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Lecture 10 – AIR FRONTS

10.1 GENERAL

- A *front* is a boundary between two air masses
 - Usually there is a sharp temperature contrast across a front
 - There is often also a contrast in moisture across a front
 - There is a shift in wind direction across a front
- Because the two air masses have different temperatures and different humidities they are of different density
- The lighter air mass will *outrun* the denser air mass, which causes lifting along the frontal zone
- This is why fronts are associated with clouds and precipitation
- In general, the faster a front moves, the more severe the weather will be (which is why cold fronts are more violent than warm fronts)
- The sharper the temperature contrast across the front, the more severe the weather will be
- There are four general types of fronts with the name reflective of the advancing air mass as shown in figure (10.1)

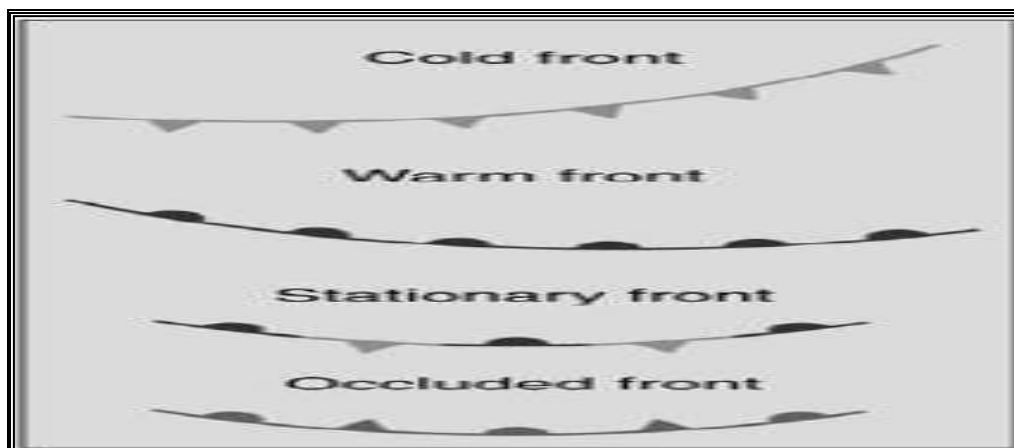
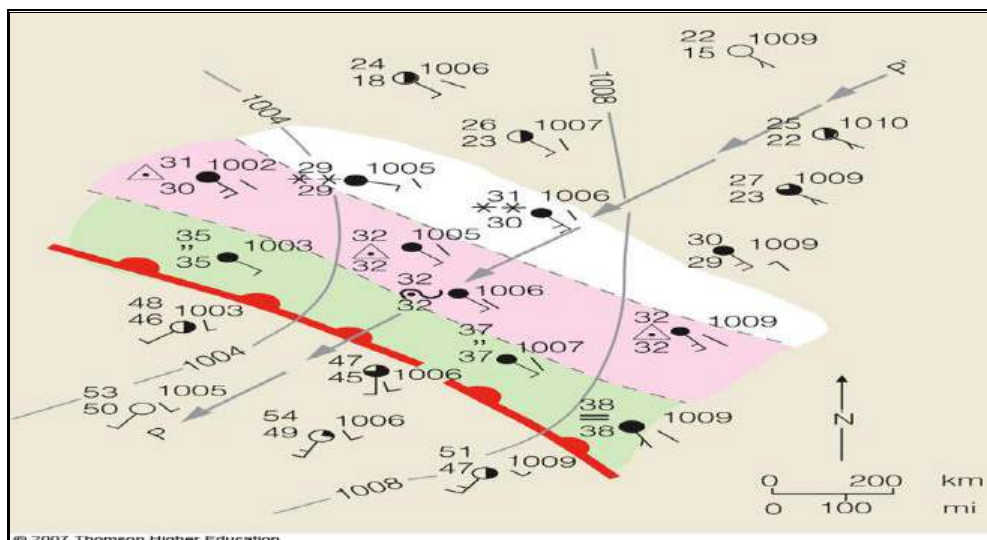


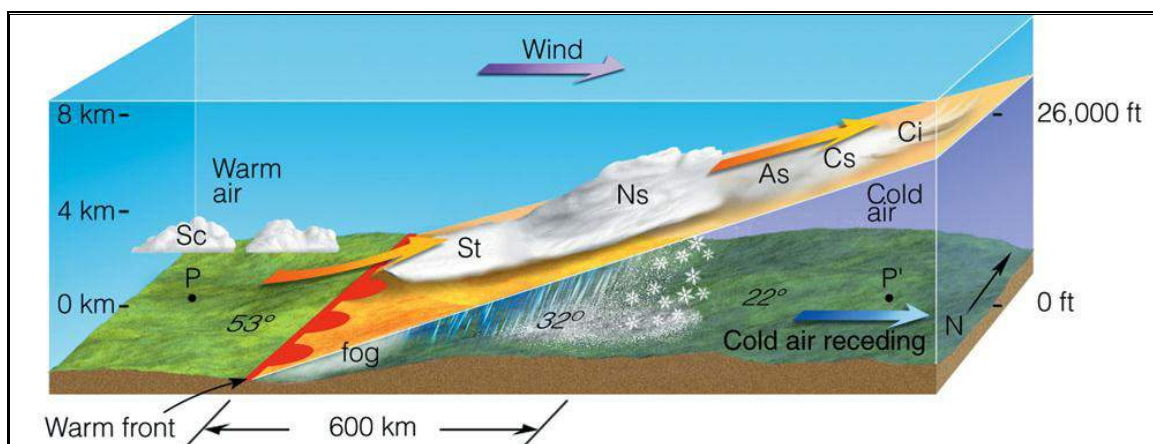
Fig.(10.1) : The Types and Symbols of Fronts

10.2 WARM AIR FRONTS

- Warm air advances into region formerly covered by cold air
- Warm front, a transition zone where a warm air mass advances and replaces a cold air mass
- Weather map symbol is red line with circular teeth
- Warm air rides up and over cold air
- The frontal surface slopes very shallowly (about **1:200**) (ratio of vertical rise to horizontal distance)
- The front moves forward at **15 - 20 mph**
- **Cloud sequence :**
 - Cirrus
 - Cirrostratus (possibly cirrocumulus)
 - Altostratus
 - Nimbostratus (sometimes with embedded cumulonimbus)
- **Precipitation :**
 - Steady rain, drizzle, or snow
 - Freezing rain or sleet may occur on cold side of front



Surface weather associated with a typical warm front. (Green-shaded area represents precipitation.)



Vertical view of clouds, precipitation, and winds across the warm front in Fig. 8.14 along the line P-P'.

• **TABLE 11.3**

Typical Weather Conditions Associated with a Warm Front in the Northern Hemisphere

WEATHER ELEMENT	BEFORE PASSING	WHILE PASSING	AFTER PASSING
Winds	South or southeast	Variable	South or southwest
Temperature	Cool to cold, slow warming	Steady rise	Warmer, then steady
Pressure	Usually falling	Leveling off	Slight rise, followed by fall
Clouds	In this order: Ci, Cs, As, Ns, St, and fog; occasionally Cb in summer	Stratus type	Clearing with scattered Sc, especially in summer; occasionally Cb in summer
Precipitation	Light-to-moderate rain, snow, sleet, or drizzle; showers in summer	Drizzle or none	Usually none; sometimes light rain or showers
Visibility	Poor	Poor, but improving	Fair in haze
Dew point	Steady rise	Steady	Rise, then steady

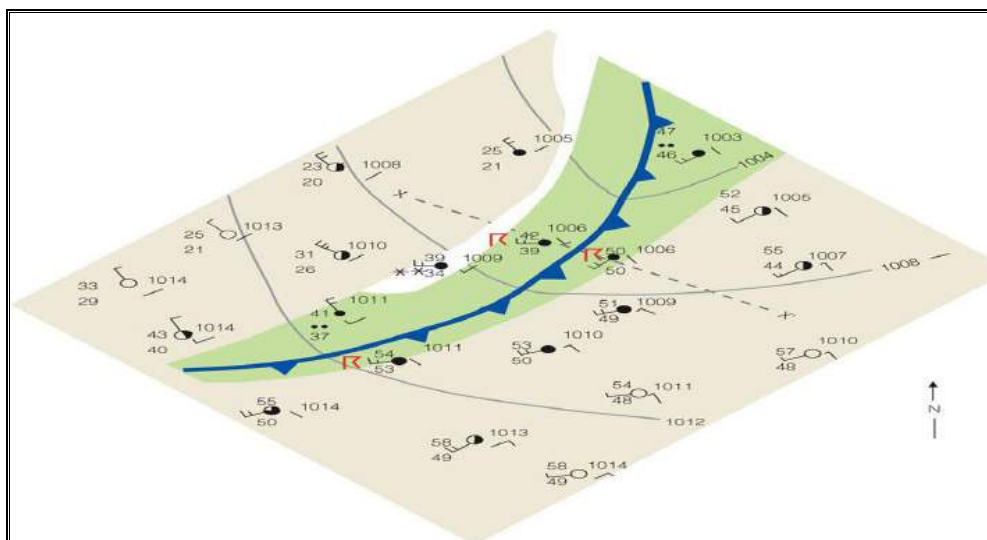
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Typical Weather Conditions Associated with a Warm Front

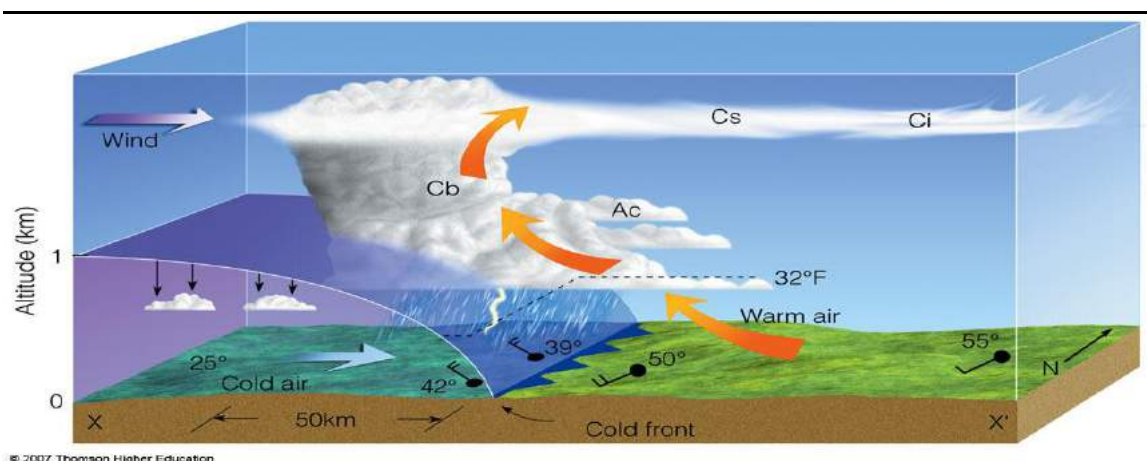
10.3 COLD AIR FRONTS

- Cold air advances into region formerly covered by warm air
- Cold front, a transition zone where a cold air mass advances and replaces a warm air mass
- Weather map symbol is blue line with triangular teeth
- Warm air rides up and over cold air
- The frontal surface has a steeper slope than a warm front (about **1:100**)
- The front moves forward at **20 - 35** mph (much faster than warm front)
- **Cloud sequence :**
 - Cirrus and cirrostratus (from thunderstorm anvils)
 - Altocumulus (sometimes)
 - Cumulonimbus
- **Precipitation :**
 - Showers of rain or snow
 - Often thunderstorms
- Precipitation region is much narrower with a cold front than with a warm front

METEOROLOGY



Surface weather associated with a typical warm front. (Green-shaded area represents precipitation.)



Vertical view of clouds, precipitation, and winds across the warm front in Fig. 8.14 along the line P-P'.

•TABLE 11.2

Typical Weather Conditions Associated with a Cold Front in the Northern Hemisphere

WEATHER ELEMENT	BEFORE PASSING	WHILE PASSING	AFTER PASSING
Winds	South or southwest	Gusty, shifting	West or northwest
Temperature	Warm	Sudden drop	Steadily dropping
Pressure	Falling steadily	Minimum, then sharp rise	Rising steadily
Clouds	Increasing Ci, Cs, then either Tcu* or Cb*	Tcu or Cb	Often Cu, Sc* when ground is warm
Precipitation	Short period of showers	Heavy showers of rain or snow, sometimes with hail, thunder, and lightning	Decreasing intensity of showers, then clearing
Visibility	Fair to poor in haze	Poor, followed by improving	Good, except in showers
Dew point	High; remains steady	Sharp drop	Lowering

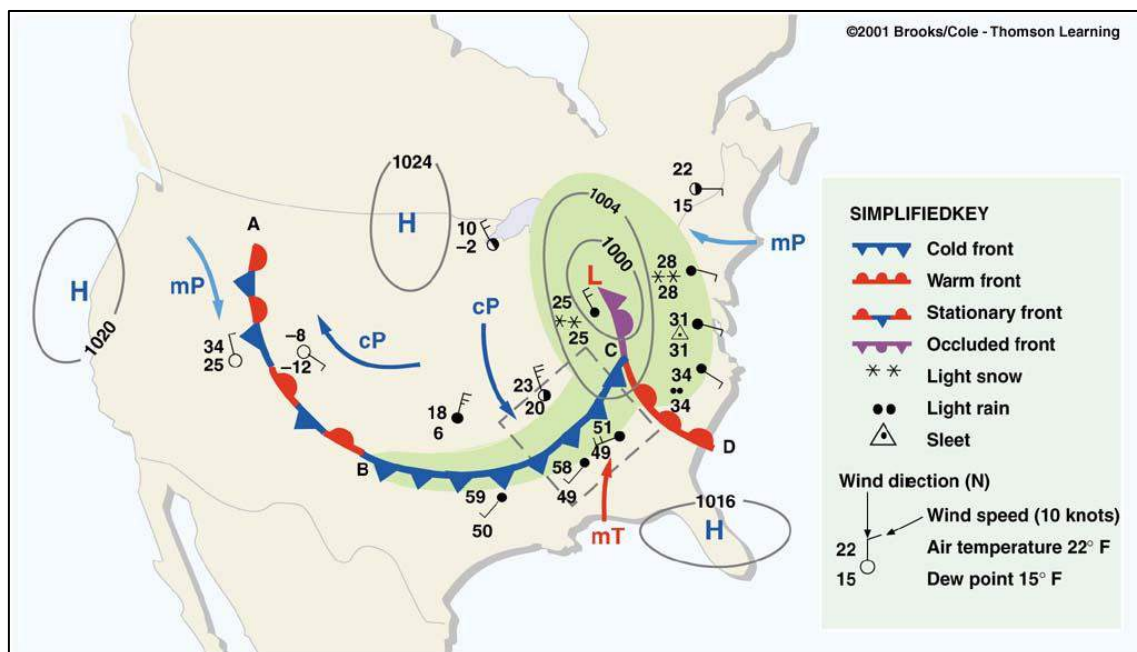
*Tcu stands for towering cumulus, such as cumulus congestus; whereas Cb stands for cumulonimbus. Sc stands for stratocumulus.

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Typical Weather Conditions Associated with a Warm Front

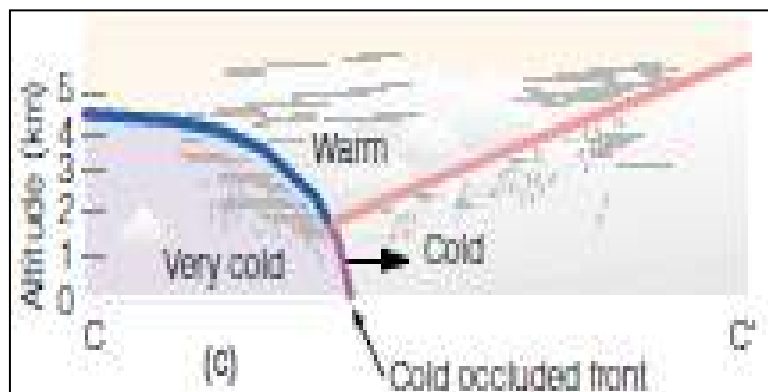
10.4 STATIONARY FRONT

- Stationary front , a front that is nearly stationary with winds blowing almost parallel and from opposite directions on each side of the front
- Boundary between air masses is not moving
- Weather map symbol is alternating red and blue line with alternating warm and cold front teeth pointing in opposite directions
- Even though frontal boundary itself doesn't move, the warm air is still moving up and over the cold air
- Clouds associated with stationary fronts are usually stratiform (stratus, nimbostratus , altostratus , cirrostratus)
- Precipitation is usually light to moderate, and steady (rain or snow)

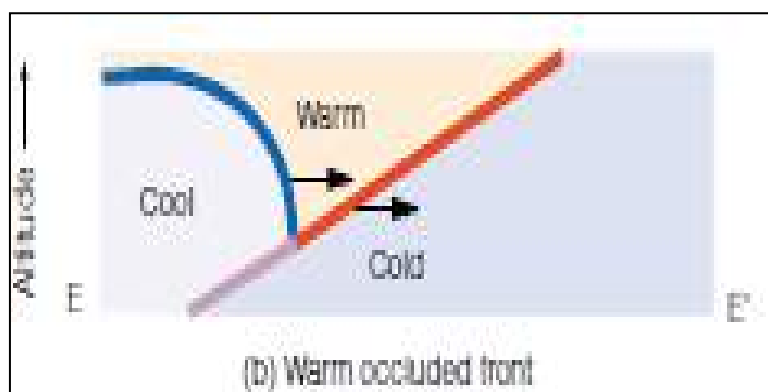


10.5 OCCLUDED FRONTS

- Occluded front (occlusion) , a complex frontal system that ideally forms when a cold front overtakes a warm front
- Weather map symbol is a purple line with both sharp and circular teeth pointing in the same direction
- There are two types of occlusions
 - **cold occlusion** – air behind cold front is colder than air ahead of warm front



- **warm occlusion** – air behind cold front is warmer than air ahead of warm front



- Clouds associated with occluded fronts are a complicated mixture of those associated with warm and cold fronts