



دانشگاه رازی

Synoptic Meteorology 1
Lecture 7

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Cloud Formations



When the temperature in the Earth's atmosphere drops below the condensation temperature, water vapor condenses or freezes out; the numerous water droplets and/or ice crystals make up clouds.

CONDENSATION

Sunlight causes water to evaporate into the atmosphere

This air containing the water vapor is heated at the surface of the earth and rises.

As the air rises, it cools and the water vapor condenses on some form of particulate matter such as dust, ash, or smoke to form clouds.

The particulate matter are called **Condensation Nuclei**.



So, what is a cloud?

~ It is a thick mass of suspended water drops or ice crystals.

Importance of Clouds

What do clouds tell us?

~ The presence of clouds in the sky is one type of signal to meteorologists that there will be changes in the weather.

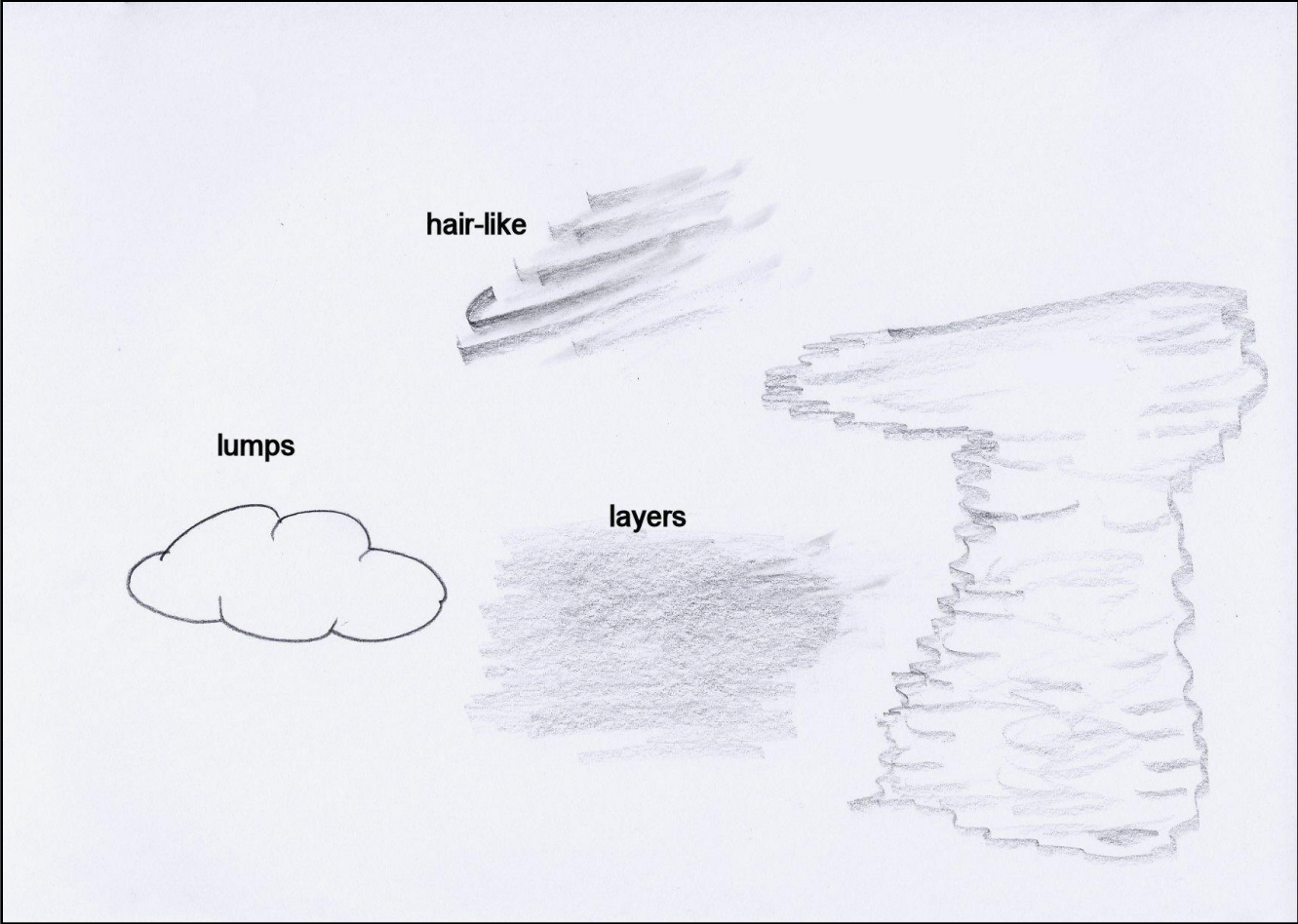
Predicting the weather requires the understanding of the different types of clouds

Identifying Clouds

To better communicate and understand the many cloud forms in the sky, meteorologists identify clouds based on five basic cloud characteristics:

1. The altitude at which they occur
2. Color
3. Density
4. Shape
5. Degree of cover

From this information, we can identify three basic cloud types and seven other common cloud types.



Cloud Type by Form

Clouds can be classified by some simple, but **subjective**, criteria that also provides information on the atmospheric conditions

One form of classification is based on appearance or form.

Using these characteristics you can identify the three basic cloud types:

Cirrus: fibrous or hair-like

stratus

Nimbus: rain-bearing

cirrus

Stratus: a horizontal sheet or layer

cumulus

Cumulus: a heap or pile

Stratus Clouds

Stratus clouds are thin, sheet-like clouds.

They are layered with some rippling, and cover large portions of the sky.

They are frequently gray and thick.

Stratus clouds are formed when air is forced up slowly.



Cirrus Clouds



Cirrus clouds are thin, white clouds with a feathery appearance.

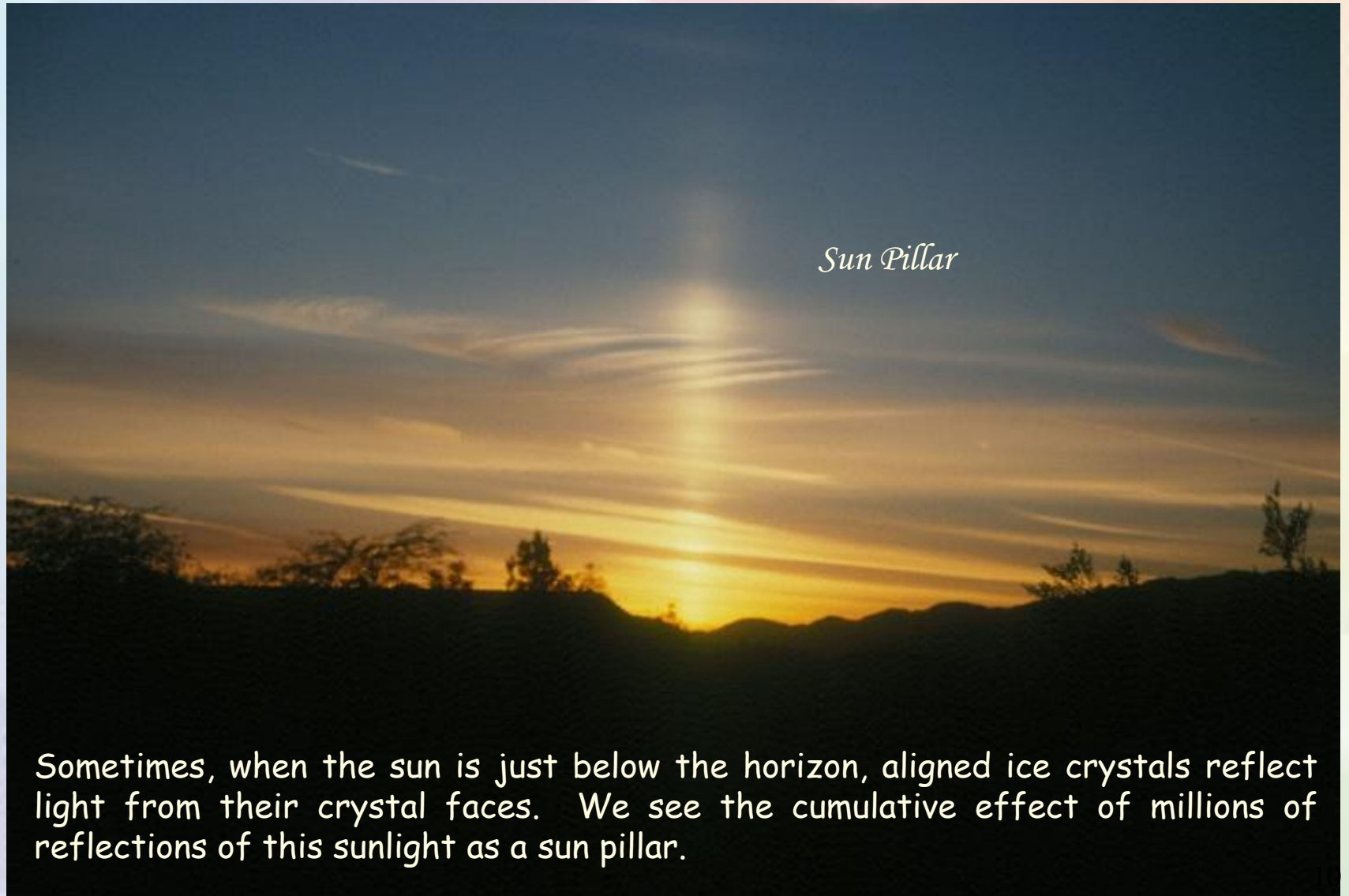
They are the highest of all clouds

Cirrus clouds are formed by ice crystals.

They generally occur in fair weather and point in the direction of air movement at their elevation.

Cirrus clouds are usually the first sign of an approaching storm.

Cirrus Cloud Phenomenon



Sun Pillar

Sometimes, when the sun is just below the horizon, aligned ice crystals reflect light from their crystal faces. We see the cumulative effect of millions of reflections of this sunlight as a sun pillar.

Cumulus Clouds

Cumulus clouds are flat-based, billowing clouds with vertical doming.

Often the top of cumulus clouds have a "cauliflower-like" appearance.

Cumulus clouds are most prominent during the summer months.

Cumulus or fluffy clouds form when air is forced up rapidly and therefore rises higher.



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Cloud Type by Altitude

Clouds can also be classified based on their altitude

There are three categories of cloud heights:

High Clouds = Cirrus

Middle Clouds = Alto

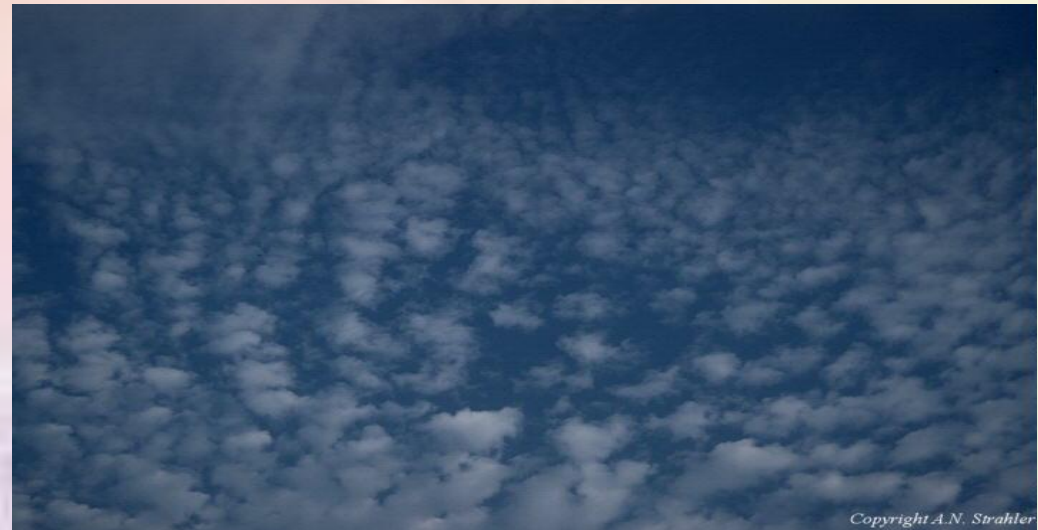
Low Clouds = Stratus

Cirro

High clouds: 7-18km

Cold: less than 25 °C & made up of ice crystals

Cirrostratus: high, wispy clouds. They give the sky a milky white appearance.



Cirrocumulus: delicate clouds appearing in bands or ripples across the sky. They are one of the least common of the cloud types.

Alto

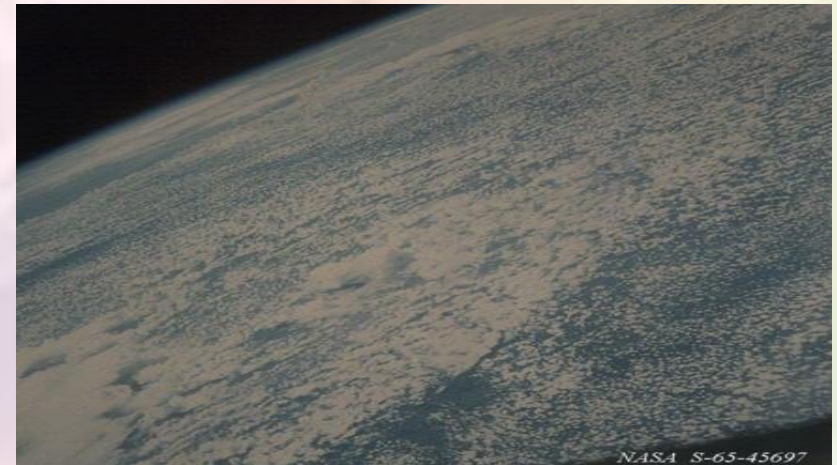
These clouds usually form from the gradual lifting of air in advance of a cold front.

Middle level clouds: 2-7 km

0-25 °C & composed of both water and ice crystals

The presence of altocumulus clouds on a warm and humid summer morning is commonly followed by thunderstorms later in the day.

Altostratus: thin, layered clouds that are blue-gray or whitish in color and often cover large portions of the sky. They are thinner if formed at higher altitudes but are heavier and more dense if closer to the ground.



* *Picture of altocumulus clouds taken by satellite*
Altocumulus: oval or elliptical in shape, and can have gray undersides. They often have a "cottonball-like" appearance.



Strato

Low level clouds: 0 - 2 km
Greater than 5°C & composed of water



Stratus: Dense, uniform dark gray layers.



Stratocumulus: groups of dense, puffy clouds that cover the sky in dark heavy masses, long and gray. They often form in bands across the sky.

Cloud Types

cirrus

cirrocumulus

cirrostratus

HIGH



Cumulonimbus



altocumulus

altostratus

MIDDLE



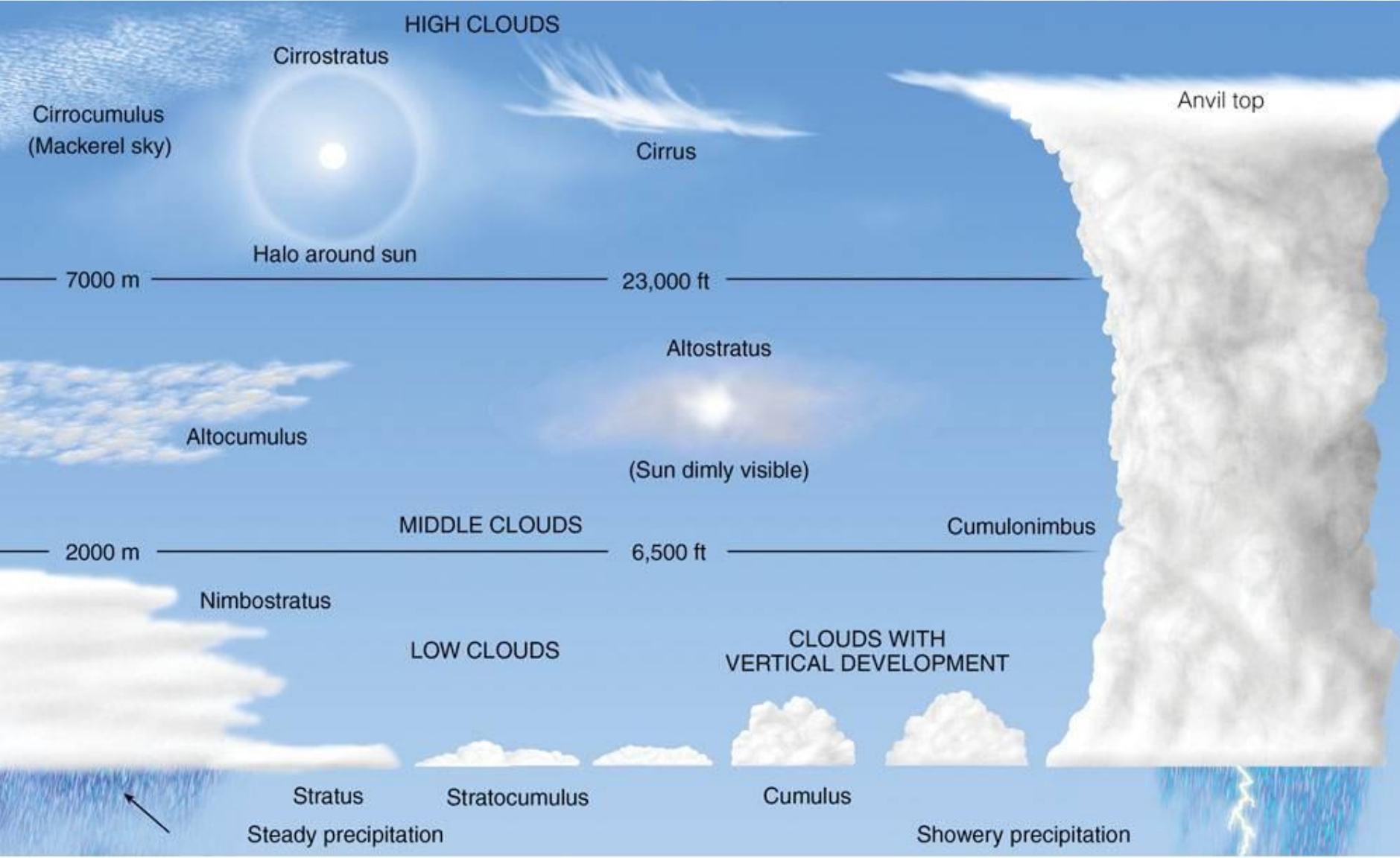
**Cumulus
(fair weather)**

**Cumulus
(with development)**

Stratus

LOW





Fog

Fog : Clouds at ground level

Radiation fog: forms at night when cold ground cools the air above it
(in valleys)

Advection fog: forms when warm, moist air moves over colder surface and cools
(in coastal areas)



Advection Fog

A cold ocean current cools the air to the air's dew point temperature.

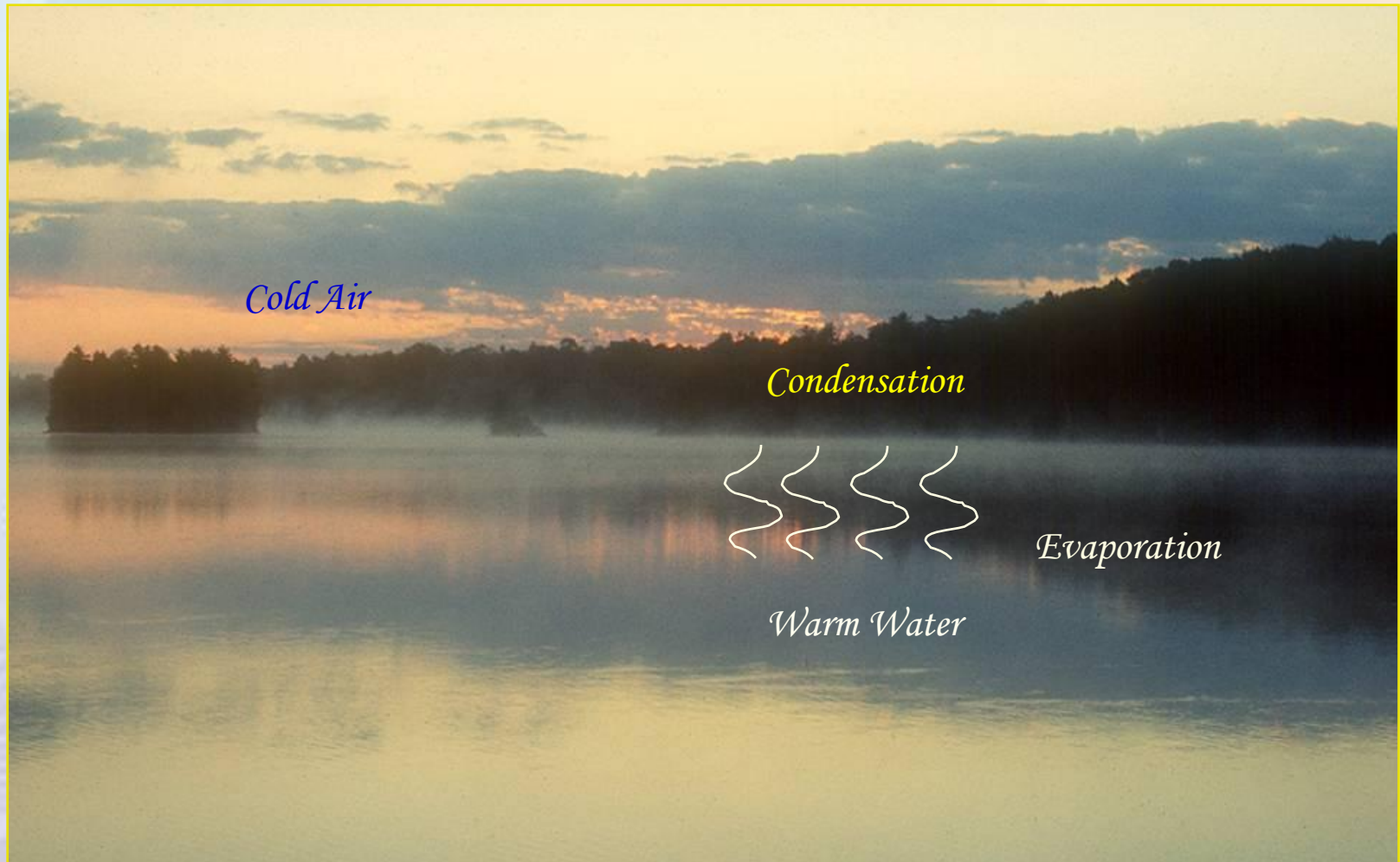
This cooling of the air created the fog



Radiation Fog

For the development of this fog, warm water is evaporating into cool air

The cool air becomes saturated (its relative humidity becomes 100%) and condensation creates the fog



Cloud Type by Rain

Finally, we can classify them based on the presence of rain

Nimbus: any cloud that rains

Cumulonimbus: taller, towering versions of cumulus clouds. Their height can be from two to five miles. These clouds often form thunderstorms.

Nimbostratus: low, flat clouds that are often associated with steady precipitation and occur in thick, continuous layers and are often dark gray in color.



Cumulonimbus Clouds As seen from Apollo 8

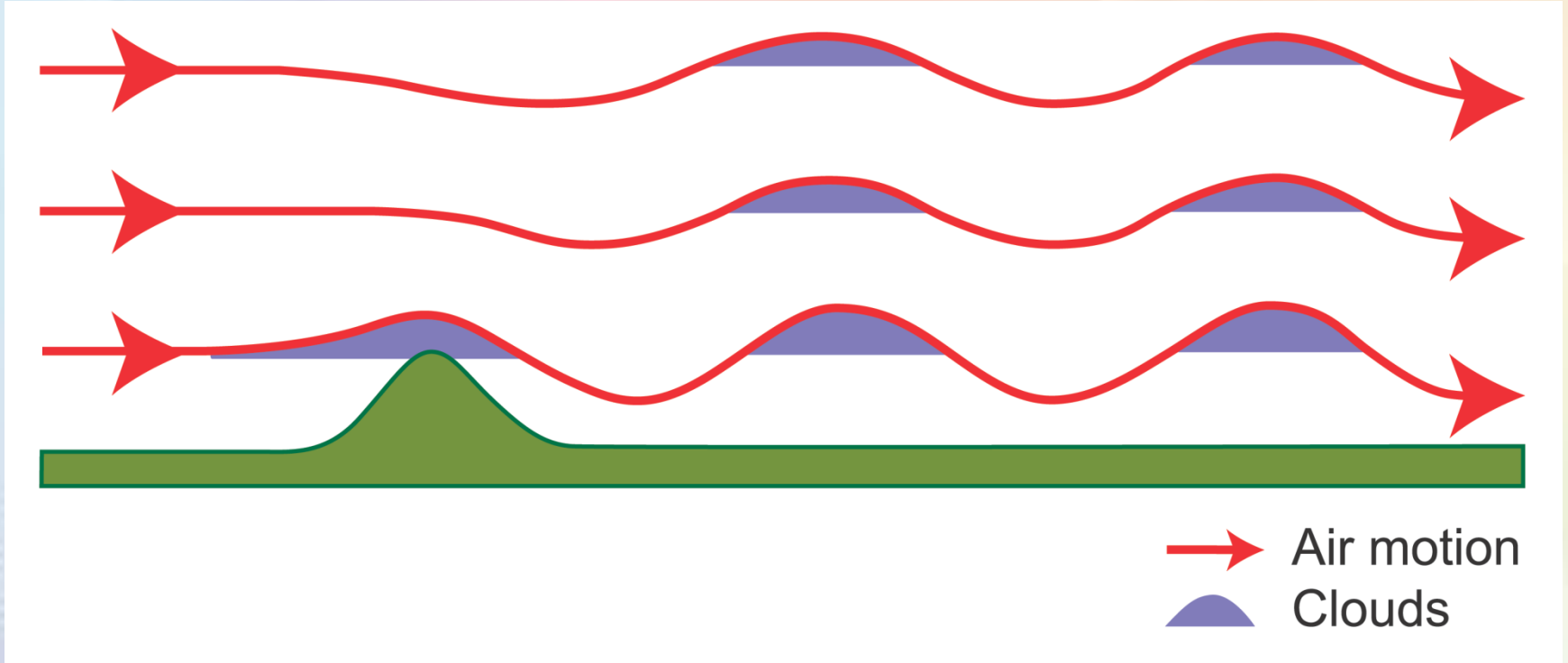


Lenticular or Mountain Wave Clouds





Mountain Wave Clouds





Influences of Clouds

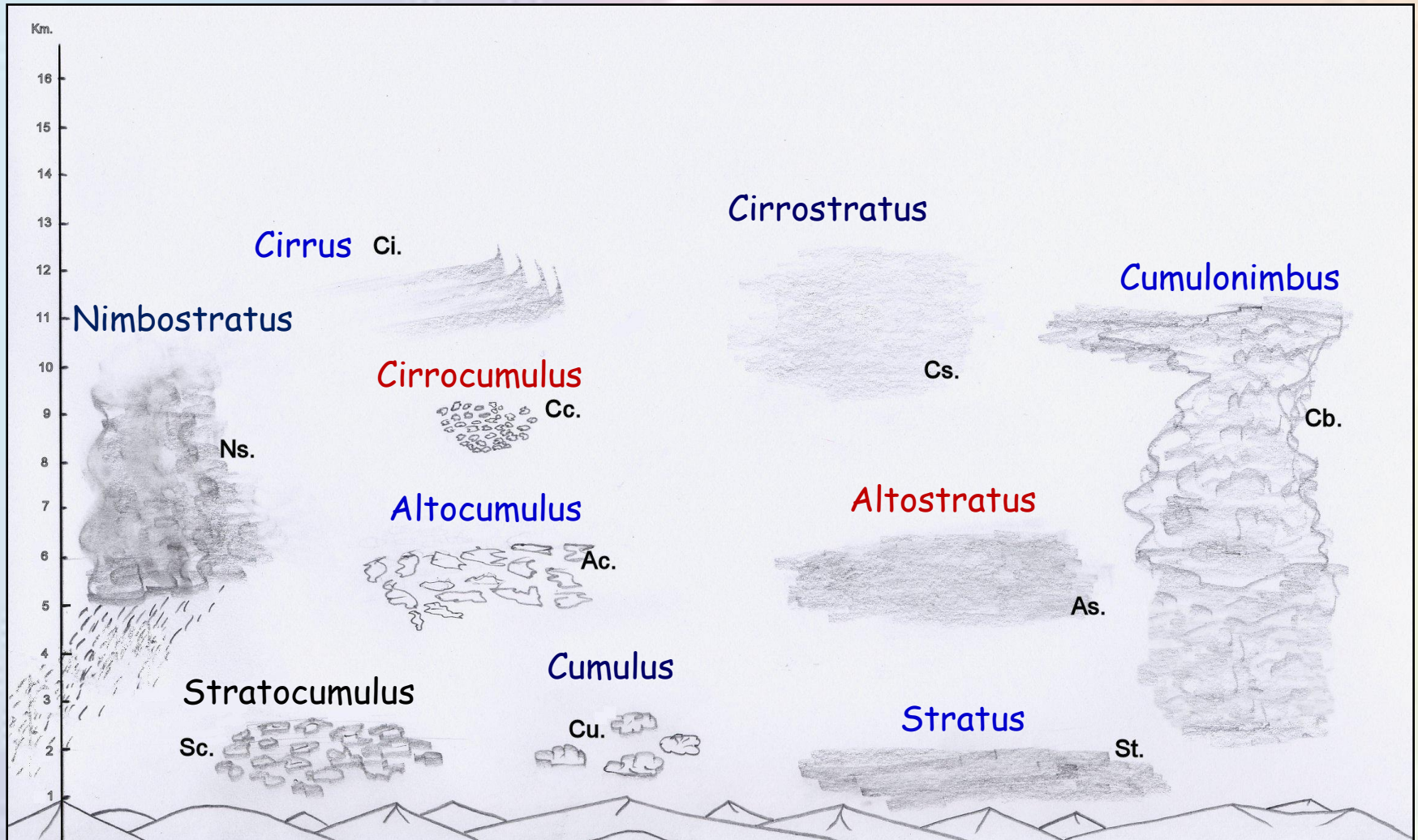


(1) Reflect and absorb solar radiation

(1) Reflect and absorb terrestrial radiation

(1) Latent heat release → atmospheric heating

The ten main cloud types



Ci. Cc. Cs. Ac. As. Ns. Sc. St. Cu. Cb.

Cirrus



Cirrocumulus



These clouds look like tiny lumps.
They have clear gaps between them.
They are ice crystals high in the sky.

Cirrostratus



These clouds are featureless sheets at high levels

These can signal approaching bad weather

Alto cumulus



These clouds are at mid-level in the sky
They are formed from clear lumps with gaps between them

Altostratus



These are made of sheets of featureless clouds
at a medium level in the sky

Nimbostratus



These dark grey clouds, found at middle levels, often also extend lower down

They can bring heavy rain

The rain can be seen falling in this picture



Stratocumulus



This is a mixture of both lumps and layers

There can be some gaps in the clouds

It is a low level cloud

Stratus



This featureless, grey cloud can be found at low levels

If it was any lower it would be fog

Cumulus



These low level clouds are made of fluffy white rounded heaps

Cumulonimbus

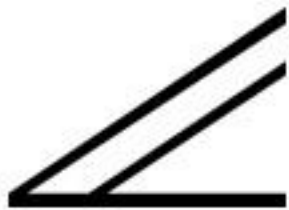


These are very large towering clouds

They extend to great heights

They often bring heavy precipitation

It can be a giant storm cloud



altostratus



cirrostratus



nimbostratus



stratus

www.visualdictionaryonline.com



altocumulus



cirrocumulus



stratocumulus



cumulus



cumulonimbus



cirrus

Cloud symbols

	1	2	3	4	5	6	7	8	9
C _L									
C _M									
C _H									

CL Low

- 1 Cu fair weather
- 2 Cu towering
- 3 Cb no anvil
- 4 Sc from Cu
- 5 Sc
- 6 St
- 7 Fs
- 8 Cu and Sc
- 9 Cb

CM Middle

- As thin
- As
- Ac thin
- Ac patchy
- Ac thickening
- Ac from Cu
- Ac thick
- Ac turrets
- Ac chaotic

CH High

- Ci filaments
- Ci dense
- Ci from Cb
- Ci hooks, spreading
- Cs and Ci
- Ci and Cs
- Cs
- Cs partial, stable
- Cc

Weather map Symbols for Clouds



ALTOSTRATUS, STRATOCUMULUS, STRATOCUMULUS,
thick spreading from cumulus not from cumulus



CUMULUS, little
vertical development



CUMULUS, consider-
able development



CUMULUS and
STRATOCUMULUS



CUMULONIMBUS,
clear-cut tops lacking



CUMULONIMBUS,
clear top ALTOCUMULUS,
thin, semi-transparent



ALTOCUMULUS,
thin, patches



ALTOCUMULUS,
bands and thickening



ALTOCUMULUS,
double-layered



ALTOCUMULUS,
spreading from cumulus ALTOCUMULUS,
tufts or turrets



ALTOCUMULUS,
of chaotic sky (Mare's Tails)



CIRRUS filaments
(Mare's Tails)high clouds



CIRRUS, dense,
patches, tufts



CIRRUS, dense,
anvil, shaped



CIRRUS, hook-
shaped, thickening



CIRRUS, and
Cirrostratus, over 45°



CIRRUS, and
Cirrostratus, not 45°



CIRROSTRATUS,
not increasing



CIRROSTRATUS,
veil covering sky



CIRROCUMULUS



STRATUS and/or
FRACTOSTRATUS



FRACTOSTRATUS,
Fractocumulus(Scud)



ALTOSTRATUS,
thin, semi-transparent

Thanks

For your

Attention



Chronicle / Frederic Larson