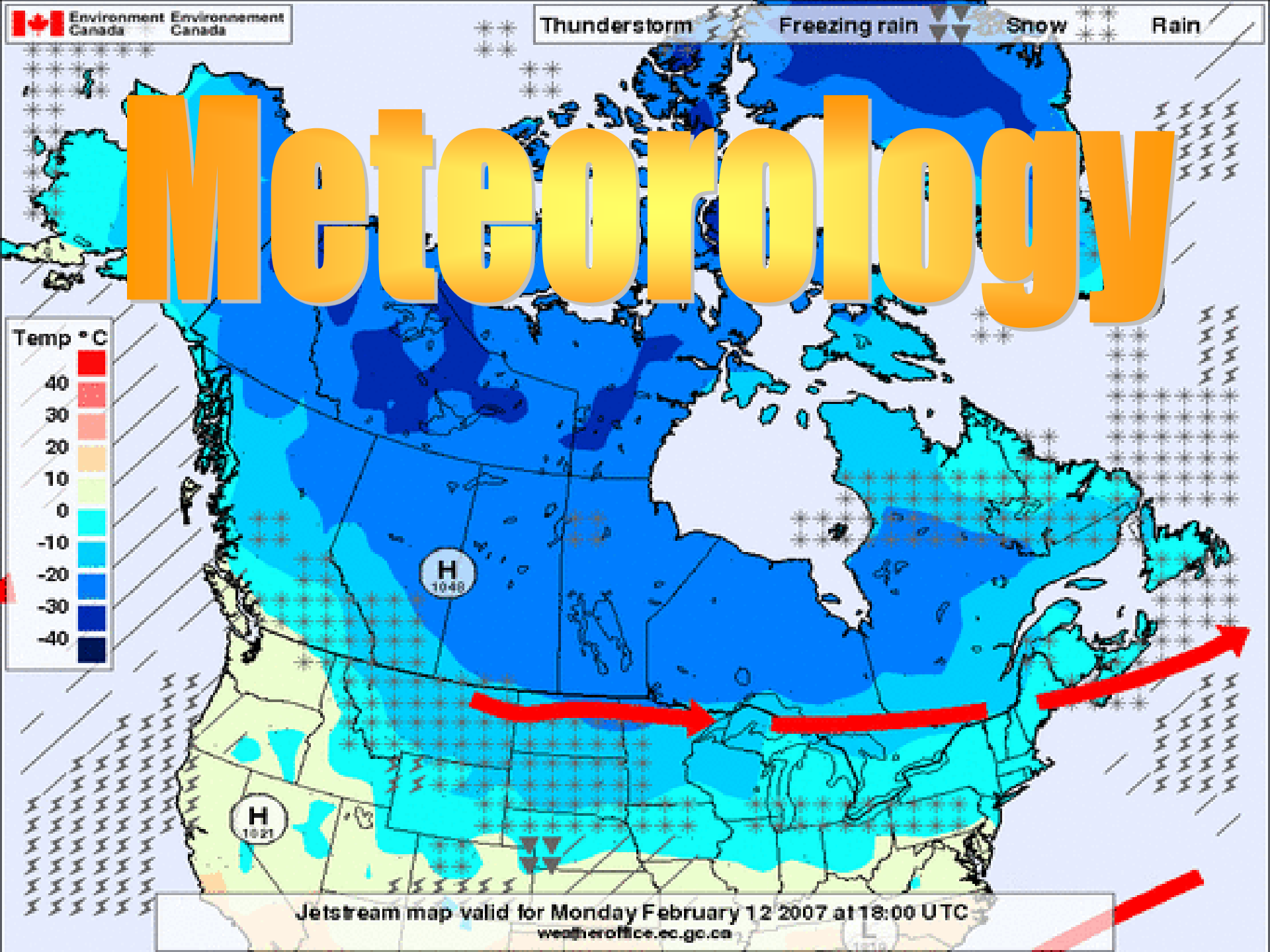
Environment Canada Environnement Canada
Thunderstorm
Freezing rain
Snow
Rain
Meteorology
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-40
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1048
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1021
Jetstream map valid for Monday February 12 2007 at 18:00 UTC
weatheroffice.ec.gc.ca

This lesson is based on the
Glider Pilot License Study and
Reference Guide (TP 876E)

SECTION 3: METEOROLOGY

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.1 Composition and Physical Properties
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.3 Standard Atmosphere
.4 Density and Pressure
.5 Mobility
.6 Expansion and Compression

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.6 Isobars
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.2 Density Altitude
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.2 Aviation Weather Briefing Service (AWBS)
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.4 Pilots Automatic Telephone Weather Answering Service (PATWAS)
.5 Transcribed Weather Broadcasts (TWB)

3.17 AVIATION WEATHER REPORTS

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.4 Terminal Area Forecasts (TAF)
.5 Upper Level Winds and Temperature Forecasts (FD) – Up to 9,000 feet AGL.
6 Significant In-flight Weather Warning Message (SIGMET)

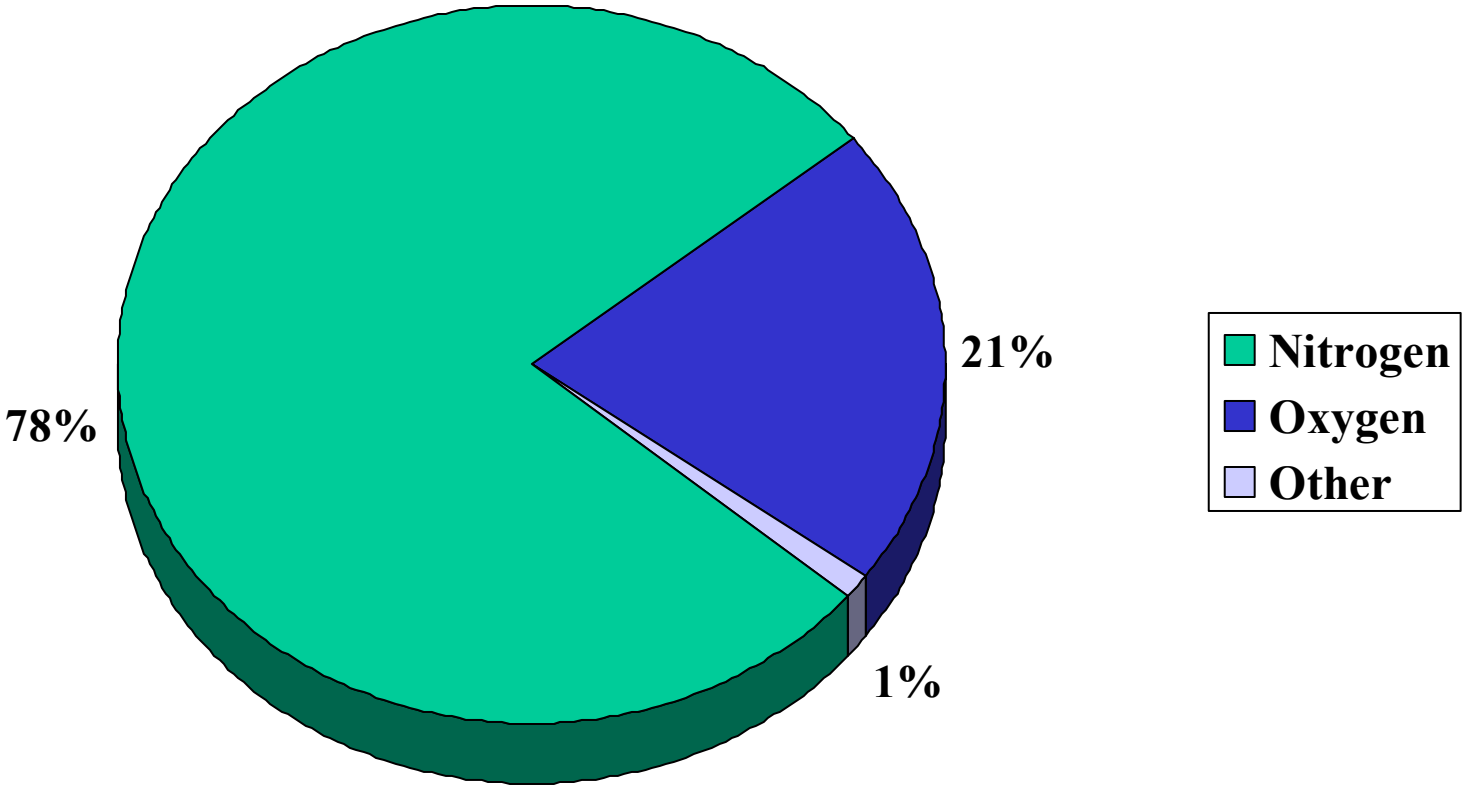
3.19 WEATHER MAPS AND PROGNOSTIC CHARTS

.1 Times Issued/Validity Periods
.2 Symbols/Decoding
.3 Surface Weather Map

Key Facts to Keep in Mind

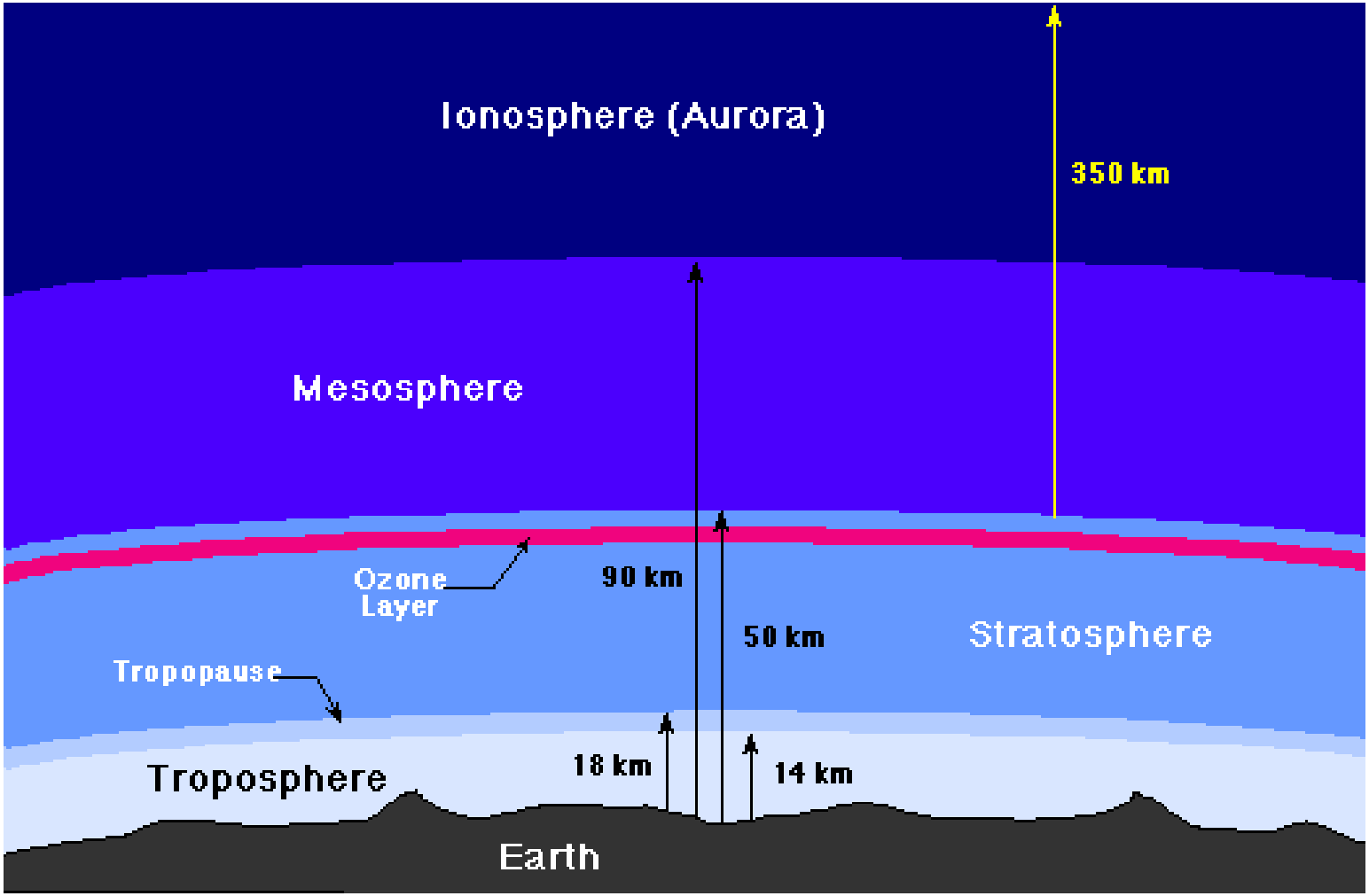
- All clouds are caused by rising air.
- Warm air can hold more water vapour than cold air.
- On average, the temperature drops by 2 C for every 1,000’ in elevation.
- Most weather phenomena are due to adiabatic process rather than heat transfer.

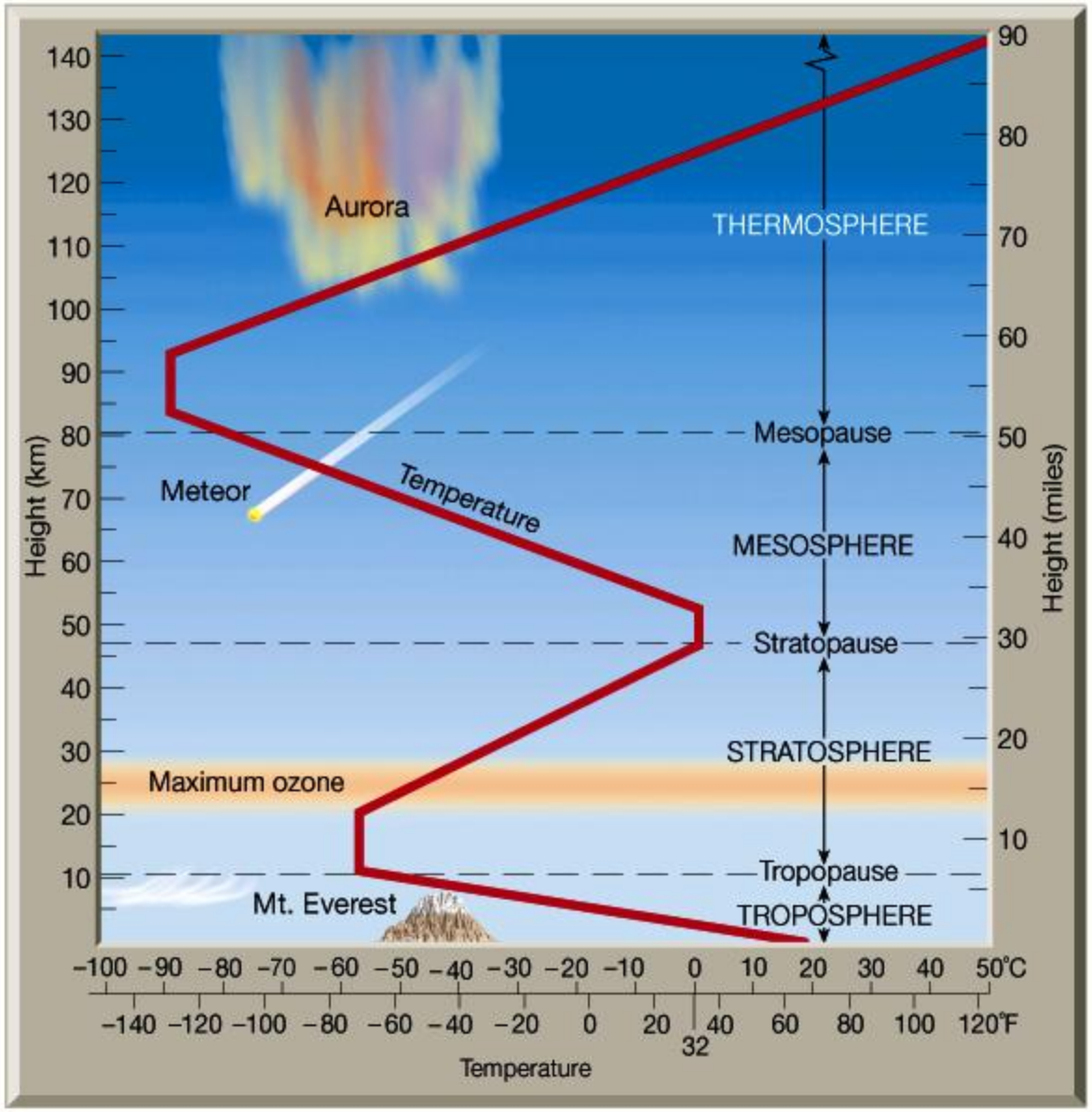
Composition of the Earth's Dry Atmosphere by Volume



Other Gases: argon 0.93%, carbon dioxide 0.036% and other gases. (Not shown: Water vapour 0% to 4%)

Divisions of the Earth's Atmosphere




Aurora
THERMOSPHERE
Mesopause
Meteor
Temperature
MESOSPHERE
Stratopause
STRATOSPHERE
Maximum ozone
Tropopause
Mt. Everest
TROPOSPHERE
Height (km)
Height (miles)
140
130
120
110
100
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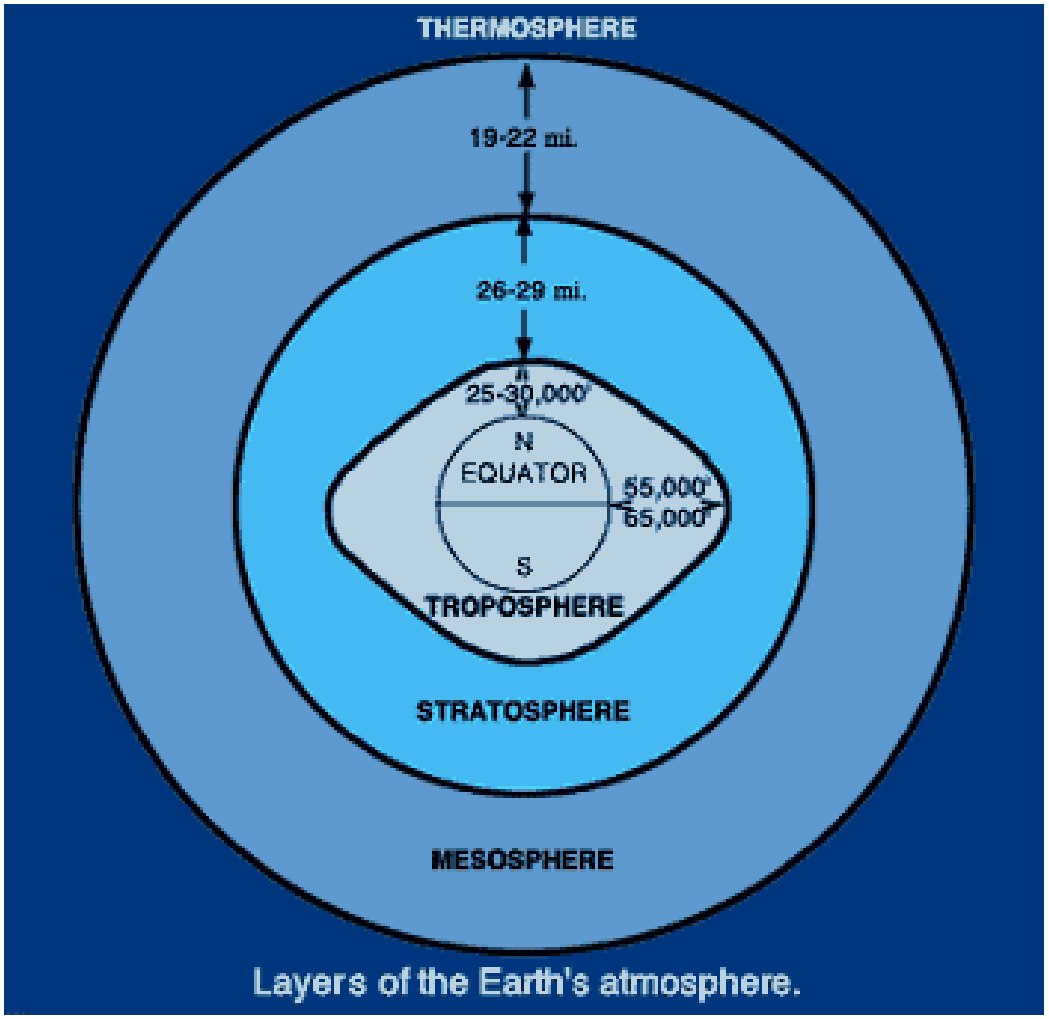
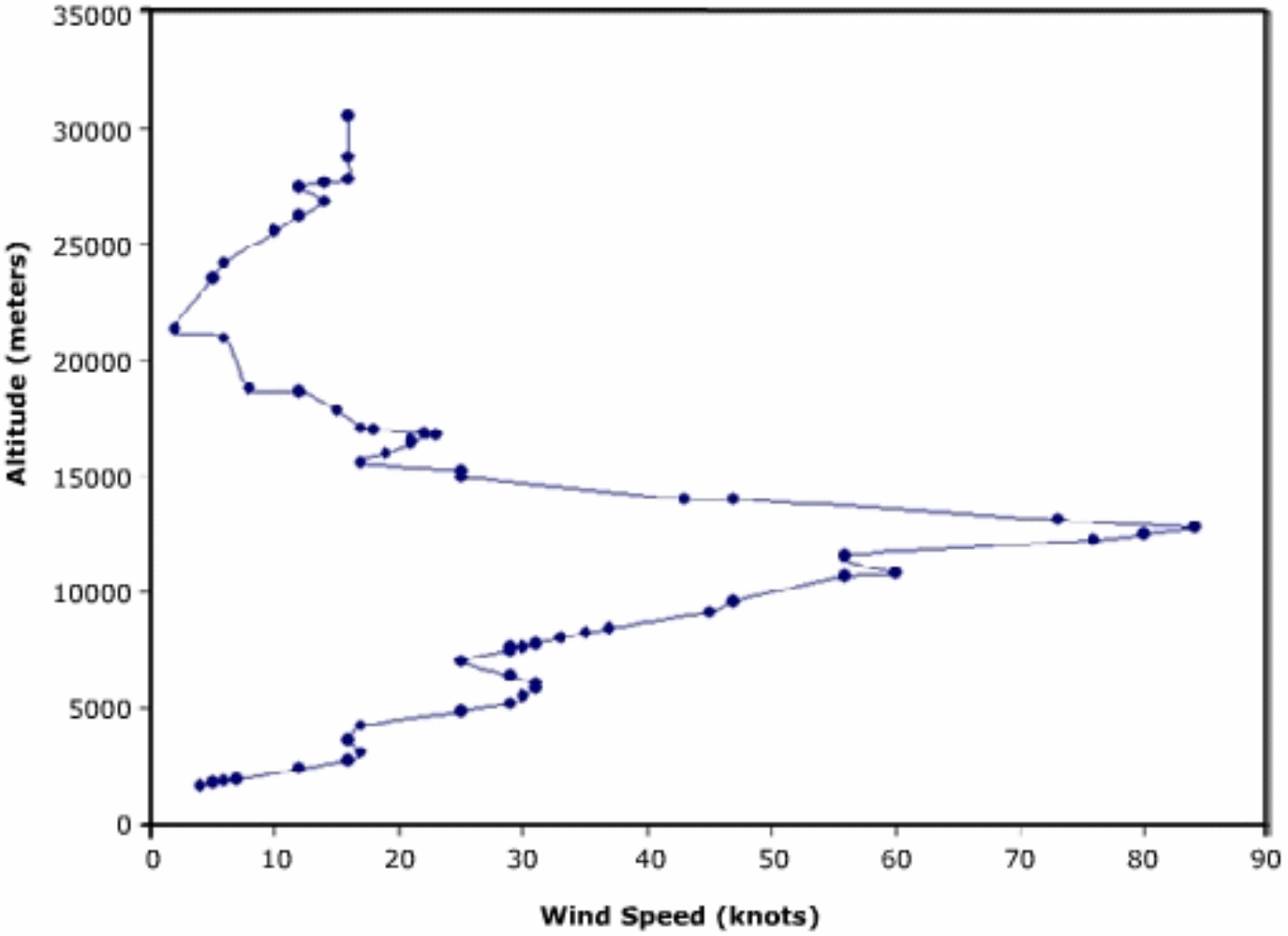
10
−100 −90 −80 −70 −60 −50 −40 −30 −20 −10 0 10 20 30 40 50°C
−140 −120 −100 −80 −60 −40 −20 0 20 40 60 80 100 120°F
32
Temperature

The Height of the Troposphere



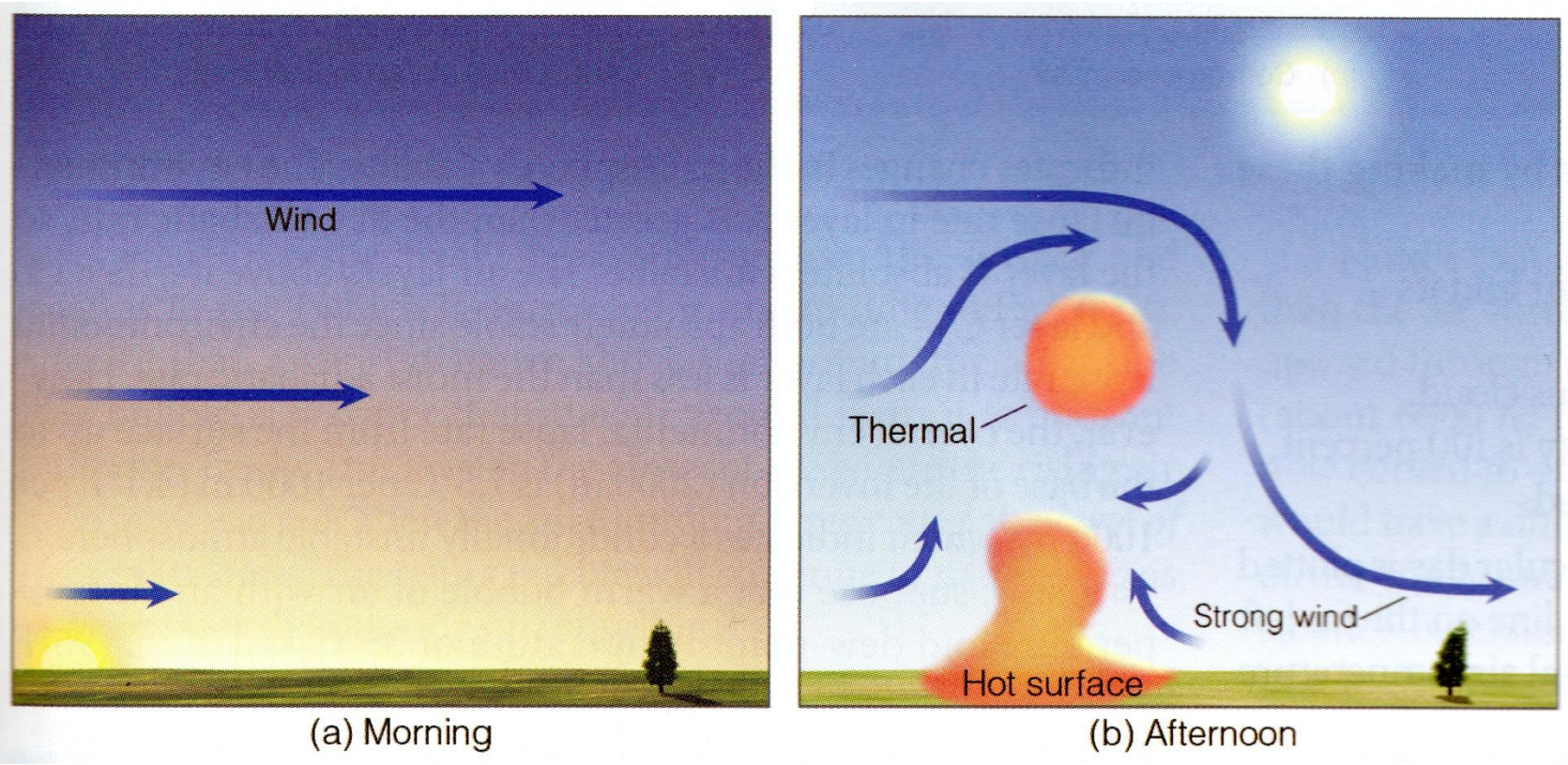
The troposphere is highest at the equator and lowest at the poles

Wind Speed



The Wind is typically fastest at the upper part of the troposphere.

Why is it often windy during the day?



ICAO Standard Atmosphere

- The air is a perfectly dry gas.
- a mean sea level pressure of 29.92 inches of mercury.
- a mean sea level temperature of 15º C.
- the rate of decrease of temperature with height is 1.98 º C per 1000 feet (Standard lapse rate).

The Standard Atmosphere

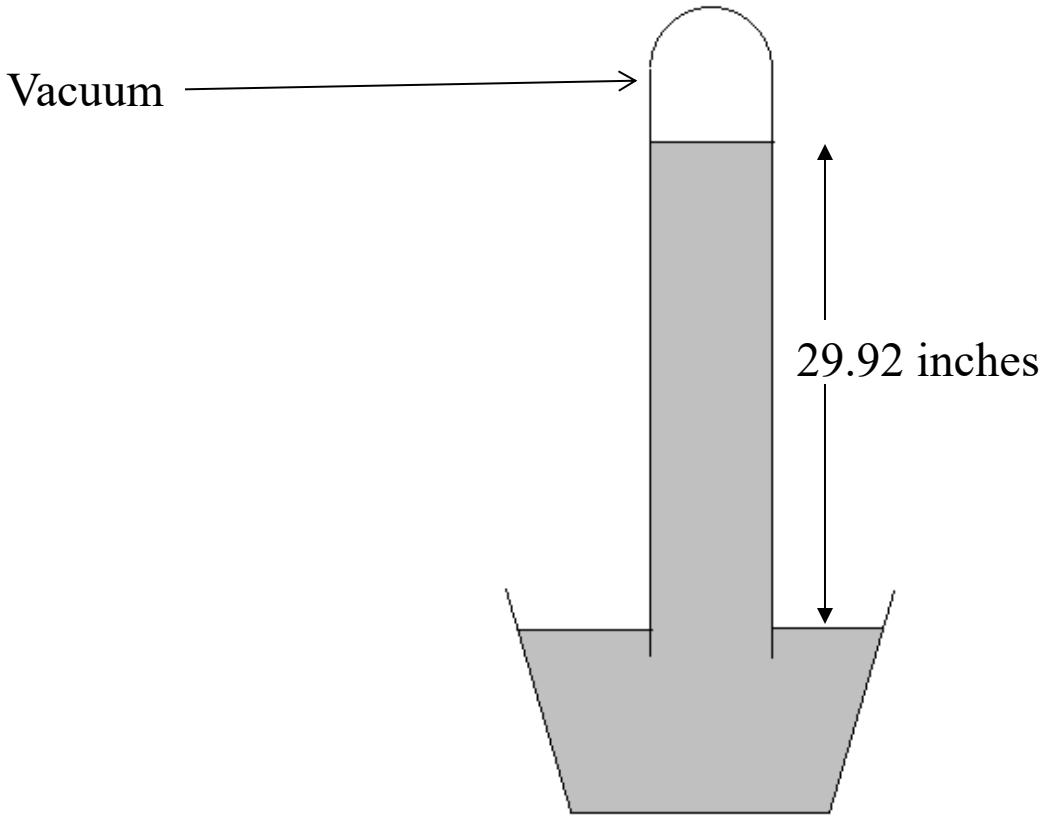
Altitude	**Temperature**	**Pressure**			
50,000ft	**-56.5**	**3.44**	**116**	0.15	1.7
40,000ft	**-56.5**	**5.54**	**187**	0.24	2.7
30,000ft	**-44.4**	**8.88**	**300**	0.37	4.4
20,000ft	**-24.6**	**13.75**	**465**	0.53	6.8
15,000ft	**-14.7**	**16.88**	**572**	0.63	8.3
10,000ft	**-4.8**	**20.58**	**697**	0.74	10.1
5,000ft.	**5.1**	**24.89**	**843**	0.86	12.2
Sea Level	**15.0**	**29.92**	**1013**	1	14.7
Altitude in feet	**Temperature in degrees Celsius**	**Pressure in inches of mercury (Hg.)**	**Millibars (Hectopascals)**	Relative Density (Atmospheres)	Pounds per square inch

Pressure can be expressed in different measures.

Compression of the atmosphere

The weight of the air above compresses the air below.

Principle of the Mercury Barometer

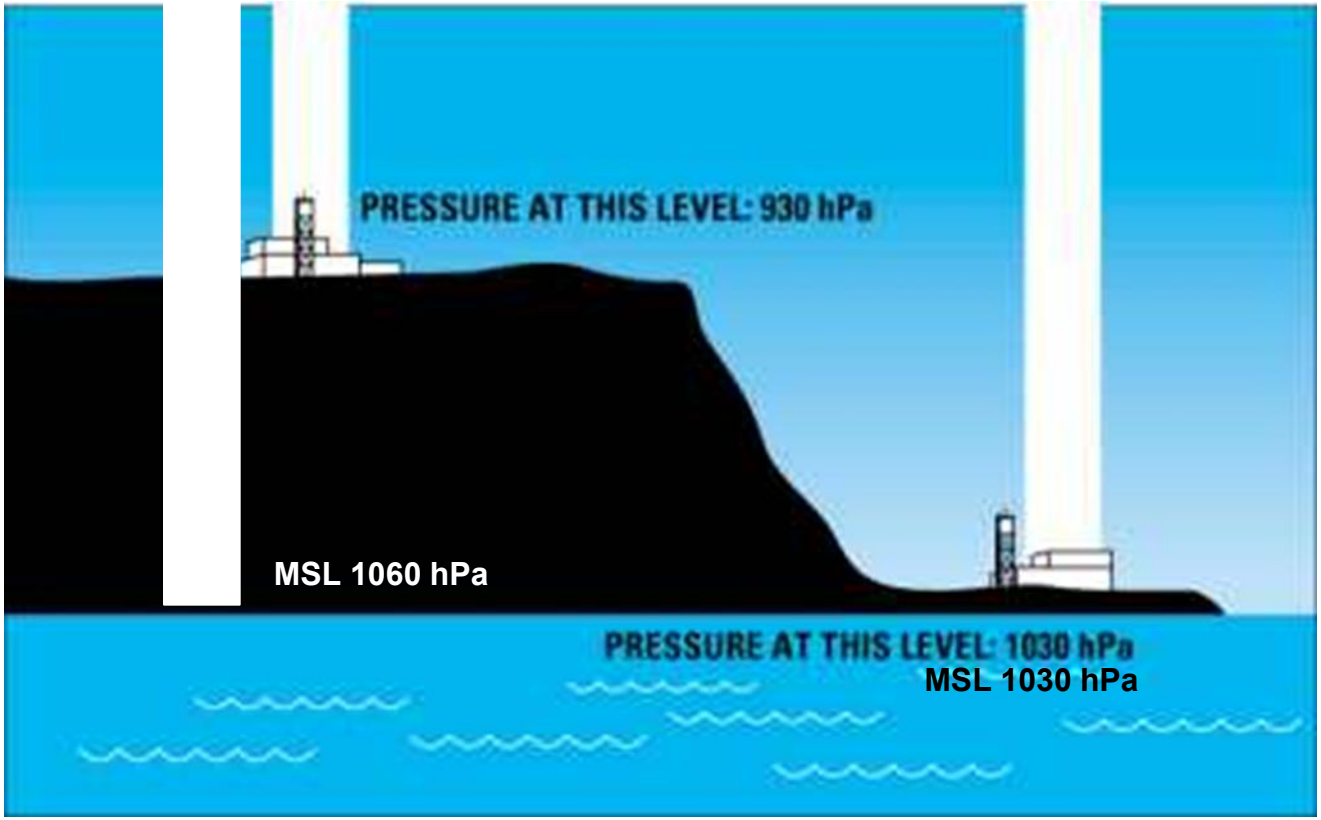


The pressure caused by the weight of the air pushes the mercury up

Station Pressure, Mean Sea Level Pressure and Altimeter Setting Pressure

- **Station pressure** is the actual atmospheric pressure of the observing station.
- **Mean sea level (MSL) pressure** at the observing station is achieved by adding an imaginary column or air down to mean sea level (taking into account local temperature for 12 hours before). It estimates the pressure that would exist at sea level at a point directly below the station using a temperature profile based on temperatures that actually exist at the station. In the METAR – TAF, it is expressed in hectopascals.
- **Altimeter setting pressure** is used to set the sub-scale of an altimeter. It is station pressure adjusted to mean sea level using the ICAO standard 15ºC and 1.98 ºC per 1000 feet lapse rate. It is measured in inches of Hg.

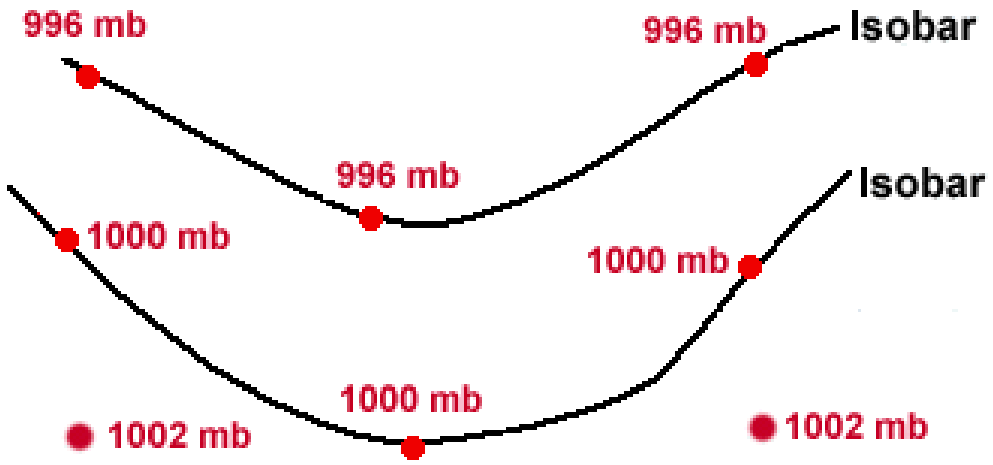
Station Pressure and Mean Sea Level Pressure

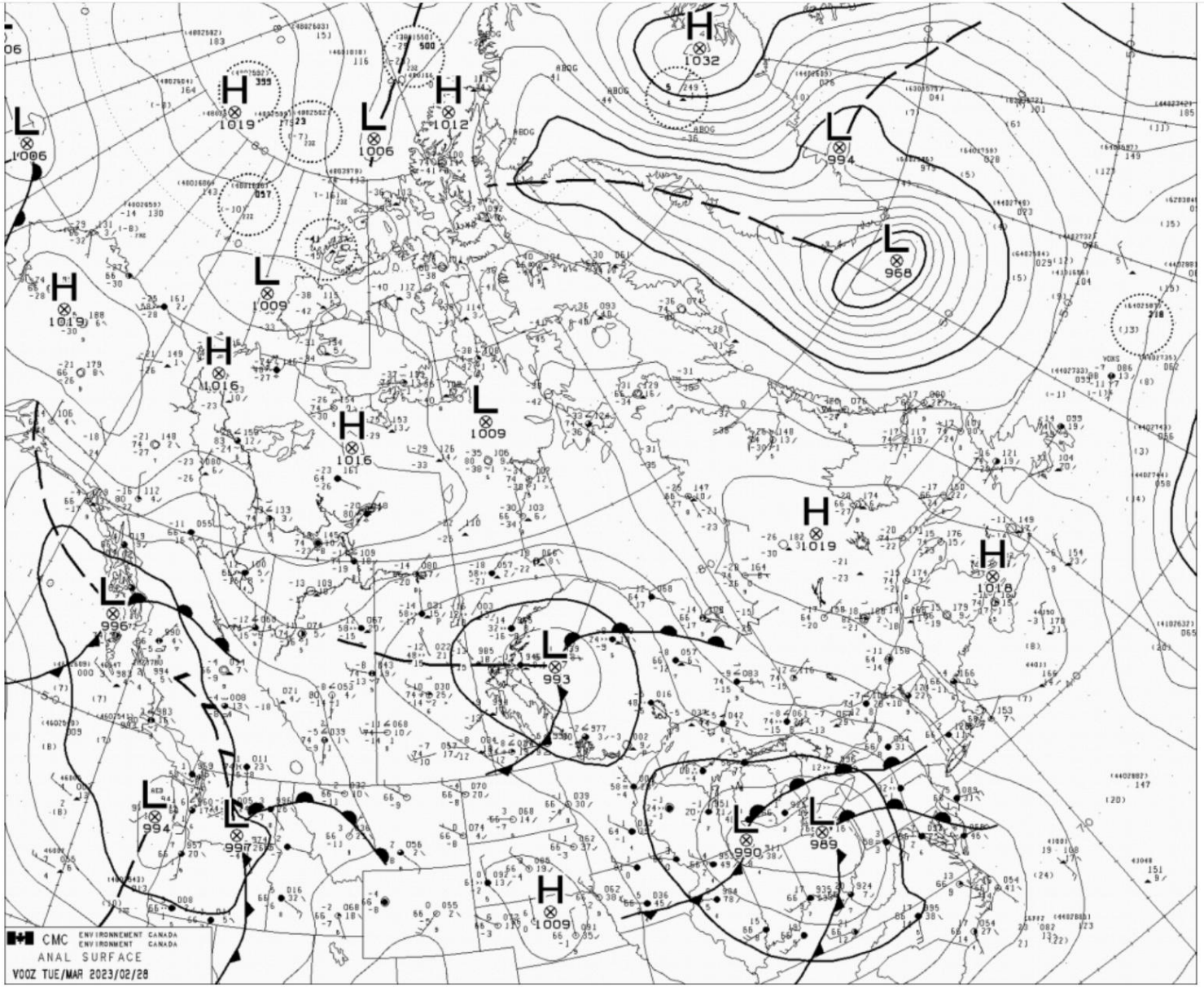


Station pressure is the actual pressure of the air at the observing station
Mean sea level pressure is station pressure adjusted by adding an imaginary column of air down to the sea level. Weather reports are usually given in MSLP, not the actual local atmospheric pressure.

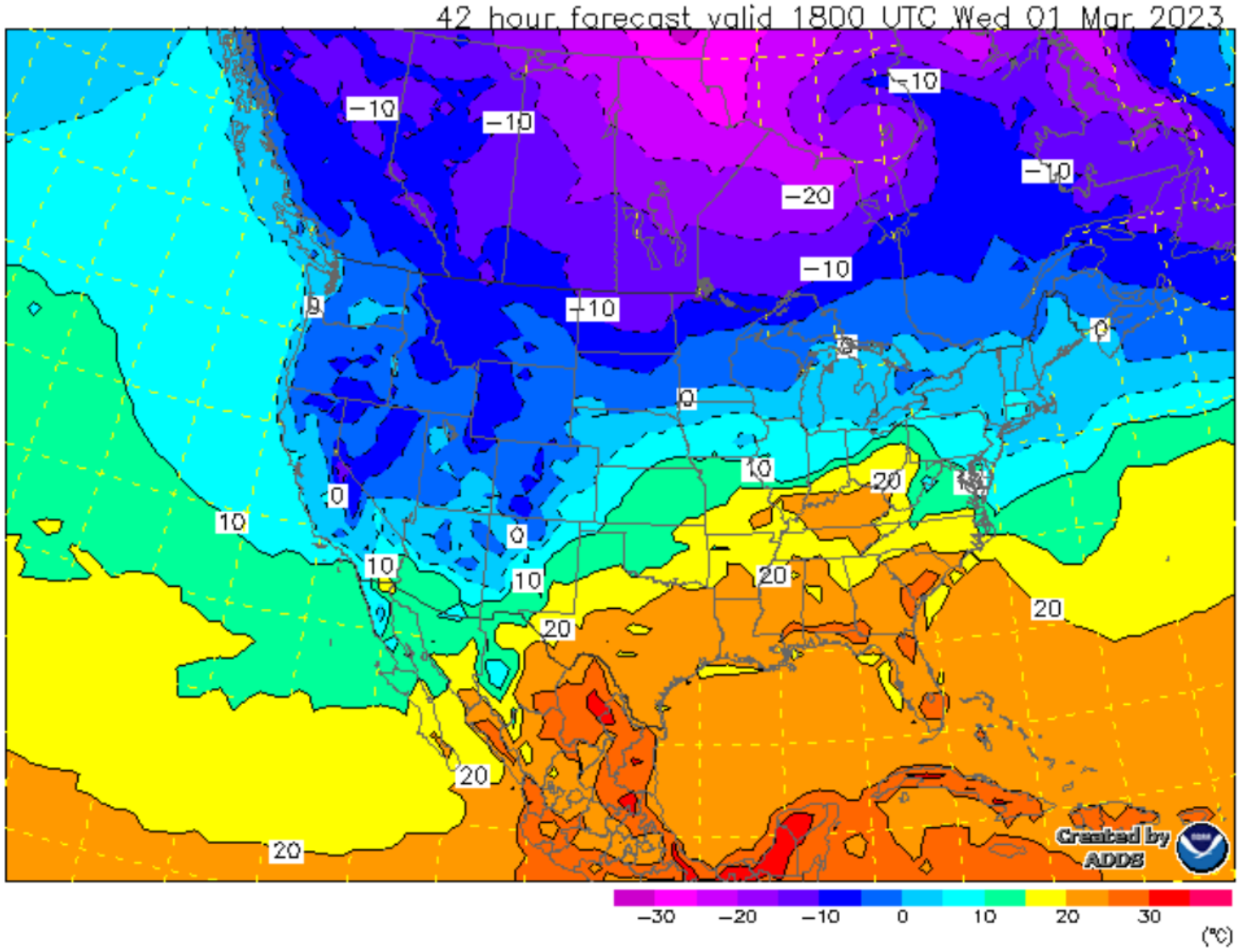
Isobars

- The lines that join, on a weather map, areas of equal barometric pressure are called isobars.




CMC ENVIRONNEMENT CANADA
ENVIRONMENT CANADA
ANAL SURFACE
VOOZ TUE/MAR 2023/02/28

Isobars


42 hour forecast valid 1800 UTC Wed 01 Mar 2023
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30
(°C)

Isotherm

Resetting the Altimeter

- Because air pressure varies with location:
  - When cross country flying, call stations and ask for altimeter setting.
  - This should be done at every 100 nautical miles or when the weather is changing.

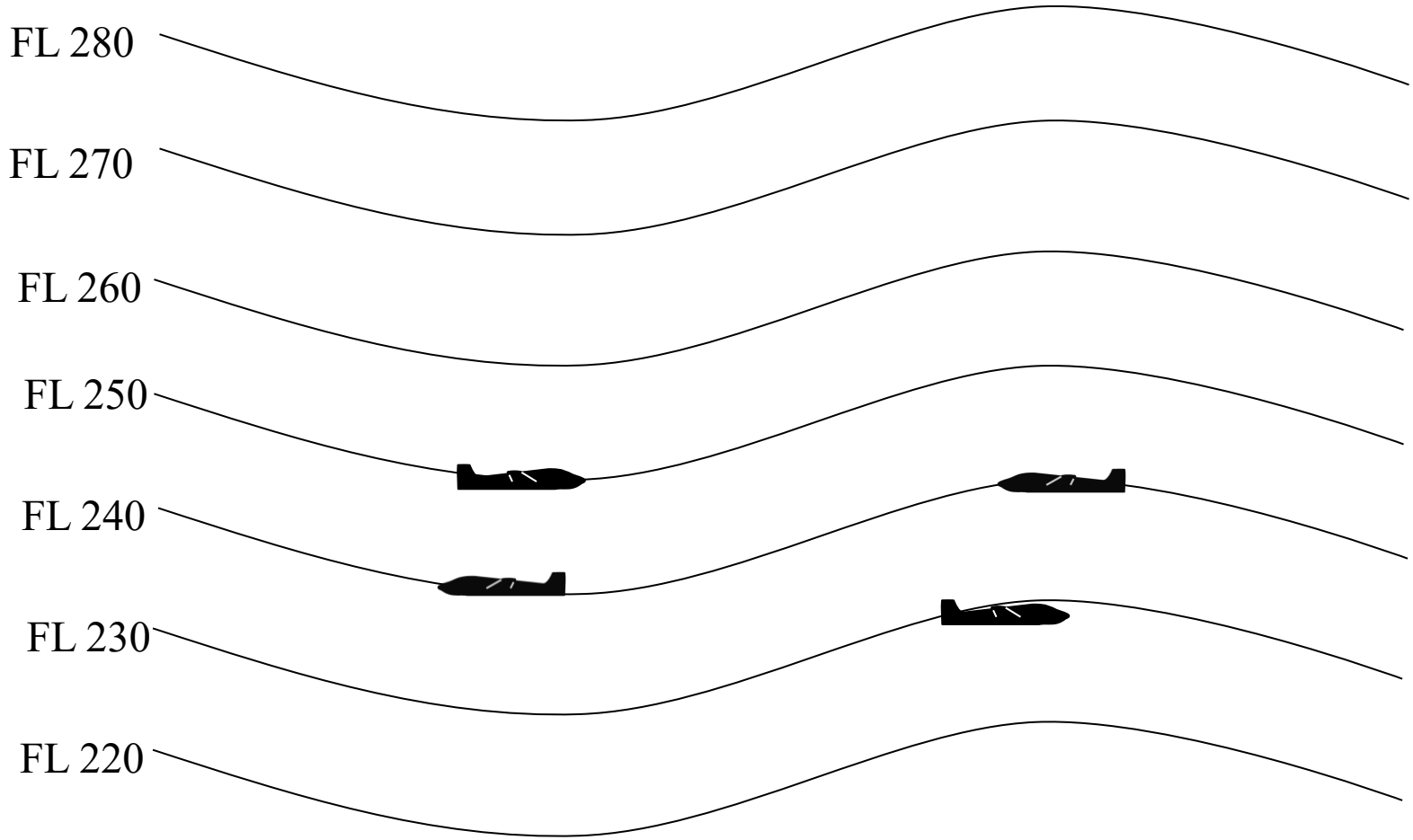
Altimeter

Pressure Altitude
Density Altitude

- When the altimeter's barometric scale is set to 29.92" Hg, the indicated altitude is called the pressure altitude.
- Density altitude is a measure of the density of the air. It is pressure altitude corrected for temperature. It is used to determine permissible take-off weights.

Flying at Flight Level

Based on Pressure Altitude



Determining Density Altitude

- The approximate density altitude can be found by this formula:
- Density altitude = Pressure altitude + 120 X (actual temperature - standard temperature at the pressure altitude)
  - Note: standard temperature at the altitude (pressure altitude) of the measurement.

Example for Calculating Density Altitude

An airport is at 2000 feet altitude.

You set the altimeter barometric scale to 29.92 Hg. The altimeter shows 1000 feet. This is pressure altitude.

The temperature is 8° C .

What is the density altitude?

First, determine the standard temperature: at pressure altitude of 1000, the standard temperature is 13° (a drop of 2 for every 1000 feet of altitude).

Density altitude = Pressure altitude + 120 X (actual temperature - standard temperature)

Density altitude = 1000 + 120 (8 – 13)

Density altitude = 1000 + 120 (– 5)

Density altitude = 1000 – 600

Density altitude = 400 feet

Review Questions

1. What should the temperature of standard air be at 2000 feet?

a) 19° C
b) 15° C
c) 11° C
d) 9° C

2. The tropopause is lower

a) in summer than in winter
b) over the equator than over the north pole.
c) over the north pole than over the equator.
d) south of the jet stream than north of it.

3. In which condition would the density altitude be the highest?

a) Airport at sea level, hot day and in a weather low.
b) Airport at sea level, cold day and in a weather high.
c) Airport at 5,000’, hot day and in a weather low.
d) Airport at 5,000’, hot day and in a weather high.

4. If the pressure altitude is 4,500 feet, and the temperature is 20°C, the density altitude will be nearest to

a) 7,300 feet.
b) 6,200 feet.
c) 5,400 feet.
d) 4,500 feet.

Solution to Question 4

First, determine the standard temperature at the pressure altitude. The standard temperature drops 2° for every 1,000'. So, at 4,500', the standard temperature is 15° - 9° = 6°C

Density altitude = Pressure altitude + 120 X (actual temperature - standard temperature)

Density altitude = 4,500 + 120 (20° - 6°)

Density altitude = 4,500 + 120 (14°)

Density altitude = 4,500 + 1680

Density altitude = 6180 feet

5. An airport is 1000 feet above sea level. When set to 29.92 Hg, the altimeter reads 2000 feet. This is pressure altitude. The outside temperature reads 20 Celsius. What is the density altitude?

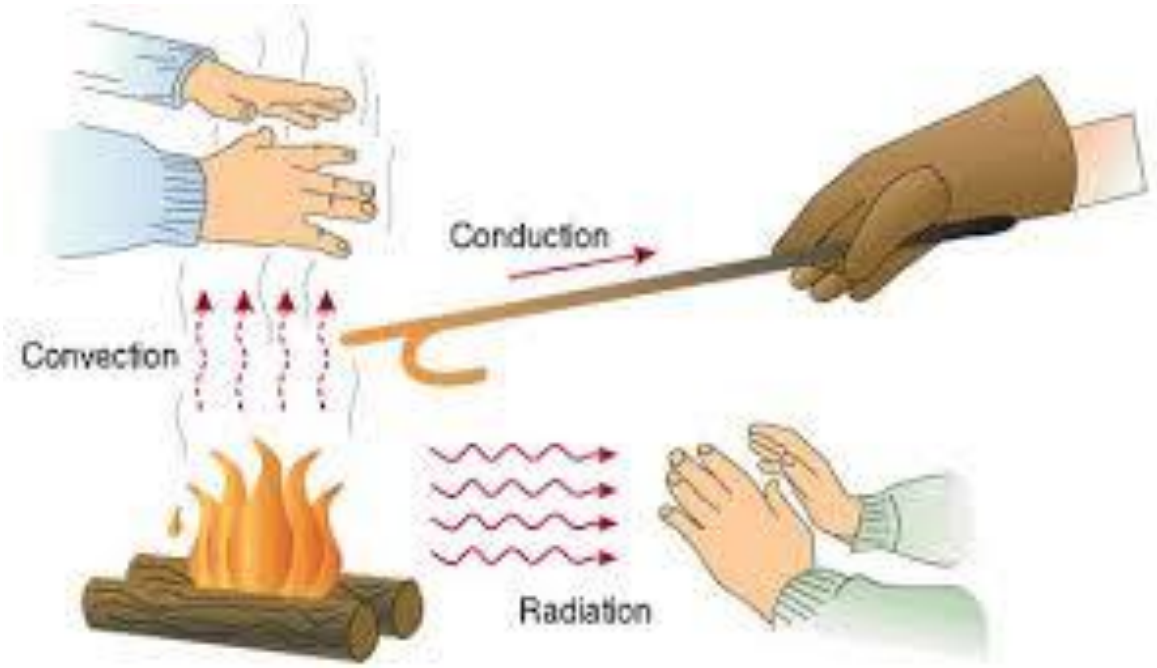
a) 3080 feet
b) 2840 feet
c) 3000 feet
d) 2000 feet

6. A plane altimeter indicates 4000 feet when it is set to pressure altitude. The outside temperature reads 7 Celsius. What is the density altitude?

a) 3600 feet
b) 4000 feet
c) 3200 feet
d) 4800 feet

Heat transfer

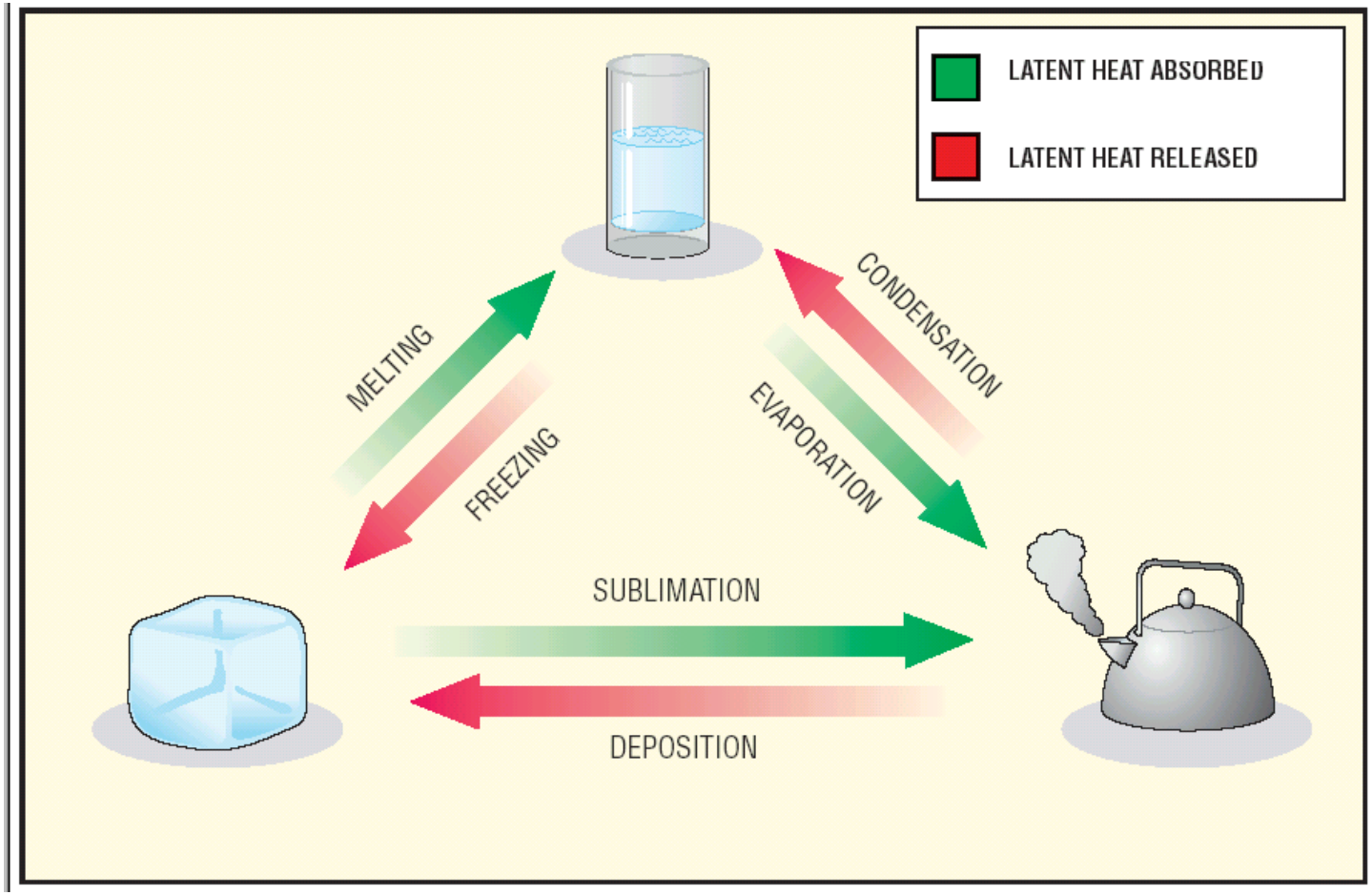
- Radiation
- Conduction
- Convection



Latent Heat

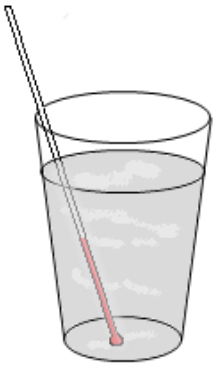
- The quantity of heat absorbed or released by a substance undergoing a change of state, such as ice changing to water or water to steam, at constant temperature and pressure. (also called heat of transformation)

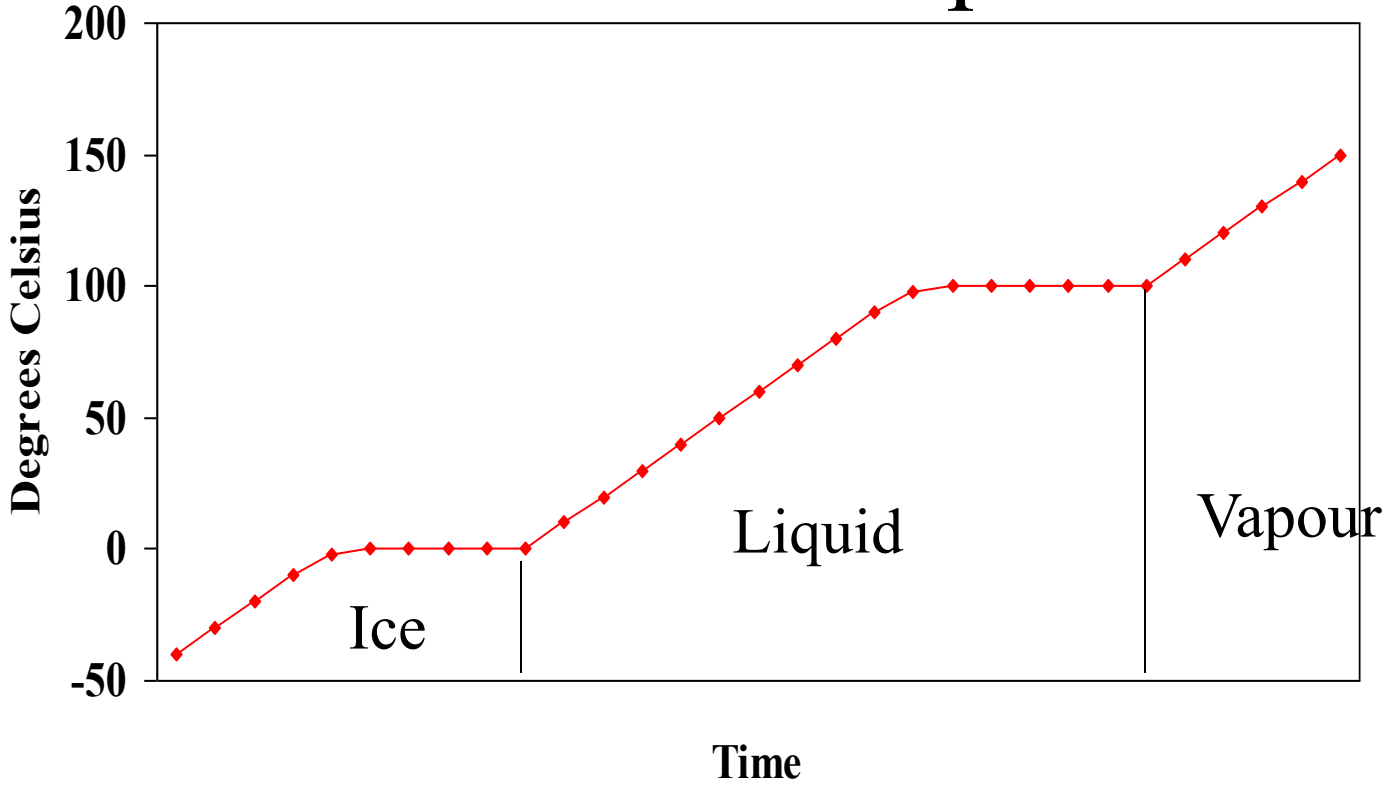
Phase Transitions



Actually, the kettle does not illustrate the vapour state very well; vapour is invisible.

A Container of Ice in an Oven: Latent Heat Absorption



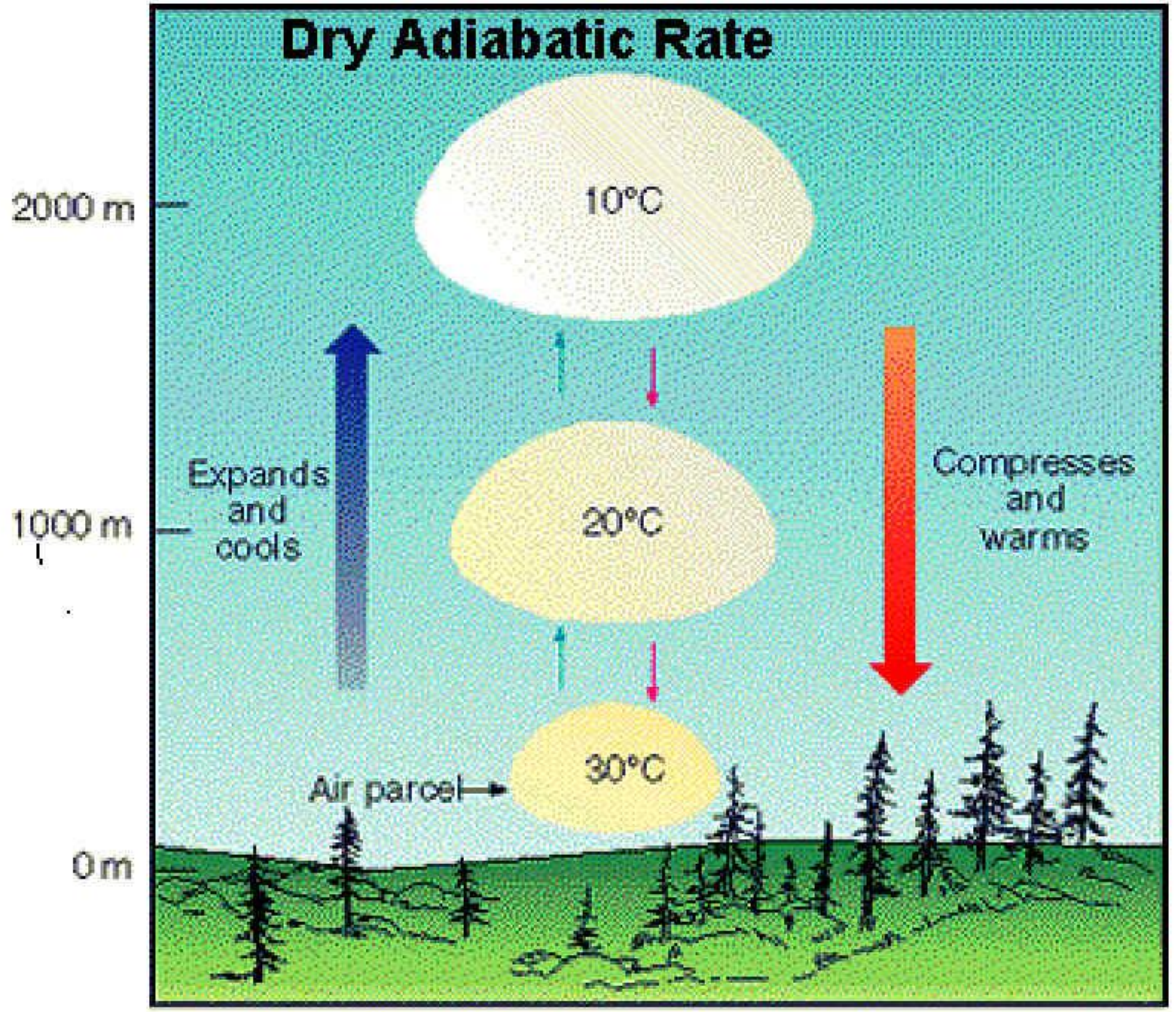


This chart shows over time the temperature of a thermometer in a container of solid ice placed in a 150°C oven. The temperature stops rising at two stages because the energy is absorbed to undergo a change of phase.

Adiabatic Heating and Cooling

- Temperature change takes place without transfer of heat.
  - Subsidence heating because of compression (adiabatic heating)
  - Cooling due to expansion (adiabatic cooling)
- Most weather phenomena are due to adiabatic process rather than heat transfer.

Adiabatic Heating and Cooling



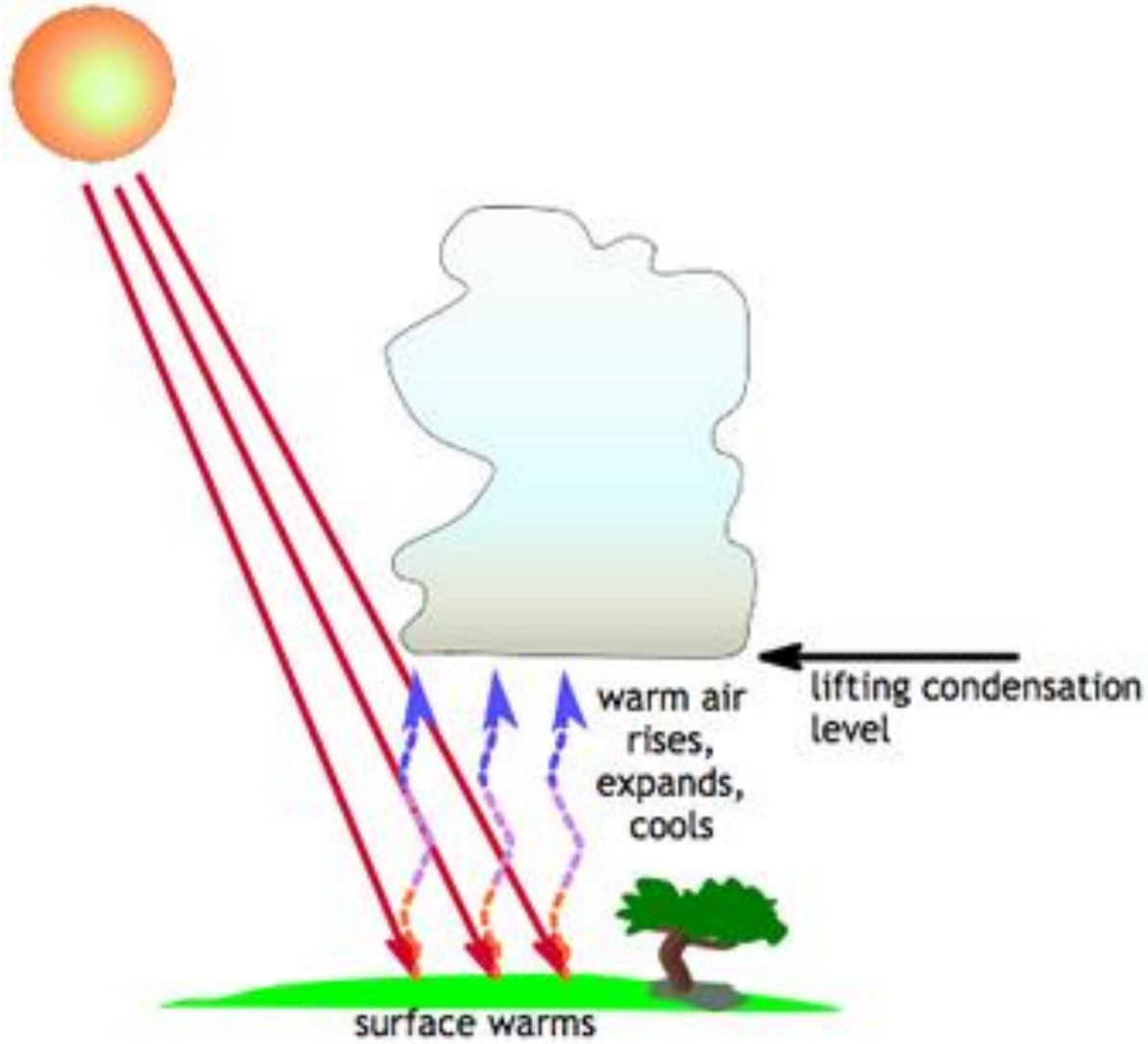
Heating of the Atmosphere

The atmosphere can get warmer in two ways:

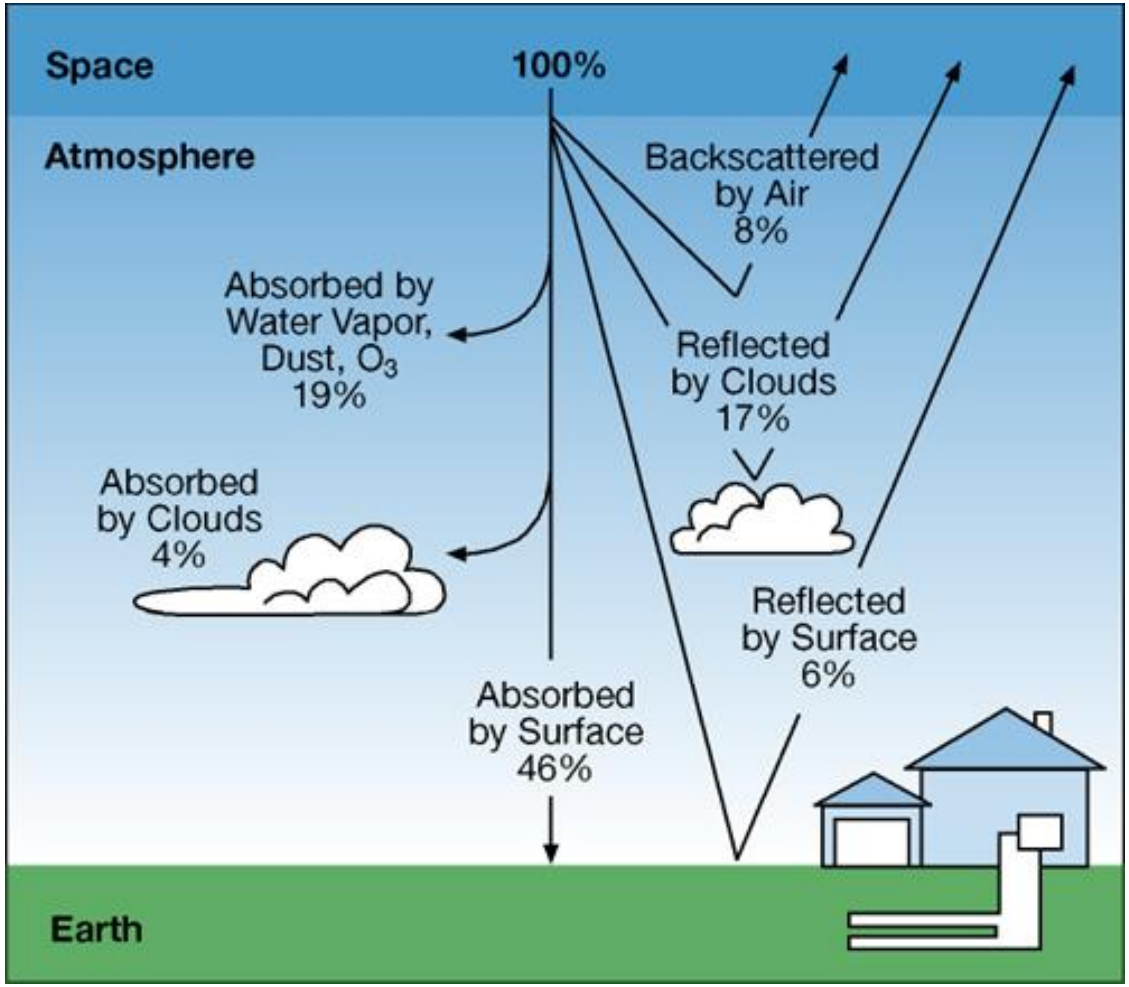
1) Through the processes of convection (and some radiation). The atmosphere is mainly heated from below; the sun heats the ground and the heat is passed on to the atmosphere

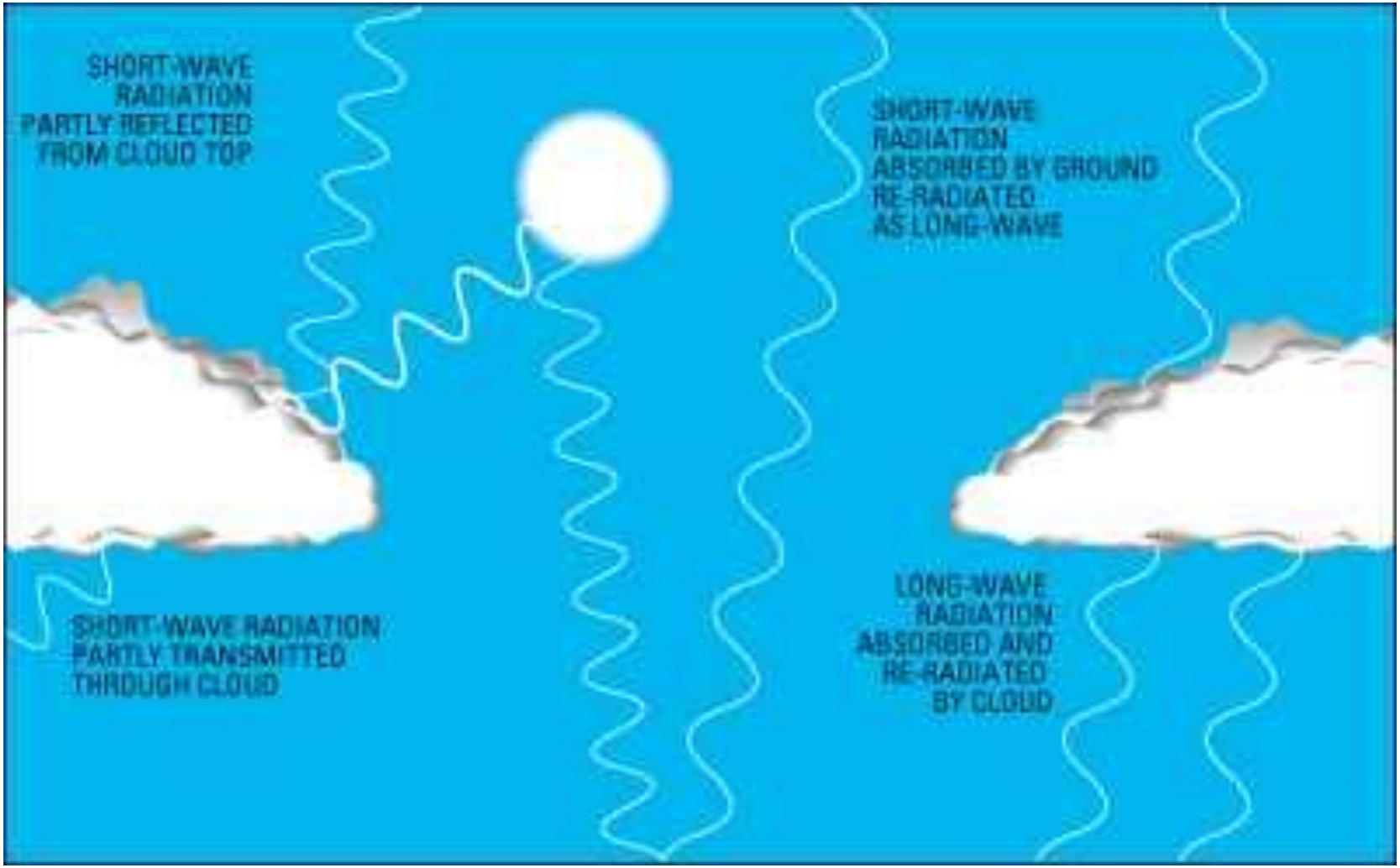
2) Compression (adiabatic heating)

Heating of Air Through Convection

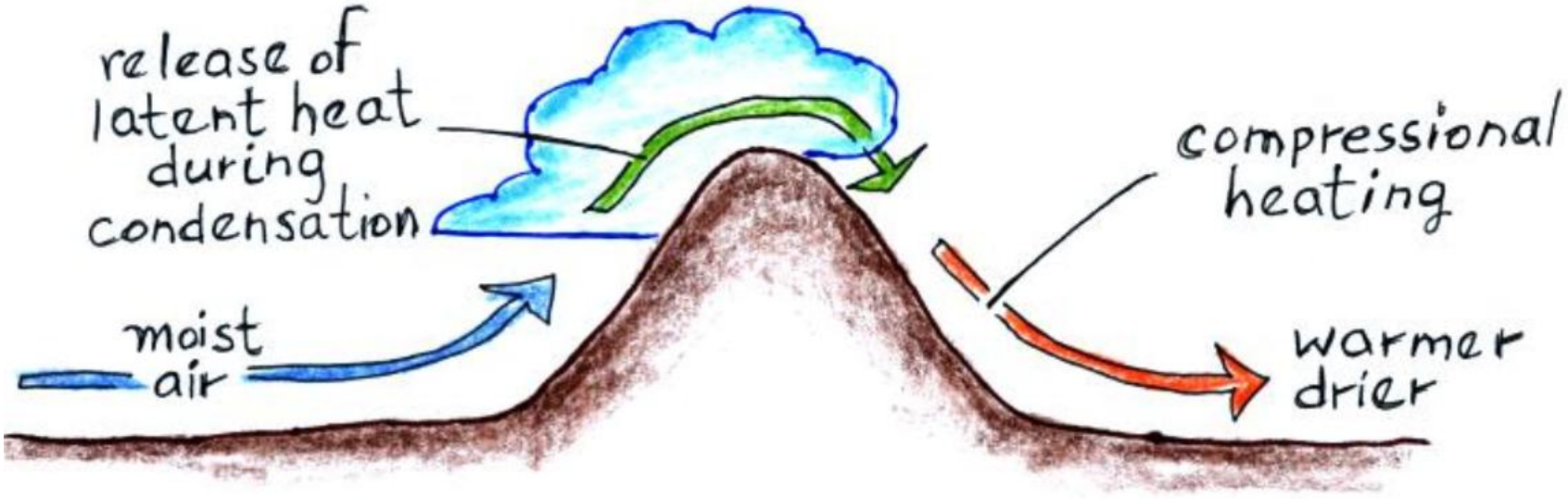


The Sun's Radiation




SHORT-WAVE
RADIATION
PARTLY REFLECTED
FROM CLOUD TOP
SHORT-WAVE
RADIATION
ABSORBED BY GROUND
RE-RADIATED
AS LONG-WAVE
SHORT-WAVE RADIATION
PARTLY TRANSMITTED
THROUGH CLOUD
LONG-WAVE
RADIATION
ABSORBED AND
RE-RADIATED
BY CLOUD

Chinook Winds



Cooling of the atmosphere

- The atmosphere (and the earth) cool through the process of radiation.
- Expansion (Adiabatic cooling)
- Advection Cooling

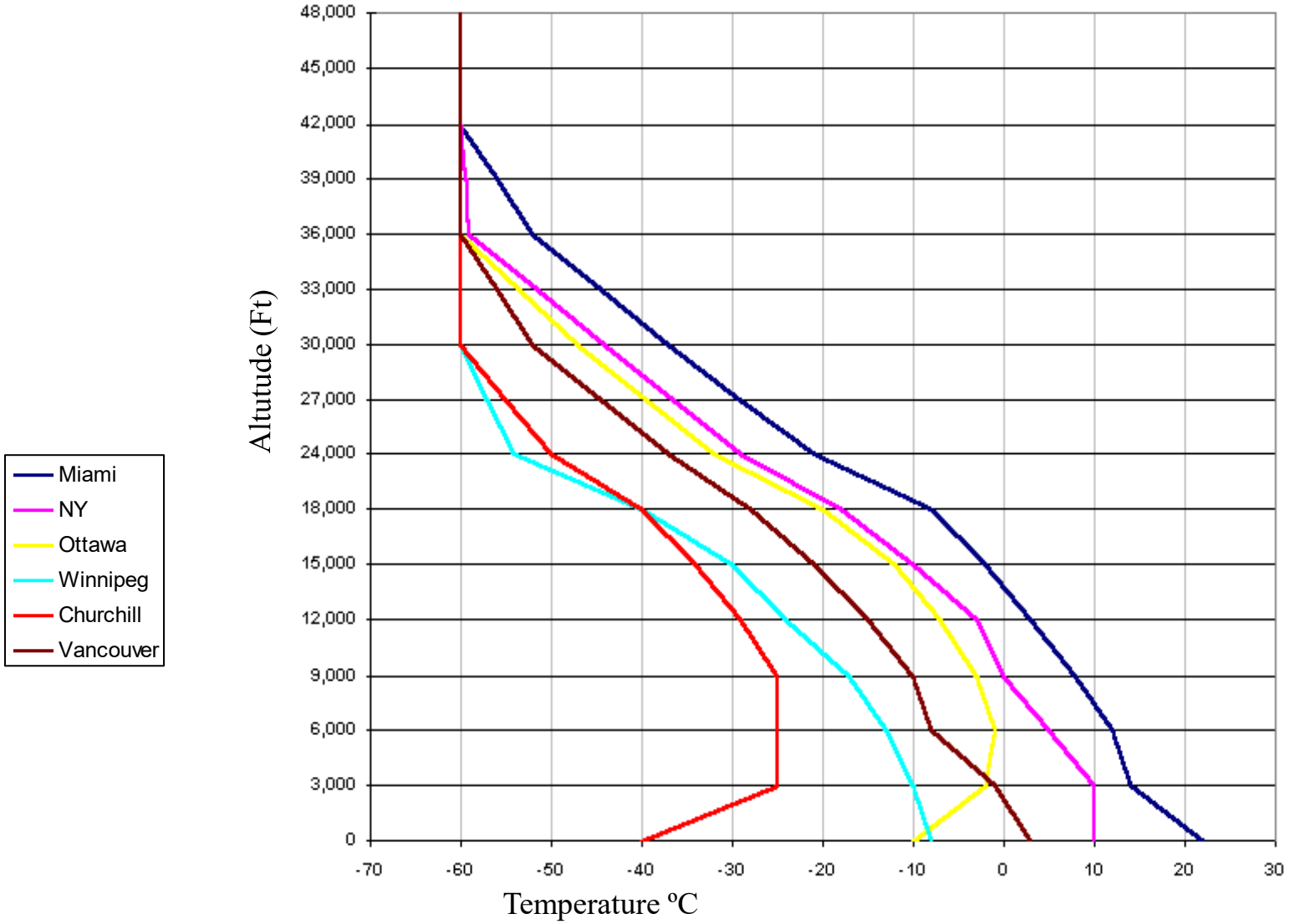
Relative Humidity / Dewpoint

- Relative humidity is the ratio of actual vapour present in the air to the amount of vapour when the air is saturated.
- Dew point is the temperature to which unsaturated air must be cooled to become saturated.

Lapse Rates

- Standard lapse rate: 1.98ºC per 1000 ft.
- Environmental Lapse Rate: actual rate of decrease of temperature with height.
- Dry Adiabatic Lapse Rate (Cooling rate of a rising dry parcel of air: 3 ºC per 1000 ft.
- Saturated Adiabatic Lapse Rate (Cooling rate of a rising saturated parcel of air: 1.5 ºC per 1000 ft.

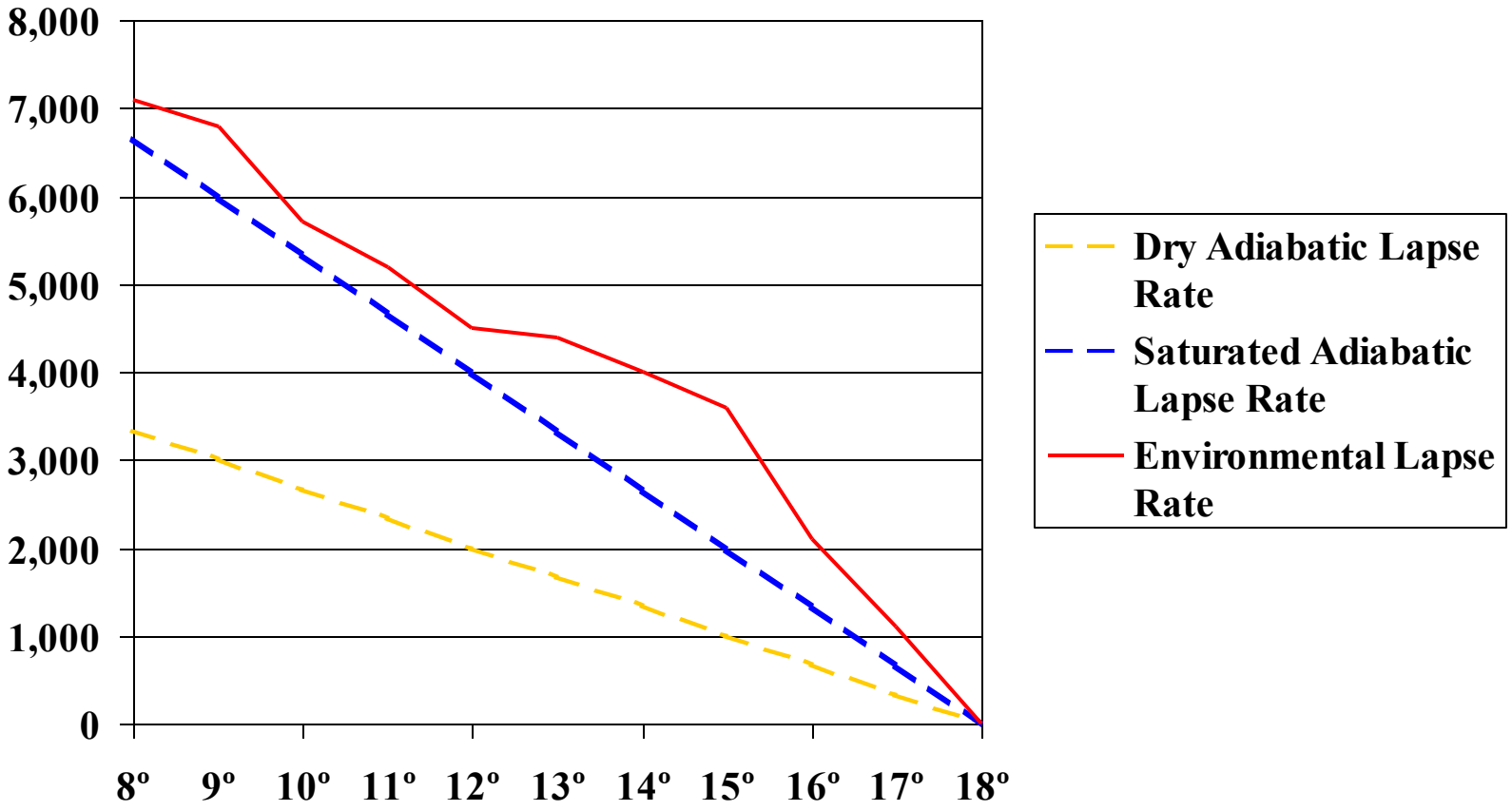
Environmental lapse rates vary - depending on weather conditions



Towering Cumulonimbus

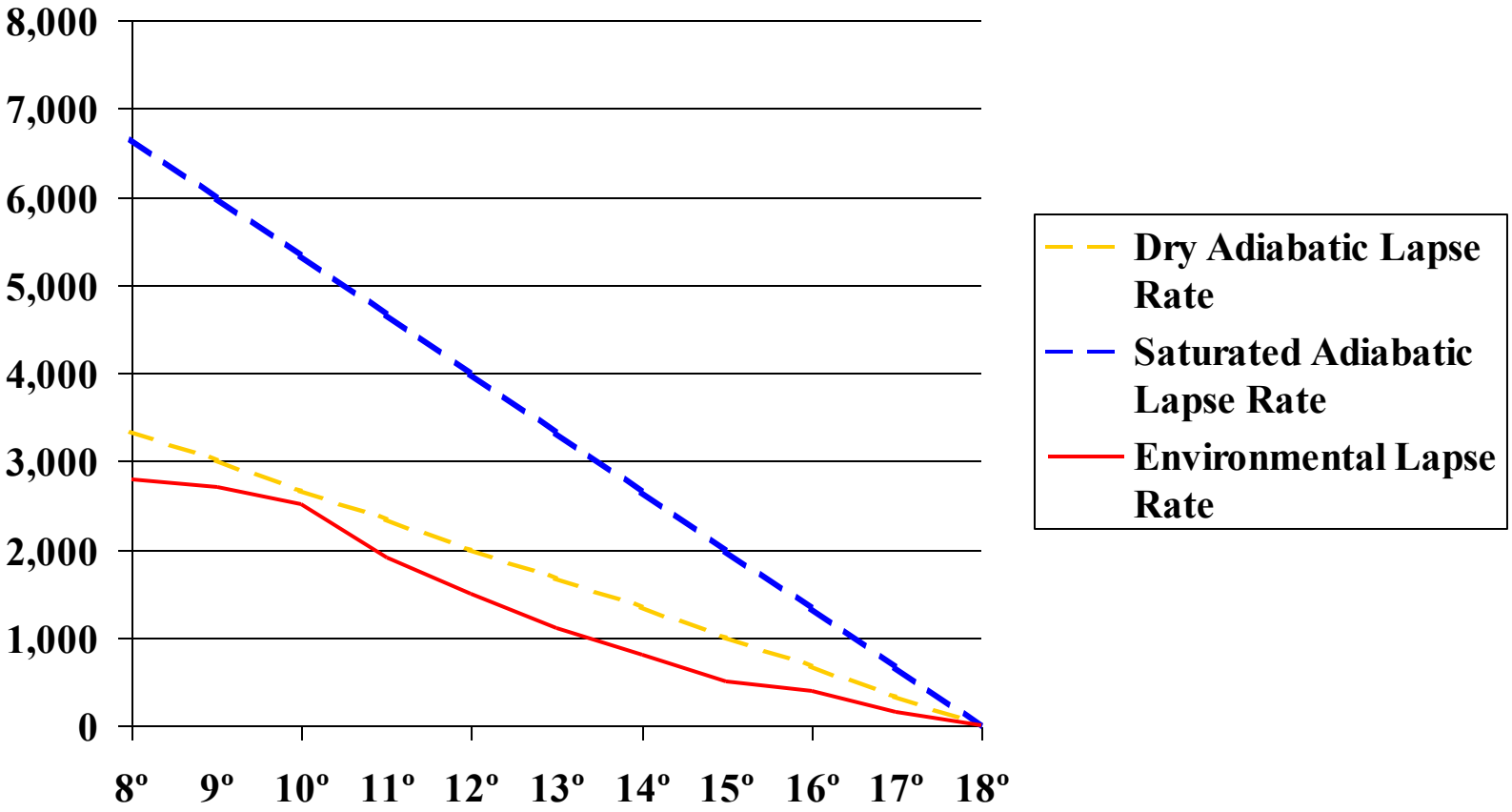
Convective Overshoot

Absolute Stability



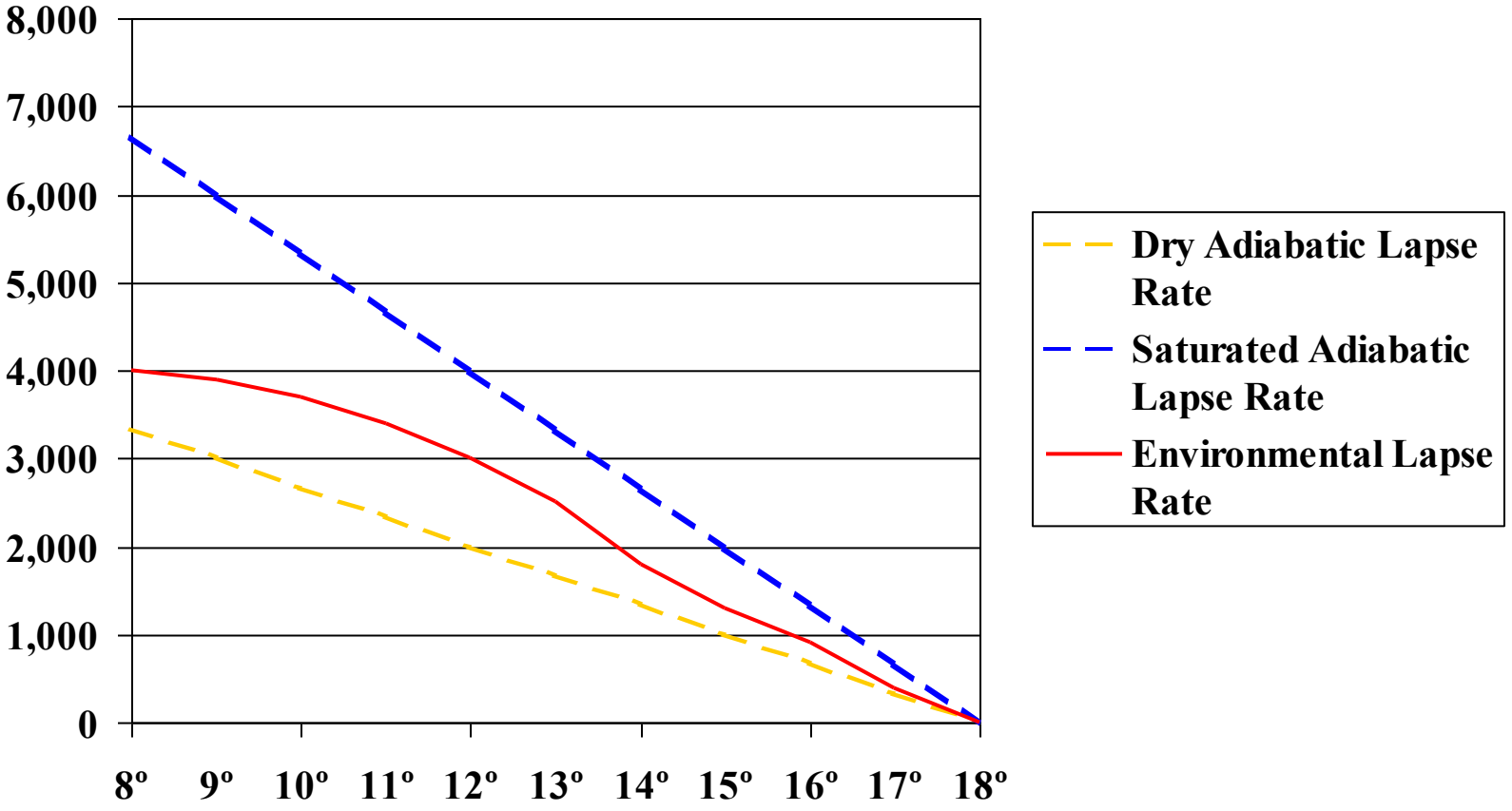
The air mass temperature decreases rather slowly with altitude.

Absolute Instability



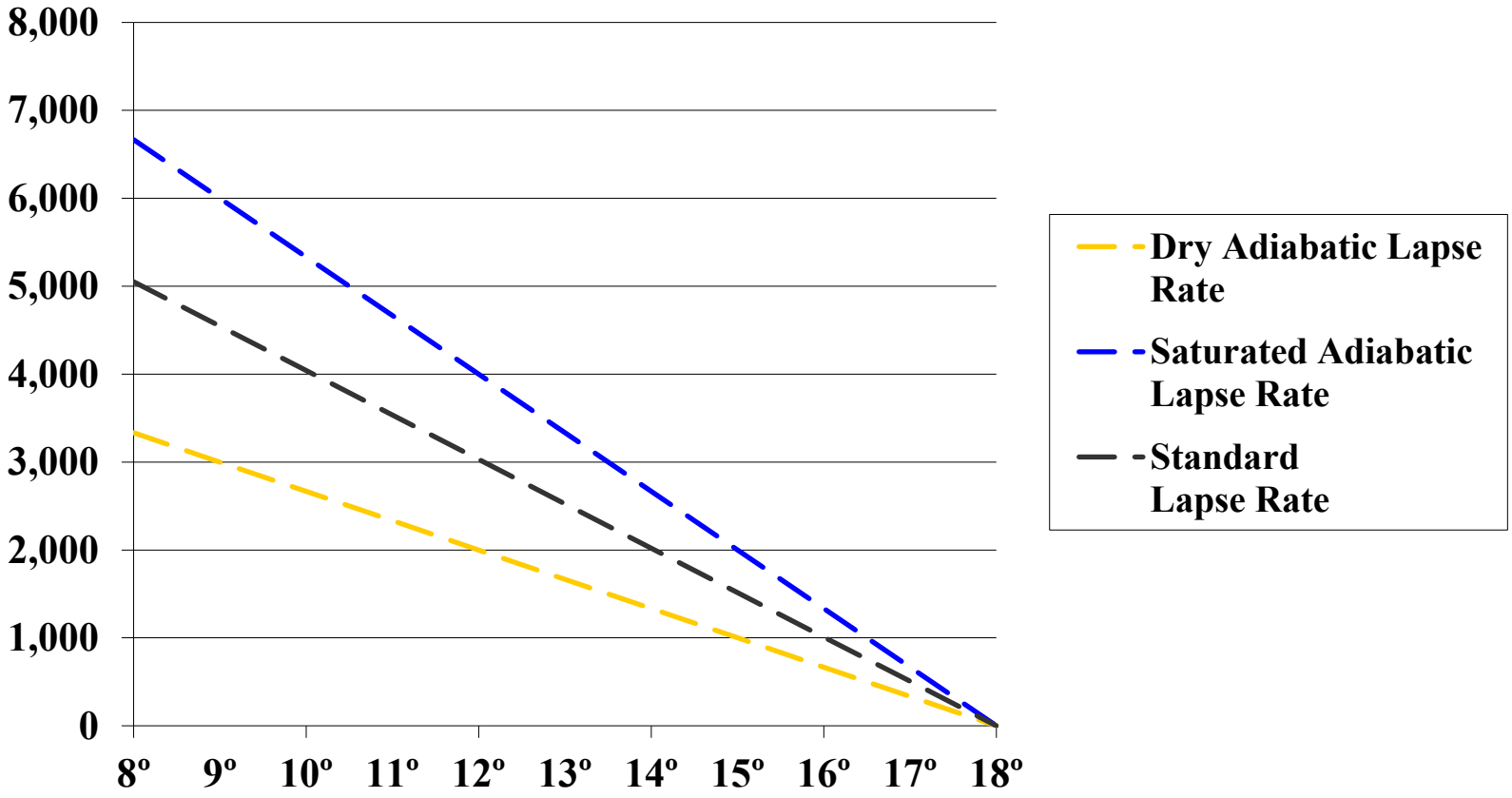
The air mass temperature decreases rapidly with altitude.

Conditional Instability



The temperature of the air mass decreases with altitude faster than the saturated lapse rate but slower than the dry adiabatic rate.

Standard Lapse Rate



On many summer days, the environmental lapse rate approaches the standard lapse rate. Ground heating is necessary to create convective activity (conditional stability)

Review Questions

7. Relative humidity is the

a) amount of moisture present in the air.
b) weight of water present in the air.
c) amount of moisture present in the air compared to the amount the air could hold at that temperature and pressure.
d) temperature to which the air must be lowered to bring about saturation.

8. Select the correct statement from the following

a) A shallow lapse rate indicates unstable air.
b) An isothermal layer favours vertical motion.
c) Vertical current develop readily in unstable air.
d) Visibility is always good in stable air.

9. When unsaturated air is forced to rise, the expansion of the rising air causes it to cool. This cooling is called

a) the environmental lapse rate and is 1.98° C per 1,000 feet.
b) advection cooling and is 2° C per 1,000 feet.
c) radiation cooling and is 3° C per 1000 feet.
d) the dry adiabatic lapse rate and is 3° C per 1000 feet.


Clouds

Requirements for Cloud Formation

- Saturated air
- Condensation Nuclei

Requirements for Precipitation

- Water droplets grow through coalescence and become sufficient in size and weight to fall due to gravity

Cloud are formed through these processes

- Convection
- Orographic Lift
- Frontal Lift
- Turbulence
- Convergence

Note: In all of the above, the clouds are formed because the air mass is rising.

Convection

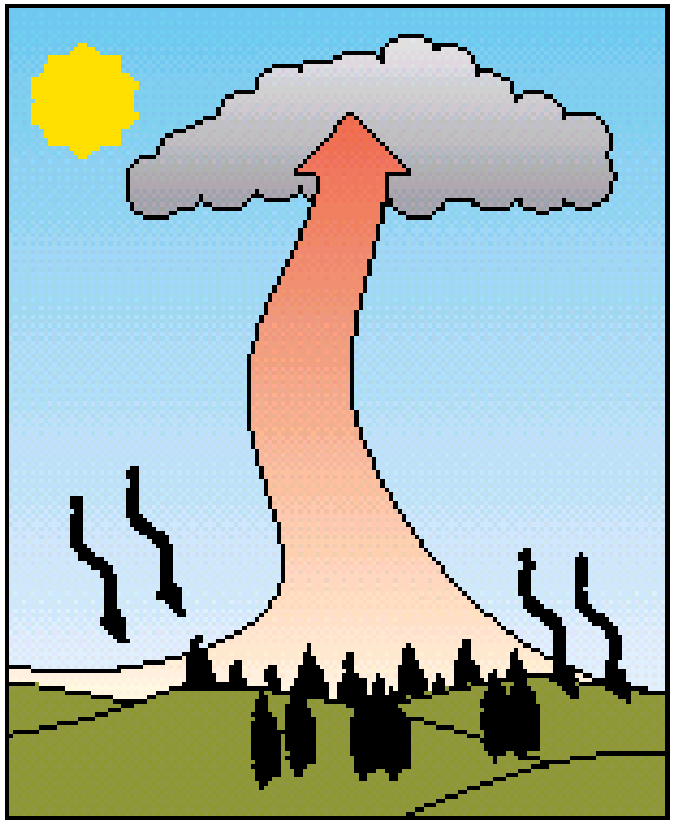


Fig. 1-2 - Convection as a result of daytime heating

Orographic

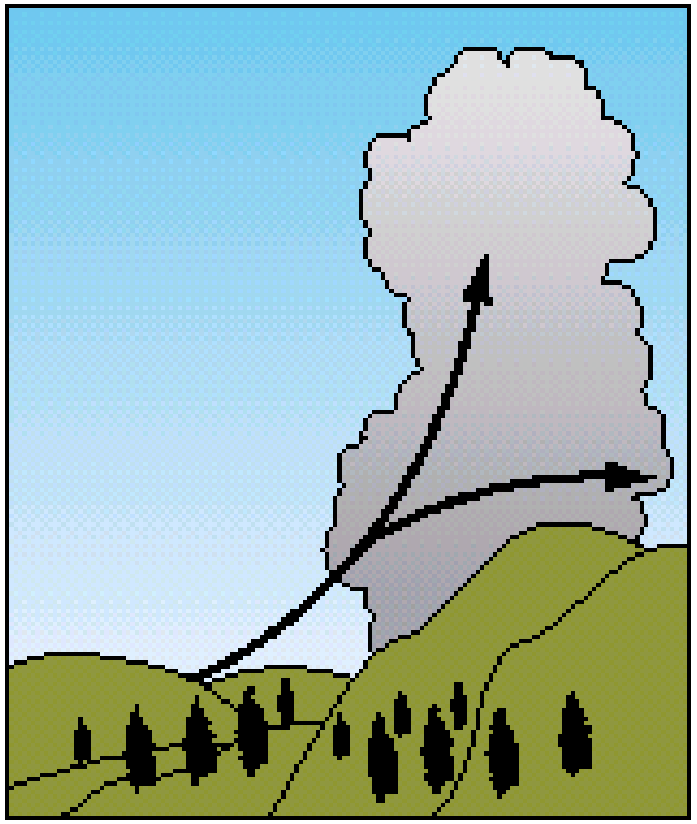


Fig.1-3 - Orographic (upslope) lift

Frontal Lift

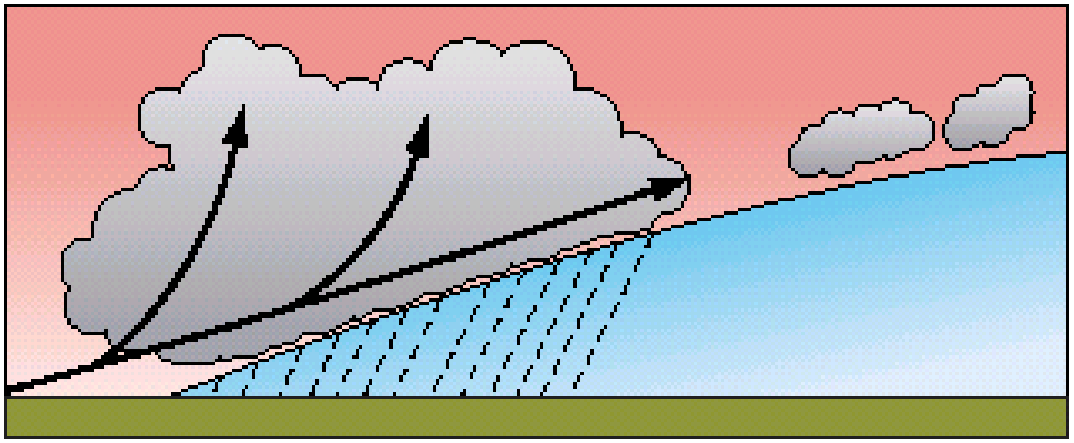
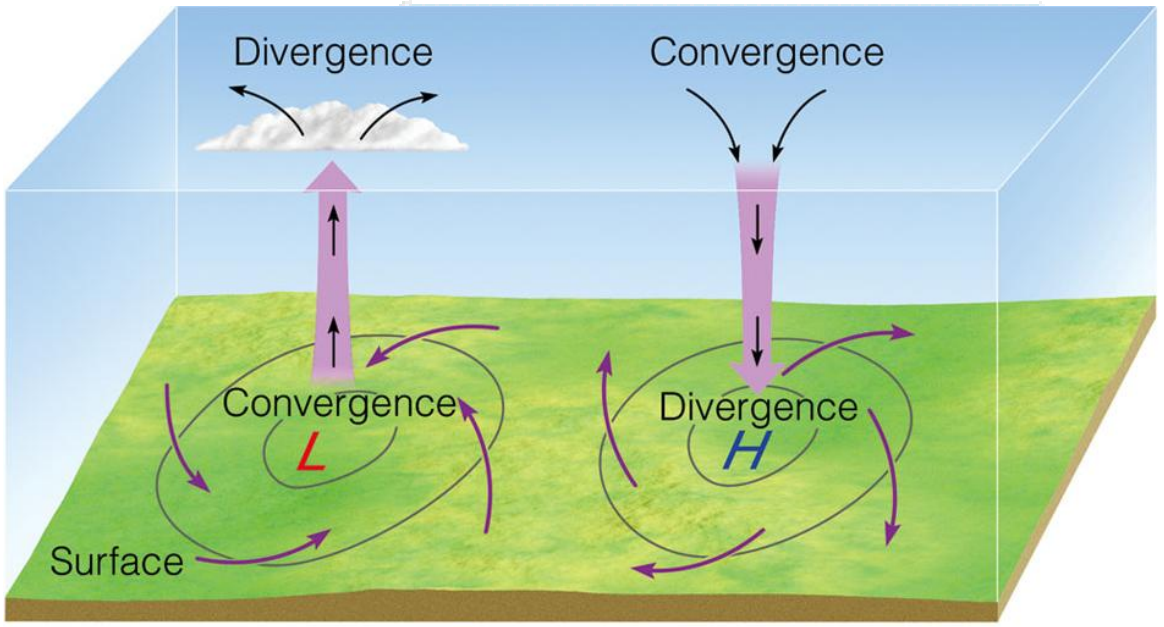


Fig.1-4 - Warm air overrunning cold air along a warm front

Surface Convergence



Cloud Naming System

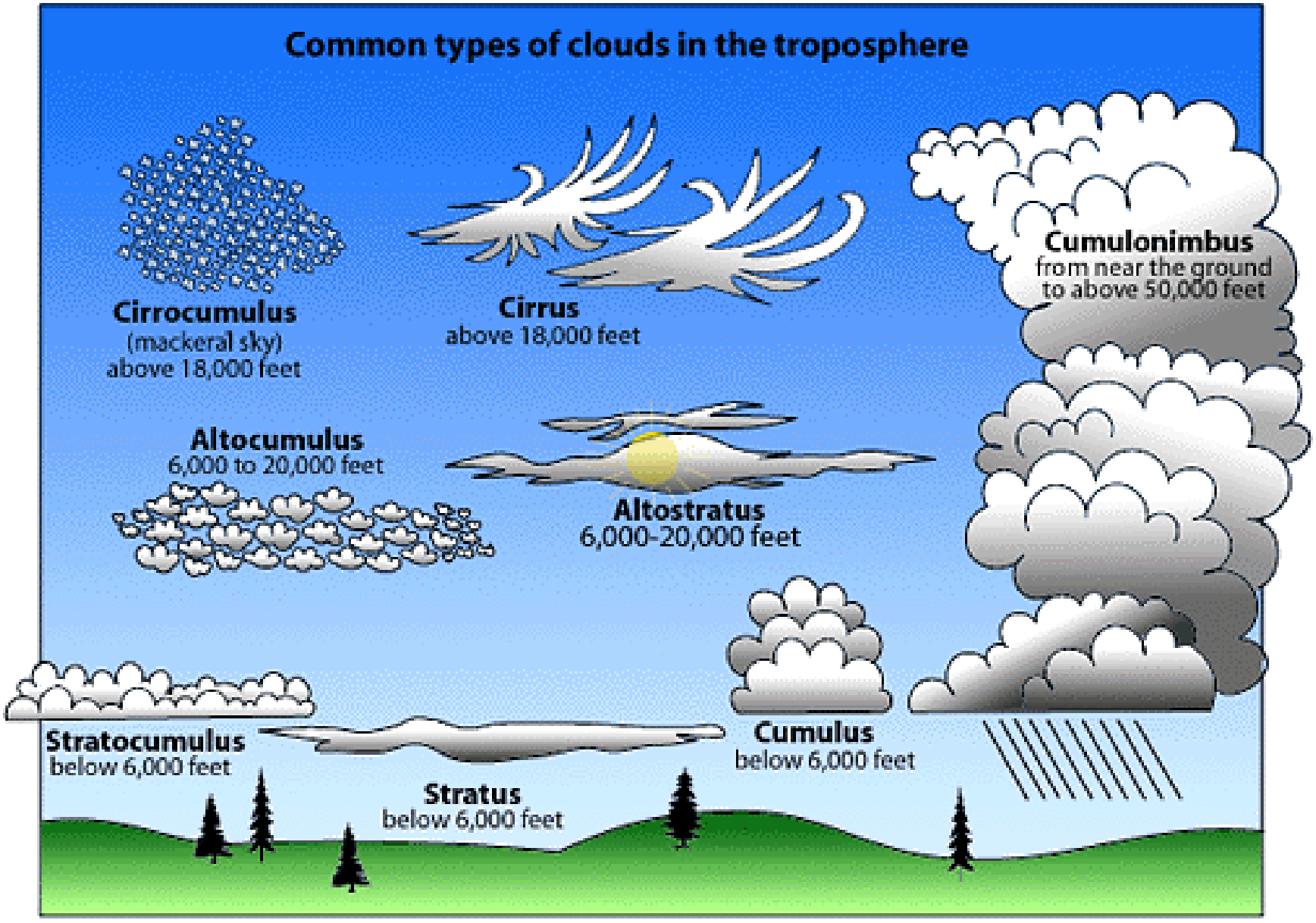
Height	Prefix for Height	Shape of Cloud	Precipitation
Above 20,000 ft	Cirro	Stratus / cirrus / cumulus	nimbus
6,000 ft to 20,000 ft	Alto	Stratus / cirrus / cumulus	nimbus
Below 6,000 ft		Stratus / cumulus	nimbus

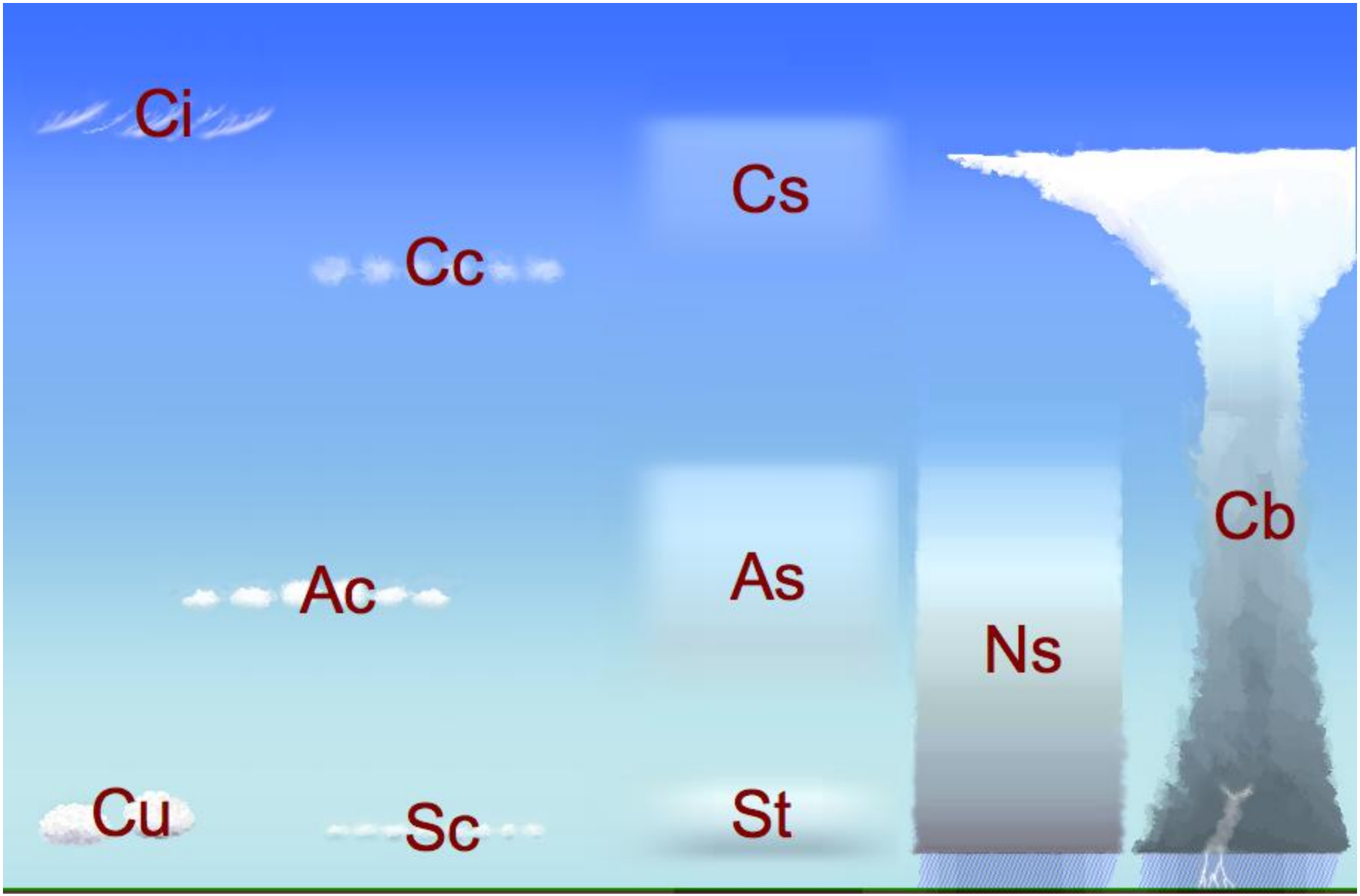
Cloud Suffixes

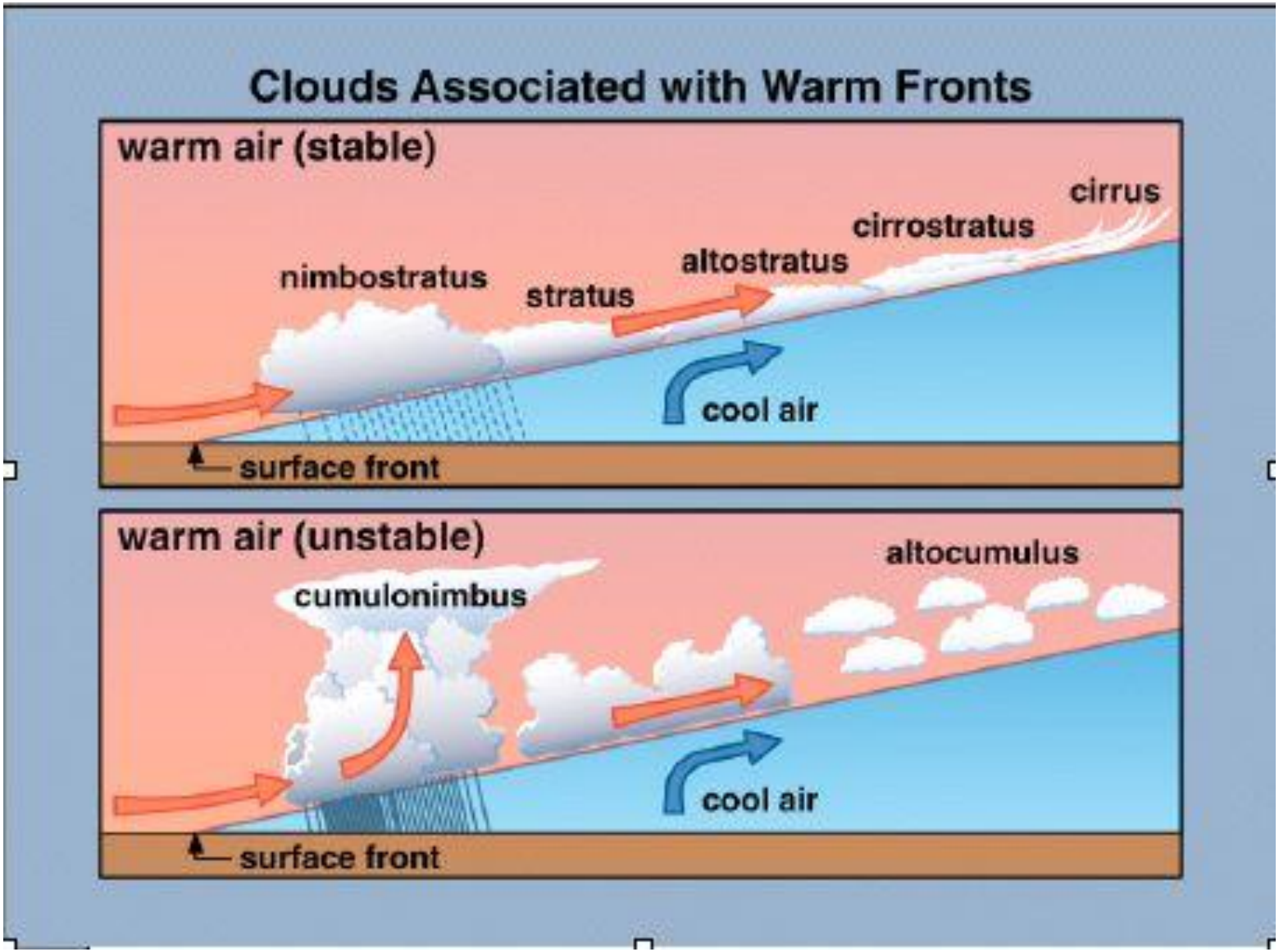
- Stratus: layered
- Cirrus: curly or fibrous
- Cumulus: lumpy or piled
- Nimbus: rain

Cloud Names

Cirrostratus (CS) 	Cirrocumulus (CC) 	Cirrus (CI) 				Cumulonimbus (CB)  Towering Cumulonimbus (TCU)  	Lenticular Clouds (LENT)
Altostratus (AS) 	Altocumulus (AC)	Altocumulus Castellanus (ACC) 					
Stratus (ST)	Cumulus (CU) 	Nimbostratus (NS)	Stratus Fractus (SF)	Stratocumulus (SC) 	Cumulus Fractus (CUFRA)		


Common types of clouds in the troposphere
Cirrocumulus
(mackeral sky)
above 18,000 feet
Cirrus
above 18,000 feet
Cumulonimbus
from near the ground
to above 50,000 feet
Altocumulus
6,000 to 20,000 feet
Altostratus
6,000-20,000 feet
Stratocumulus
below 6,000 feet
Cumulus
below 6,000 feet
Stratus
below 6,000 feet


Ci
Cs
Cc
Cb
Ac
As
Ns
Cu
Sc
St


Clouds Associated with Warm Fronts
warm air (stable)
cirrus
cirrostratus
altostratus
nimbostratus
stratus
cool air
surface front
warm air (unstable)
altocumulus
cumulonimbus
cool air
surface front

Cirrus (Mare's tail)

Cumulus

Cumulus

Lenticular

Cumulus fractus

Lenticular

Stratus and Lenticular

Cumulus and Stratus

Nimbostratus

Altocumulus castellanus

Altocumulus castellanus

Cirrostratus

Cirrocumulus

Virga

Review Questions

10. The cloud type usually associated with steady rain is

a) altostratus.
b) altocumulus.
c) stratocumulus.
d) nimbostratus.

11. A condition when the air temperature aloft is higher than that of the lower atmosphere is generally referred to as

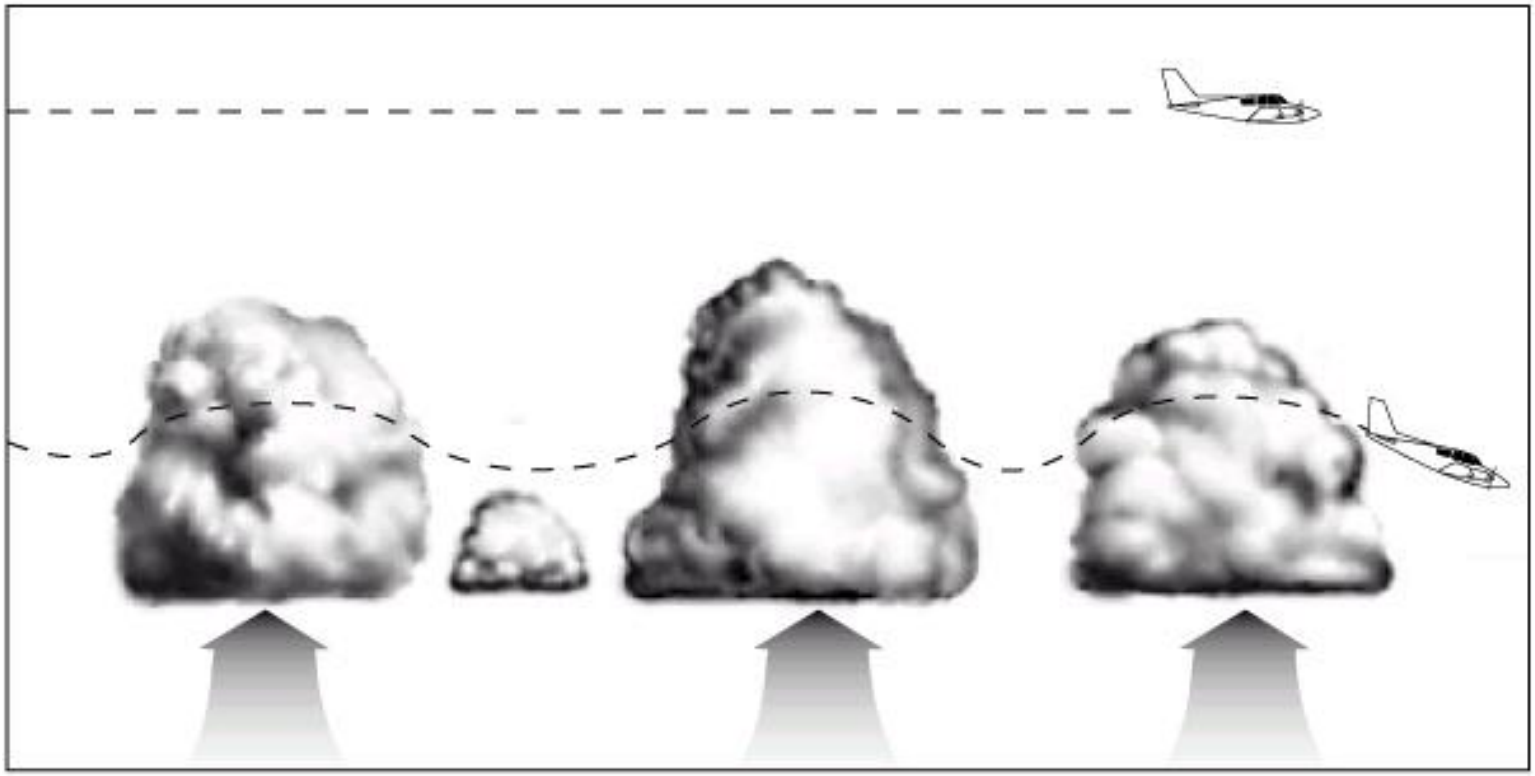
a) a low pressure area.
b) an inversion.
c) a reverse temperature condition.
d) an inverse convection condition.

Turbulence

- Convection (Thermal)
- Mechanical
- Frontal
- Orographic
- Wind Shear

Convection Turbulence

Convection Turbulence



Effect of Convection Turbulence on Landing Flight Path

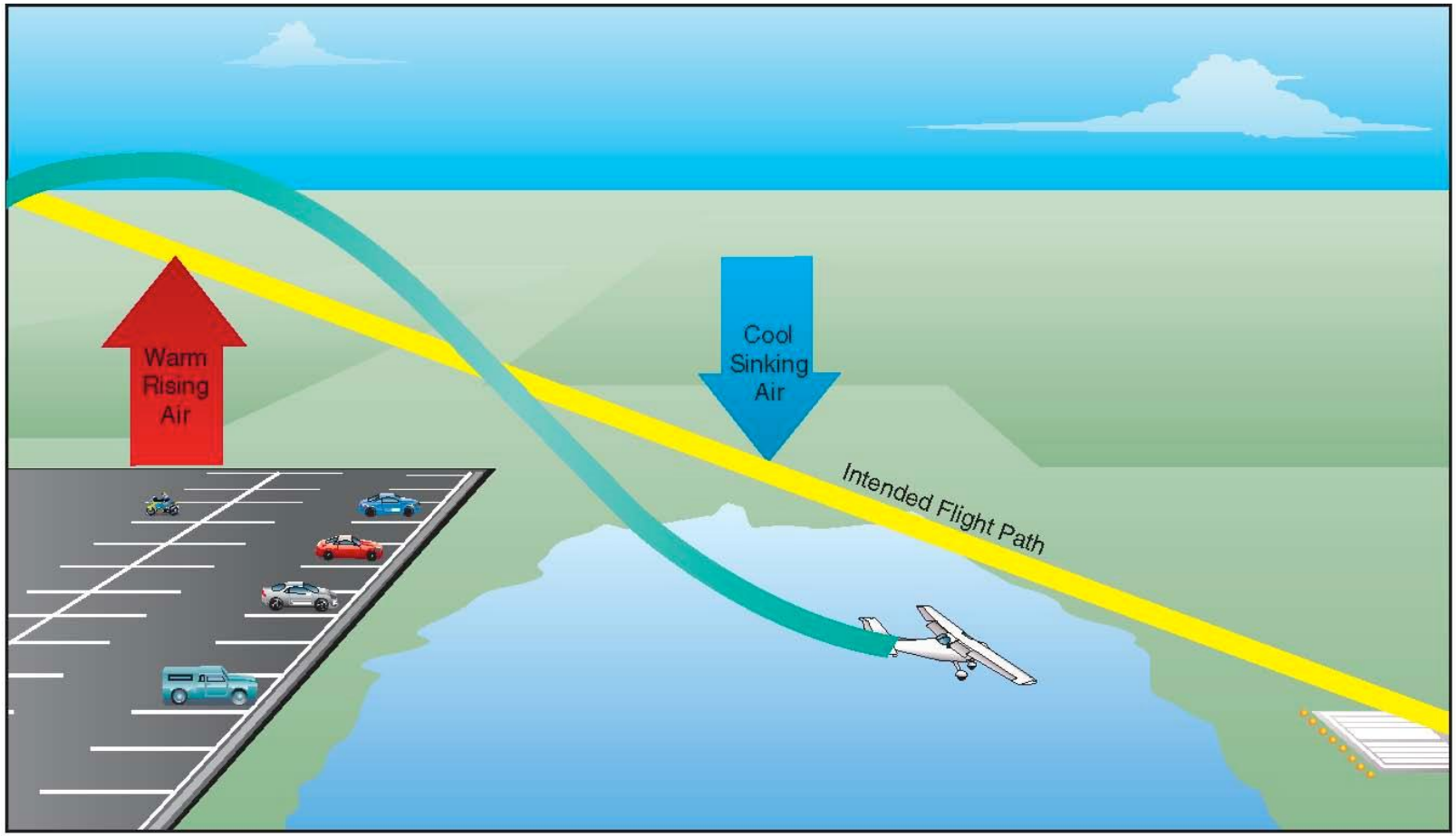
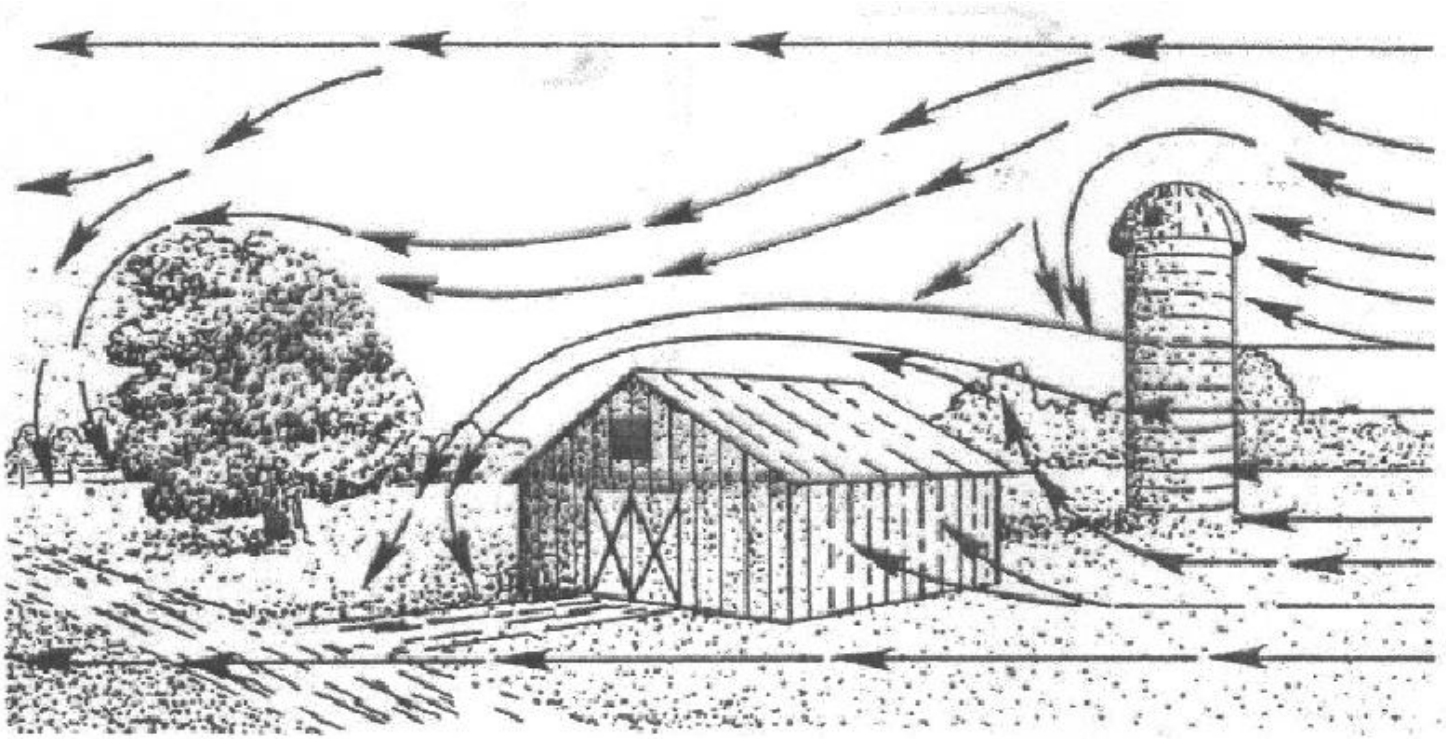
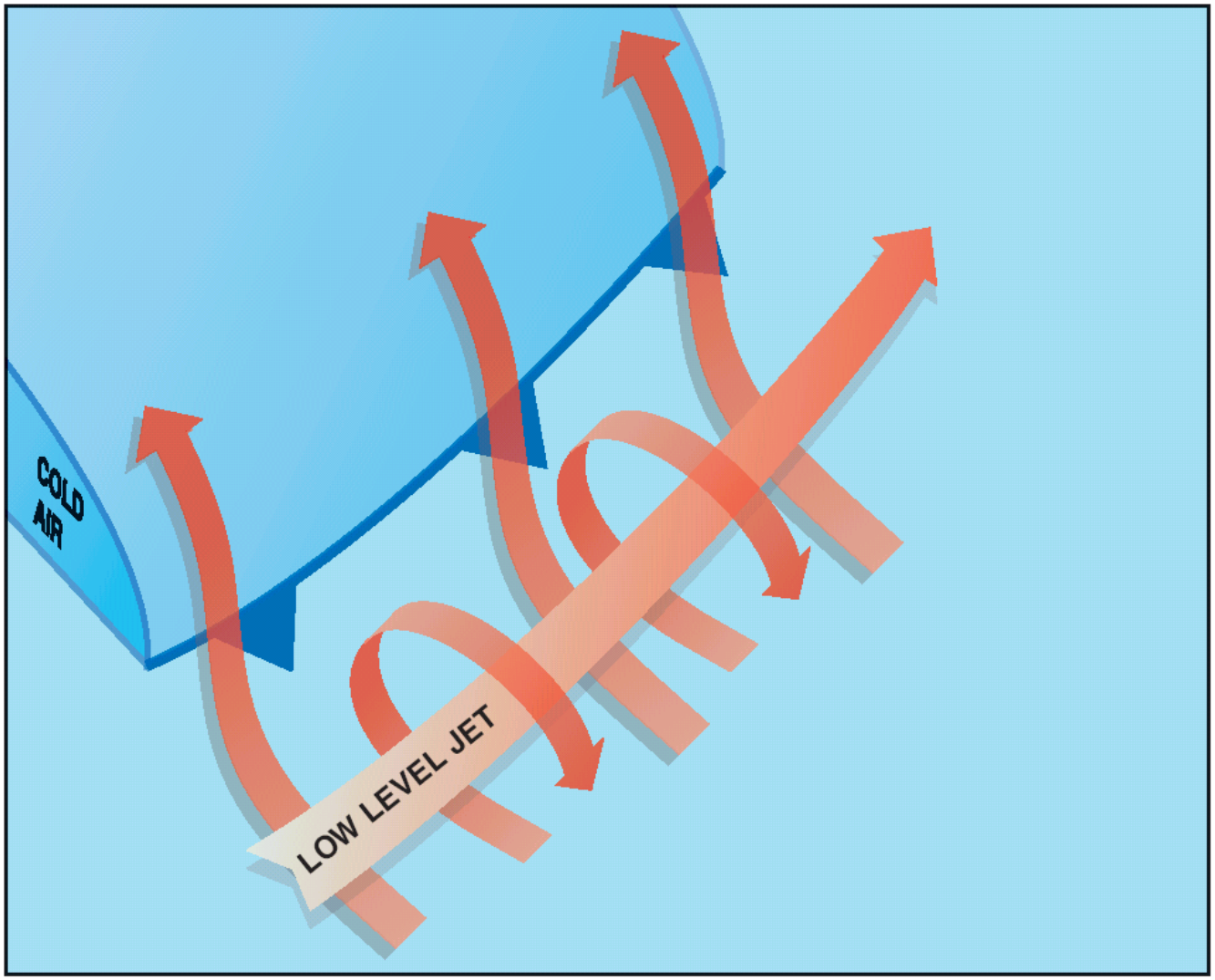


Figure 10-14. Currents generated by varying surface conditions.

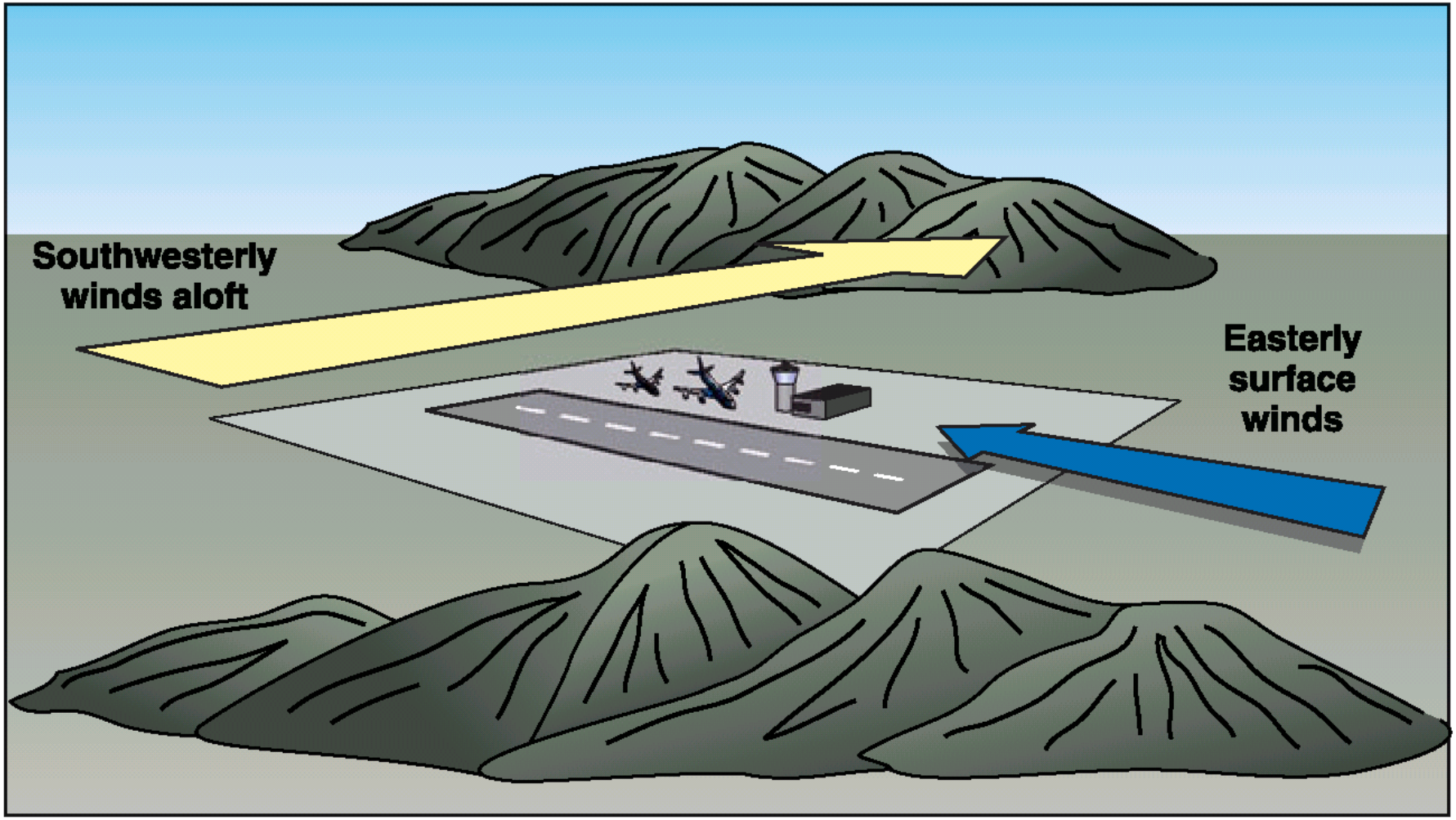
Mechanical Turbulence



Frontal Turbulence



Wind Shear

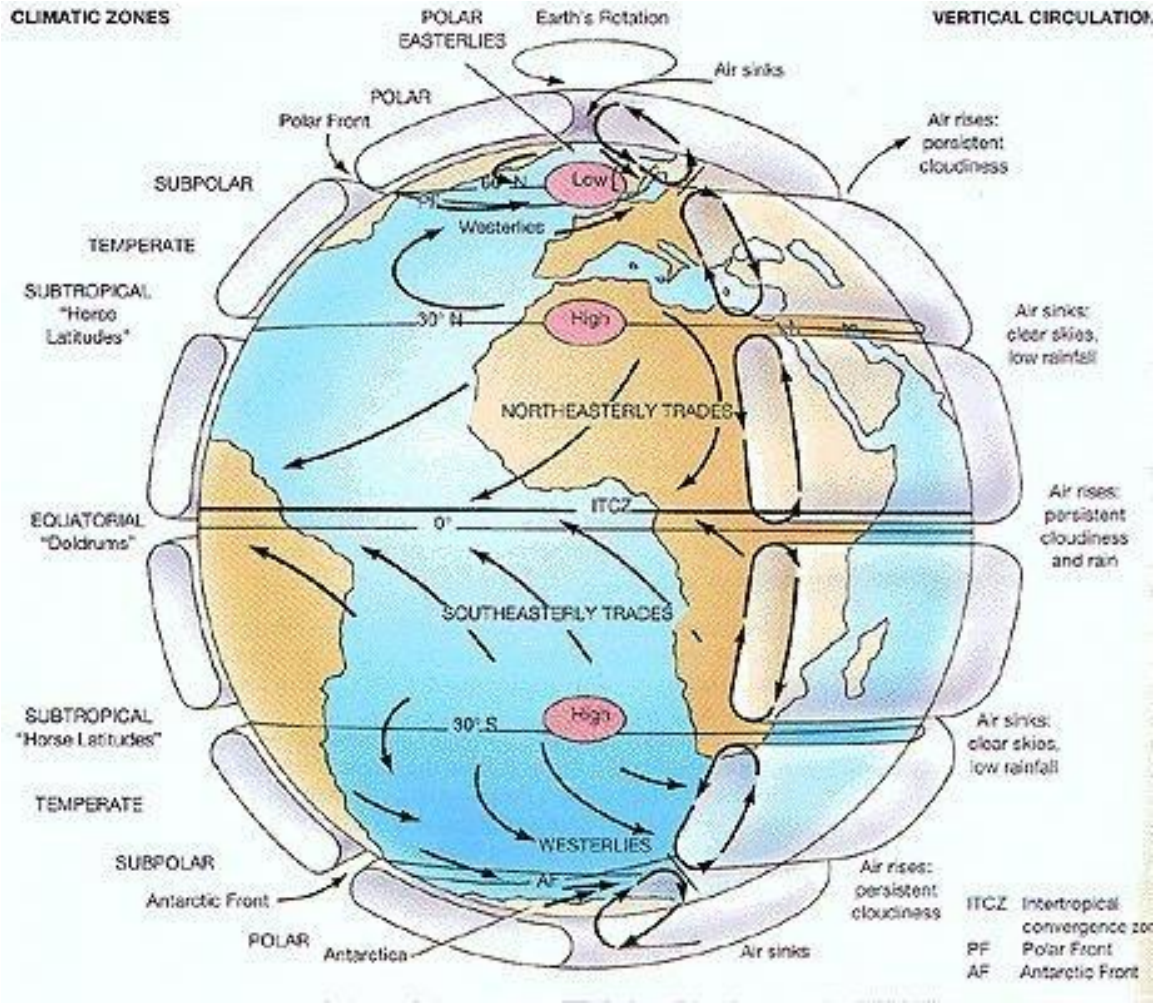


Orographic Turbulence

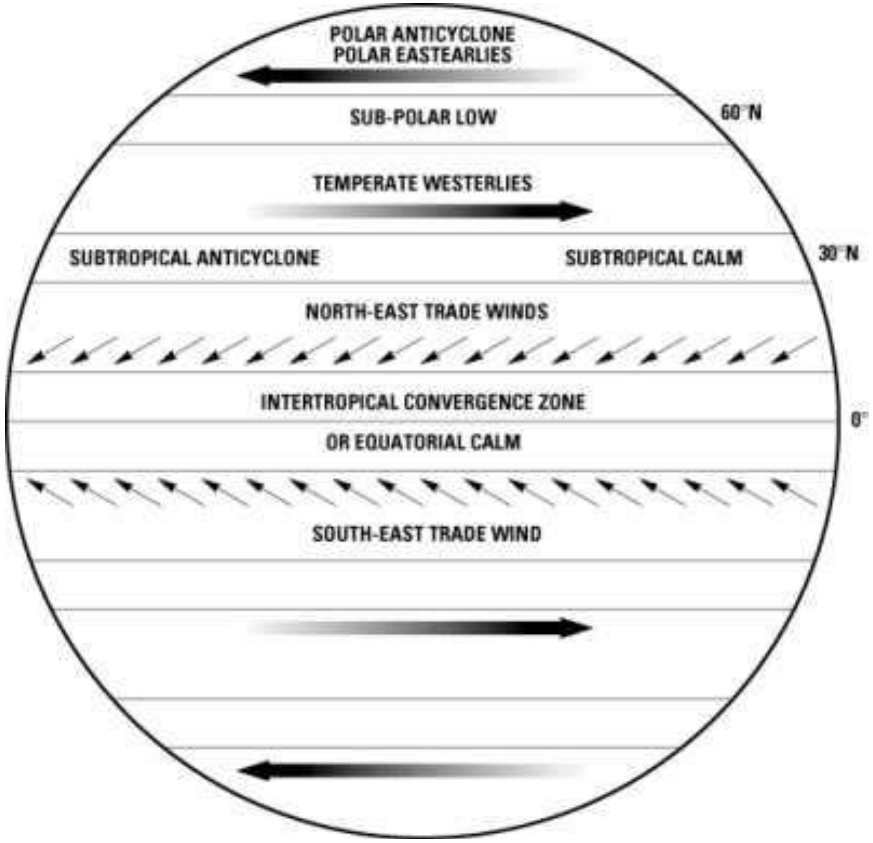
Winds

- Horizontal movement of air

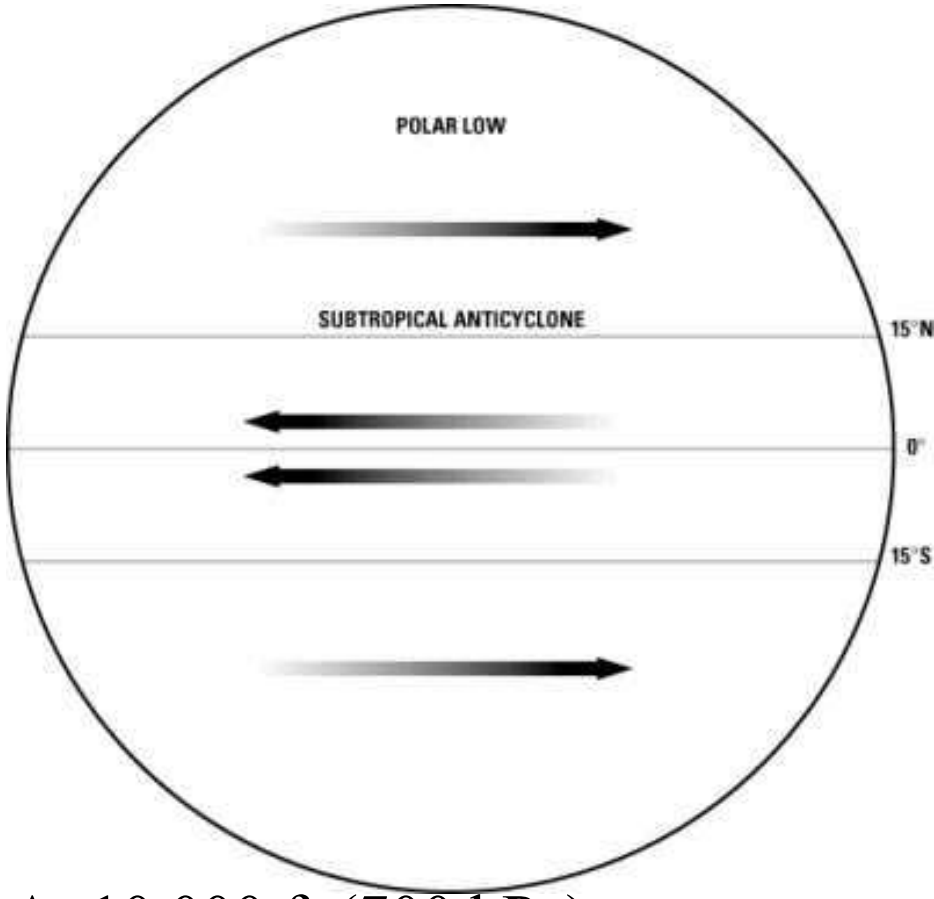
Prevailing Winds



Prevailing Winds

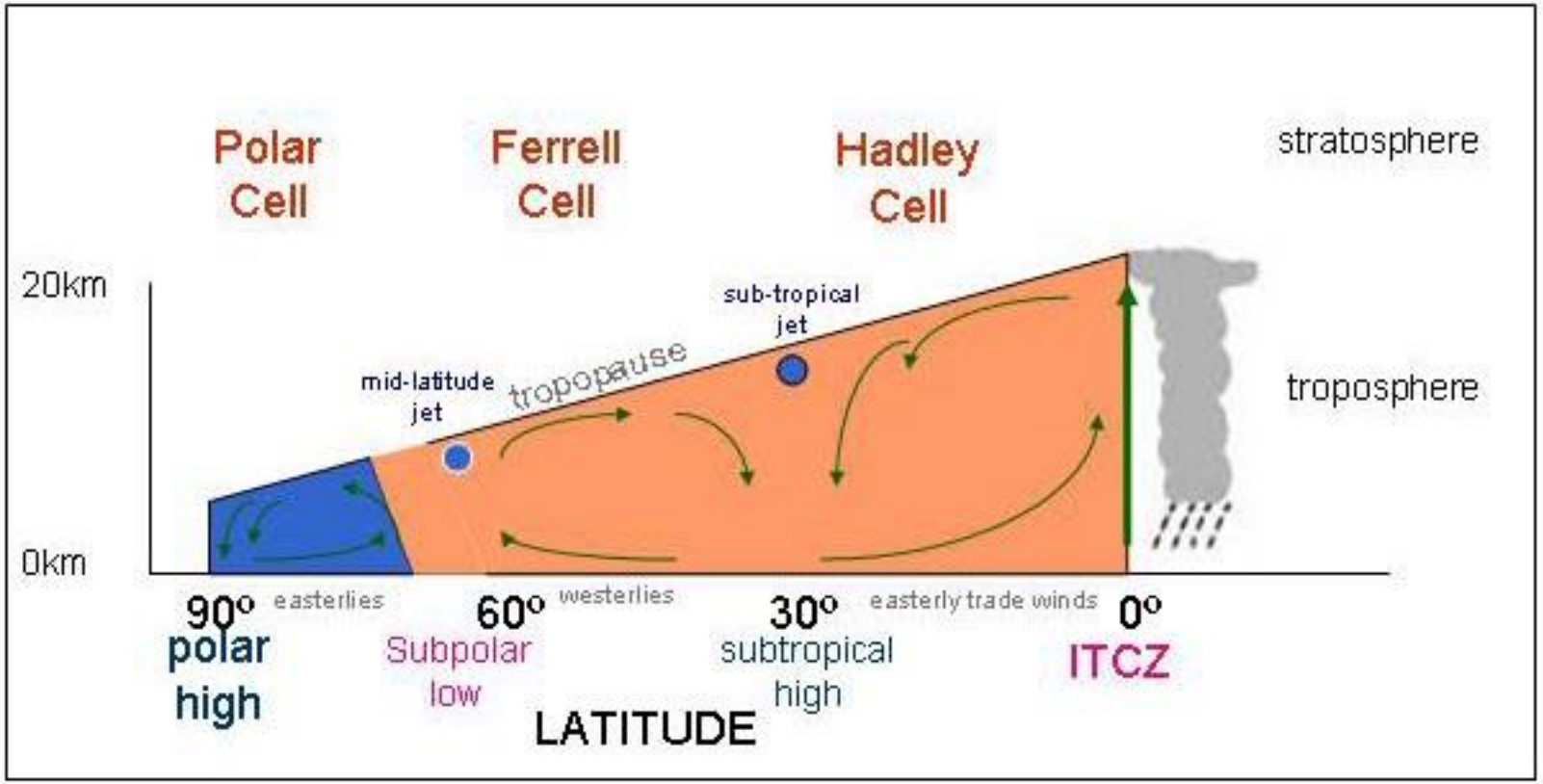


At sea level



At 10,000 ft (700 hPa)

Wind Circulation Patterns



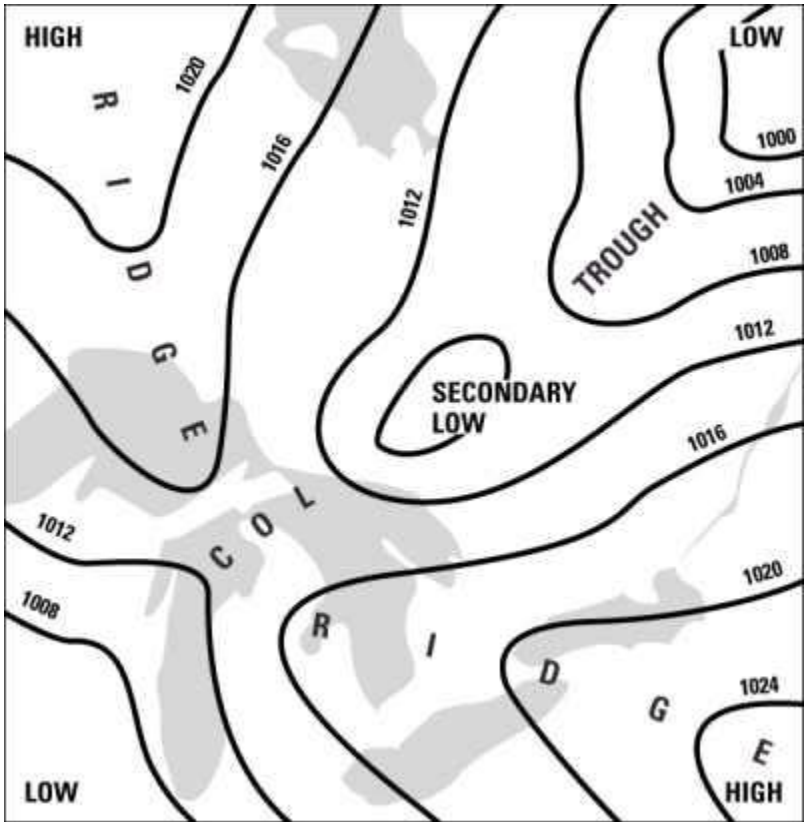
Ferrel's Law

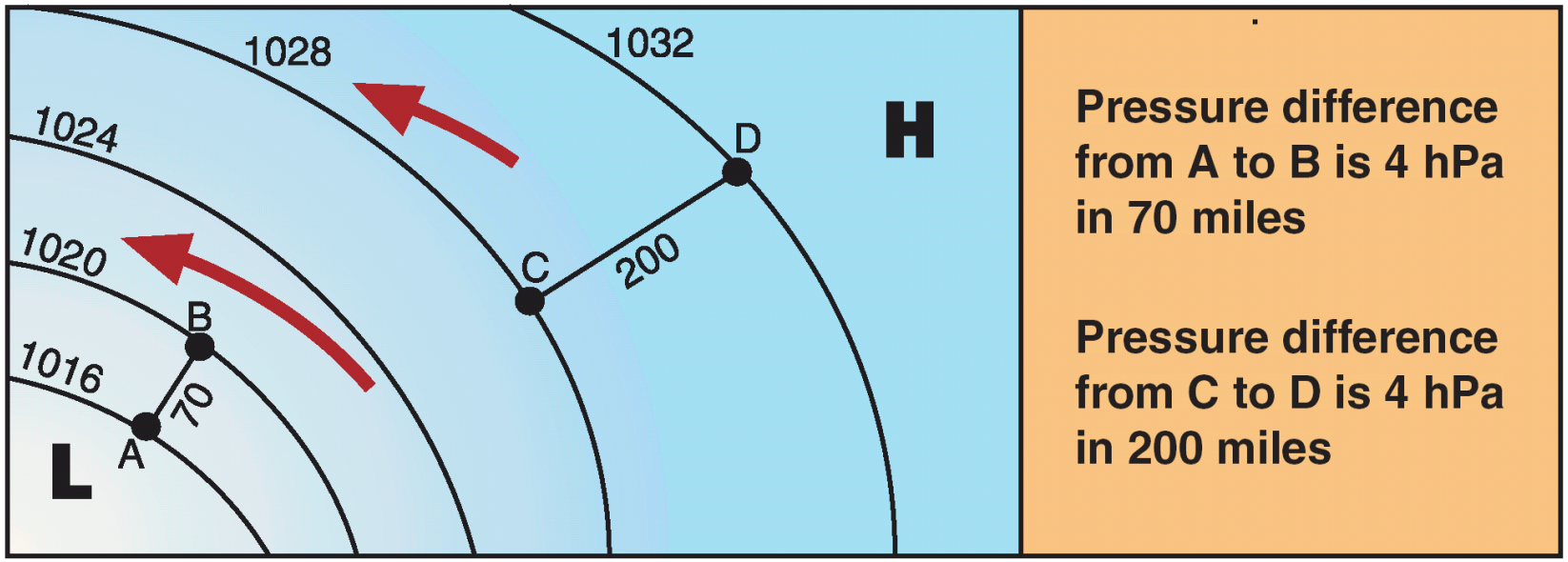
- Air moving from a high-pressure area to low-pressure area is deflected to the right by the Coriolis Force.

Pressure Gradient

- The speed of wind depends on the pressure gradient.
- The pressure gradient is defined as the rate of change of pressure over a given distance.
- On a weather map, the steepness of the pressure gradient can be shown by the nearness of the isobars.

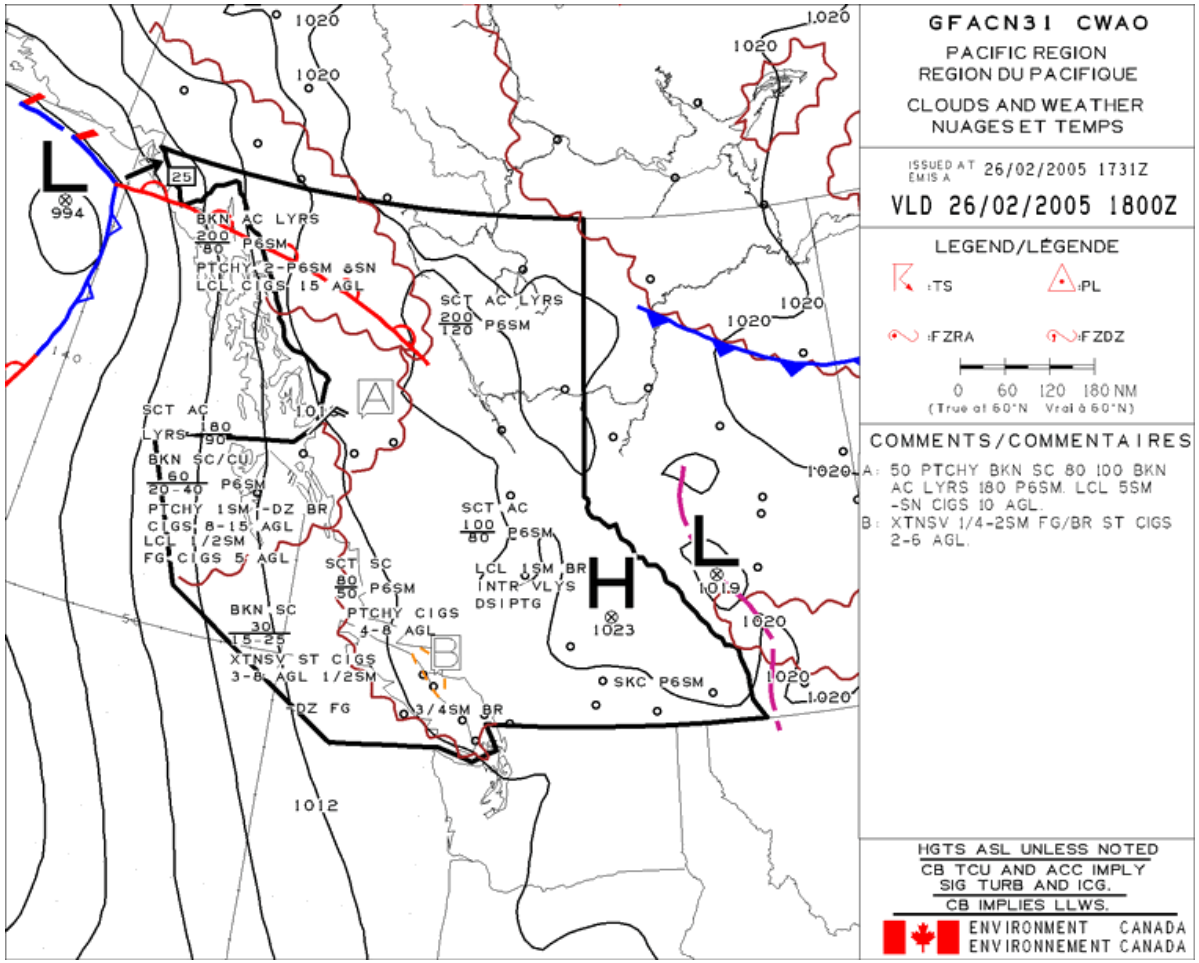
Pressure Systems





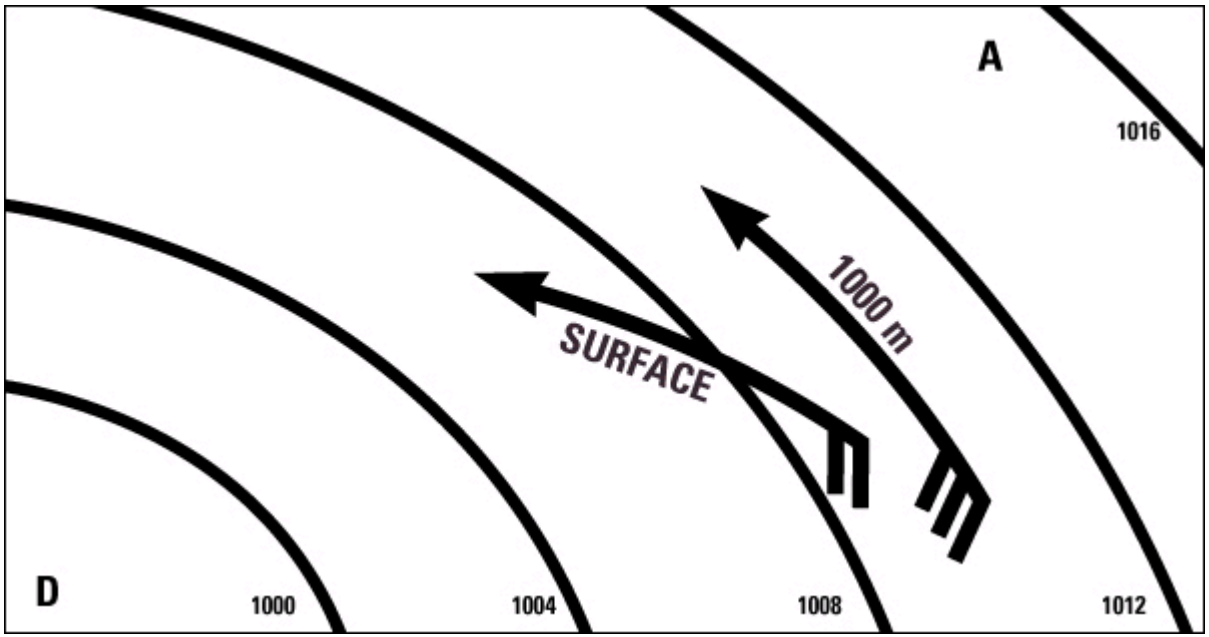
The greater pressure changes with horizontal difference, the stronger the wind.

Where will the strongest wind be?



Low Level Winds

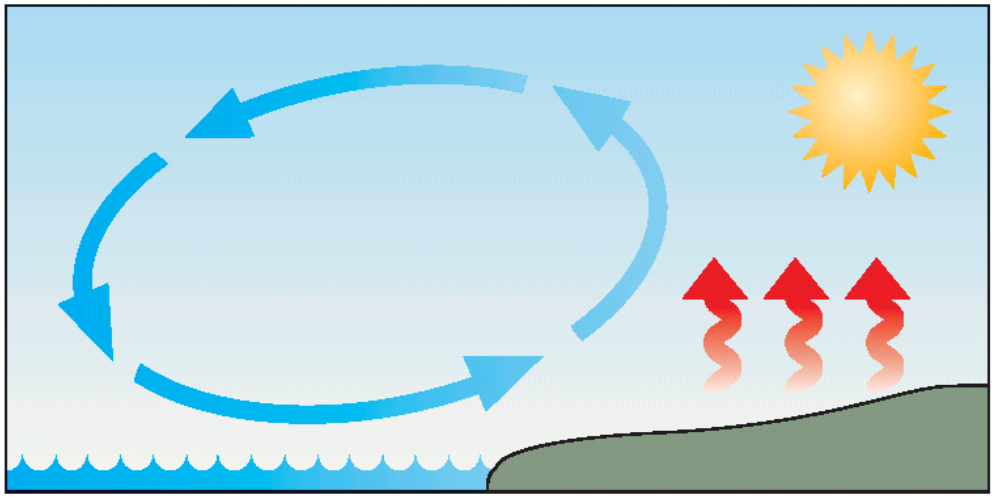
- Effect of friction does not extend much beyond a couple of thousand feet from the ground.
- In cyclones and anti-cyclones, wind veers as you go up; backs as you go down.



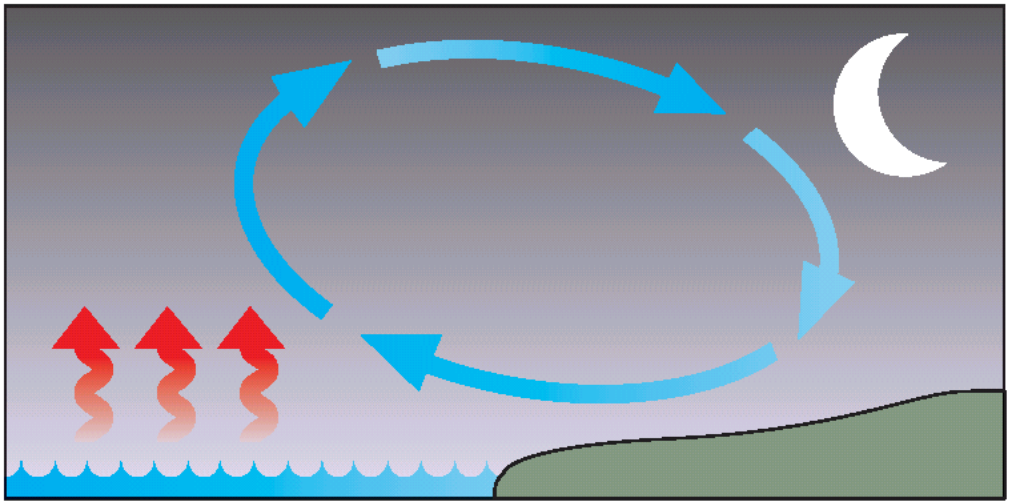
Comparison of surface wind and wind at 1000 m above a flat surface.

Land and Sea Breezes

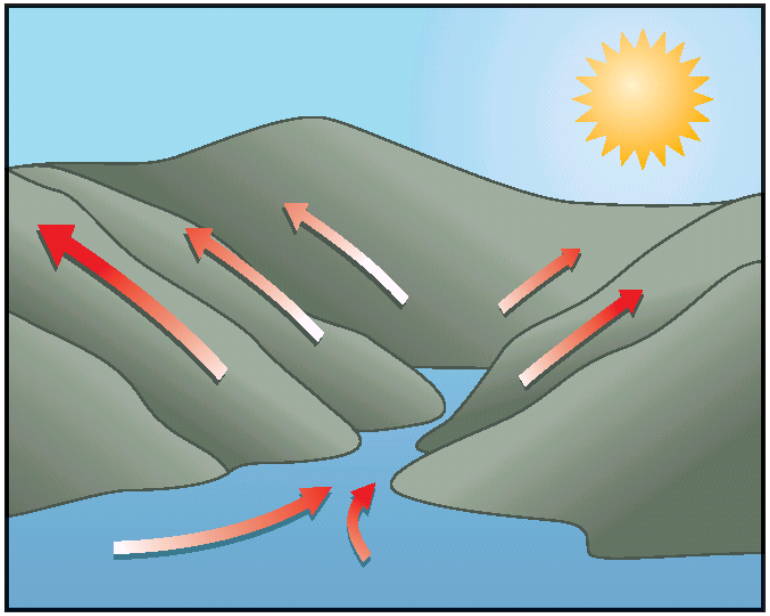
Sea Breeze



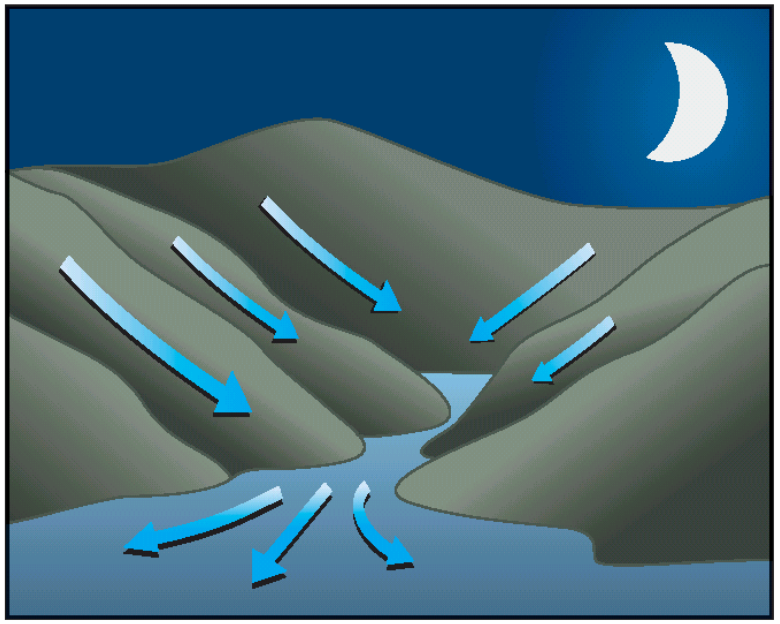
Land Breeze



Valley and Mountain Breezes

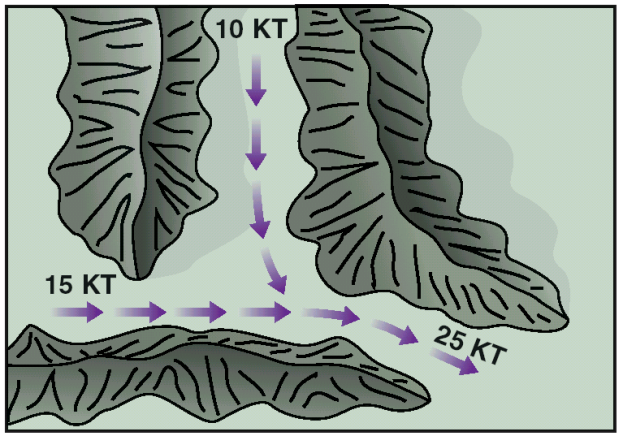


Anabatic Winds (Valley Breeze

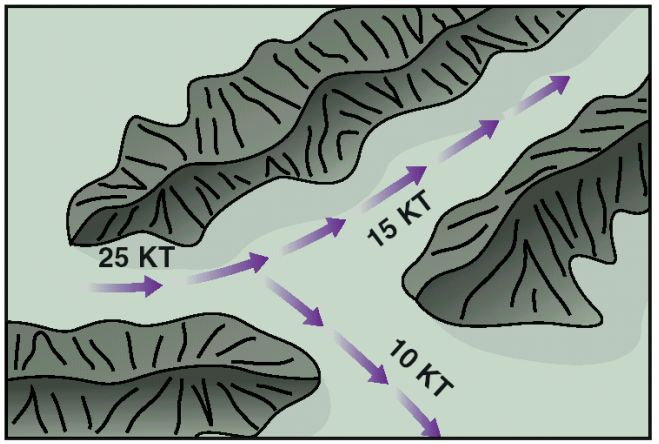


Katabatic Winds (Mountain Breeze)

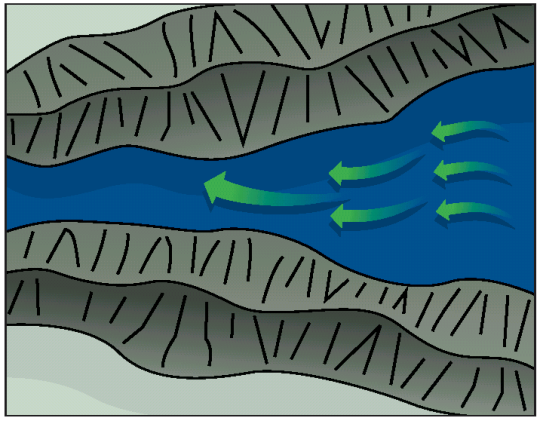
Mountain Winds



Converging Winds

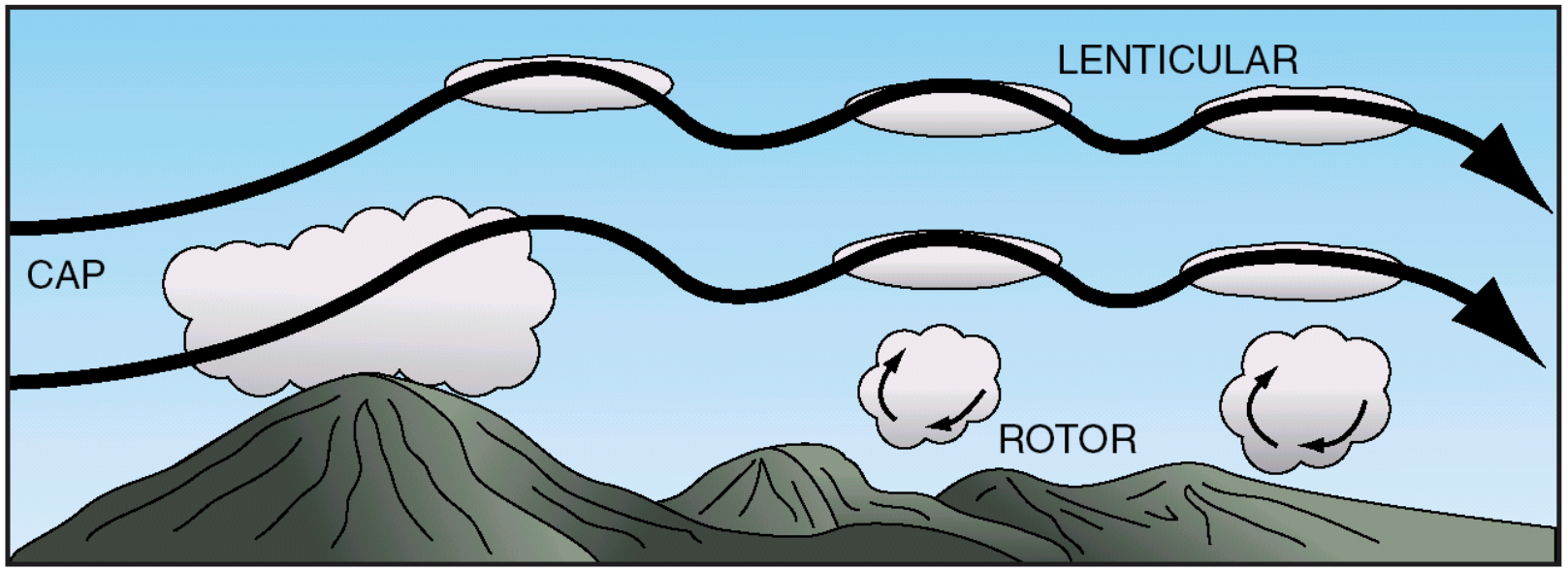


Diverging Winds



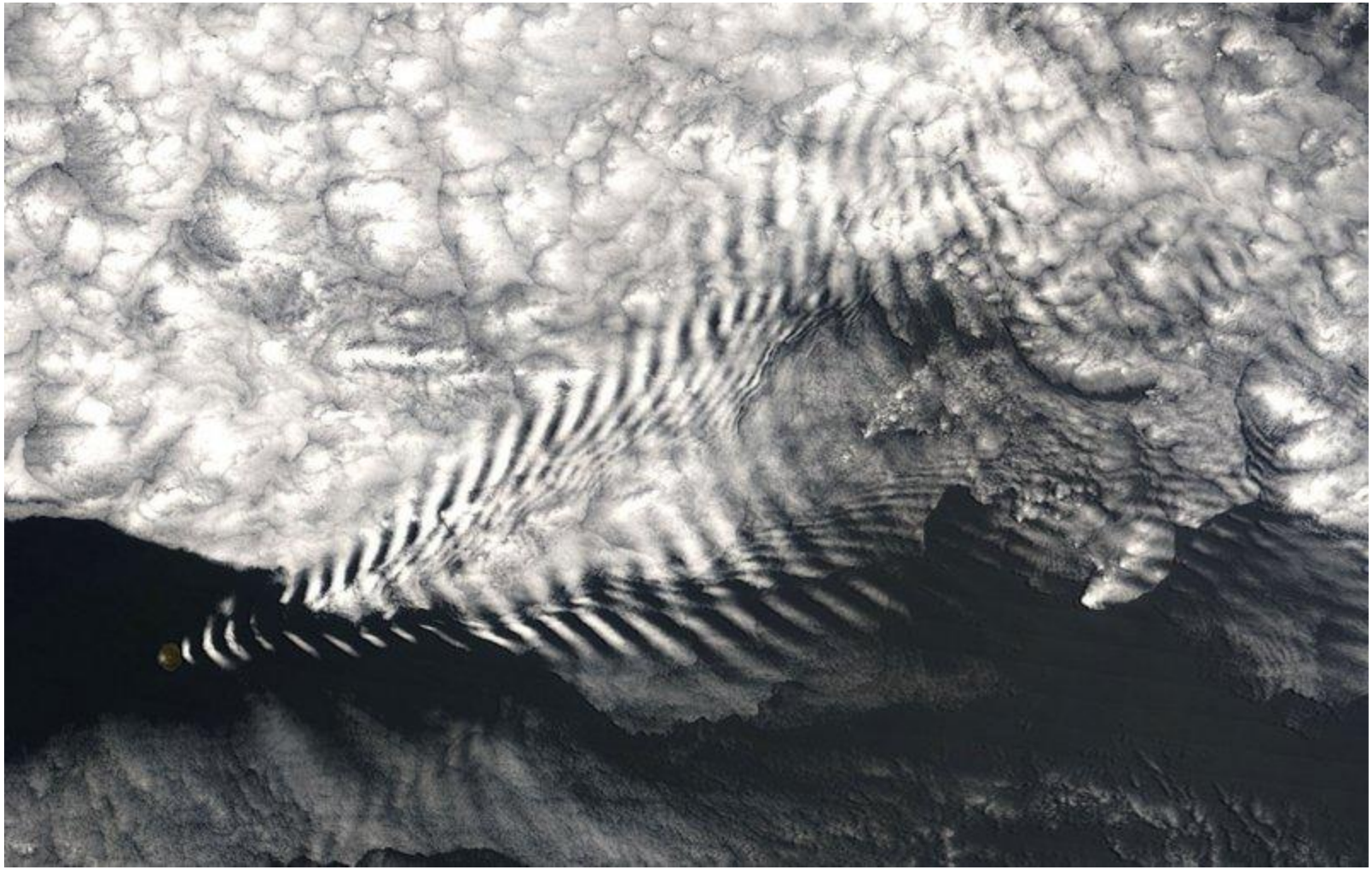
Funelled Winds

The Mountain Wave



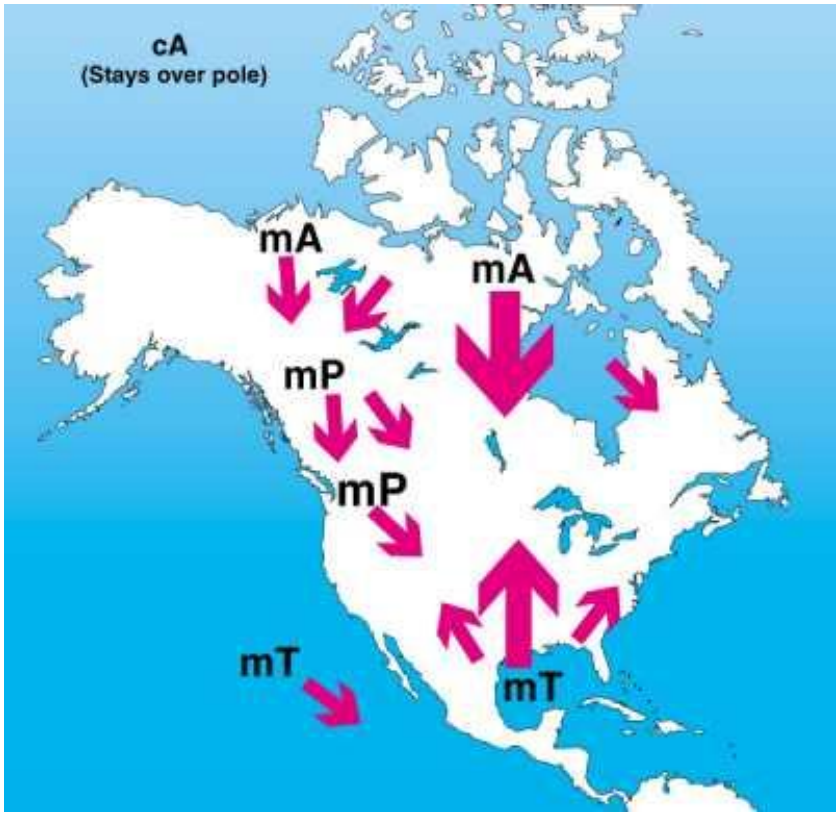
Lenticular Cloud over the Presidential Range in New Hampshire


Feb . 6, 2000

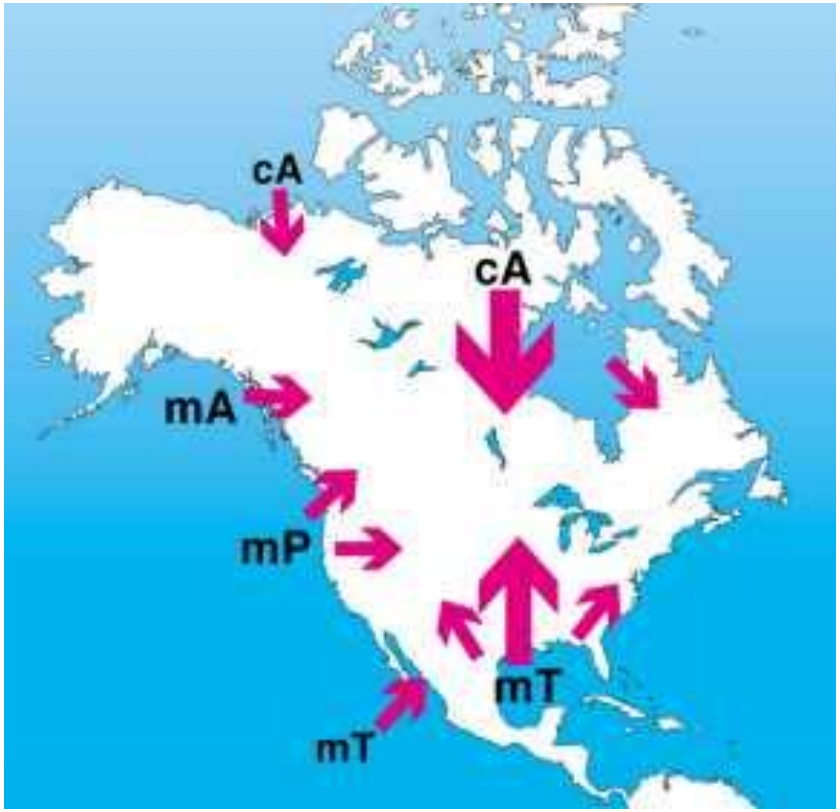


Air Masses

- An air mass is large section of the troposphere with uniform properties of temperature and moisture in the horizontal
- Usually thousands of kilometres across
- Influenced by the regions it has crossed in its lifetime
- If it has formed over water, it is called maritime. If it has formed over land, it is continental.
- From North Pole to permafrost line: Arctic. From permafrost to where mean temperature is 10°: Polar
- From Gulf of Mexico and South Pacific: Maritime Tropical

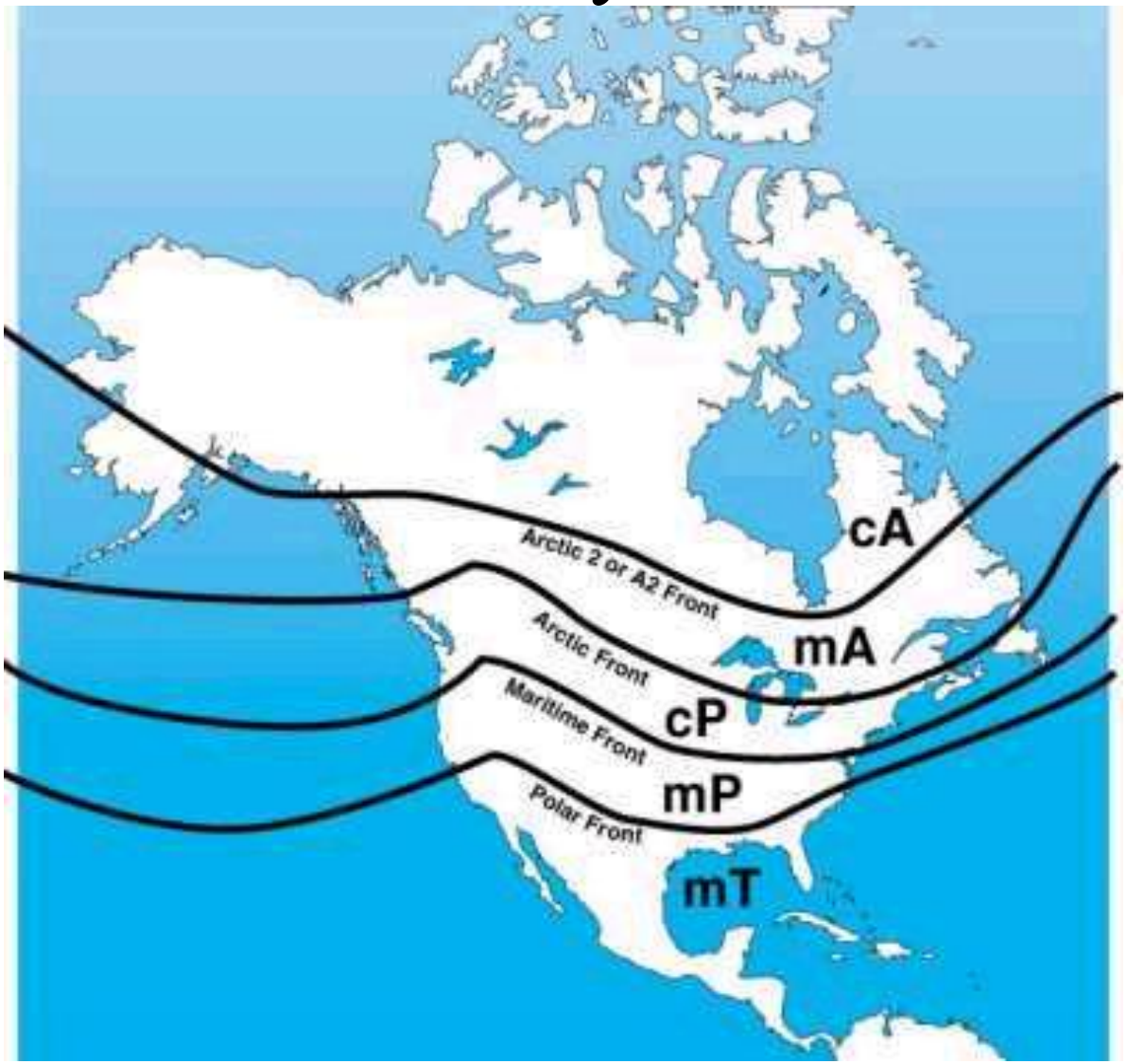


Summer Air Masses

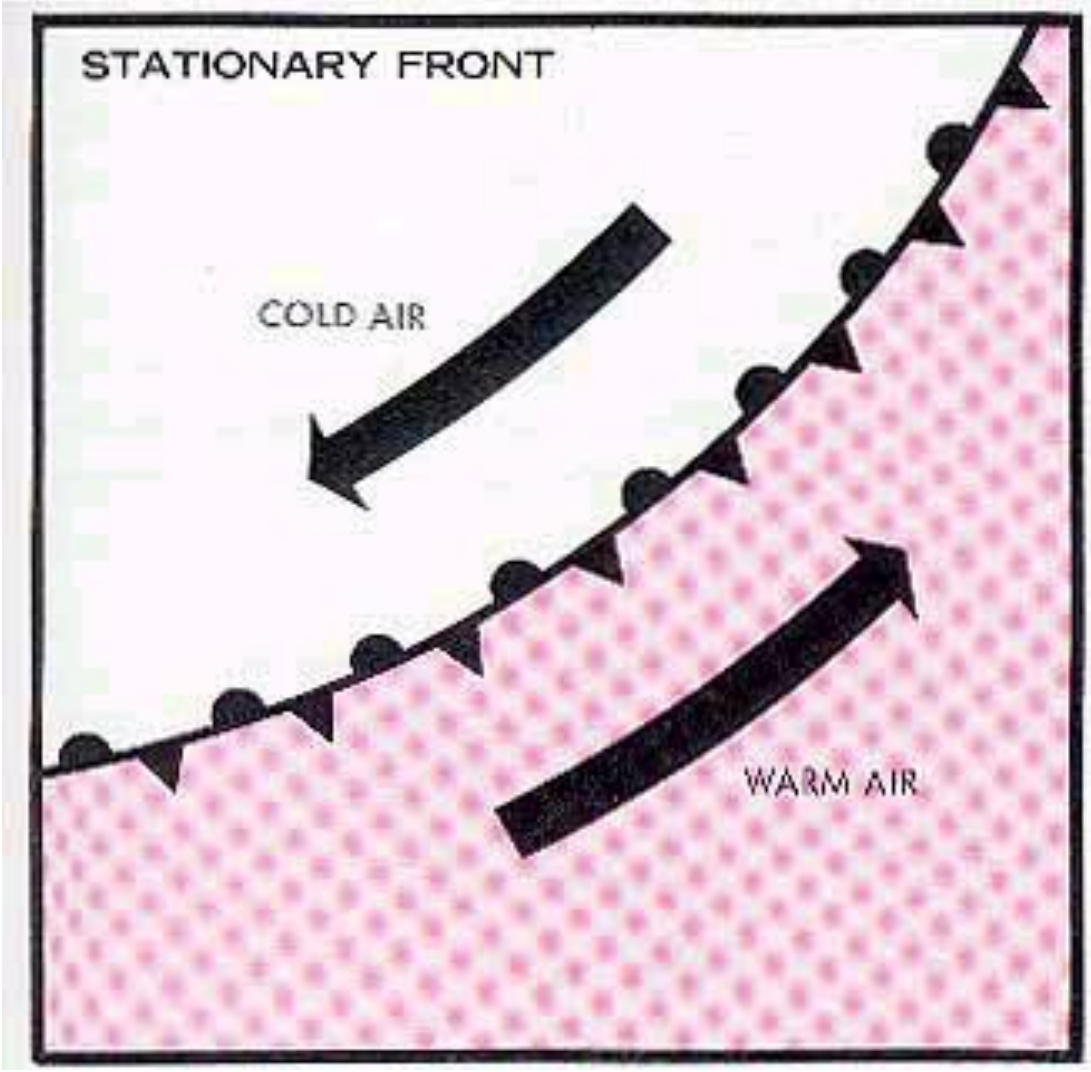


Winter Air Masses

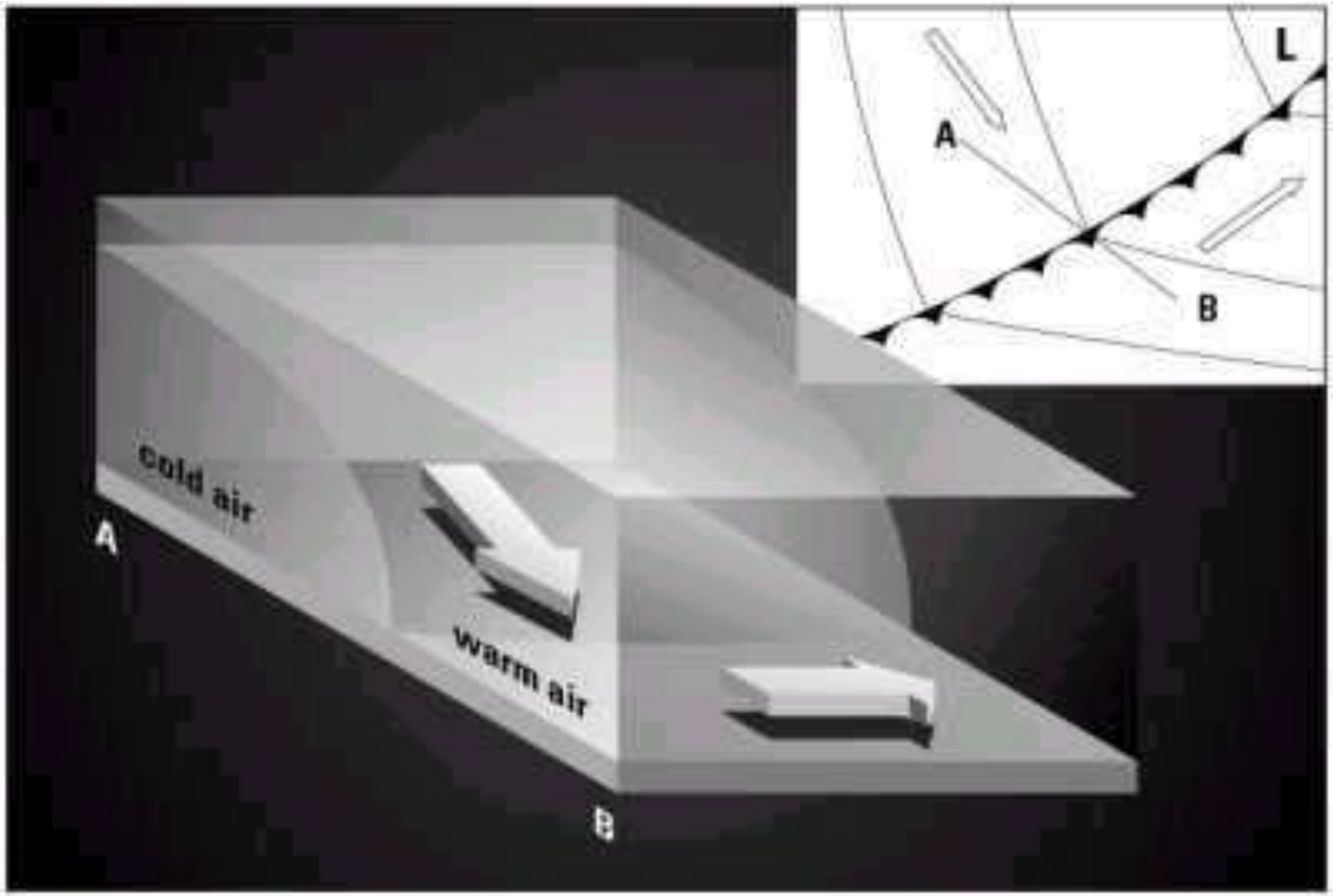
Frontal Systems



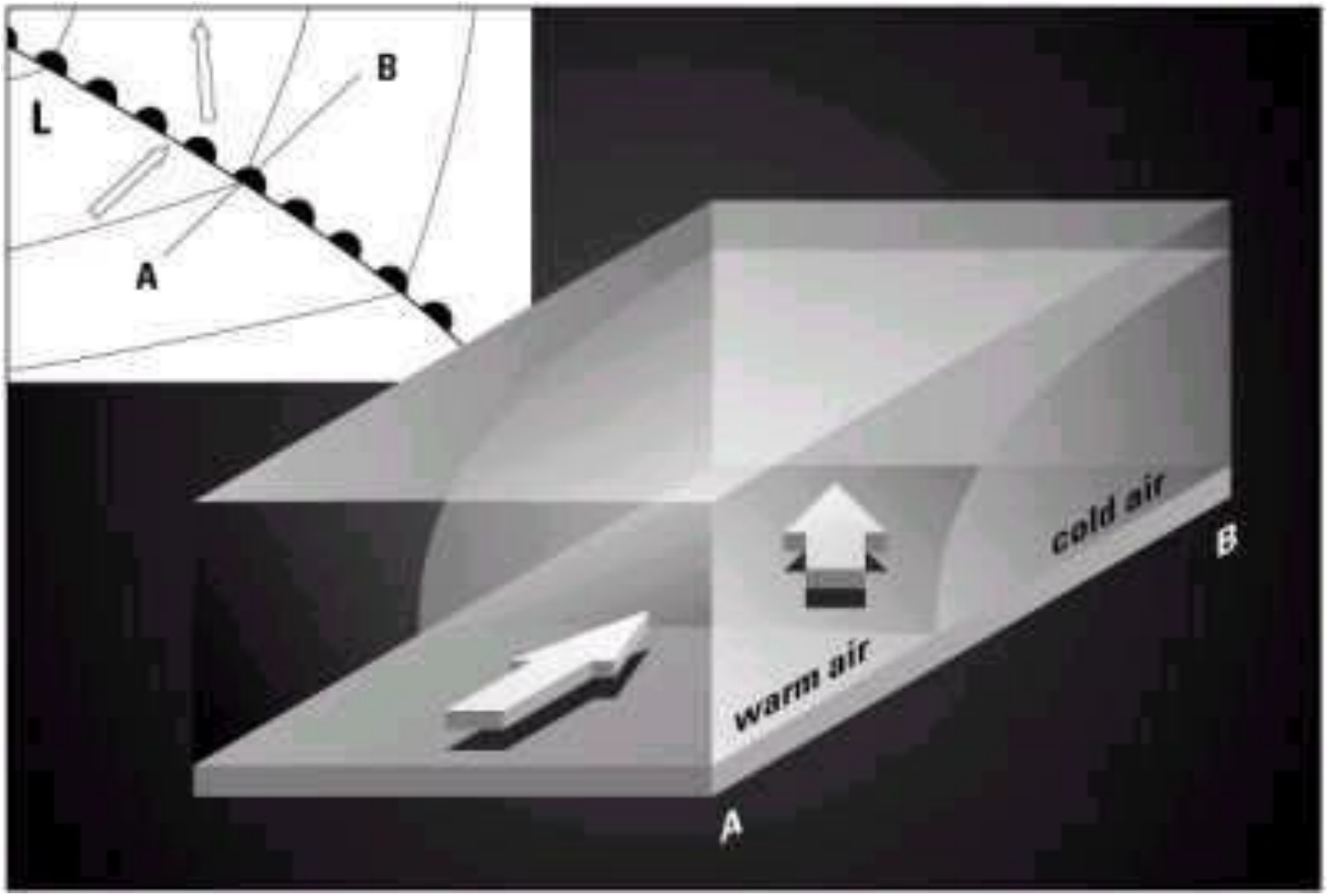
Stationary Front



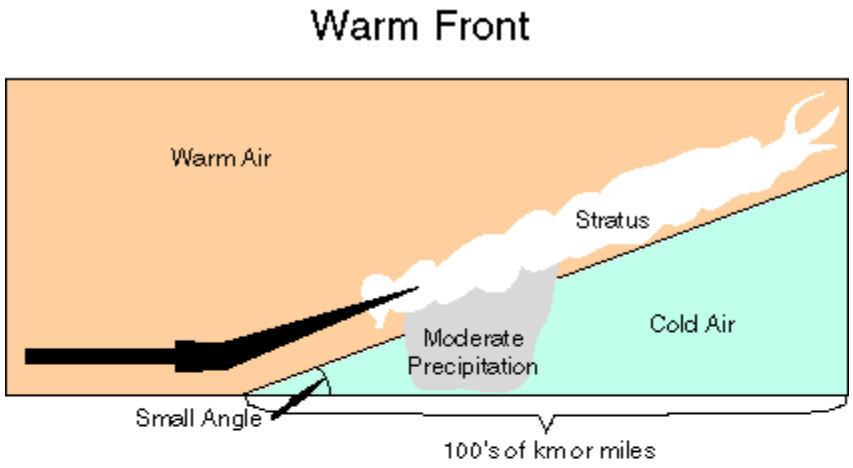
Cold Front

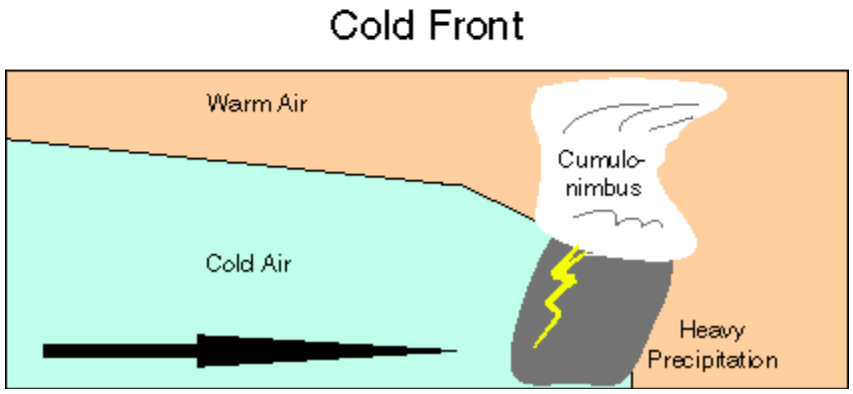


Warm Front

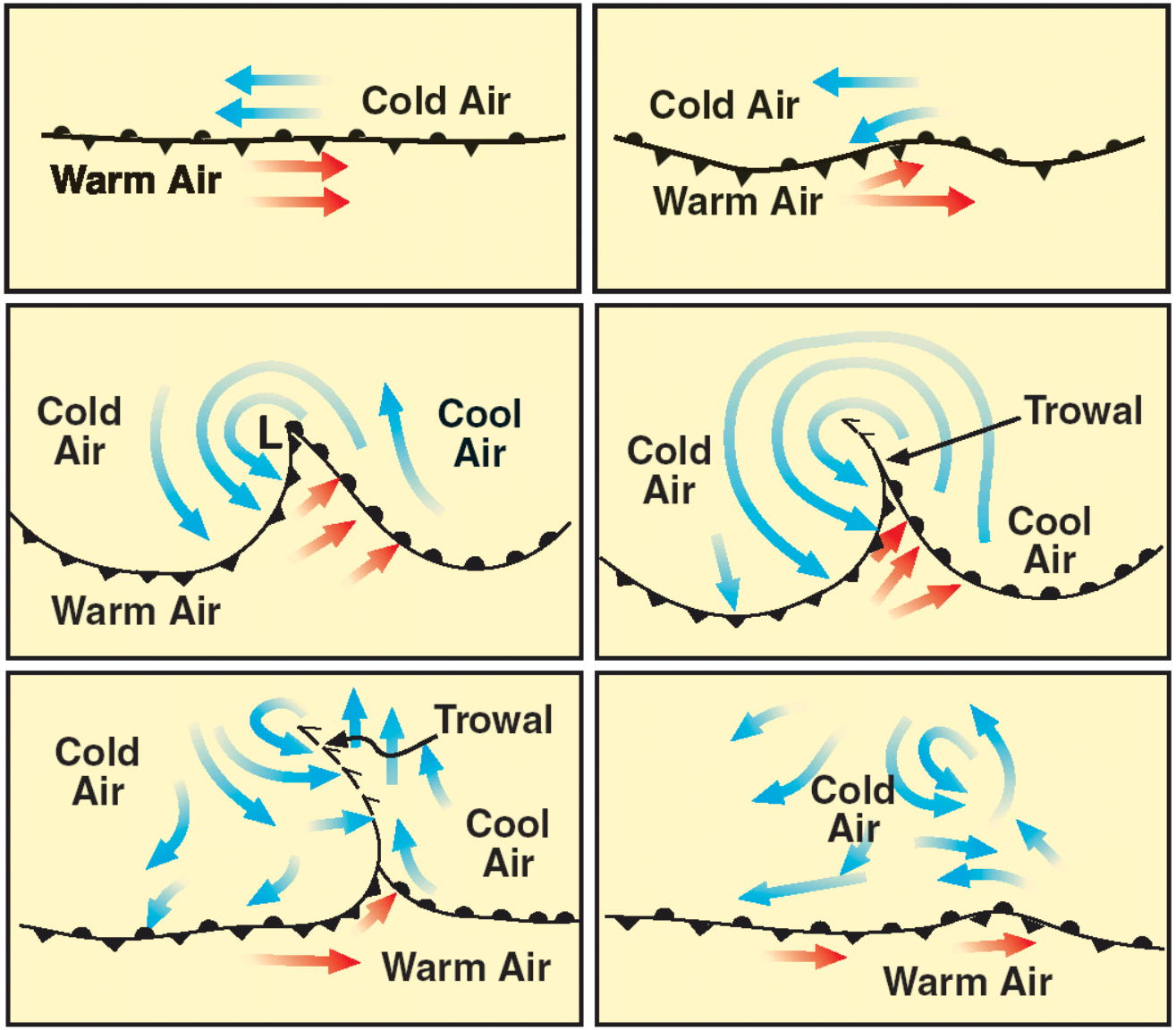


Transverse View of Cold and Warm Fronts

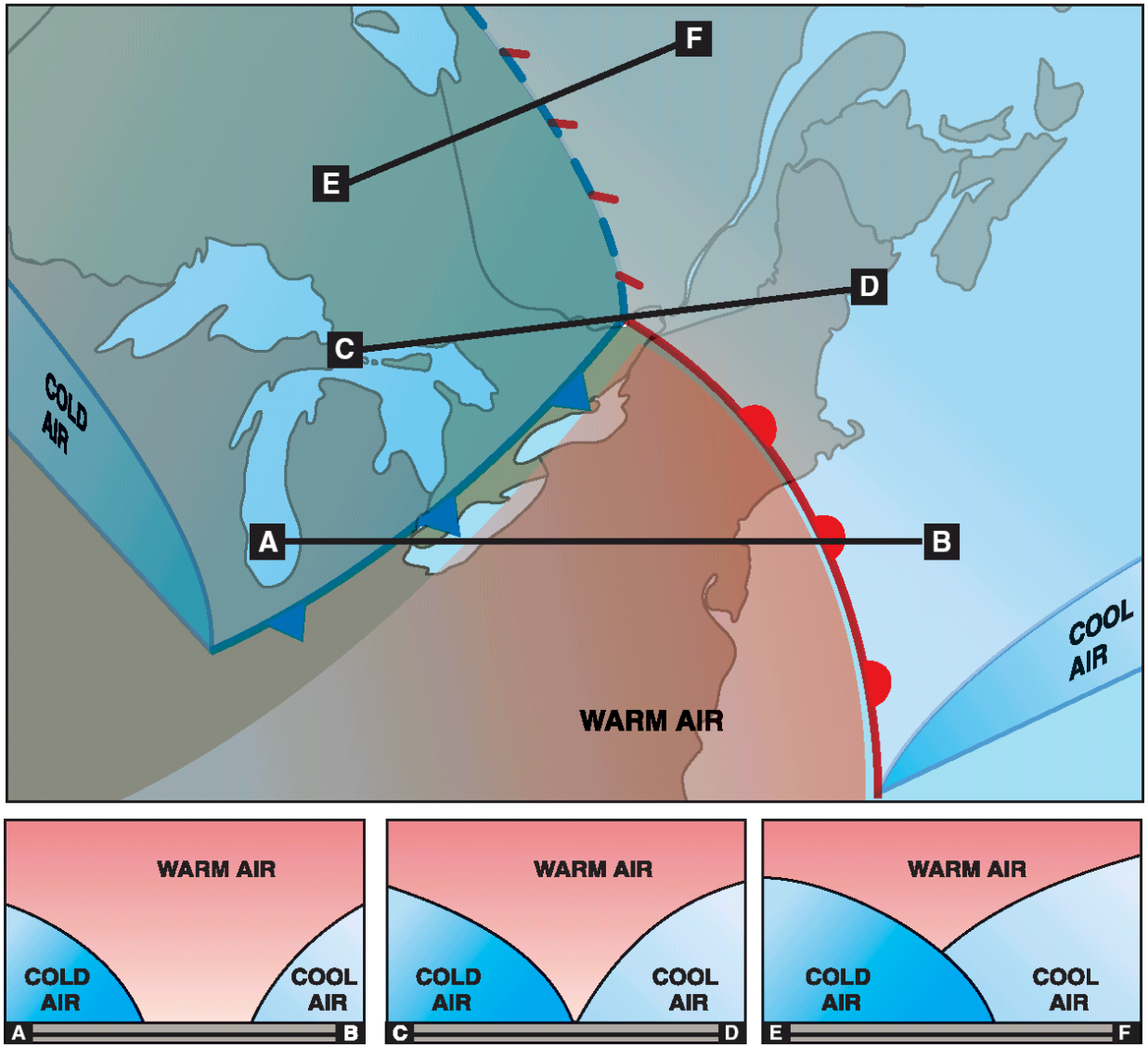




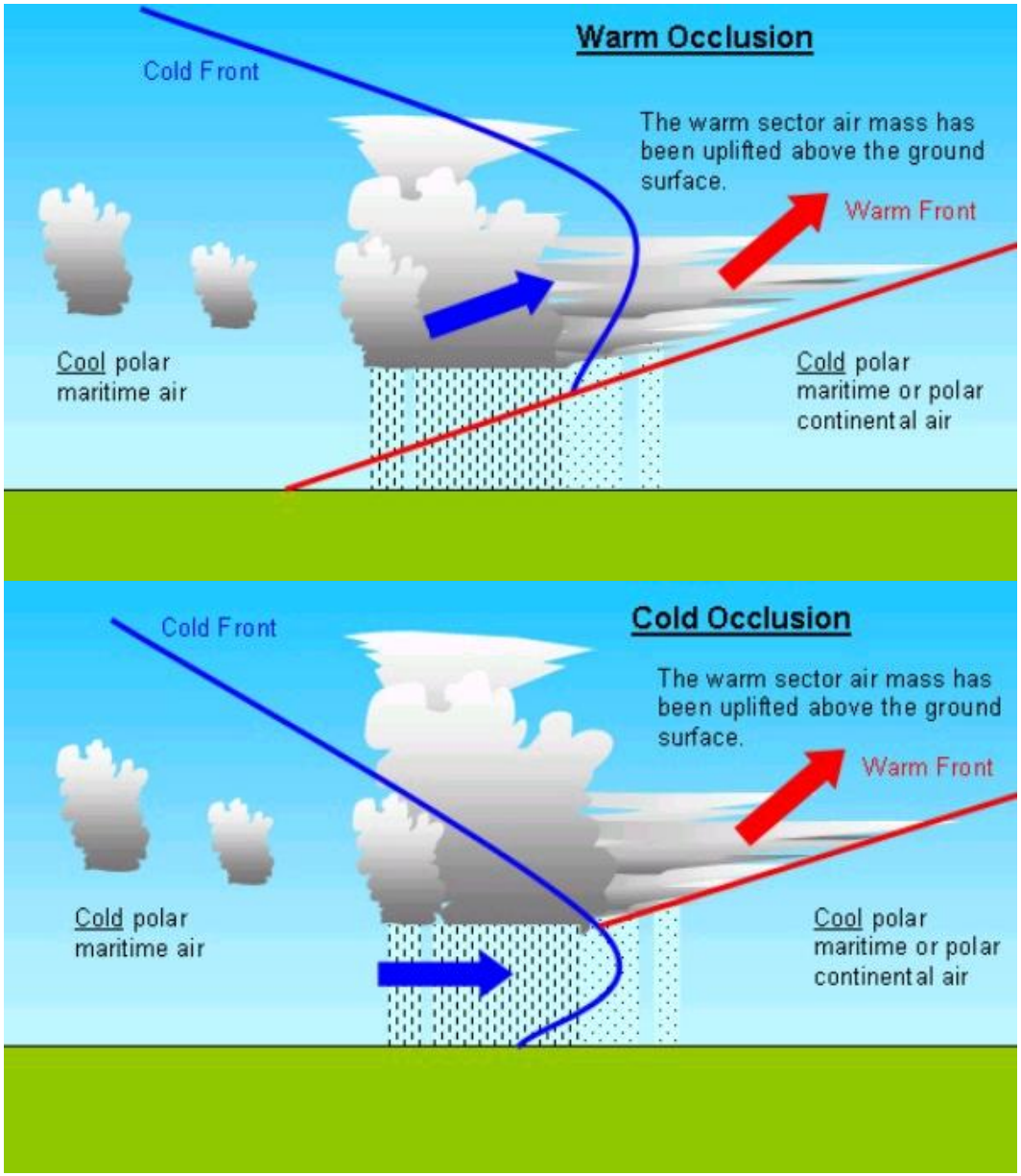
Development of a Frontal Depression



Frontal Depression Cross Sections



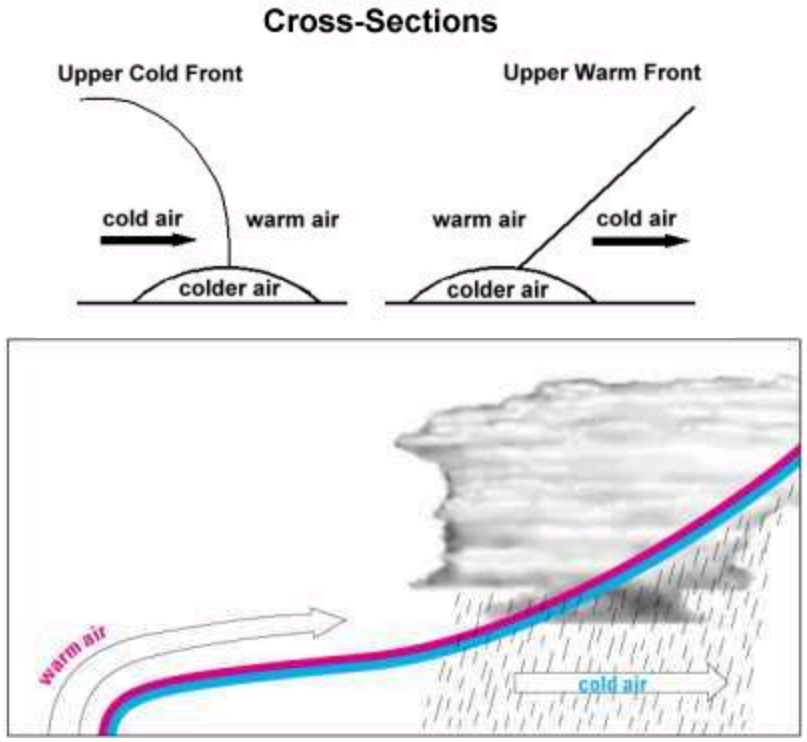
Warm Occlusion and Cold Occlusion



Upper Front

- Fronts that are not in contact with the ground
- Cool air overrunning cold air that was covered by warmer air.
- A shallow front that steepens abruptly at altitude.
- There is no longer sufficient contrast at ground level due to daytime heating.

Upper Front



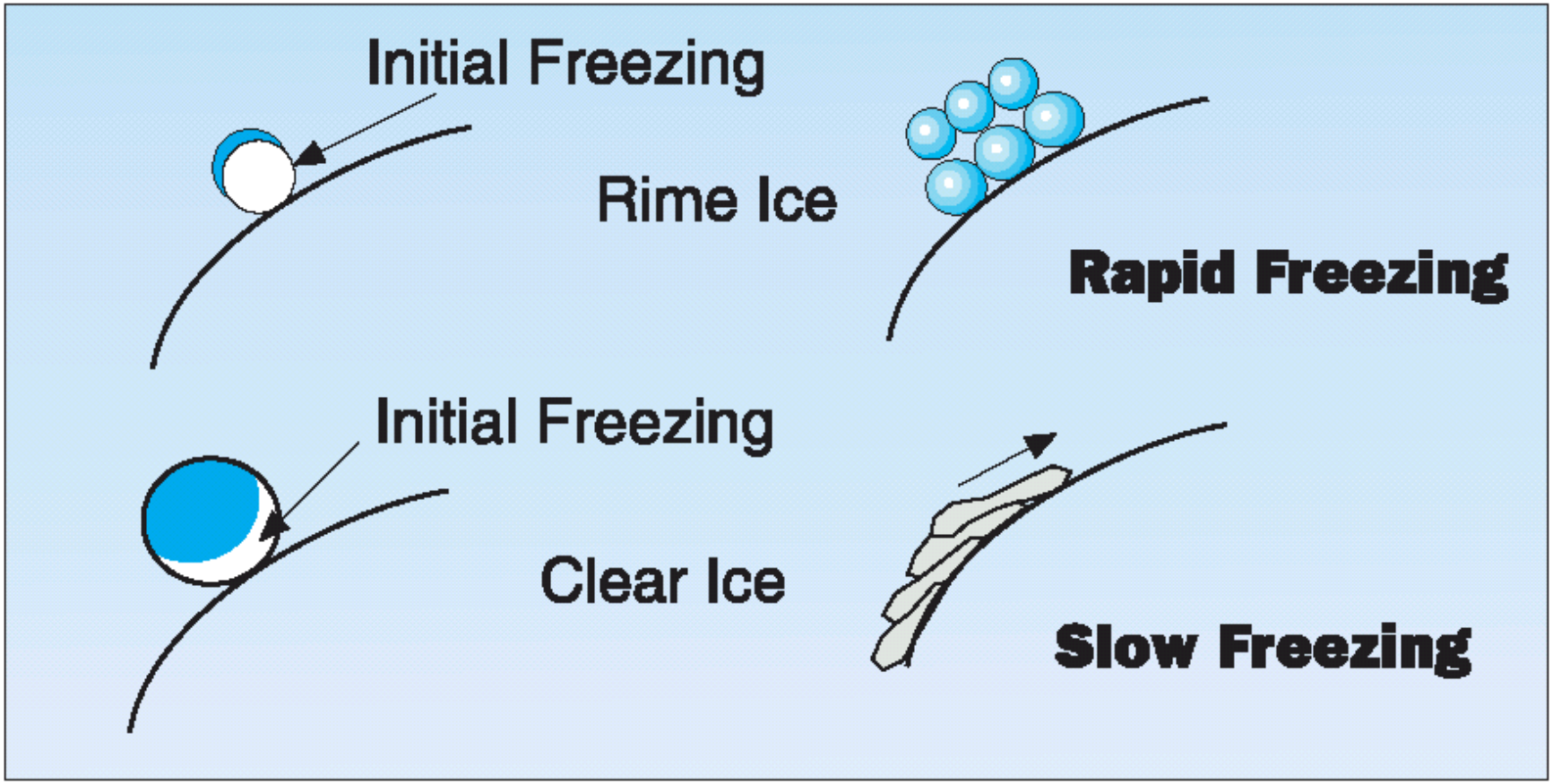
Upper Warm Front

Aircraft Icing

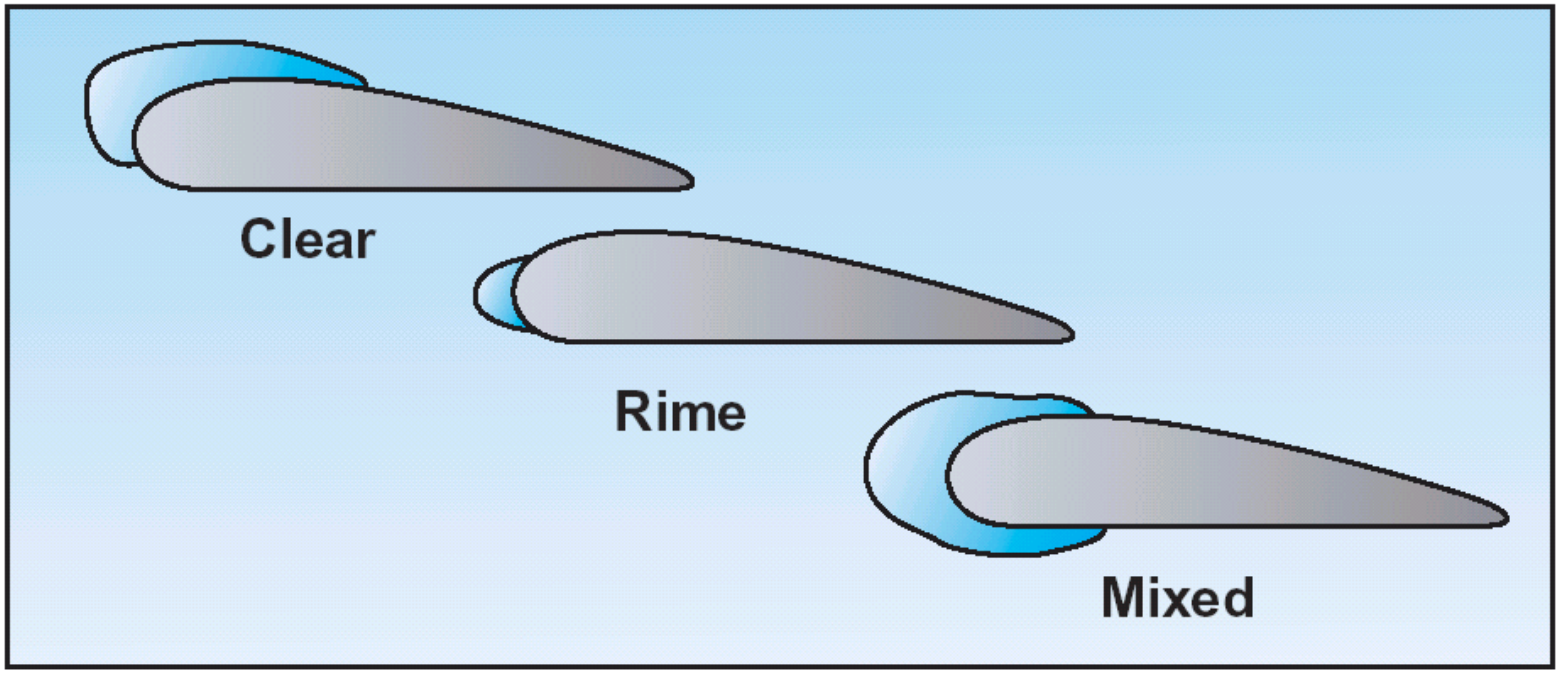
- An airplane strikes supercooled water droplets, which freeze when disturbed.
- Most often occurs in stratocumulus, but also occurs in cumulus.

Aircraft Icing

- An airplane strikes supercooled water droplets, which freeze when disturbed.
- Most often occurs in stratocumulus, but also occurs in cumulus



Accumulation Patterns of Different Icing Types



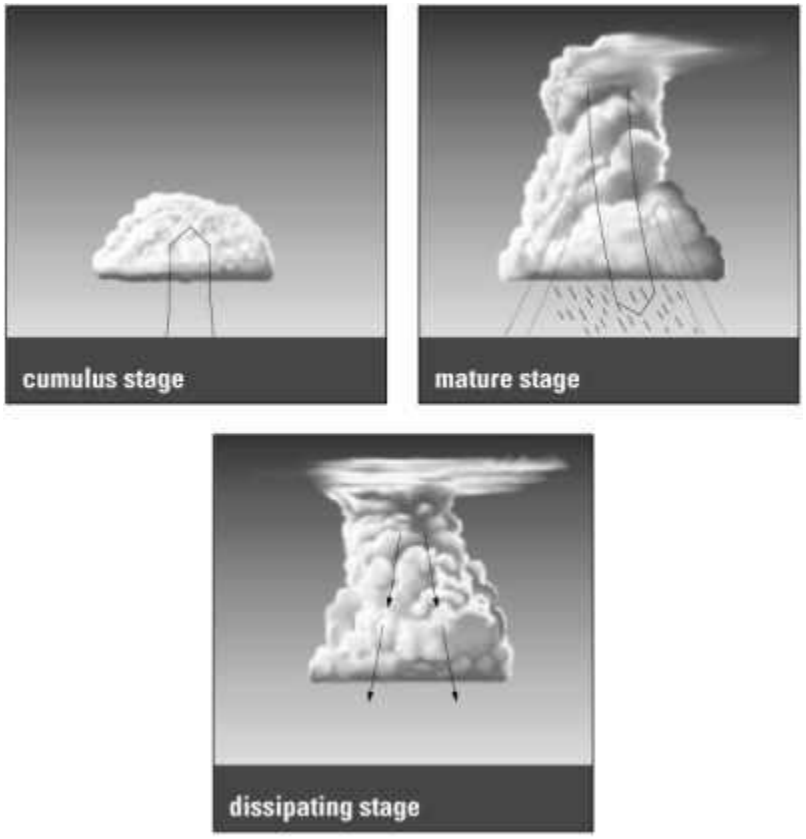
Hoar Frost

- Formed by deposition process on clear cold nights
- Frost and frozen dew must be removed from aircraft prior to take-off

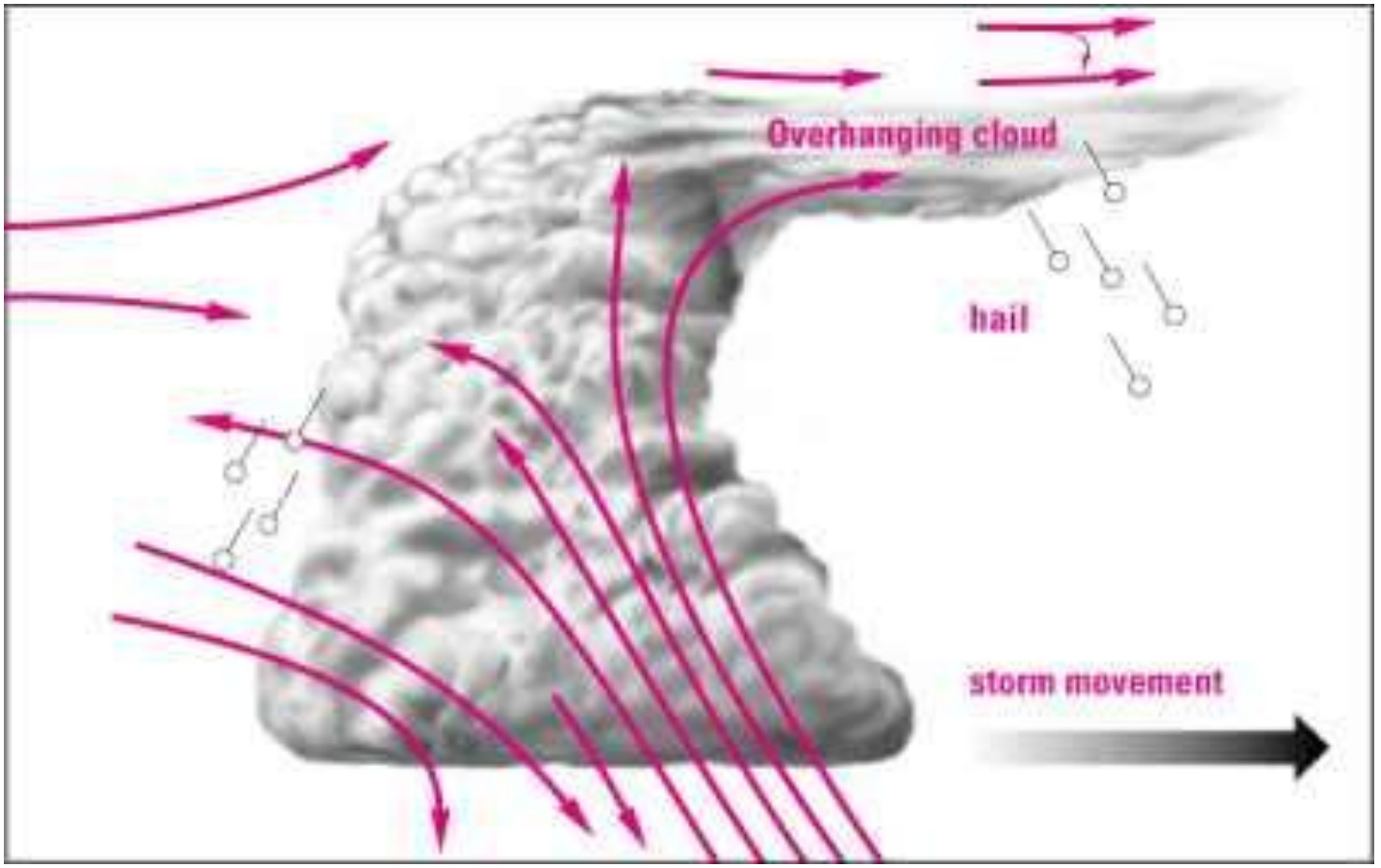
Thunderstorms

- Requirements: unstable air, some form of lifting action and a high moisture content
- Types: air mass, frontal, squall line, orographic

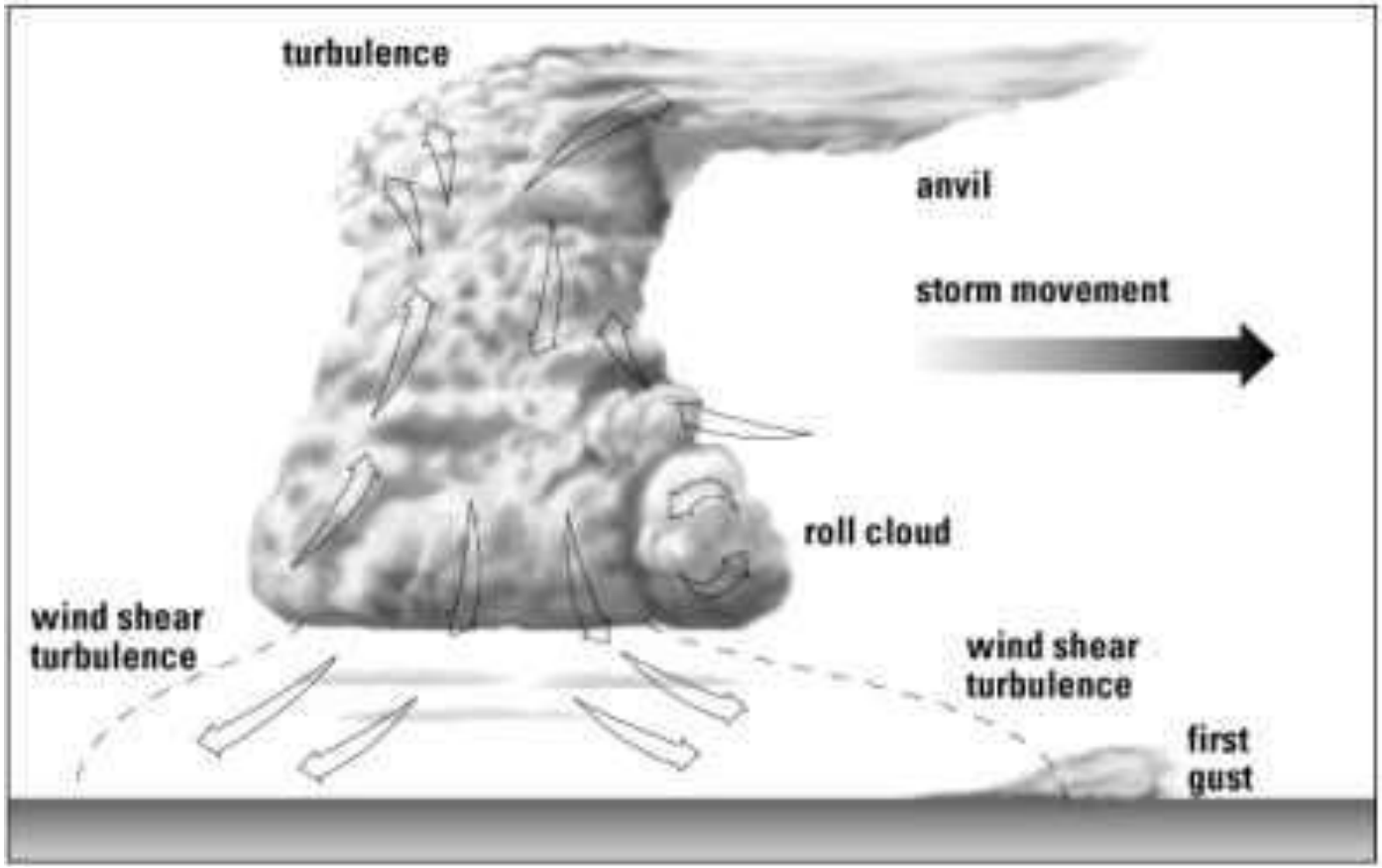
Stages of a thundercloud



Position of Hail in a Thunderstorm



Position of Turbulence in a Thunderstorm



Dangers of Thunderstorms

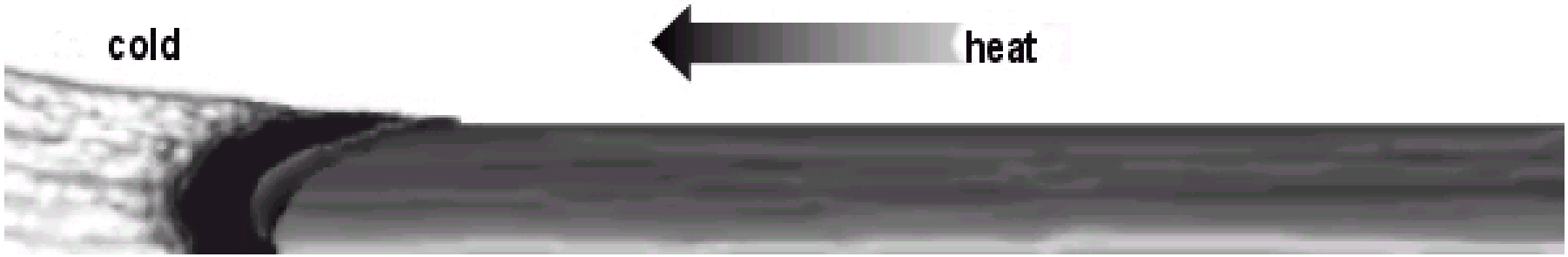
- Lightning
- Macrobursts
- Microbursts
- Icing
- Hail
- Unreliable Altimeter readings

Fog

- Like clouds, fog is a visible mass of condensed droplets or ice crystals, but it is in contact with the ground.
  - Radiation Fog
  - Advection Fog
  - Precipitation Fog
  - Steam Fog
  - Ice Fog
  - Upslope fog

Radiation Fog

Advection Fog



Steam Fog

Review Questions

12. Radiation fog forms as a result of the

a) passage of cold air over a warm surface.
b) air becoming moist as it moves over the sea.
c) clouds becoming cold and heavy at night so that they settle to the ground.
d) ground becoming cold at night and cooling the air in contact with it.

13. Advection fog forms when

a) moist air moves from a warm surface to a colder surface.
b) the cold ground cools the air in contact with it at night.
c) moist air is influenced by Orographic effect.
d) moist cool air moves from a cold surface to a warm surface.

14. A front is a

a) narrow zone of fog between a cyclone and an anticyclone.
b) line of thunderstorms.
c) narrow transition zone between two air masses.
d) mass of layer cloud which is very thick and which covers a wide area.

15. During the passage of a cold front

a) warm air is compressed as cold air rides over it.
b) temperature rises owing to increased pressure.
c) fog will always form from the interaction of warm and cold air.
d) warm air is lifted as colder air pushes under it.

Meteorological Services for Pilots

Nav Canada Aviation Weather Services

CAR 602.71 The pilot-in-command of an aircraft shall, before commencing a flight, be familiar with the available information that is appropriate to the intended flight.

CAR 602.72 The pilot-in-command of an aircraft shall, before commencing a flight, be familiar with the available weather information that is appropriate to the intended flight.

Collaborative Flight Planning Service:

- Pilot Briefing Services (by phone) still available
- However most access is by internet: https://plan.navcanada.ca/wxrecall/
- ATIS: (**Automatic terminal information service)** is a continuous and repetitive broadcast of recorded aeronautical information in busier terminal areas. Refer to CFS for frequency (121.15 for CYOW).

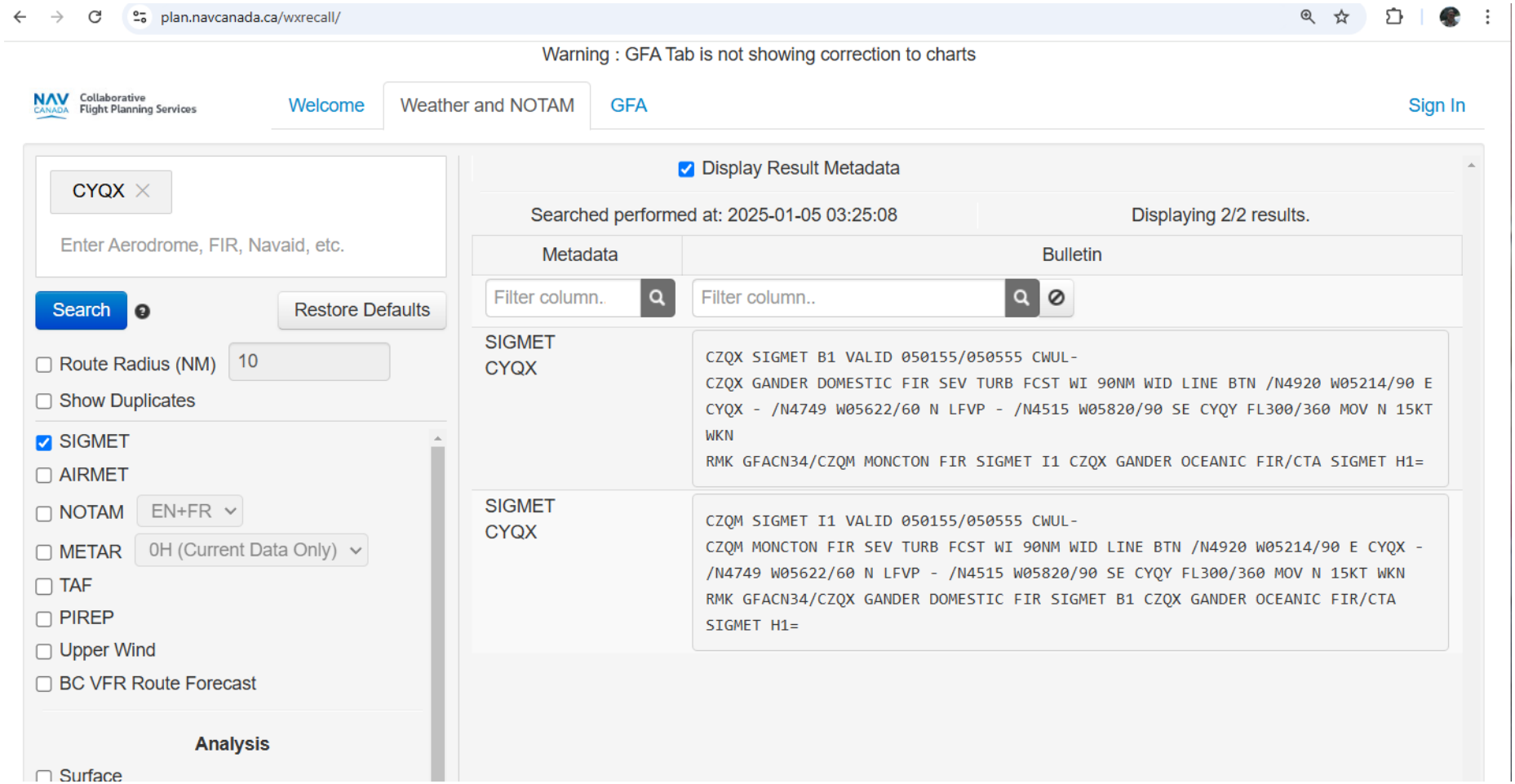
Some Useful Links

- AWS Guide https://www.navcanada.ca/en/aeronautical-information/operational-guides.aspx

- Weather manuals and documentation – especially the MANAIR (Manual of standards and procedures for aviation forecasts) and the MANAB (Manual of Word Abbreviations): https://www.canada.ca/en/environment-climate-change/services/weather-manuals-documentation.html

- AVMET: https://avmet.navcanada.ca/en/ : educational reference guide showcases weather as it relates directly to aviation.

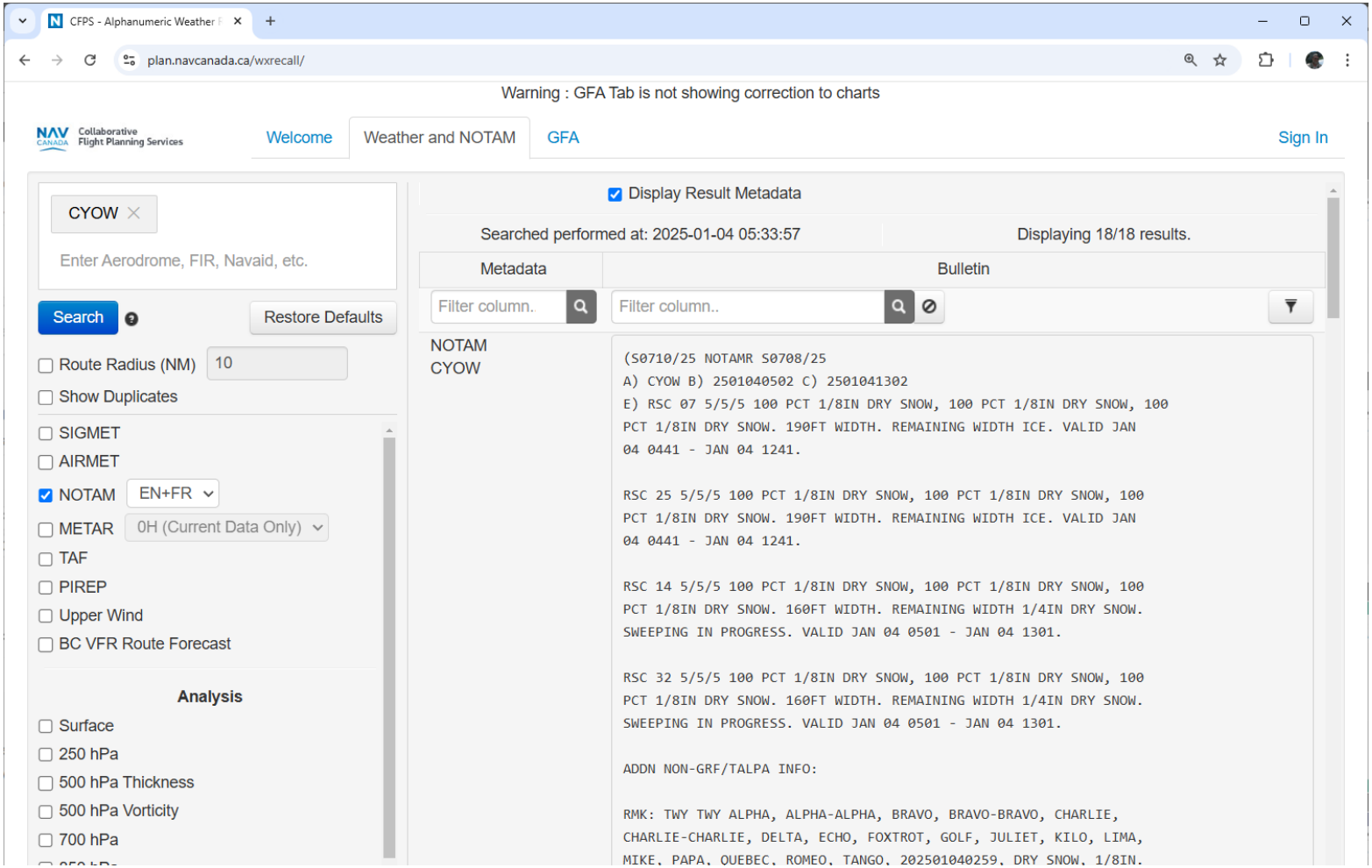
SIGNIFICANT METEOROLOGICAL INFORMATION (SIGMET): Information message issued by a meteorological watch office (MWO) to advise pilots of the occurrence or expected occurrence of specified weather phenomena, which may affect the safety of aircraft operations, and the development of those phenomena in time and space.



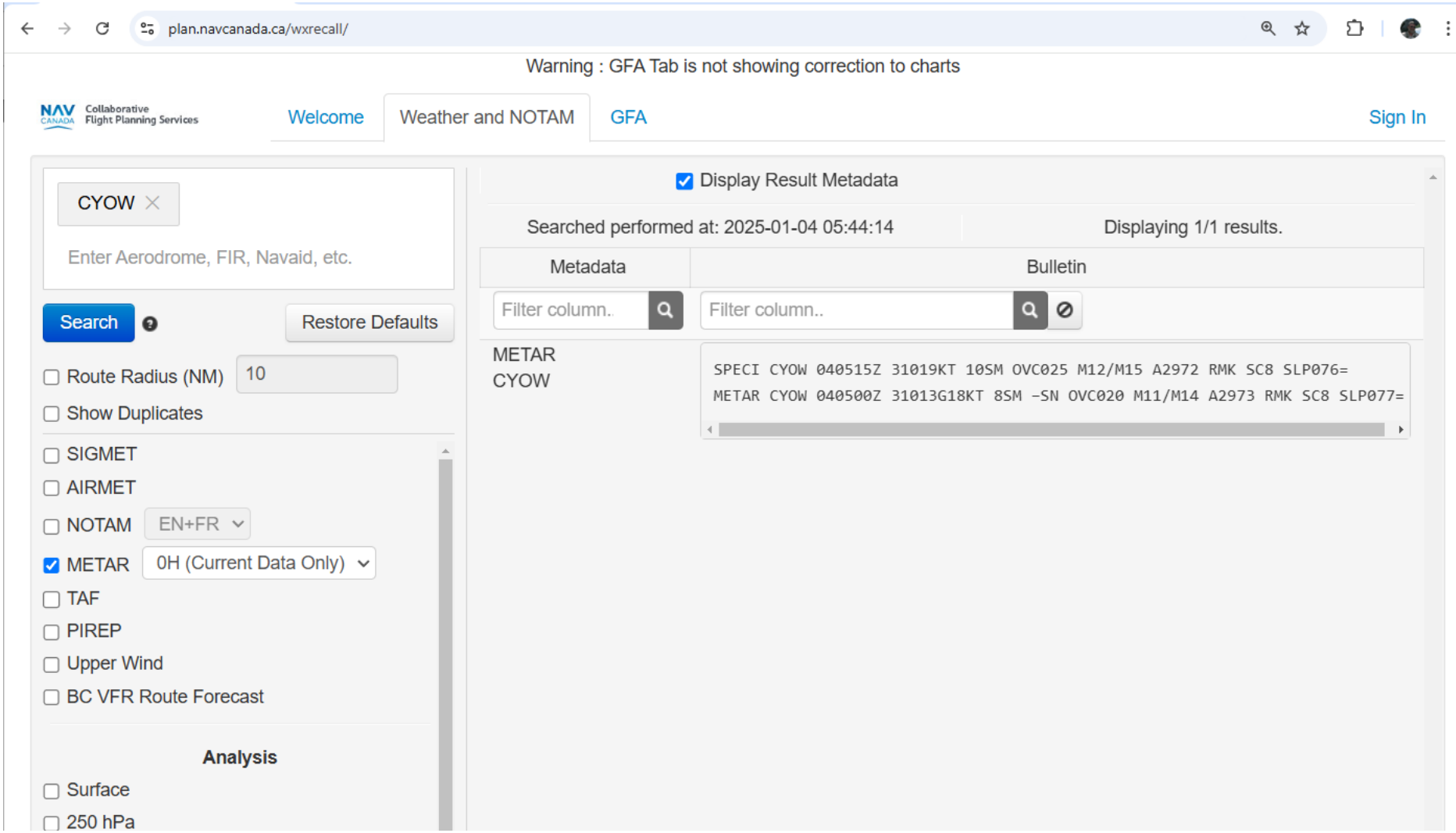
AIRMET: An information message issued by a meteorological watch office (MWO) to advise pilots of the occurrence or expected occurrence of weather phenomena, which may affect the safety of aircraft operations and which were not already included in the graphic area forecast (GFA). The message shall describe potentially hazardous weather conditions up to and including 24 000 ft (FL 240).

The main difference between an AIRMET and a SIGMET is the severity of the weather event they warn about.

NOTAM (Notice to Airmen) is a notice that contains information concerning the establishment or condition of, or any changes in, any aeronautical facility, service, procedure, or hazard.



METAR (Aerodrome Routine Meteorological Report) describes the actual weather conditions at a specified location and at a specified time as observed from the ground.



The main elements contained in a METAR are as follows:

- correction code;
- METAR/SPECI/LWIS identifier;
- station identifier;
- date stamp;
- wind information;
- prevailing horizontal visibility;
- present weather;
- cloud group;
- temperature/dew point;
- altimeter setting and
- Remarks

- METAR CYOW 280600Z 18004KT 15SM FEW150 SCT250 M11/M15 A3013 RMK AC1CI0 SLP213

METAR

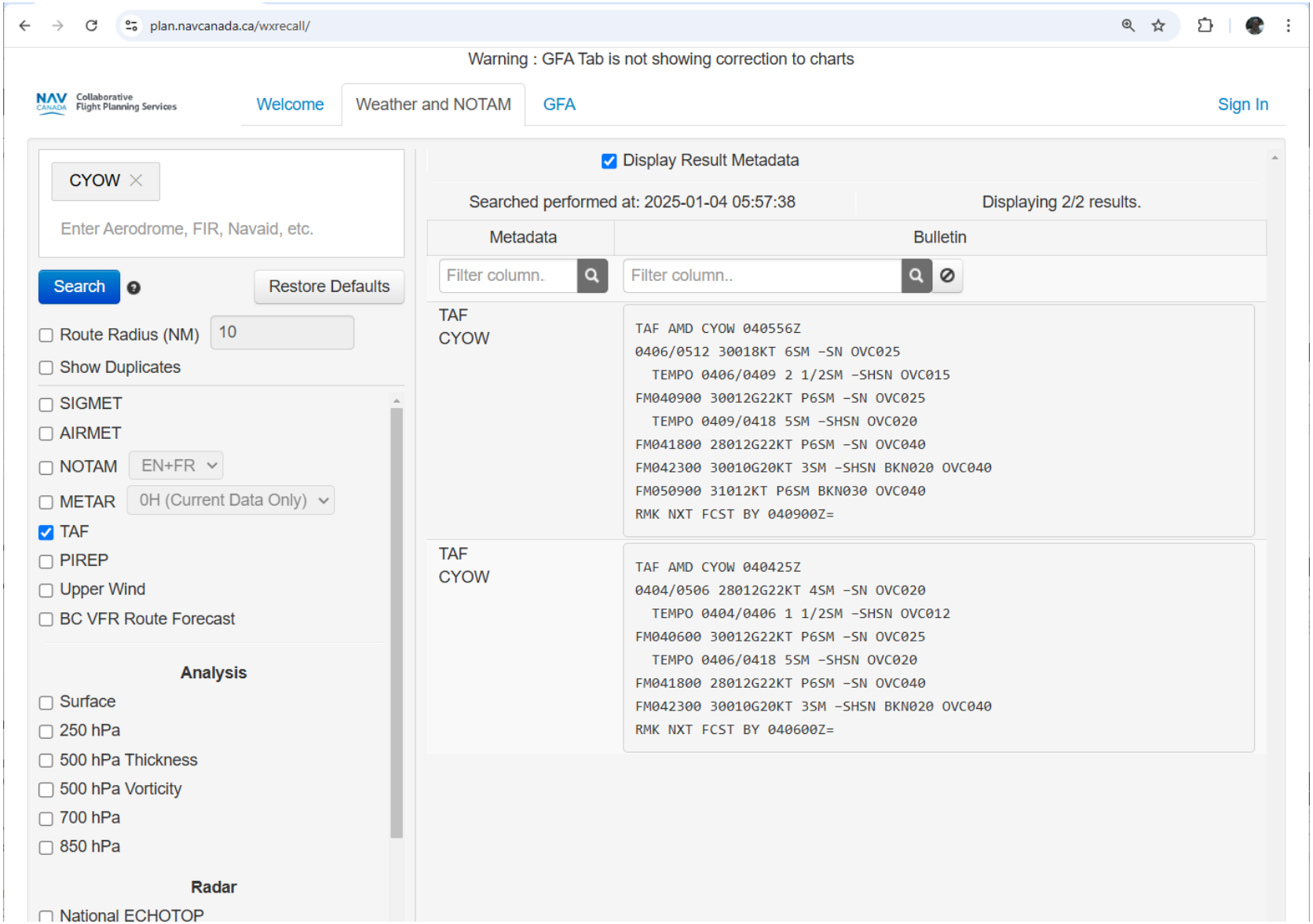
METAR CYOW 280600Z 18004KT 15SM FEW150 SCT250 M11/M15 A3013 RMK AC1CI0 SLP213=

METAR	LOCATION	DATE - TIME
	CYOW - OTTAWA/MACDONALD-CARTIER INTL/ON	28 FEBRUARY 2005 - 0600 UTC
WIND	**VISIBILITY**	**RUNWAY VISUAL RANGE**
180 TRUE @ 4 KNOTS	15 STAT. MILES	
WEATHER	**CLOUDINESS**	**TEMP / DEWPOINT**
	FEW CLOUDS (1/8 - 2/8) 15000 FT SCATTERED CLOUDS (3/8 - 4/8) 25000 FT	-11 C / -15 C
ALTIMETER	**RECENT WEATHER**	**WIND SHEAR**
30.13 IN HG		

REMARKS

RMK AC1CI0 SLP213=
CLOUD WITH OPACITY: ALTOCUMULUS 1 /8 CIRRUS 0 /8
SEA LEVEL PRESSURE: 1021.3 hPa

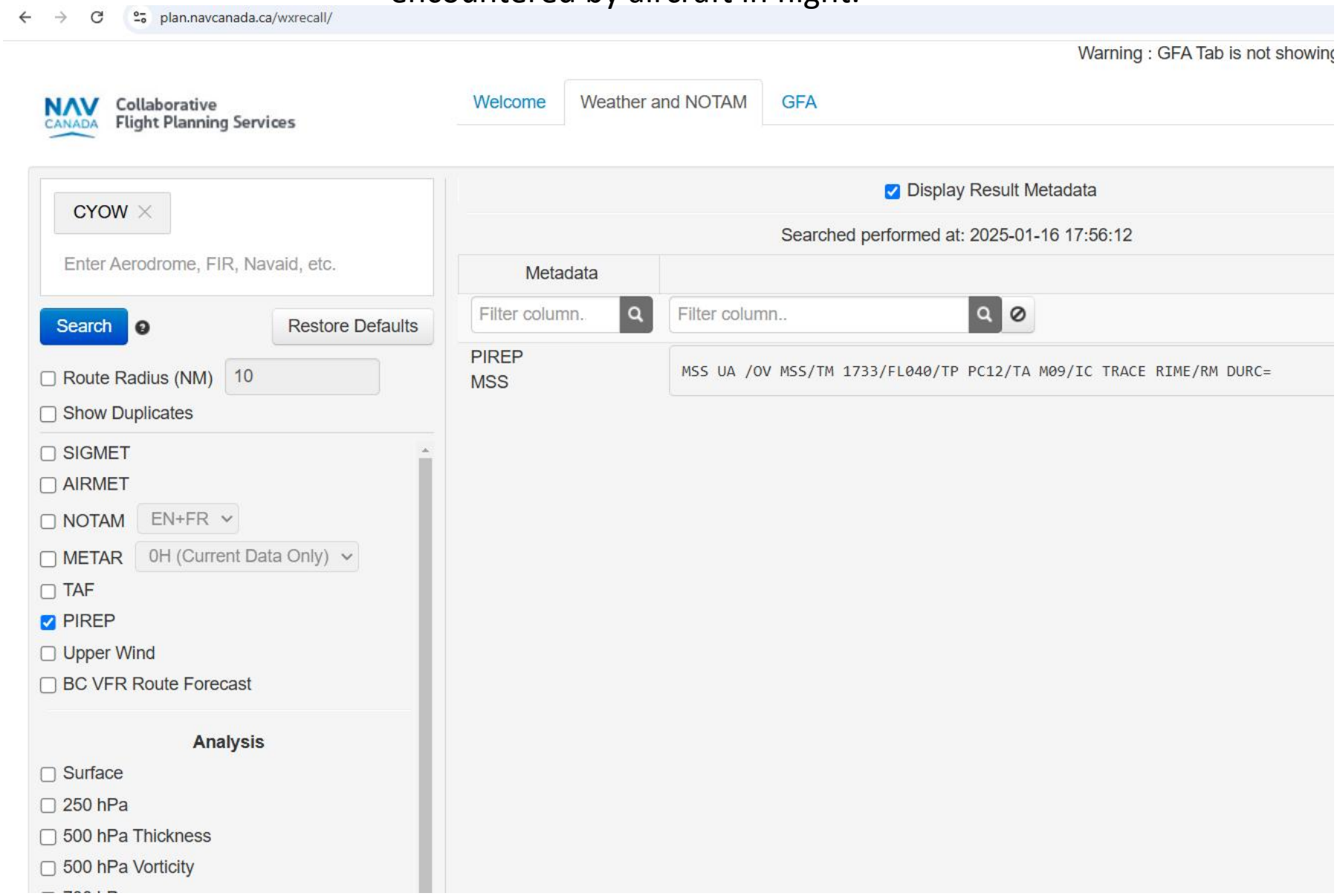
TAF: (Aerodrome Forecast) Weather forecast at an aerodrome to a maximum of 30 hours using the same meteorological code as METAR.



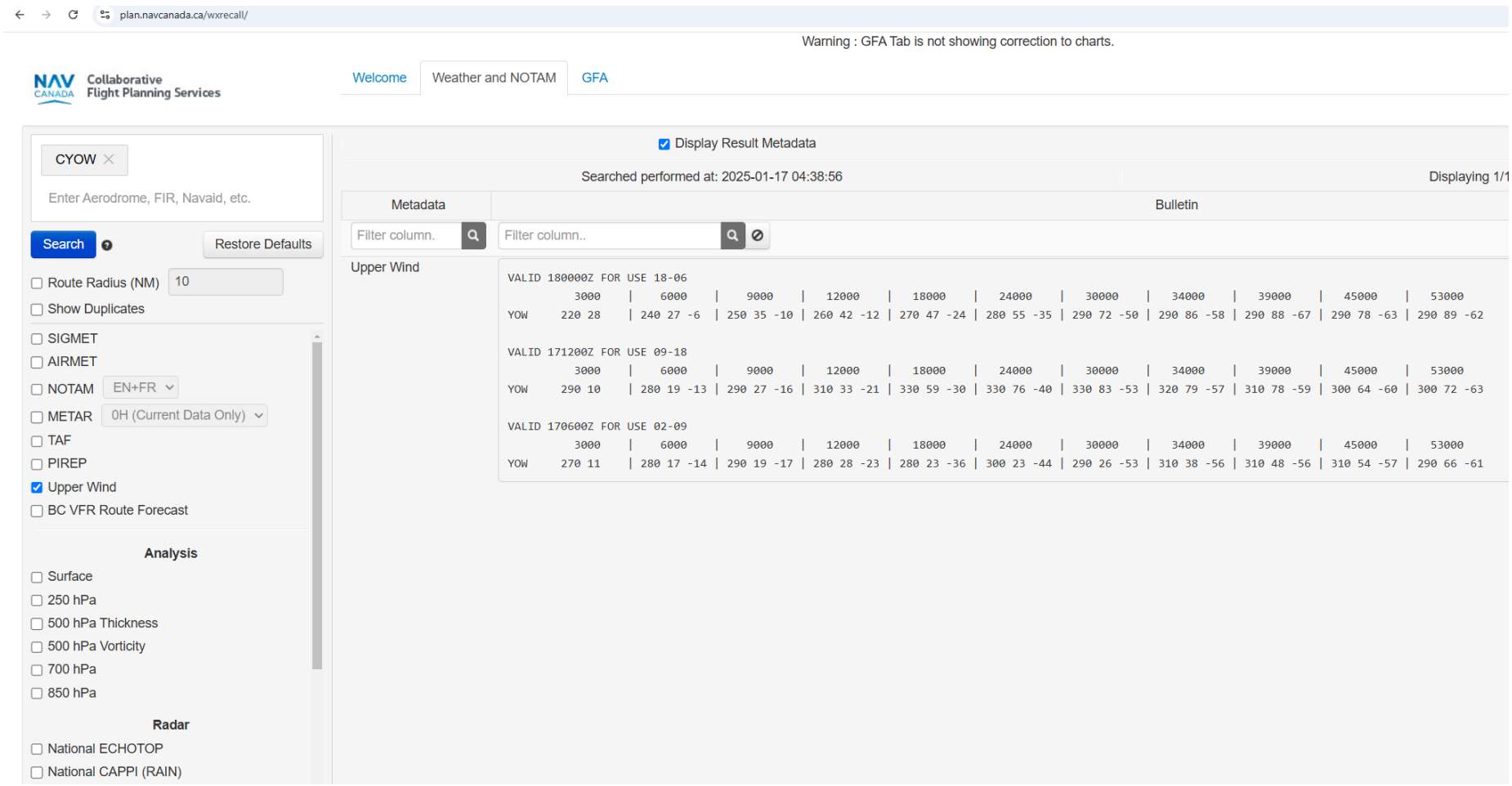
Sky Condition (Cloud Cover)

- Celestial Dome is divided into 8 segments called okta
  - SKC: Sky clear – 0 okta
  - FEW: Few - Less than 2 okta
  - SCT: Scattered - 3 or 4 okta
  - BKN: Broken - 5, 6, or 7 okta
  - OVC: Overcast - 8 okta

PIREP is a pilot weather report pertaining to current weather conditions encountered by aircraft in flight.



Upper Wind


plan.navcanada.ca/wxrecall/
Warning : GFA Tab is not showing correction to charts.
NAV CANADA Collaborative Flight Planning Services
Welcome
Weather and NOTAM
GFA
CYOW
Enter Aerodrome, FIR, Navaid, etc.
Search
Restore Defaults
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Show Duplicates
SIGMET
AIRMET
NOTAM EN+FR
METAR 0H (Current Data Only)
TAF
PIREP
Upper Wind
BC VFR Route Forecast
Analysis
Surface
250 hPa
500 hPa Thickness
500 hPa Vorticity
700 hPa
850 hPa
Radar
National ECHOTOP
National CAPPI (RAIN)
Display Result Metadata
Searched performed at: 2025-01-17 04:38:56
Displaying 1/1
Metadata
Bulletin
Filter column.
Filter column..
Upper Wind
VALID 180000Z FOR USE 18-06
3000 | 6000 | 9000 | 12000 | 18000 | 24000 | 30000 | 34000 | 39000 | 45000 | 53000
YOW 220 28 | 240 27 -6 | 250 35 -10 | 260 42 -12 | 270 47 -24 | 280 55 -35 | 290 72 -50 | 290 86 -58 | 290 88 -67 | 290 78 -63 | 290 89 -62
VALID 171200Z FOR USE 09-18
3000 | 6000 | 9000 | 12000 | 18000 | 24000 | 30000 | 34000 | 39000 | 45000 | 53000
YOW 290 10 | 280 19 -13 | 290 27 -16 | 310 33 -21 | 330 59 -30 | 330 76 -40 | 330 83 -53 | 320 79 -57 | 310 78 -59 | 300 64 -60 | 300 72 -63
VALID 170600Z FOR USE 02-09
3000 | 6000 | 9000 | 12000 | 18000 | 24000 | 30000 | 34000 | 39000 | 45000 | 53000
YOW 270 11 | 280 17 -14 | 290 19 -17 | 280 28 -23 | 280 23 -36 | 300 23 -44 | 290 26 -53 | 310 38 -56 | 310 48 -56 | 310 54 -57 | 290 66 -61

Warning : GFA Tab is not showing correction to charts.

nd NOTAM | GFA

Display Result Metadata

Searched performed at: 2025-01-17 04:38:56 | Displaying

Bulletin

Filter column..

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VALID 180000Z FOR USE 18-06
          3000    |    6000    |    9000    |   12000    |   18000    |   24000    |   30000    |   34000    |   39000    |   45000    |   53000
YOW     220 28    | 240 27 -6  | 250 35 -10 | 260 42 -12 | 270 47 -24 | 280 55 -35 | 290 72 -50 | 290 86 -58 | 290 88 -67 | 290 78 -63 | 290 89 -62

VALID 171200Z FOR USE 09-18
          3000    |    6000    |    9000    |   12000    |   18000    |   24000    |   30000    |   34000    |   39000    |   45000    |   53000
YOW     290 10    | 280 19 -13 | 290 27 -16 | 310 33 -21 | 330 59 -30 | 330 76 -40 | 330 83 -53 | 320 79 -57 | 310 78 -59 | 300 64 -60 | 300 72 -63

VALID 170600Z FOR USE 02-09
          3000    |    6000    |    9000    |   12000    |   18000    |   24000    |   30000    |   34000    |   39000    |   45000    |   53000
YOW     270 11    | 280 17 -14 | 290 19 -17 | 280 28 -23 | 280 23 -36 | 300 23 -44 | 290 26 -53 | 310 38 -56 | 310 48 -56 | 310 54 -57 | 290 66 -61
```

Upper Winds - Explanation

The symbolic form of the forecast is ddfftt where dd is the wind direction in tens of degrees with respect to true north, ff is the wind speed in knots, and tt is the temperature in degrees Celsius.
Temperature not shown at 3000’

Valid ddhh:00 this means that by the hour indicated, you should use the next issue.
Subtracting 100 knots from the speed and adding 50 to the direction indicate wind speeds from 100 to 199 knots. For example, 240 degrees @ 130 knots is coded 7430. Speeds in excess of 199 knots are coded as if they were of 199 knots (e.g. winds of 90 degrees @ 210 knots are coded 5999, as would winds of 199 knots). Finally, wind speeds less than 5 knots are indicated by 9900.

Upper Winds (Text Version)

STN YYZ - TORONTO. ONT	for use	3000	6000	9000	12000	18000
FDCN01 CWAO FCST BASED ON 211200 DATA **VALID 211800**	**17-21**	2218	2330-10	2429-11	2440-15	2455-26
FDCN02 CWAO FCST BASED ON 211200 DATA **VALID 220000**	**21-06**	2812	2620-09	2626-12	2632-17	2557-28
FDCN03 CWAO FCST BASED ON 211200 DATA **VALID 221200**	**06-17**	2706	2529-10	2542-15	2653-19	2662-32

VALID 221200Z

STN YYZ - TORONTO. ONT	for use	24000	30000	34000	39000	45000	53000
FDCN01 KWBC DATA BASED ON 211200Z **VALID 211800Z**	**1700-2100Z.**	2575-37	750453	750759	268056	266153	265257
FDCN02 KWBC DATA BASED ON 211200Z **VALID 220000Z**	**2100-0600Z.**	2577-39	742051	741356	258354	267354	265756
FDCN03 KWBC DATA BASED ON 211200Z **VALID 221200Z**	**0600-1700Z.**	2673-44	258254	258451	257450	256852	265755

Your time 21 Feb 2015 18:43:08 UTC time 21 Feb 2015 23:43:08 Clock Disclaimer Log out

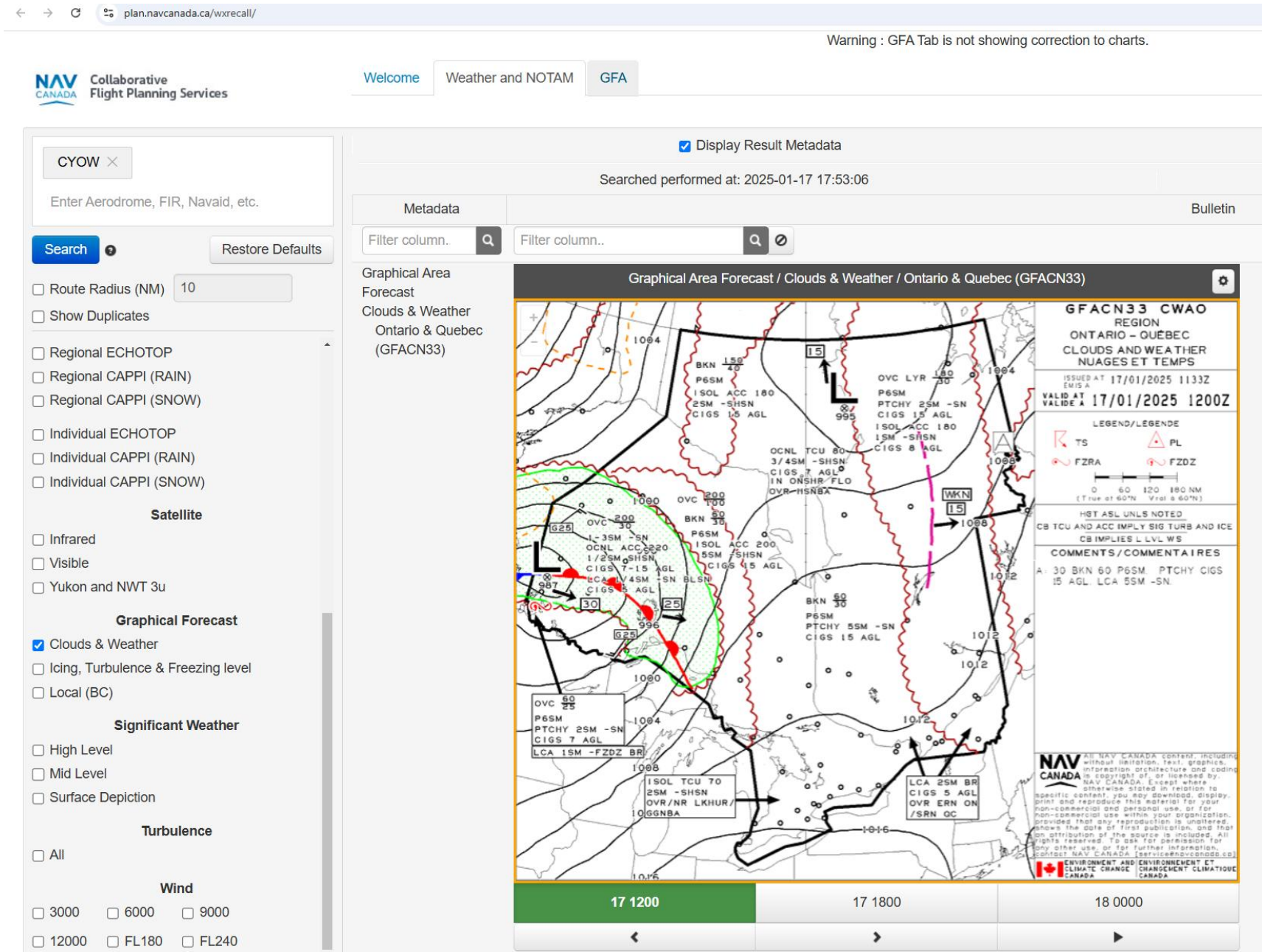
Weather data provided by Environment Canada and NAV CANADA

Environment Canada Environnement Canada

GFA: Graphical Forecast Analysis

The Clouds and Weather GFA chart provides a forecast of cloud layers and/or surface-based phenomena, visibility, weather, and obstructions to vision. Isobars are depicted at 4mb intervals. In addition, the speed and direction of movement of relevant fronts and high / low pressure centres are depicted. When the speed of fronts or pressure systems is less than 5 knots, the letters QS are used to indicate a quasi-stationary front.

GFA: Graphical Forecast Analysis – 17 1200



GFA: Graphical Forecast Analysis – 17 1200

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Welcome | Weather and NOTAM | GFA

CYOW

Enter Aerodrome, FIR, Navaid, etc.

Search | Restore Defaults

- Route Radius (NM) 10
- Show Duplicates

- Regional ECHOTOP
- Regional CAPPI (RAIN)
- Regional CAPPI (SNOW)
- Individual ECHOTOP
- Individual CAPPI (RAIN)
- Individual CAPPI (SNOW)

Satellite

- Infrared
- Visible
- Yukon and NWT 3u

Graphical Forecast

- Clouds & Weather
- Icing, Turbulence & Freezing level
- Local (BC)

Significant Weather

- High Level
- Mid Level
- Surface Depiction

Turbulence

- All

Wind

- 3000 | 6000 | 9000
- 12000 | FL180 | FL240

Display Result Metadata

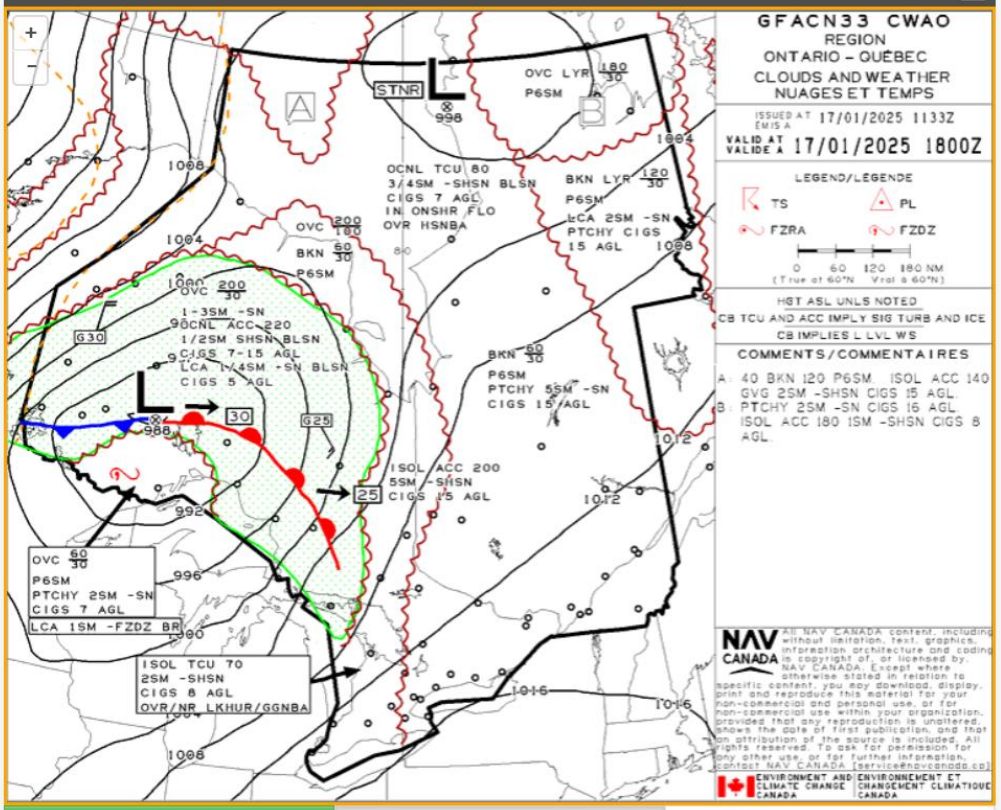
Searched performed at: 2025-01-17 17:53:06

Metadata | Bulletin

Filter column. | Filter column..

Graphical Area Forecast
Clouds & Weather
Ontario & Quebec (GFACN33)

Graphical Area Forecast / Clouds & Weather / Ontario & Quebec (GFACN33)



17 1200 | 17 1800 | 18 0000

17 1800

GFA: Graphical Forecast Analysis – 18 0000

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CYOW

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Search | Restore Defaults

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- Regional CAPPI (RAIN)
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Turbulence

- All

Wind

- 3000
- 6000
- 9000
- 12000
- FL180
- FL240

Display Result Metadata

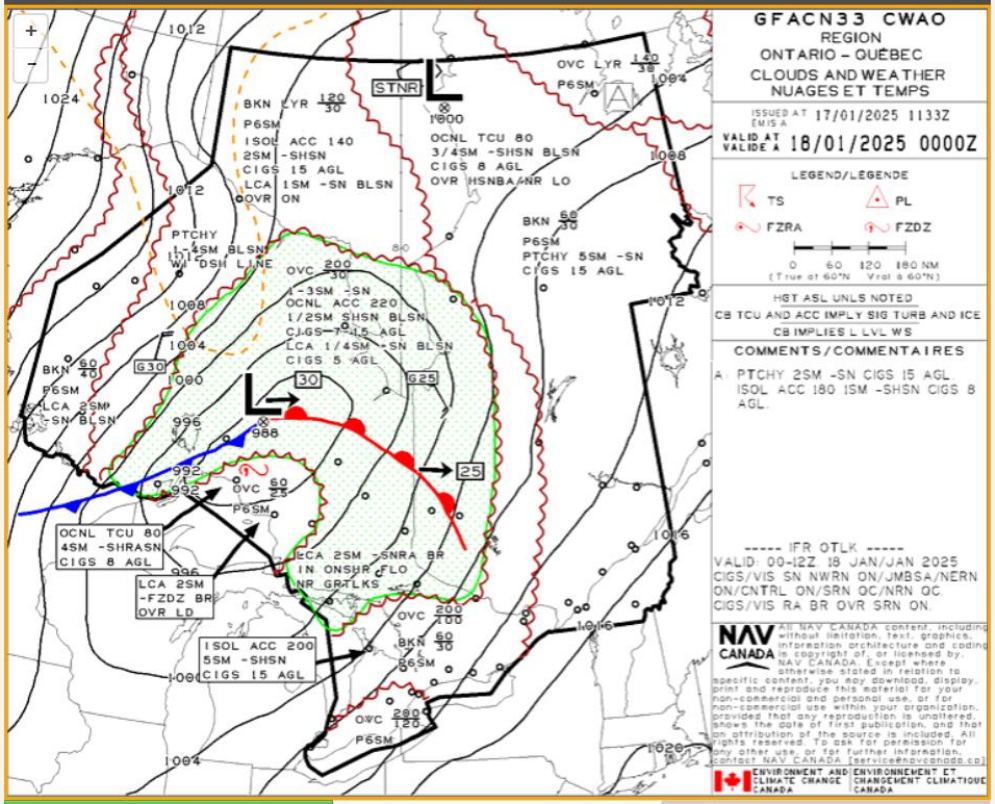
Searched performed at: 2025-01-17 17:53:06

Metadata | Bulletin

Filter column. | Filter column..

Graphical Area Forecast
Clouds & Weather
Ontario & Quebec (GFACN33)

Graphical Area Forecast / Clouds & Weather / Ontario & Quebec (GFACN33)



17 1200 | 17 1800 | 18 0000

Icing, Turbulence & Freezing level

plan.navcanada.ca/wxrecall/

Warning : GFA Tab is not showing correction to charts.

NAV CANADA Collaborative Flight Planning Services

Welcome | Weather and NOTAM | GFA

CYOW

Enter Aerodrome, FIR, Navaid, etc.

Search | Restore Defaults

- [ ] Route Radius (NM) 10
- [ ] Show Duplicates

- [ ] Regional ECHOTOP
- [ ] Regional CAPPI (RAIN)
- [ ] Regional CAPPI (SNOW)
- [ ] Individual ECHOTOP
- [ ] Individual CAPPI (RAIN)
- [ ] Individual CAPPI (SNOW)

Satellite

- [ ] Infrared
- [ ] Visible
- [ ] Yukon and NWT 3u

Graphical Forecast

- [ ] Clouds & Weather
- [x] Icing, Turbulence & Freezing level
- [ ] Local (BC)

Significant Weather

- [ ] High Level
- [ ] Mid Level
- [ ] Surface Depiction

Turbulence

- [ ] All

Wind

- [ ] 3000 [ ] 6000 [ ] 9000
- [ ] 12000 [ ] FL180 [ ] FL240
- [ ] FL340 [ ] FL390 [ ] FL450

[x] Display Result Metadata

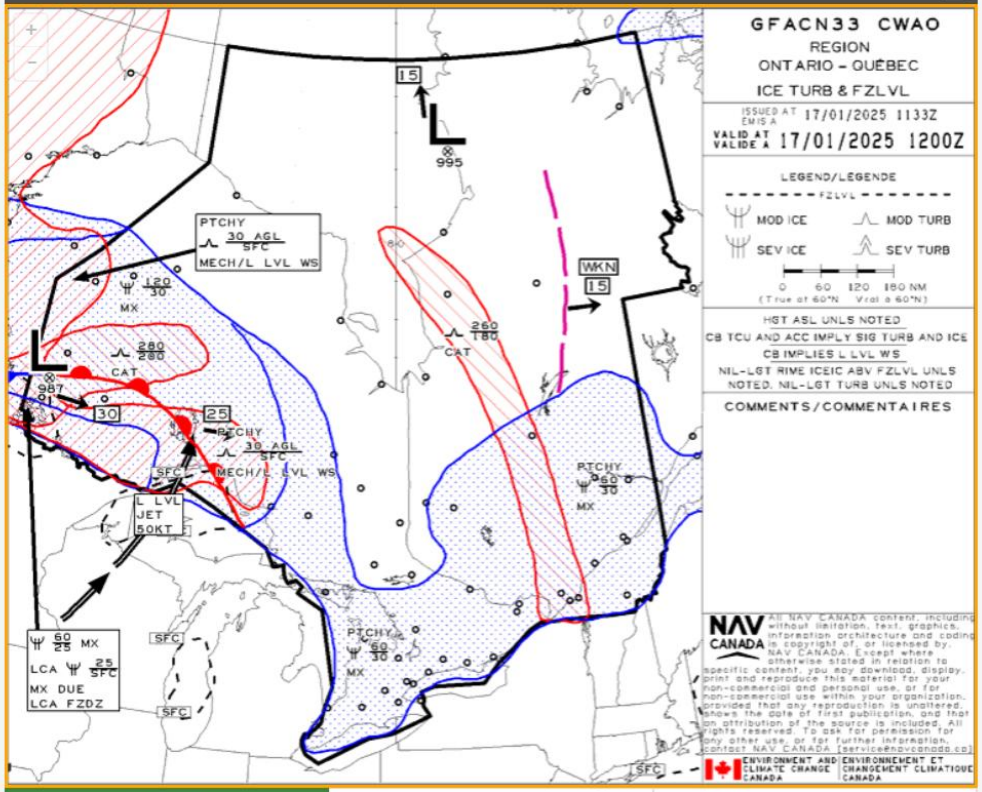
Searched performed at: 2025-01-17 17:59:56

Metadata | Bulletin

Filter column. | Filter column..

Graphical Area Forecast
Icing, Turbulence & Freezing level
Ontario & Quebec (GFACN33)

Graphical Area Forecast / Icing, Turbulence & Freezing level / Ontario & Quebec (GFACN33)



17 1200 | 17 1800 | 18 0000

Some Mnemonics and Rules of Thumb

- From high to low, look out below
- A drift to the right - flying into low pressure
- When the air is warmer than standard, you are higher than your altimeter indicates. Subsequently, when the air is colder than standard you are lower than indicated.
- When you go back down to the ground, the wind backs.
- With the wind at your back, the low is on your left.

Review Questions

16. Clouds which form when moist warm air overruns cold air, are caused because the warm air

a) is cooled by the cold air underneath.
b) is cooled by the surrounding cold air aloft.
c) becomes unstable as a result of cooling from below.
d) cools as a result of expansion as it rises.

17. Wind is caused by

a) the rotation of the earth.
b) friction between the air and the ground.
c) horizontal pressure differences.
d) the movements of fronts.

18. In the northern hemisphere, the winds blow

a) direct from high to low pressure areas.
b) clockwise around a high and counter-clockwise around a low.
c) at a 30° angle out of a low pressure area.
d) at a 30° angle into a high pressure area.

19. During a descent from 2,000 feet AGL to the surface you will usually find that the wind

a) veers and increases.
b) backs and increases.
c) veers and decreases.
d) backs and decreases.

20. The lapse rate is the rate of change of

a) temperature with height.
b) pressure with height.
c) pressure in the horizontal.
d) temperature in the horizontal.

21. Air masses which are being cooled from below are characterized by

a) strong winds, cumulus cloud, good visibility.
b) uniform temperature, good visibility.
c) decreasing humidity, poor visibility.
d) fog, poor visibility and layer cloud.

22. The following sequence of clouds is observed at an airport: cirrus, altostratus, nimbostratus.
The observer should expect

a) the passage of a cold front.
b) anticyclonic weather.
c) the passage of a warm front.
d) clearing skies and a decrease in temperature.

23. Which clouds have the international family prefix "Cumulo"?

a) Clouds with bases between surface and 6,500 feet AGL.
b) Clouds with bases between 6,500 feet and 20,000 feet AGL.
c) Clouds with bases above 20,000 feet AGL.
d) Clouds of vertical development.

24. The Dry adiabatic lapse rate is

a) 1.98° Celsius per 1000 ft of altitude
b) 3.0 ° Celsius per 1000 ft of altitude
c) 1.5 ° Celsius per 1000 ft of altitude
d) 2.0 ° Celsius per 1000 ft of altitude

25. In the standard atmosphere, the temperature at an altitude of 5,000 feet will be closest to

a) 0ºC.
b) 5ºC.
c) 8ºC.
d) 10ºC.