

INTRODUCTORY CLASS FOR METEOROLOGY AND GEOMETRY

Geography

- ▣ The word derived from Greek *geographia*, "earth describe-write"
- ▣ It is the science that studies:
 - ▣ the lands,
 - ▣ the features,
 - ▣ the inhabitants, and
 - ▣ the phenomena of the Earth.

- ▣ A literal translation would be "to describe or write about the Earth".
- ▣ The first person to use the word "geography" was Eratosthenes (276-194 BC)



Meteorology

- ▣ Meteorology is the **interdisciplinary** scientific study of the atmosphere.
 - Meteorology,
 - climatology,
 - atmospheric physics, and
 - atmospheric chemistry are sub-disciplines of the atmospheric sciences.

- ▣ Meteorology and hydrology compose the interdisciplinary field of **hydrometeorology**.

- ▣ Meteorology has application in many diverse fields such as the military, energy production, transport, agriculture and construction.

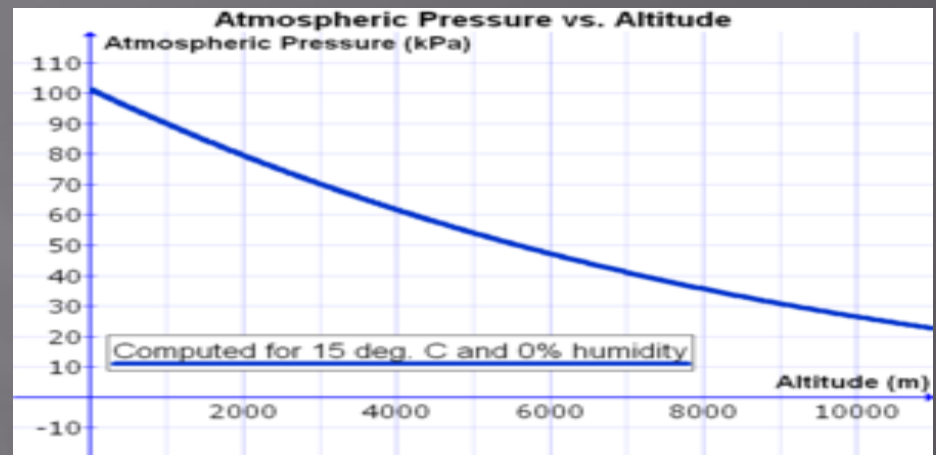
Atmosphere

- ▣ The atmosphere of earth is a **layer of gases** surrounding the planet earth that is retained by **earth's gravity**.

- ▣ The atmosphere **protects life** on earth by:
 - **absorbing ultraviolet** solar radiation,
 - **warming the surface** through heat retention (greenhouse effect), and
 - **reducing temperature extremes** between day and night (the diurnal temperature variation).

Atmospheric pressure

- ▣ Atmospheric pressure is the **force per unit area** exerted into a surface by the weight of air above that surface in the atmosphere of Earth (or that of another planet).
- ▣ In most circumstances atmospheric pressure is closely approximated by the hydrostatic pressure caused by the mass of air above the measurement point.



- Low-pressure areas have less atmospheric mass above their location, whereas high-pressure areas have more atmospheric mass above their location.
- Likewise, as elevation increases, there is less overlying atmospheric mass, so that **pressure decreases with increasing elevation**. On average, a column of air one square centimeter in cross-section, measured from sea level to the

Weather

- ▣ Weather is the **state of the atmosphere**, to the degree that it is:
 - ▣ hot or cold,
 - ▣ wet or dry,
 - ▣ calm or stormy,
 - ▣ clear or cloudy.
- ▣ Most weather phenomena occur in the **troposphere**, just below the stratosphere.
- ▣ Weather refers, generally, **to day-to-day** temperature and precipitation activity, whereas climate is the term for the **average atmospheric conditions over longer periods of time**.

Climate

- ▣ Climate encompasses the **statistics of** temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological elemental measurements in a **given region over long periods.**
- ▣ Climate can be contrasted to weather, which is the **present condition** of these elements and their variations over **shorter periods**

Temperature

- ▣ Temperature is a **physical property** of matter that quantitatively expresses the common notions of **hot and cold**.
- ▣ Objects of low temperature are cold, while various degrees of higher temperatures are referred to as warm or hot.
- ▣ When a heat transfer path between them is open, heat spontaneously flows from bodies of a higher temperature to bodies of lower temperature.

Humidity

- Humidity is a term for the **amount of water vapor in the air**.
- Formally, humid air is not "moist air" but a **mixture of water vapor and other constituents of air**, and
- humidity is defined in terms of the **water content of this mixture**, called the **absolute humidity**.
- In everyday usage, it commonly refers to **relative humidity**, expressed as a percent in weather forecasts and on household humidistats; it is so called because it measures the current absolute humidity *relative* to the maximum. **Specific humidity** is a ratio of the water vapor content of the mixture to the total air content (on a mass basis)

Air

- ▣ Air the name given to atmosphere used in **breathing** and **photosynthesis**.

- ▣ Dry air contains roughly (by volume):
 - 78.09% nitrogen,
 - 20.95% oxygen,
 - 0.93% argon,
 - 0.039% carbon dioxide, and
 - small amounts of other gases.
 - Air also contains a variable amount of water vapor, on average around 1%.

Water

- ▣ Water is a chemical substance with the chemical formula H_2O .
- ▣ A water molecule contains one oxygen and two hydrogen atoms connected by covalent bonds.
- ▣ Water is a **liquid** at ambient conditions, but it often co-exists on Earth with its **solid** state, ice, and **gaseous** state (water vapor or steam).

Wind



- ❑ Wind is the **flow of gases** on a **large scale**.
- ❑ On Earth, wind consists of the bulk movement
- ❑ In outer space, **solar wind** is the movement of gases or charged particles from the sun through space, while **planetary wind** is the **outgassing of light chemical elements** from a planet's atmosphere into space.
- ❑ Winds are commonly classified by their:
 - **spatial scale,**
 - **speed,**
 - **the types of forces that cause them,**
 - **the regions in which they occur, and**
 - **their effect.**
- ❑ The strongest observed winds on a planet in our solar system occur on Neptune and Saturn.

Cloud

- ▣ A **cloud** is a **visible mass of liquid droplets** or **frozen crystals** made of **water** or various **chemicals** **suspended** in the atmosphere above the surface of a planetary body.
- ▣ These suspended particles are also known as **aerosols**.
- ▣ Clouds in earth's atmosphere are studied in the cloud physics branch of meteorology.
- ▣ **Two processes**, possibly acting together, can lead to air becoming saturated:
 - **cooling the air** or
 - **adding water vapor to the air.**
- ▣ In general, **precipitation** will fall to the surface. If it is **virga**, which evaporates before reaching the surface.



Thunderstorm

- A **thunderstorm**, also known as:
 - an **electrical storm**,
 - a **lightning storm**,
 - **thundershower** or
 - simply a **storm**

- It is a form of weather characterized by the **presence of lightning** and its **acoustic effect** on the Earth's atmosphere known as **thunder**.

- The meteorologically assigned cloud type associated with the thunderstorm is the **cumulonimbus**.

- Thunderstorms are usually accompanied by:
 - strong winds,
 - heavy rain and
 - sometimes
 - snow,
 - sleet,
 - hail, or
 - no precipitation at all.



Storm

- A **storm** (Proto-Germanic **sturmaz* “noise, tumult”) is any disturbed state of an astronomical body's atmosphere, especially affecting its surface, and strongly implying severe weather.

- It may be marked by:
 - strong wind, hail, thunder and/or lightning (**a thunderstorm**),
 - heavy precipitation (**snowstorm, rainstorm**),
 - heavy freezing rain (**ice storm**),
 - strong winds (**tropical cyclone, windstorm**) or
 - wind transporting some substance through the atmosphere (as in a **dust storm, blizzard, sandstorm**, etc.).

- Storms generally lead to **negative impacts to lives** and property, such as storm surge, heavy rain or snow (**causing flooding or road impassibility**), lightning, wildfires, and vertical wind shear;

- However, systems with significant rainfall can **alleviate drought** in places they move through. Heavy snowfall can allow special **recreational activities** to take place which would not be possible otherwise, such as **skiing** and **snowmobiling**.

Cartography

- ▣ (from Greek *chartes* or *charax* = sheet of papyrus (paper) and *graphein* = to write)
- ▣ **Cartography** is the study and practice of making maps.
- ▣ Combining science, aesthetics, and technique, cartography builds on the premise that reality can be modeled in ways that communicate spatial information effectively.