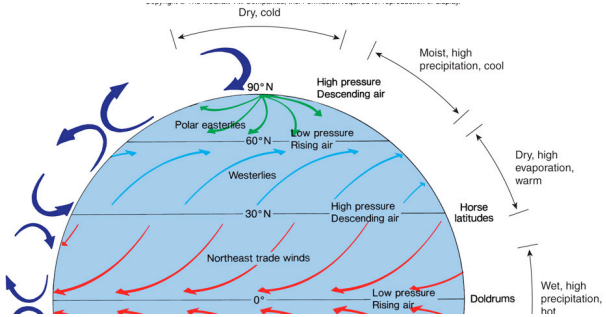
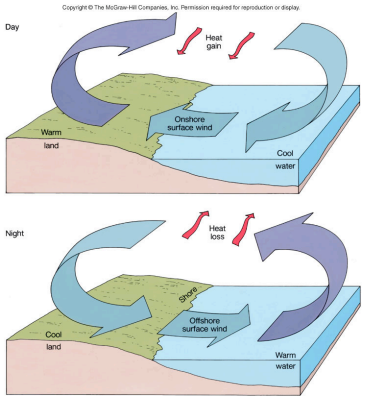
The Real Atmosphere

- Effect of Seasons & Continents
  - Disrupt global continuity of latitudinal belts of high and low pressure



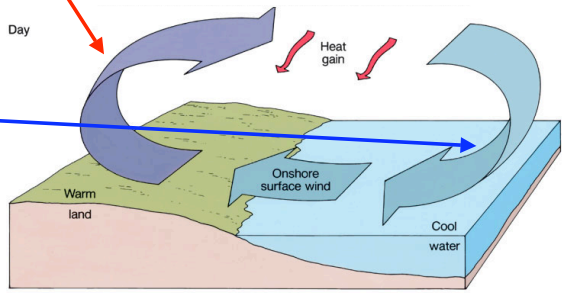
The Real Atmosphere

- Effect of Seasons & Continents
  - Water has a greater **heat capacity** than land
  - More energy needed to raise water temperature
    - Stays cooler in summer
  - More energy must be removed to lower water temperature
    - Stays warmer in winter



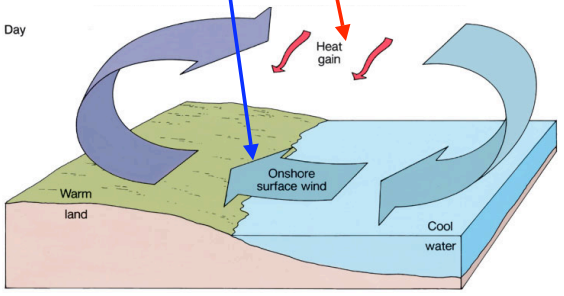
The Real Atmosphere

- In summer & daytime, land heats more than ocean.
  - Warm air rises over land.
  - "Thermal low" pressure forms over land.
- Cool air sinks over ocean.
  - High pressure forms over ocean



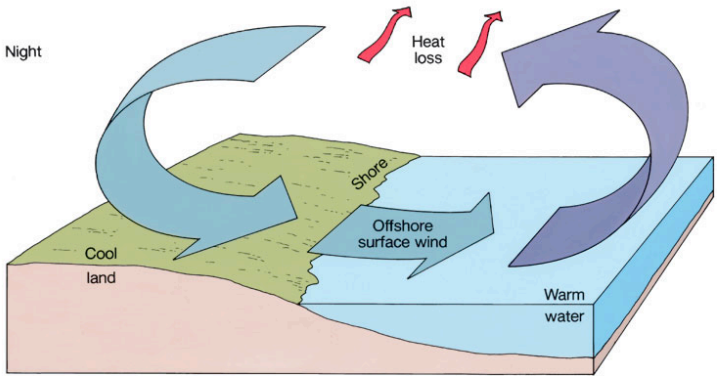
The Real Atmosphere

- Surface wind blows from ocean to land.
  - Onshore wind = "sea breeze"
  - Wind aloft completes the convection cell



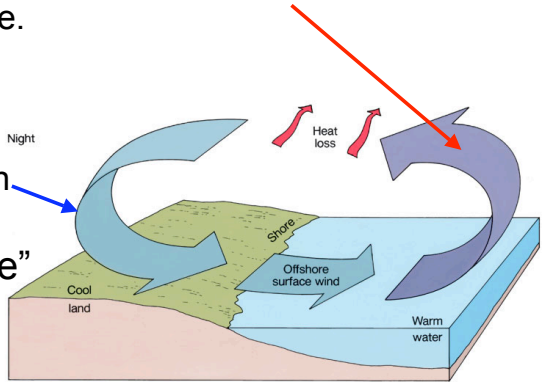
The Real Atmosphere

- In winter or night, the pattern reverses.



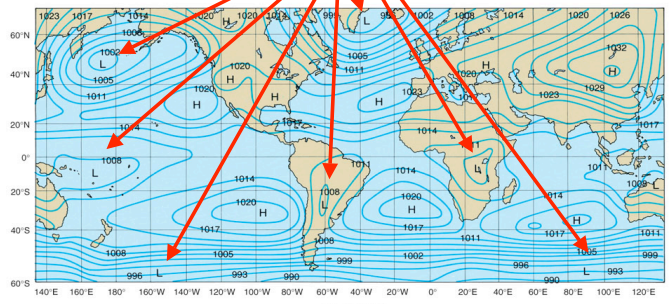
The Real Atmosphere

- In winter or night, the pattern reverses.
  - Air rises over the warmer ocean, forming low pressure.
  - Air sinks over the cooler land, forming high pressure.
- "Land breeze"
  - Offshore wind



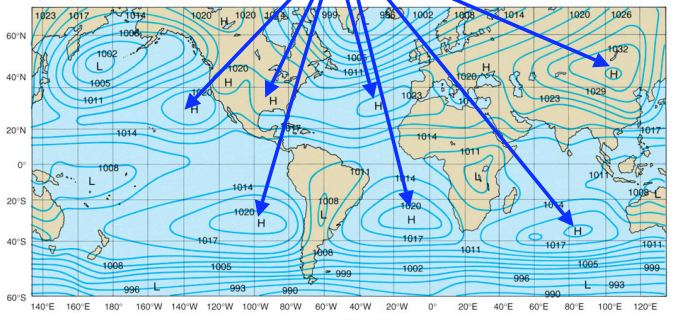
Coriolis and the Atmosphere

- Coriolis effect + continents:
  - Blue lines = isobars (lines of constant pressure)
  - Creation of low pressure **centers** rather than belts of low pressure (0˚ and 60˚)



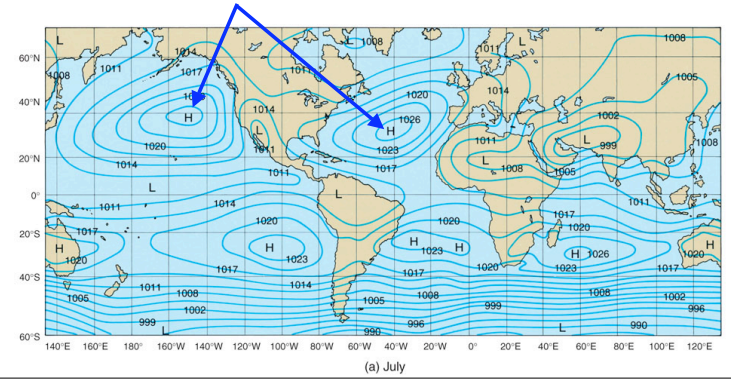
Coriolis and the Atmosphere

- Coriolis effect + continents:
  - Creation of high pressure **centers** rather than belts of high pressure (30˚)



Coriolis and the Atmosphere

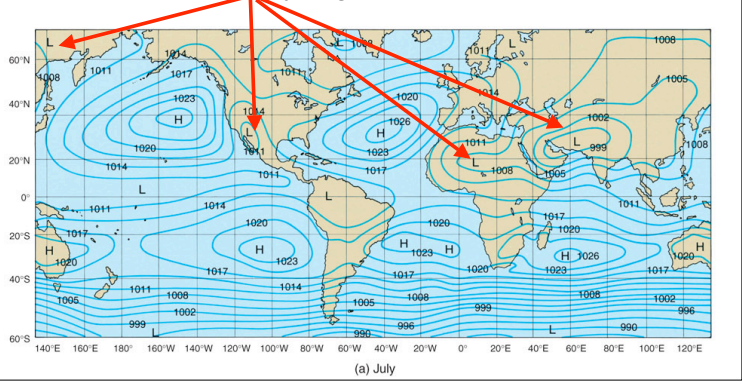
- Look at northern hemisphere in summer
  - High pressure centers over the ocean
    - Higher heat capacity, cooler temperature



(a) July

Coriolis and the Atmosphere

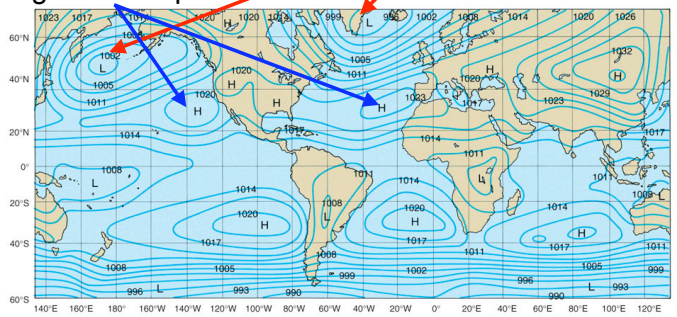
- Look at northern hemisphere in summer
  - Low pressure centers over land
    - Lower heat capacity, higher temperature



(a) July

Coriolis and the Atmosphere

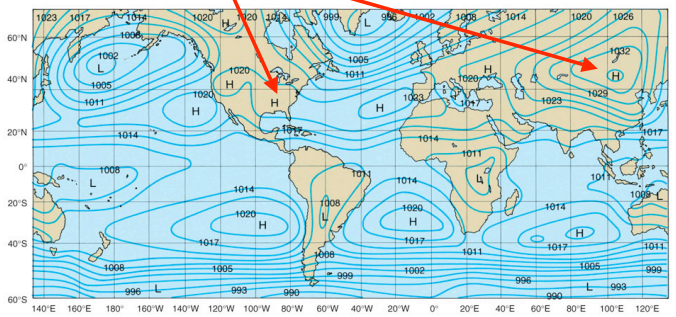
- Look at northern hemisphere in winter
  - Low pressure centers over the ocean
    - Higher heat capacity, warmer temperature
    - High centers present but shrunken



(b) January

Coriolis and the Atmosphere

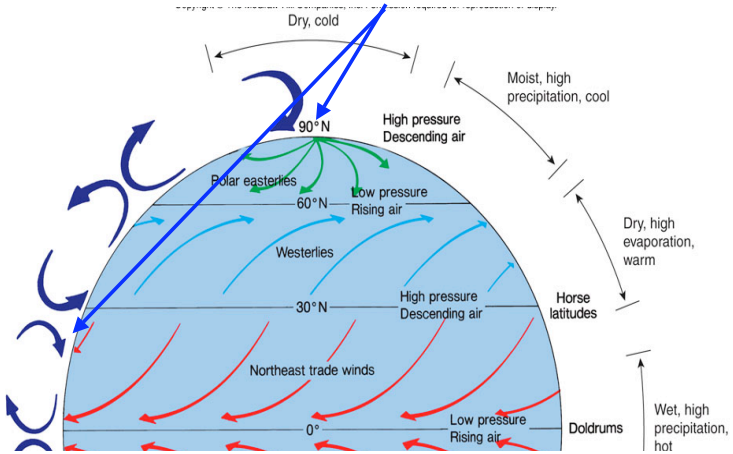
- Look at northern hemisphere in winter
  - High pressure centers over land
    - Lower heat capacity, lower temperature



(b) January

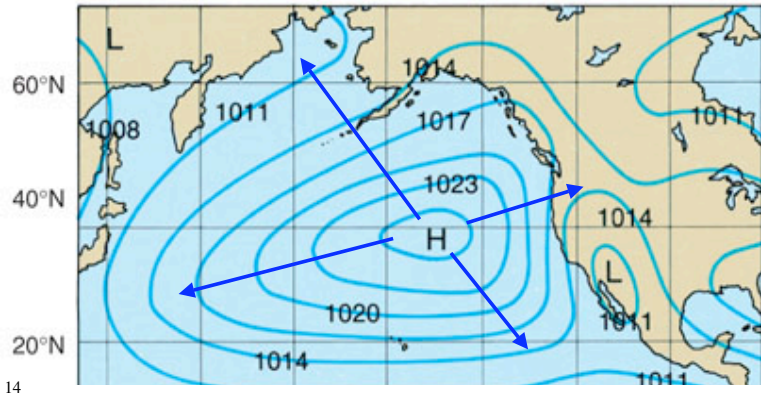
Coriolis and the Atmosphere

- High pressure = surface divergence



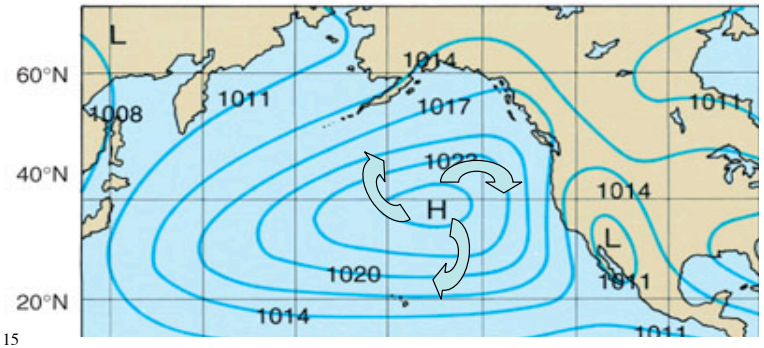
Coriolis and the Atmosphere

- High pressure = surface divergence
  - Air moves away from the center.



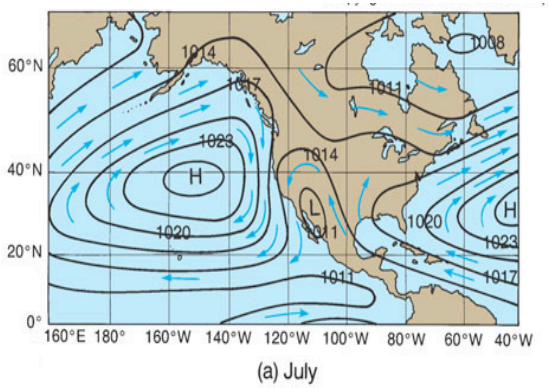
Coriolis and the Atmosphere

- High pressure = surface divergence
  - Air moves away from the center.
  - As it does, it turns (right in the N. Hemisphere)



Coriolis and the Atmosphere

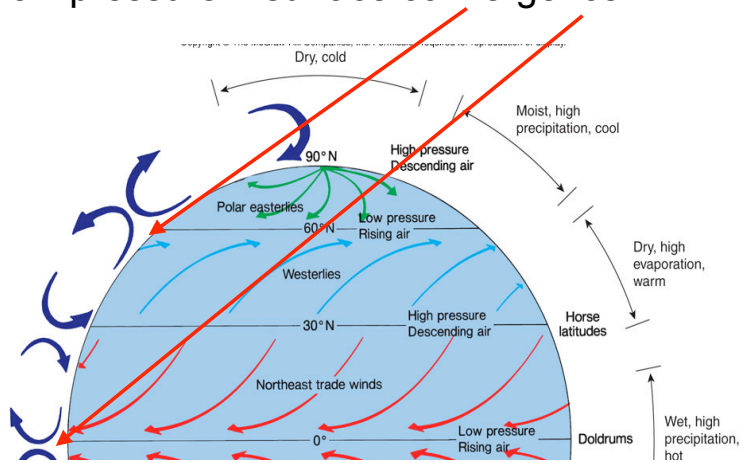
- High pressure = surface divergence
  - Air moves away from the center.
  - As it does, it turns (right in the N. Hemi-sphere)
  - Clockwise circulation around the high center



(a) July

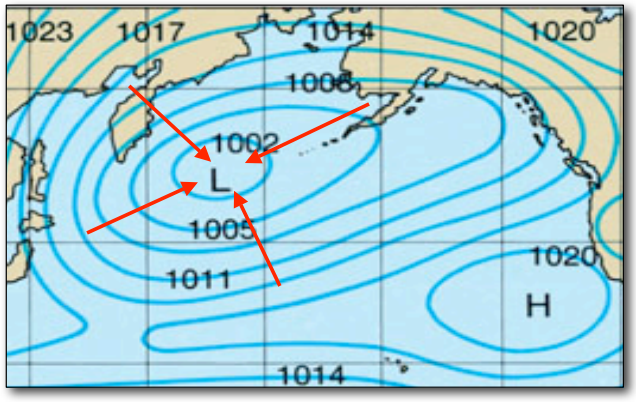
Coriolis and the Atmosphere

- Low pressure = surface convergence



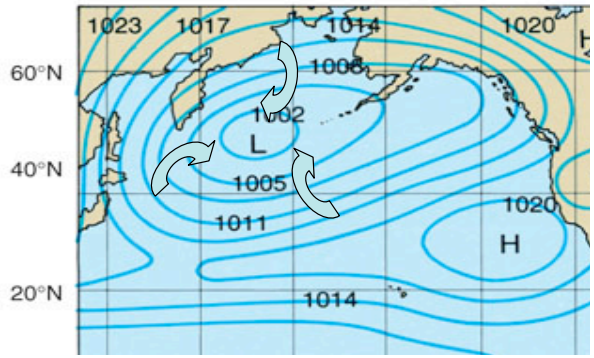
Coriolis and the Atmosphere

- Low pressure = surface convergence
  - Air moves toward center



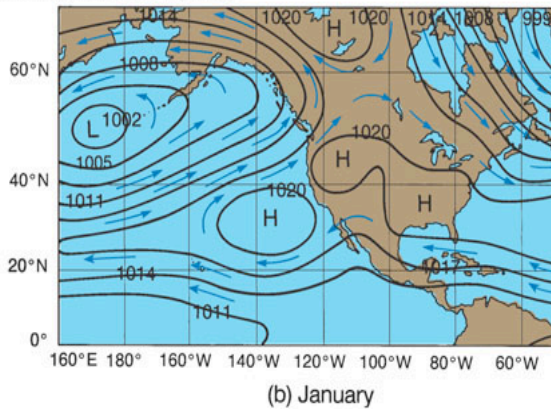
Coriolis and the Atmosphere

- Low pressure = surface convergence
  - Air moves toward center
  - As it does, it turns (right in the N. Hemisphere)



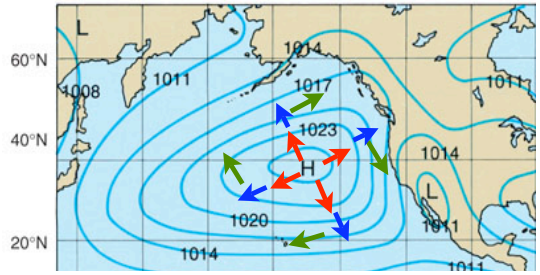
Coriolis and the Atmosphere

- Low pressure = surface convergence
  - Air moves toward center
  - As it does, it turns (right in the N. hemi-sphere)
  - Counter-clockwise circulation around the low



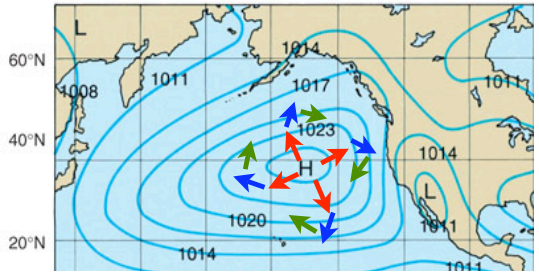
Geostrophic Winds

- Pressure forces air out of high centers and into low centers at the surface.
  - Air starts to move in response to pressure
  - Coriolis effect acts to divert moving air right (NH) as it travels from high to low pressure.



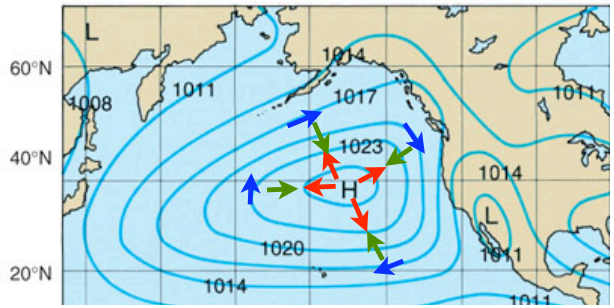
Geostrophic Winds

- Coriolis always acts 90˚ to the right of the direction of motion
  - Air starts to turn in response to Coriolis
  - Direction of Coriolis effect changes as air turns, staying 90˚ right of motion



Geostrophic Winds

- Reaches an equilibrium
  - Coriolis effect acts to right of motion
  - Becomes equal & opposite to pressure
- Winds blow parallel to isobars

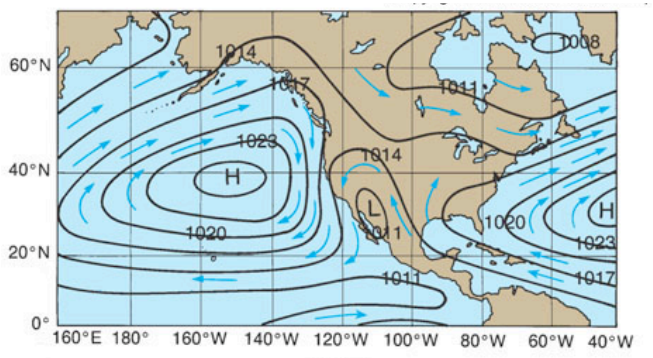


Geostrophic Flow

- Coriolis is equal in magnitude and opposite in direction to pressure
- Winds flow parallel to isobars
- The closer together the isobars, the stronger the pressure gradient, and the stronger the winds.
- We will also see it in the oceans.

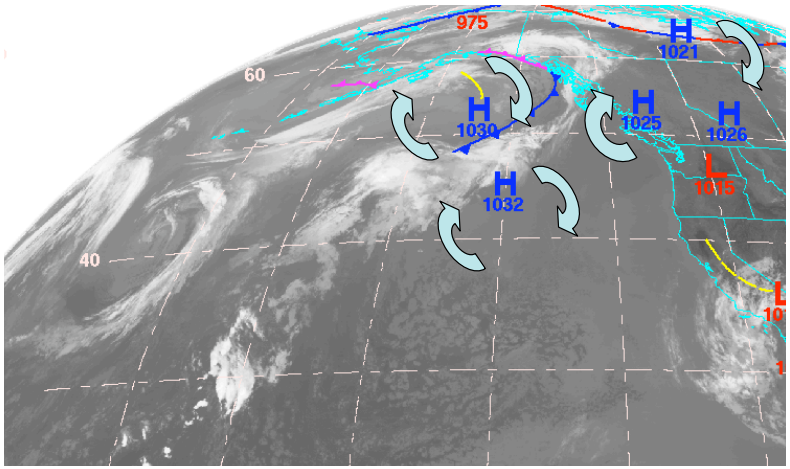
Geostrophic Winds

- High pressure clockwise in N. Hemisphere



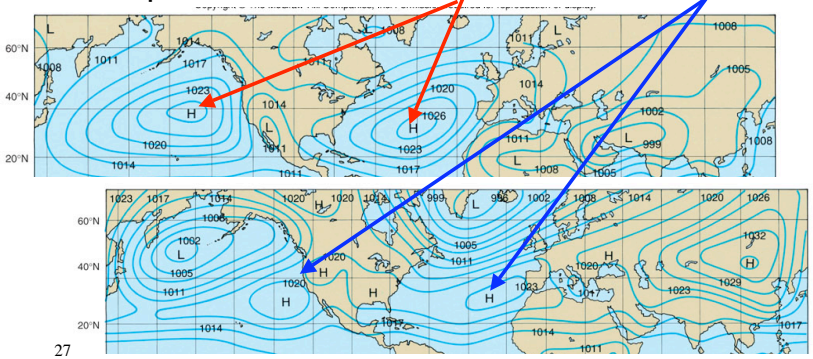
(a) July

High Pressure



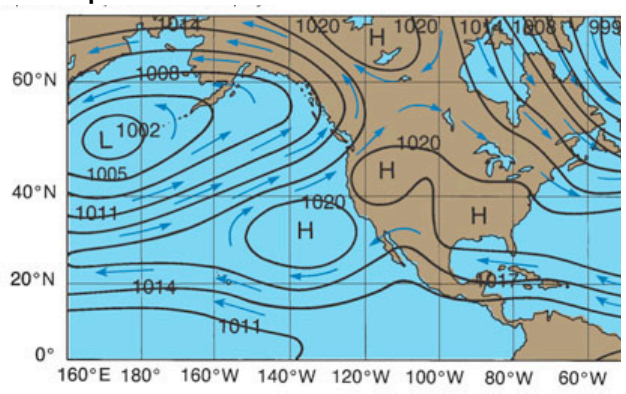
Geostrophic Winds

- High pressure & clockwise winds in N. Hemisphere
  - Expands over ocean summer, shrinks winter



Geostrophic Winds

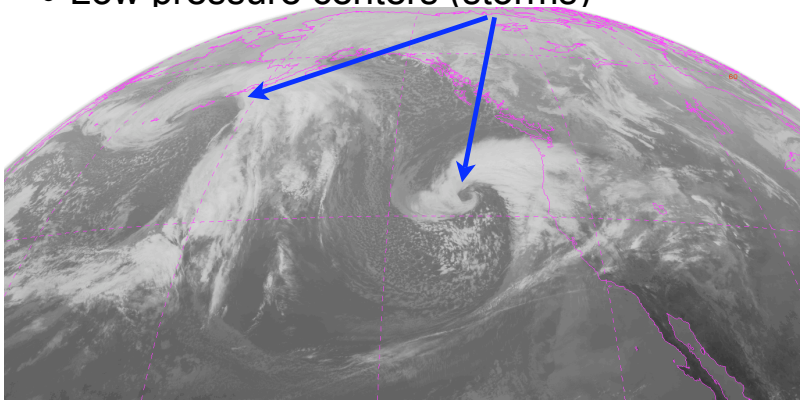
- Low pressure counterclockwise in N. Hemisphere



(b) January

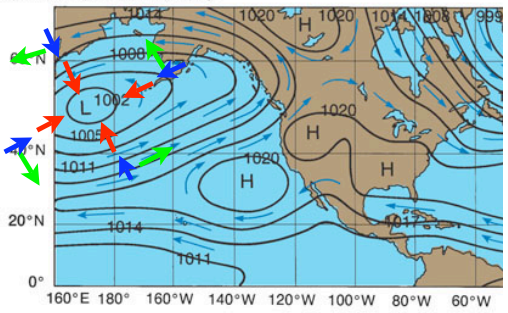
Geostrophic Winds

- Low pressure centers (storms)



Geostrophic Winds-Low

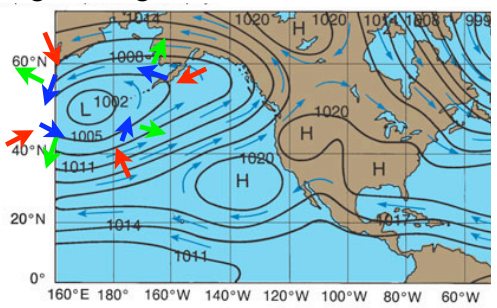
- Pressure forces surface air into low centers
  - Air starts to move in response to pressure
  - Coriolis effect acts to divert moving air right (NH) as it travels from high to low pressure.



(b) January

Geostrophic Winds

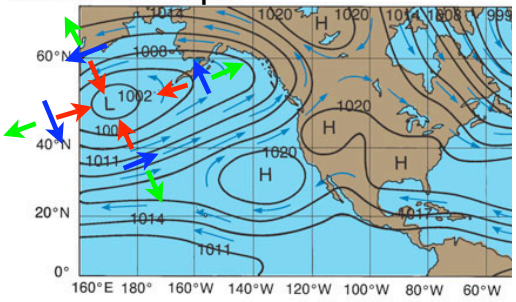
- Coriolis always acts 90˚ right of motion (NH)
  - Air starts to turn in response to Coriolis
  - Direction of Coriolis effect changes as air turns, staying 90˚ right of motion



(b) January

Geostrophic Winds

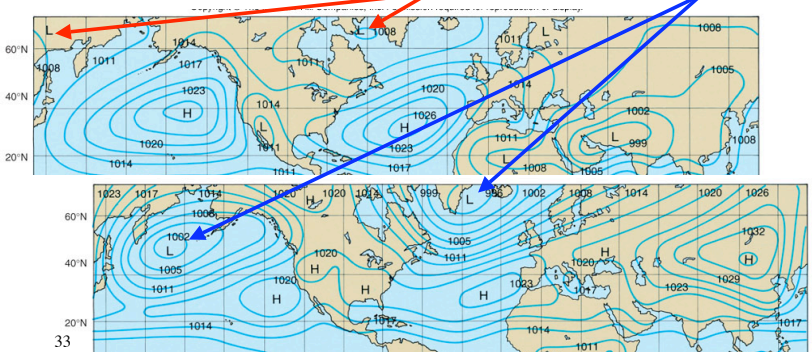
- Reaches an equilibrium
  - Coriolis effect acts to right of motion
  - Becomes equal & opposite to pressure
- Winds blow parallel to isobars



(b) January

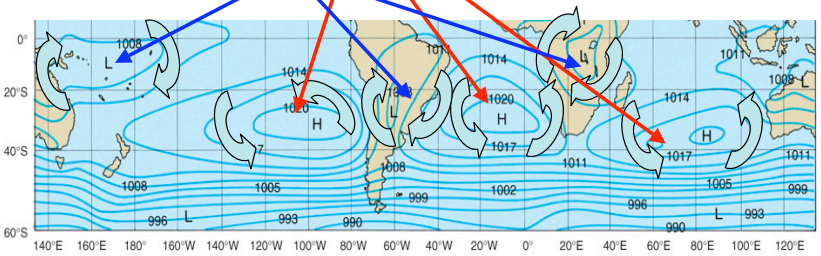
Geostrophic Winds

- Low pressure & counterclockwise winds in N. Hemisphere
  - Shrinks over ocean summer, expands winter



Geostrophic Winds

- Both directions reversed in S. Hemisphere
  - Summer = January (winter = July)
  - High = counterclockwise winds
  - Low = clockwise winds



(b) January

Seasonal shifts

- Pressure & wind patterns shift
  - Poleward in the summer
  - Equatorward in the winter