not available for self-study students).



The Stein Fire was discovered at 3:00 pm on August 1, 1996 at 20+ hectares. Firefighting crews were dispatched and air tanker action was initiated. After discussions with B.C. Parks it was decided to let the fire burn and to monitor. The fire spread slowly during the next few weeks and caused no problems. During the last week of August, after a prolonged dry spell the fire intensity increased and firefighter crews were again dispatched to the head end of the fire. August 30th saw an approaching cold front and associated low level jet. An account of the action on this day follows.



1st problem.....wind direction?



Glacier

SPOT FORECAST

1. REQUEST

ZONE:	Lillooet	DATE:	August 29, 1996
NAME OR PERSON MAKING REQUEST:			

LOCATION NAME:	Stein - K70239
LOCATION CO-ORDINATES	

FORECAST REQUESTED FOR DATE:	Today	TIME:	1300
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ELEVATION:	1000/2000	<u>LATEST WX READING</u>	
ASPECT		NAME OF REPRESENTATIVE STN:	
SLOPE:		DATE - TIME:	
VALLEY ORIENTATION:	SW/NE	TEMPERATURE	
		RELATIVE HUMIDITY:	
		WIND:	
		PRECIPITATION:	

2. SPOT FORECAST:

DATE: August 29, 1996

1 PM TEMP: 1000m	24	RH:	35%	WIND:	SW 10 km/h	% CHANCE RAIN:	0%
2000m	20		40%		SW 12 km/h		0%

MAX TEMP:	28	MIN RH:	25%	MAX WIND:	Gusts 25 km/h
2000 m	23	MIN RH:	30%	MAX WIND:	Gusts 25 km/h

VENTING: Poor venting this morning increasing to good by afternoon then back to poor this evening. Good venting Friday and Saturday. Poor venting mornings Sunday and Monday, good in the afternoons.

OUTLOOK: Cloudy with sunny periods Friday. Cooler. Wind increasing to Southwest 20 km/h and gusty.

Signature: PBR

FIRE WEATHER FORECAST FOR THE KAMLOOPS FIRE CENTRE

MORNING ISSUE

Thursday August 29, 1996

SYNOPSIS: Upper ridge moving Eastward as trough of low pressure digs in along the coast. Southwesterly flow of air across the region with patchy moisture embedded. Upper trough moves inland late Friday.

TODAY: Sunny with cloudy periods. Wind light with afternoon gusts to 25 km/h. Highs low 30's except high 20's North Thompson. Minimum humidities 25 to 35%.

TONIGHT: A few clouds. Wind light. Lows 12 to 16 except 8 to 11 North Thompson. Overnight recoveries 60 to 70% except 90 to 100% North Thompson.

TMRRW: Cloudy with sunny periods. Scattered showers developing. Wind increasing to Southerly 20 to 30 km/h by afternoon except 30 to 40 km/h through the Fraser Canyon. High's mid to high 20's. Minimum humidities 30 to 40%.

3 TO 5 DAY OUTLOOK: Upper trough crosses the region Saturday then weak ridging occurs behind the trough. A Westerly flow of air develops across B.C. following the ridge. Mix of sun and cloud Saturday with isolated showers. Clearing late in the day. Windy. Mainly sunny with near normal temperatures Sunday and Monday.

VENTING: Poor venting below 600 metres this morning otherwise good. Breakthrough temperature 24 C. Plume drift light and variable below 2000 metres, Northerly 10 to 15 km/h above 2000 metres and Northeast 20 to 25 km/h above 2500 metres.

WINDS ALOFT: Light and variable below 2000 metres. Southerly 10 to 20 km/h above 2000 metres. Southwesterly 20 to 25 km/h above 2500 metres.

Paul Robertson - Fire Weather - Kamloops fire Centre
Phone - 554 5517 Fax - 376-3485 Email - kfirewx@pop.gov.bc.ca

SPOT FORECAST - AFTERNOON UPDATE

1. REQUEST

ZONE:	Lillooet	DATE:	August 29, 1996
NAME OR PERSON MAKING REQUEST:		CFCO	

LOCATION NAME:	Stein K70239
LOCATION CO-ORDINATES	

FORECAST REQUESTED FOR DATE:	Today	TIME:	1300
------------------------------	-------	-------	------

ELEVATION:	1000/2000	LATEST WX READING	
ASPECT		NAME OF REPRESENTATIVE STN:	
SLOPE:		DATE - TIME:	
VALLEY ORIENTATION:	SW/NE	TEMPERATURE	
		RELATIVE HUMIDITY:	
		WIND:	
		PRECIPITATION:	

2. SPOT FORECAST:

DATE: August 29, 1996

Cloudy with sunny periods Friday. Cooler. Wind increasing to Southwesterly 20 km/h and gusty. Wind shifting to Northerly 20 to 30 km/h and gusty following the front. For 2 to 3 hours then back to Southwesterly 20 km/h. Slight chance of a light shower. Mix of cloud and sun Saturday. Dry. Wind Southwest 20 km/h and gusty. Mainly sunny Sunday and Monday. Wind light with afternoon gusts to 25 km/h.

Signature: PBR

3. FEEDBACK & COMMENTS

ACTUAL OBSERVATIONS

DATE-TIME:		WIND:	
TEMP:		PCPN:	
RH:			

GENERAL COMMENTS:

FIRE WEATHER FORECAST FOR THE KAMLOOPS FIRE CENTRE

AFTERNOON UPDATE

Thursday August 29, 1996

Ridge of high pressure continues Eastwards as trough of low pressure digs in along the coast. Frontal system preceding the trough will move inland Friday morning and cross the region during the day. Trough of low pressure will follow the front later in the day and Saturday morning.

Sunny with cloudy periods today. Wind light with afternoon gusts to 25 km/h main valleys. A few clouds overnight.

Cloudy with sunny periods Friday. Scattered showers developing as the front moves through the area with a risk of a thundershower accompanying the front. Wind increasing to Southerly 20 to 30 km/h ahead of the front then shifting to West to Northwest 30 to 40 km/h and gusty following the front. Wind tapering off during the evening to 20 to 30 km/h.

Mix of cloud and sun Saturday. Isolated light showers. Wind West to Northwest 20 to 30 km/h and gusty.

Sunny with cloudy periods Sunday and Monday. Wind light with afternoon gusts to 25 km/h main valleys.

Paul Robertson - Fire Weather - Kamloops fire Centre
Phone - 554 5517 Fax - 376-3485 Email - kfirewx@pop.gov.bc.ca

SPOT FORECAST

1. REQUEST

ZONE:	Lillooet	DATE:	August 30, 1996
NAME OR PERSON MAKING REQUEST:	CFCO		

LOCATION NAME:	Stein K70239
LOCATION CO-ORDINATES	

FORECAST REQUESTED FOR DATE:	Today	TIME:	1300
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ELEVATION:	1000/2000	LATEST WX READING	
ASPECT		NAME OF REPRESENTATIVE STN:	
SLOPE:		DATE - TIME:	
VALLEY ORIENTATION:	SW/NE	TEMPERATURE	
		RELATIVE HUMIDITY:	
		WIND:	
		PRECIPITATION:	

2. SPOT FORECAST:

DATE: August 30, 1996

1 PM TEMP:1000m	20	RH:	45%	WIND:	SW 15 km/h	% CHANCE RAIN:	30%
2000m	16		50%		SW 20 km/h		40%

MAX TEMP:	24	MIN RH:	40%	MAX WIND:	Gusts 40 to 50 km/h
2000 m	20		40%		Gusts 40 to 50 km/h

Increasing Southwesterly winds this morning will shift to Northerly with and just behind the front then back to Southwest following the front.

VENT: Good venting today and Saturday. Poor mornings and good in the afternoons Sunday through Tuesday.

OUTLOOK: Weak ridge of high pressure builds Saturday returning sunny and dry conditions. Temperatures near normal values. Wind Southwesterly 10 to 15 km/h and gusty.

Signature: PBR

FIRE WEATHER FORECAST FOR THE KAMLOOPS FIRE CENTRE

MORNING ISSUE

Friday August 30, 1996

SYNOPSIS: Pacific cold front along the coast this morning will move eastward today to lie just East of the region by late afternoon. Front appears to be stronger than indicated yesterday. A low level jet accompanies the front across the region. Upper trough follows overnight and Saturday. Weak ridge of high pressure builds behind the trough.

TODAY: Increasing cloud with scattered showers or thundershowers developing with the front. Wind increasing to Southwesterly 20 to 30 km/h this morning except 40 km/h through the Fraser Canyon shifting to West to Southwest 40 to 60 km/h with the frontal passage except 50 to 80 km/h through the Fraser Canyon. Highs high 20's to 30 except mid 20's North Thompson. Minimum humidities 30 to 40%.

TONIGHT: Cloudy with clear breaks. Isolated showers except scattered showers or thundershowers in the North Thompson and Monashees. Wind Southwest 40 to 50 km/h except 50 to 70 km/h through the Fraser Canyon. Lows 10 to 14. Overnight recoveries 70 to 80% except 90 to 100% North Thompson.

TMRRW: Sunny with cloudy periods. Wind Southwesterly 20 to 30 km/h except 40 to 50 km/h through the Fraser Canyon. Highs low to mid 20's. Minimum humidities 35 to 45%.

3 TO 5 DAY OUTLOOK: Weak ridge of high pressure builds over the South Interior. Mainly sunny Sunday and Monday. Windy at times. Temperatures near normal. Next disturbance to move through the region Tuesday. Cloudy with sunny periods Tuesday. Isolated showers. Windy.

VENTING: Poor venting below 1000 metres this morning becoming good with the frontal passage. Plume drift North to Northeast 20 to 25 km/h below 1500 metres. North to Northeast 30 to 40 km/h above 1500 metres.

VENT OUTLK: Good Saturday. Poor in the valleys during the mornings Sunday through Tuesday becoming good by afternoon.

WINDS ALOFT: South to Southwest 20 to 25 km/h below 1500 metres. South to Southwest 30 to 40 km/h above 1500 metres.

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FIRE WEATHER FORECAST FOR THE KAMLOOPS FIRE CENTRE

Friday August 30, 1996

GENERAL WEATHER ADVISORY - RED FLAG WARNING

Attn: ALL ZONES and ALL FIRE STAFF

Please ensure all line staff receive this information.

Cold front and low level jet tracking across the region today. System just crossing the coast mountains and should be East of the region by late afternoon.

Strong winds with and behind the front reaching 40 to 60 km/h with gusts to 80 km/h and as high as 80 km/h with gusts to 100 km/h through the Fraser Canyon.

A band of thunderstorms is accompanying the front.

Major wind shift as the front moves through.

Extreme spread rates will occur.

Fire activity will be aggressive and challenge initial attack.

Priority should be given to crew placement and escape routes.

PBR/CFCO

Fire Weather - 554 5517 Fax - 376 3485

Kamloops Fire Centre

An examination of Thursdays forecasts indicates that although an upper trough and front were forecast for the next day, winds were expected to remain in the moderate range, southwesterly 20 to 30 km/h with the approach of the front, then shift to northerly 20 to 30 km/h with the frontal passage, and finally shift back to southwesterly 20 km/h about two hours after the frontal passage.

Fridays forecasts started off very similar but changed dramatically as more information became available.

The spot forecast issued at 7:00 am indicated southwest winds 20 km/h shifting to north with the frontal passage for a short period then back to southwest. Gusts were forecast from 40 to 50 km/h. It would still be a manageable situation, but one that would need caution during the frontal passage.

The morning forecast, issued at 8:15 am, had several changes. It shows the addition of a low level jet to the synoptic picture and a stronger cold front than first analyzed. General winds are now forecast to be 40 to 60 km/h. A wind shift is still forecast, but the directions in the general forecast do not match the spot forecast. This is quite common and not a concern; the spot forecast wind directions remain valid. Thunderstorms are forecast to develop along the front.

The Weather Advisory and Red Flag Warning (now called a Fire Behaviour Warning) were issued at 8:30 am. Further analysis of the situation has increased forecast wind speeds from 40 to 60 km/h with gusts to 80 km/h with and behind the frontal passage. A major wind shift will accompany the front. A band of thunderstorms lies along the front.

Decisions based on the Forecasts?

STEIN FIRE - Morning of August 30, 1996

8:30 am

- Crews to the fire

9:30 am

- Crews were ordered evacuated from the site to safe areas.
- Aircraft were ordered to land and hold.

10:30 am

- All crews were in safe areas and aircraft were on the ground.

11:00 am

- Frontal passage at the fire.

11:30 am

- Crews and aircraft become operational.

An observer near the fire reported the frontal passage at approximately 11:00 am. His report of conditions during and following the passage were very close to forecast conditions. Increasing southwesterly winds at 30 to 40 km/h shifted into the north with the front and increased to 40 to 60 km/h with peak gusts to 80 km/h. The winds tapered off to 20 to 30 km/h approximately 1/2 hour after the frontal passage and shifted back into the southwest. Thunderstorms did accompany the front.

Conditions on the fire became chaotic with the frontal passage. The strong winds created fire whirls, flying debris and also blew down several trees. The observer indicated that at least 2 crews would have been in imminent danger had they remained on the fire.

