Lecture notes

FUNDAMENTALS OF CLIMATE CHANGE AND NATURAL DISASTERS

Course Code: ER601

Chapter 1

BASICS ON CLIMATE SCIENCES

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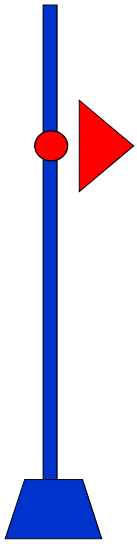


CONTENTS

- **Meteorology**

Meteorology is the science that studies the atmosphere, mainly about monitoring and forecasting the weather (temperature, humidity, rain, sun, wind, radiation,...)

- **Weather**

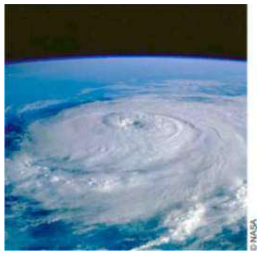
Weather is a collection of states of meteorological factors occurring in the atmosphere at a certain short period of time (day/time).

- **Climate**

Climate is average weather over a long period of time.(over 30 years – according to WMO)

"Climate is what you would expect, Weather is what you get"

(Idioms)



Meteorology - Hydrology is a branch of science that studies:

- **the properties, characteristics of formation and classification of physical phenomena occurring in the atmosphere and river flows, as well as the mutual influence of these phenomena with each other.**
- **describe the complex changes of nature so that we can prevent, prevent and partially avoid natural disasters, reduce risks in production life and improve living environment.**

Climatology is the science that studies the laws and phenomena of the climate and predicts climate change.

>>Meteorology - Hydrology >>> >>>>>>> Climatology >>>>>>

SOME WEBSITES RELATED TO WEATHER – CLIMATE

http://pclb.vnn.vn

http://www.nsc.org/ehc/ew/disaster

http://www.discovery.com/giudes/weather

http://www.hurricanehunters.com

http://rsd.gsfc.nasa.gov/rsd/images

http://www.meto.govt.uk/sec6

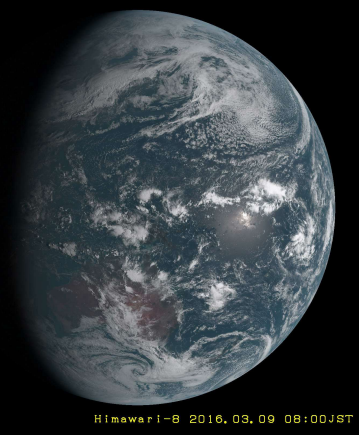
http://www.stormchaser.niu.edu/chaser

http://weather.yahoo.com

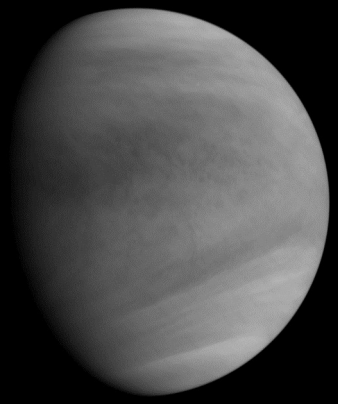
https://climate.nasa.gov/

WEATHER ON THE EARTH IS NEVER THE SAME FROM ONE PLACE TO ANOTHER

EARTH ≠ OTHER PLANETS

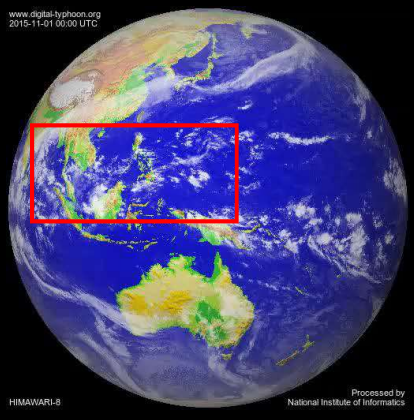


Himawari-8/JMA (1-30 Nov 2015)

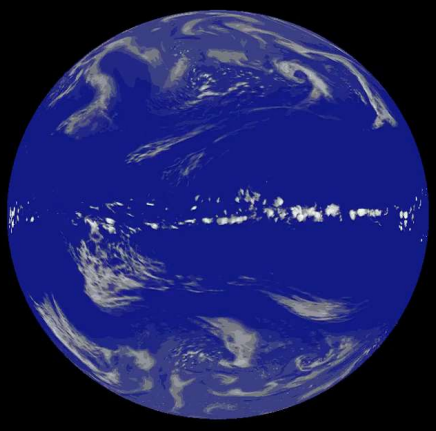


NICAM/JAMSTEC (Satoh et al., 2008)

EARTH ≠ EARTH WITHOUT CONTINENTS

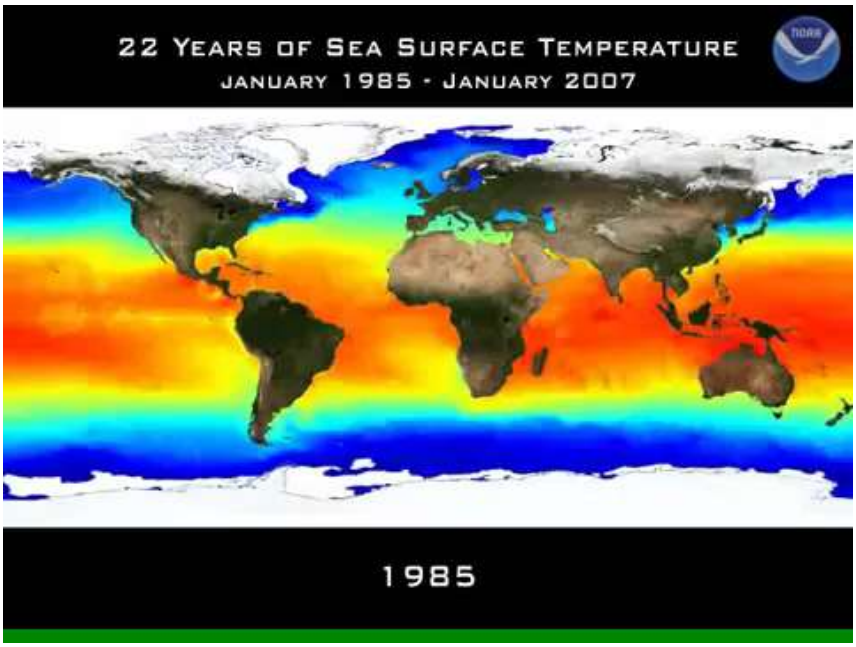


Himawari-8/JMA (1-30 Nov 2015)



NICAM/JAMSTEC (Satoh et al., 2008)

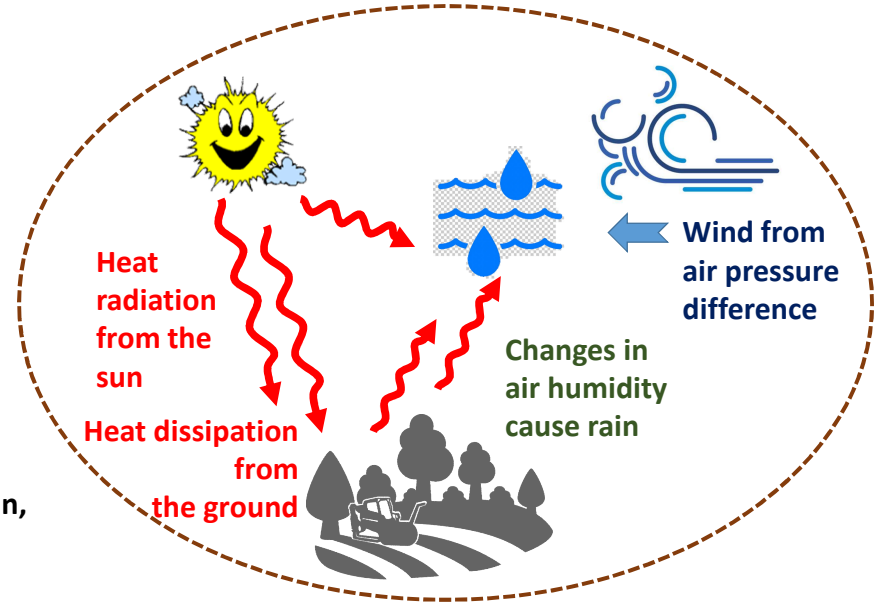
COLDER



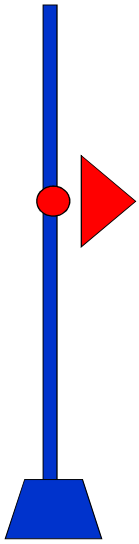
HOTTER

COLDER

WHY THE WEATHER CHANGES ON EARTH?



Weather in different parts of the world varies greatly due to many combined factors such as temperature, humidity, rain, wind, air pressure, etc.



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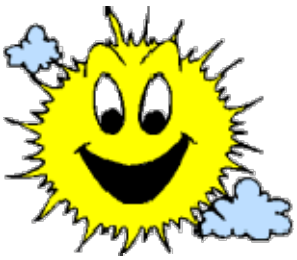
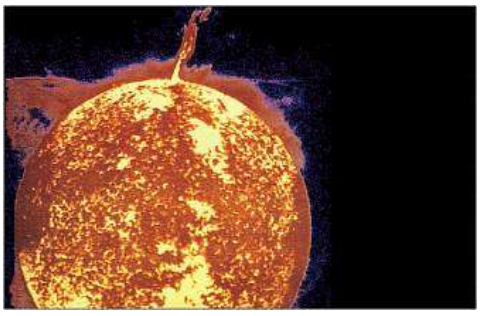
EARTH'S CLIMATE SYSTEM

Climate is the result of a complex interaction of physical, chemical and biological processes under the influence of solar energy.

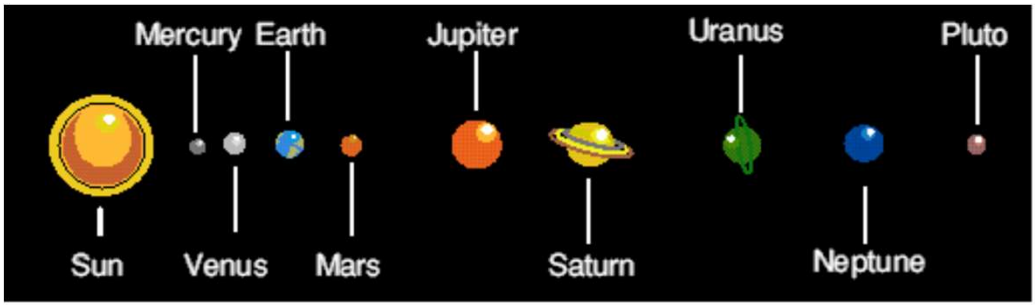




The sun is the source of energy for life on earth and the source of energy for the climate.

https://www.youtube.com/watch?reload=9&v=HFT7ATLQQx8

SOLAR SYSTEM



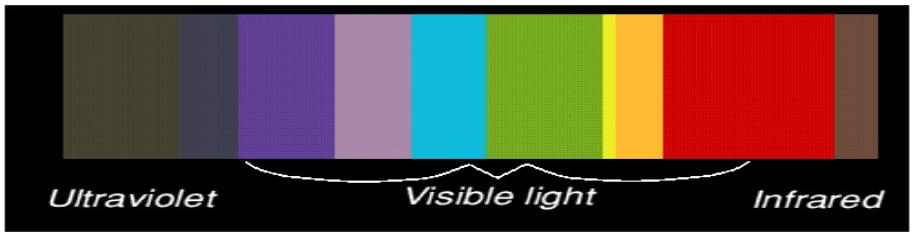
(0) **Sun**: Mặt trời; (1) **Mercury**: Thủy tinh; (2) **Venus**: Kim tinh; (3**) Earth**: Trái đất; (4) **Mars**: Hỏa tinh; (5) **Jupiter**: Mộc tinh; (6) **Saturn**: Thổ tinh; (7) **Uranus**: Thiên vương tinh; (8) **Nepturn**: Hải vương tinh; (9) **Pluto**: Diêm vương tinh

(Currently, astronomers do not consider Pluto as a planet in the solar system)

SOLAR SPECTRUM

Solar energy radiates in all directions as electromagnetic radiation: visible light, ultraviolet radiation, infrared radiation,…

Solar radiation is actually an electromagnetic wave that propagates through space at the speed of light, its wavelength is not the same, but it creates a spectrum.

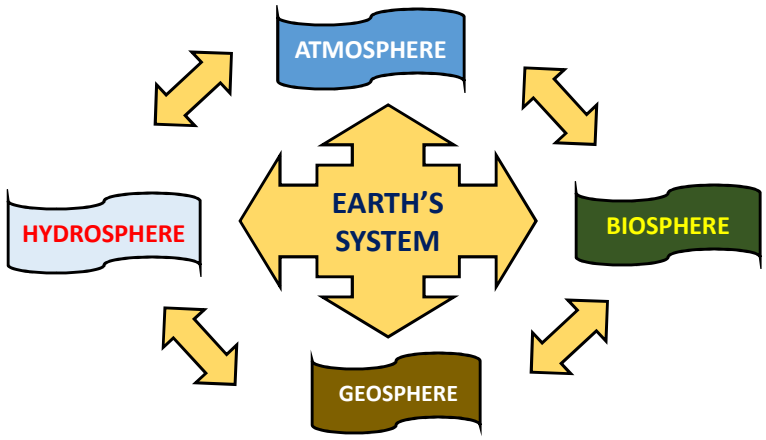


λ= 0,20 - 0,39 μ	λ= 0,39 - 0,76 μ	λ= 0,76 - 24,0 μ
ultraviolet radiation	***visible light***	***infrared radiation***

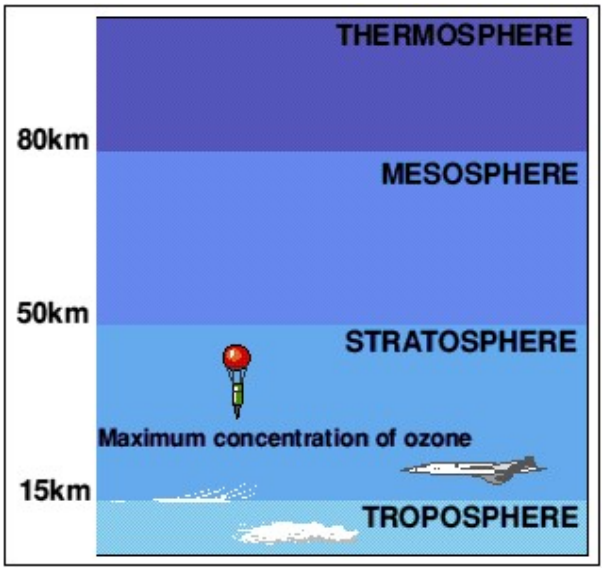
(μ là micromet = 10^{-6} metter)

EARTH'S CLIMATE SYSTEM

"Climate system" is the sum total of the atmosphere, hydrosphere, biosphere and geosphere and their interactions.



4 layers of atmosphere

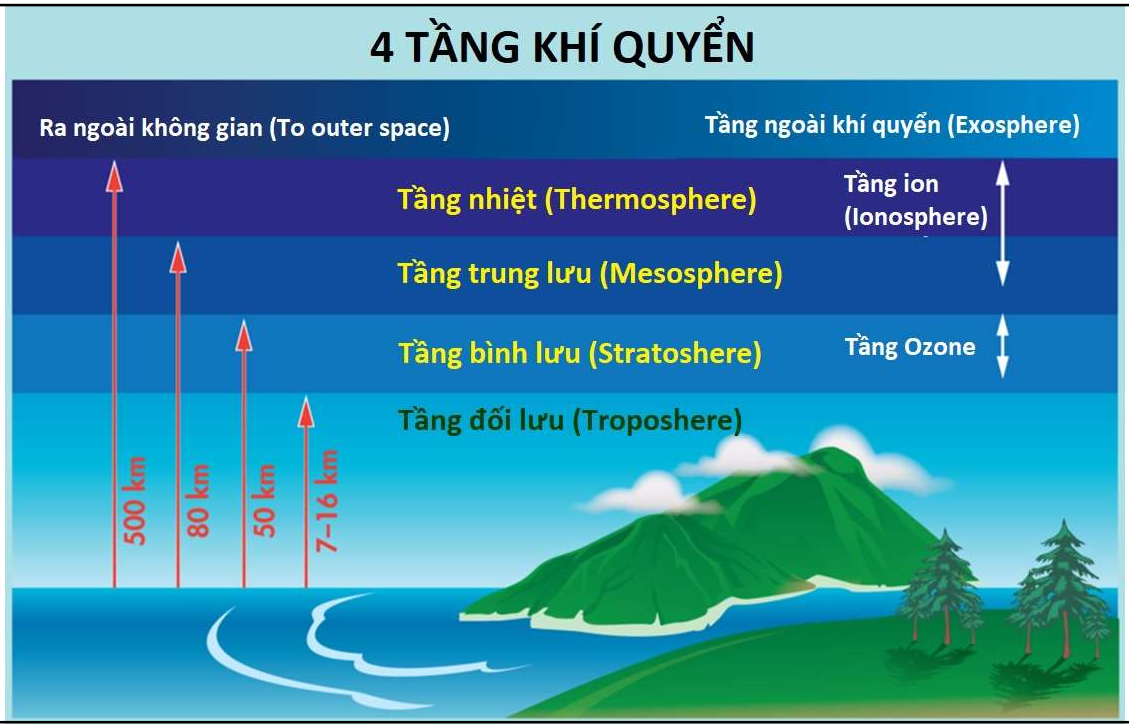


TẦNG NHIỆT (TẦNG ION)

TẦNG TRUNG GIAN

TẦNG BÌNH LƯU

TẦNG ĐỐI LƯU



TẦNG ĐỐI LƯU (Troposphere)

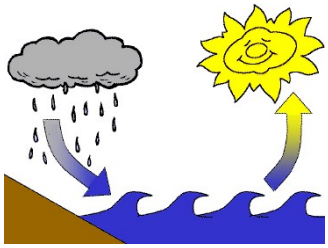
- Cao độ trung bình từ mặt đất lên cao 11 km, ở 2 cực của Trái đất dày khoảng 8 - 10 km, còn ở vùng xích đạo là 15 - 18 km.
- Mây và hơi nước tập trung dày đặc từ độ cao 1 - 8 km, tất cả các hiện tượng như mưa, gió, bốc hơi, bão, ... đều xảy ra ở tầng này.
- Tầng này chiếm 80% khối lượng không khí và 90% hơi nước và luôn có sự tác động qua lại giữa mặt đất, đại dương và khí quyển.
- Không khí chuyển động theo hình thẳng đứng: dòng thăng (không khí đi từ dưới lên trên) và dòng giáng (không khí đi theo chiều từ trên xuống dưới).

TROPOSPHERE

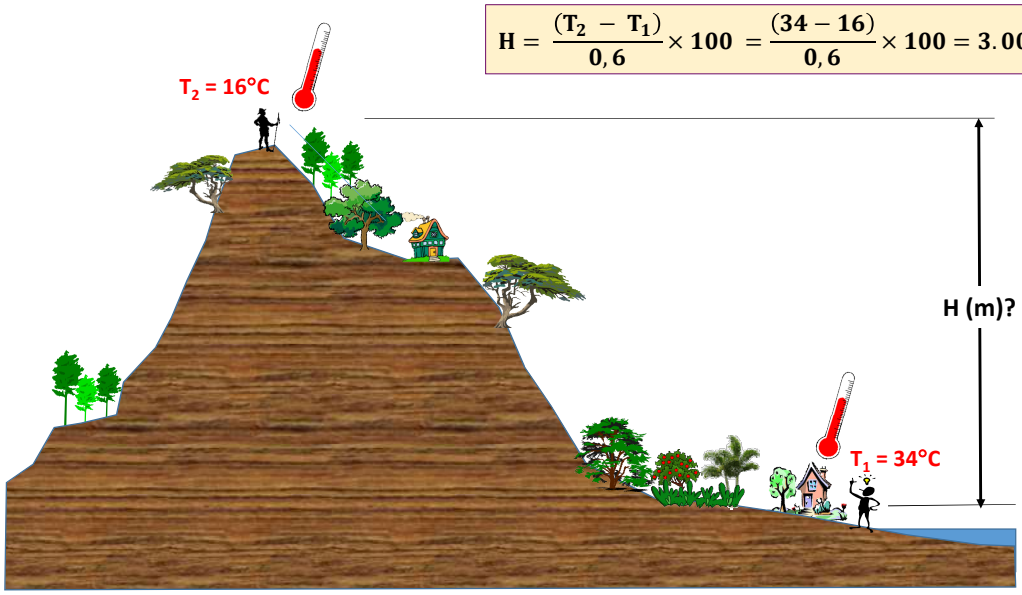
• The movement of air produces a change in kinetic energy, which is dependent on atmospheric pressure and produces a thermal state. As the air mass moves upward, the pressure decreases and expands due to the decrease in density and causes the temperature to decrease accordingly. Conversely, as the air mass goes down, the pressure increases and the temperature also increases.

• The phenomenon of vertical fluctuations (up and down) in air masses is the main cause of climate change on earth.

• In the troposphere, for every 100 m elevation, the air temperature decreases by about 0.6 °C. At an altitude of nearly 11 km, the air temperature can be minus 60 - 50 °C.



$$H = \frac{(T_2 - T_1)}{0,6} \times 100 = \frac{(34 - 16)}{0,6} \times 100 = 3.000\ m$$

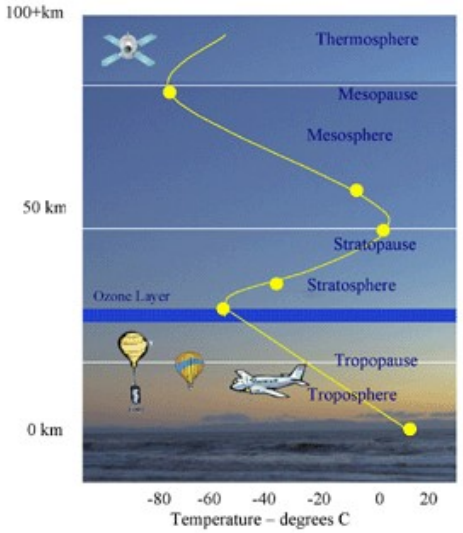


STRATOSPHERE

• The stratosphere is at an altitude of 11 km to 50 km. Here the density of water vapor is very small or negligible, so there are no clouds.

• In the stratosphere the air is less perturbed in the vertical direction. In the stratosphere, the air is very thin, the temperature changes little between 15 - 35 km, about – 55 °C.

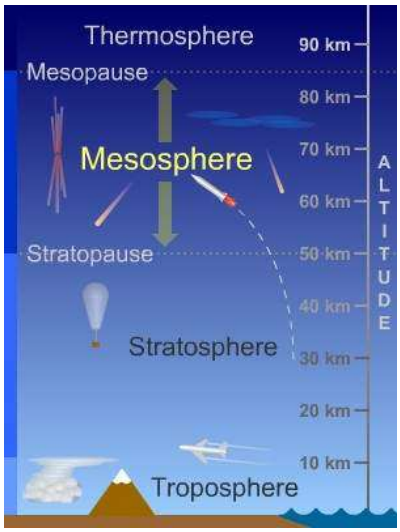
• In this layer, the proportion of ozone gas (O_3) is high, the stratosphere has the effect of absorbing short-wave rays of solar radiation (ultraviolet rays), significantly reducing the danger of these rays from the sun. shine on earth.



MESOSPHERE

• The mesosphere is at an altitude of about 50 - 80 km, located between the stratosphere and the thermosphere.

• The intermediate layer between the atmosphere and space (over 2000 km), the air in the extremely thin string contains only hydrogen and helium.



THERMOSPHERE

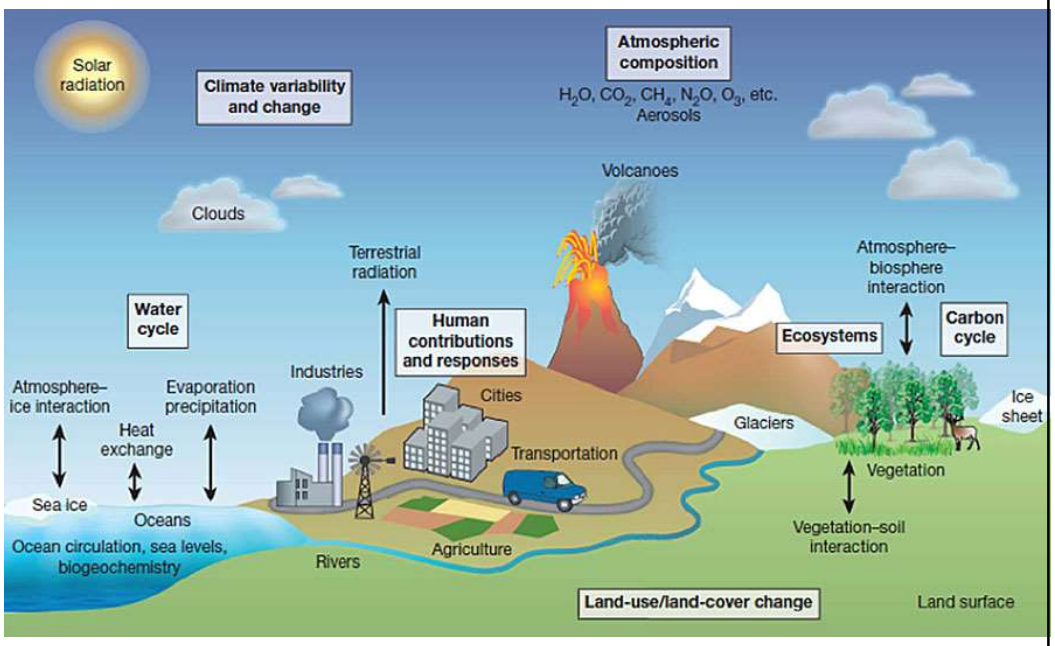
• The thermosphere, also known as the ionosphere or ionospheric layer, at an altitude of over 85 km, the air is very thin, only in the form of charged ion particles, this layer has the effect of preventing solar radiation. Heaven helps creatures on earth to survive.

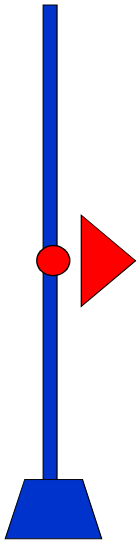
• The important feature of this layer is that the temperature is quite high and increases rapidly with altitude. At an altitude of 200 km, the temperature is 200 °C and the limit is around 2,000°C.

• This layer has a high electrical conductivity that reflects radio waves emitted from the ground.

GLOBAL CLIMATE SYSTEM

The complex and continuous interactions between the Atmosphere, Hydrosphere, Geosphere and Biosphere(and part of the Icesphere)





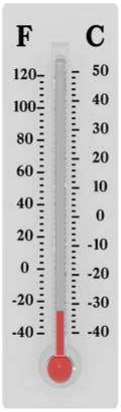
CONTENTS

Meteorological elements present in the atmosphere include:

- Temperature
- Humidity
- Vaporize
- Cloud
- Rain
- Wind
- Barometric
- Etc…

TEMPERATURE

- *Temperature is a measure of how hot or cold a mass of gas, land, water, or object is.*



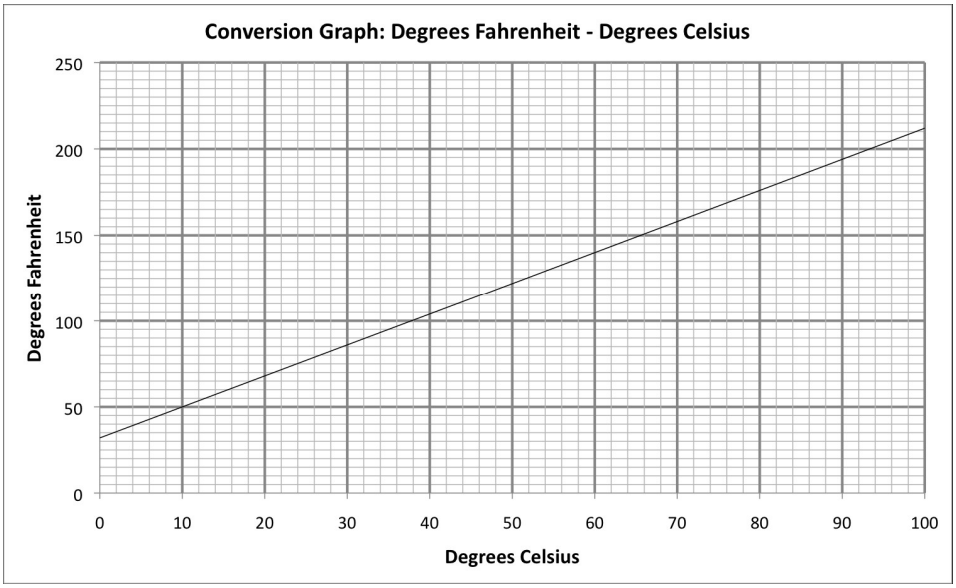
- **There are two types of thermometers:**
  - *+ Celsius thermometer (℃)*
  - *+ Fahrenheit thermometer (℉)*

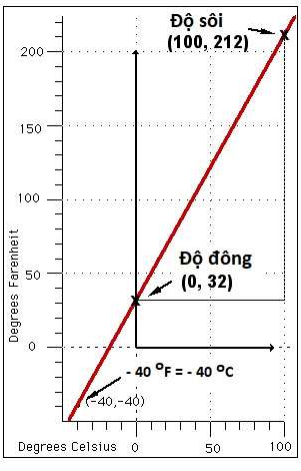
Relationship between°C and °F:

$$°C = \frac{5}{9}(°F - 32)$$

$$°F = \frac{9}{5}°C + 32$$

RELATIONSHIP BETWEEN CELSIUS TEMPERATURE AND FAHRENHEIT TEMPERATURE





AIR HUMIDITY/ MOISTURE

- *Air humidity is the amount of water vapor contained in the air.*
- *The air layer close to the ground always has water vapor: water from lakes, rivers, seas, ... evaporates, transpiration from respiration of plants and animals and water vapor from industrial activities, the boiler emits.*

Ẩm kế cầm tay

There are 4 concepts of humidity and units of measurement:

- **Absolute humidity**: describes the amount of water vapor present in a given volume of a gaseous mixture. The common unit used to calculate absolute humidity is grams of water per cubic meter of air (g/m^3).
- **Relative humidity**: is the ratio of the present vapor pressure of any mixture of gases to water vapor to the saturated water vapor pressure, in %.
- **Saturated humidity**: also known as maximum humidity, is the amount of water vapor saturated in the air at a given time, volume and temperature, expressed in $grams/m^3$.
- **Humidity ratio f**: is a quantity measured as the ratio of the absolute humidity a and the maximum humidity A of the air at the same given

$$f = (a/A) \times 100\%$$

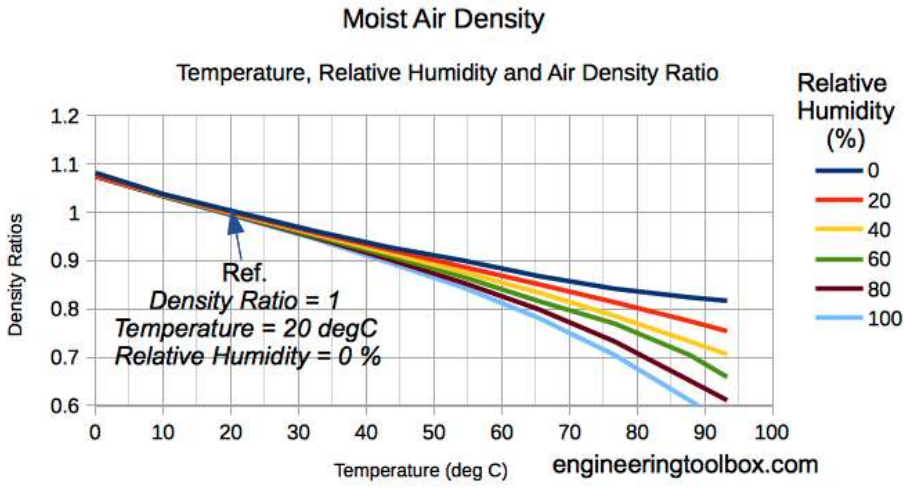
Relative humidity (RH%) is determinced as:

$$\mathbf{RH} = \frac{e_p}{e_s} \times 100\%$$

e_p – specific pressure of water and
e_s – steam pressure has been equalized.

Hygrometers usually indicate relative humidity(%).

Relationship between Temperature (oC), Relative Humidity (%)and the ratio of density of water vapor in the air



WHEN HIGH HUMIDITY:

- *Feeling uncomfortable, tired for the body*
- *Clothes take a long time to dry, appear moldy*
- *Floor standing water causes slippery*
- *Viruses, bacteria, molds, and house dust mites have the opportunity to grow.*
- *Increased risk of respiratory, digestive and some skin diseases.*
- *Irritation of the lining of the airways, leading to inflammation, increased secretion and bronchospasm leading to coughing, sneezing, difficulty breathing, etc.*
- *In addition, high air humidity can easily cause fire and damage to equipment.*

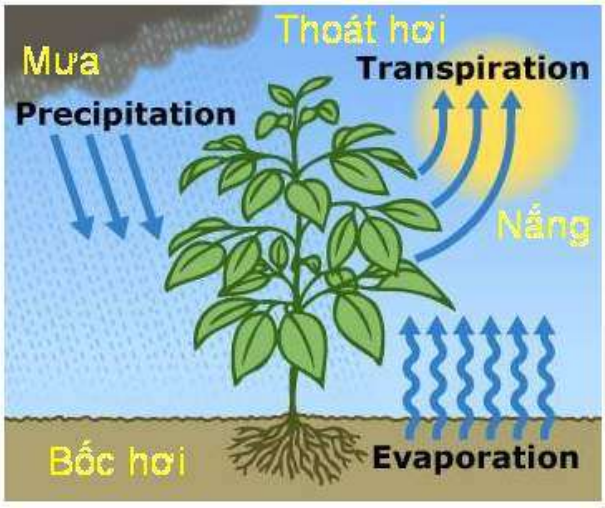
TEMPERATURE

Relative humidity (RH%) / Độ ẩm tương đối (%)	NHIỆT ĐỘ																
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
40	27	28	29	30	31	32	34	35	37	39	41	43	46	48	51	54	57
45	27	28	29	30	32	33	35	37	39	41	43	46	49	51	54	57	
50	27	28	30	31	33	34	36	38	41	43	46	49	52	55	58		
55	28	29	30	32	34	36	38	40	43	46	48	52	55	59			
60	28	29	31	33	35	37	40	42	45	48	51	55	59				
65	28	30	32	34	36	39	41	44	48	51	55	59					
70	29	31	33	35	38	40	43	47	50	54	58						
75	29	31	34	36	39	42	46	49	53	58							
80	30	32	35	38	41	44	48	52	57								
85	30	33	36	39	43	47	51	55									
90	31	34	37	41	45	49	54										
95	31	35	38	42	47	51	57										
100	32	36	40	44	49	54											

Cảnh báo
Đặc biệt cảnh báo
Nguy hiểm
Đặc biệt nguy hiểm

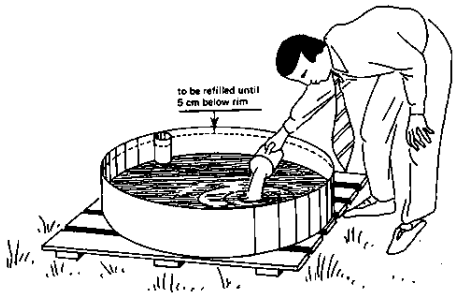
EVAPORATION & TRANSPIRATION

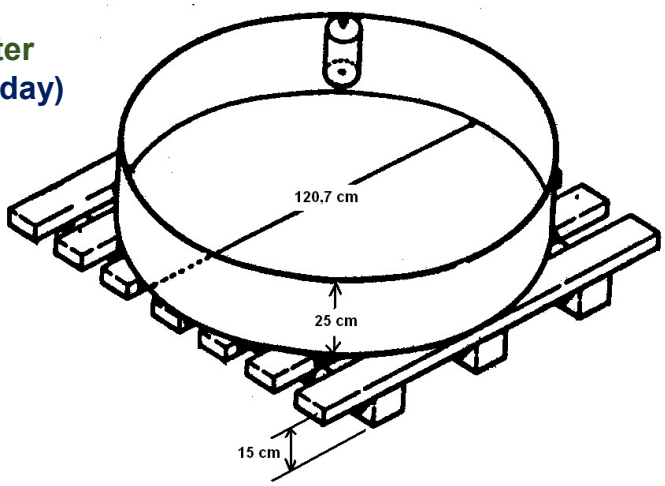
- ***Evaporation*** *is the phenomenon of converting water molecules from liquid to vapor due to the main effect of temperature, wind and entering the air.*
- ***Transpiration*** *is evaporation that occurs at the surface of plant and animal tissues, or the ground.*
- *In the water balance, collectively known as* ***evapotranspiration****, is the total amount of water lost due to the evaporation of water from the surface of the water, the ground, through the leaves of the vegetation cover, ...*
- *The amount of evapotranspiration is usually calculated by the thickness of the evaporated water layer, the unit is* ***mm****.*



BỐC HƠI + THOÁT HƠI = BỐC THOÁT HƠI
EVAPORATION + TRANSPIRATION = EVAPOTRANSPIRATION

Evaporation rate is the amount of water that evaporates in a unit of time (mm/day)





WOMEN STANDARD EVAPORATOR
Round cube, stainless steel or galvanized sheet
Diameter: 120.7 cm
Height: 25cm, pour water 20cm high.
Place on Shelf height: 15 cm

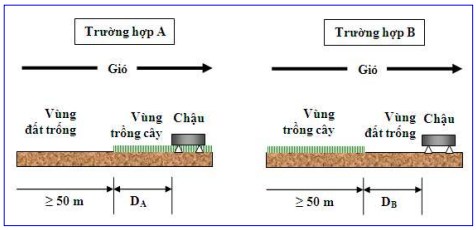
Type A pan evaporation recording method

$ET_o = K_p \times E_{pan}$

E_{pan} - the amount of evaporation measured directly from the pan (mm)

K_p - pan evaporation coefficient. Kp depends on the shape of the pan (pan type, color), location of the pan, humidity and wind conditions..

The Kp value is usually in the range of 0.35 - 0.85, on average, Kp = 0.70 can be selected.



Bảng 3.2. Bảng tra hệ số Kp cho chậu A

Chậu A		Trường hợp A: đặt trên thảm cỏ				Trường hợp B: đặt trên mặt đất khô ráo		
Độ ẩm RH trung bình (%)		Thấp < 40	Tr. Bình 40-70	Cao > 70		Thấp < 40	Tr. Bình 40-70	Cao > 70
Vận tốc gió (m/s)	D_A (m)				D_B (m)			
Nhẹ < 2	1	0.55	0.65	0.75	1	0.7	0.8	0.85
	10	0.65	0.75	0.85	10	0.6	0.7	0.8
	100	0.7	0.8	0.85	100	0.55	0.65	0.75
	1000	0.75	0.85	0.85	1000	0.5	0.6	0.7
Trung bình 2-5	1	0.5	0.6	0.65	1	0.65	0.75	0.8
	10	0.6	0.7	0.75	10	0.55	0.65	0.7
	100	0.65	0.75	0.8	100	0.5	0.6	0.65
	1000	0.7	0.8	0.8	1000	0.45	0.55	0.6
Mạnh 5-8	1	0.45	0.5	0.6	1	0.6	0.65	0.7
	10	0.55	0.6	0.65	10	0.5	0.55	0.65
	100	0.6	0.65	0.7	100	0.45	0.5	0.6
	1000	0.65	0.7	0.75	1000	0.4	0.45	0.55
Rất mạnh > 8	1	0.4	0.45	0.5	1	0.5	0.6	0.65
	10	0.45	0.55	0.6	10	0.45	0.5	0.55
	100	0.5	0.6	0.65	100	0.4	0.45	0.5
	1000	0.55	0.6	0.65	1000	0.35	0.4	0.45

(Nguồn: FAO, Irrigation and Drainage paper No. 50)

Blaney – Crridle Method

$ET_o = p(0,48T + 8)$

T - average daily temperature (° C);

p - percentage of annual average lighting hours for days of the month in an irrigation cycle. The value of p depends on the geographical latitude of the place of consideration and the calculation time for the crop season, determined according to table 3.1.

Bảng 3.1: Bảng tra hệ số p trong công thức Blaney-Criddle

Vĩ độ	Tháng											
Bắc	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Nam	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI
60°	0.15	0.20	0.26	0.32	0.38	0.41	0.40	0.34	0.28	0.22	0.17	0.13
55°	0.17	0.21	0.26	0.32	0.36	0.39	0.38	0.33	0.28	0.23	0.18	0.16
50°	0.19	0.23	0.27	0.31	0.34	0.36	0.35	0.32	0.28	0.24	0.20	0.18
45°	0.20	0.23	0.27	0.30	0.34	0.35	0.34	0.32	0.28	0.24	0.21	0.20
40°	0.22	0.24	0.27	0.30	0.32	0.34	0.33	0.31	0.28	0.25	0.22	0.21
35°	0.23	0.25	0.27	0.29	0.31	0.32	0.32	0.30	0.28	0.25	0.23	0.22
30°	0.24	0.25	0.27	0.29	0.31	0.32	0.31	0.30	0.28	0.26	0.24	0.23
25°	0.24	0.26	0.27	0.29	0.30	0.31	0.31	0.29	0.28	0.26	0.25	0.24
20°	0.25	0.26	0.27	0.28	0.29	0.30	0.30	0.29	0.28	0.26	0.25	0.25
15°	0.26	0.26	0.27	0.28	0.28	0.29	0.29	0.28	0.28	0.27	0.26	0.25
10°	0.26	0.27	0.27	0.28	0.28	0.29	0.29	0.28	0.28	0.27	0.26	0.26
5°	0.27	0.27	0.27	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.27	0.27
0°	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

Example 3.1: Calculate ETo reference evapotranspiration according to Blaney – Cridle for April in the 25° North latitude region. The average daily temperature in April is 21.5 °C.

At latitude 25 ° North in April there is p = 0.29 (table 3.1).With T = 21.5 °C, the reference evapotranspiration will be:

ET_o = p(0,48T + 8) = 0,29 (0,48 × 21,5 + 8) = 5,2 mm/day

Bảng 3.1: Bảng tra hệ số p trong công thức Blaney-Criddle

Vĩ độ	Tháng											
Bắc	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Nam	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI
60°	0.15	0.20	0.26	0.32	0.38	0.41	0.40	0.34	0.28	0.22	0.17	0.13
55°	0.17	0.21	0.26	0.32	0.36	0.39	0.38	0.33	0.28	0.23	0.18	0.16
50°	0.19	0.23	0.27	0.31	0.34	0.36	0.35	0.32	0.28	0.24	0.20	0.18
45°	0.20	0.23	0.27	0.30	0.34	0.35	0.34	0.32	0.28	0.24	0.21	0.20
40°	0.22	0.24	0.27	0.30	0.32	0.34	0.33	0.31	0.28	0.25	0.22	0.21
35°	0.23	0.25	0.27	0.29	0.31	0.32	0.32	0.30	0.28	0.25	0.23	0.22
30°	0.24	0.25	0.27	0.29	0.31	0.32	0.31	0.30	0.28	0.26	0.24	0.23
25°	0.24	0.26	0.27	0.29	0.30	0.31	0.31	0.29	0.28	0.26	0.25	0.24
20°	0.25	0.26	0.27	0.28	0.29	0.30	0.30	0.29	0.28	0.26	0.25	0.25
15°	0.26	0.26	0.27	0.28	0.28	0.29	0.29	0.28	0.28	0.27	0.26	0.25
10°	0.26	0.27	0.27	0.28	0.28	0.29	0.29	0.28	0.28	0.27	0.26	0.26
5°	0.27	0.27	0.27	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.27	0.27
0°	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

Blaney – Corrected Modified Formula

(Doorenbos và Pruitt, 1977)

$$ET_o = N\left(\frac{a}{K_5} + bP\left[\frac{T}{K_1} + K_2\right]\right)$$

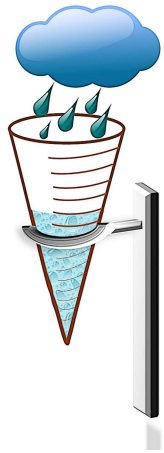
N - number of watering days in 1 irrigation cycle ($10 \le N \le 30$) (day);
a - experience factor, dependent on RH_{min} (%) and ratio n/N;
b - experience factor, dependent on RH_{min}, n/N and U_d;
RH_{min} - minimum relative humidity (%);
n/N - the ratio of actual hours/hours of maximum sunshine;
U_d - daily average wind speed (m/s);
P - percentage of average lighting hours, taken from table 3.1;
T - average daily temperature during the irrigation period (°C);
K_1, K_2, K_5 – adjustment factors, can take K_1 = 2,19; K_2 = 8,13, K_5 = 1.

PRECIPITATION/ RAINFALL

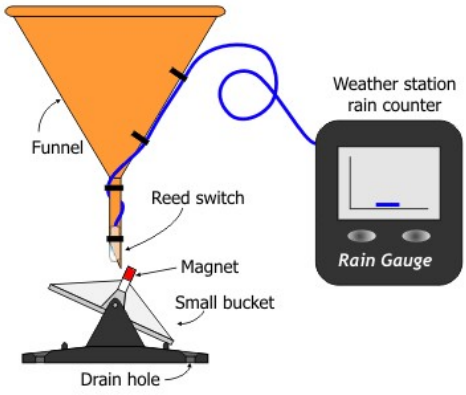
Precipitation is the result of condensation of water vapor in the atmosphere, the process by which water changes from a vapor state to a liquid (rain, dew) or solid state (hail, snow) and falls to the ground.

In an approximate concept in our country, the amount of precipitation and the amount of rain falling (rainfall) have almost the same value.

RAINFALL Recorders



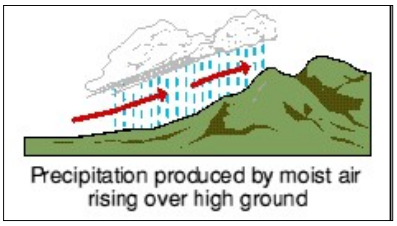
Rain gauges in the form of funnels



Automatic rain gauge by count type

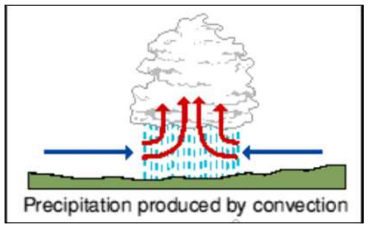
PRECIPITATION/ RAINFALL

3 types of precipitation



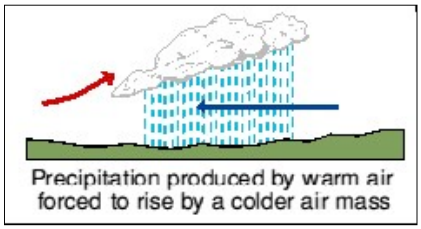
Mưa địa hình

Orographic precipitation

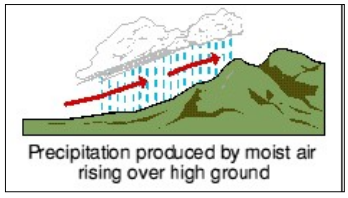


Mưa đối lưu

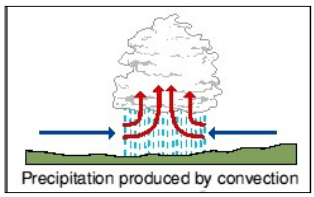
Convective precipitation



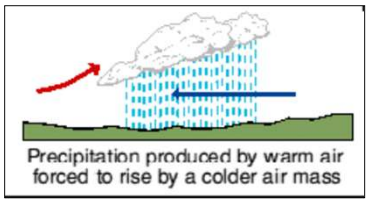
Mưa front



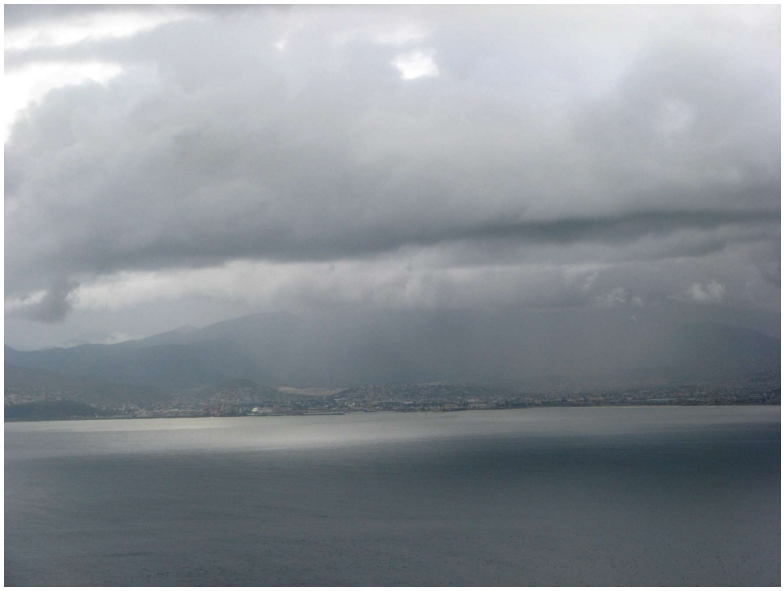
Orographic precipitation



Convective precipitation



Front



CÁC QUI ĐỊNH GỌI MƯA TRONG CÁC BẢN TIN THỜI TIẾT

Lượng mưa được tính bằng chiều dày đo bằng mm của lớp nước rơi trên một mặt phẳng nằm ngang, không bốc hơi, không thấm và chảy tràn đi. Cường độ mưa là lượng mưa tính ra mm rơi trong 1 phút. Cường độ mưa vượt quá 1 mm/phút gọi là *mưa rào*.

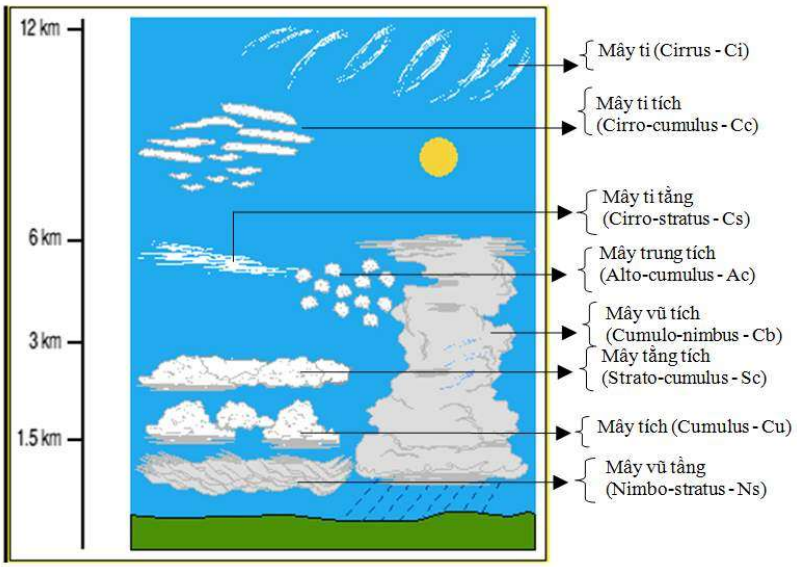
Tên gọi	Qui định về diện mưa (khu vực mưa)
• *Mưa vài nơi*	Số trạm có mưa ≤ 1/3 tổng số trạm đo mưa khu vực.
• *Mưa rải rác*	Số trạm có mưa > 1/3 hoặc = 1/2 tổng số trạm đo mưa khu vực.
• *Mưa nhiều nơi*	Số trạm có mưa > 1/2 tổng số trạm đo mưa khu vực.

Tên gọi	Qui định về lượng mưa
• *Mưa không đáng kể*	Lượng mưa từ 0,0 - 0,5 mm.
• *Mưa nhỏ*	Lượng mưa từ 0,5 - 10,0 mm
• *Mưa vừa*	Lượng mưa từ 10,0 - 50,0 mm
• *Mưa to*	Lượng mưa từ 50,0 - 100,0 mm
• *Mưa rất to*	Lượng mưa > 100,0 mm

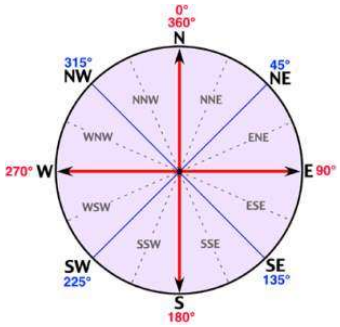
CLOUDS

Clouds are visible masses of condensed water droplets or ice crystals suspended in the atmosphere above Earth.

SHAPES AND LOCATIONS OF CLOUDS



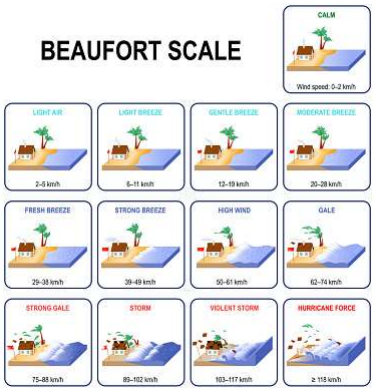
WIND



The horizontal movement of air relative to the ground is called wind.

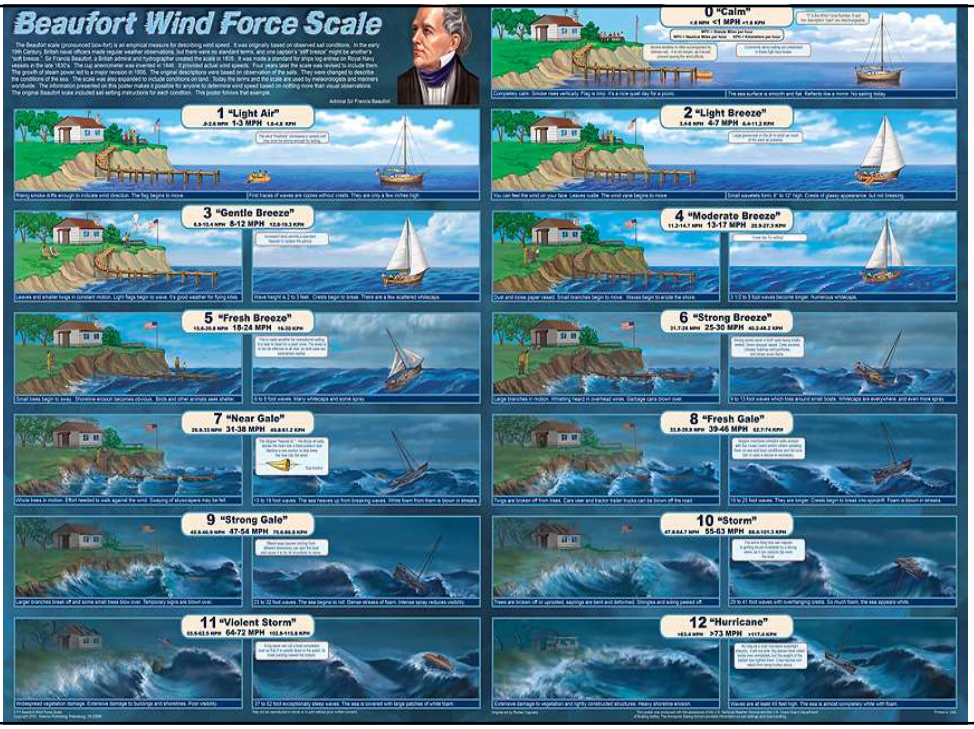
Air tends to move from areas of high pressure to areas of low pressure. It is the movement of the air that creates the wind.

Wind is represented by wind speed and wind direction.



Bảng cấp gió (Beaufort Scale)

Cấp gió	Tốc độ (m/s) (km/g)	Phân hạng	Mô tả
1	0 - 0,2 (0 - 2,9)	Lặng gió	Mọi vật yên tĩnh, khói lên thẳng, hồ nước phẳng lặng như gương
2	0,3 - 1,5 (3,0 - 8,9)	Gió rất nhẹ	Khói hơi bị rối động, mặt nước gợn lên như vảy cá
3	1,6 - 3,3 (9,0 - 15,9)	Gió nhẹ	Mặt cảm thấy có gió, lá cây xào xạc, sóng gợn nhưng không có sóng vỗ
4	3,4 - 5,4 (16,0 - 23,9)	Gió nhỏ	Lá và cành cây nhỏ bắt đầu rung động. Cờ lay nhẹ. Sóng rất nhỏ
5	5,5 - 7,9 (24,0 - 33,9)	Gió vừa	Bụi và mảnh giấy nhỏ bắt đầu bay. Cành nhỏ lung lay, sóng nhỏ và dài hơn
6	8,0 - 10,7 (34,0 - 43,9)	Gió khá mạnh	Cây nhỏ có lá lung lay, mặt nước hồ ao gợn sóng. Ngoài biển sóng vừa và dài
7	10,8 - 13,8 (44,0 - 54,9)	Gió mạnh	Cành lớn lung lay, dây điện ngoài phố thổi vi vu. Ngọn sóng bắt đầu có bụi nước bắn lên
8	13,9 - 17,1 (55,0 - 67,9)	Gió khá to	Cây to rung chuyển, khó đi bộ ngược chiều gió. Sóng khá cao
9	17,2 - 20,7 (68,0 - 81,9)	Gió to	Cành nhỏ bị bẻ gãy. Không đi ngược gió được. Ngoài biển sóng cao và dài
10	20,8 - 24,4 (82,0 - 95,9)	Gió rất lớn	Làm hư hại nhà cửa, giật ngói trên mái nhà. Sóng lớn có bọt dày đặc. Hạn chế ra khơi
11	24,5 - 28,4 (96,0 - 109,9)	Gió bão	Làm bật rễ cây. Phá đổ nhà cửa. Sóng rất lớn và reo dữ dội. Cấm tàu thuyền ra khơi
12	> 28,5 (> 110,0)	Gió bão to	Sức phá hoại rất lớn. Sóng cực kỳ lớn, có thể phá vỡ các tàu nhỏ, thiệt hại lớn và rất lớn

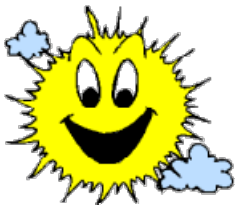


WIND SUPPLY, TROPICAL LOW PRESSURE AND STORM IN ADDITIONS

Cấp gió	Cấp bão	Tốc độ gió		Độ cao sóng TB (m)	Mức độ nguy hại
		m/s	km/h		
0	-	0 - 0,2	< 1	-	- Gió nhẹ không gây nguy hại
1	-	0,3 - 1,5	1 - 5	0,1	
2	-	1,6 - 3,3	6 - 11	0,2	
3	-	3,4 - 5,4	12 - 19	0,6	
4	-	5,5 - 7,9	20 - 28	1,0	- Cây nhỏ có lá bắt đầu lay động, ảnh hưởng đến lúa đang phơi màu - Biển hơi động. Thuyền đánh cá bị chao nghiêng, phải cuốn bớt buồm
5		8,0 - 10,7	29 - 38	2,0	
6	ATNĐ	10,8 - 13,8	39 - 49	3,0	- Cây cối rung chuyển. Khó đi ngược gió - Biển động. Nguy hiểm đối với tàu, thuyền
7		13,9 - 17,1	50 - 61	4,0	
8	Bão	17,2 - 20,7	62 - 74	5,5	- Gió làm gãy cành cây, tốc mái nhà gây thiệt hại về nhà cửa. Không thể đi ngược gió - Biển động rất mạnh. Rất nguy hiểm đối với tàu, thuyền
9		20,8 - 24,4	75 - 88	7,0	

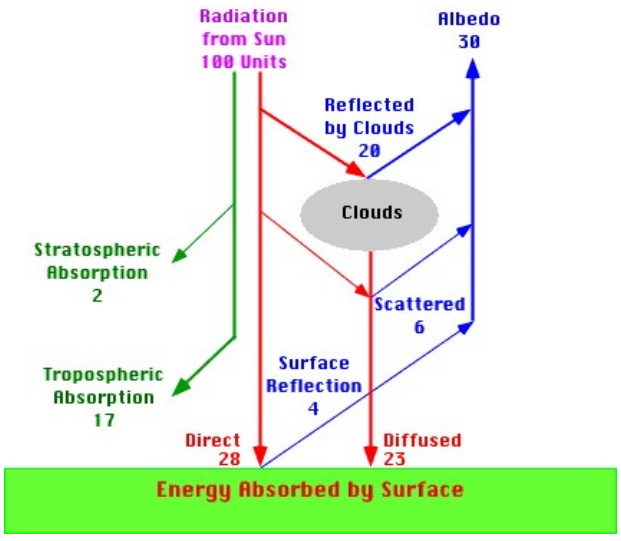
Cấp gió	Cấp bão	Tốc độ gió		Độ cao sóng TB (m)	Mức độ nguy hại
		m/s	km/h		
10	Bão mạnh	24,5 - 28,4	89 - 102	9,0	- Làm đổ cây cối, nhà cửa, cột điện. Gây thiệt hại rất nặng - Biển động dữ dội. Làm đắm tàu biển
11		28,5 - 32,6	103 - 117	11,5	
12	Bão rất mạnh	32,7 - 36,9	118 - 133	14,0	- Sức phá hoại cực kỳ lớn - Sóng biển cực kỳ mạnh. Đánh chìm tàu biển có trọng tải lớn
13		37,0 - 41,4	134 - 149		
14		41,5 - 46,1	150 - 166		
15		46,2 - 50,9	167 - 183		
16	Siêu bão	51,0 - 56,0	184 - 201		
17		56,1 - 61,2	202 - 220		
≥ 18	Siêu bão	> 61,3	> 221	> 14,1	- Sức phá hoại cực kỳ nghiêm trọng. - Gây thiệt hại về nhà và các phương tiện lưu thông trên đất liền.

SUNSHINE/ SOLAR RADIATION

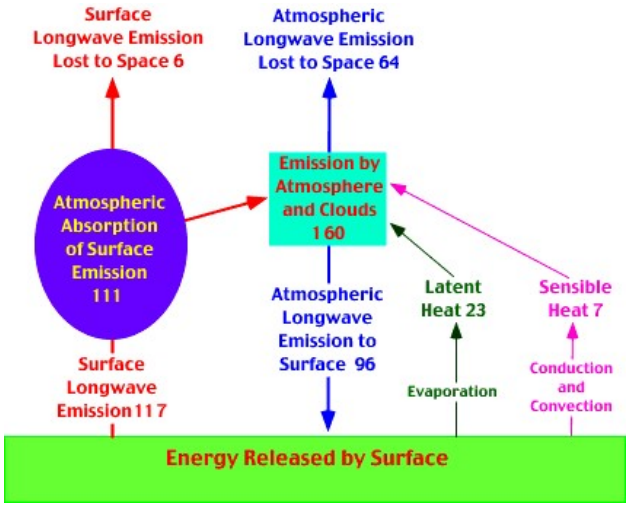


Sunshine is expressed by the number of hours of light per day.

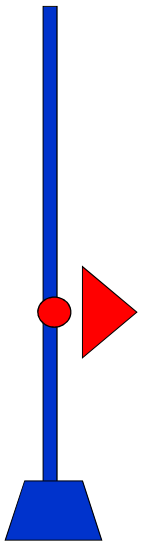
Solar radiation can be expressed as the energy emitted by the sun per unit area in a day (Kcal/cm^2/ngày)



Global shortwave radiation cascade
(Pidwirny, 2006)

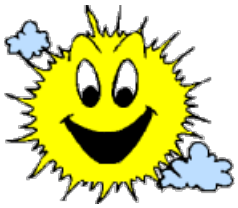


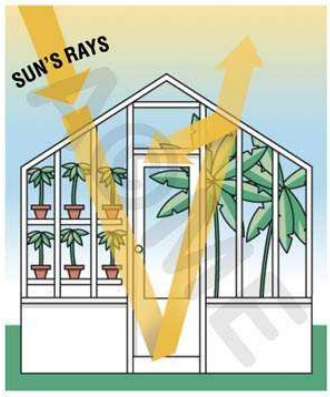
Global longwave radiation cascade
(Pidwirny, 2006)

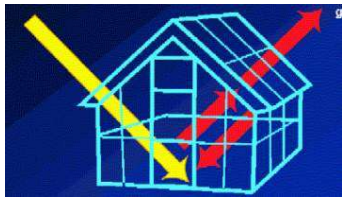


CONTENTS

GREENHOUSE EFFECT





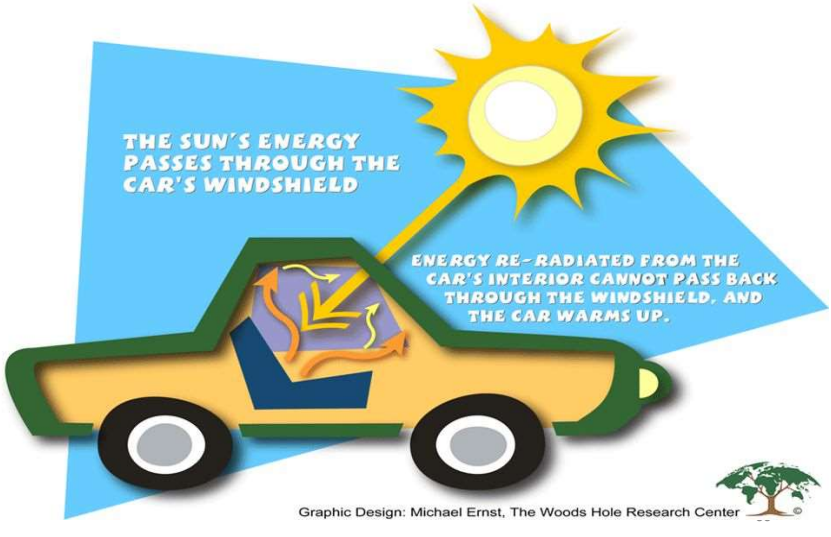


The greenhouse effect causes the temperature of the interior of a greenhouse made of glass to rise when the sun hits it.

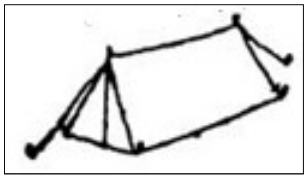
Thanks to this warmth, plants can sprout, flower and bear fruit sooner.

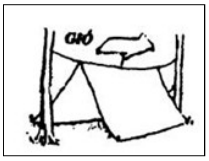
A Greenhouse Effect we can all relate to!

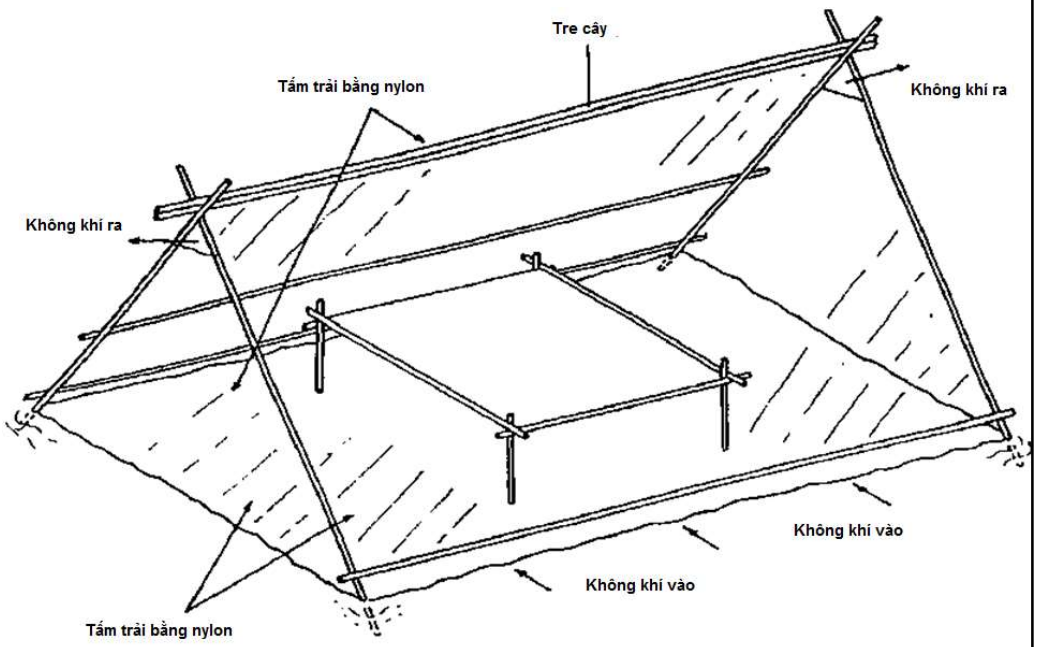
EXAMPLE ILLUSTRATION
THE GREENHOUSE EFFECT IN A CAR THAT'S BEEN OUT IN THE SUN

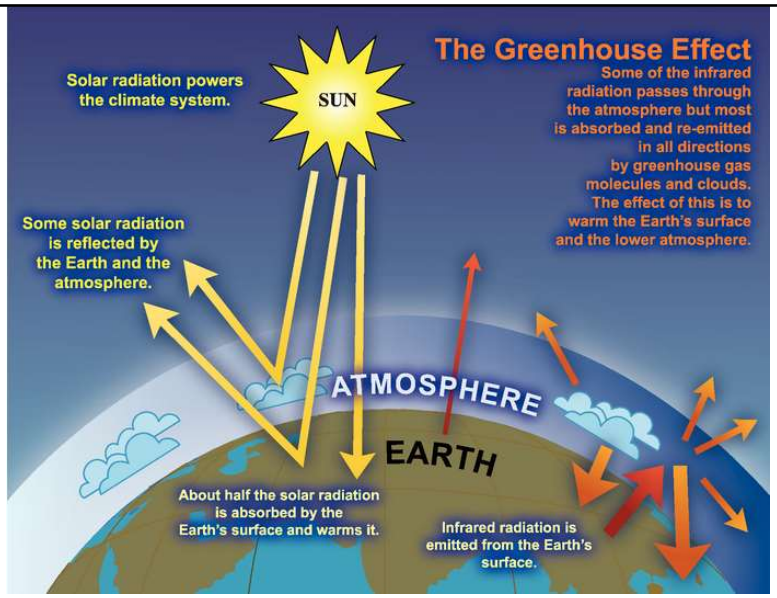


BUILDING
"CLOSED HOT"



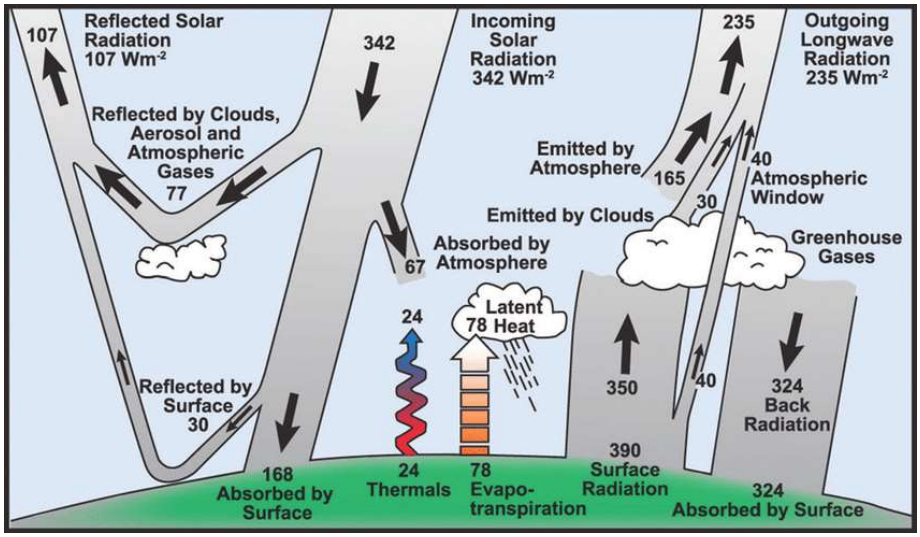




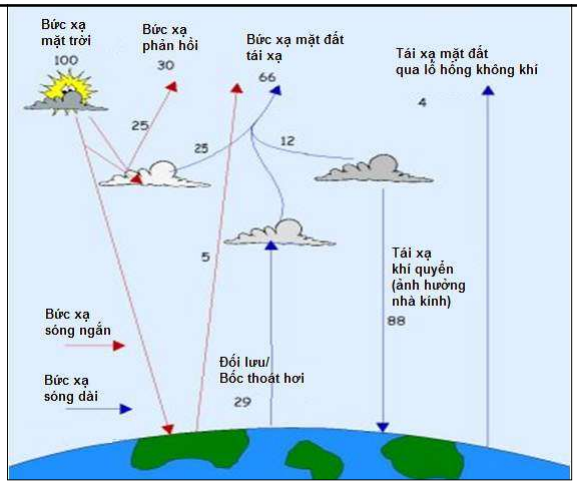


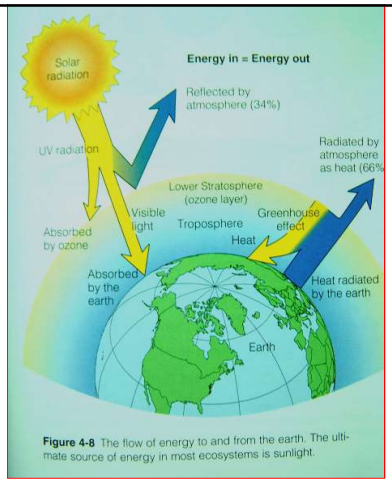
The greenhouse effect is also the phenomenon of heat blocking in the atmosphere of the Earth illuminated by the Sun is the atmospheric greenhouse effect.

GLOBAL RADIATION BALANCE

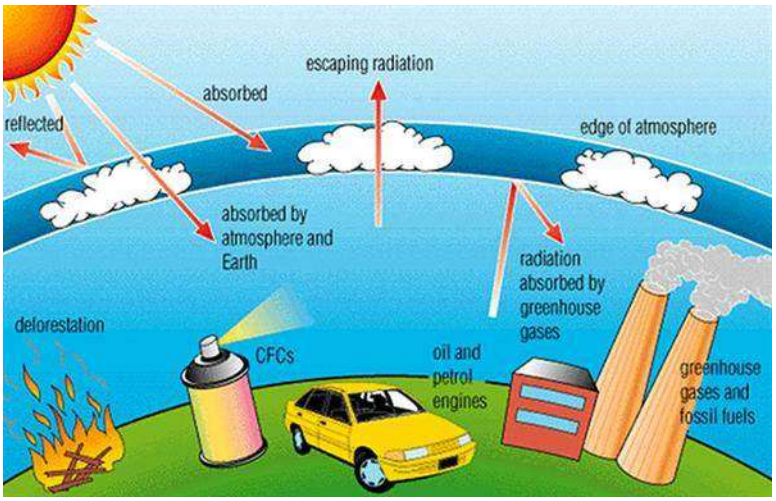


Source: Kiehl and Trenberth, 1997





Energy from the Sun's radiation reaching the Earth = **Energy absorbed by the Earth** + **Energy lost back to Space.**

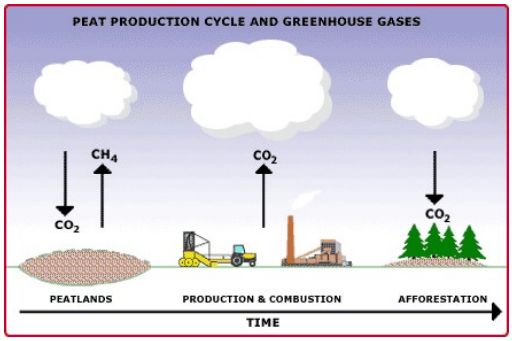


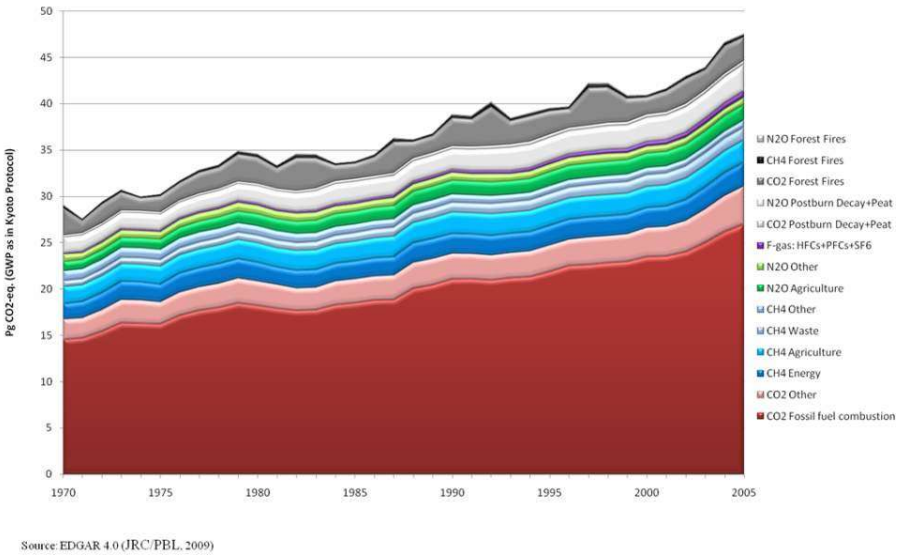
When the atmosphere layer has too much CO_2, CFCs, CH_4 and water vapor, the Earth becomes a heat-retaining sphere, absorbing a lot but giving off less heat.

Gases that contribute to greenhouse effect:

- **Dioxidecarbon (CO_2)**
- **Metane (CH_4)**
- **Nitrous Oxide (N_2O)**
- **Ozon (O_3)**
- **Cholorofluorcarbons (CFCs)**
- **Water vapor (H_2O)**

The cause of the increase in the temperature of the earth's surface, the rapid increase is mainly (more than 90%) due to the increased content of CO_2 and other greenhouse gases released into the atmosphere by human activities..





Source: European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), release version 4.0. http://edgar.jrc.ec.europe.eu, 2009

Sources of greenhouse gases

Agricultural cultivation

Landfills

Industrial pollution

Chemical spray

Sources of greenhouse gases

Fossil fuel

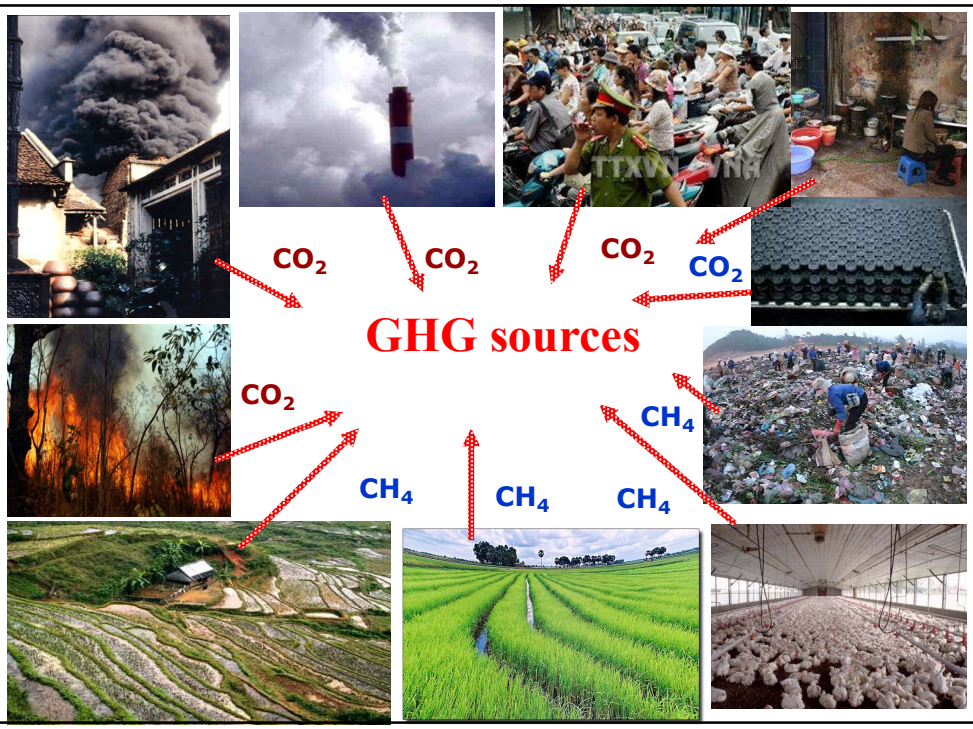
Deforestation

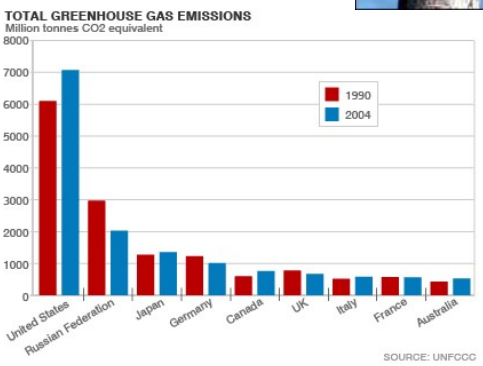
Vocanoes

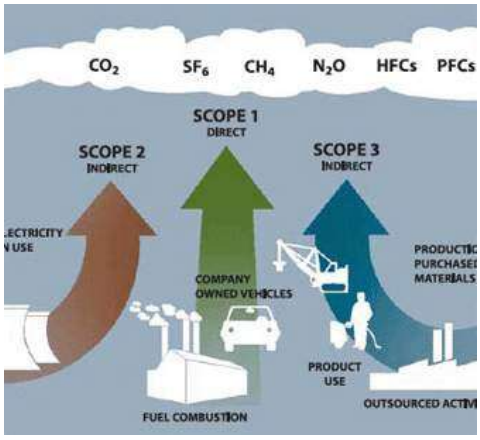
Traffics

Animal husbandry

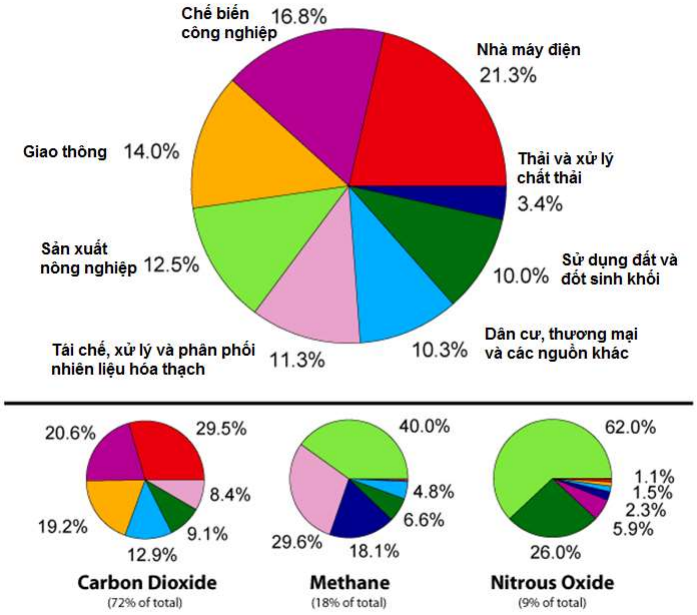
Forest fires







MỨC THẢI KHÍ NHÀ KÍNH HẰNG NĂM PHÂN THEO LĨNH VỰC



Name of fuel	CO_2 emission rate ($lbs/10^6$ BTU)
Than đá (anthracite)	227
Than cốc	225
Than non	215
Than cặn từ nhựa đường	213
Than nhựa bitum	205
Gỗ và mạc cưa	195
Vỏ xe hơi	189
Dầu đốt	161
Kerosene	159
Xăng xe hơi	156
Xăng máy bay	153
Khí đốt	139
Khí hóa lỏng	139
Khí tự nhiên	117

Based on the structure of the molecules, some gases are more efficient at trapping heat and staying in the atmosphere longer.

The gas that retains heat better and stays in the atmosphere longer is more likely to warm the earth..

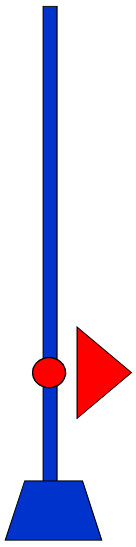
Based on the ability of CO_2 to warm the earth as a standard to compare with other trace gases.

- **Use CO_2 as a unit of measure for Global Warming Potential (GWP) = 1.**
- **Methane (CH_4) has a GWP = 23 (measured over a 100-year period).**
- **Other gases with longer atmospheric retention times, for example sulfur hexafluoride have a GWP = 22,000 after 100 years.**

Global Warming Potential (GWP)

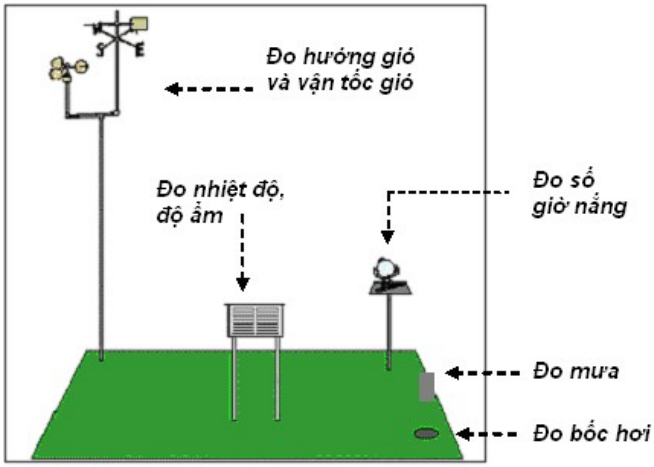
US EPA's "Greenhouse Gases and Global Warming Potential Values"

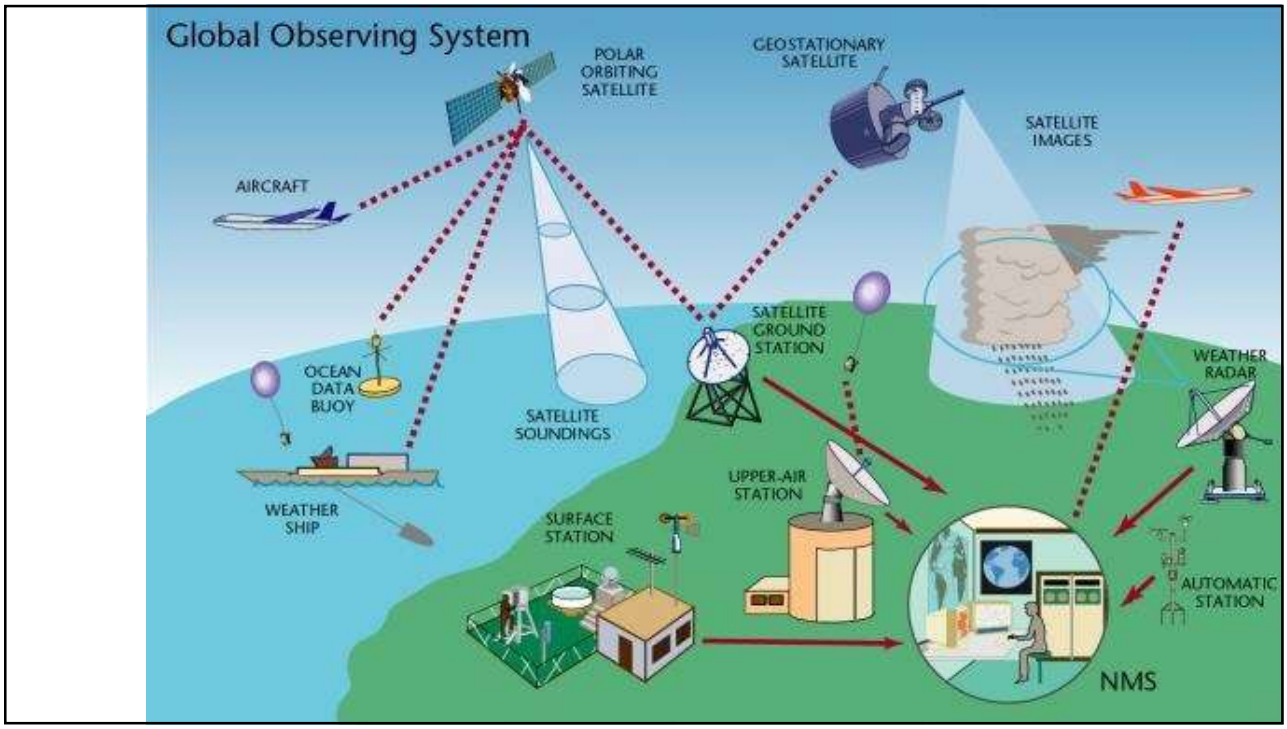
Gas	Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310
HFC-23	11,700
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-227ea	2,900
HFC-236fa	6,300
HFC-4310mee	1,300
CF_4	6,500
C_2F_6	9,200
C_4F_{10}	7,000
C_6F_{14}	7,400
SF_6	23,900

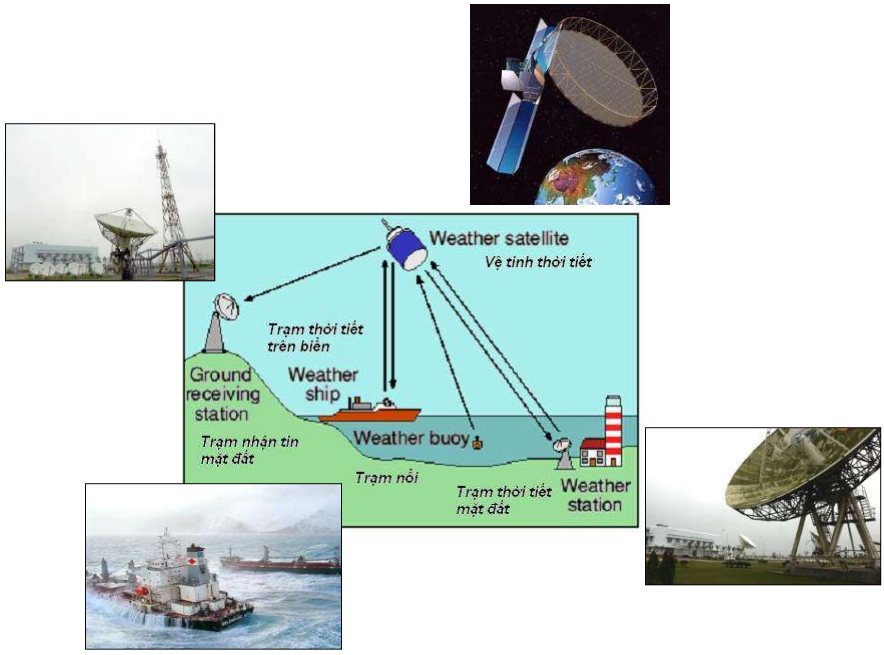


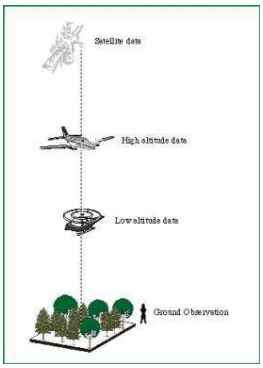
CONTENTS

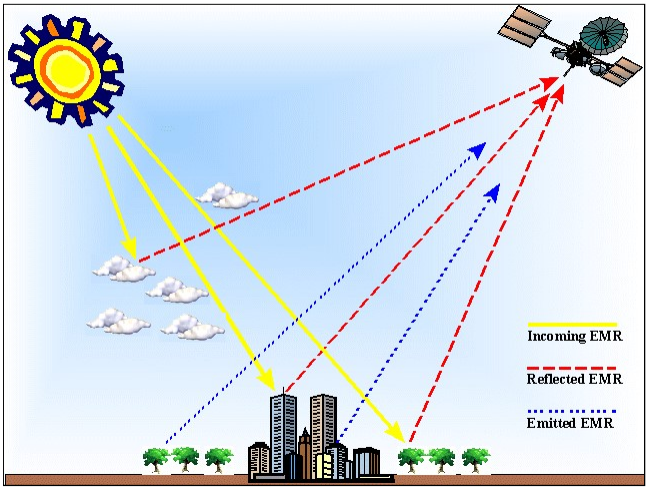
Monitoring and forecasting the weather

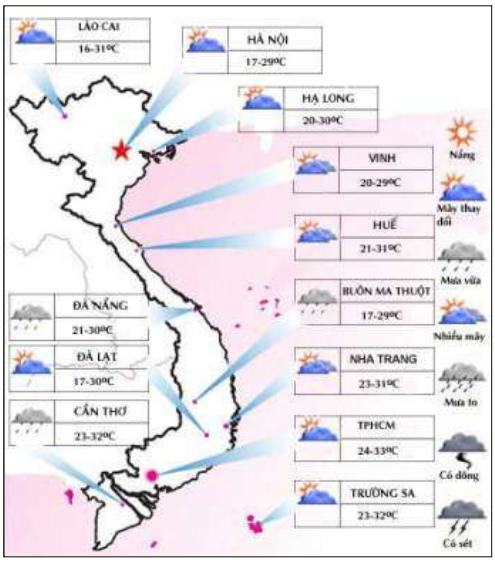


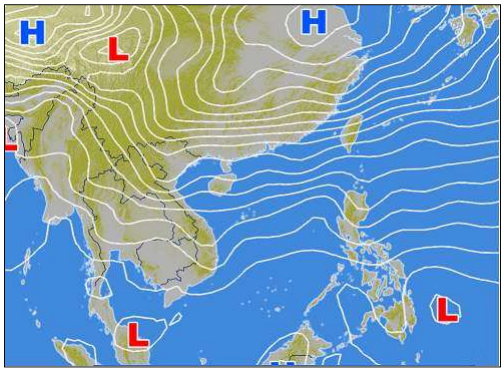

Global Observing System
POLAR ORBITING SATELLITE
GEOSTATIONARY SATELLITE
SATELLITE IMAGES
AIRCRAFT
SATELLITE GROUND STATION
OCEAN DATA BUOY
WEATHER RADAR
SATELLITE SOUNDINGS
UPPER-AIR STATION
WEATHER SHIP
SURFACE STATION
AUTOMATIC STATION
NMS


Weather satellite
Vệ tinh thời tiết
Trạm thời tiết trên biển
Ground receiving station
Weather ship
Trạm nhận tin mặt đất
Weather buoy
Trạm nổi
Trạm thời tiết mặt đất
Weather station


Satellite data
High altitude data
Low altitude data
Ground Observation


Incoming EMR
Reflected EMR
Emitted EMR


LÀO CAI
16-31ºC
HÀ NỘI
17-29ºC
HẠ LONG
20-30ºC
VINH
20-29ºC
HUẾ
21-31ºC
BUÔN MA THUỘT
17-29ºC
ĐÀ NẴNG
21-30ºC
ĐÀ LẠT
17-30ºC
NHA TRANG
23-31ºC
CẦN THƠ
23-32ºC
TPHCM
24-33ºC
TRƯỜNG SA
23-32ºC
Nắng
Mây thay đổi
Mưa vừa
Nhiều mây
Mưa to
Có dông
Có sét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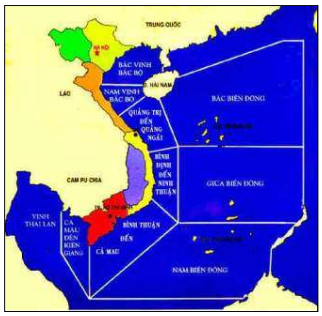
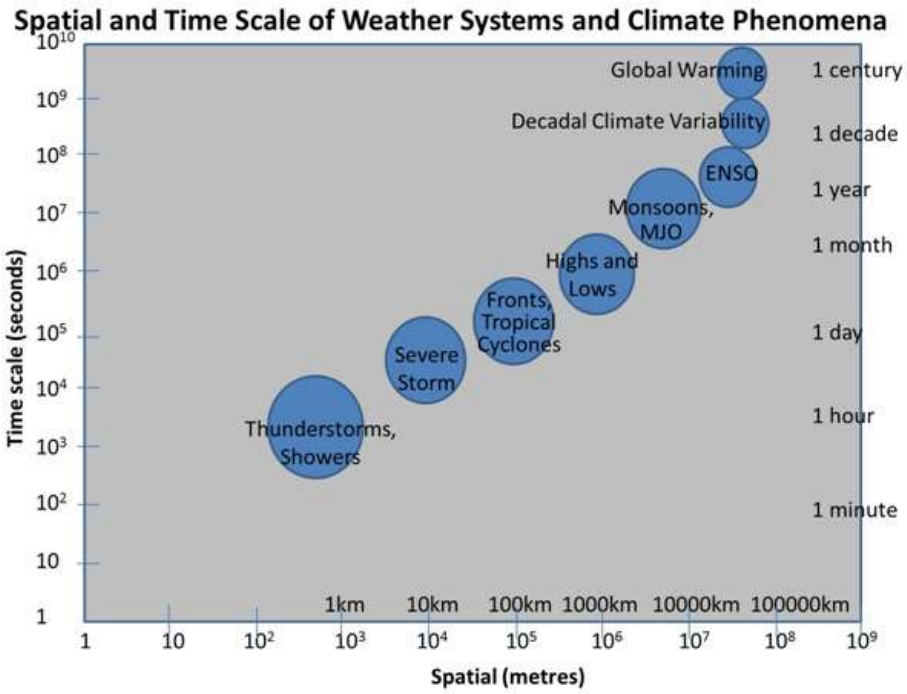
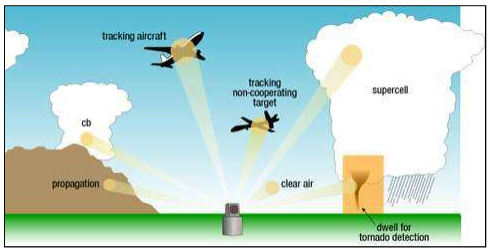

TRUNG QUỐC
LÀO
BẮC BIỂN ĐÔNG
GIỮA BIỂN ĐÔNG
NAM BIỂN ĐÔNG



Hàng không



Tin thời tiết rất hữu ích cho tất cả mọi hoạt động…

Hàng hải

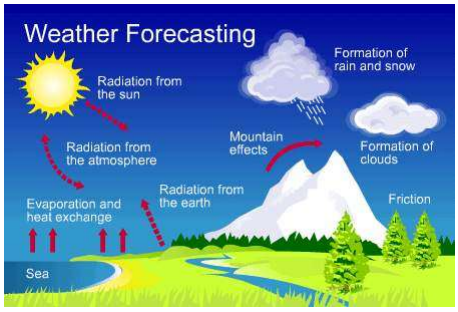
Nông nghiệp

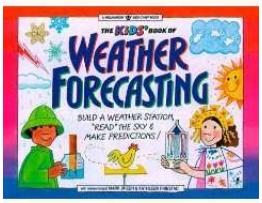
Du lịch

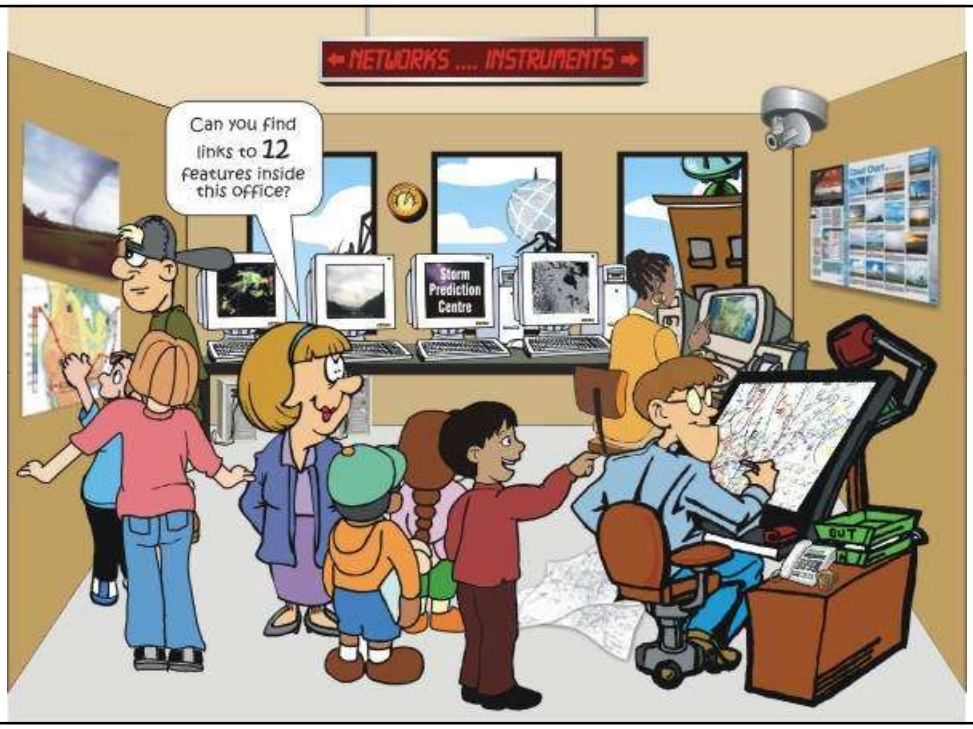
Monitoring and forecasting the weather

Weather forecasting is an applied science and engineering that predicts the state of the weather in a certain place in the future.

Forecasting must be done by collecting quantitative data of atmospheric parameters at the present time and using meteorological equations and laws to predict atmospheric changes in the coming time.

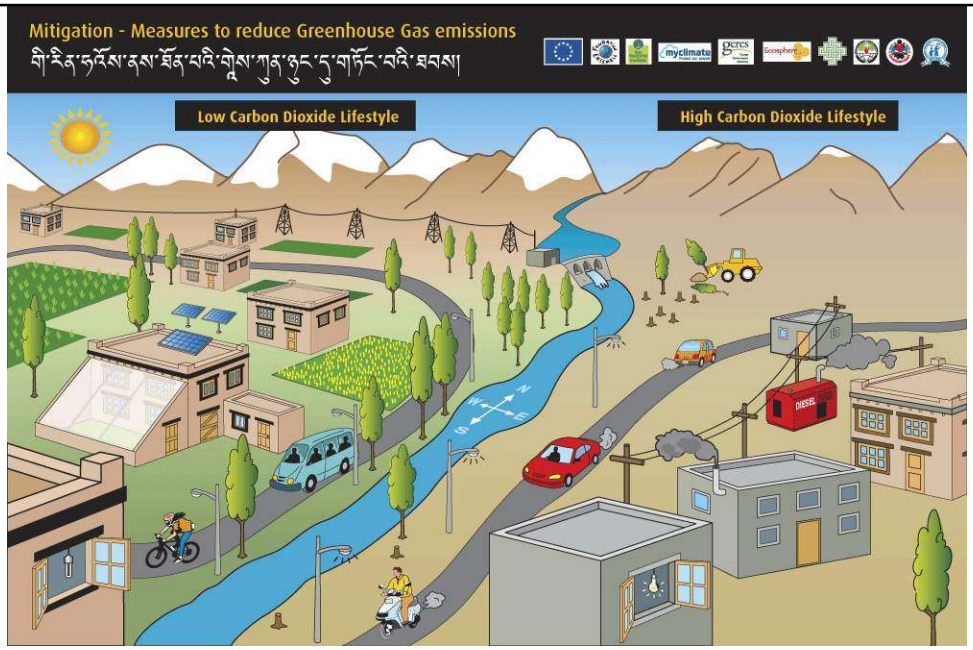


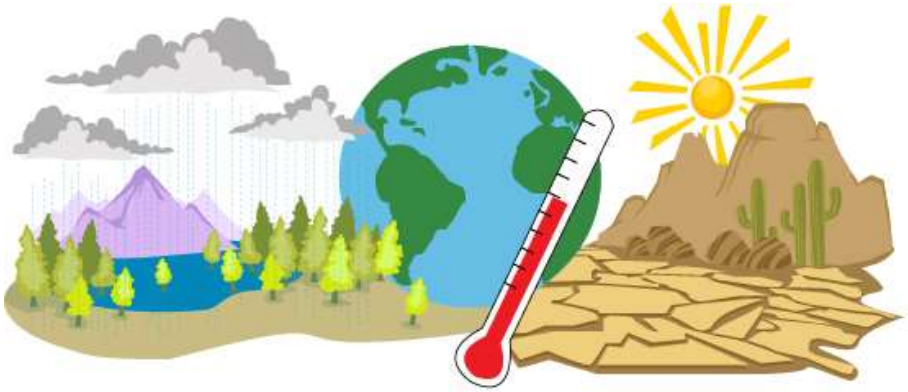




EXERCISE

Think about measures or actions at the family and community scale to reduce greenhouse gas emissions.


Mitigation - Measures to reduce Greenhouse Gas emissions
གཡོ་རིན་ཤའོས་རླས་ཐོན་བའི་གྲེས་ཀུན་ཉུང་དུ་གཏོང་བའི་ཐབས།
Low Carbon Dioxide Lifestyle
High Carbon Dioxide Lifestyle
DIESEL



QUESTION ?