



Severe Weather 101 – Thunderstorms

## **UNDERSTANDING CLOUDS**

By

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# What is a Cloud?

A visible mass of condensed water vapor floating in the atmosphere, typically high above the ground.

# How Much Clouds are There in the Sky?

About two-thirds of the Earth's surface is covered by clouds.

And about 2000 thunderstorms are active at any moment.

# Clouds and Solar Radiation

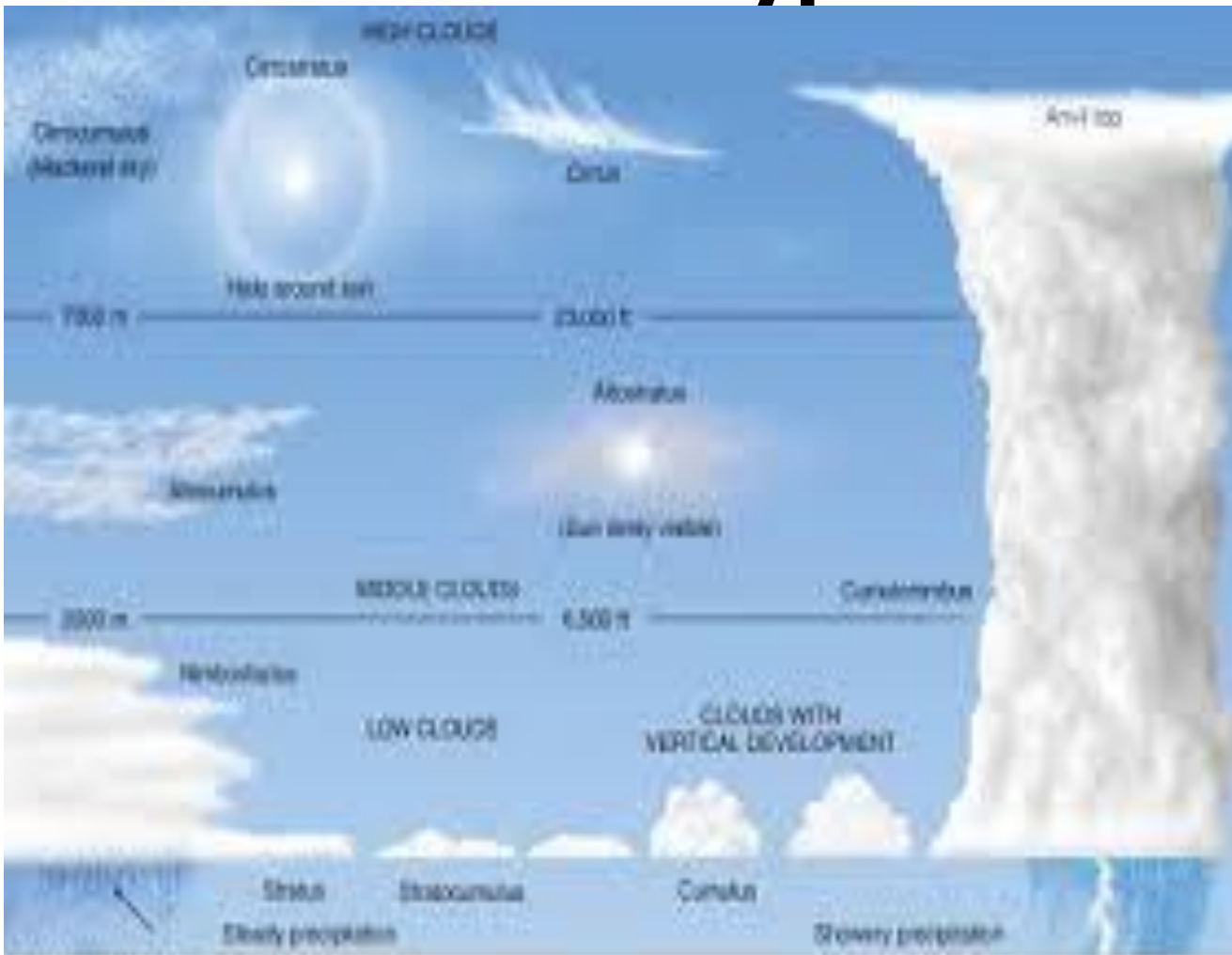


# Formation of Clouds

Clouds form when humid air cools enough for water vapor to condense into droplets or ice crystals.

The altitude at which this happens depends on the humidity and the rate at which temperature drops with height.

# Cloud Types



# High-Level Clouds

Called cirrus clouds, can reach heights of 20,000 feet (6,000 meters) and are typically thin.

They do not produce rain and they are usually made up of ice.



# High Clouds



# High Clouds



# High Clouds



# Cirrus related to Jet Stream



# Medium-Level Clouds

- Midlevel clouds form between 6,500 feet (2,000 meters) and 15000 feet (4500 meters).
- They are referred to as (Alto-) clouds (**Altostratus or Altocumulus**), depending on their shape.
- (Altostratus clouds are flat; altocumulus clouds are puffy.)
- They frequently indicate an approaching storm. They themselves sometimes produce virga.

# Medium Clouds





# Medium Clouds



# Medium Clouds





# Nimbo-Stratus (NS)



# Low-Level Clouds

Low-level clouds lie below 6,500 feet (2,000 meters).

They are sheet type (Stratus) or heap type (Cumulus) or a combination of them known as (Strato-Cumulus).

They are dense, dark, and sometimes rainy.

# Low clouds



# Towering Cumulus



Towering Cumulus (Cumulus Congestus) , are a form of cumulus cloud that can be based in the low or middle height ranges.

They achieve considerable vertical development in areas of deep, moist convection.

They are an intermediate stage between cumulus and cumulonimbus.

# CB

Cumulonimbus Clouds reach high elevations, their tops reach the tropopause that cause them to spread out sideways to have the anvil shape.

They can reach elevations of 50,000 feet (15,000 meters).

# Towering Cumulus



# Rainy Cumulonimbus



# Cloud Types





# Cloud Amount

Cloud amount is measured in octas (oktas).or 1/8.

No Clouds means Sky Clear.

Clouds less than 2 octas are considered (FEW).

Cloud amount between 3 and 4 octas are considered scattered (SCT).

Cloud amount between 4 and 6 octas are considered broken layer (BKN).

Full sky, cloud amount 8/8 is OVERCAST (OVC).

Sometimes the sky condition cannot be specified due to dust, smoke or etc...

The sky condition is considered obscured.

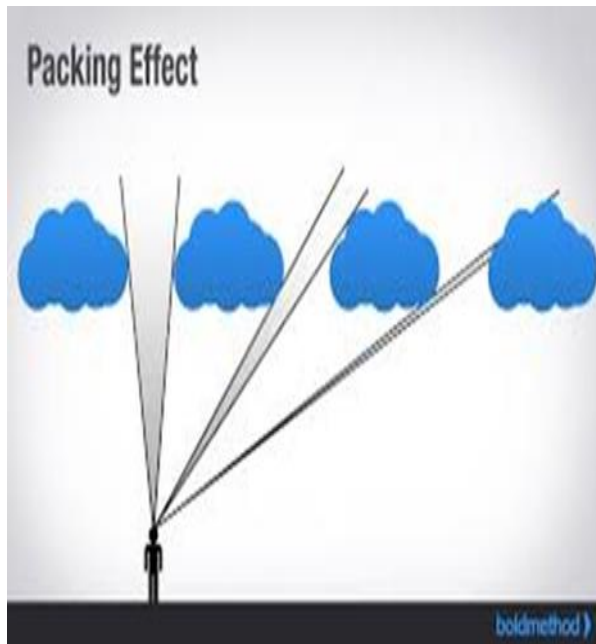
# Cloud Heights

The height of the base of clouds is measured by a ceilometer.

# Ceilometers

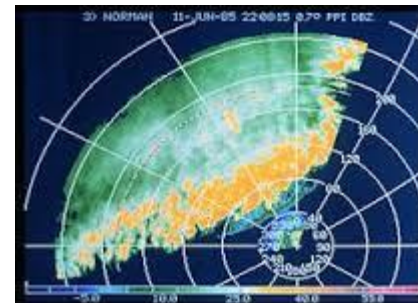


# Limitations of Ceilometers



# RADAR

Weather radar is a type of radar used to locate precipitation, calculate its motion, and estimate its type (rain, snow, hail etc.). ...



# Clouds from above (satellite and Aircraft)



# Organized Clouds

- Clouds are organized in well defined systems and tracks.
- This organization is controlled by the prevailing winds on the surface and within the troposphere.
- Winds are results of pressure differences.
- Pressure is controlled by temperature.
- Temperature is controlled by the response of the underlying surface to solar radiation.



# Satellite Image of Clouds

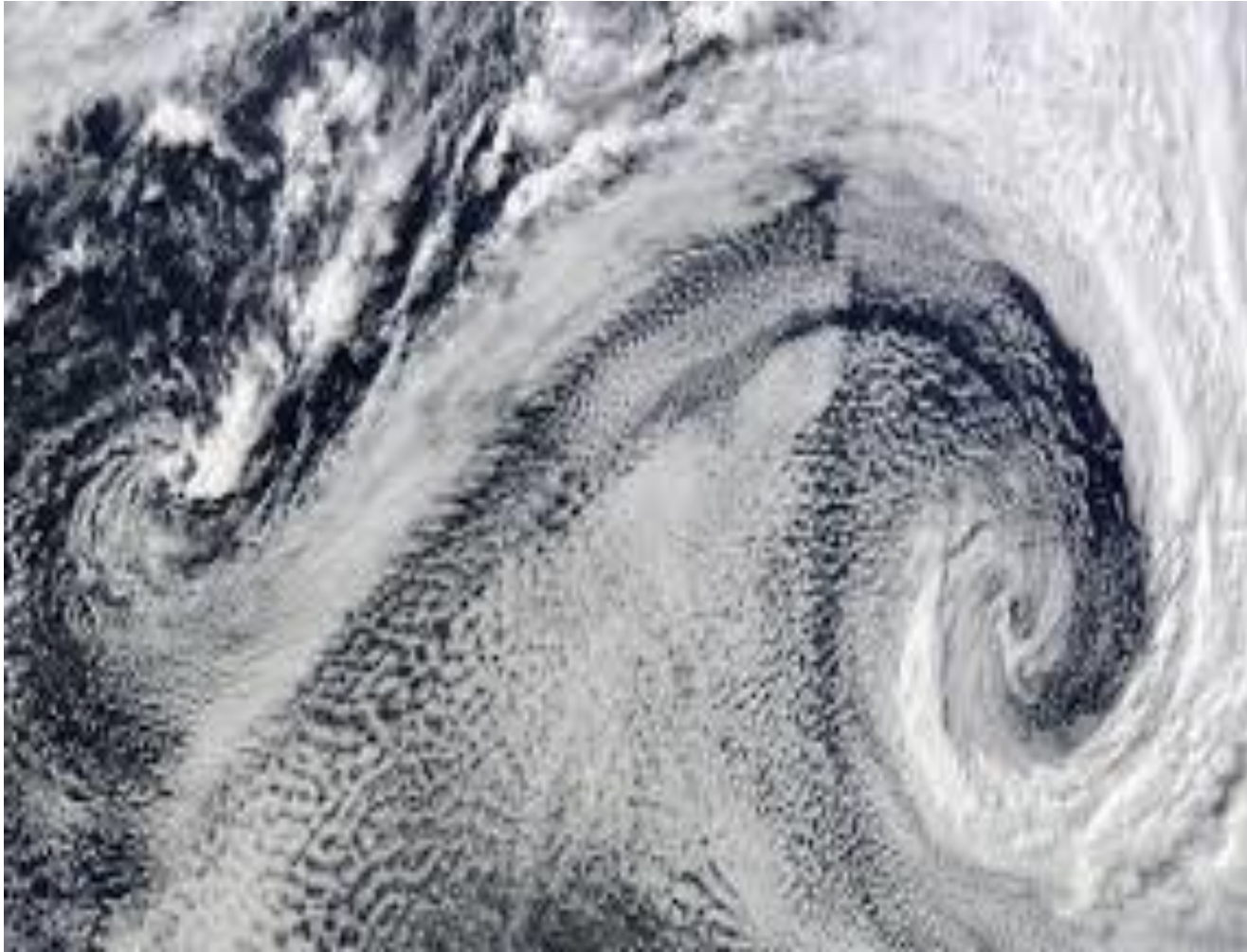




# Tropical Storm (Hurricane; Typhoon)



# Frontal Storms



# Cloud Formation Mechanisms

There are four lifting mechanisms that form clouds: Orographic Lifting, Convection, Convergence, and Updraft.

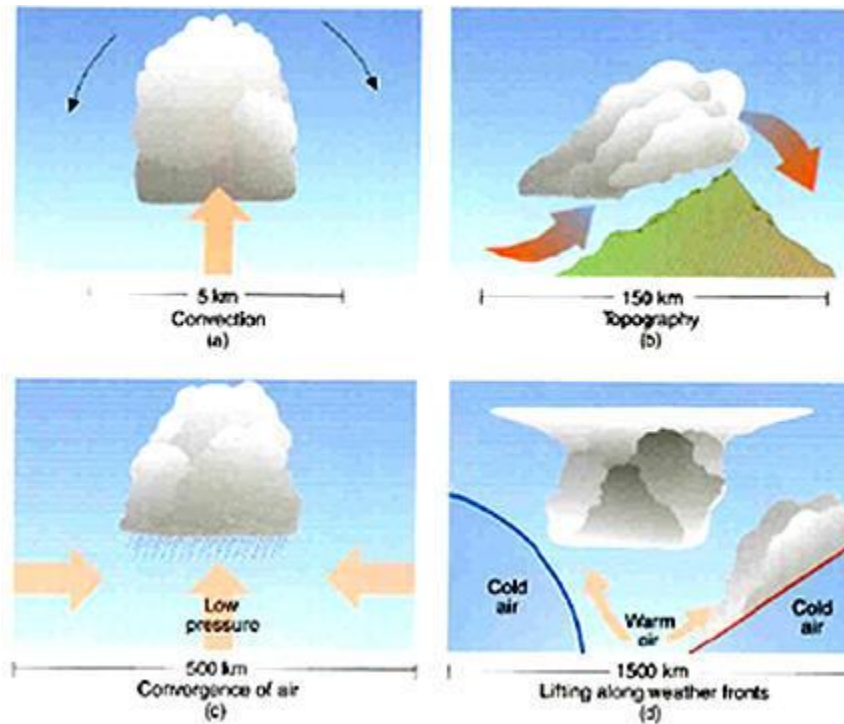
1- Orographic lifting is when air cannot go through a mountain, and so it flows over it.

2- Frontal Lifting is when less dense warm air is forced to rise over cooler, denser air as a weather front moves. Most common in winter.

3- Convection is when solar energy passes through the atmosphere and heats the surface, where the air becomes less dense than the air around it, making it rise.

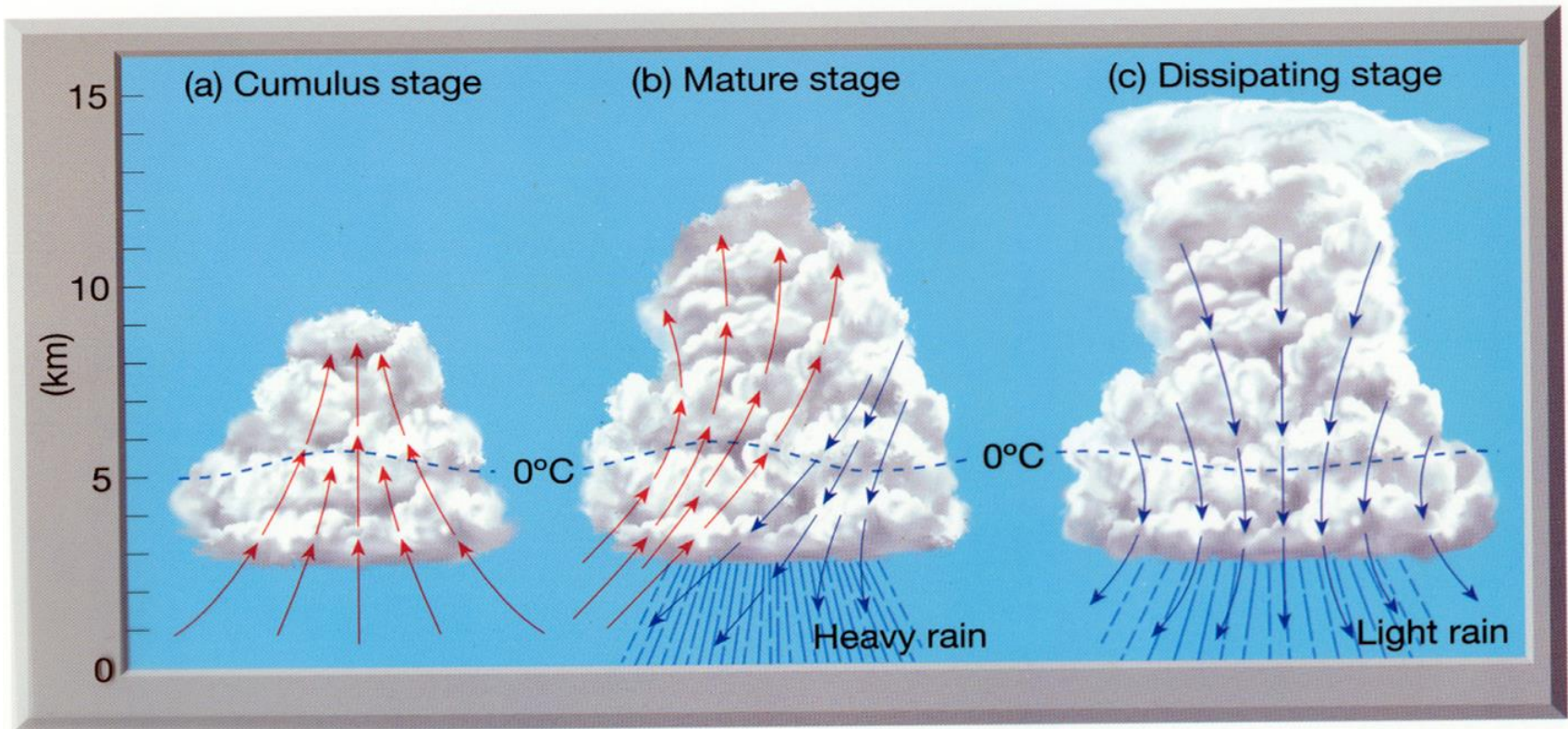
4- Convergence lifting is when air near the surface flows together and is pushed upward when it is squeezed together.

# Cloud Formation Mechanisms

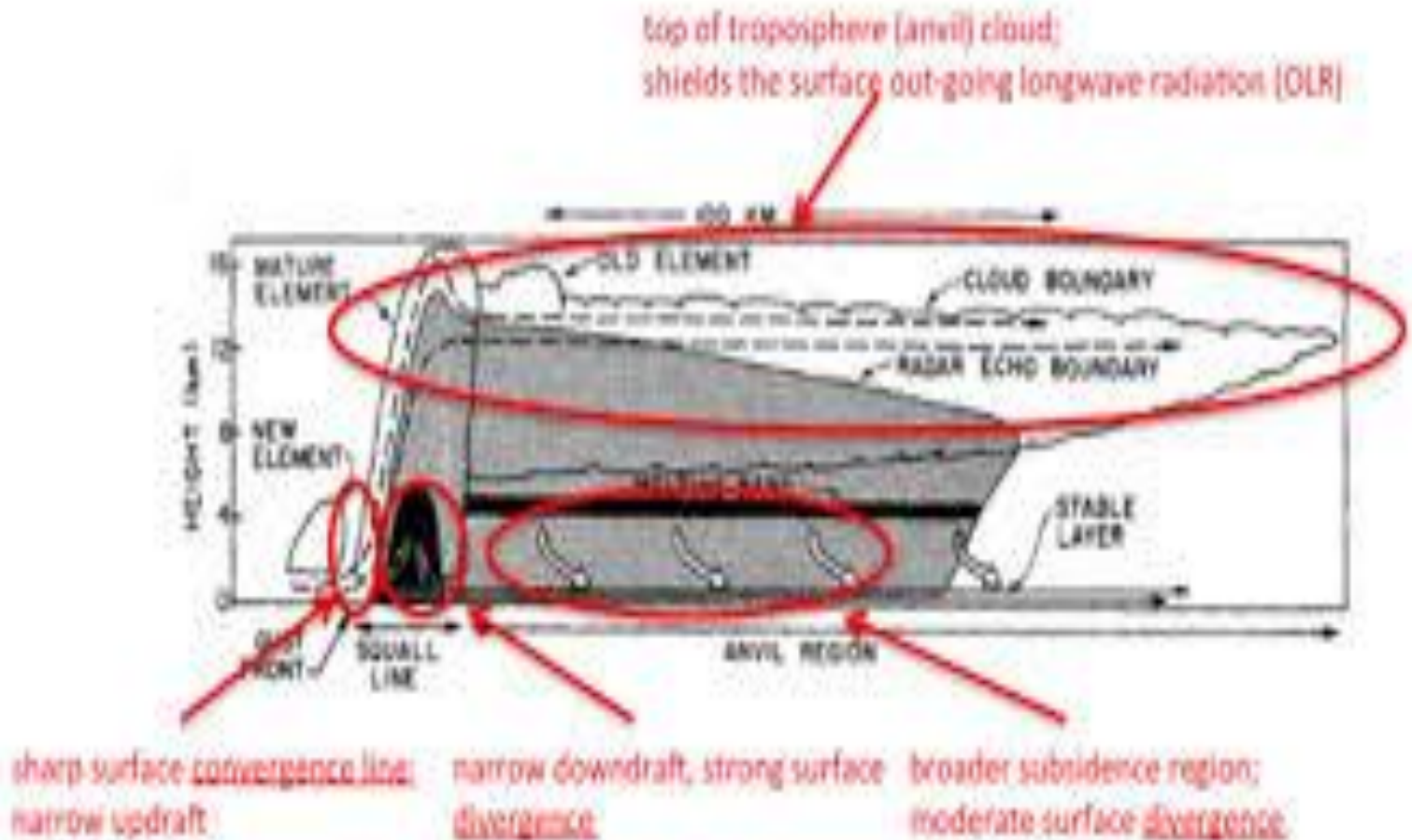




# Stages of Cumulonimbus Cloud



# Westwards Propagation of Tropical Squall Lines



# Cloud Formation

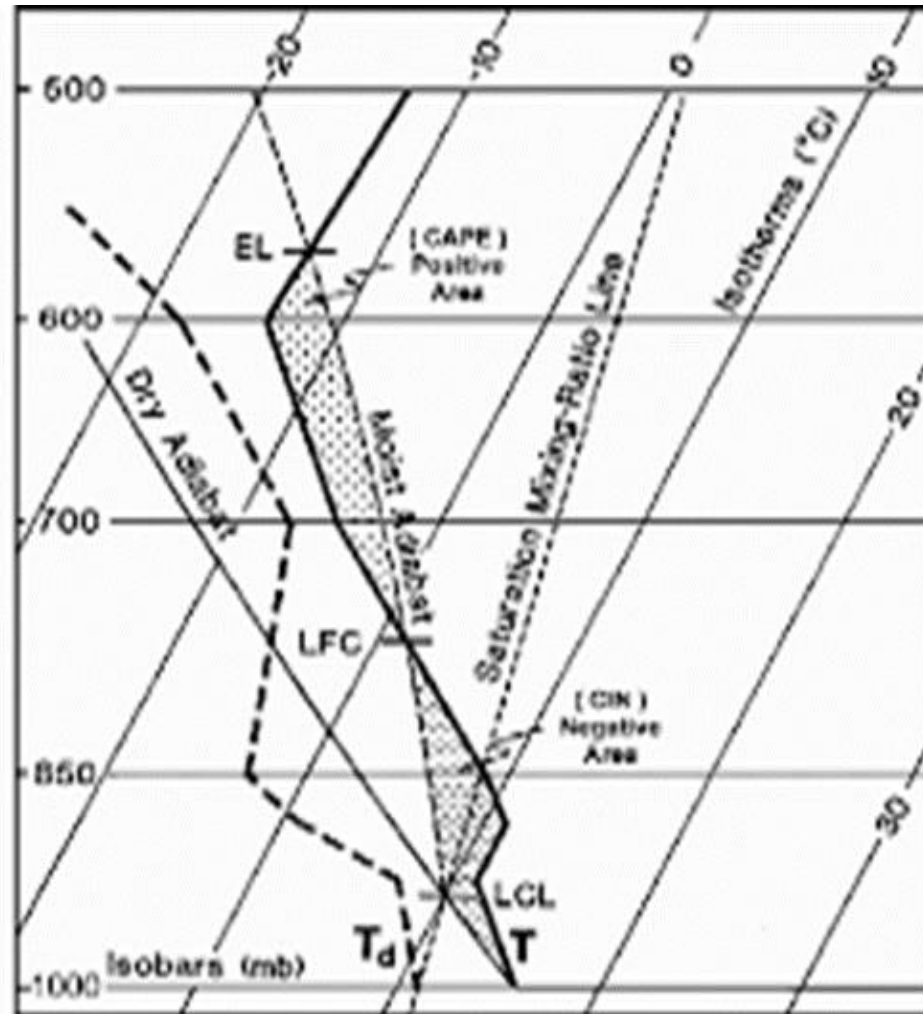
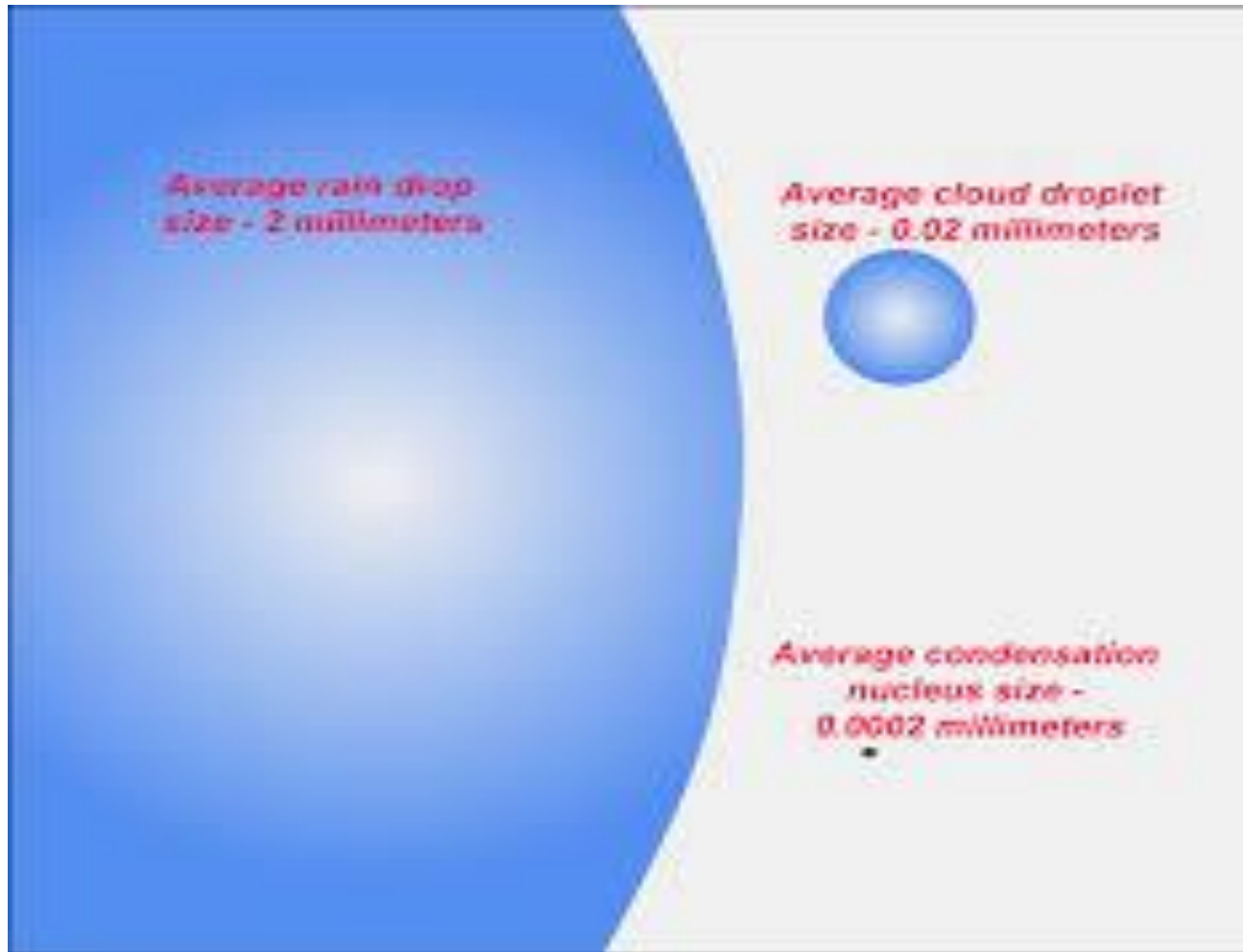


Figure 1. Showing the Positive [CAPE] and Negative [CIN] areas (from *WMO/OSY/OSB*, 1991).

# Cloud Droplet and Rain Drop





# Thunderstorm

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# Special Types of Clouds

# Light on Clouds



# Mount Fuji in Japan



# Cumulonimbus Cloud



# Showering CB



# CB MAM





# CB MAM



# Contrail



# Contrails



# Kassala and Stratus Clouds



# Dubai Masked by Fog



# Cloud Hazards

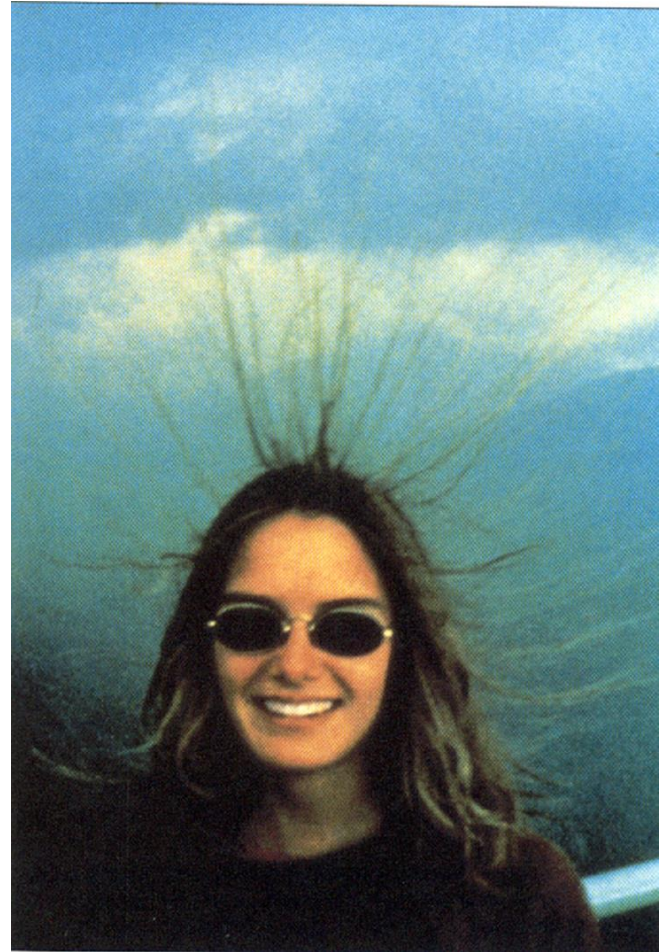
# Lightning





# Static Electricity

If you feel static electricity like this person get to a low area immediately



# Tornado



# Tornado



# Hail



# Hail





# Hail



# Hail on Farm





# Turbulence



# Super-Cooled Water

Cloud droplets at temperatures below zero.

When it contacts a solid surface it condenses instantaneously.

This may lead to aircraft crash.

# Strong Winds



# Strong Winds



# Dust Storms



# Functions of Clouds

1- Produce rain.

2- Reflect Solar radiation.

3- Re-emit Terrestrial radiation as a GHG.

4- Re-distribute energy in the atmosphere via latent heat.

5-What else

# Functions of Clouds

**Boost romantic feelings.**



# Heavy Clouds

هُوَ الَّذِي يُرِيكُمْ الْبَرْقَ خَوْفًا وَطَمَعًا وَيُنشِئُ السَّحَابَ

الثَّقِيلَ ﴿١٢﴾

# How Heavy is the Cloud?

Consider a cloud that is 1km long, 1 km wide and 1km tall. Its volume will be **1000x1000x1000** cubic meters.

If the amount of water particles in one cubic meter is **0.5 grams** then:

The weight of the water in this cloud will be:

**500,000kg** (500 tons).

# Strati-form Clouds

اللَّهُ الَّذِي يُرْسِلُ الرِّيحَ فَتُثِيرُ سَحَابًا فَيُبْسِطُهُ فِي

السَّمَاءِ كَيْفَ يَشَاءُ وَيَجْعَلُهُ كِسْفًا فَنَرَى الْوَدُوقَ يُخْرُجُ

مِنْ خَلَالِهِ فَإِذَا أَصَابَ بِهِ مِنْ يَشَاءُ مِنْ عِبَادِهِ إِذَا هُمْ

يَسْتَبْشِرُونَ ﴿٤٨﴾

# Cumuli-form Clouds

أَلَمْ تَرَ أَنَّ اللَّهَ يُزْجِي سَحَابًا ثُمَّ يُؤَلِّفُ بَيْنَهُمْ ثُمَّ يَجْعَلُهُ رُكَّامًا فَتَرَى

الْوَدُوقَ يَخْرُجُ مِنْ خِلَالِهِ وَيُنزِلُ مِنَ السَّمَاءِ مِنْ جِبَالٍ فِيهَا مِنْ بَرَدٍ

فَيُصِيبُ بِهِ مَنْ يَشَاءُ وَيَصْرِفُهُ عَنِ مَنْ يَشَاءُ يَكَادُ سَنَا بَرْقَاهُ يَذْهَبُ

بِالْأَبْصَرِ ﴿٤٣﴾



**Thank You** **Thank You** **Thank You**