



# What is Weather?

Weather is the **state of the atmosphere**: hot or cold, wet or dry, calm or stormy, clear or cloudy.



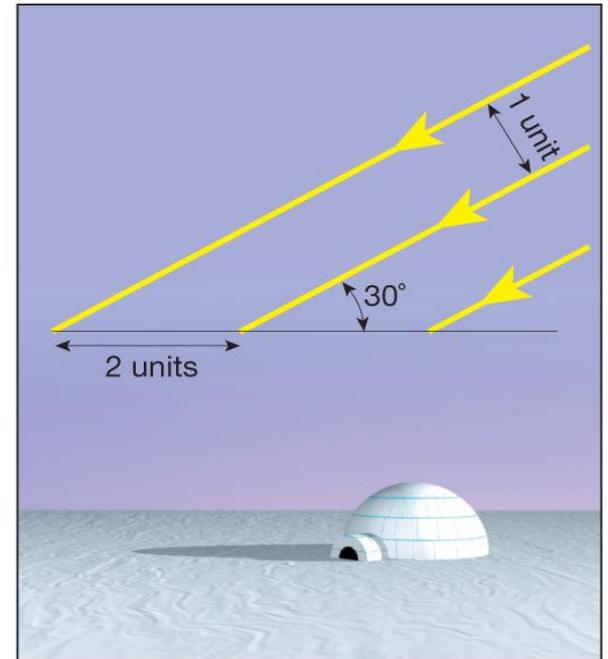
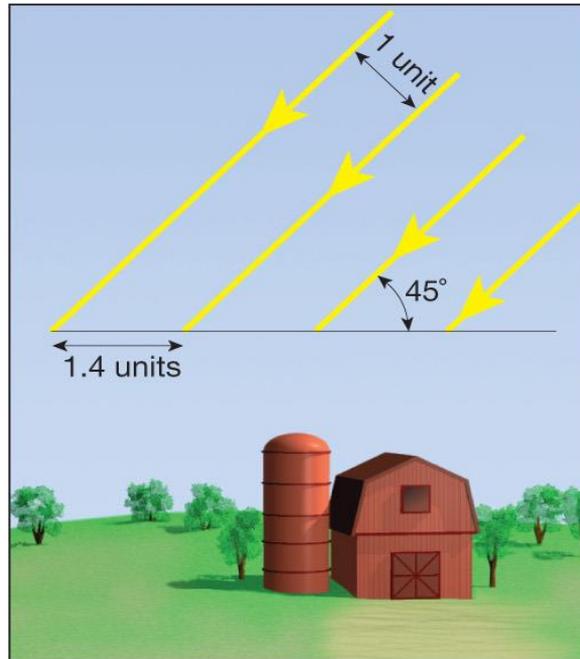
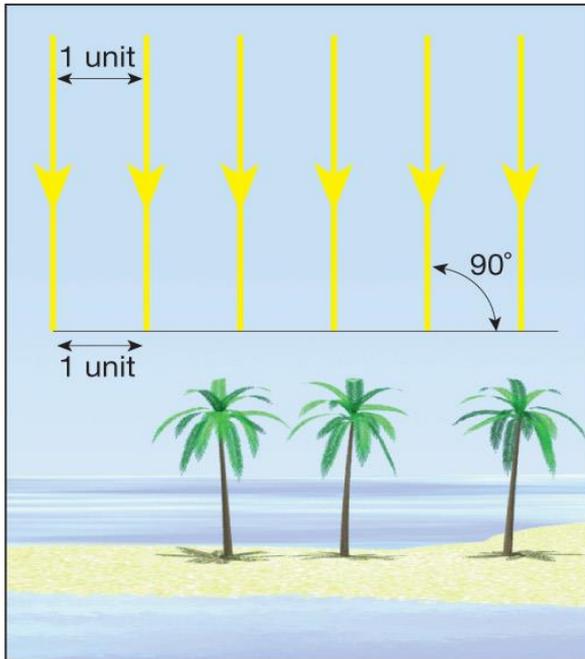
- Weather is **driven by air pressure differences between one place and another** (in turn, air pressure is defined by temperature and moisture).
- Most weather phenomena occur in the **troposphere**:
  - On Earth, the *common weather phenomena* include wind, clouds, rain, snow, fog and dust storms.
  - *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 vs Climate

- **Weather** is the **day-to-day state of the atmosphere**, and its **short-term variation** in minutes to weeks.
  - We talk about changes in weather in terms of the near future: "How hot is it *right now*?" "What will it be like *today*?" and "Will we get a snowstorm *this week*?"
- **Climate** is the weather of a particular region **averaged over a long period of time** (usually 30 years).
  - Climate information includes the *statistical* weather information that tells us about the **normal weather** (average pattern), as well as the **range of weather extremes** for a location.
  - We talk about climate change in terms of *decades* and *centuries*.

# Heating of the Atmosphere

The Sun shines more directly **near the equator** bringing these areas **more warmth**; the **polar regions** are at such an angle to the Sun that they get little or no sunlight during the winter, causing **colder temperatures**.

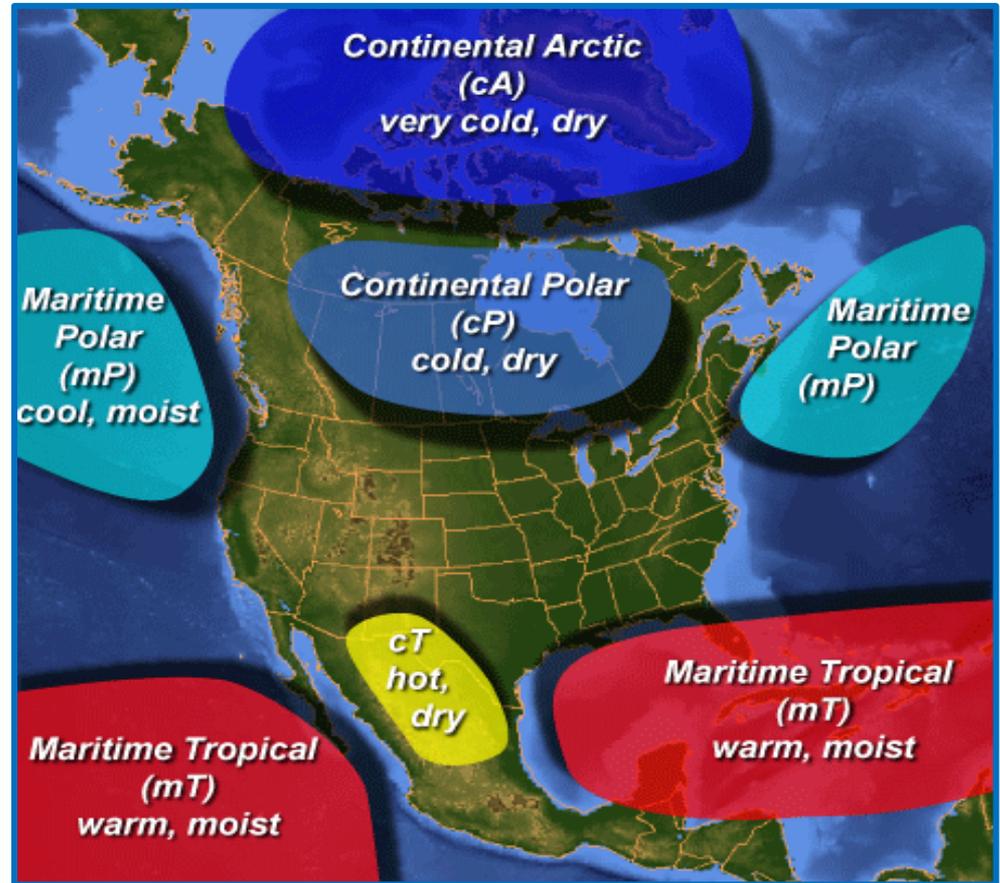


**Unequal heating of the atmosphere creates a restless movement of air (and water!) to distribute heat energy from the Sun across the planet.**

# Air Masses

Air mass 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 origin:
  - Land (continental)
  - Water (maritime)
  - Tropical (within 25° of equator)
  - Polar (poleward of 60° north and south)



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

# Air Masses and Fronts

Air masses cover many thousands of square kilometers.

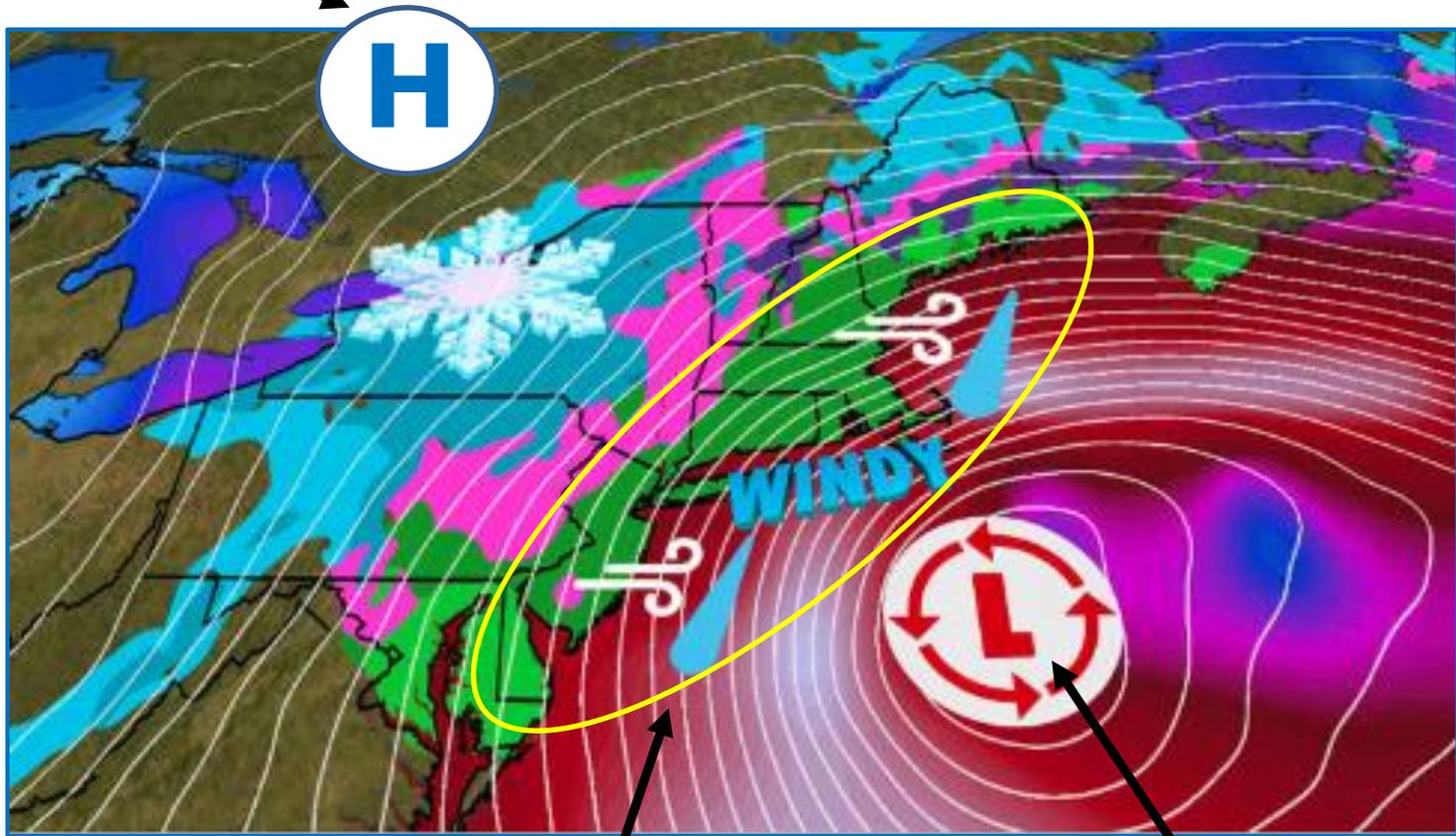


A boundary that separates two different air masses is called a weather (*atmospheric*) front.

# Winter Storm Anyone?

## Weather Map Example

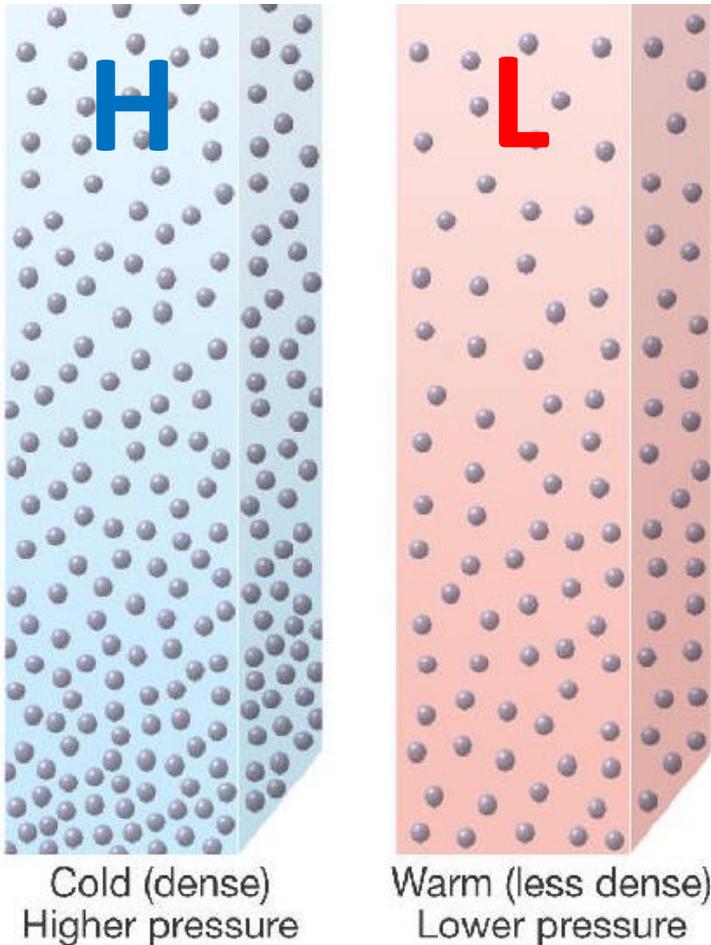
And this?



And why is it *windy* here?

What's this?

# Air Pressure Differences

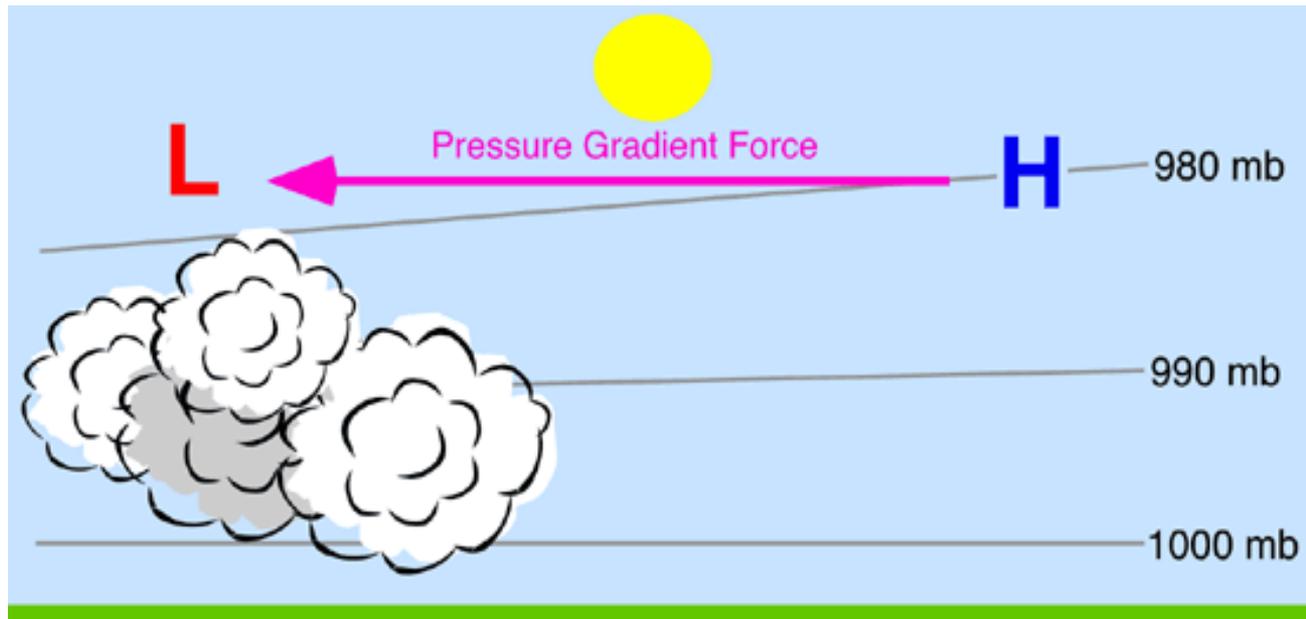


- Air pressure differences can occur due to:
  - the Sun angle at any particular spot
  - surface temperature differences (higher altitudes are cooler than lower altitudes)
- As air **warms**, it **expands** and becomes **less dense** creating **lower air pressure (L)**.
- **Cool** air **sinks** and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

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

# Wind

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

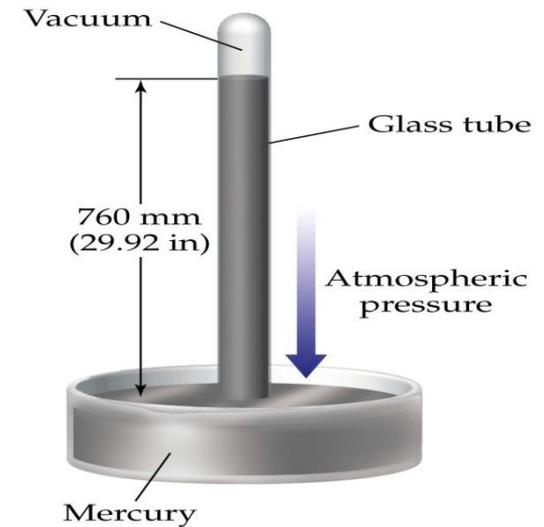
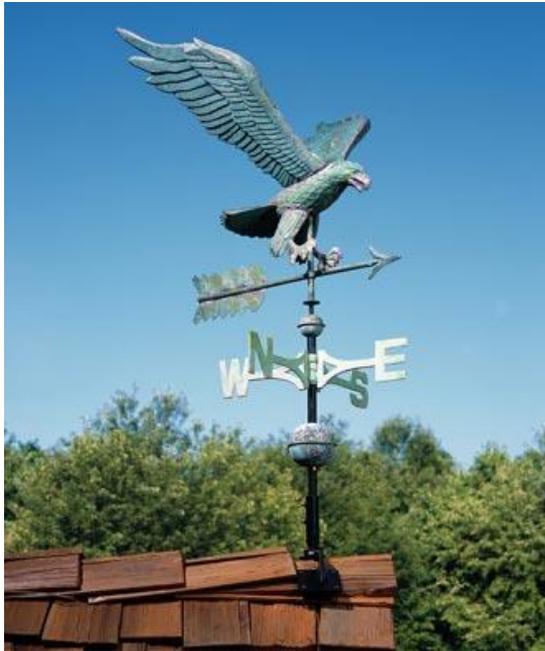


- Wind speed is often a way of classifying storms.

Meteorologists distinguish two types of winds:  
**Local Winds** and **Global Winds**.

# How to Measure?

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



Winds are characterized by their **direction** and **speed**.



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

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

# Wind Rose

- A wind rose shows how **wind speed** and **direction** are typically distributed at a particular location over a specified period of time (year, season, month):
  - typically uses **16 directions**
  - can quickly indicate the **dominant wind directions** and the direction of strongest wind speeds.
- Compiling a wind rose is one of the **preliminary steps taken in constructing airport runways**, as aircraft typically perform their best take-offs and landings pointing into the wind.



PHILADELPHIA INTL [PHL] Windrose Plot  
[All Year]

Period of Record: 01 Jun 2010 - 01 Aug 2010

Number of Obs: 1852 Calm: 6.3% Avg Speed: 8.2 mph

