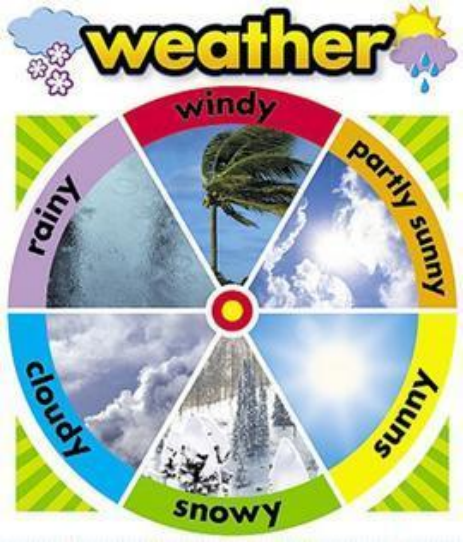
What is Weather?



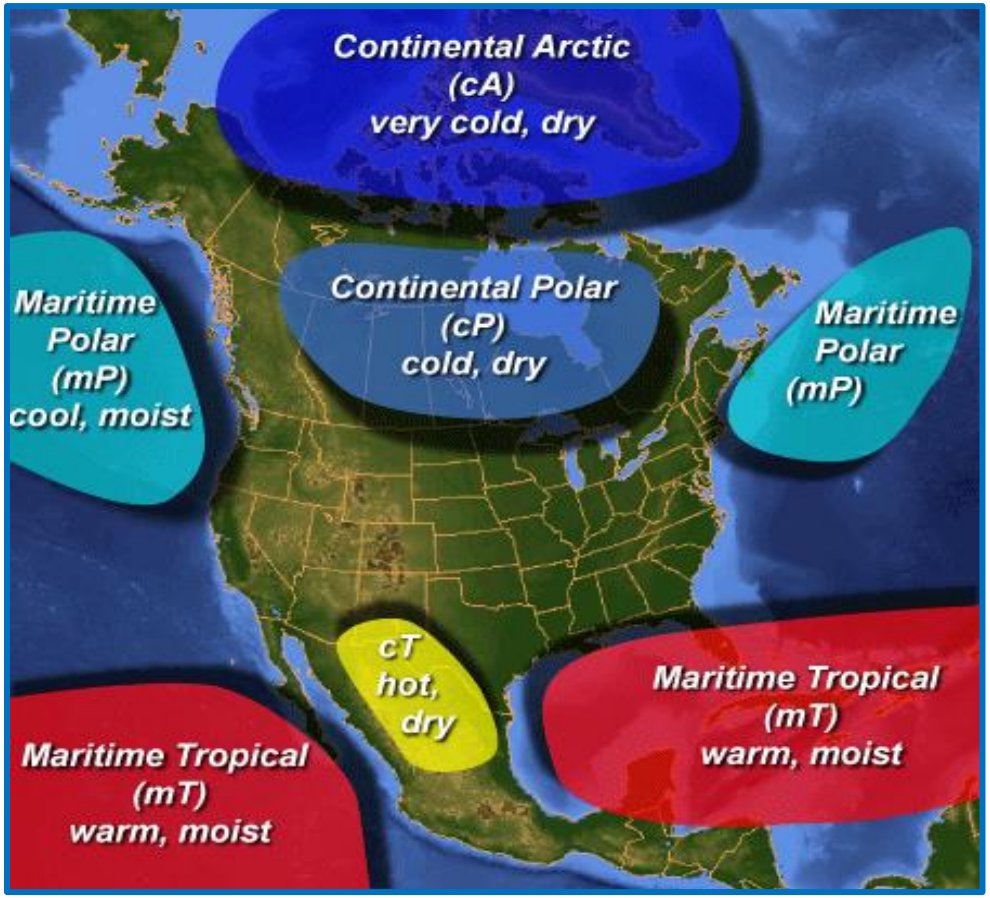
<u>Weather</u> is the state of the atmosphere: hot or cold, wet or dry, calm or stormy, clear or cloudy.

- **<u>Most weather</u> phenomena occur in the troposphere:**
  - **On Earth, the *common weather phenomena* include wind, clouds, rain, snow, fog and dust storms.**
  - ***Less common* events include *natural disasters* such as tornadoes, hurricanes, typhoons and ice storms.**
- **Weather is one of the fundamental processes that shape the Earth through *weathering* and *erosion*.**
- **Weather is driven by air pressure differences between one place and another; in turn, air pressure itself is defined by temperature and moisture.**

Air Masses

<u>Air mass</u> is defined as a *large body of air* that has *similar temperature and moisture within*.

- **Originate in flat, uniform areas with light winds.**
- ***Examples*: snow covered Arctic plains, tropic-subtropic oceans, forests, mountains, large bodies of water.**
- **Classified by their <u>origin</u>:**
  - **Land (continental)**
  - **Water (maritime)**
  - **Latitude (Equatorial, Tropical - within 25° of equator, Polar - poleward of 60° north and south, Arctic/Antarctic)**

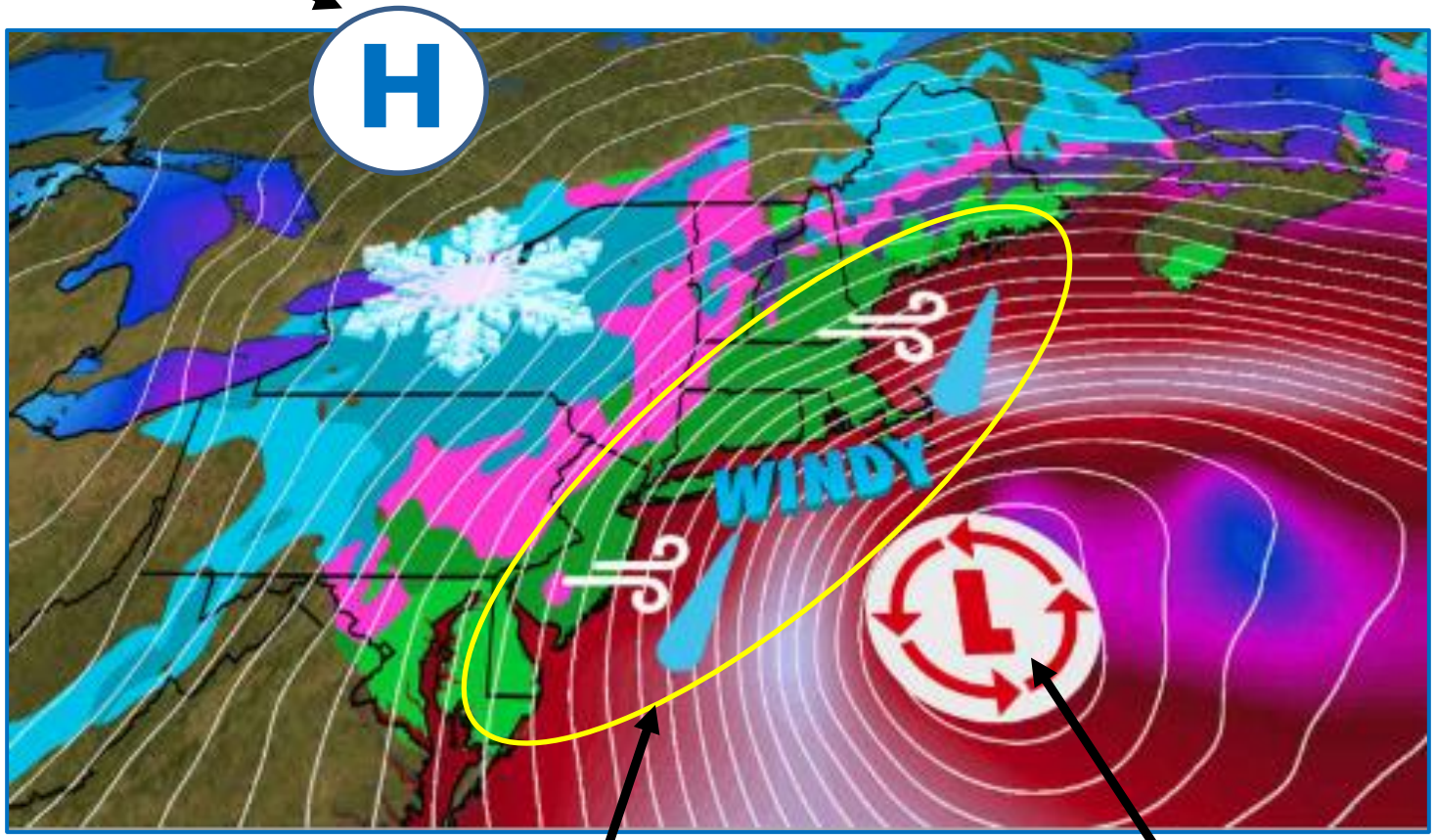


Air masses affecting the U.S. weather during the course of a typical year.

Winter Storm Anyone?

A Weather Map Example

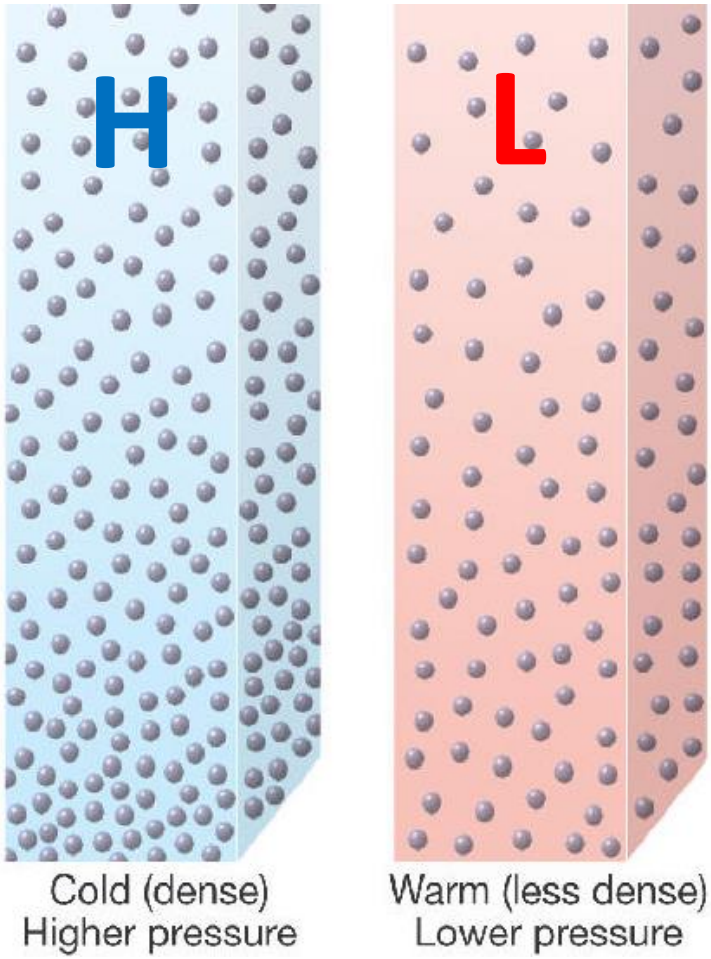
And this?



And why is it *windy* here?

What's this?

Air Pressure Differences

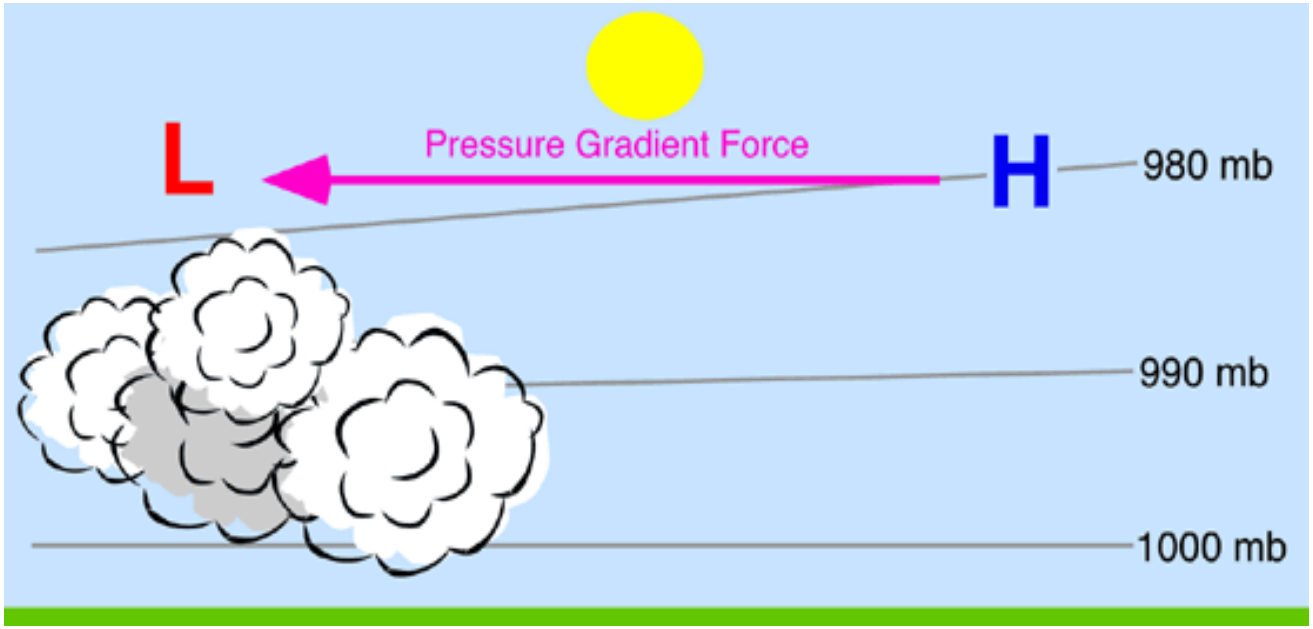


- In the troposphere, air pressure differences can occur due to:
  - the Sun angle at any particular spot
  - surface temperature differences (higher altitudes are cooler than lower altitudes)
- As air warms, it expands and becomes less dense creating lower air pressure (L).
- Cool air sinks and becomes denser creating higher air pressure (H).

Differences in air pressure cause wind: flow of tropospheric air on a large scale.

Wind Formation

- **Winds blow (that is *air moves*) from areas of high pressure to areas of low pressure.**

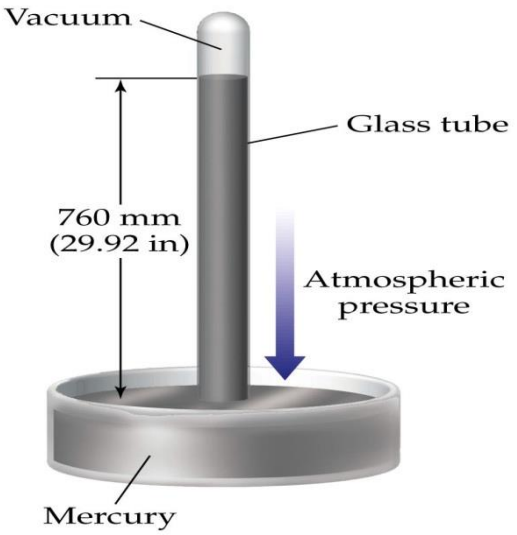


- **Wind speed is often a way of classifying storms.**

Meteorologists distinguish <u>two types of winds</u>:
Local Winds and Global Winds.

How to Measure Wind?

- **Air pressure** is measured using a **barometer** (from Greek *baros* 'weight').



- **Winds are named** by the **direction from which they come**.

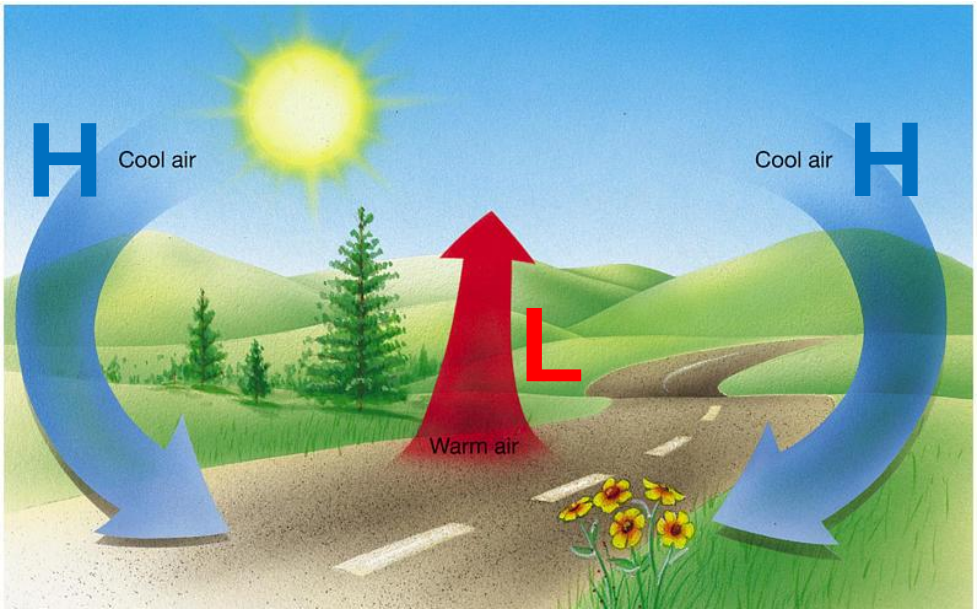
Winds are characterized by their direction and speed.

- **Wind speed** is measured by **anemometer** (from Greek *anemos* 'wind').

Local and Global Winds

Wind is the horizontal movement of air.

All wind is caused by air pressure differences due to the uneven heating of Earth's surface, which sets convection currents in motion: warm air rises and cool air falls.



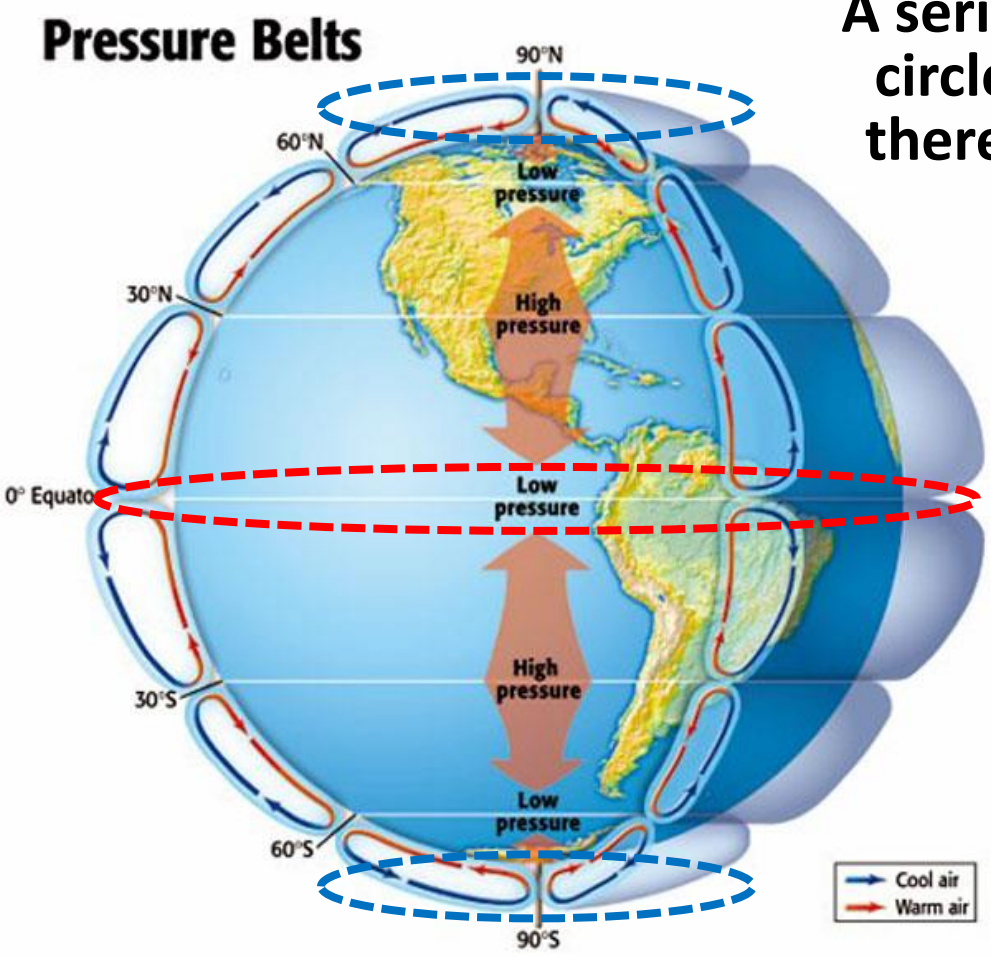
- **Convection currents on a small scale (over short distances) cause local winds - felt on the ground, often seasonal.**
- **Convection currents on a large scale (resulting from the difference in absorption of solar energy between the equatorial and polar zones on Earth) cause global winds.**

Local Winds

- cover short distances
- blow from any direction

- often are seasonal
- created and influenced by local conditions, local temperature variations, and local topography.

Global Winds Formation



A series of pressure/wind belts circles the Earth; between them there are calm areas where air is rising or falling.

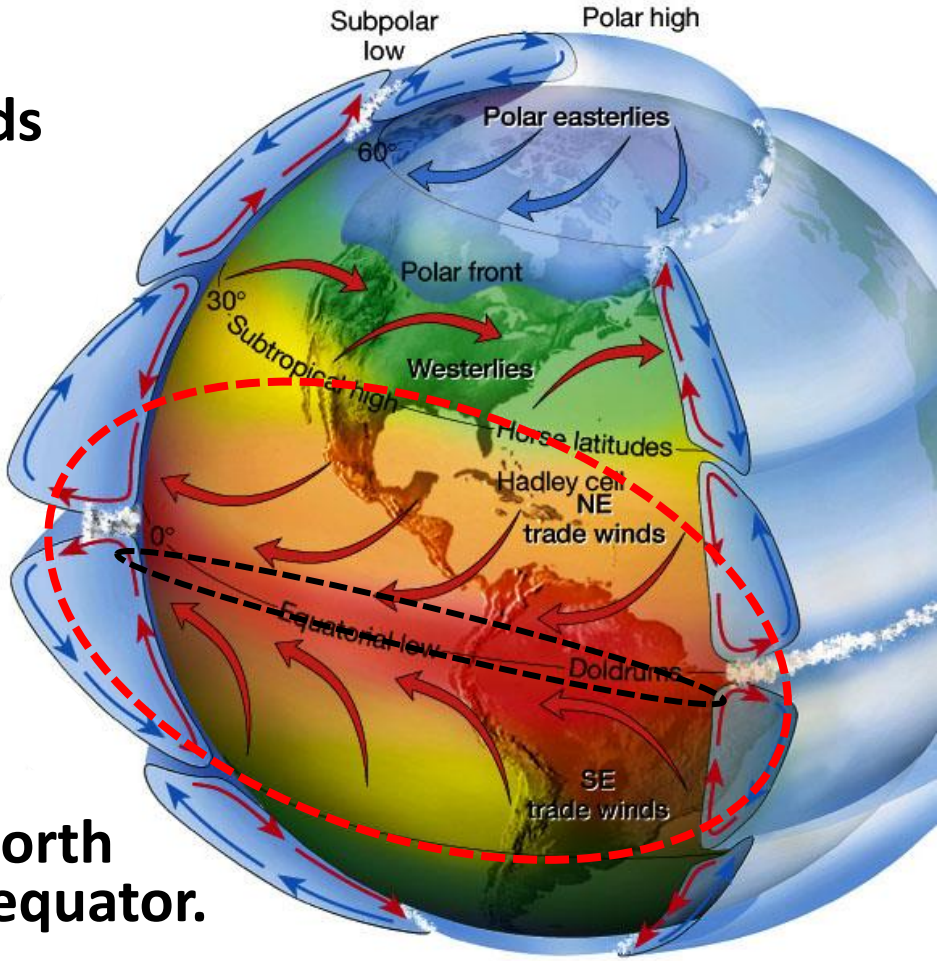
- **Example:**
  - since the warm air **near the equator** is less dense, it rises forming areas of **low pressure**
  - the cold air **near the poles** sinks because it is more dense, forming areas of **high pressure**

The air moves in large <u>circular patterns</u> called convection cells.

Types of Global Winds

Doldrums:

- Calm and weak surface winds located at the equator.
- *Name origin:* early sailors found that there were no winds near the equator for considerable periods of time (these *calm periods* were called *doldrums*) - the ships were essentially stuck in one place, not being able to move forward.

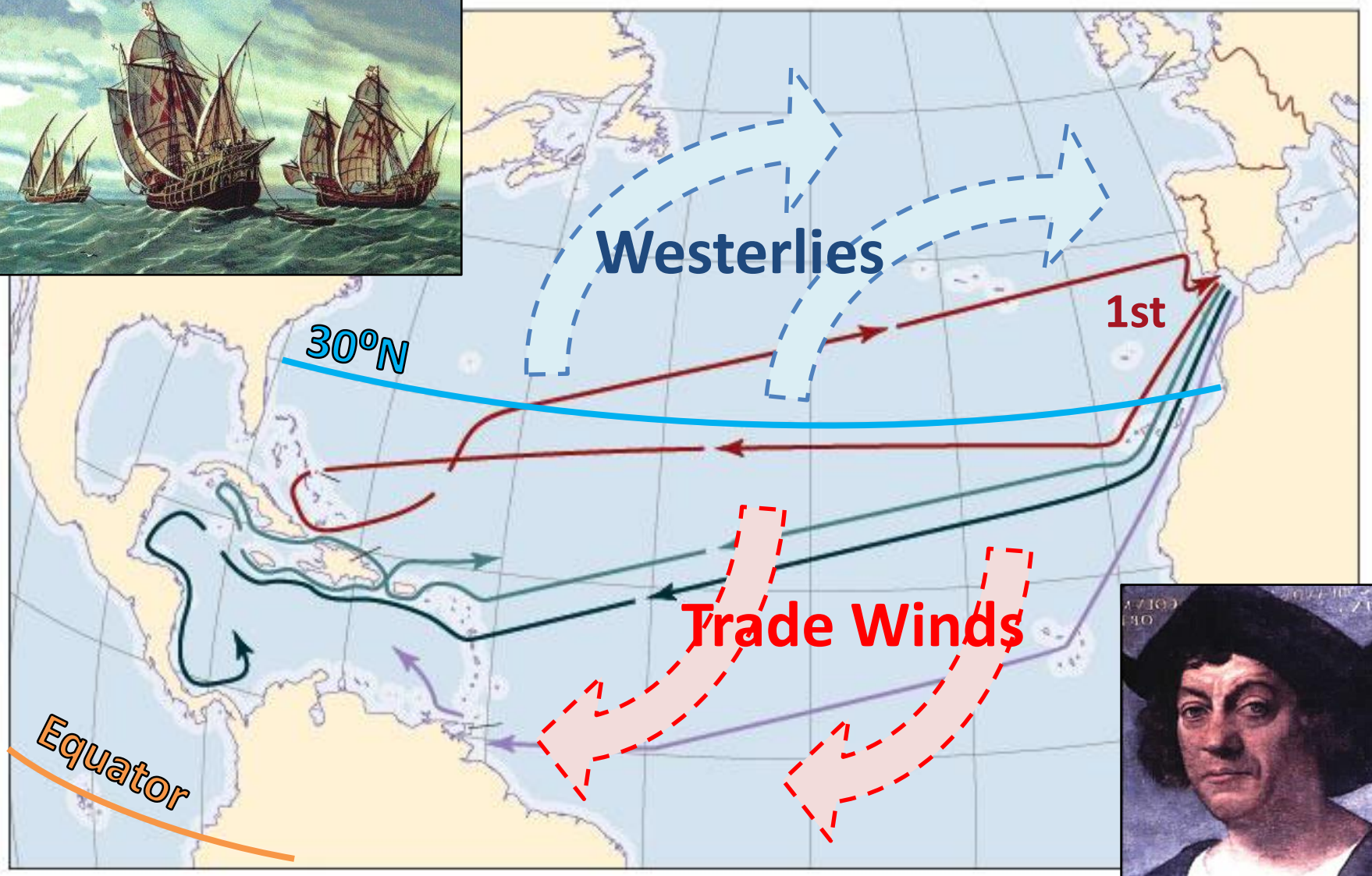


Trade Winds:

- Found between about 30˚ (north and south) latitude and the equator.
- Steady and strong, blow about 11 to 13 mph.
- *Name origin:* from their ability to propel *trading ships* across the ocean.

Voyages of Christopher Columbus

1492-1504



Types of Global Winds

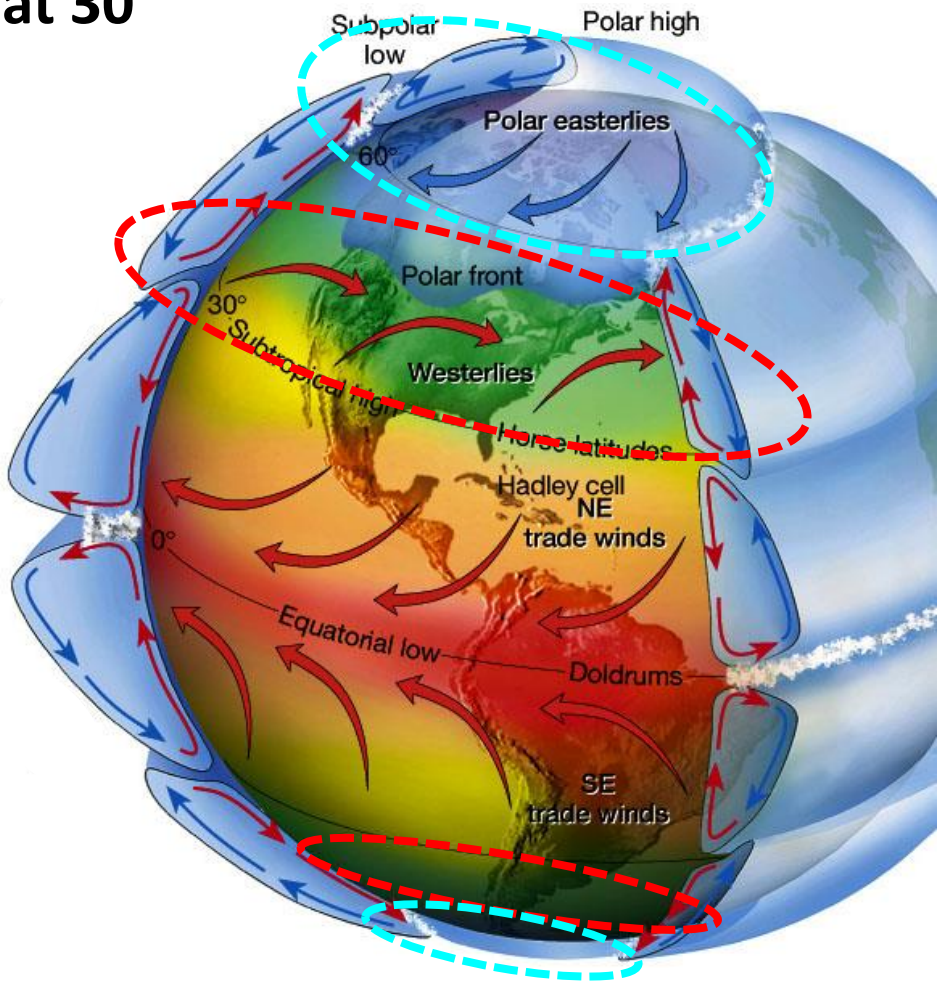
Horse latitudes: calm areas at 30˚

Prevailing Westerlies:

- **Strong winds located in the belt from 30-60˚latitude in both hemispheres.**
- **Originate in horse latitudes.**
- **Blow *from west*, tend towards the poles.**

Polar Easterlies:

- **Cold, dry, weak, irregular.**
- **Found near the North and South Poles reaching to 60˚ latitude.**



Both of these have a strong impact on the US weather.