Mariner's Guide to Clouds

…and the weather they bring

Presented by: Ron Bianchi
Meteorologist/Sailor

Who invent the cloud classification system?

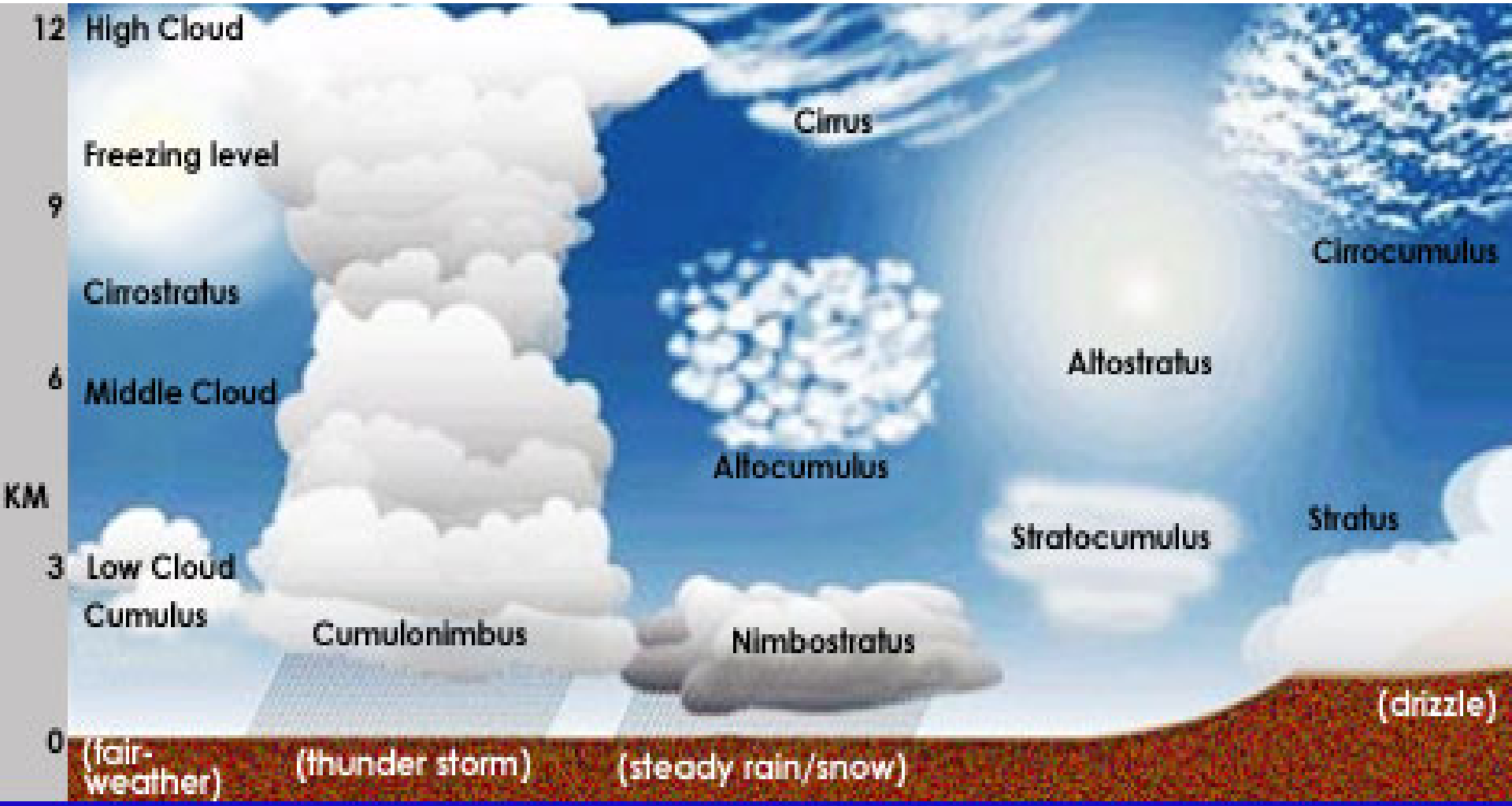
Luke Howard - "the father of meteorology" (28 November 1772 – 20 March 1864) was a British manufacturing chemist and an amateur meteorologist with broad interests in science.

His lasting contribution to science is a nomenclature system for clouds, which he proposed in an 1802 ….and stands today

Clouds are classified into a system that uses Latin words to describe the appearance of clouds as seen by an observer on the ground.

Latin Root	Translation	Example
cumulus	heap	fair weather cumulus
stratus	layer	altostratus
cirrus	curl of hair	cirrus
nimbus	rain	cumulonimbus

“The Entire Cloud Family”



Types of Clouds

Cirrus

Cumulus

Stratus

Cirrus clouds with fog rolling in

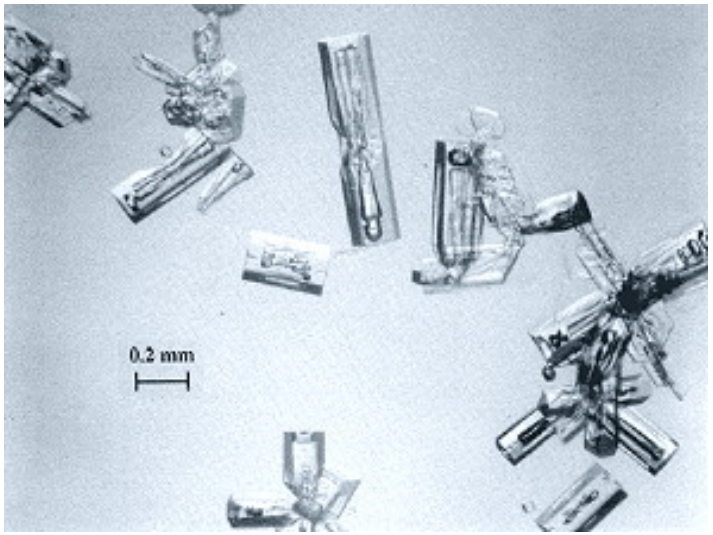
Photo by Albert E. Theberge, Jr. NOAA Central Library/ NWS

High-Level Clouds

•High-level clouds form above 20,000 feet (6,000 meters) and since the temperatures are so cold at such high elevations, these clouds are primarily composed of ice crystals.

•High-level clouds are typically thin and white in appearance

The Cirrus Family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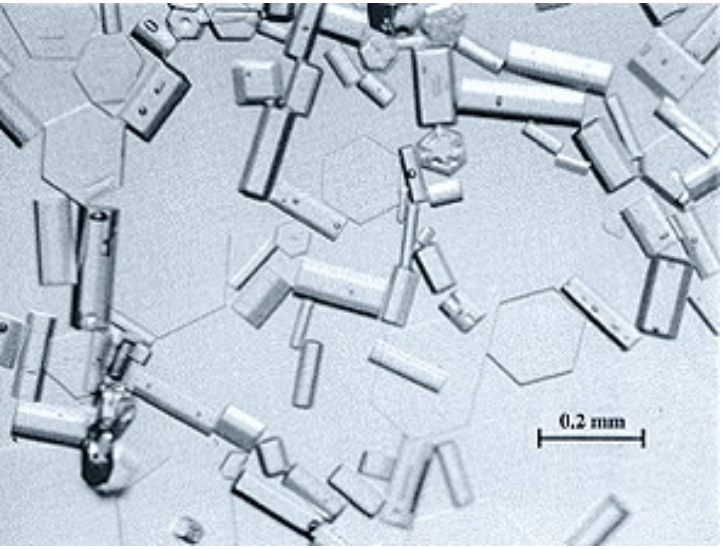
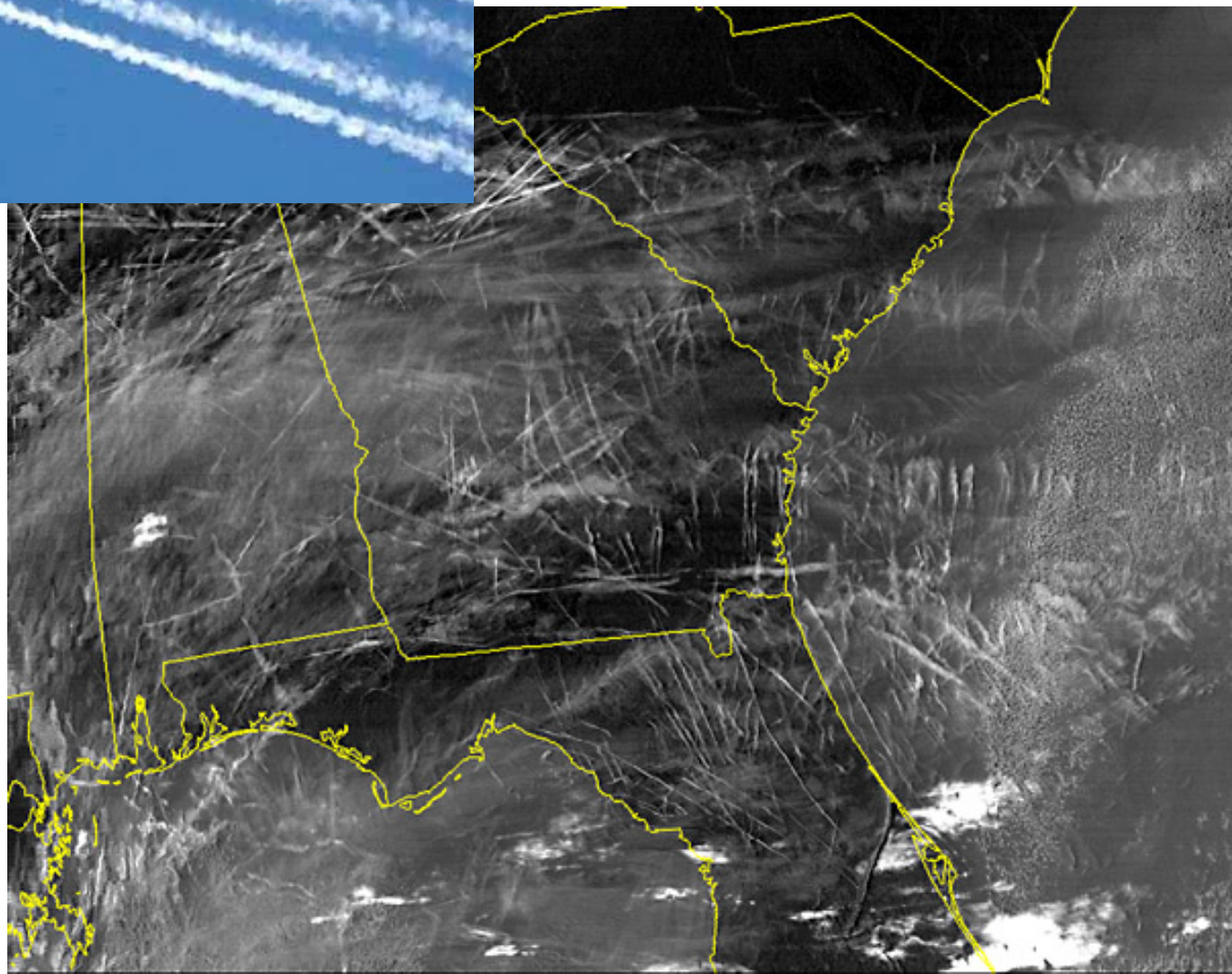

0.2 mm


© H. Michael Mogil, HOW THE WEATHER WORKS

So what does it tell the Mariner – changes such as a warming trend and some rain is a short ~ <u>24 hours</u> away.

- So enjoy you day sail

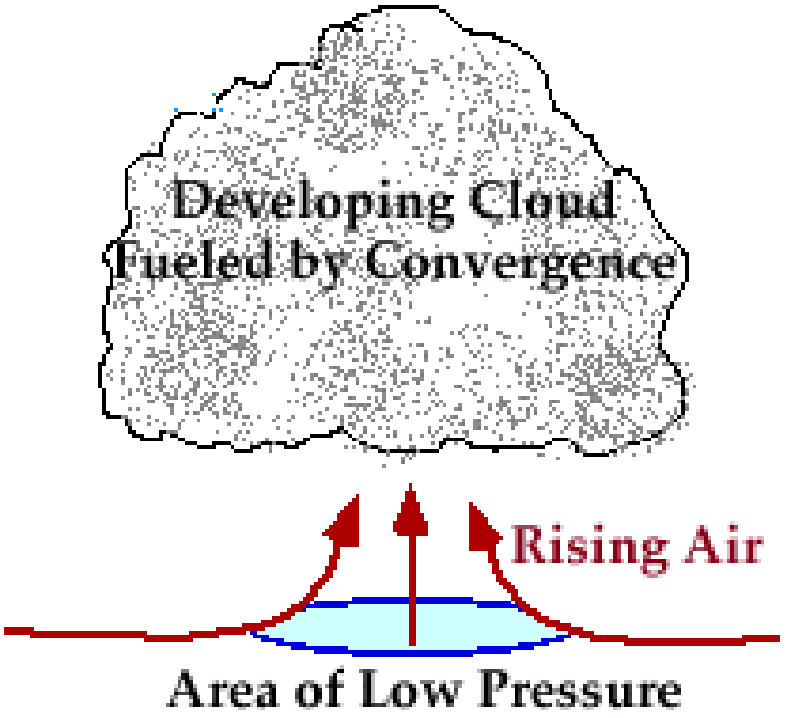


Cirrostratus Clouds
sheet-like and nearly transparent

Cirrostratus are sheet-like, high-level clouds composed of ice crystals. Though cirrostratus can cover the entire sky and be up to several thousand feet thick, they are relatively transparent, as the sun or the moon can easily be seen through them.

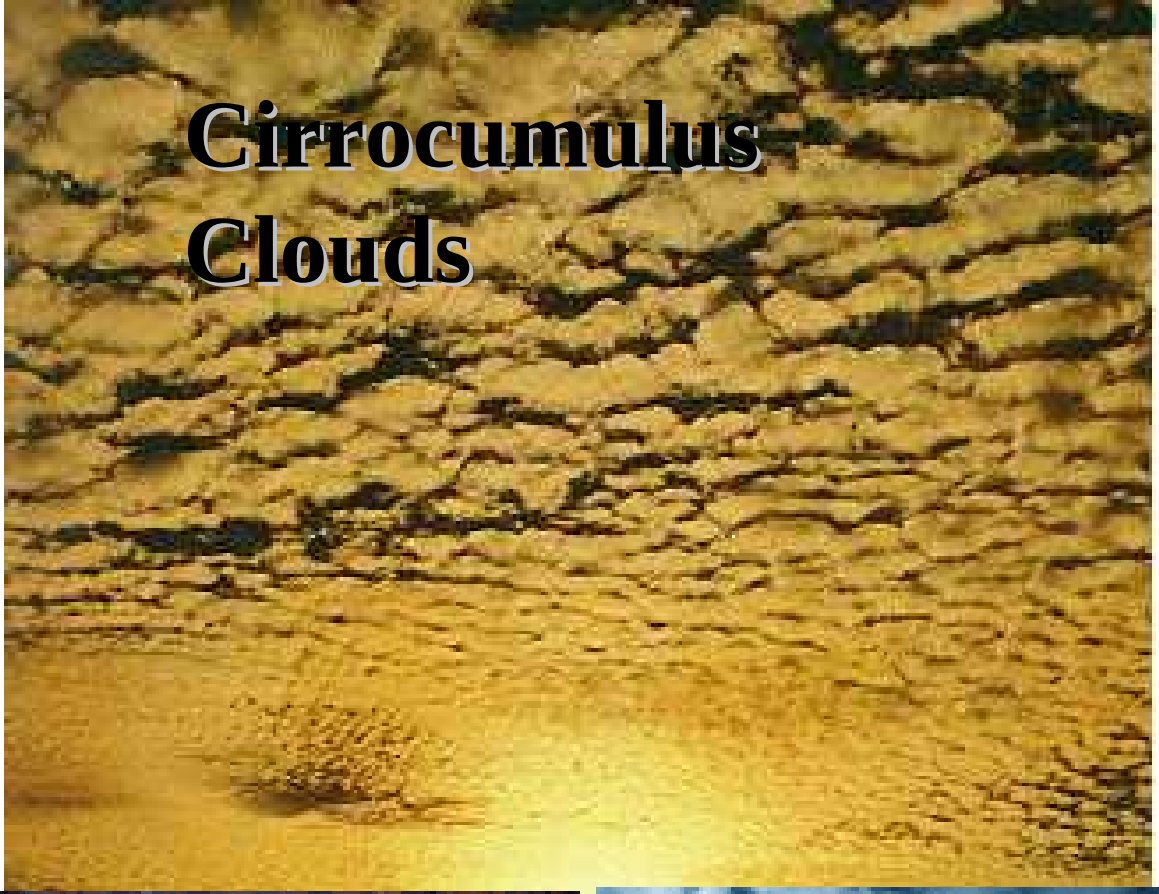
Lifting of air causes clouds to form

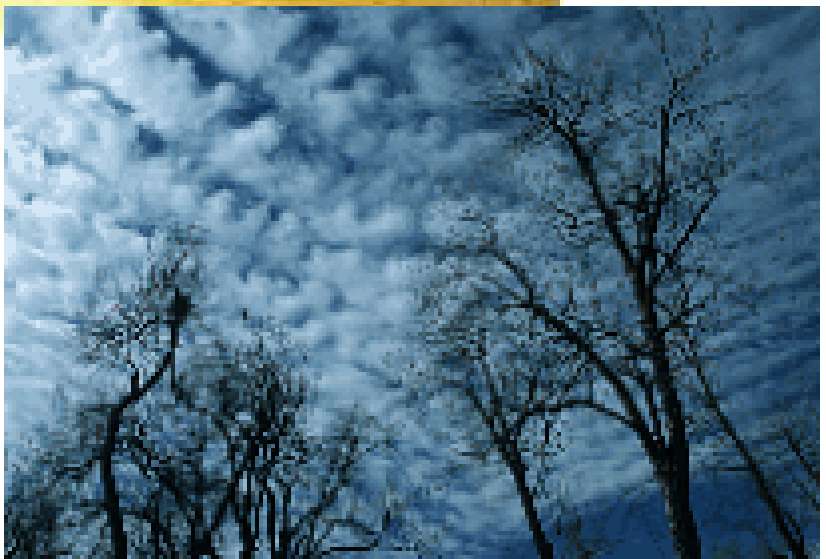
broad lifting of an entire layer of air

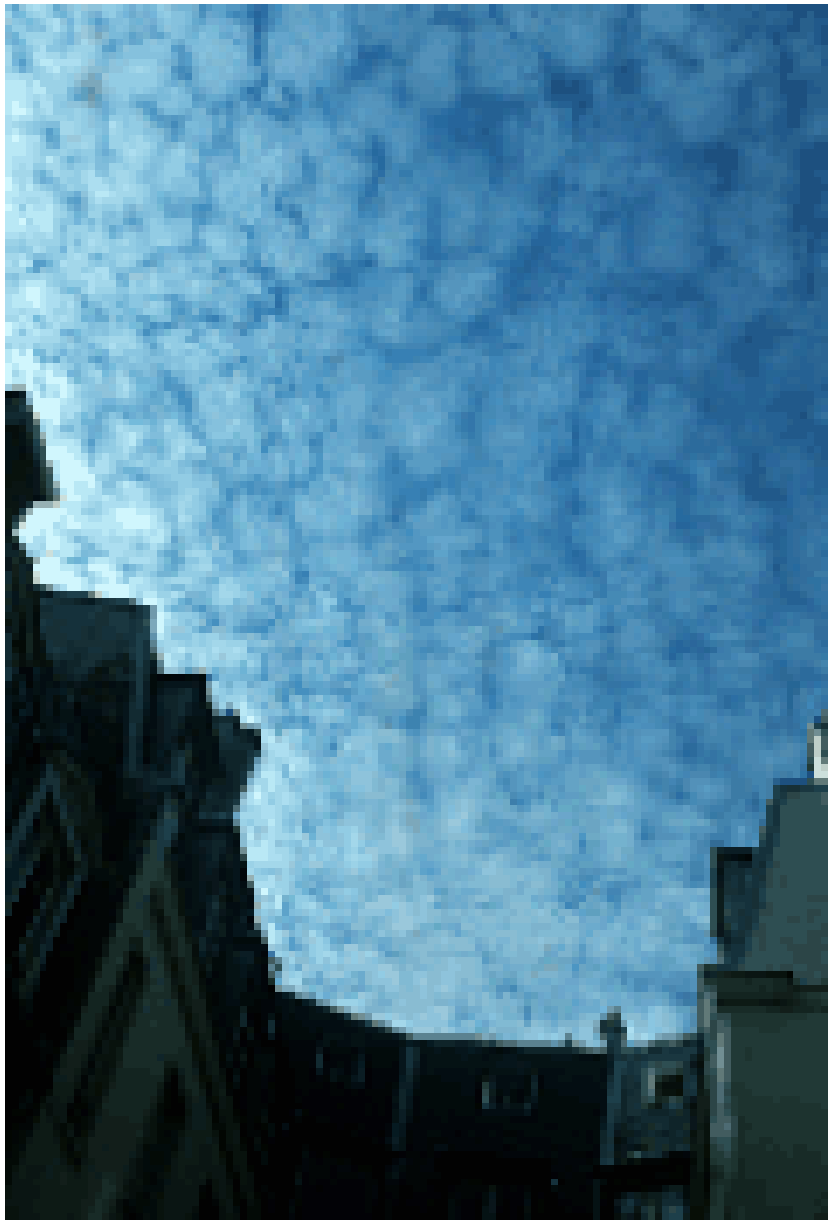


Large scale lift can cause high clouds to form hundreds of kilometers away.

Cirrocumulus Clouds







- **Cirrocumulus clouds** appear as small, rounded white puffs. The small ripples in the cirrocumulus sometimes resemble the scales of a fish. A sky with cirrocumulus clouds is sometimes referred to as a "mackerel sky."

Mid-Level Clouds The next step down…
"Alto" Clouds

Clouds with the prefix "alto" are middle level clouds that have bases between 2000 and 7000 m (6500 to 23,000 ft.). Because of their lower altitudes, they are composed primarily of water droplets, however, they can also be composed of ice crystals when temperatures are cold enough.

Altocumulus clouds are composed primarily of water droplets and are located between 6,500 and 20,000 feet (2,000 to 6,000 meters) above the ground.

Altocumulus may appear as parallel bands (left photograph) or rounded masses (right photograph).

Altocumulus clouds usually form in an unstable layer aloft. The presence of altocumulus clouds on a warm and humid summer morning is commonly followed by thunderstorms later in the day.

Altocumulus

Low-level Clouds - The last step down…. STRATUS CLOUDS

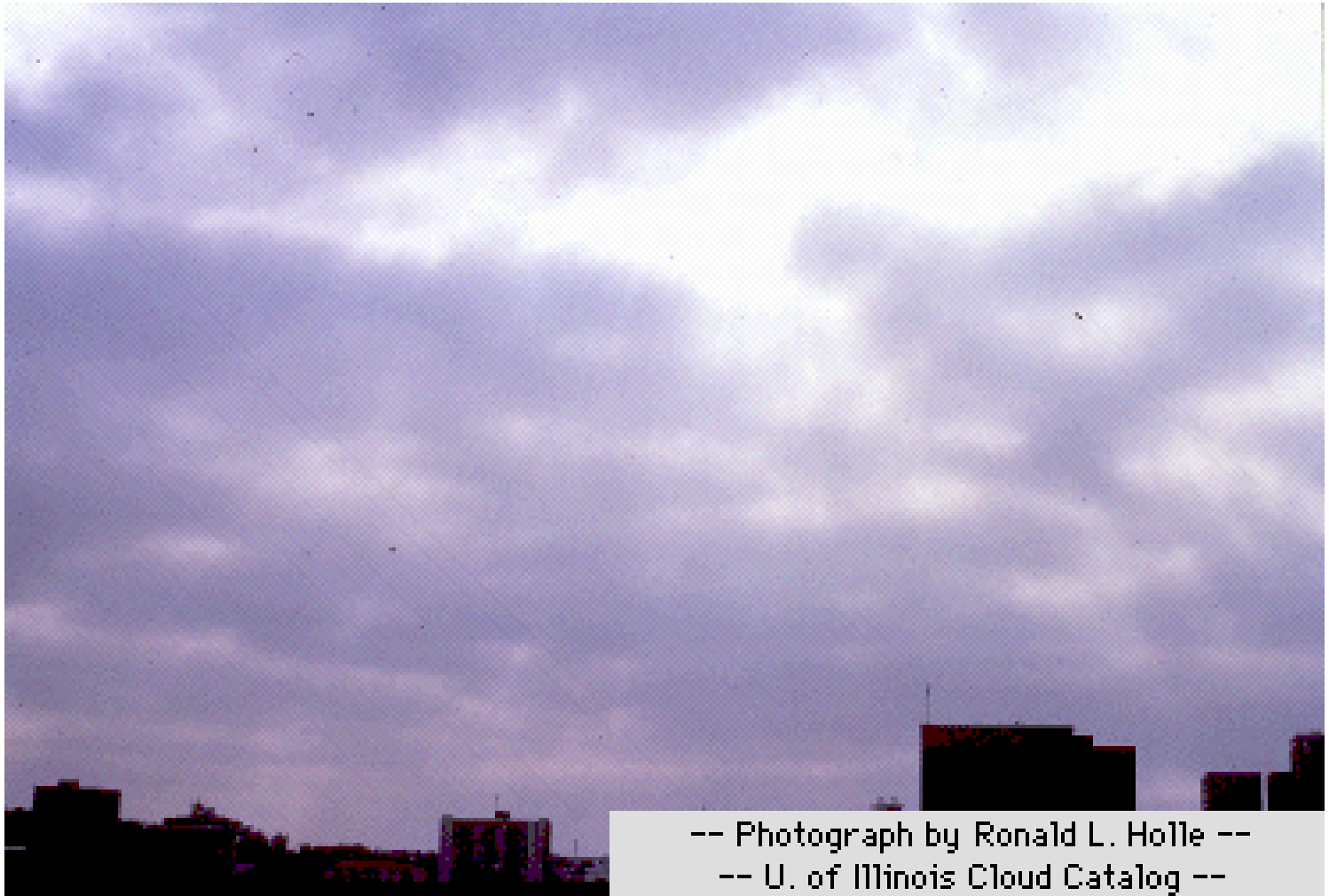
Low clouds are of mostly composed of water droplets since their bases generally lie below 6,500 feet (2,000 meters). However, when temperatures are cold enough, these clouds may also contain ice particles and snow.

Stratus clouds are uniform grayish clouds that often cover the entire sky. They resemble fog that does not reach the ground. Usually no precipitation falls from stratus clouds, but sometimes they may drizzle.

When a thick fog "lifts," the resulting clouds are low stratus.

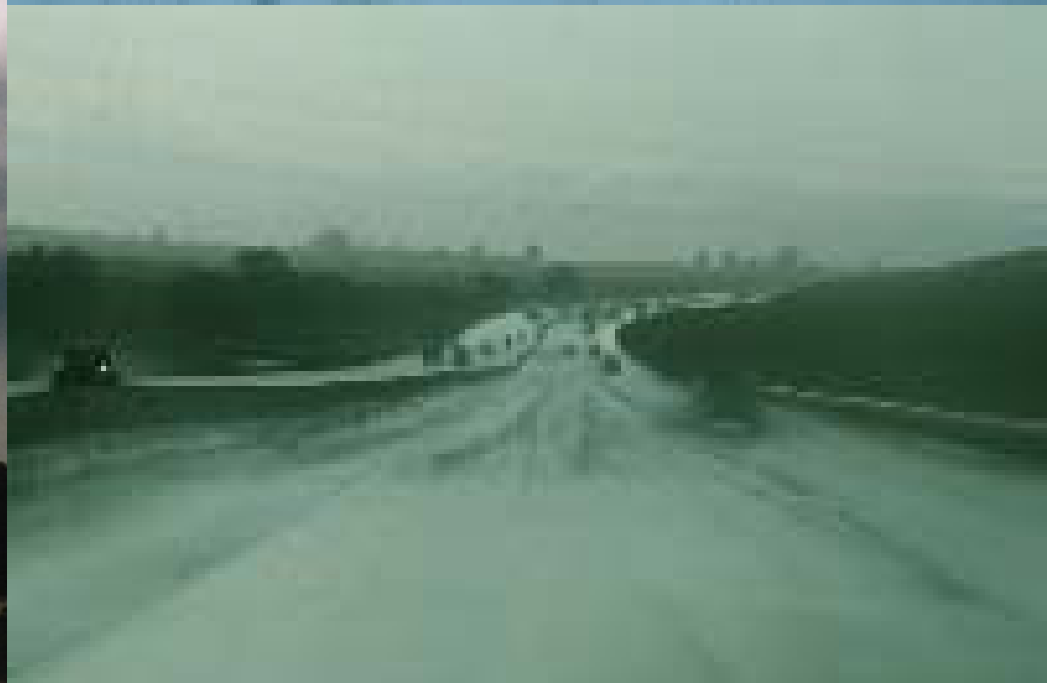
Stratocumulus Clouds

Stratocumulus clouds generally appear as a low, lumpy layer of clouds that is sometimes accompanied by weak intensity precipitation. Stratocumulus vary in color from dark gray to light gray and may appear as rounded masses, rolls, etc., with breaks of clear sky in between.



More Stratocumulus…..

Nimbostratus clouds form a dark gray, "wet" looking cloudy layer associated with continuously falling rain or snow. They often produce precipitation that is usually light to moderate.



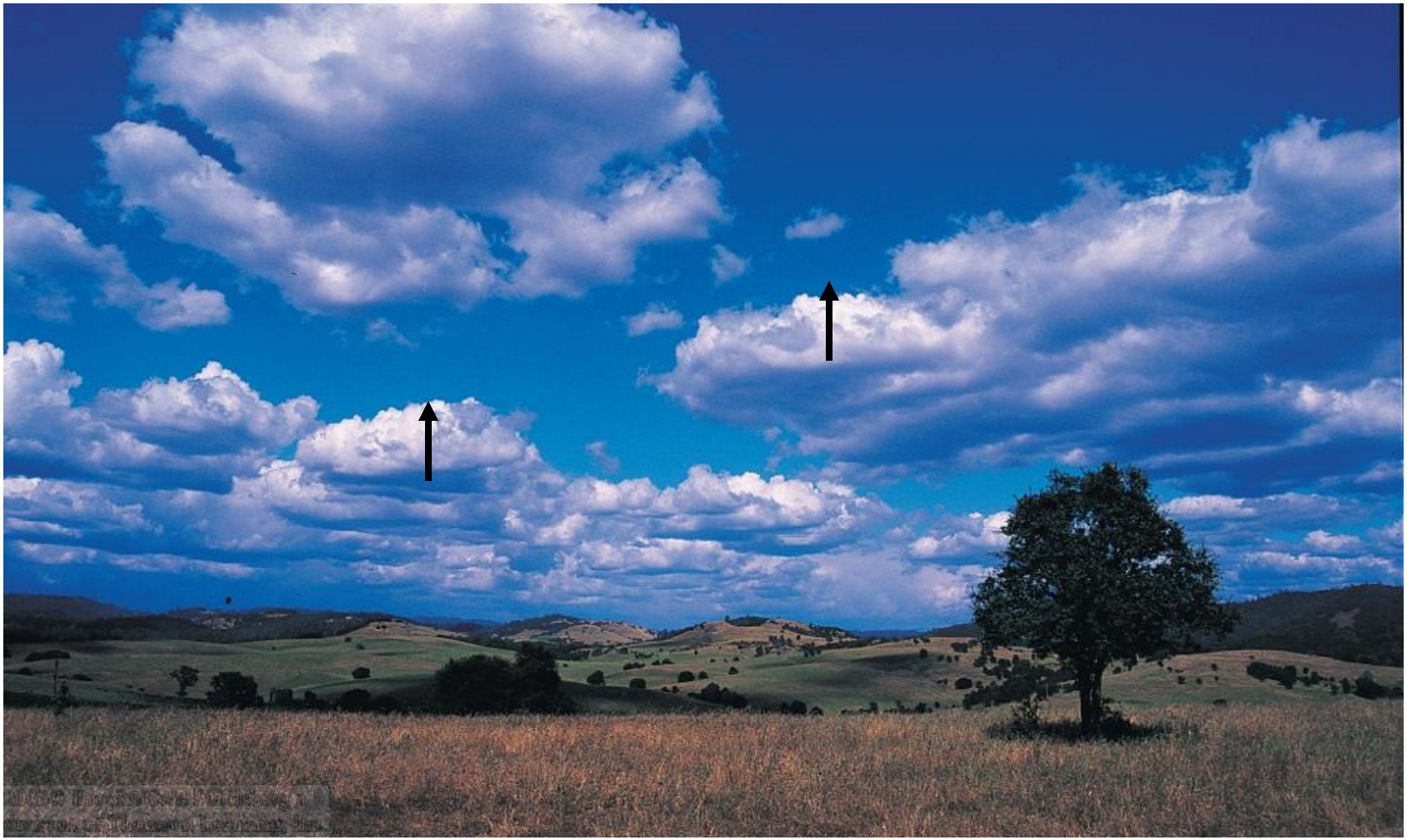
Fair Weather Cumulus Clouds

puffy cotton balls floating in the sky

Fair weather cumulus have the appearance of floating cotton and have a lifetime of 5-40 minutes. Known for their flat bases and distinct outlines, fair weather cumulus exhibit only slight vertical growth.


If these Culumus do not change height in 3-5 hrs then fair weather continues

Cumulus Humilis Clouds



Clouds with vertical development that take a variety of shapes, separated by sinking air and blue sky.

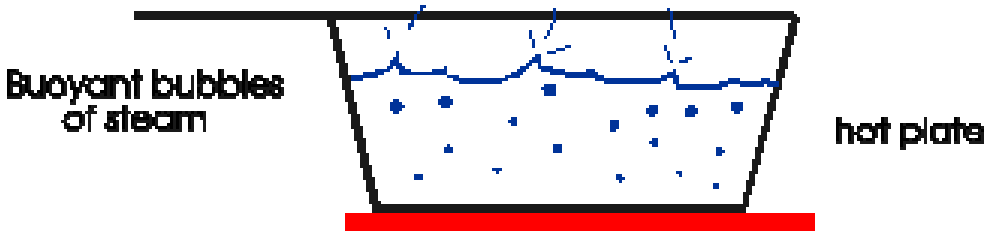
Shredded sections are called cumulus fractus.

CONVECTION

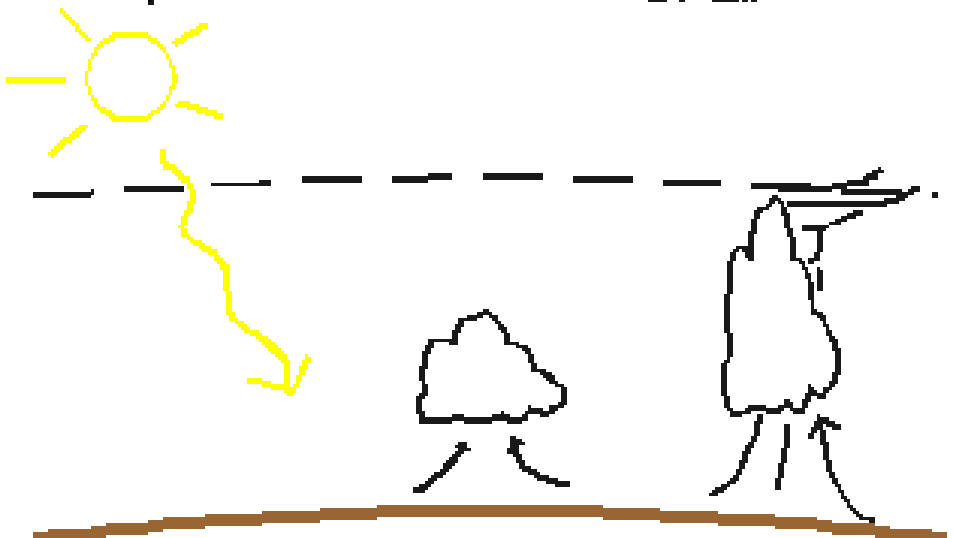
What is it?

HEAT TRANSPORT by overturning of air

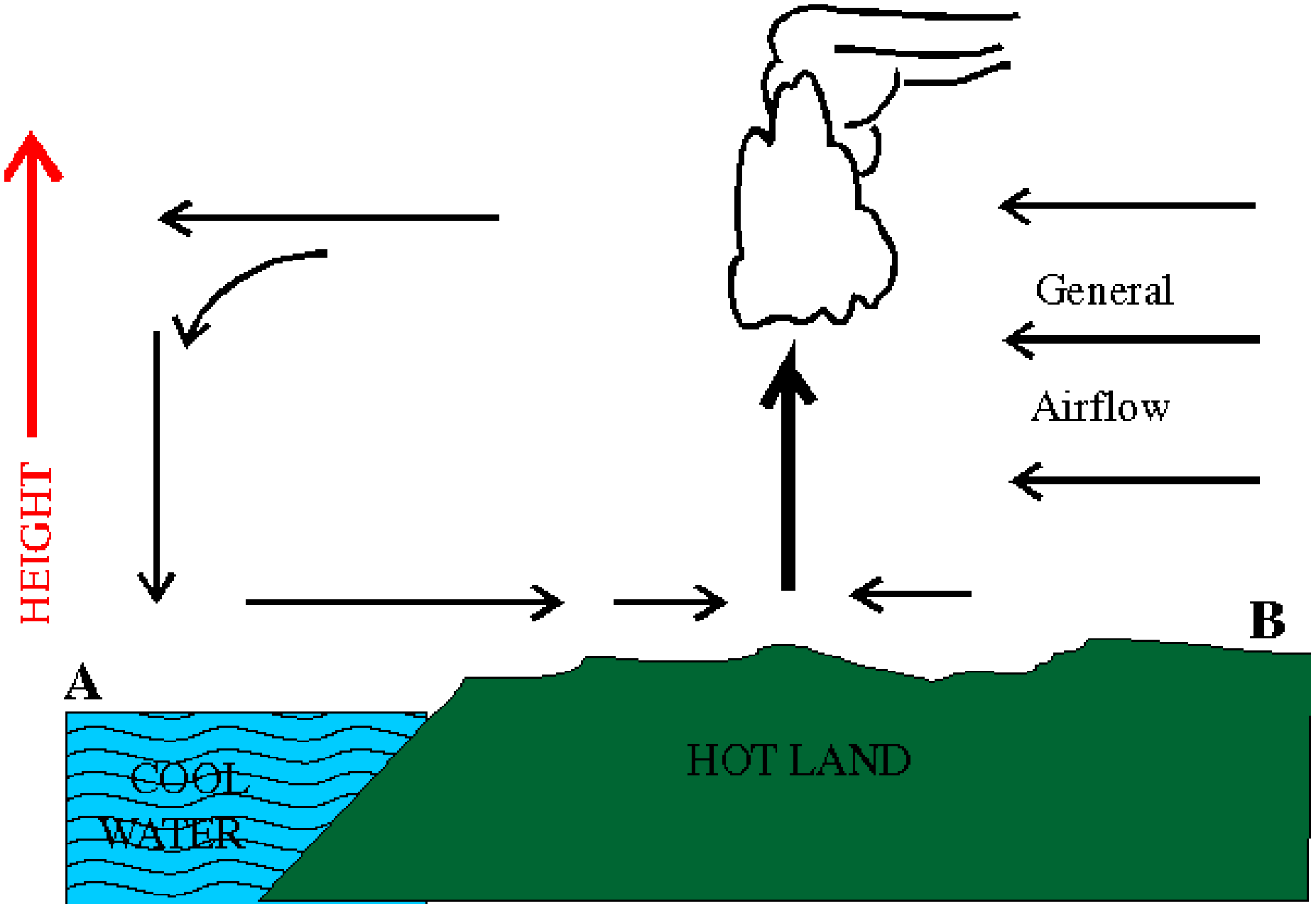
Analogy - Boiling Water

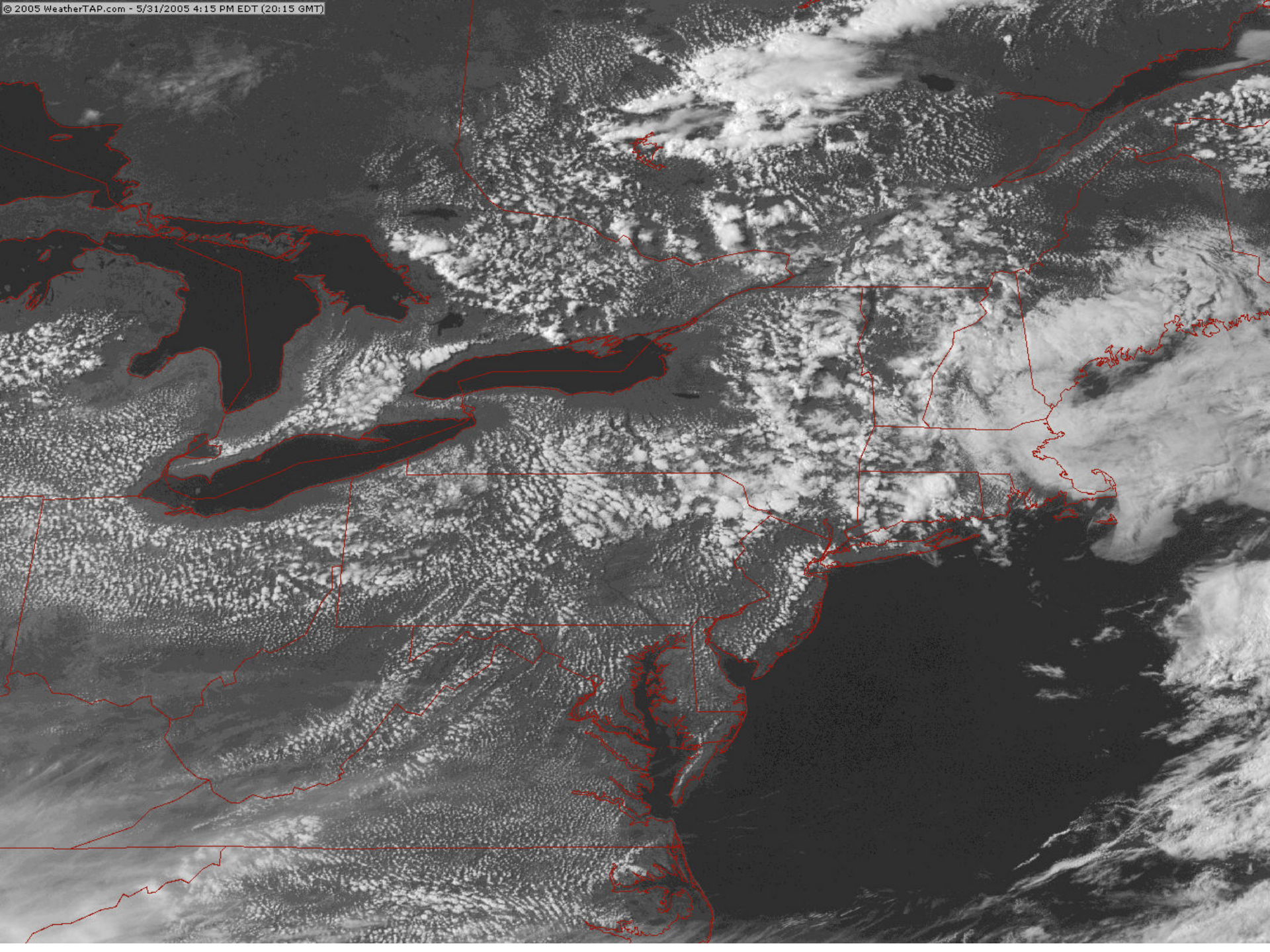


Atmosphere like Ocean of air



LAKE/SEA BREEZE

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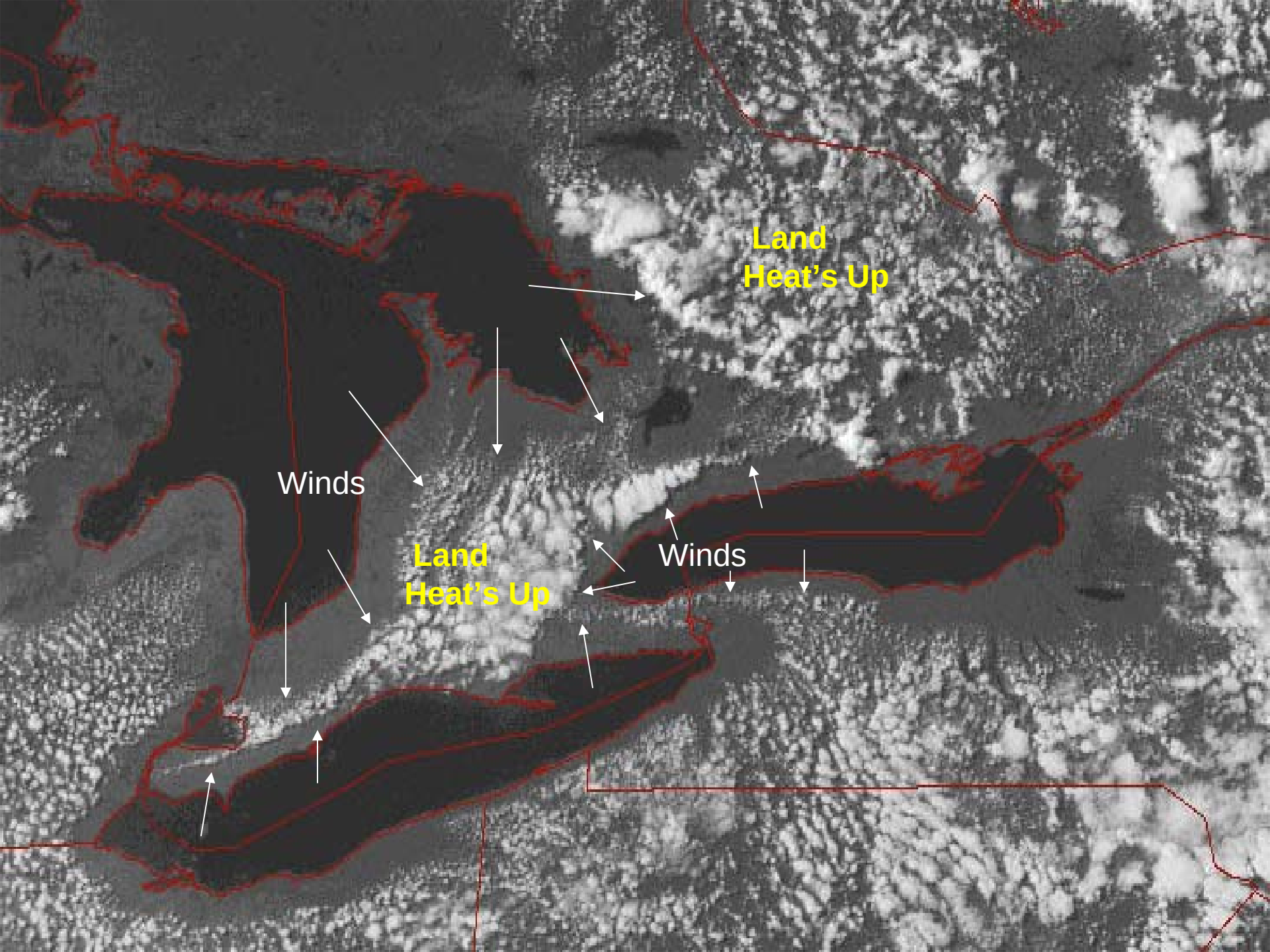
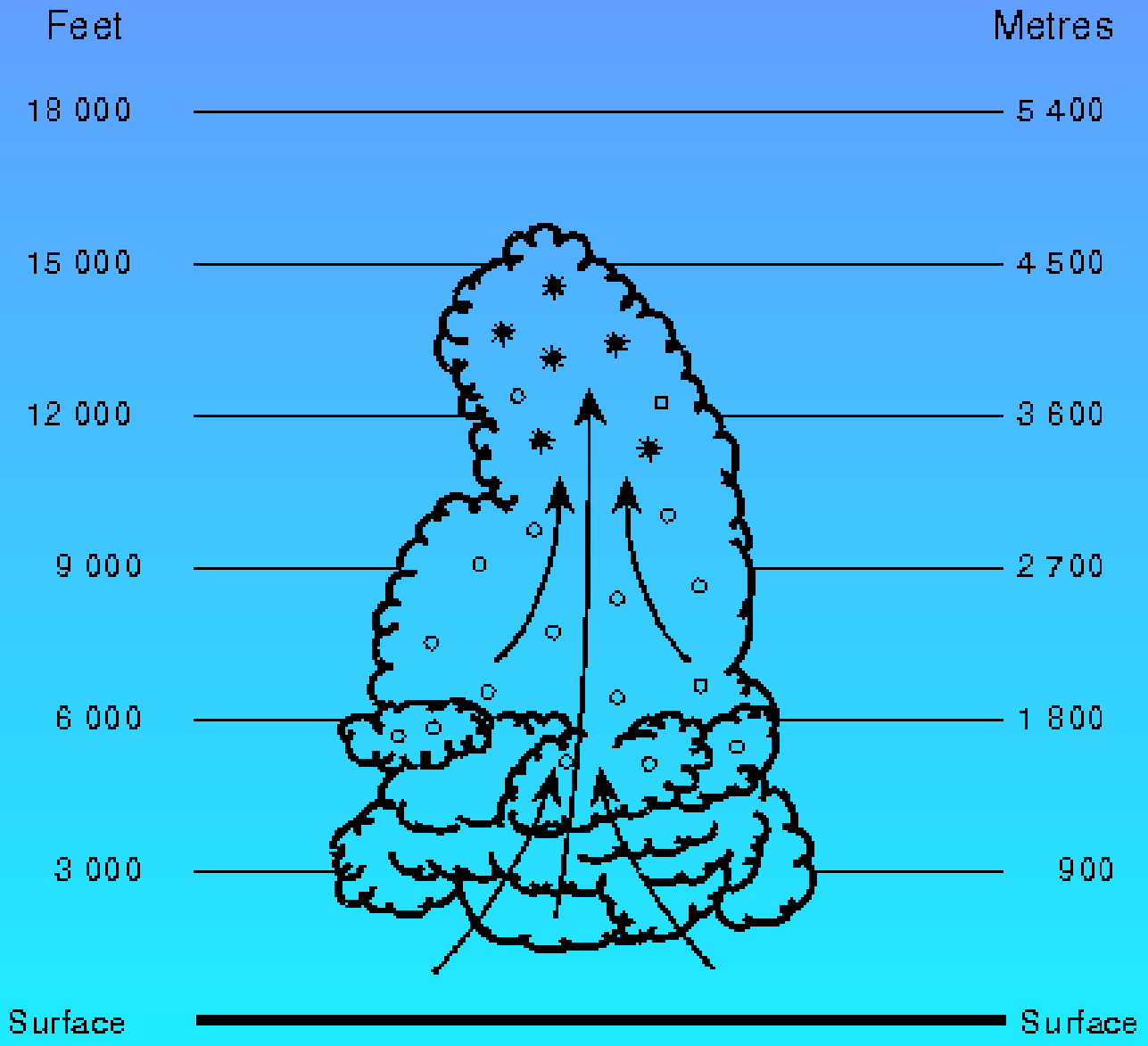
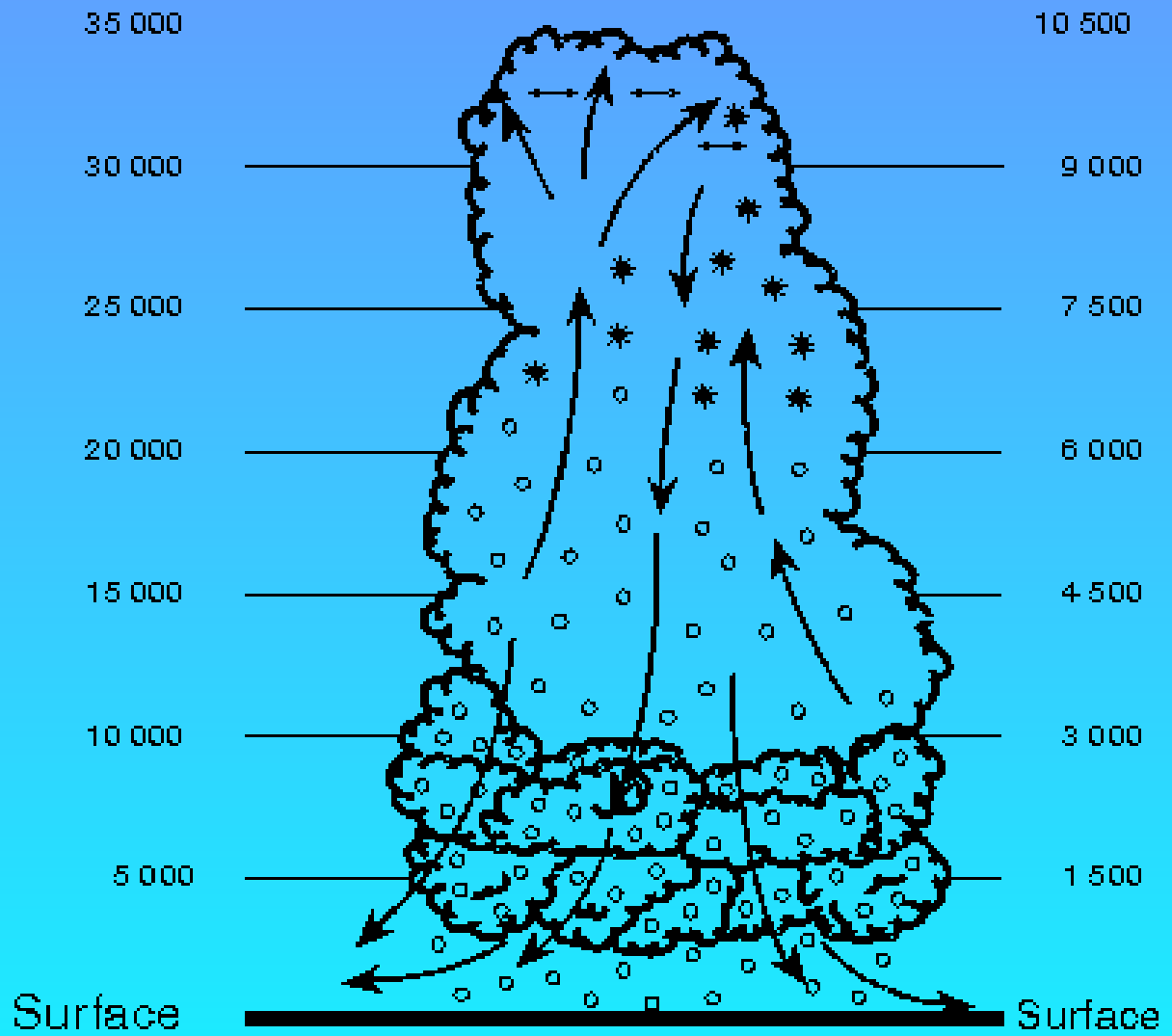
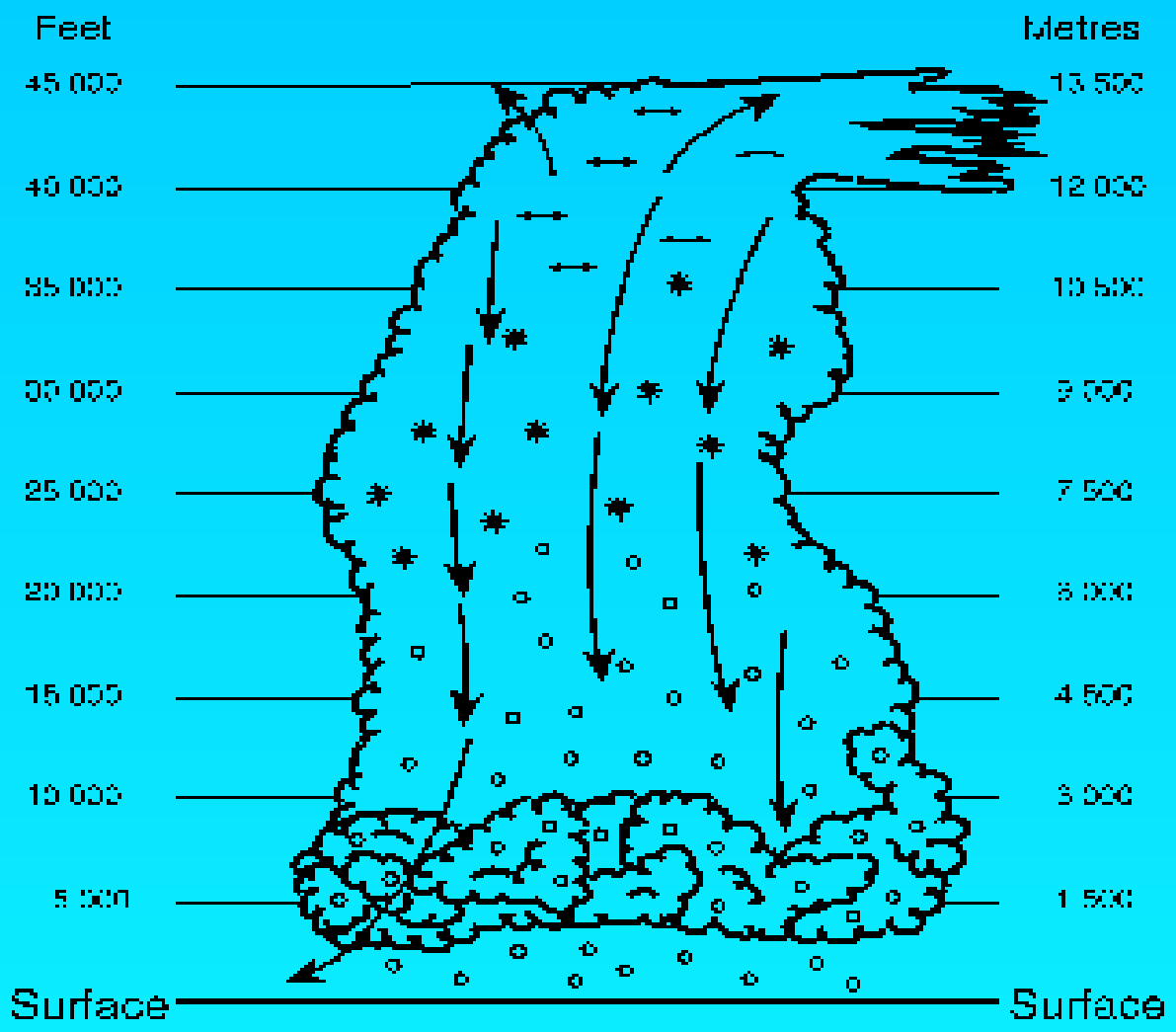

Land
Heat's Up
Winds
Land
Heat's Up
Winds



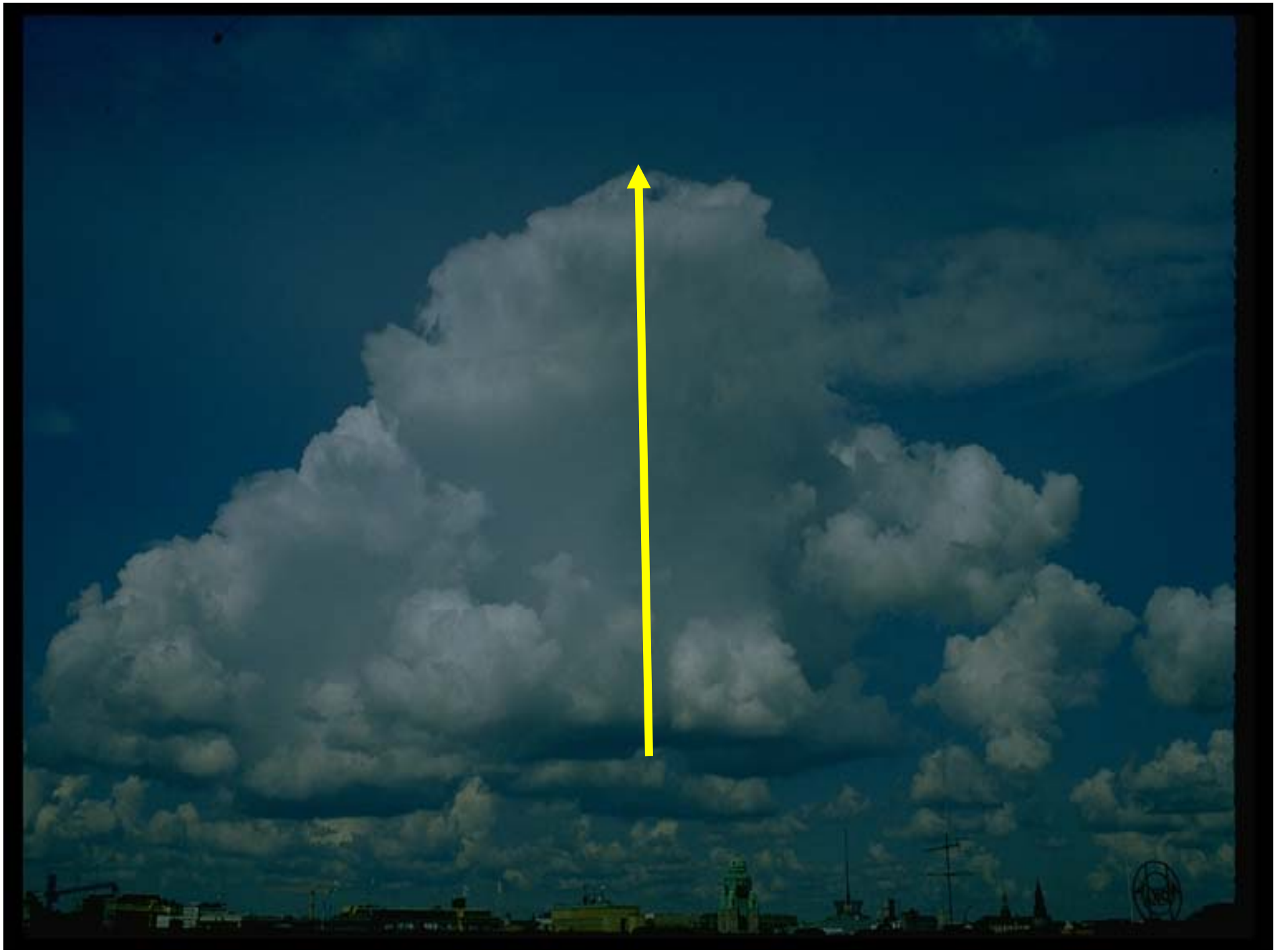
Cumulus Stage



Mature Stage



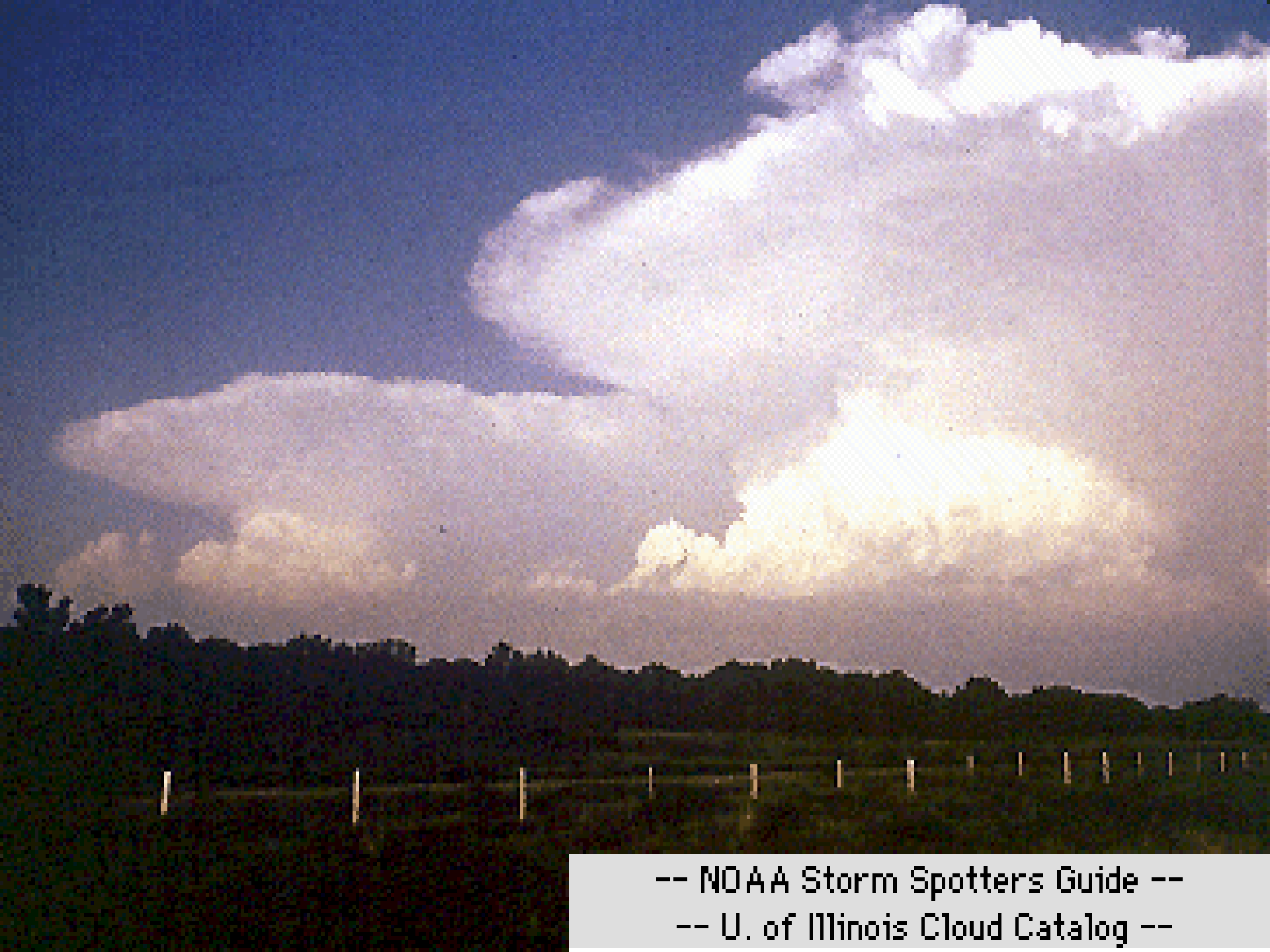
Dissipating Stage



Cumulus Congestus Clouds

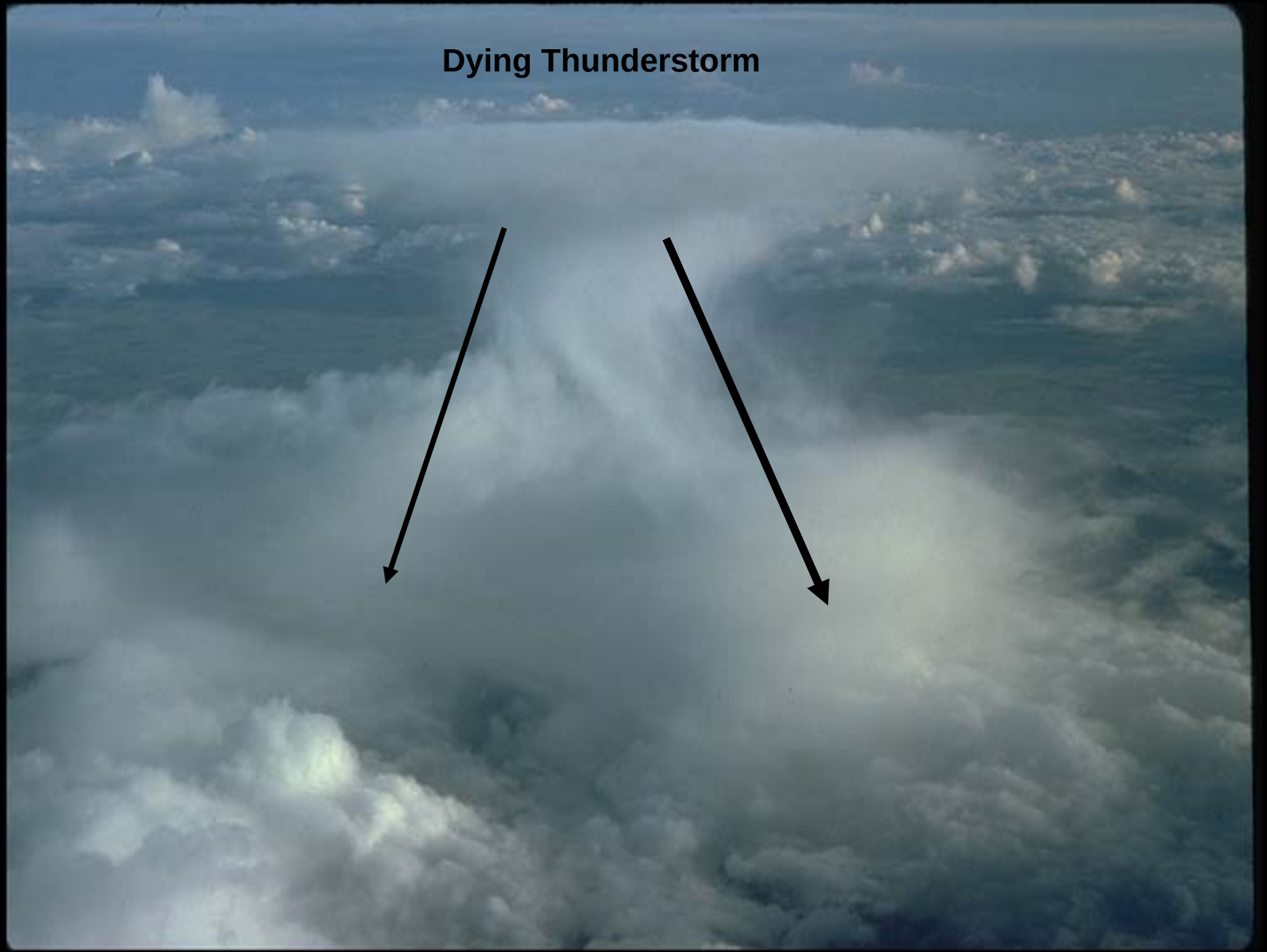
Clouds with vertical development that become larger in height, with tops taking a ragged shape similar to cauliflower. Change is certain! maybe just 1 or 2 hrs away


Weather Change maybe minutes
away



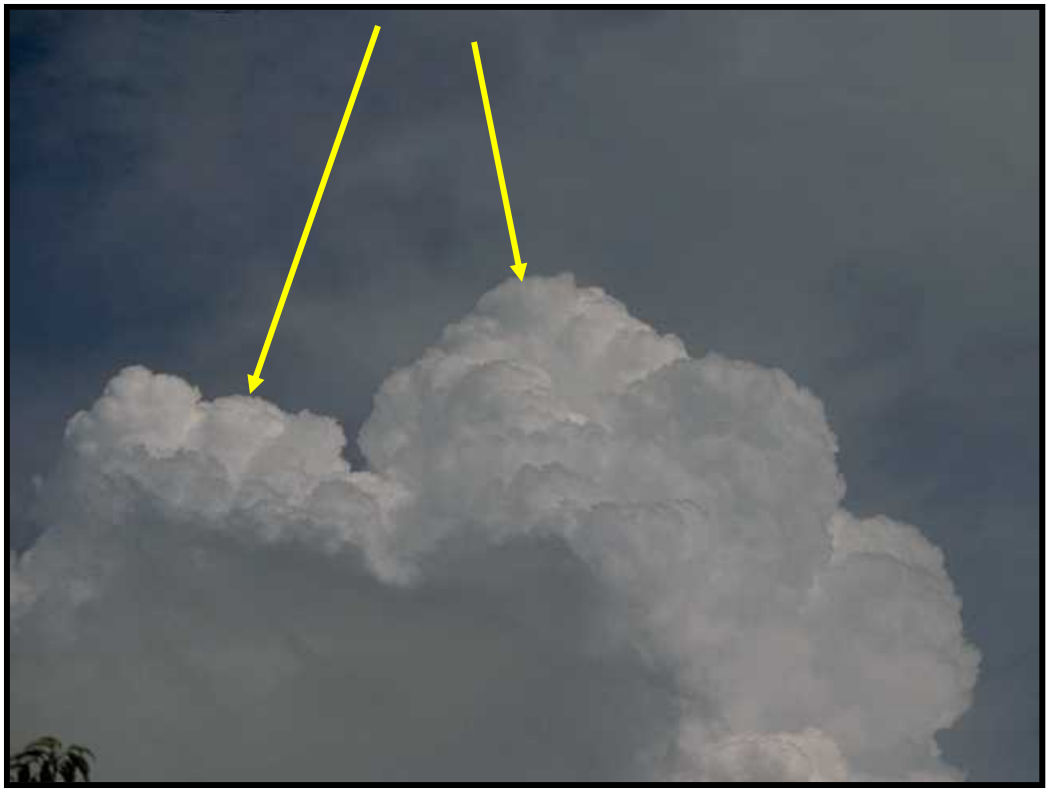
-- NOAA Storm Spotters Guide --
-- U. of Illinois Cloud Catalog --

Dying Thunderstorm



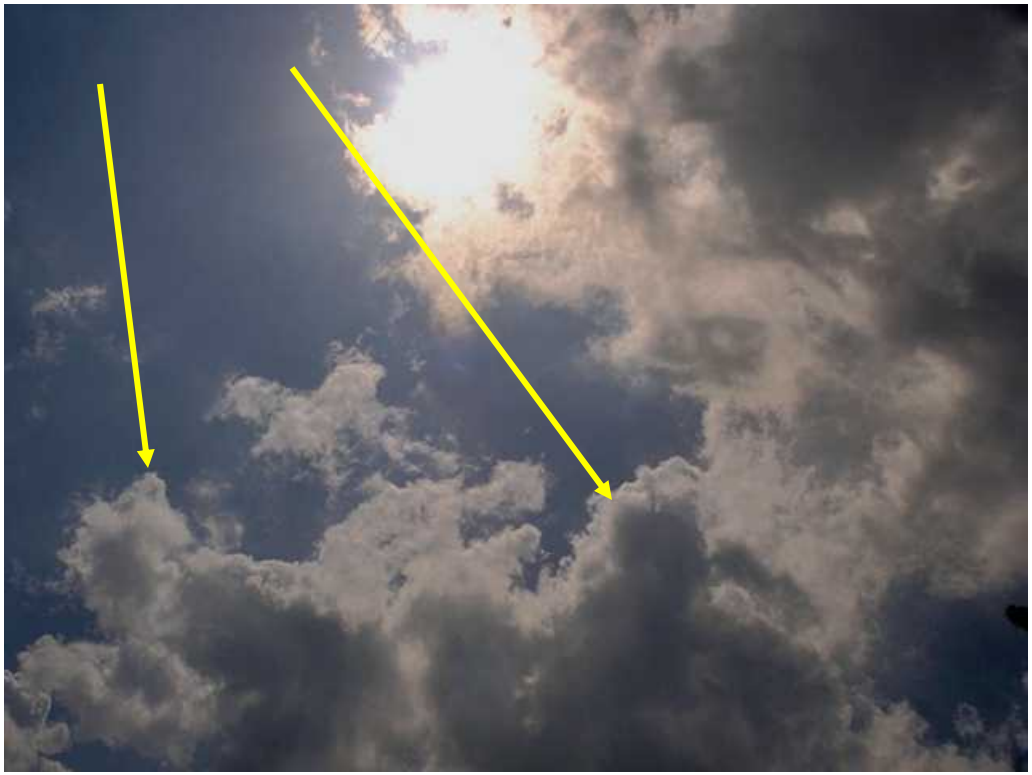
Rules of Thumb for Convection - 1

- If cumulus tops are ‘crisp’ and ‘well defined’...
  - the cloud **<u>will</u>** continue to grow.



Rules of Thumb for Convection - 2

- If cumulus tops are ‘ragged’ and ‘ill-defined’...
  - the cloud **<u>will not</u>** continue to grow.



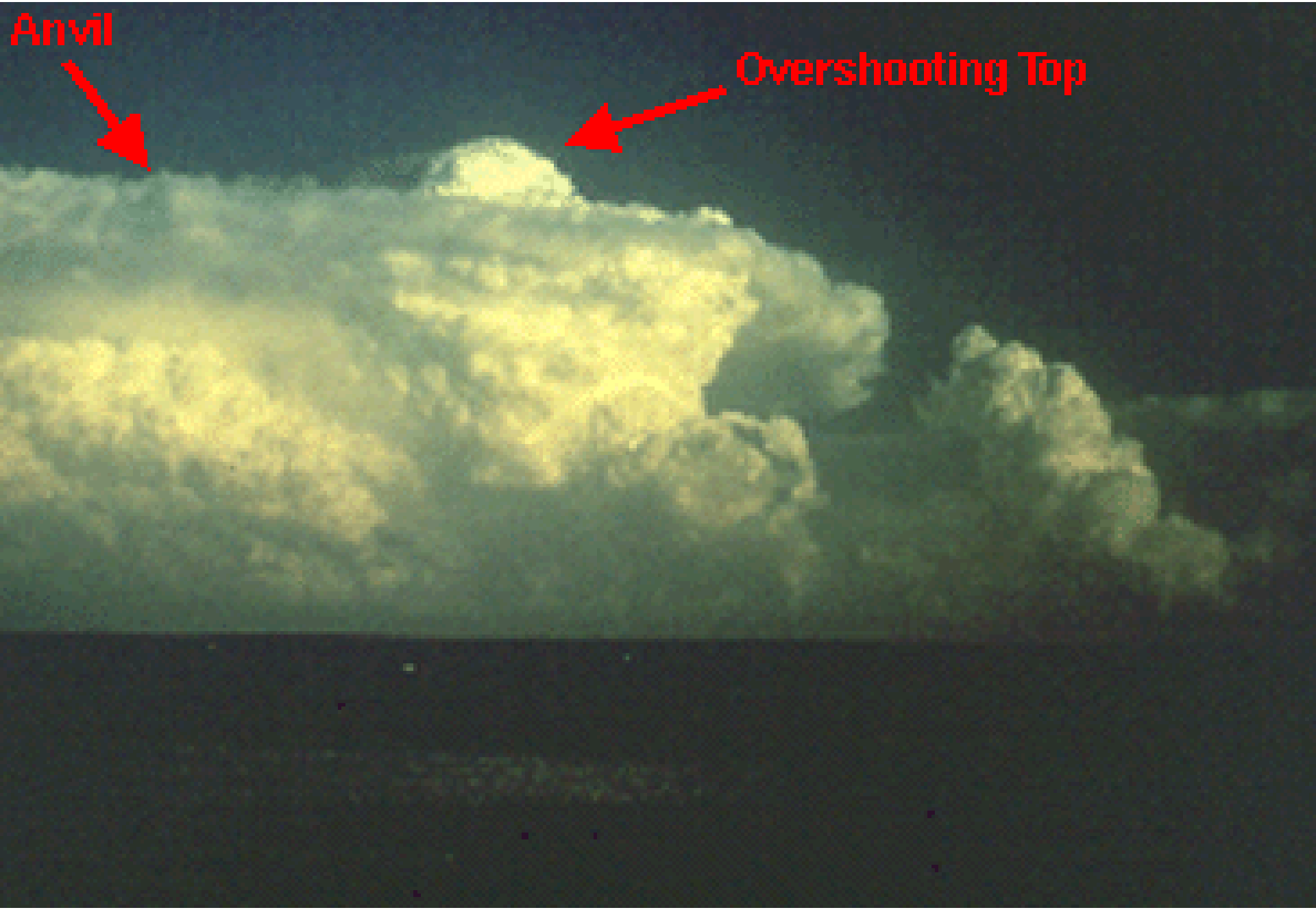

10km
8km
6km
4km
2km

Cloud Formation Leading to Severe Weather

Pileus Cloud

An unusual cloud that forms above a building cumulus by deflected moist winds.

Pileus Cloud


Anvil
Overshooting Top


Mammatus
Cumulus
Copyright © 2004 - Jorn C Olsen


Copyright © 2004 - Jorn C Olsen


Green and Yellow
Colouring
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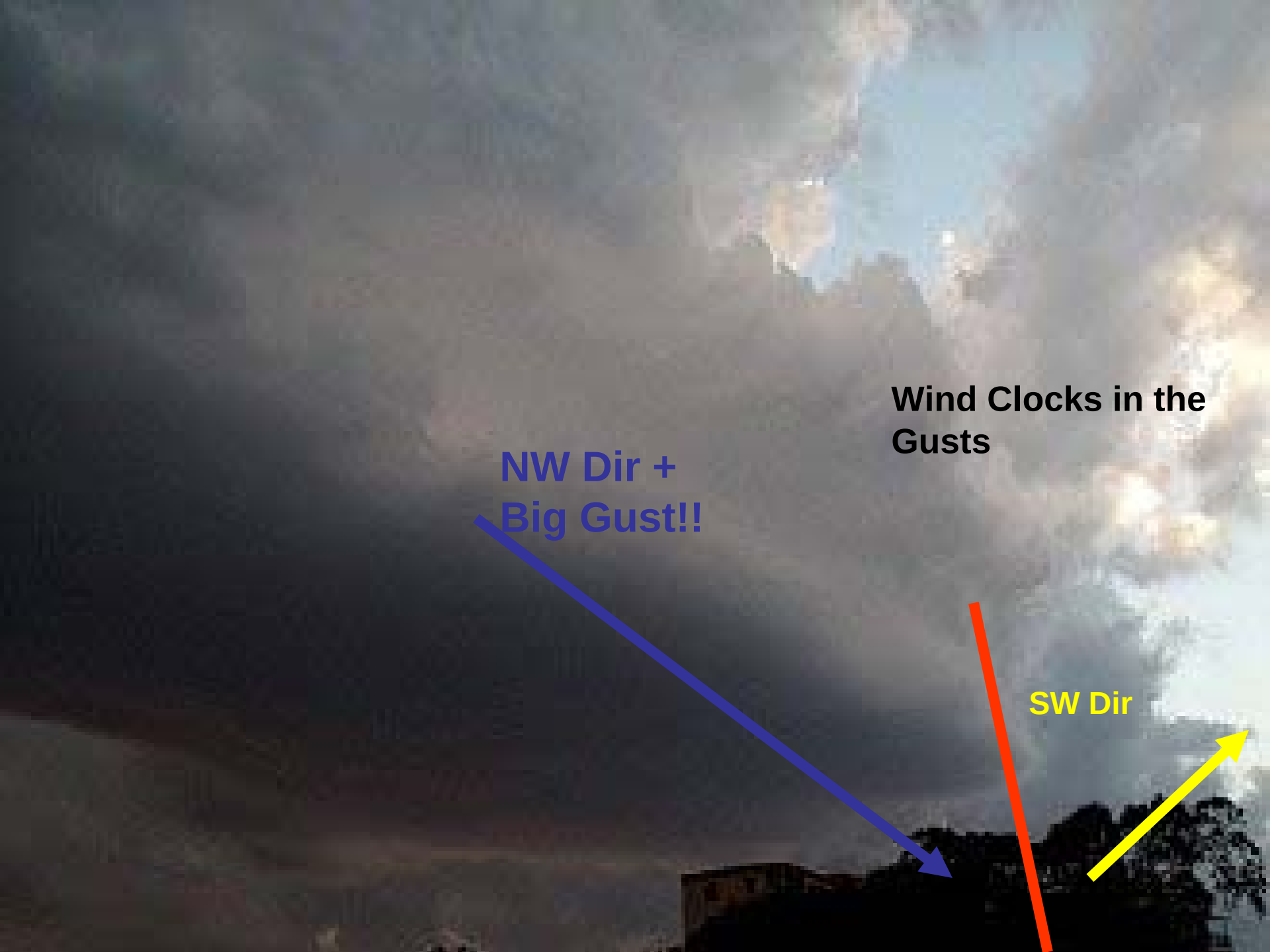
Hamilton Storm – Looking North – Weather Change Minutes away!
Wind Shift approx here
NW
GUSTS
SW Winds

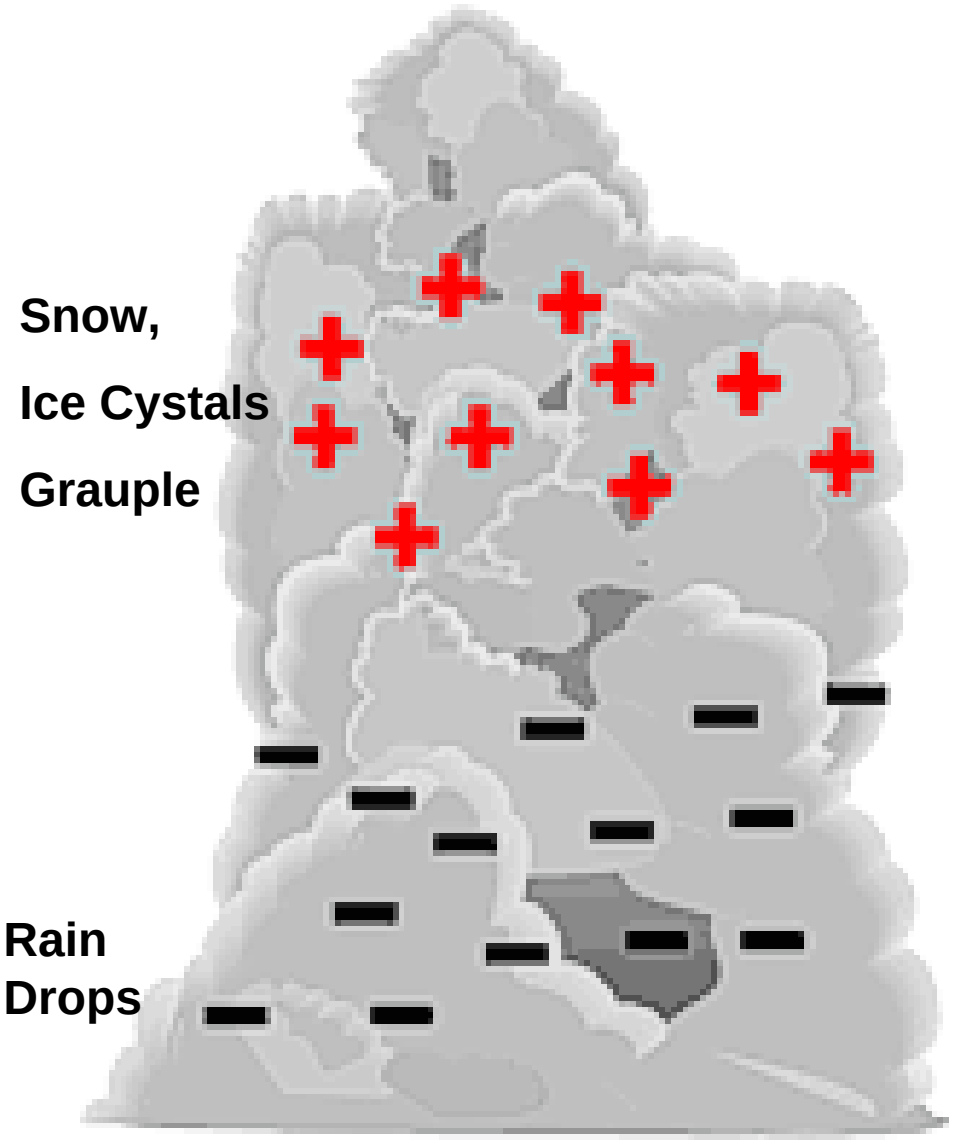

Wind shift
Line
strong NW winds in heavy rain!


Leading edge of Gust Front
Gusts up to 50+ Knots

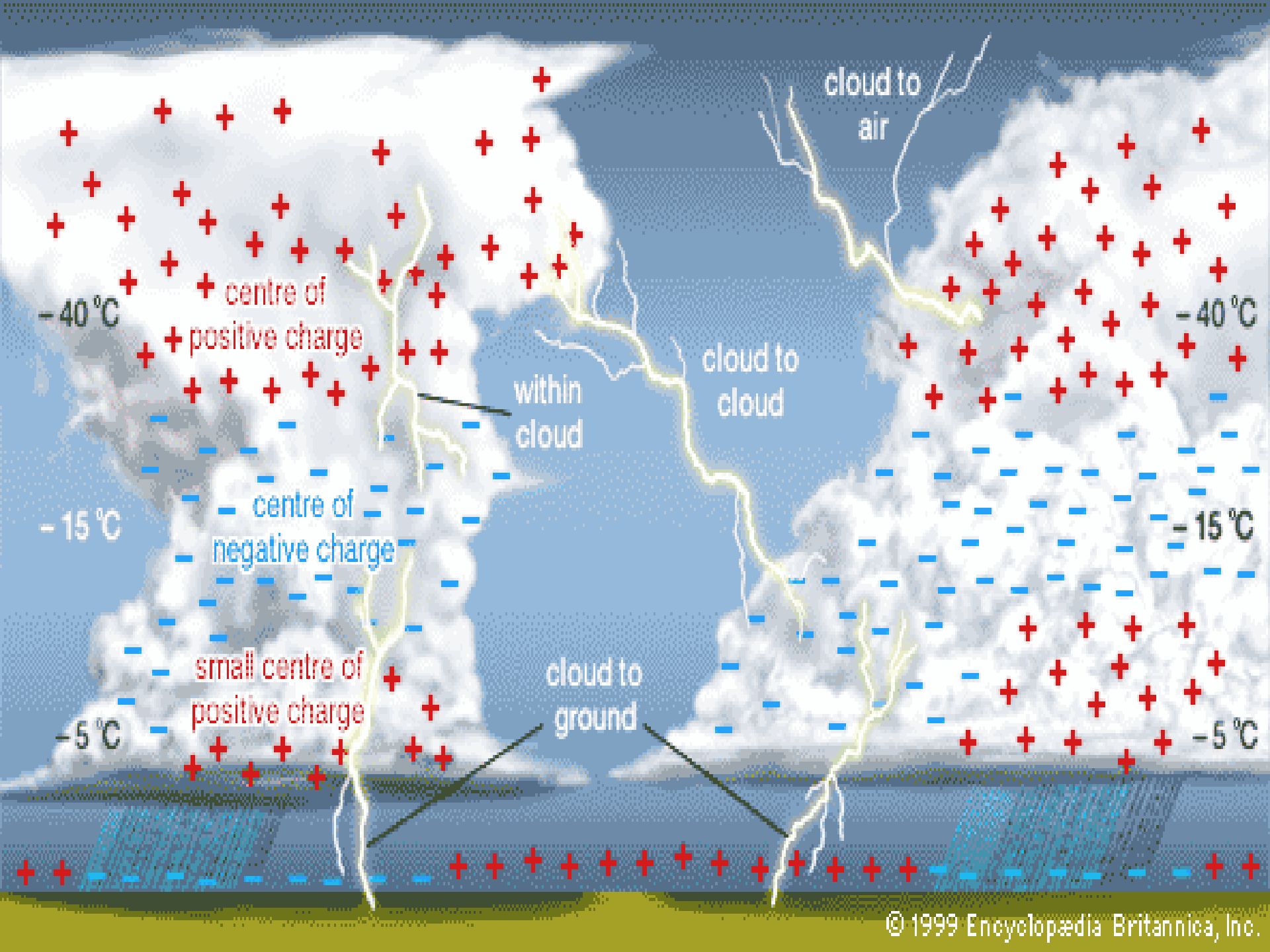

Wind Clocks in the Gusts
NW Dir + Big Gust!!
SW Dir

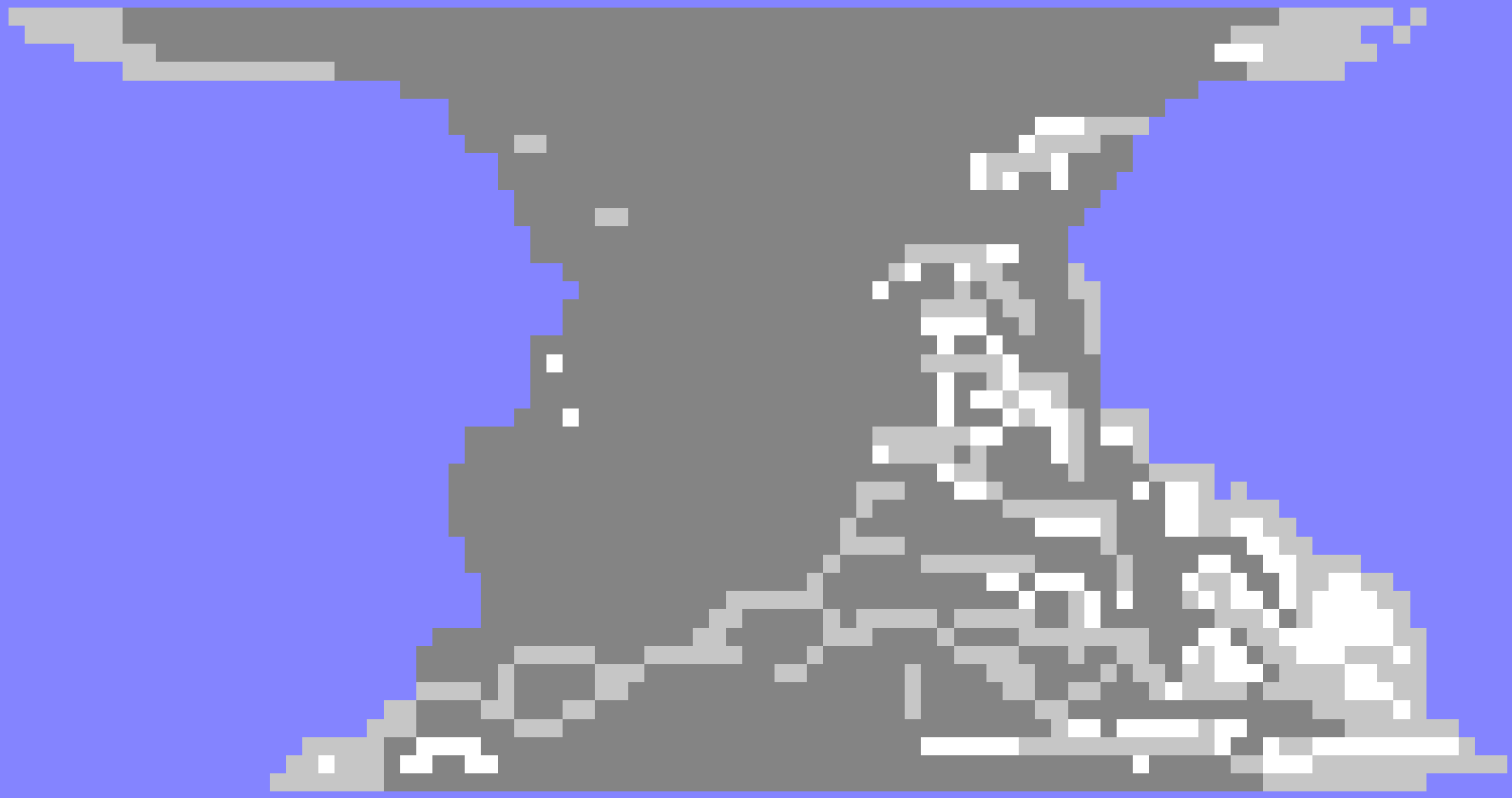
Facts and myths about lightning and boats

- **The purpose of lightning protection is NOT to stop the lightning from striking.**
- **Lightning grounding systems controls the "PATH" of the lightning after it hits.**
- **Lightning strikes land more often then water**
- **Nothing can offer 100% protection from lightning strikes or damage - but it can be reduced 95%**
- **Lightning can strike in the same place twice or more**
- **Grounded high structure makes it more likely that lightning will strike it.**
- **Lightning always strikes the tallest object.**
- **Rubber tires protect you in a car during a lightning storm.**
- **Lightning protection is your best bet**

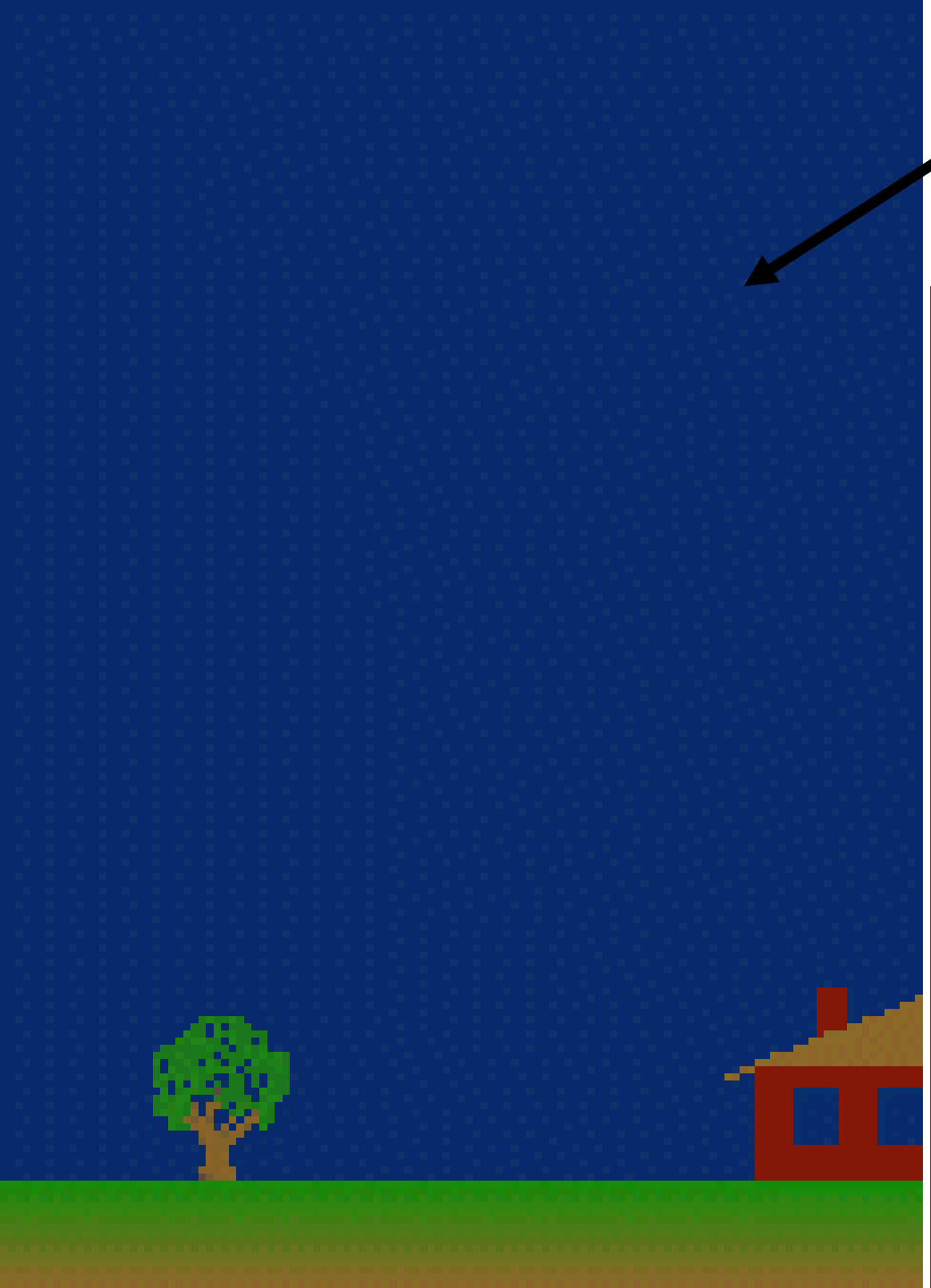


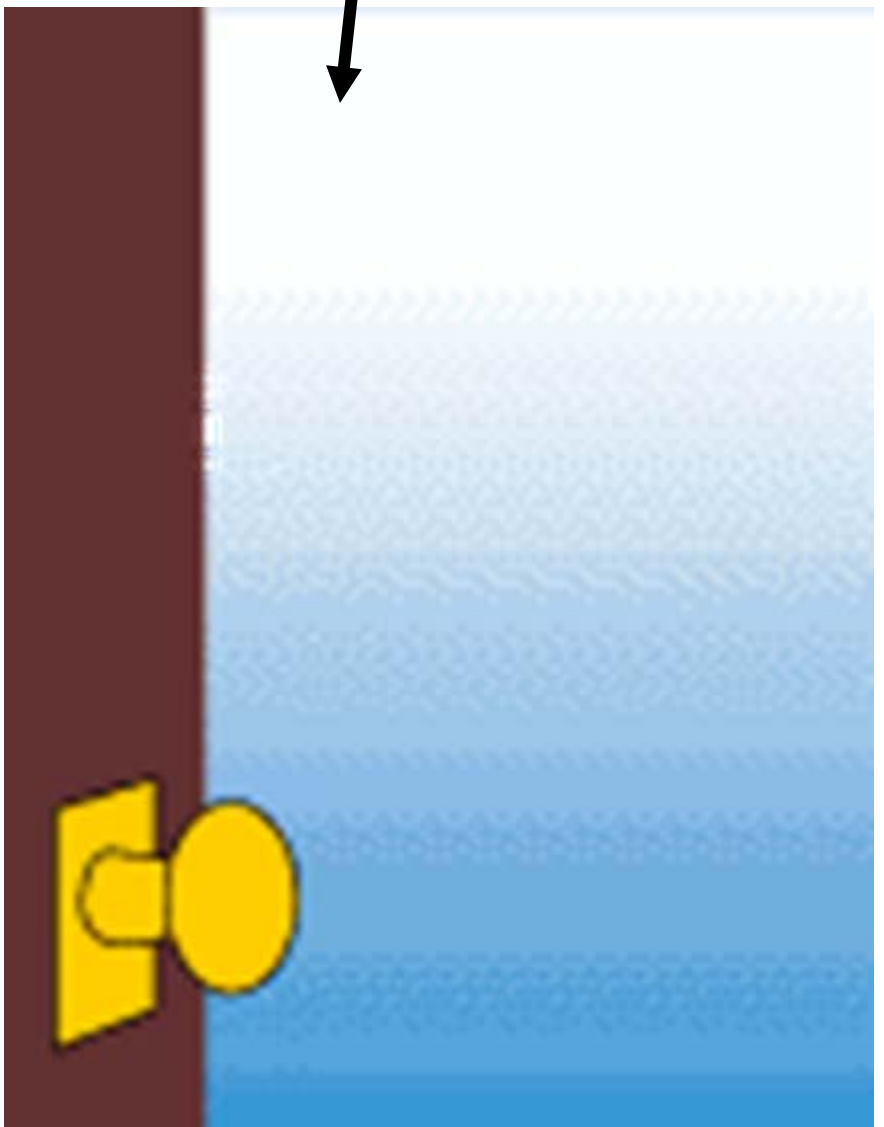
Electric charge leaking from her head



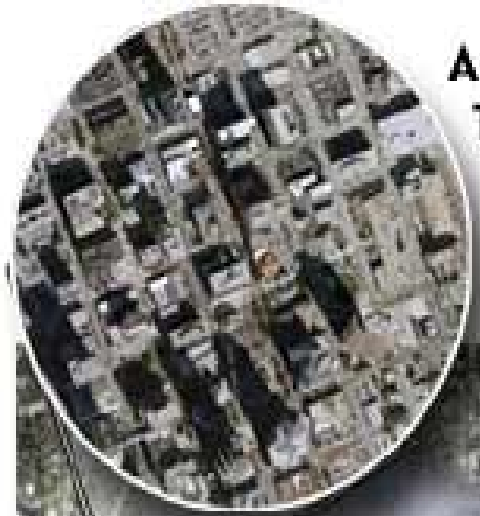


Same Principle – different scale





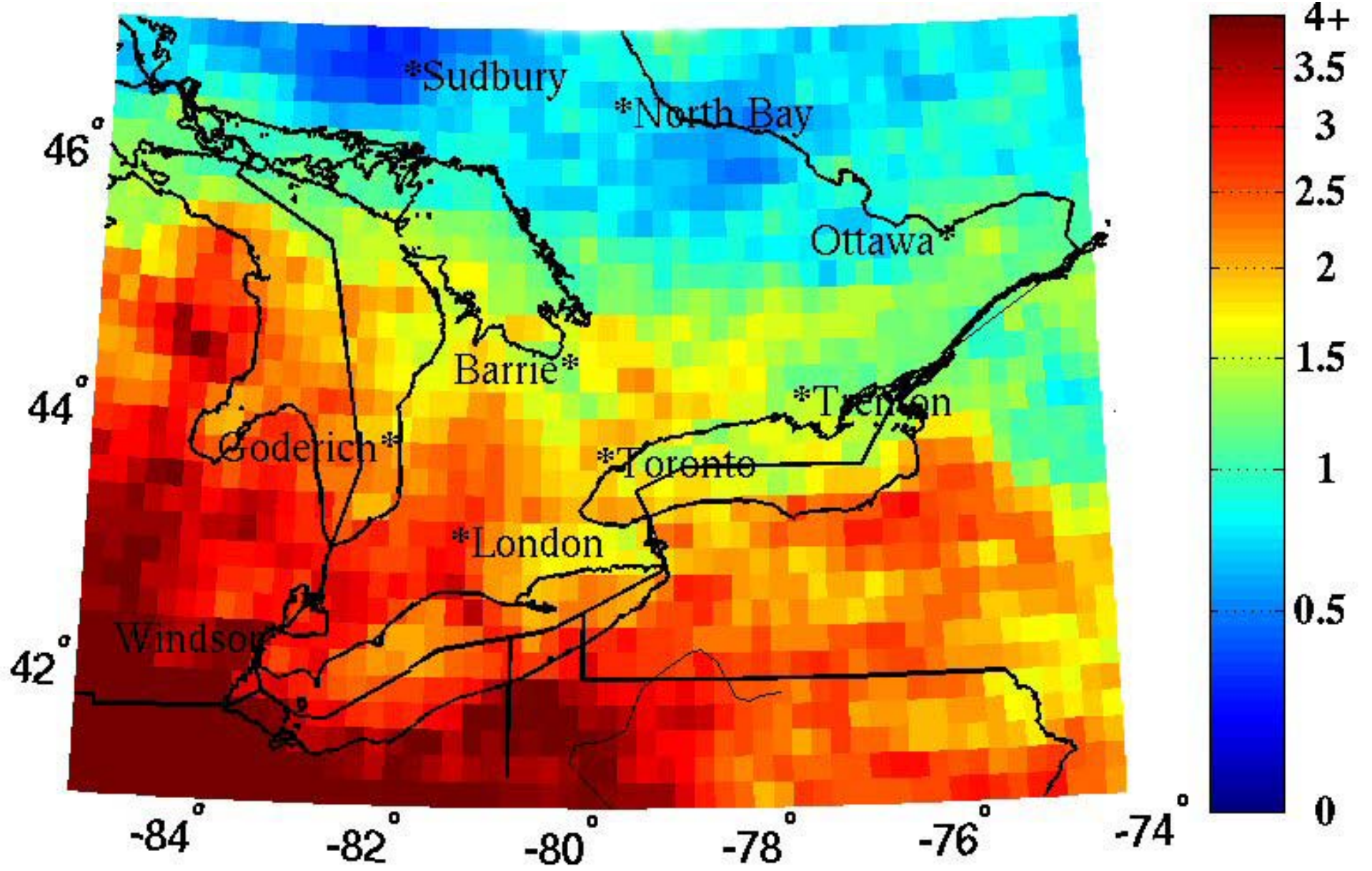
A BOLT OUT OF THE BLUE

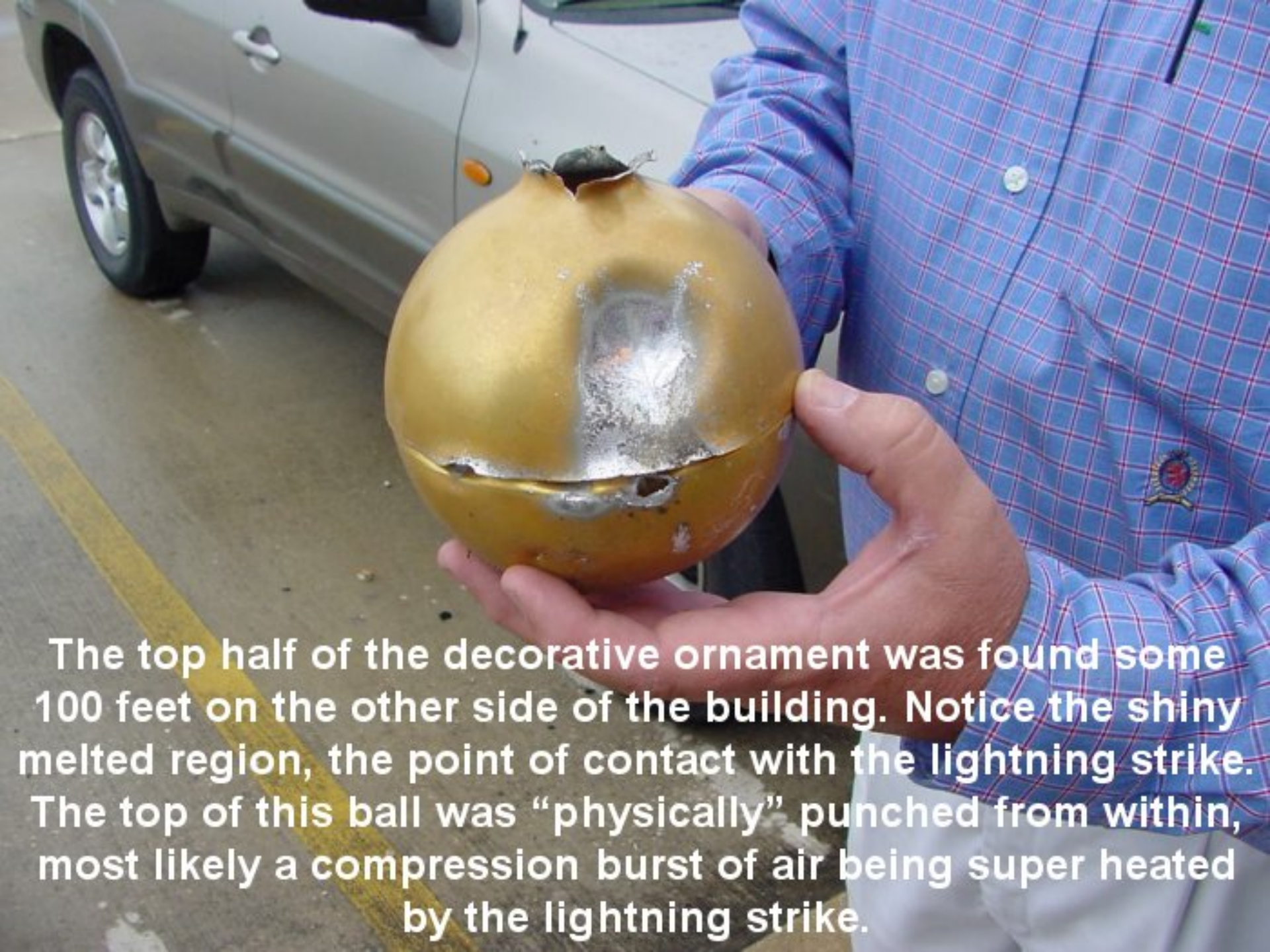


A storm cloud over Tampa...

...can send a lightning bolt into a sunny suburban baseball field complex 8 miles away.

Lightning Climatology for Southern Ontario





The top half of the decorative ornament was found some 100 feet on the other side of the building. Notice the shiny melted region, the point of contact with the lightning strike. The top of this ball was “physically” punched from within, most likely a compression burst of air being super heated by the lightning strike.


(C) 2008 InsectAPedia.com Wallace

There are four basic types of lightning damage

Physical damage – The Direct hit!

Secondary effect damage

Electromagnetic effect damage

Damage caused by changes in ground reference potential

What are the Chances of Lightning Striking Your Boat?

The following statistics are based on all of the BoatUS Marine Insurance claims for lightning damage over a five-year period.

The percentages suggest the chances of the various types of boats being struck in any given year.

Auxiliary Sail .6% Six out of 1000

Multi-hull sail .5% Five out of 1000

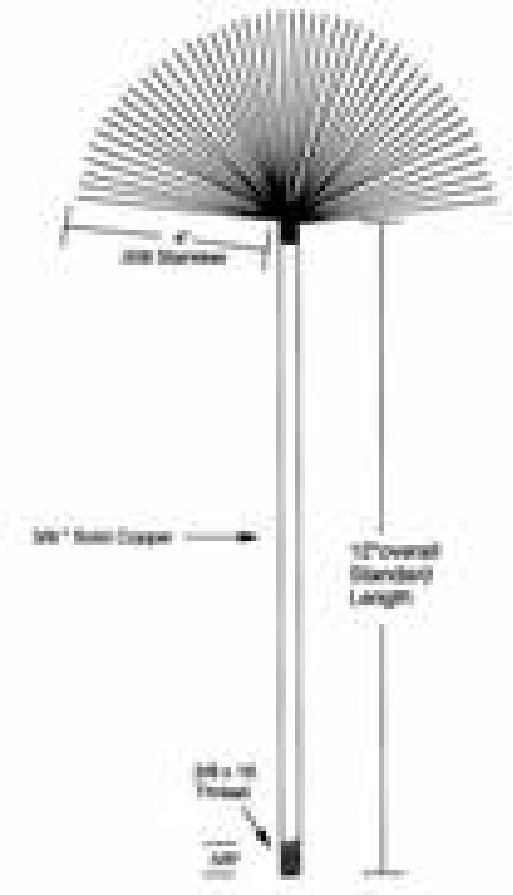
Trawlers .3% Three out of 1000

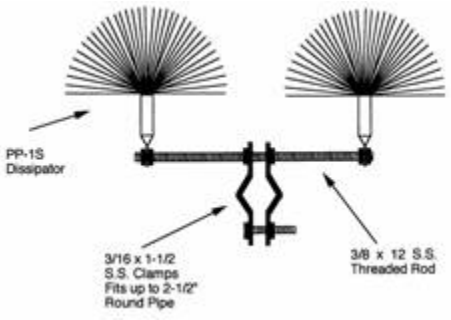
Sail Only .2% Two out of 1000

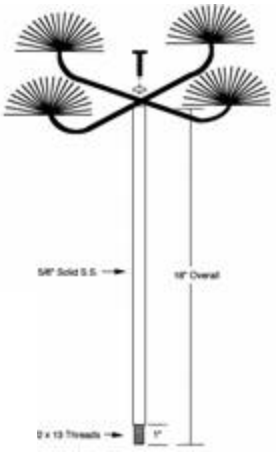
Cruisers .1% One out of 1000

Runabouts .02% Two out of 10,000

Source: BoatUS Marine Insurance Claim Files







Early Streamer Air Terminals- E.S.E. (Early streamer emission lightning conductors) –Many of the scientific community don’t agree!

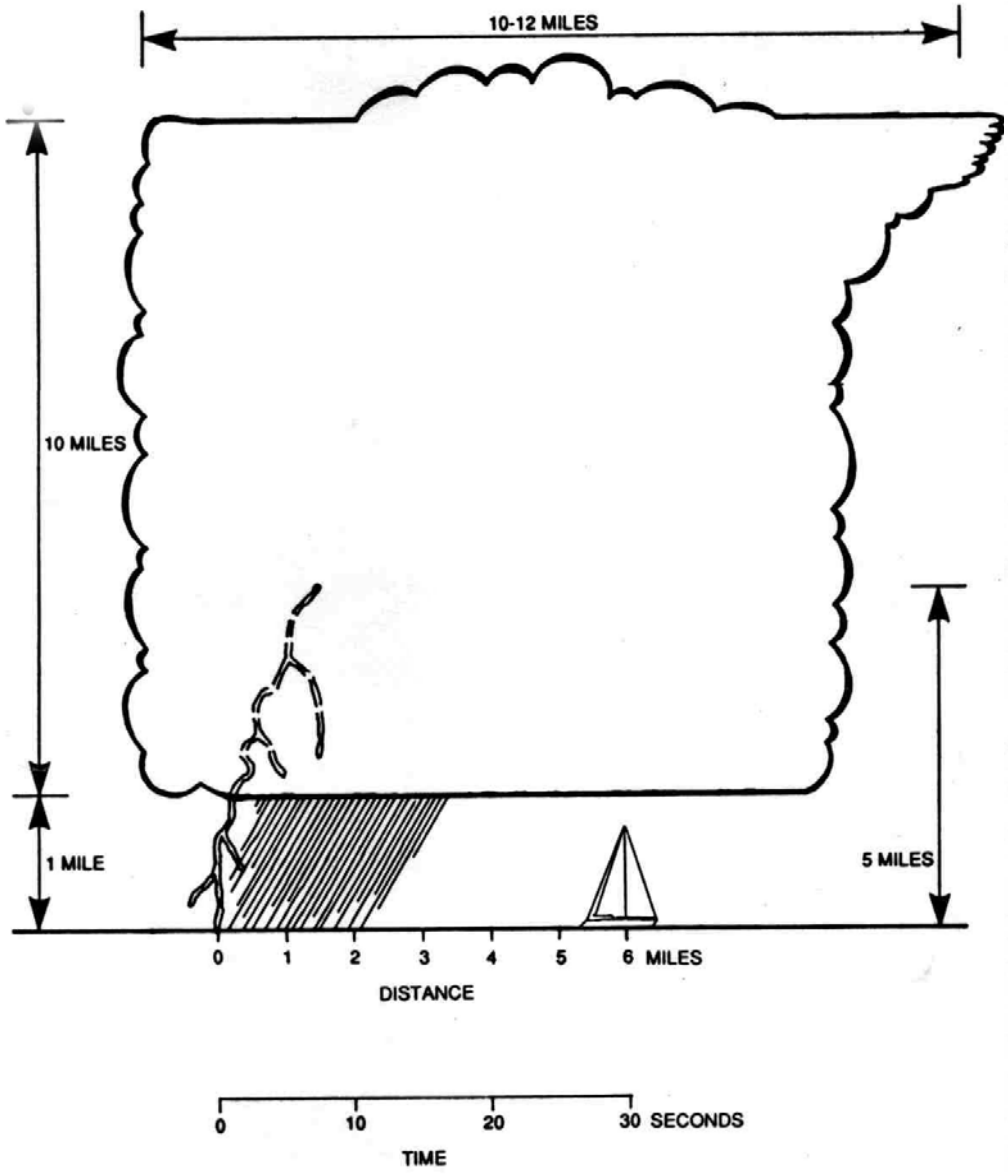


Figure 1. Thunderstorm ranging using time to thunder.

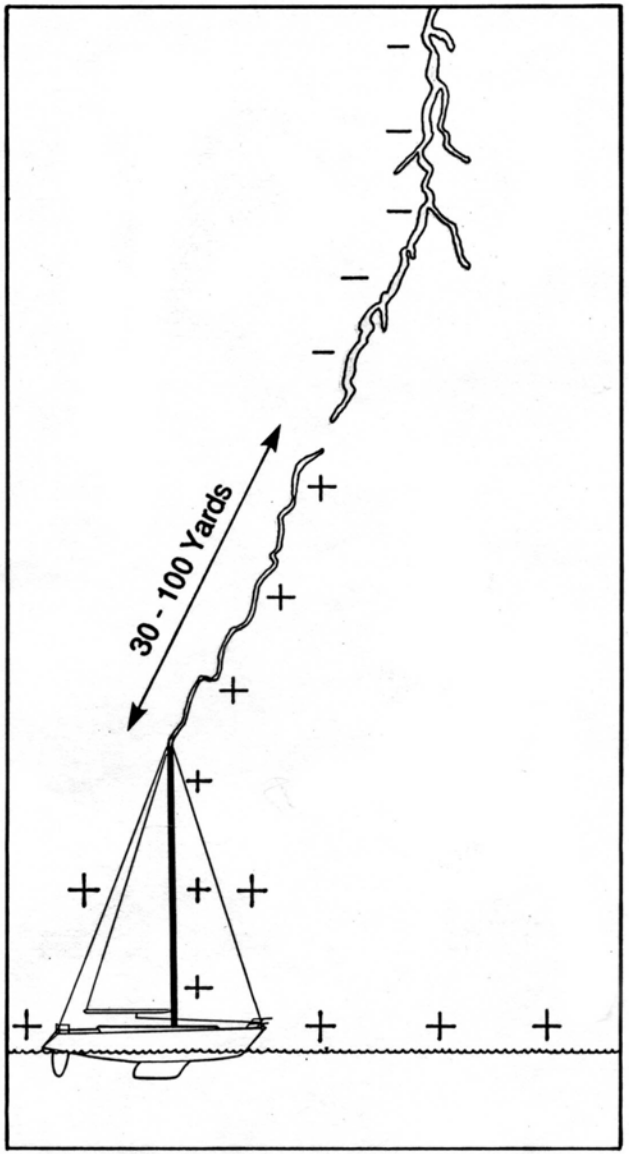


Figure 2. Lightning attachment to a sailboat.

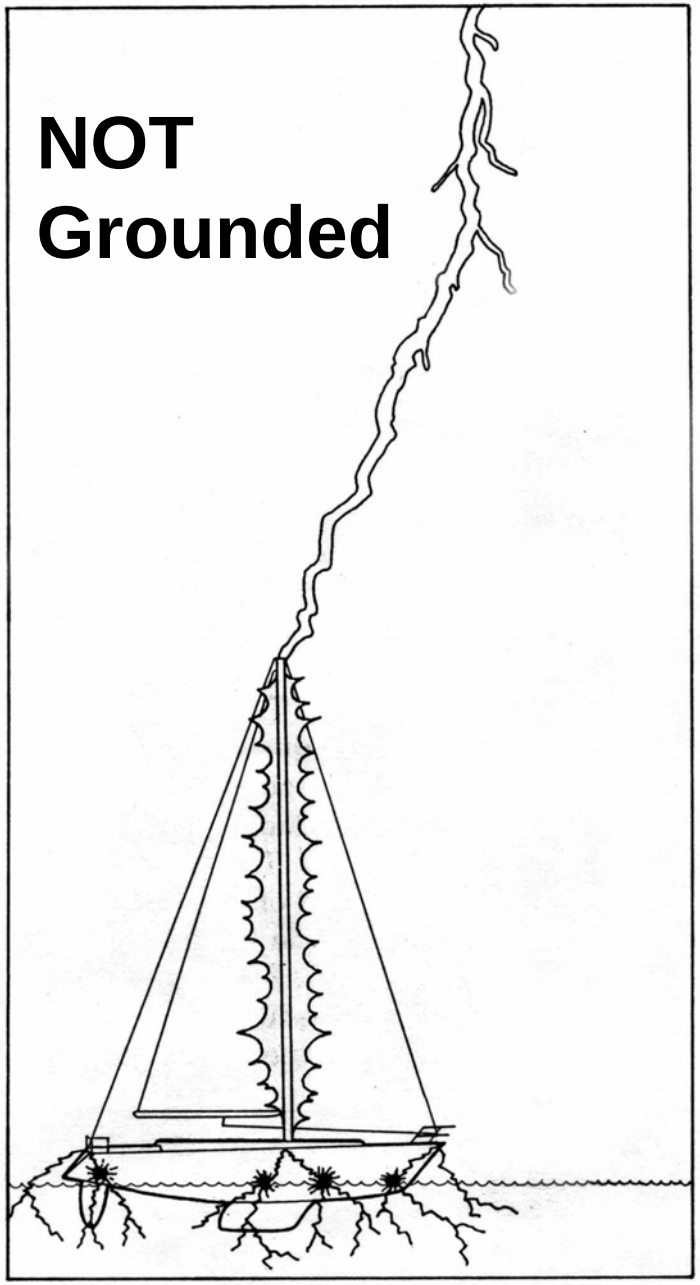


Figure 4. Possible effects of a lightning strike to an ungrounded boat.

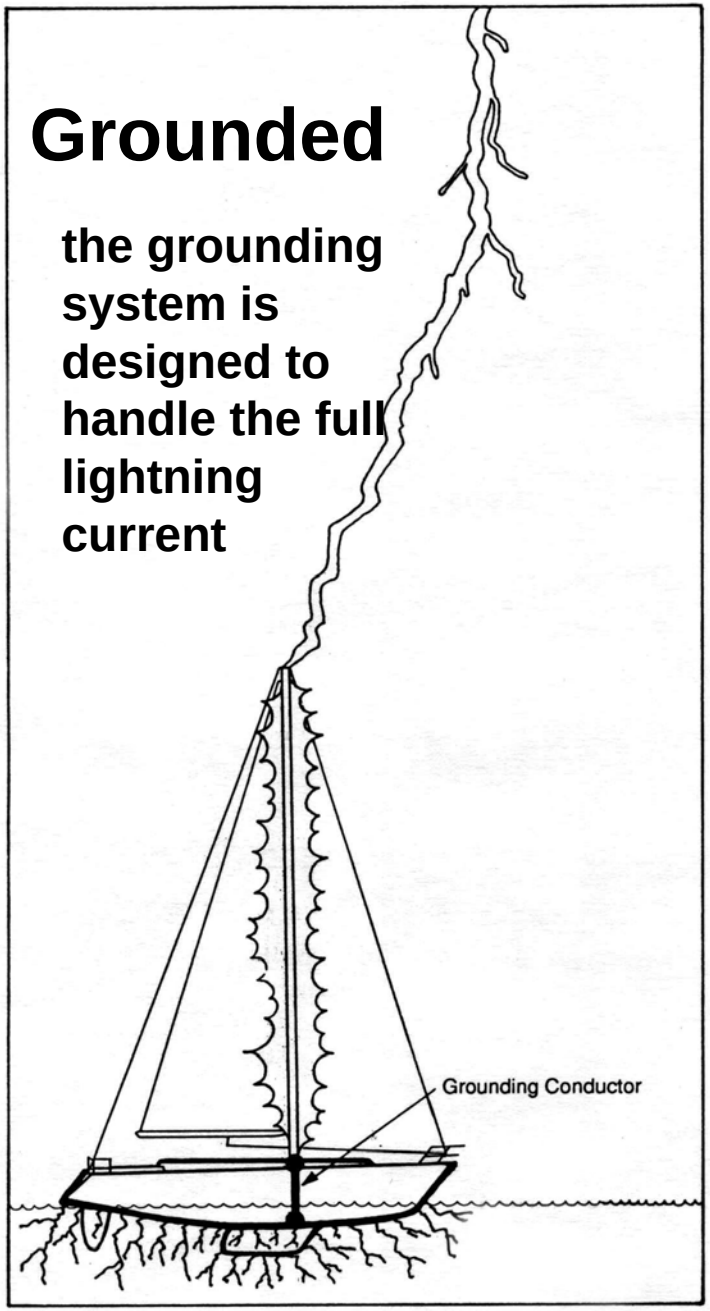
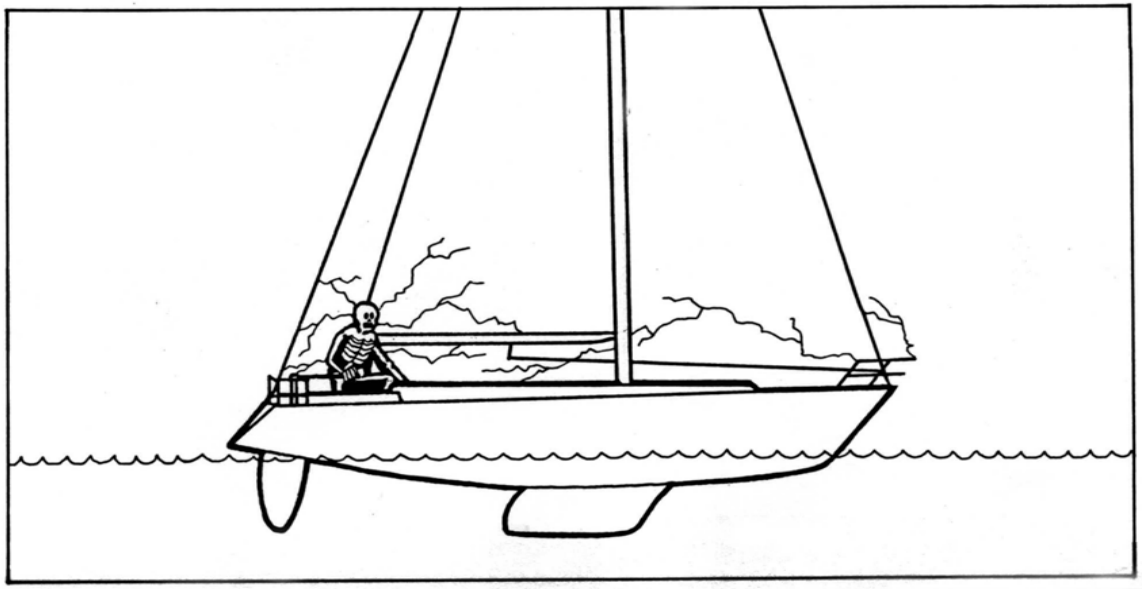


Figure 5. Effects of lightning strike to a grounded boat.



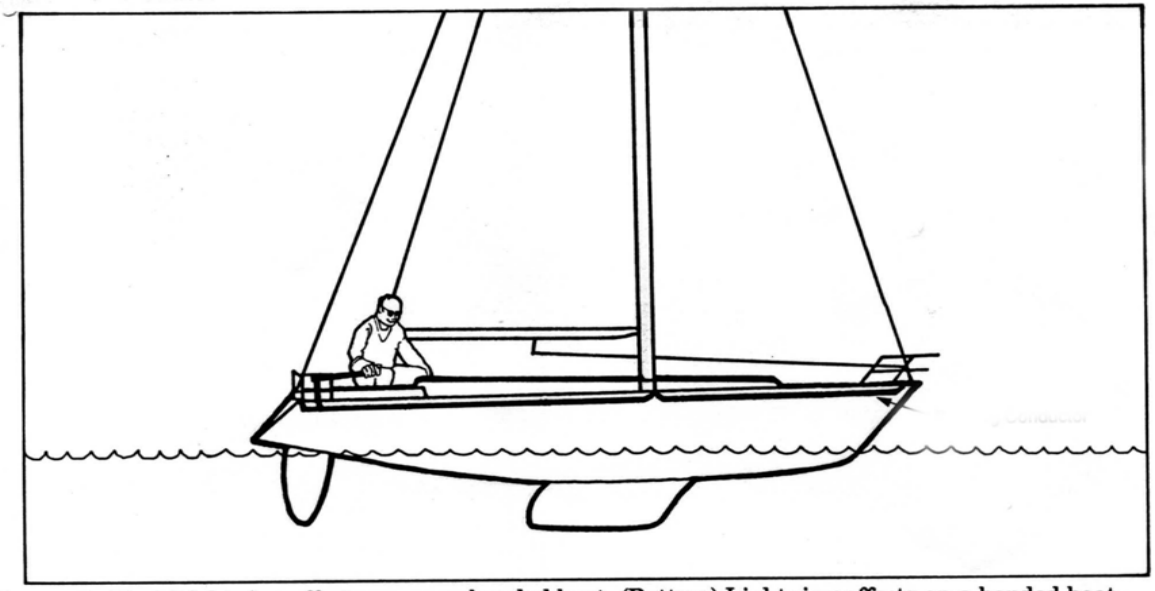


Figure 6. (Top) Lightning effects on an unbonded boat. (Bottom) Lightning effects on a bonded boat. *Note: Being in contact with a wheel or tiller during a lightning strike is extremely hazardous, even in a grounded, bonded boat.*

Unbonded

Bonded

Bonding system consists of mainly horizontal connections between metal fittings to short out any voltages that might otherwise develop. Bonding is a measure that is intended to protect the crew

THUNDER

Thunder is the acoustic shock wave caused by the extreme heat generated by a lightning flash.
The air surrounding its channel is instantaneously heated to as much as 50,000 F (~28,000 C), *five times* the surface of the sun!
Like all gases air being heated, they expand. The faster they are heated, the faster their rate of expansion.
its expansion rate exceeds the speed of sound, and a sonic boom (thunder) results. In short, the air literally explodes.

Learn the 30-30 rule

- **Take appropriate shelter when you can count 30 seconds or less between lightning and thunder.**
- **Remain sheltered for 30 minutes after the last thunder.**

Things to avoid during lightning

1. Water - This means NO showers when there is a thunderstorm; water can carry electricity.
2. High ground
3. Open spaces
4. Metal objects - This includes everything like electrical wires, fences, machinery, power tools, or motors.
5. Telephones - Do not use the phone unless it is absolutely an emergency and do not use head sets or ear phones.
6. Appliances - Unplug and stay away from things like refrigerators, computers, and televisions.
**** Wait 30 minutes after the last lightning stroke before partaking in any of the above activities or going to these areas.**

What to do if you are outside

1. Seek shelter in a truck, car, or van. If this is not an option, crouch down with your feet together and cover your ears to protect them from the thunder.
2. Stay 15 feet away from other people to avoid transfer of shock.
3. Stay away from trees, picnic shelters or rain shelters, and canopies.
4. Hide in ditches or places of lower levels, but try to avoid water.

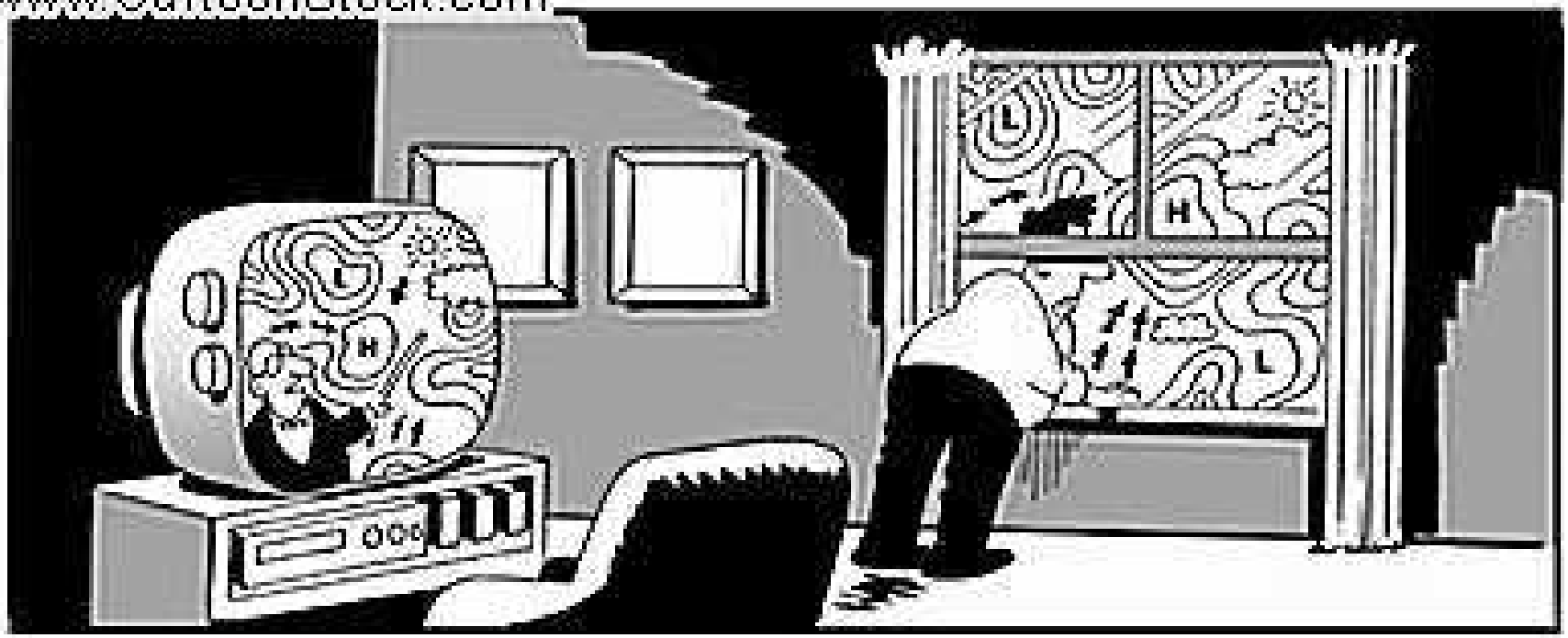
Other Tools;

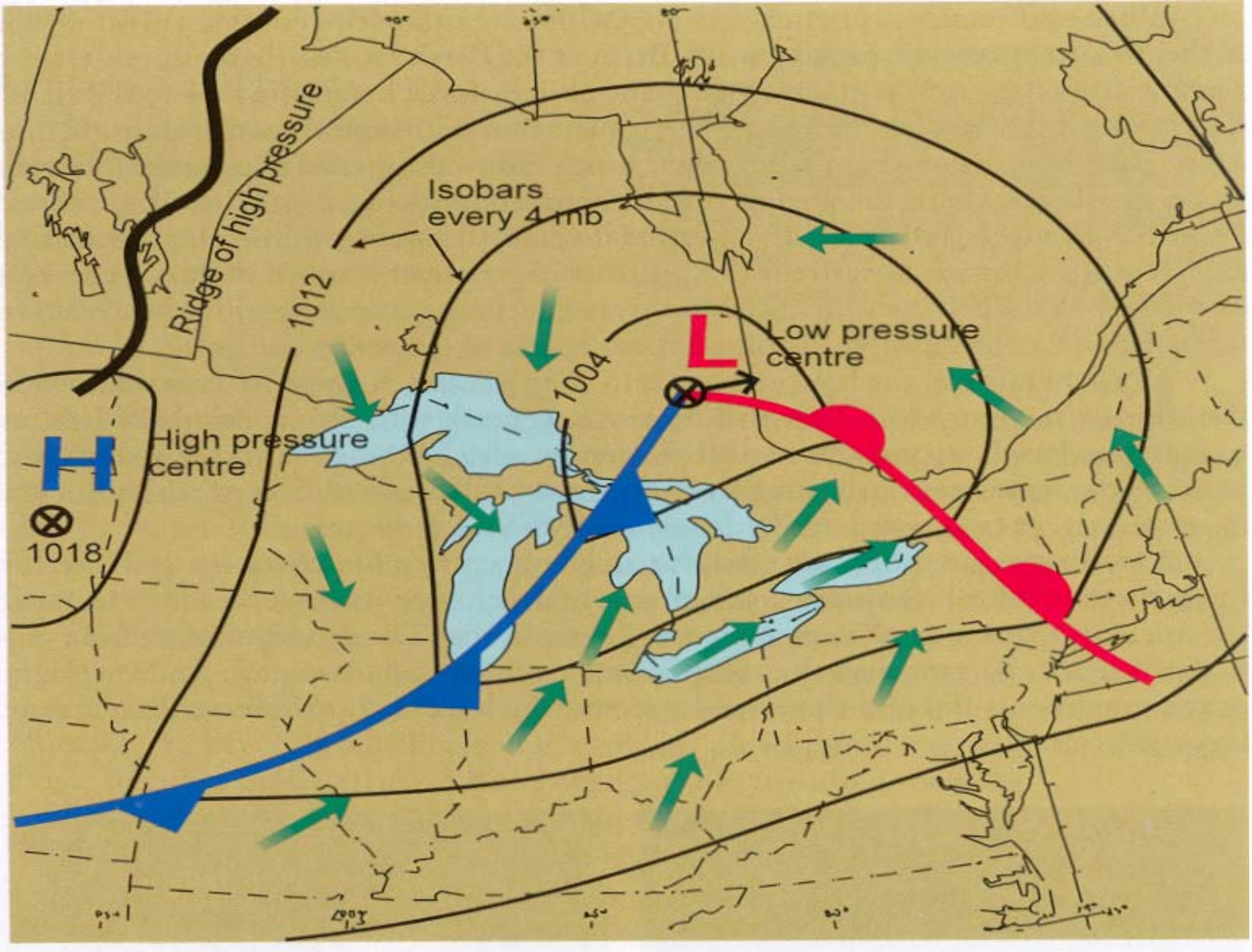
Weather radio – Weather Watches and Warnings

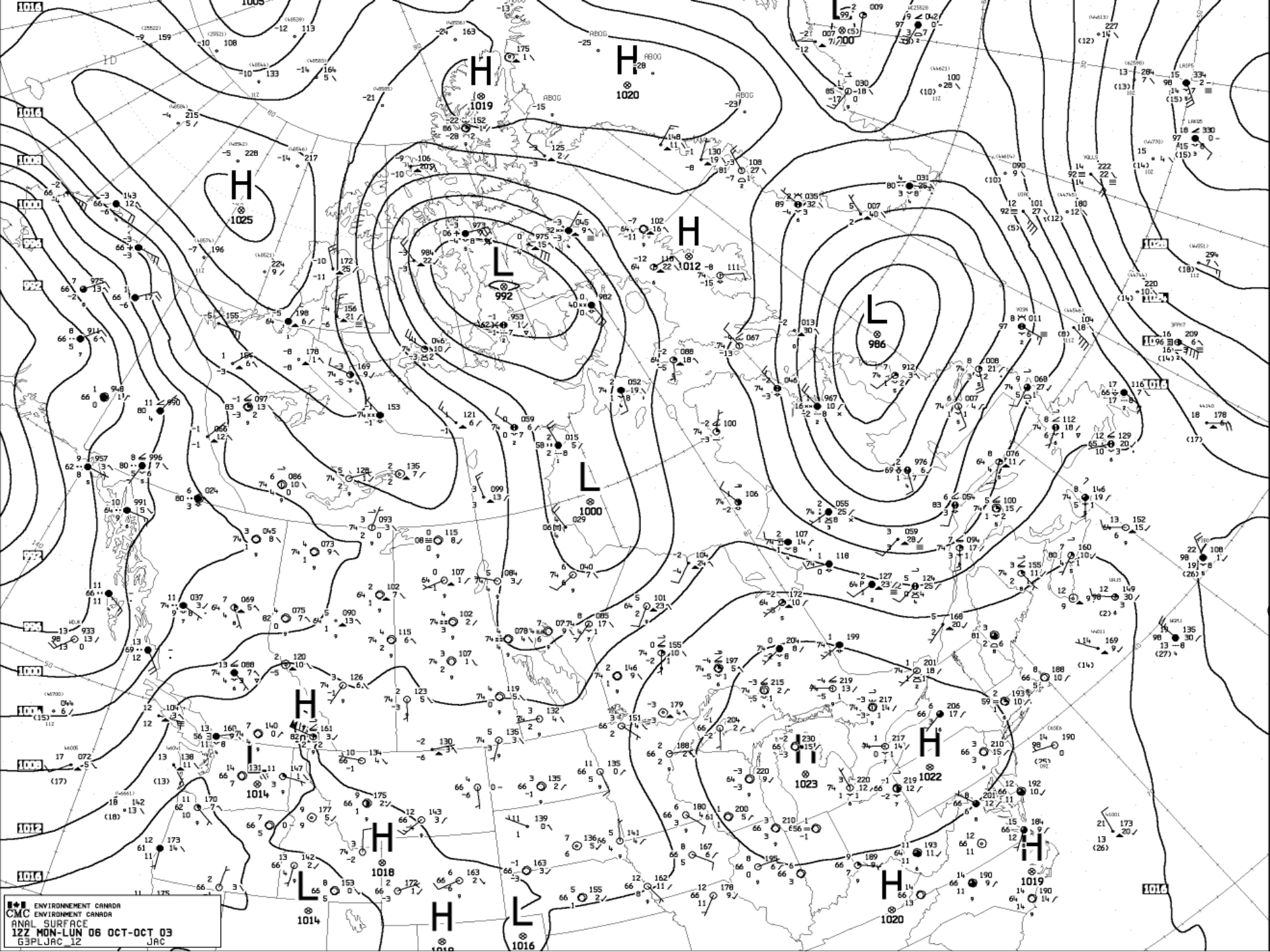
Personal Lightning Detectors

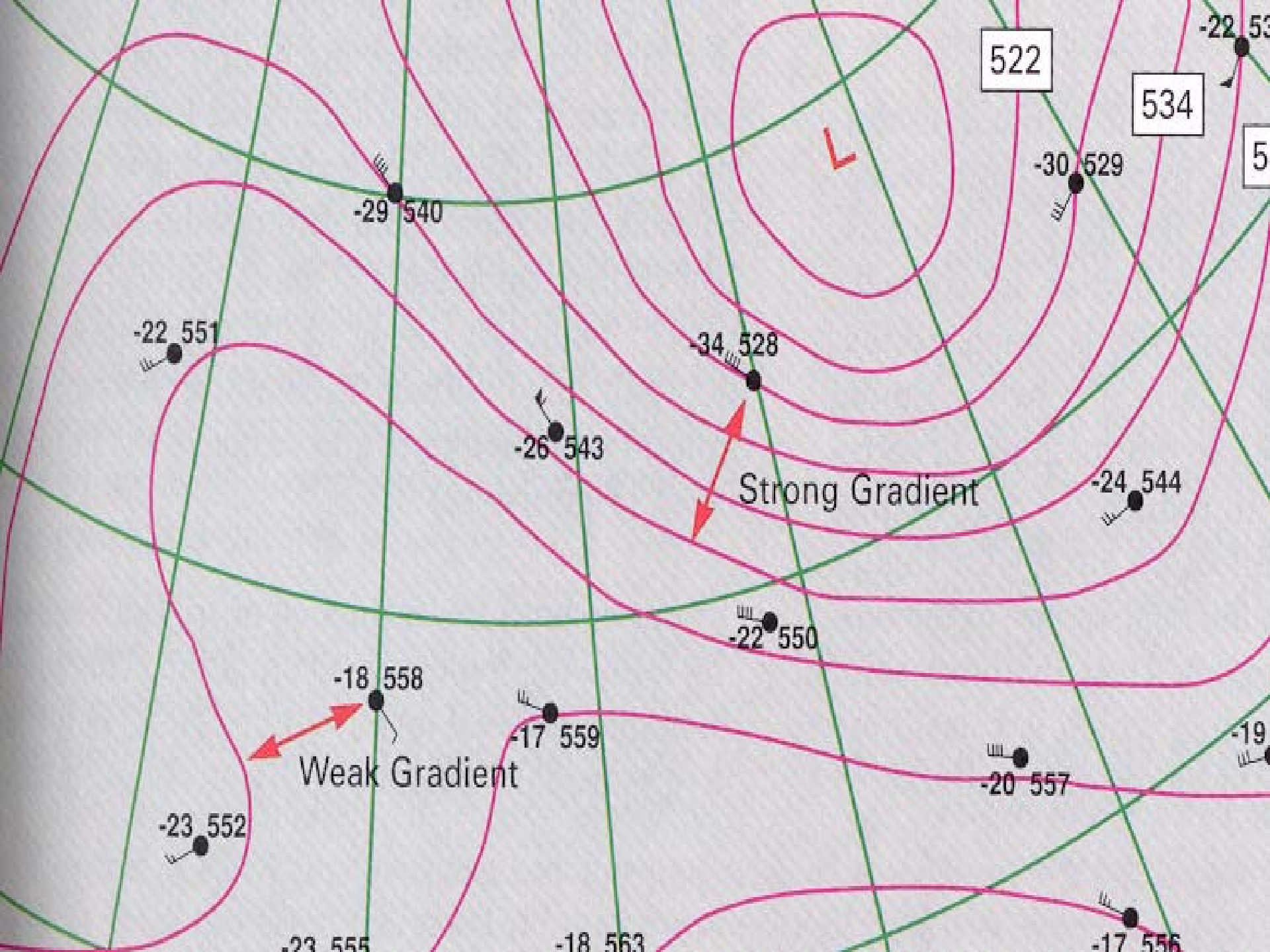
Weather Stations at the Club

Weather Map and Isobars



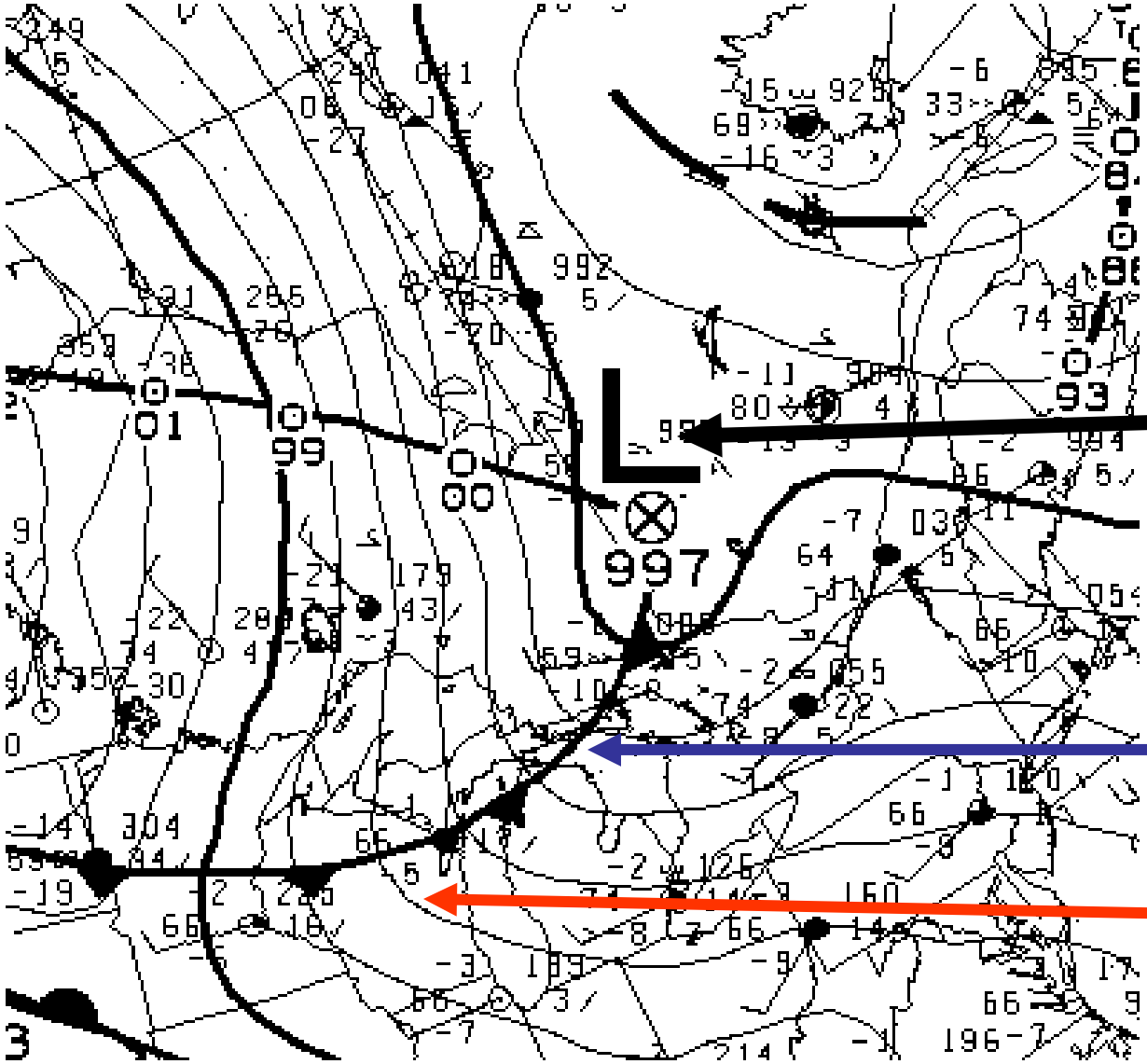

Ridge of high pressure
Isobars every 4 mb
1012
1004
L
Low pressure centre
H
High pressure centre
1018


ENVIRONNEMENT CANADA
CMC ENVIRONNEMENT CANADA
ANAL SURFACE
12Z MON-LUN 06 OCT-OCT 03
G3PLJAC_12 JAC


522
534
L
-29 540
-30 529
-22 551
-34 528
-26 543
Strong Gradient
-24 544
-22 550
-18 558
-17 559
Weak Gradient
-20 557
-23 552
-18 563
-17 556

When to start thinking about a “change” in the Weather

Look at the Weather Map



Change will occur in

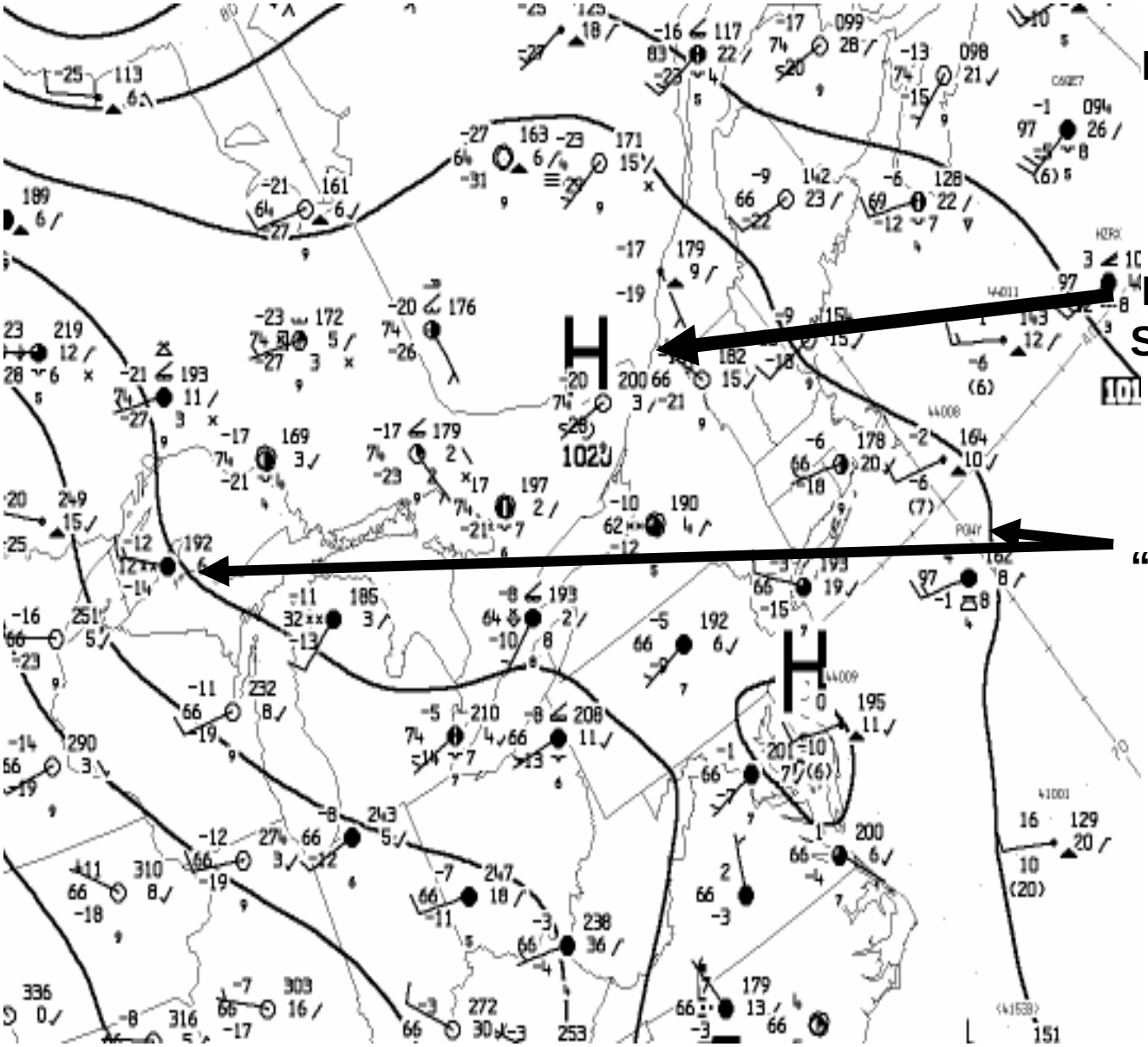
In 12 hrs or so

Near by Low Pressure

Near by Front

Tight Isobars

When not to worry about the Weather changing in the next 12 hrs or so



Don’t Worry Situation

High Pressure over Southern Ontario

“Slack” Isobar pattern

QUESTIONS?

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