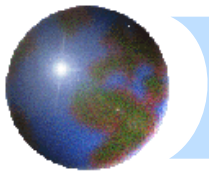


Air Masses and Fronts

GEOG/ENST 2331 – Lecture 16

Ahrens: Chapter 11



Air Masses and Fronts

✦ **Air masses**

- ✦ **Source regions**

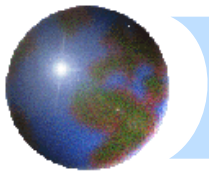
- ✦ **Classification**

- ✦ **Modification**

- ✦ A large body of air whose properties of **temperature** and **moisture** are fairly uniform in any horizontal direction at any given altitude.

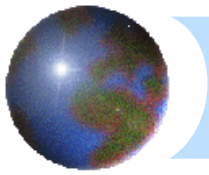
- ✦ Typically air masses cover many thousands of square kilometres

- ✦ Fronts



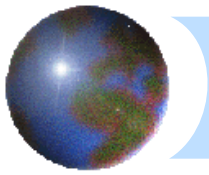
Air masses

- ✦ The temperature and moisture of air depend on continuous exchanges with the surface
- ✦ Temperature: energy inputs vs. energy losses
- ✦ Moisture: evaporation vs. precipitation



Source region

- ✦ Must be large, homogenous surface area
- ✦ Air needs to remain in place for a substantial time
- ✦ Typical source regions for North America include adjacent oceans, Gulf of Mexico, the Arctic and sub Arctic and the American/Mexican deserts
- ✦ Ontario is not a good source region; nor are most mid-latitudes – conditions change too frequently



Air mass classification

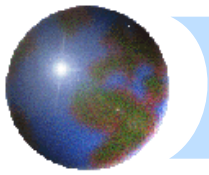
c - land (continental)

m - water (maritime)

A – high Arctic latitudes

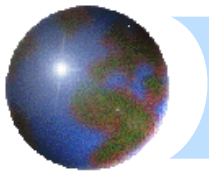
P – polar latitudes

T – tropical latitudes



Air mass classification

Source Region	Arctic (A)	Polar (P)	Tropical (T)
Land (continental)	cA Dry, very cold Stable Ice and snow	cP Dry, cold Stable	cT Dry, hot Stable aloft Unstable surface
Water (maritime)	mA Moist, cold Unstable	mP Moist, cool Unstable	mT Moist, warm Usually unstable



Air masses are not confined to their source regions and migrate to regions with less extreme weather conditions.

1. The region to which the air mass migrates undergoes major changes in temperature and humidity
2. The air mass itself becomes more moderate

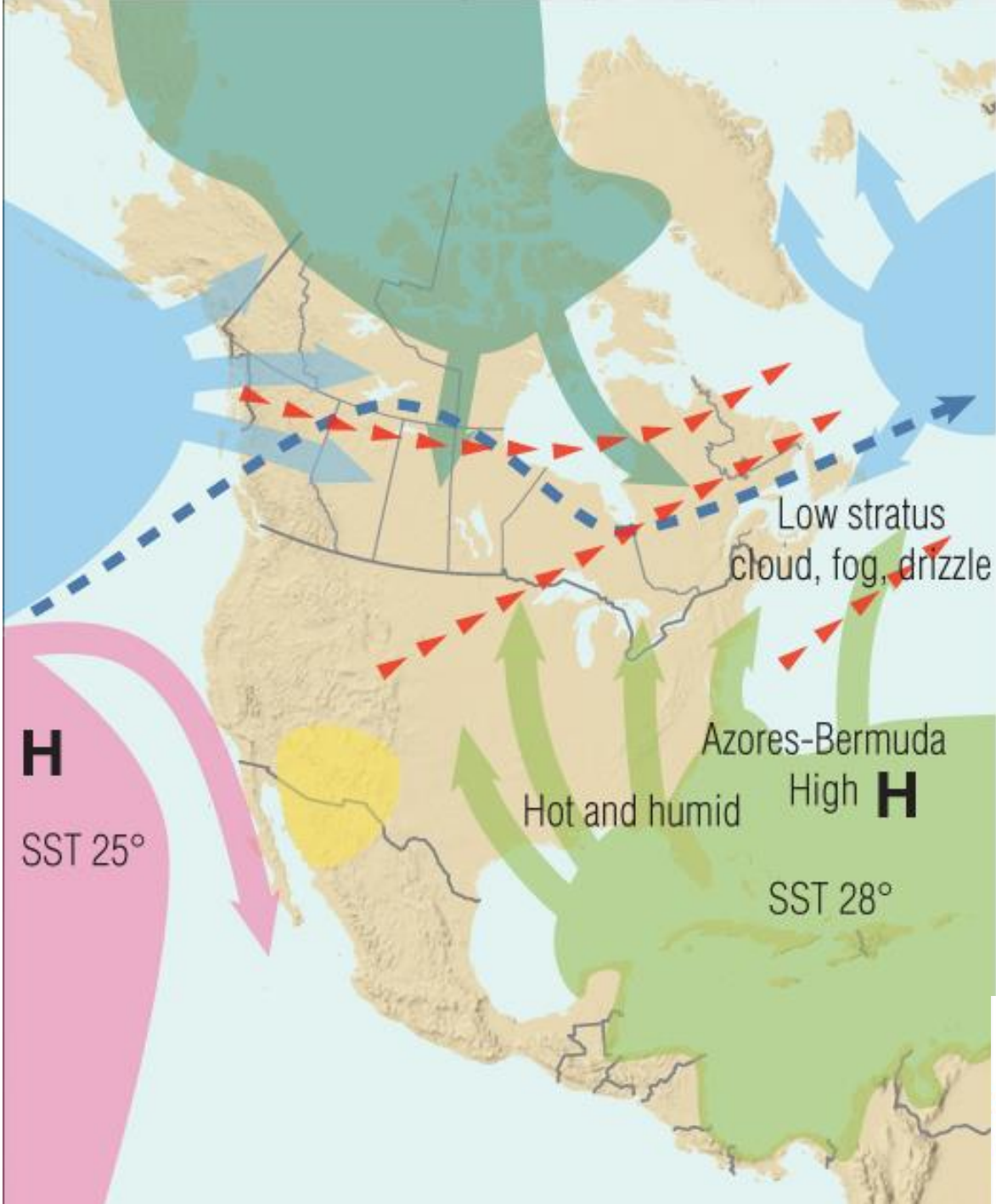
Winter



Ahrens: Figure 11.2a

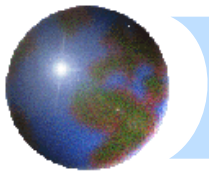
Winter Air Masses and Circulation	
Continental Arctic	Maritime Arctic
Polar jet stream	Maritime Polar
Primary storm tracks	Pacific Maritime Tropical
SST Sea surface temperature	Atlantic Maritime Tropical

Summer

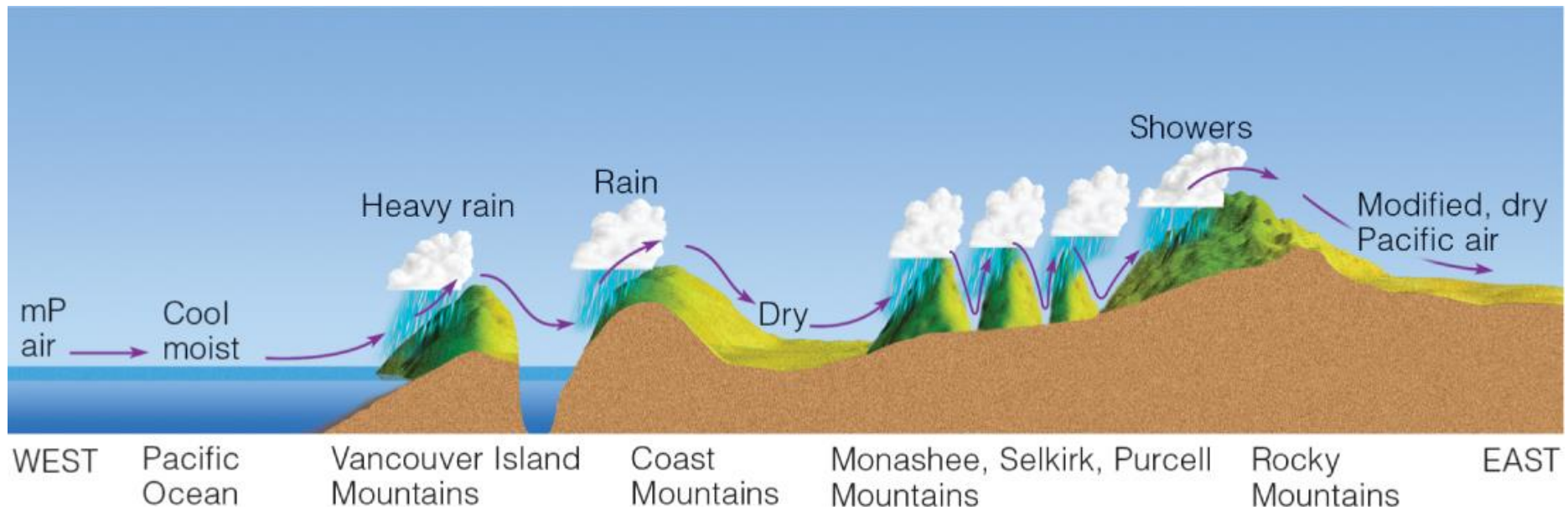


Ahrens: Figure 11.2b

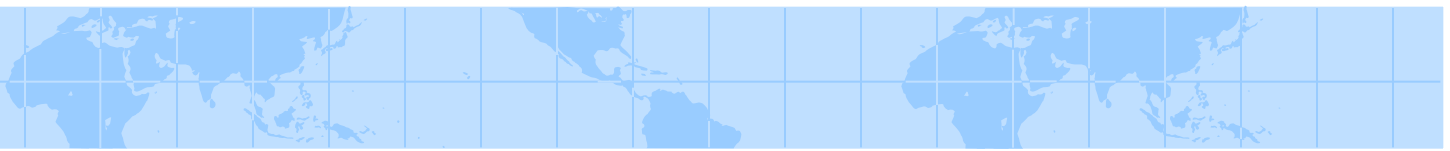
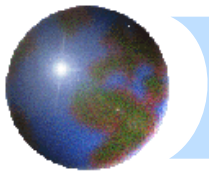
- | | |
|--|----------------------------|
| Summer Air Masses and Circulation | Continental Tropical |
| Polar jet stream | Maritime Arctic |
| Primary storm tracks | Maritime Polar |
| SST Sea surface temperature | Pacific Maritime Tropical |
| | Atlantic Maritime Tropical |



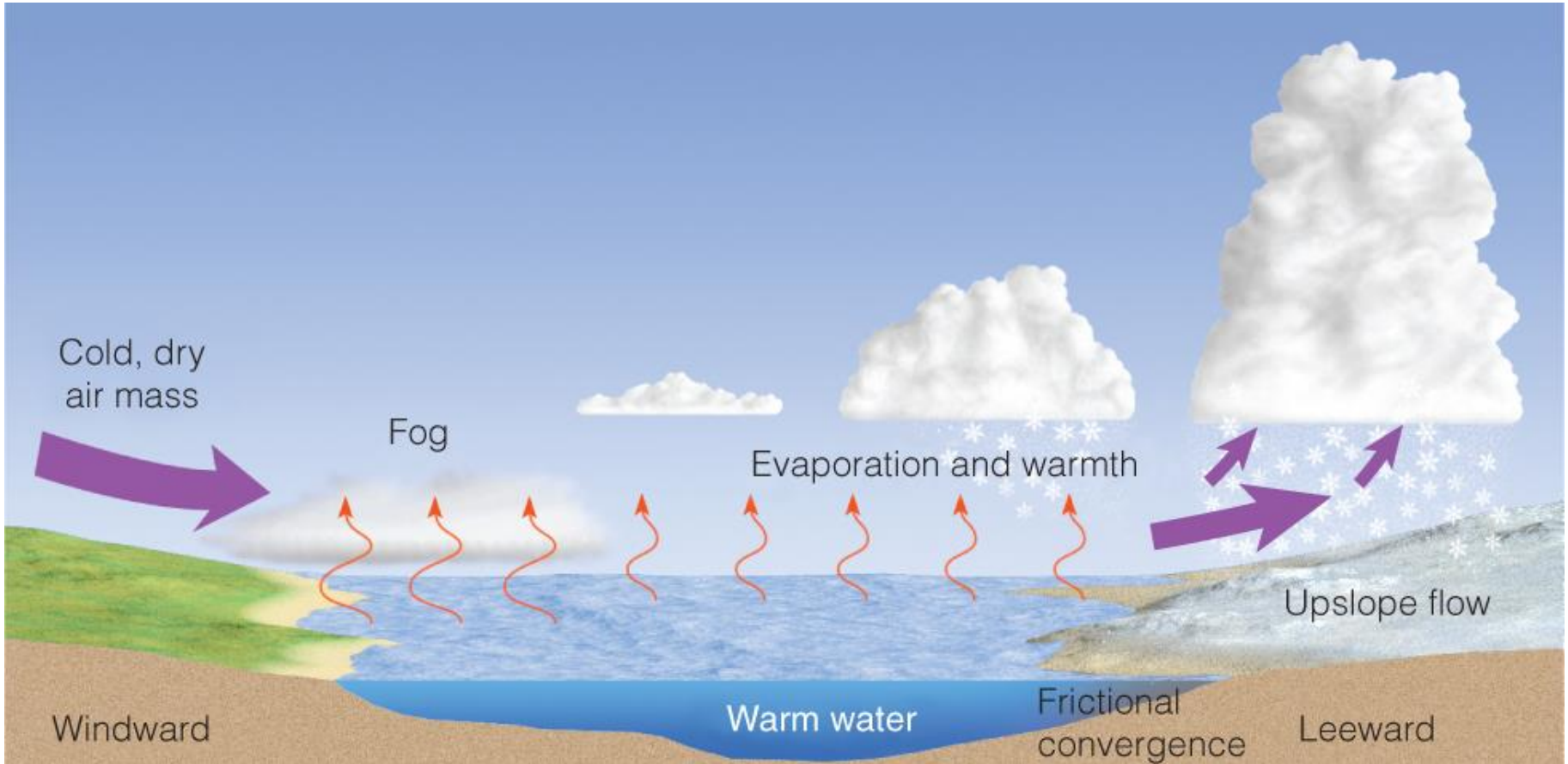
Modified Air Masses



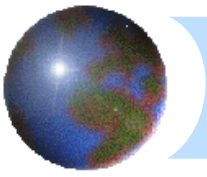
Ahrens: Figure 11.7



Lake effect precipitation



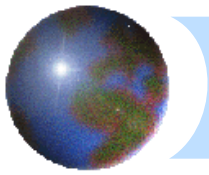
Ahrens: Fig. 1, p. 328



Lake effect snow in the Great Lakes



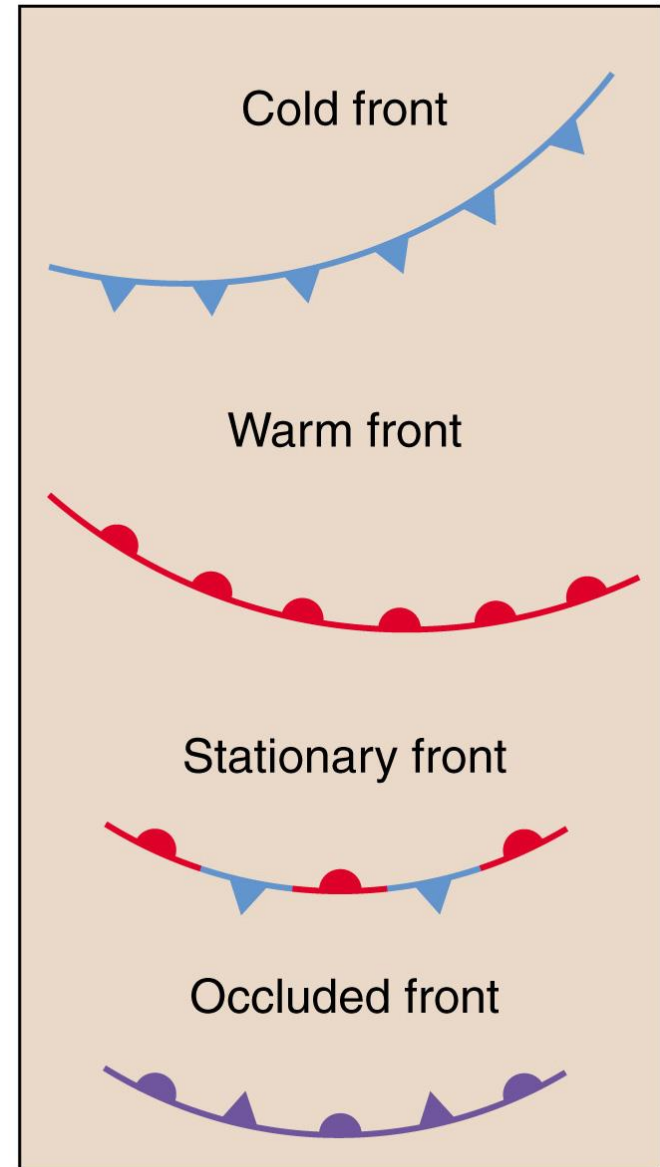
Ahrens: Fig. 2, p. 329

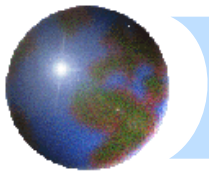


Fronts

☉ Fronts

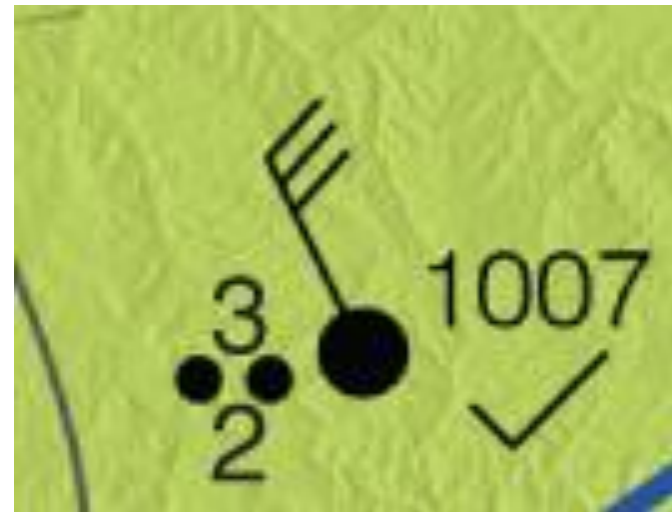
- ☒ Warm and cold
- ☒ Stationary
- ☒ Occluded
- ☒ Drylines



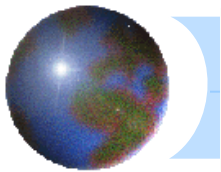


Station model for meteorology

- Temperature
- Dew point
- Sea Level Pressure
- Pressure trend
- Wind direction



See Appendix B!



SELECTED WEATHER MAP SYMBOLS



Fronts

Warm Front



Cold Front



Stationary Front

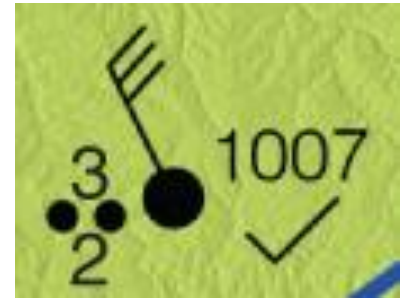


Occlusion



Cloud Cover

Full,
Half,
Quarter, etc
(shaded accordingly)



Winds

Almost Calm _____
(< 1 m/s)

1 to 4 m/s

5 to 6 m/s

7 to 8 m/s

9 to 11 m/s

12 to 14 m/s

15 to 16 m/s

17 to 18 m/s

19 to 20 m/s

Precipitation

Drizzle ☉ or ☉☉

Light Rain ●

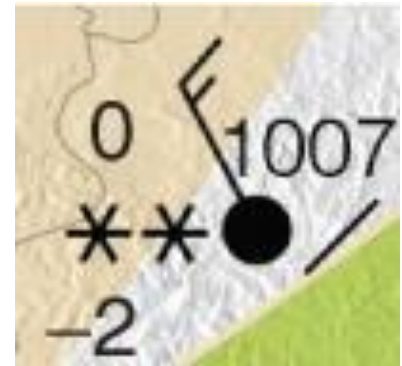
Moderate Rain Shower ☉

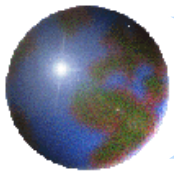
Heavy Rain ●●●

Area of continuous
Precipitation

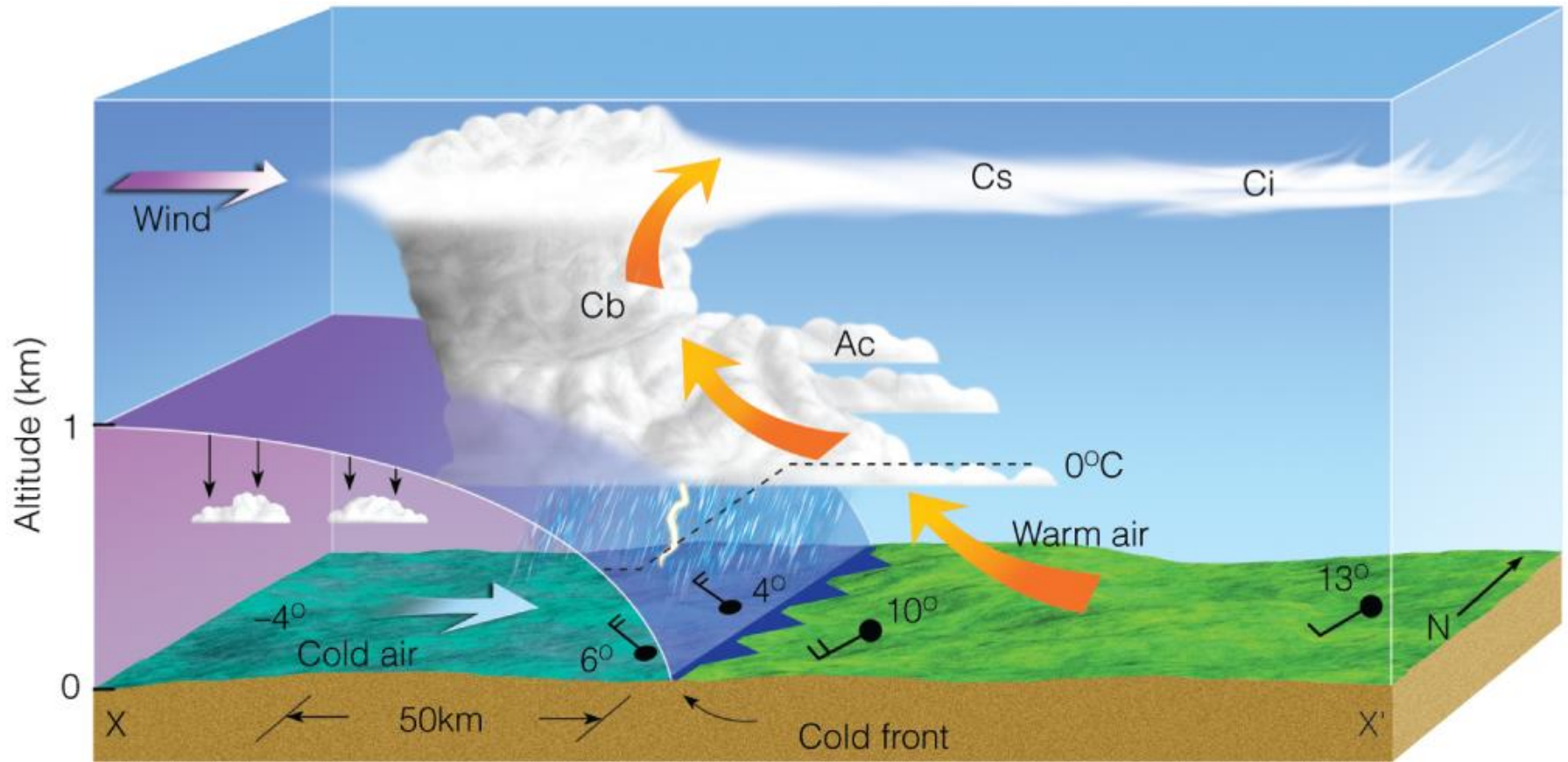
Moderate Snow * or *

Snow Shower *





Cold Fronts

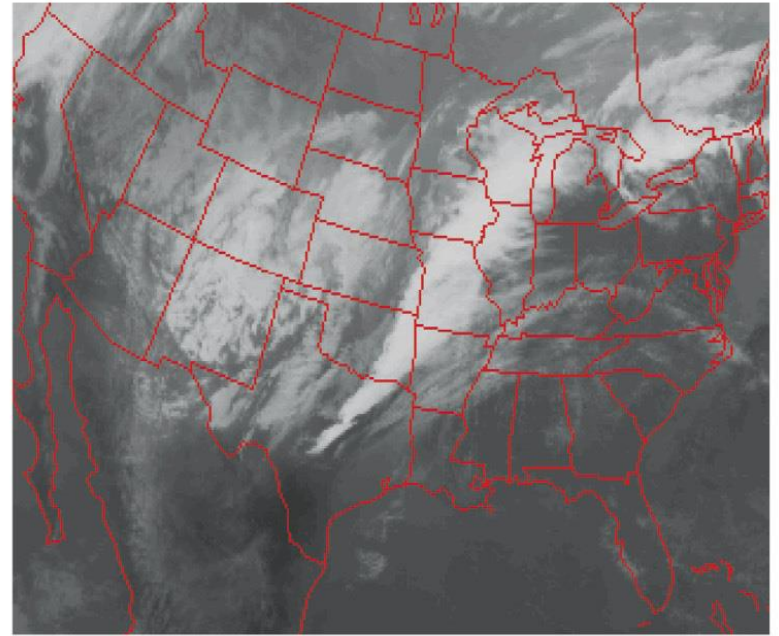


Ahrens: Active Fig. 11.15

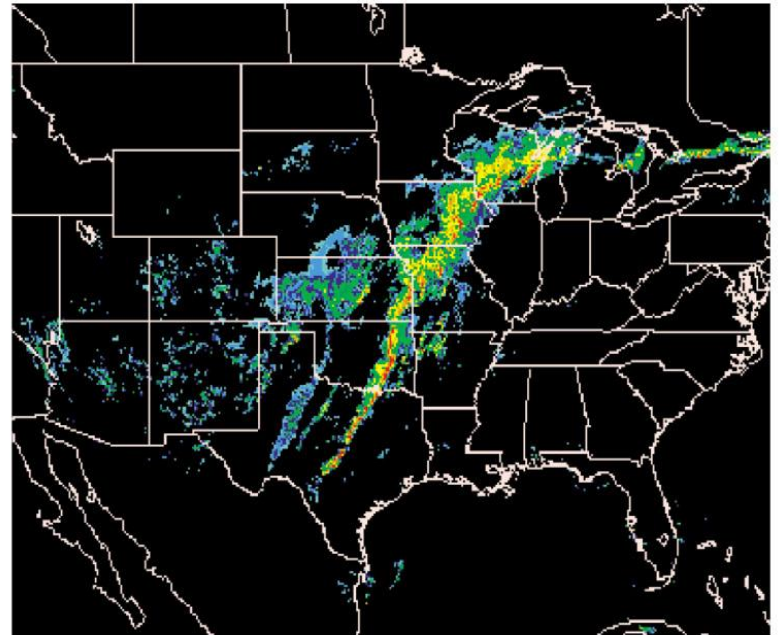
The vertical displacement of air along
a cold front boundary; steep profile (1:50 to 1:100)



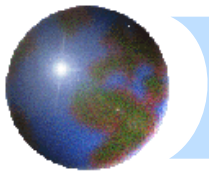
Cold Front



(a)



(b)



Identifying cold fronts

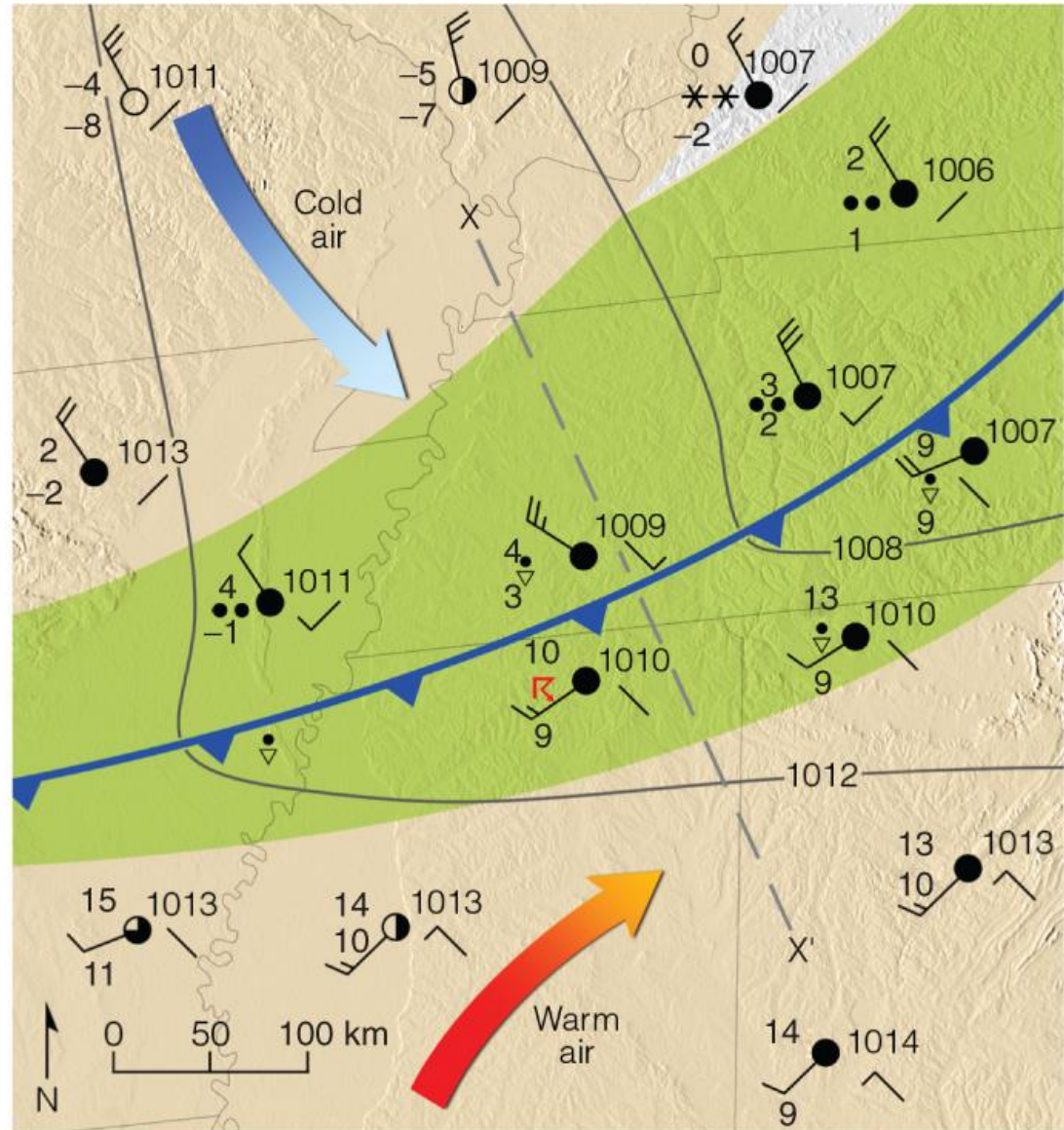
Strong temperature gradient

Humidity change

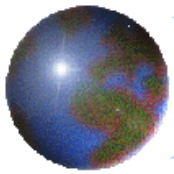
Shift in wind direction

Pressure change

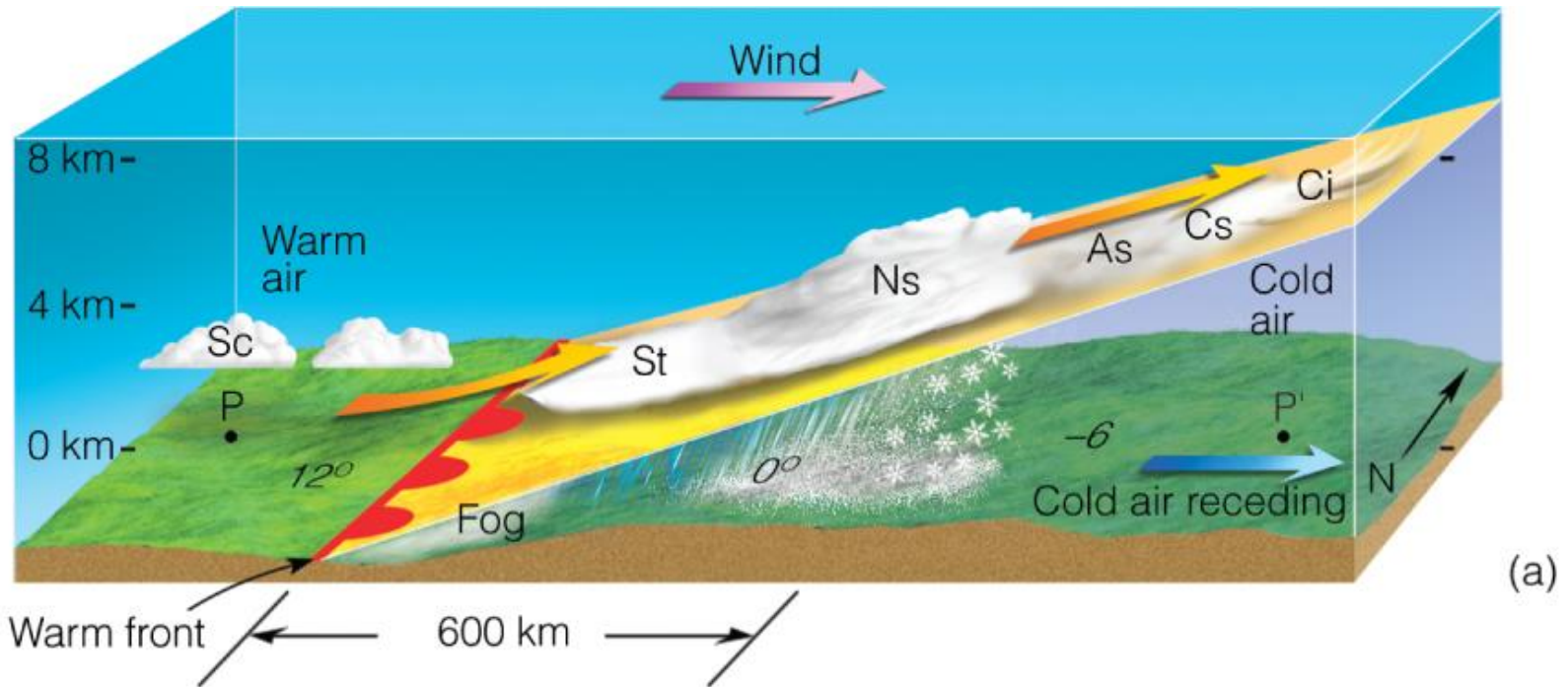
Clouds and precipitation patterns



Ahrens: Fig. 11.13

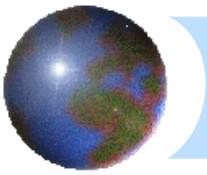


WARM FRONTS



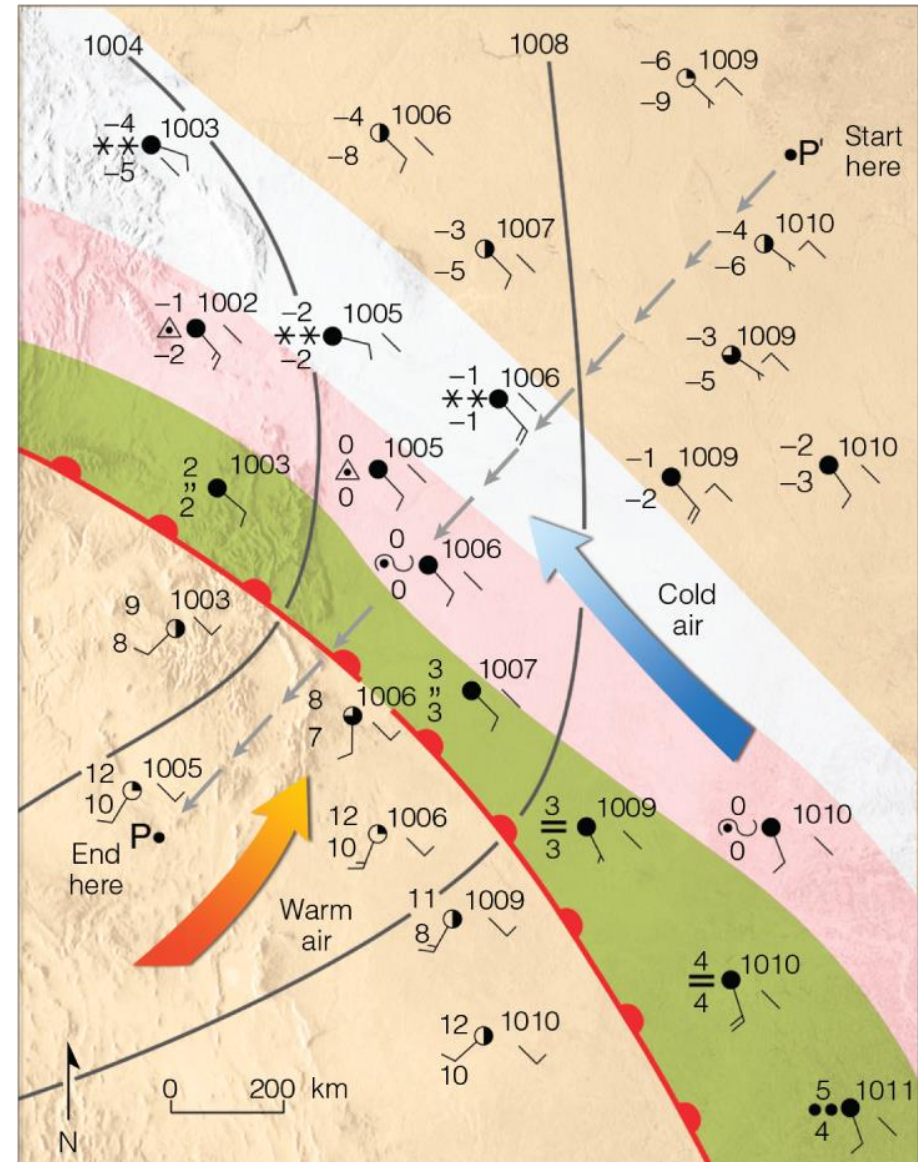
Overrunning leads to extensive cloud cover along the gently sloping surface of cold air.

Ahrens: Fig. 11.19

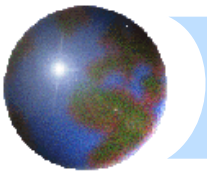


Warm front identification

- Here, mT overrides mP
- Profile 1:150 - 1:300
- Gentle precipitation (drizzle)

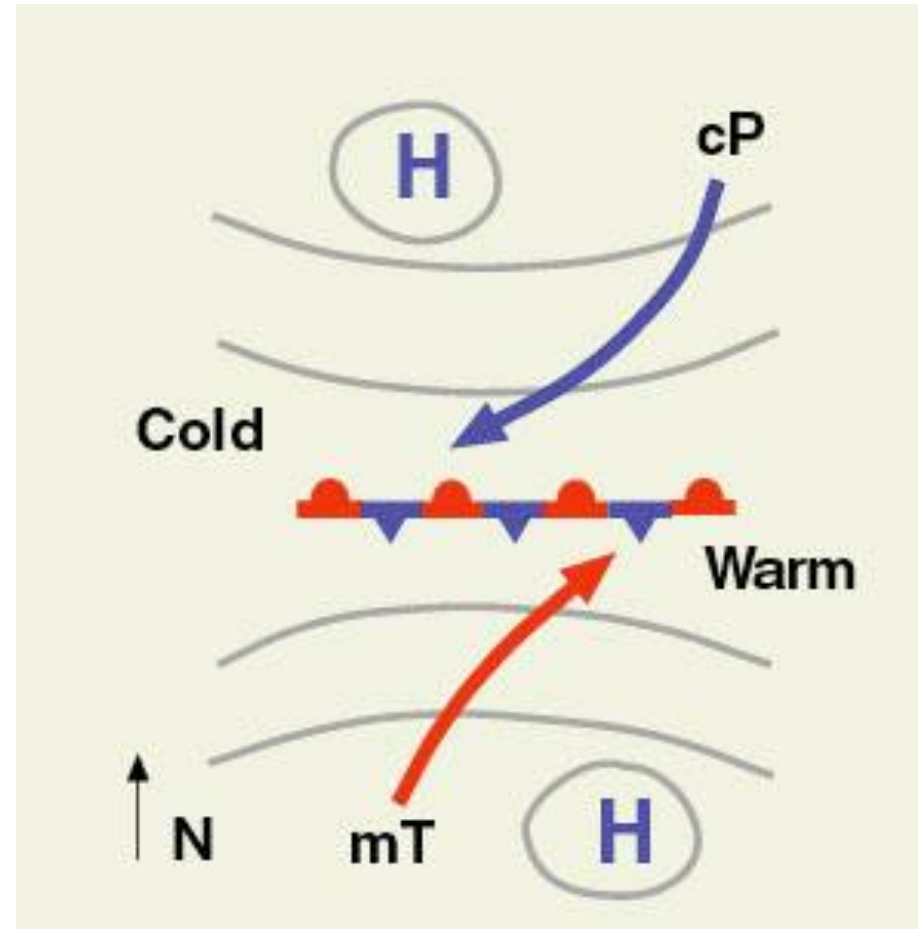


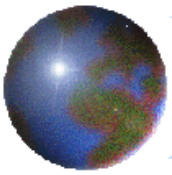
Ahrens: Active Fig. 11.18



Stationary fronts

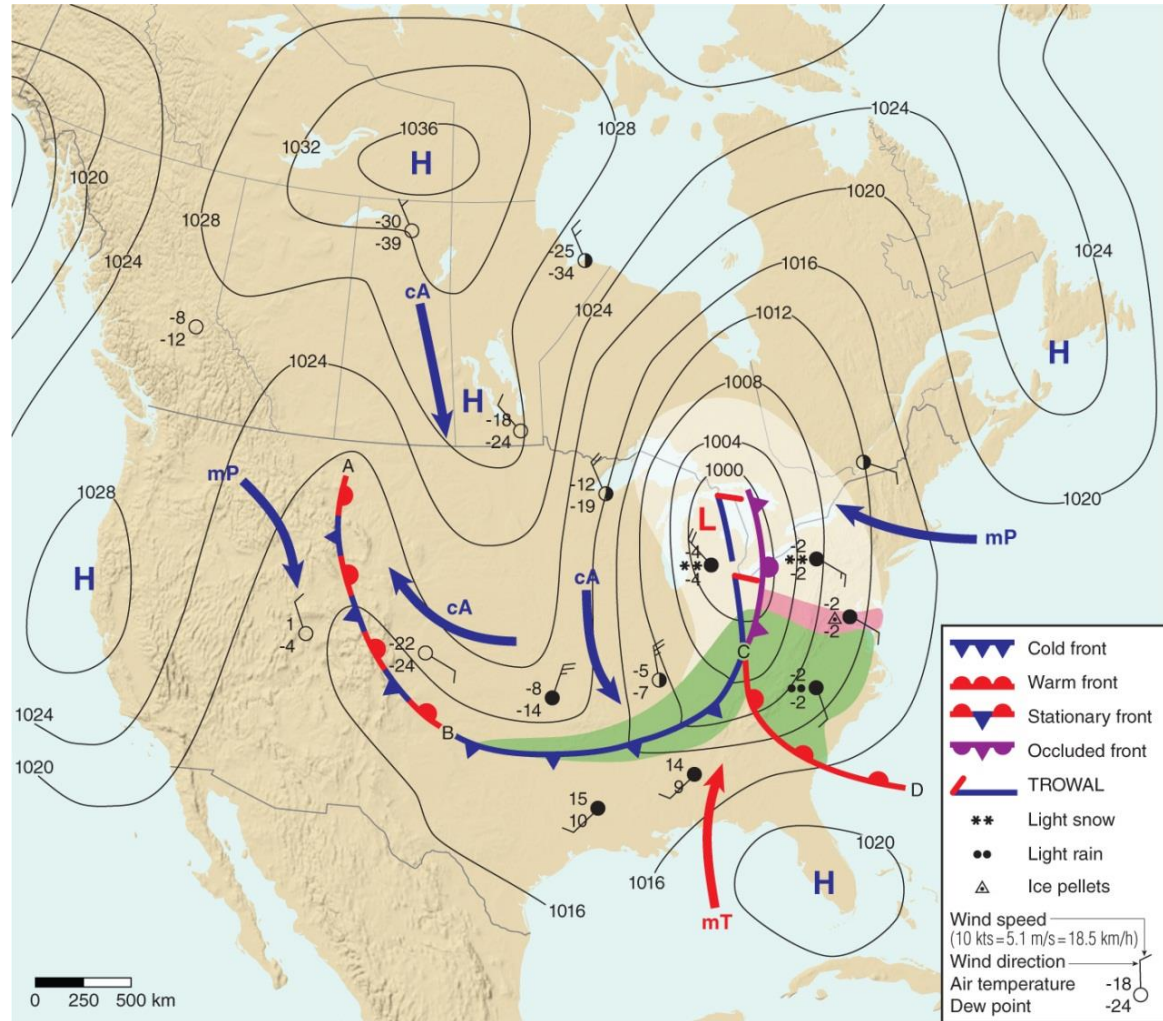
- ✦ Boundary between fronts stalls
- ✦ Stable but with strong horizontal wind shear
- ✦ Quite common along the Polar Front
 - ✦ Boundary between Polar and Ferrel cells

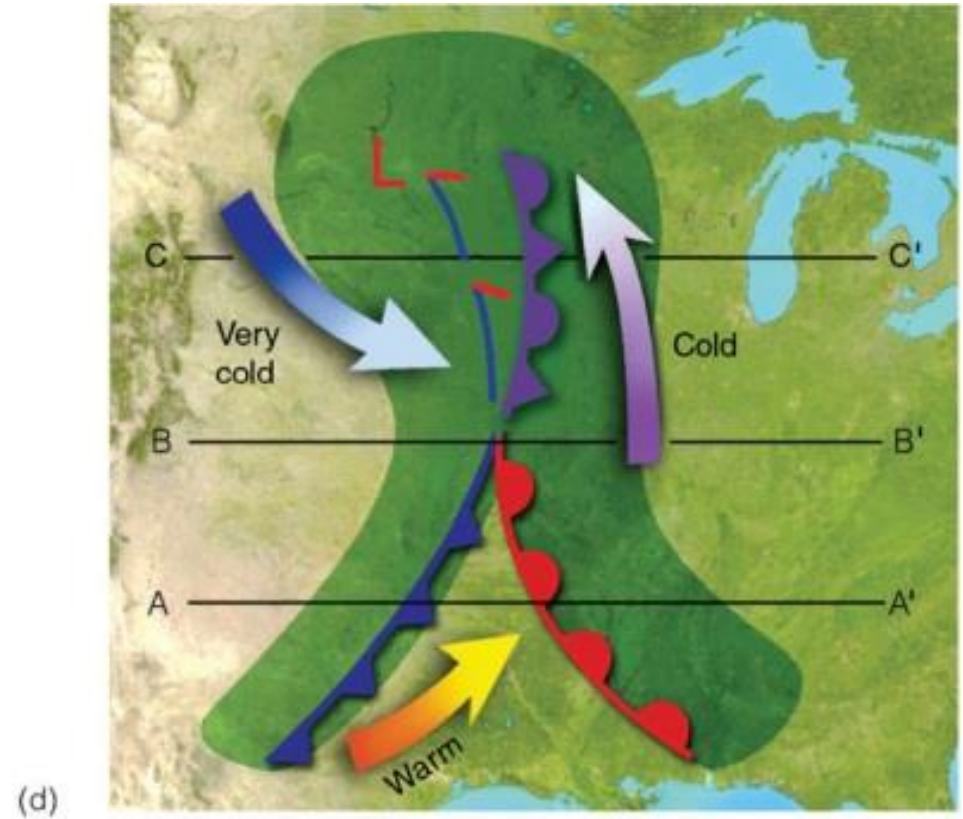
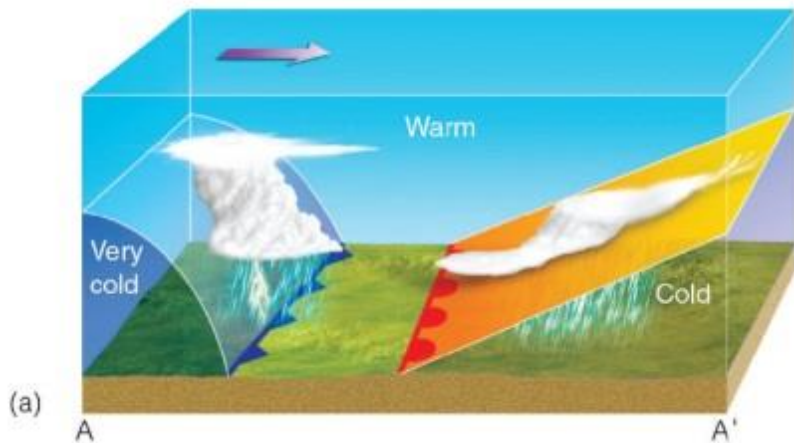
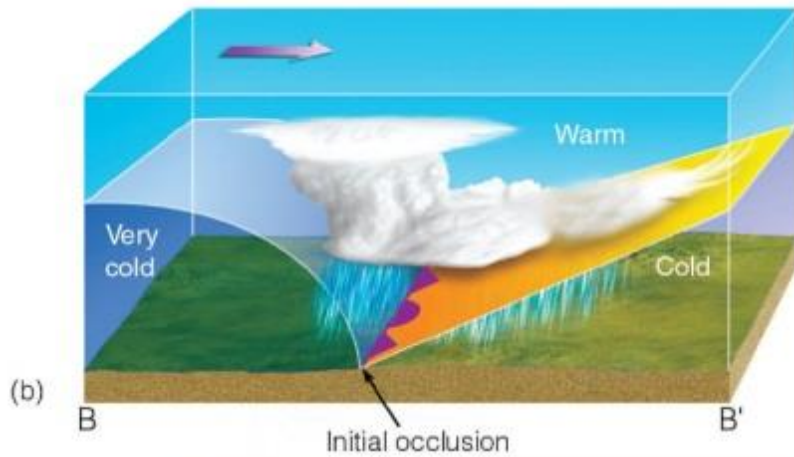
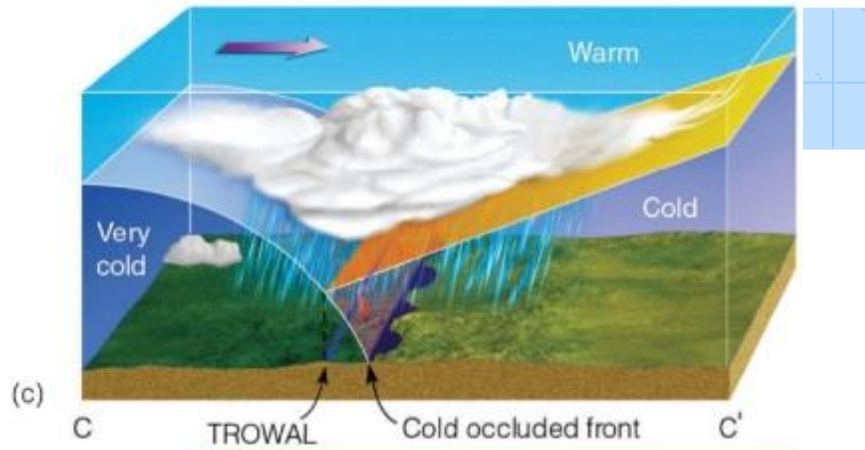




Midlatitude cyclone

Kink in the polar front
Cold and warm fronts
rotate around a central low
Wedge of warm air to the
south

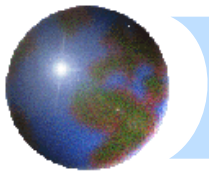




OCCLUDED FRONT

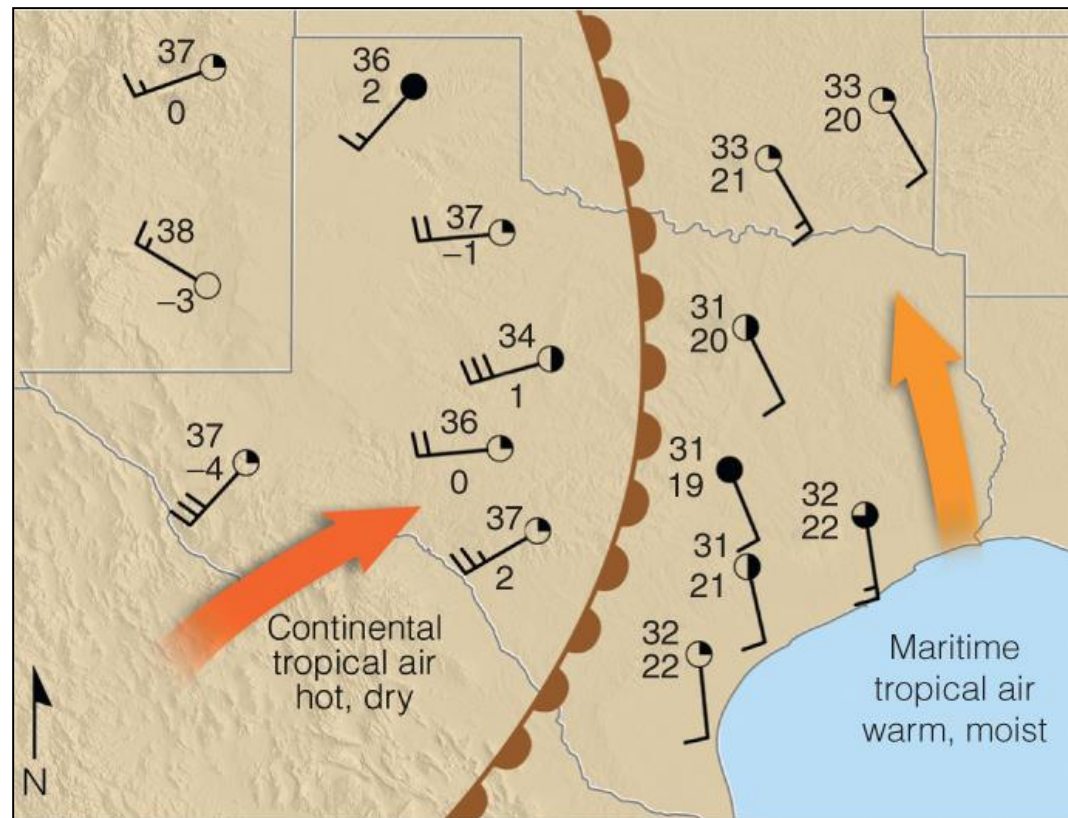
TROWAL: TRough Of Warm Air Aloft

Ahrens: Fig. 11.20

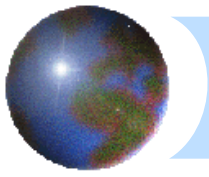


Drylines

- ✦ Boundaries between dry and moister air are called drylines
- ✦ They frequently occur throughout the US Great Plains and are an important contributor to storm development



Ahrens: Fig. 6, p. 344



Next lecture

- ⊕ Midlatitude cyclones
- ⊕ Ahrens: Chapter 12