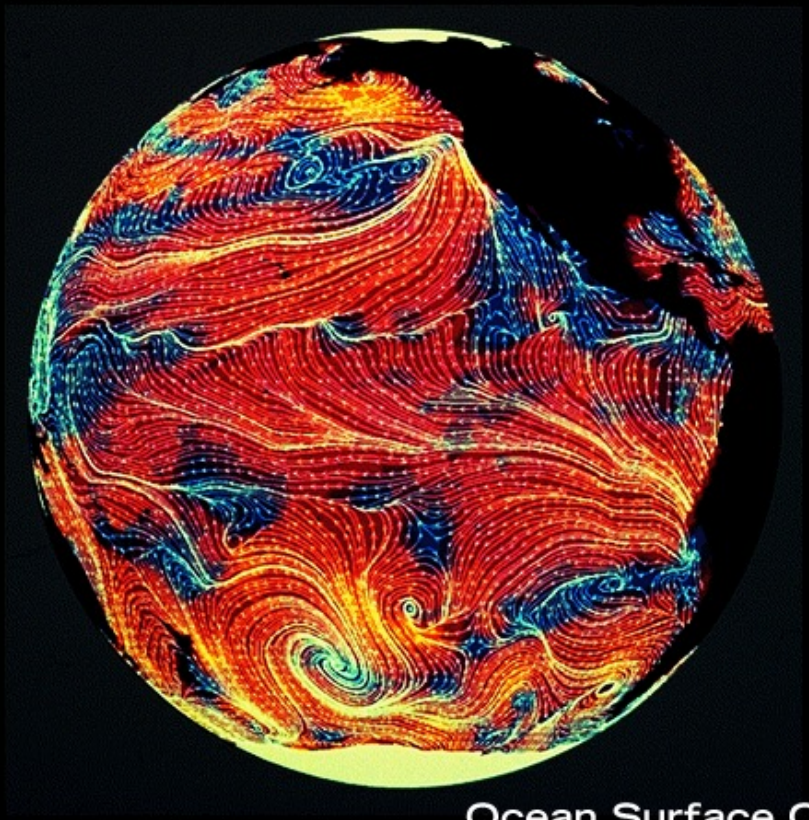
Weather II: Weather Phenomena



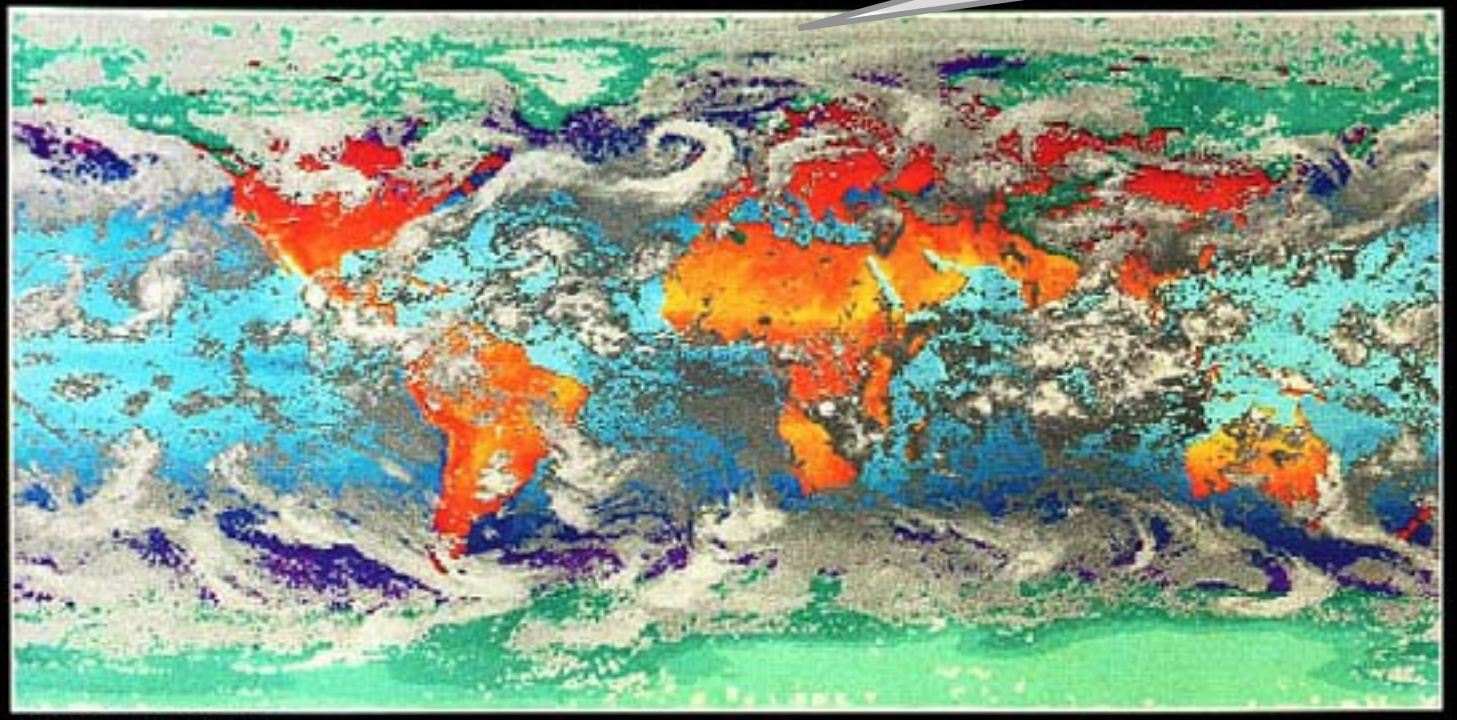
Ocean Surface Currents

- Weather prediction
- Severe Weather
- Hurricanes

http://www.earth.nasa.gov/

Composite satellite image of a typical October day

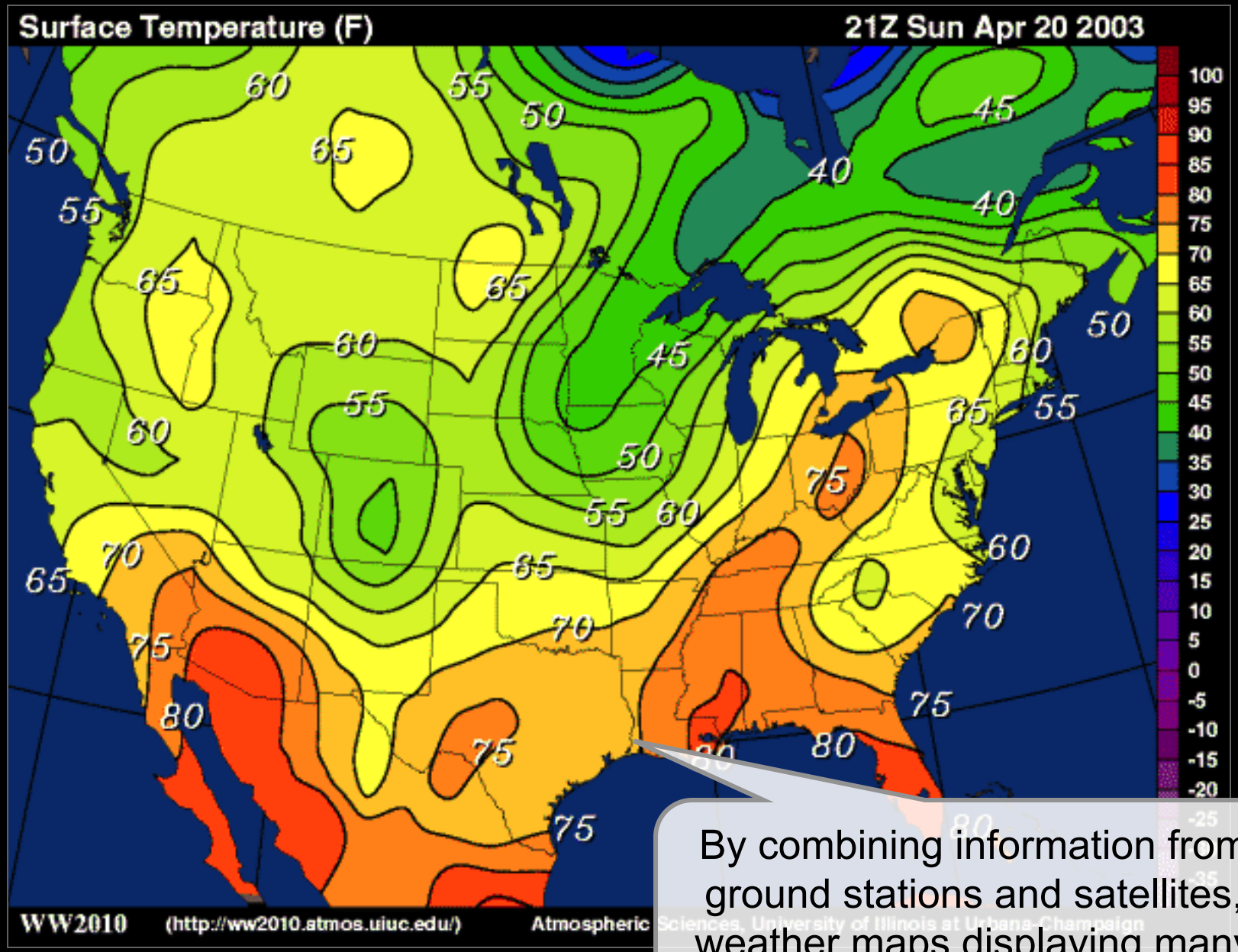
World Cloud Cover Pattern



GRAPHICS BY NASA/GISS

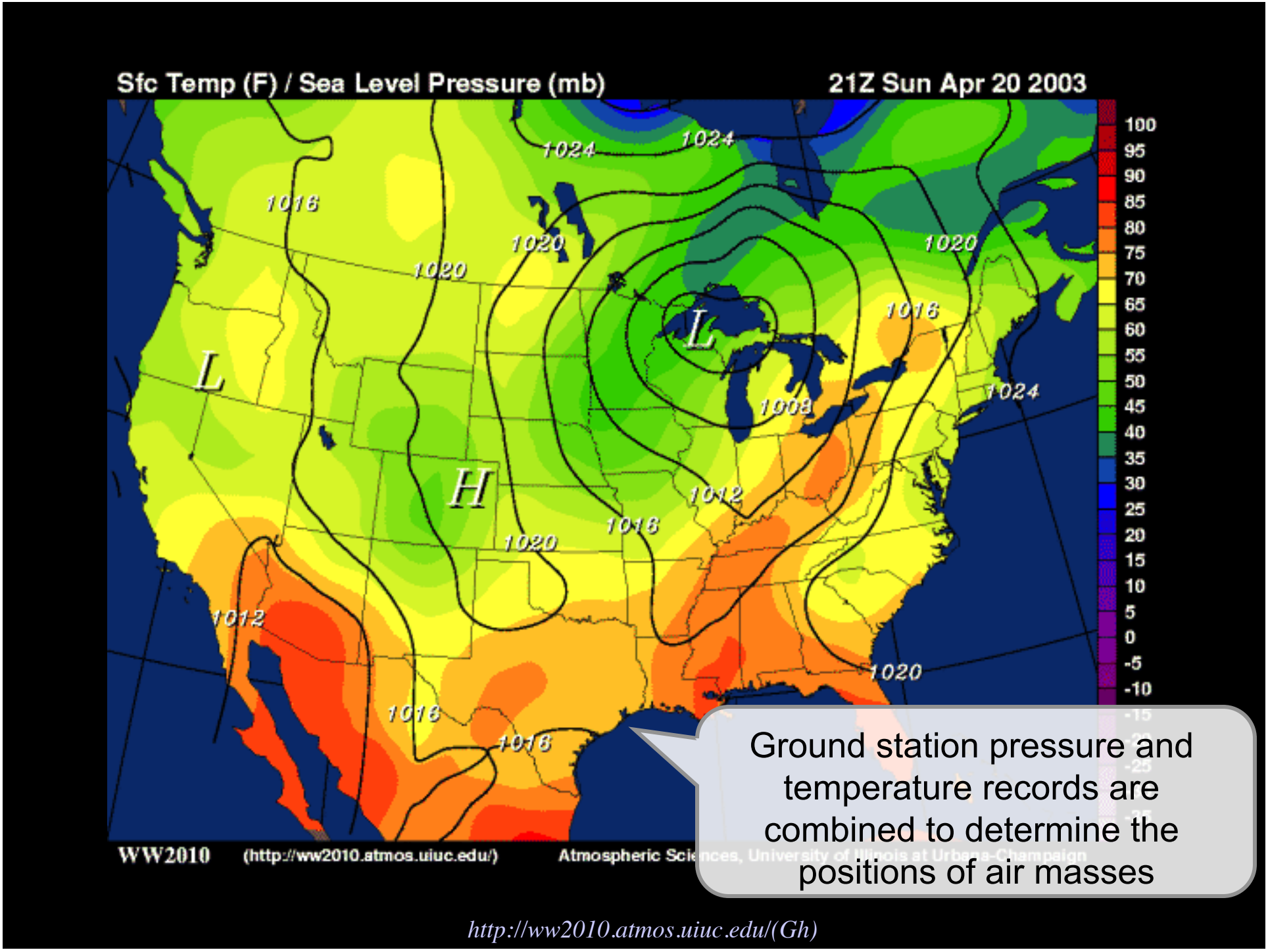
October 15,1983

http://www.earth.nasa.gov/



By combining information from ground stations and satellites, weather maps displaying many variables can be produced.

http://ww2010.atmos.uiuc.edu/(Gh)



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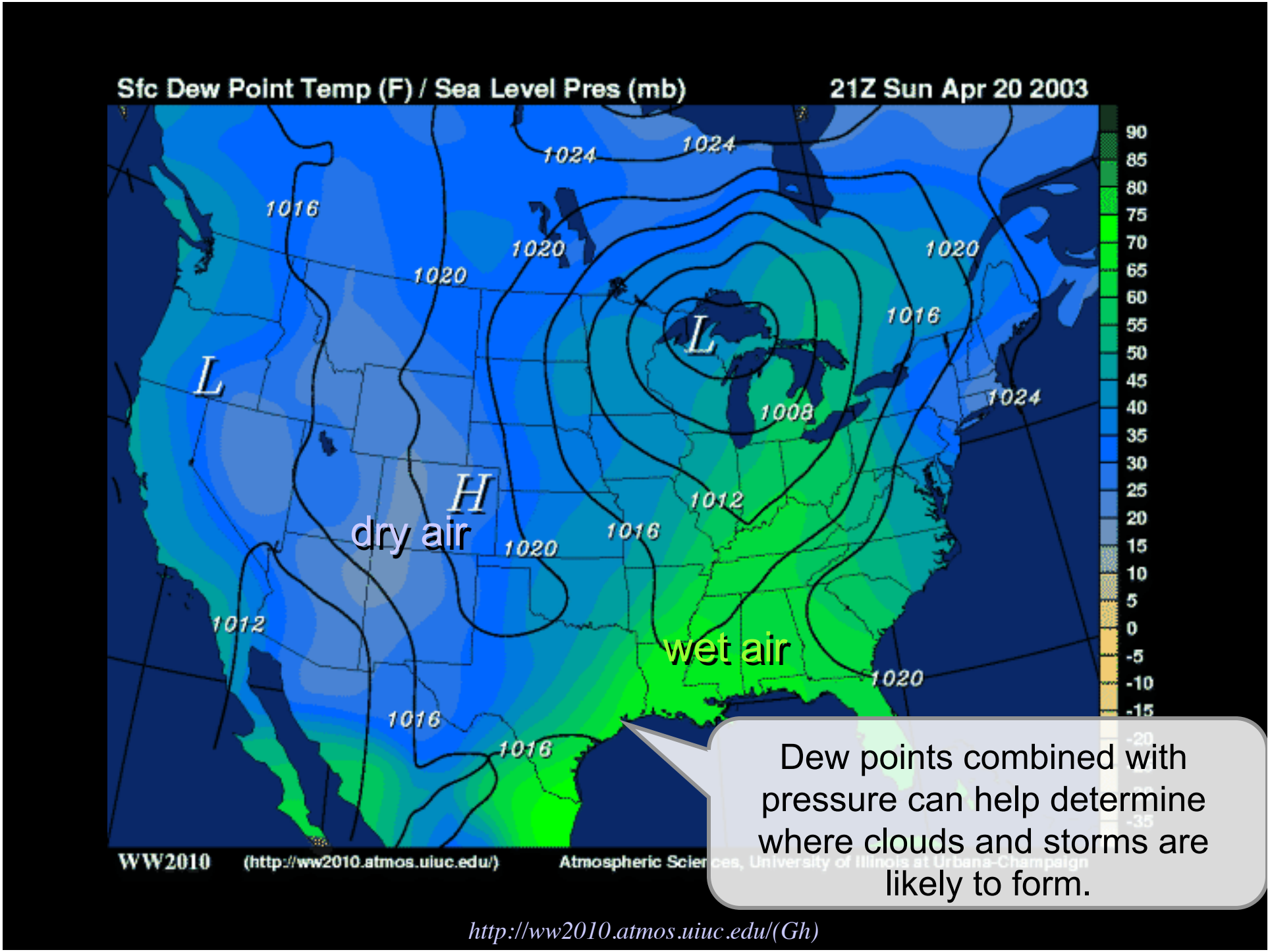
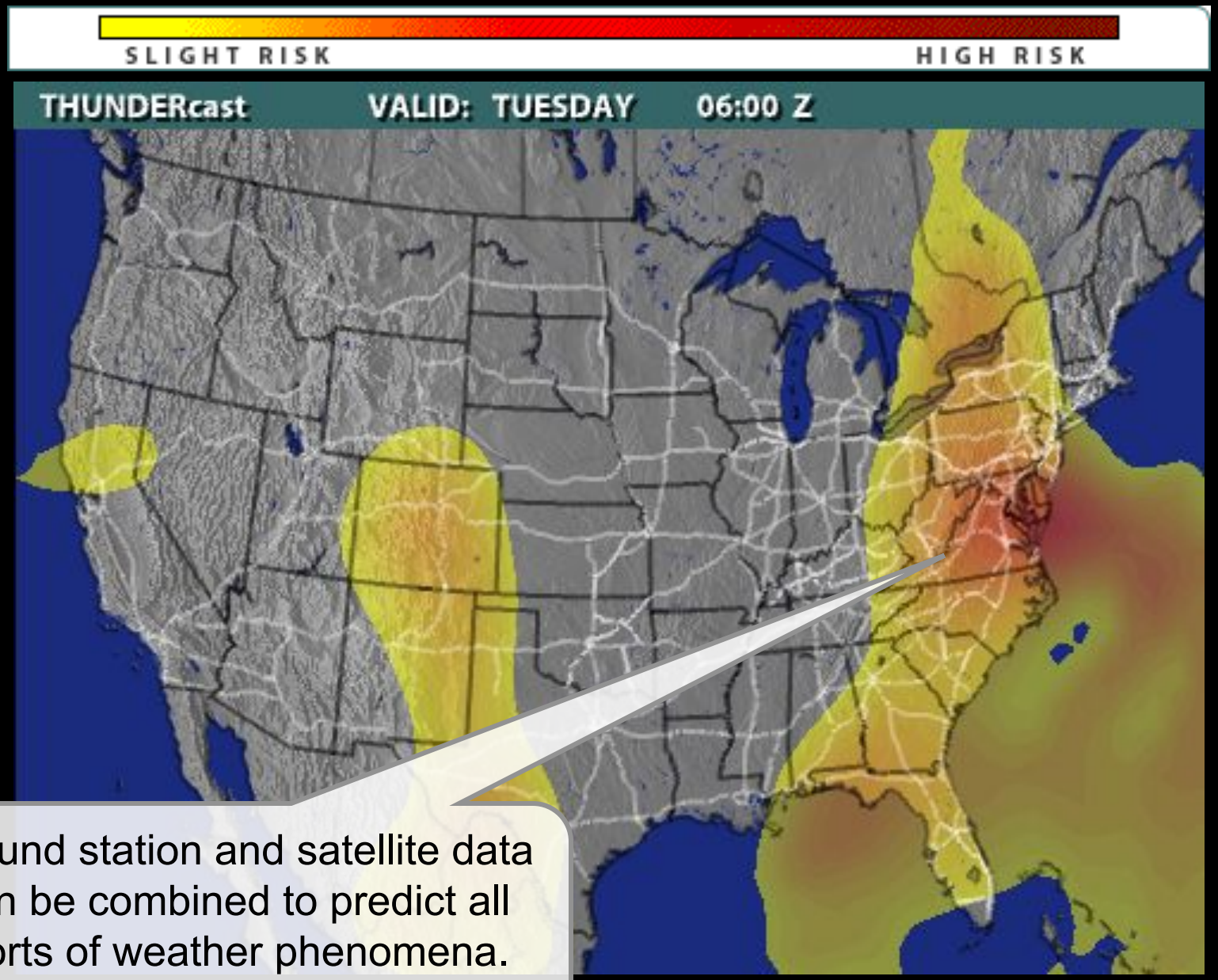


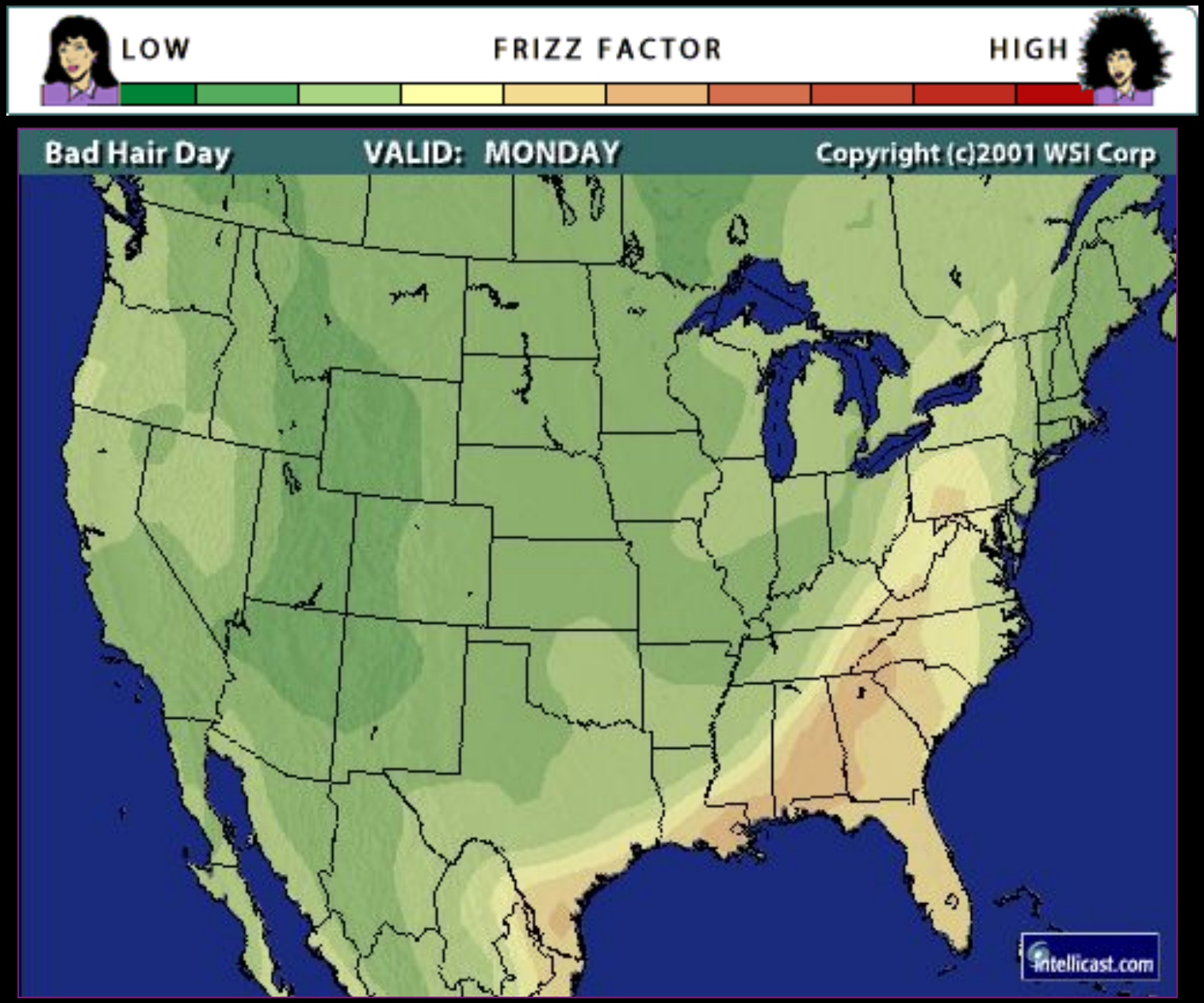
Dew points combined with pressure can help determine where clouds and storms are likely to form.

http://ww2010.atmos.uiuc.edu/(Gh)

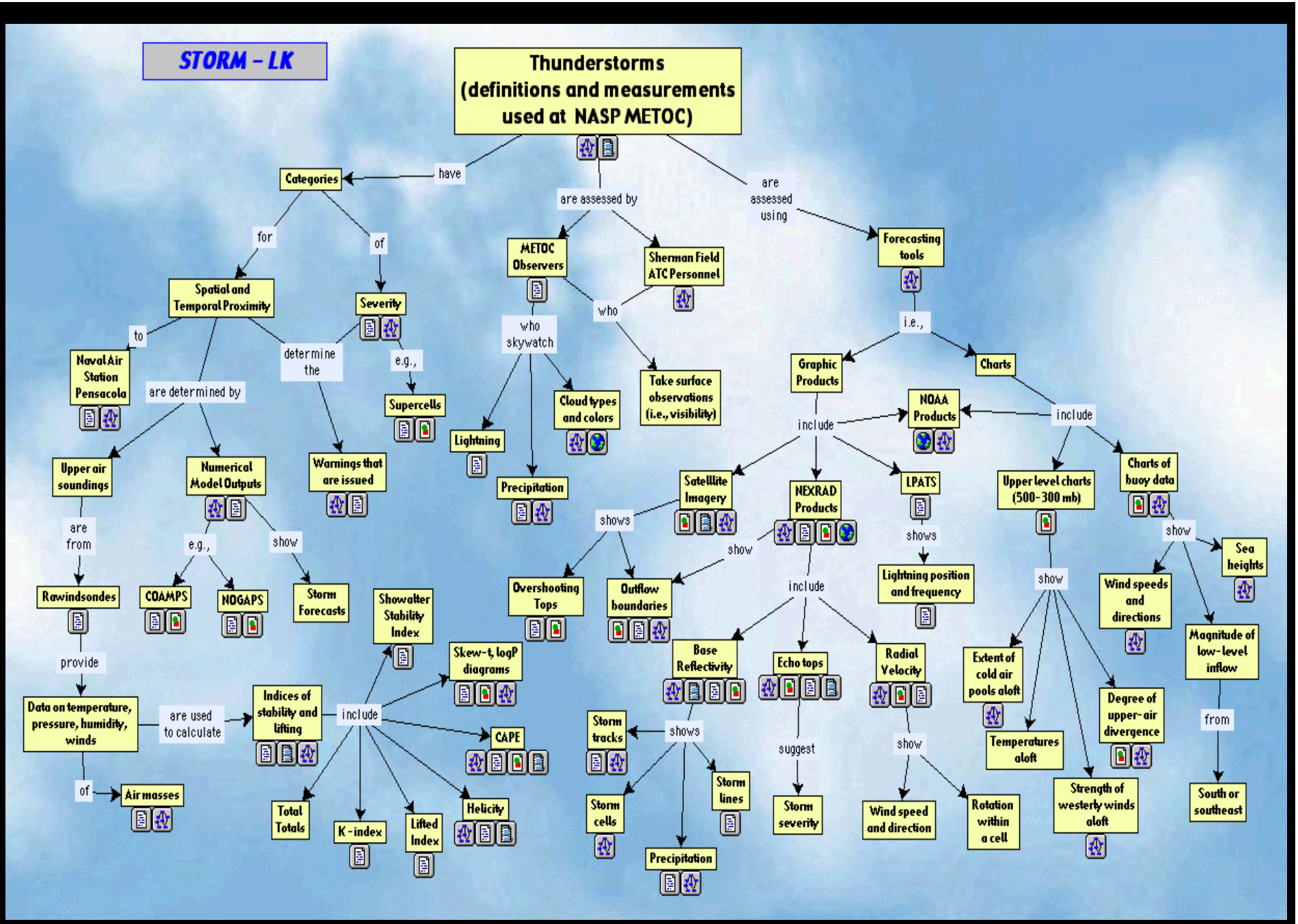


Ground station and satellite data can be combined to predict all sorts of weather phenomena.

http://www.intellicast.com/



http://www.intellicast.com/



http://www.coginst.uwf.edu/STORM-LK/maps/STORMLK/x-kaos-cmap/definitions_and_measurem.html

Severe Weather Phenomena

Thunderstorms are most likely to form where hot, moist air rises quickly through the atmosphere. Individual storms can form over the course of a hot summer afternoon.

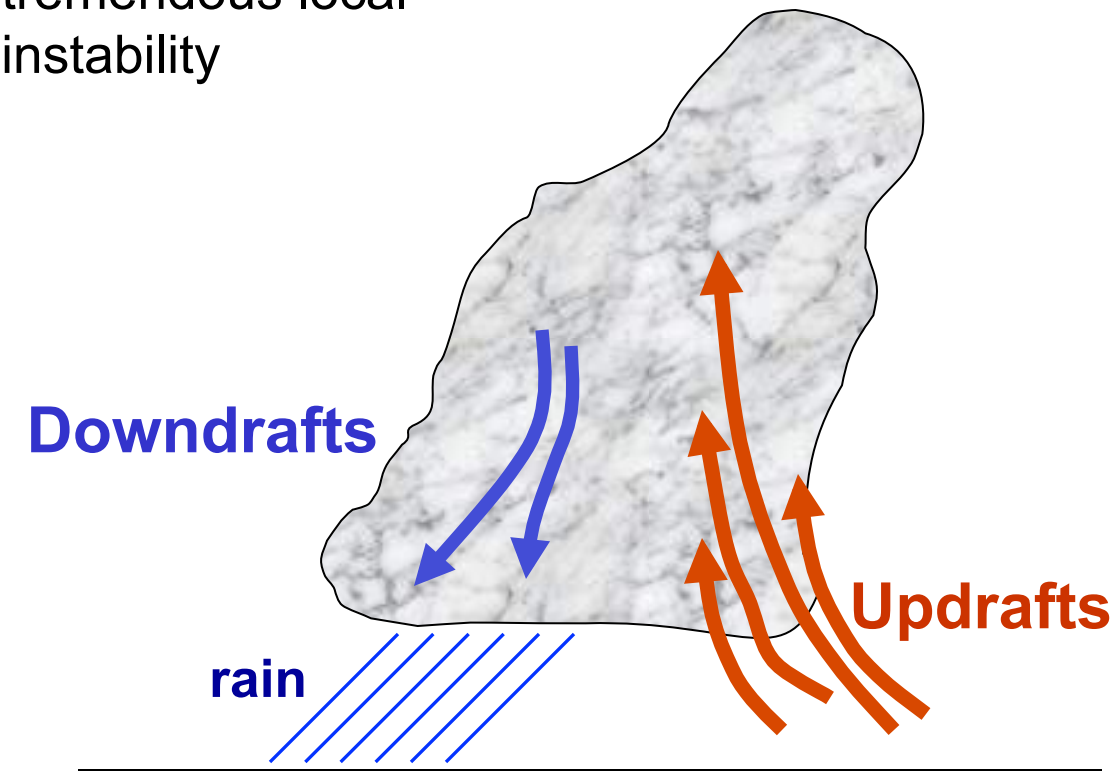
Lightning discharges are common during thunderstorms. Thunder is an atmospheric disturbance formed from the shock of super-hot lightning arcing through the air.

Thunderstorms are violent, although usually short-lived storms. Hail, wind shear, flooding and tornados can all occur with thunderstorms – even “small” ones!

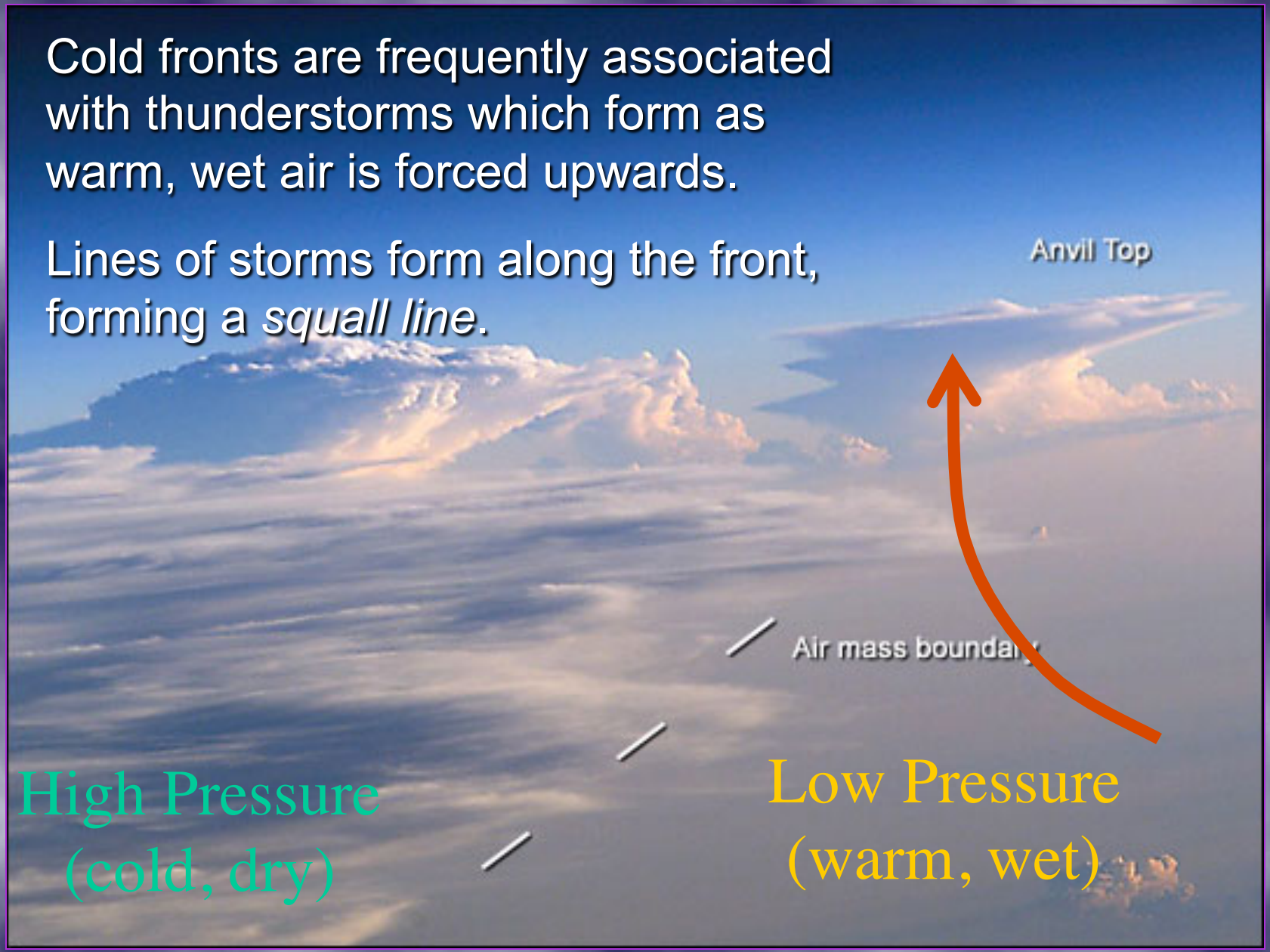
Severe Weather Phenomena

Thunderstorms

Characterized by tremendous local instability



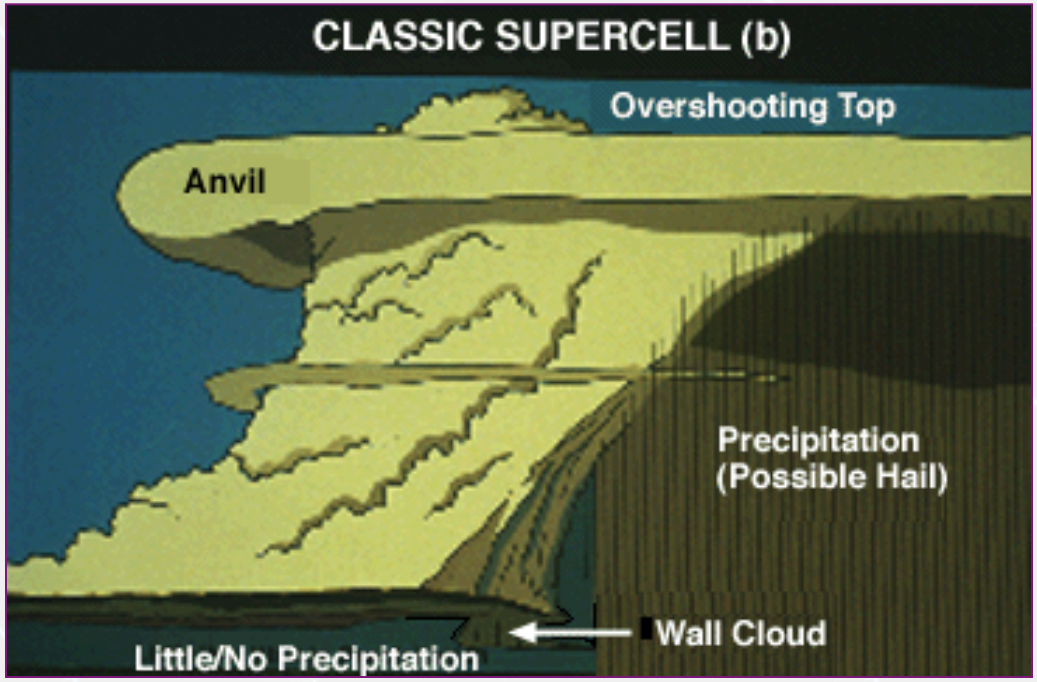
http://www.erh.noaa.gov/er/rah/education/edu1.html



http://earthobservatory.nasa.gov/

Severe Weather Phenomena

Thunderstorms come in different sizes and severities: single cell, multi-line cells (squall lines), and super-cells. The single cells are isolated storms and usually blow over quickly. Severe weather like hail and tornados are relatively uncommon with single cells, but do occur!



Super-cells are the most violent and damaging thunderstorms.

However, once they are identified, predicting the more severe effects is relatively straightforward.

http://ww2010.atmos.uiuc.edu/(Gh)/home.rxml

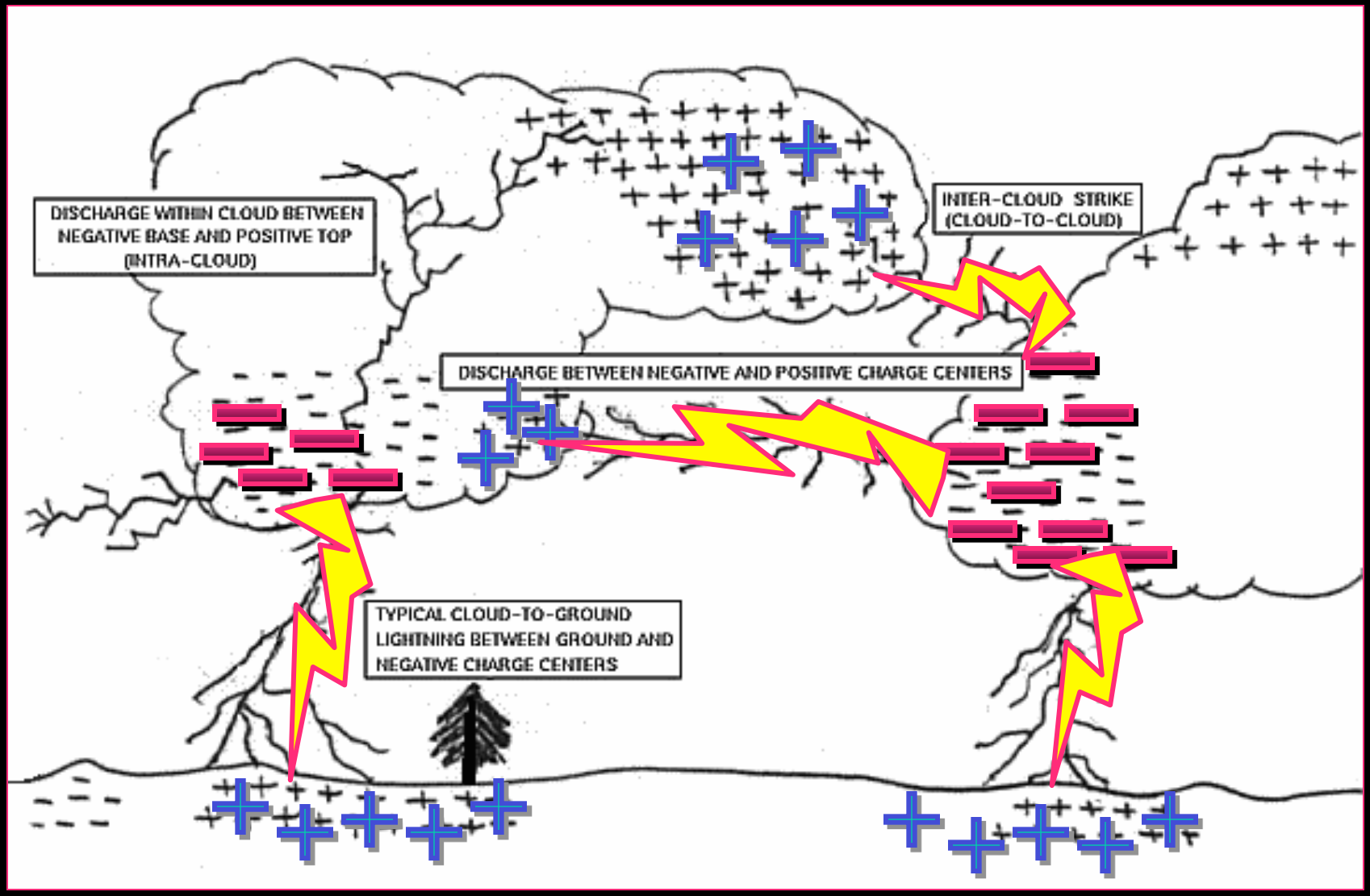
http://www.wunderground.com/

Severe Weather Phenomena

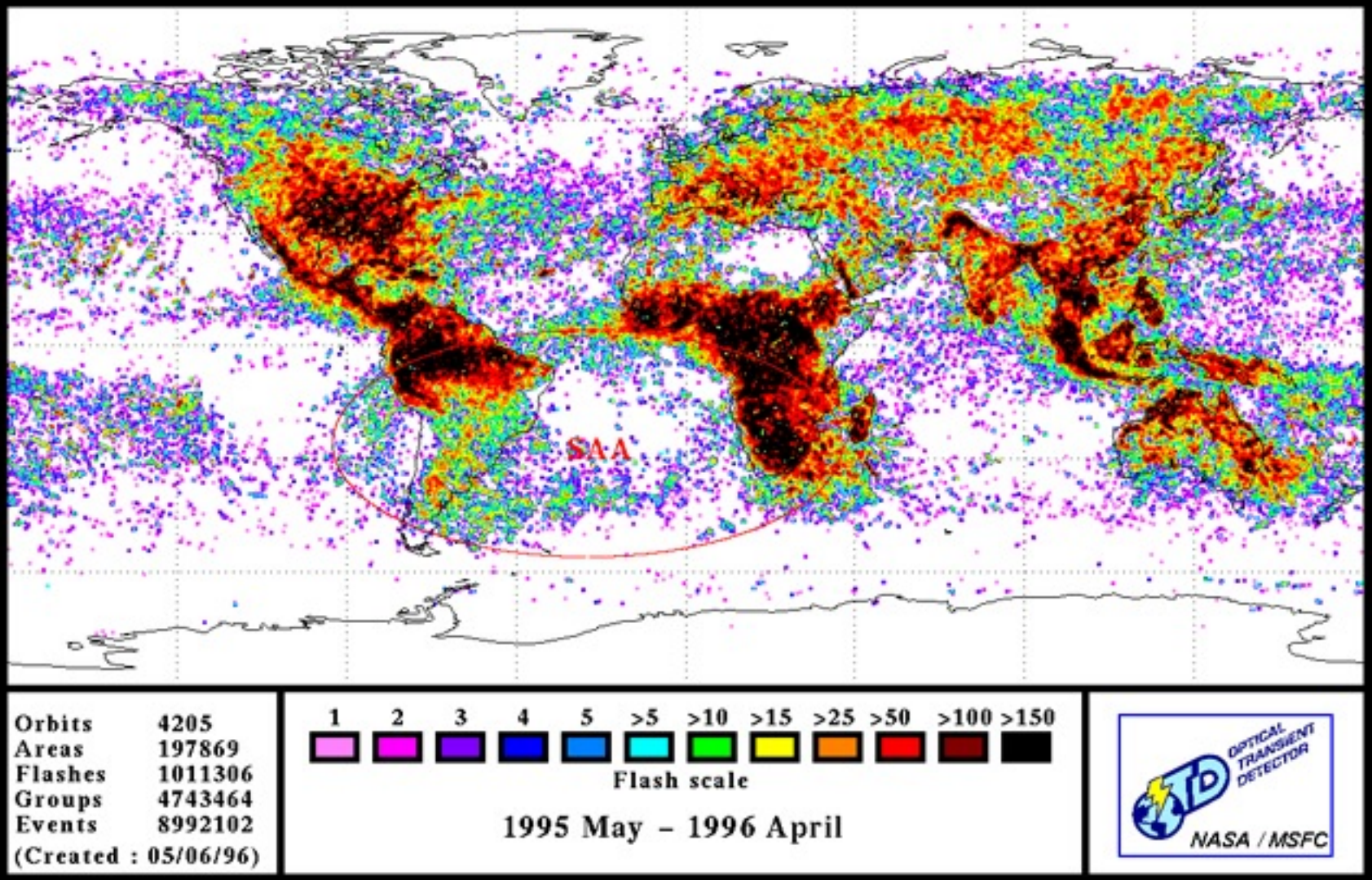
Lightning

Temperature - up to 12,000 °C
Length - up to many miles
Kinds - cloud-to-cloud, cloud-to-ground, ground-to-cloud

http://www.doc.mmu.ac.uk/aric/eae/english.html



http://thunder.msfc.nasa.gov/



One Million Lightning Flashes

http://www.earth.nasa.gov/

Contrary to myth, lightning does strike more than once in the same place. It is most likely to strike: the highest point in the area; objects with pointy tops; and objects made of conductive materials like metal. A tall, pointy, metal tower like the one above can be struck dozens of times during a single storm.

http://www.wildweather.com/

Light travels at 300,000 km/s. Sound travels at 340.29 m/s (0.2 miles/second). By counting the seconds between when you see the lightning and hear the thunder, you can determine how far away the strike was (every 5 seconds = 1 mile).

http://www.usatoday.com/weather/wlightn0.htm

http://www.oklahomalightning.com/

It is important to remember that a lightning bolt can be miles long, and thus strike even after the storm appears to have passed.

Oklahoma Lightning

Tornadoes

Tornadoes are destructive extreme uplift funnels caused by very unstable air. They are frequently associated with thunderstorms.

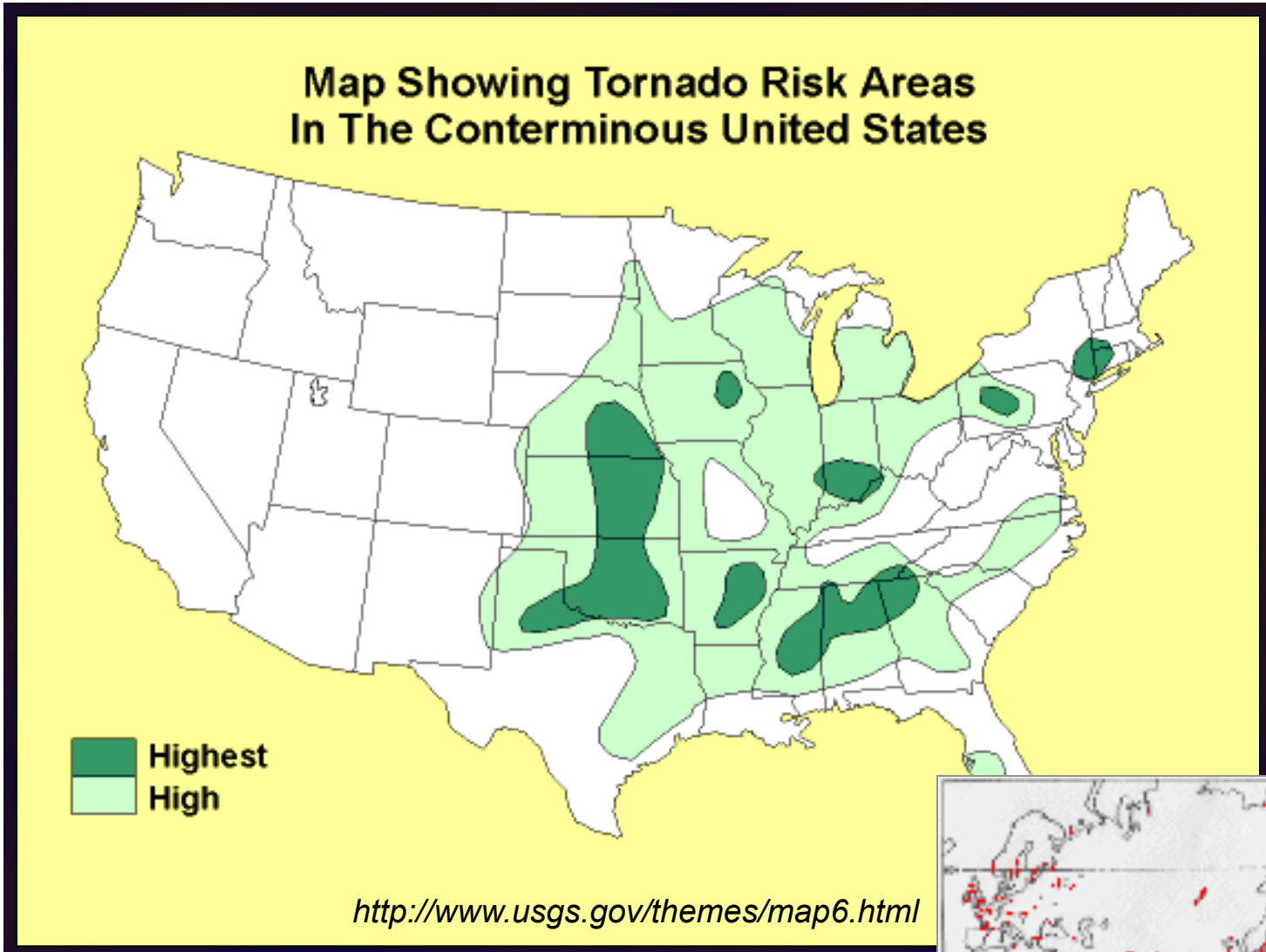
Oklahoma Lightning

http://www.oklahomalightning.com/

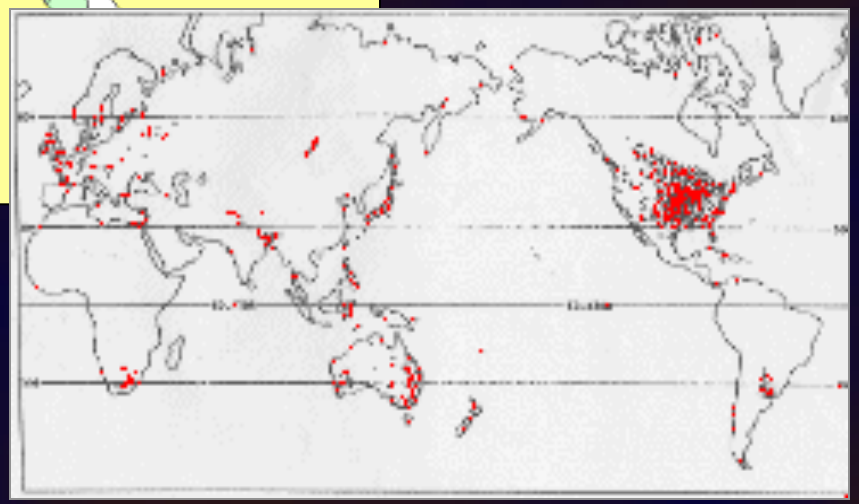
Tornadoes

“The wall cloud is a low-hanging, rotating feature below the base of the thunderstorm updraft. A wall cloud often precedes the formation of a tornado. Here, the tornado on the left is roping out as the wall cloud on the right organizes further and strengthens. Out of the shaggy cloud, a new tornado will appear.”

http://members.aol.com/tornadfoto/p-dopplr.html



http://www.usgs.gov/themes/map6.html



http://www.txdirect.net/~msattler/

Tornadoes are more common in the United States than anywhere else on Earth.

The Fujita Scale of Tornado Severity


Ted Fujita

	Wind Speed
F0	40-72 mph
F1	73-112 mph
F2	113-157 mph
F3	158-206 mph
F4	207-260 mph
F5	261-318 mph
F6	319-379 mph

http://www-news.uchicago.edu/releases/98/981120.fujita.shtml

The Fujita Scale of Tornado Severity

F0 - Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.

F1 - The lower limit is the beginning of hurricane wind speed; peels surface off roofs; *mobile homes pushed off foundations or overturned*; moving autos pushed off the roads; attached garages may be destroyed.

F2 - Considerable damage. Roofs torn off frame houses; *mobile homes demolished*; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.

F3 - Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted

F4 - *Well-constructed houses leveled*; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

F5 - *Strong frame houses lifted off foundations and carried considerable distances to disintegrate*; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-inforced concrete structures badly damaged.

F6 - These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

A tornado can destroy entire neighborhoods, or demolish one house on a block and leave the rest untouched.

http://www.usatoday.com/weather/news/2000/wftwphotos.htm

Fort Worth Tornado, 2001

http://www.usatoday.com/weather/news/2000/wftwphotos.htm

http://www.wildweather.com/

Storm Chaser Makes History with Deployment of In-Situ Tornado Probes

http://www.swiftwx.com/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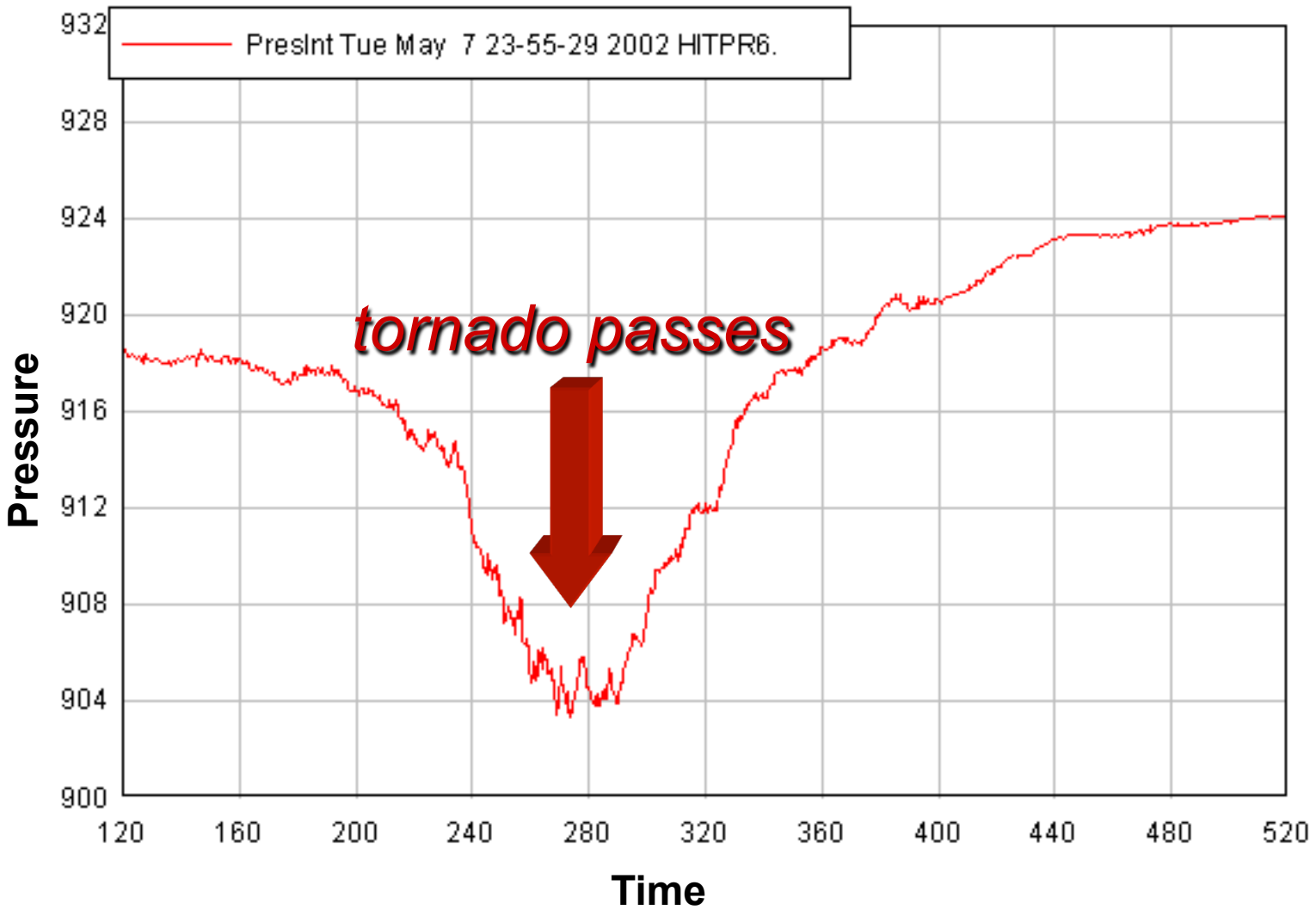
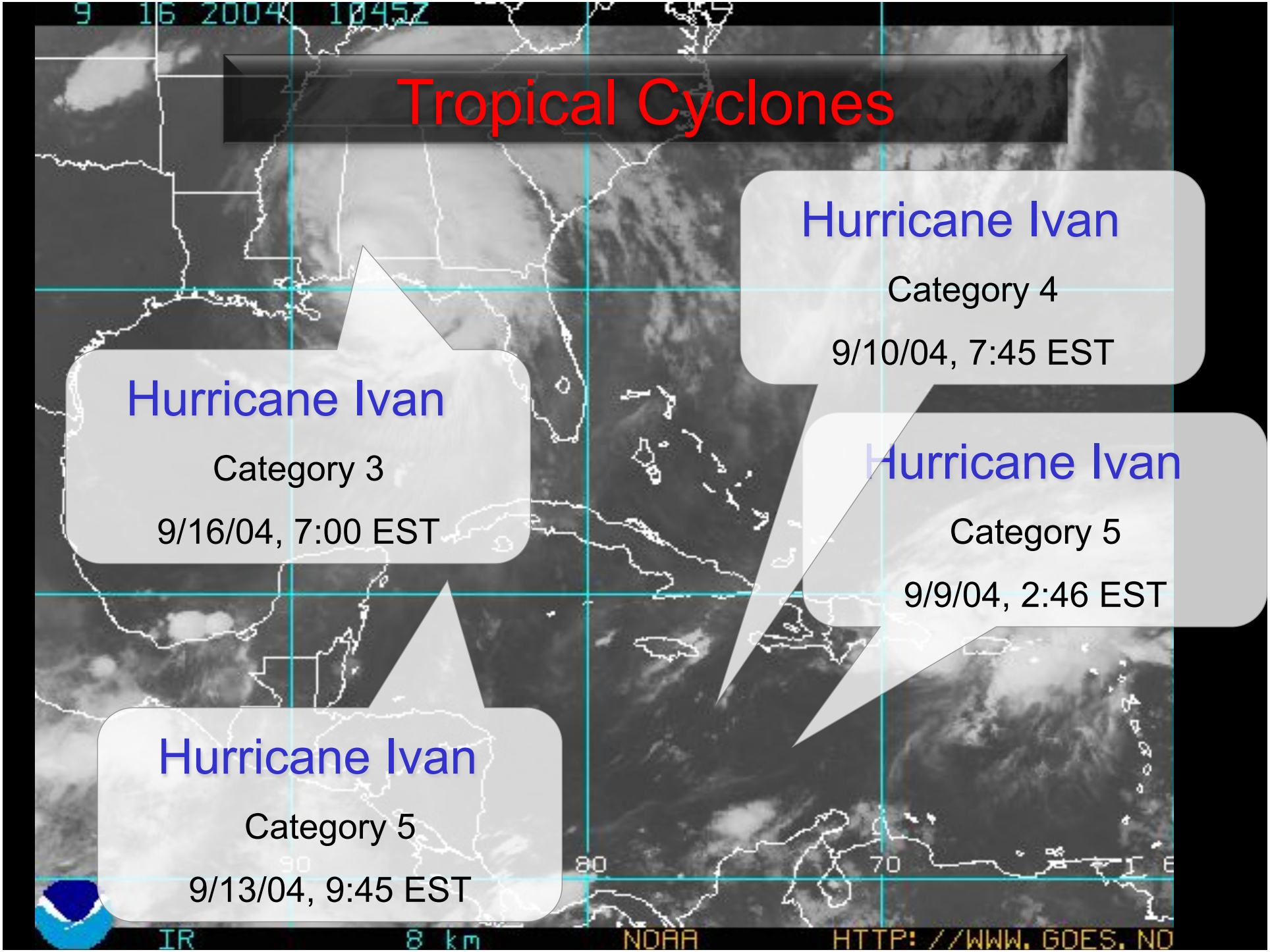
Copyright (c) 2002 Tim Samaras, Brad Carter
http://www.swiftwx.com/

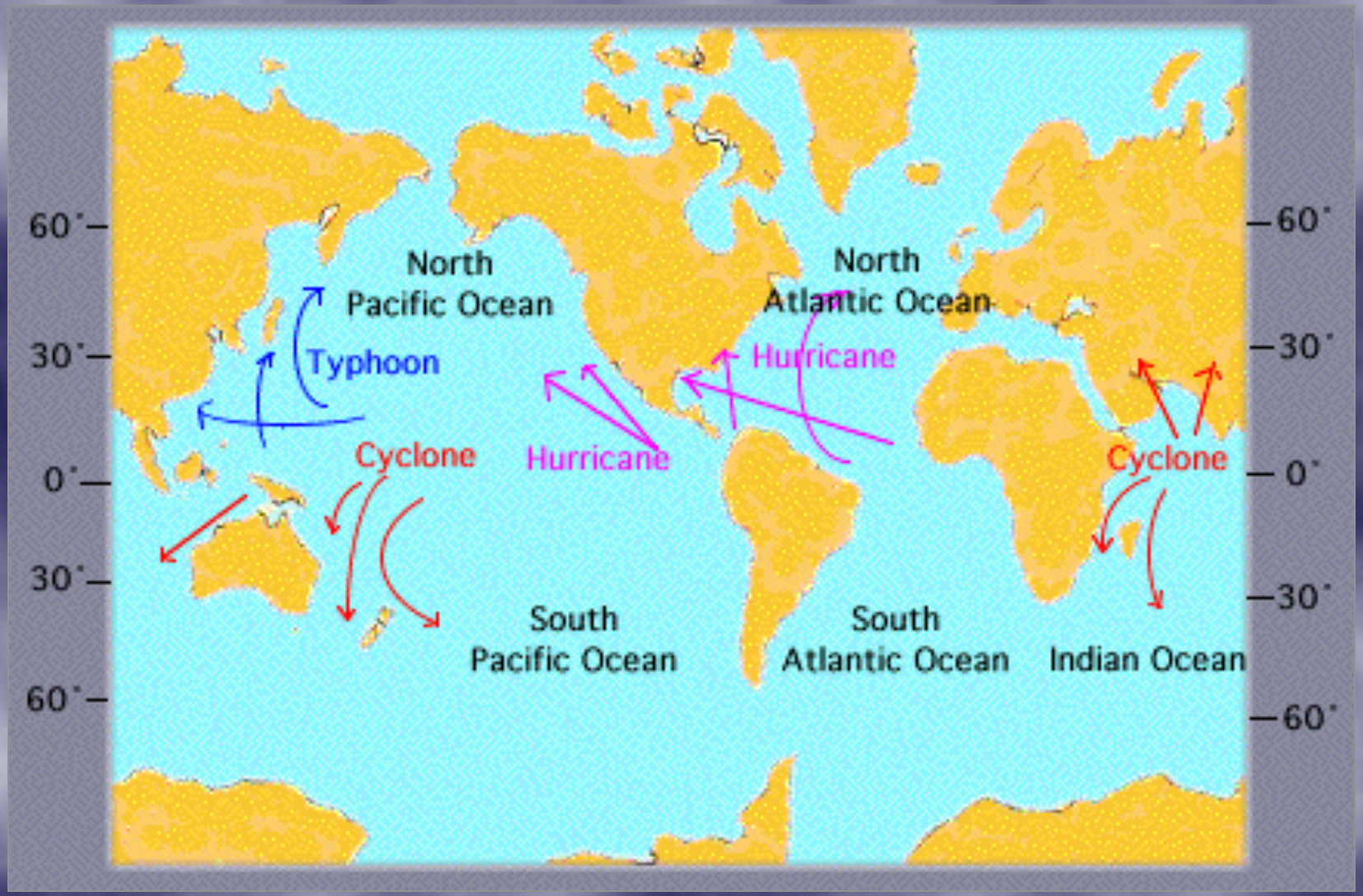
Storm Chaser Makes History with Deployment of In-Situ Tornado Probes



http://www.swiftwx.com/

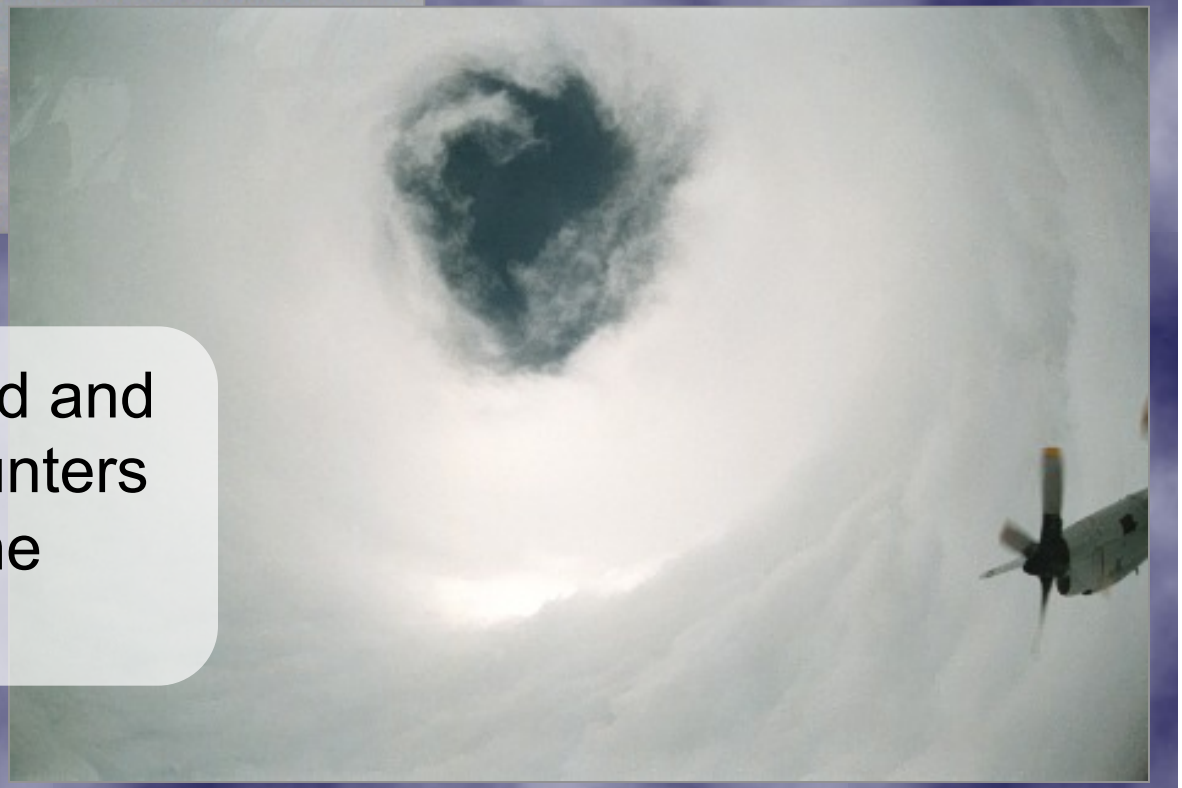

9 16 2004 1045Z
Tropical Cyclones
Hurricane Ivan
Category 4
9/10/04, 7:45 EST
Hurricane Ivan
Category 3
9/16/04, 7:00 EST
Hurricane Ivan
Category 5
9/9/04, 2:46 EST
Hurricane Ivan
Category 5
9/13/04, 9:45 EST
80
70
IR
8 km
NOAA
HTTP://WWW.GOES.NO

Tropical Cyclone Terminology



http://www.nws.noaa.gov/om/hurricane/

Hurricane Hunters



To directly measure wind and other data, hurricane hunters fly special planes into the heart of the storm.

http://ww2010.atmos.uiuc.edu/(Gh)

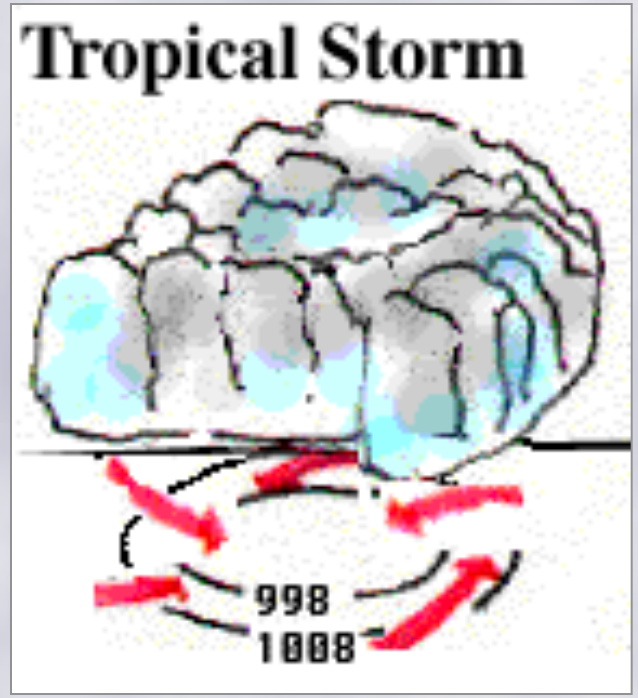
http://home.att.net/~typhoon1/

Tropical Depression

Tropical low pressure systems form regularly over the warmer parts of the Earth's oceans. This warm, wet air spawns thunderstorms, but there is no strong organization to the storms.

Winds near the center are constant between 20 and 34 knots (23 - 39 mph).

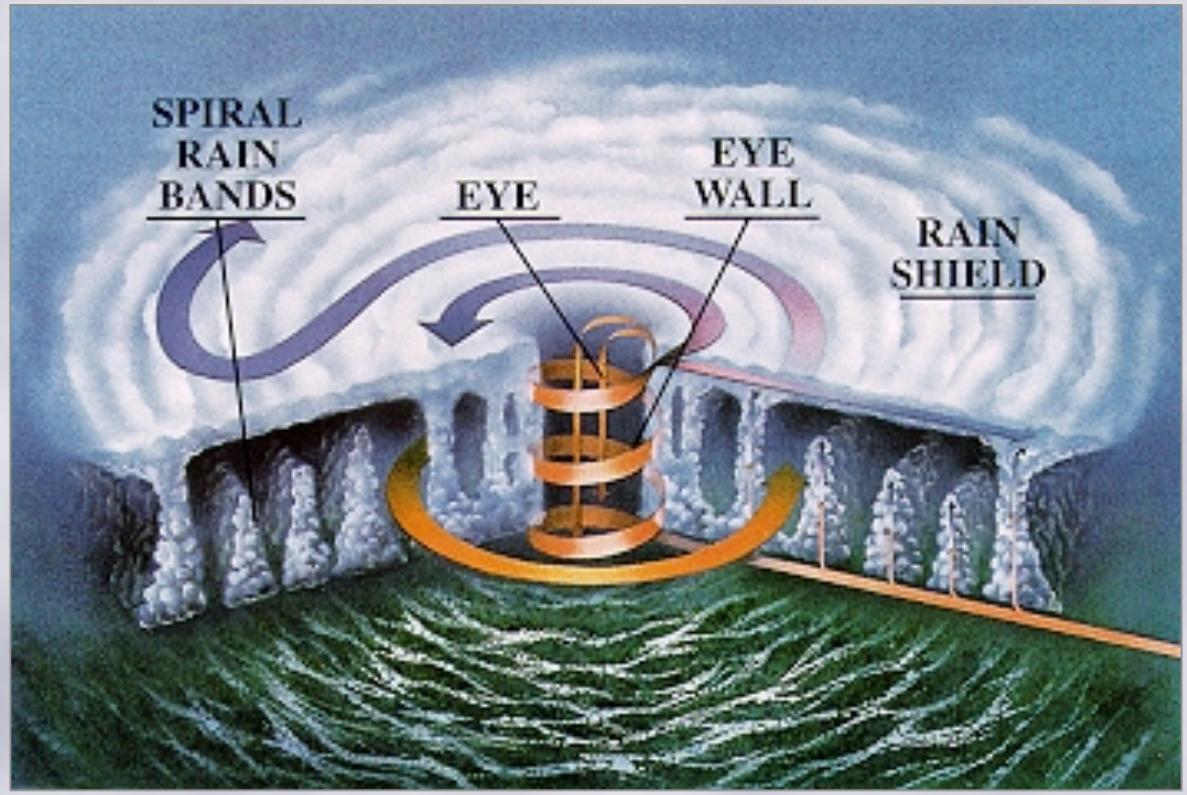
Tropical Storm



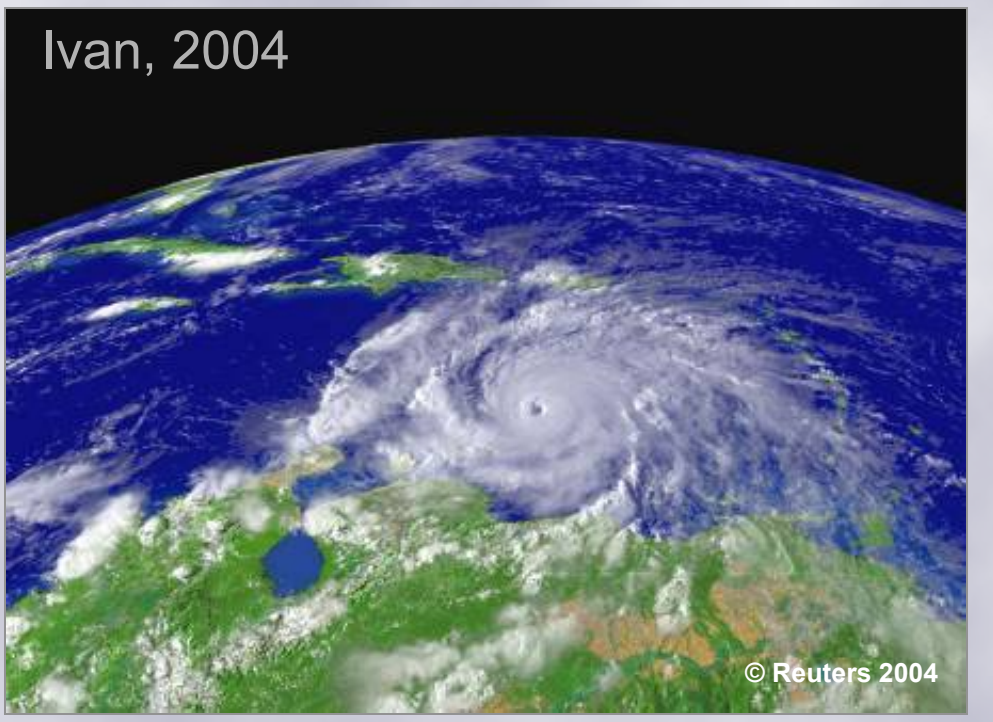
Tropical storms evolve out of tropical depressions. A strong pressure gradient develops, and as the system becomes more organized, thunderstorms and heavy rains are continually spawned.

A tropical storm becomes a hurricane when sustained wind speeds reach 64 knots (74 mph). A pronounced rotation develops around the central core.

Hurricanes

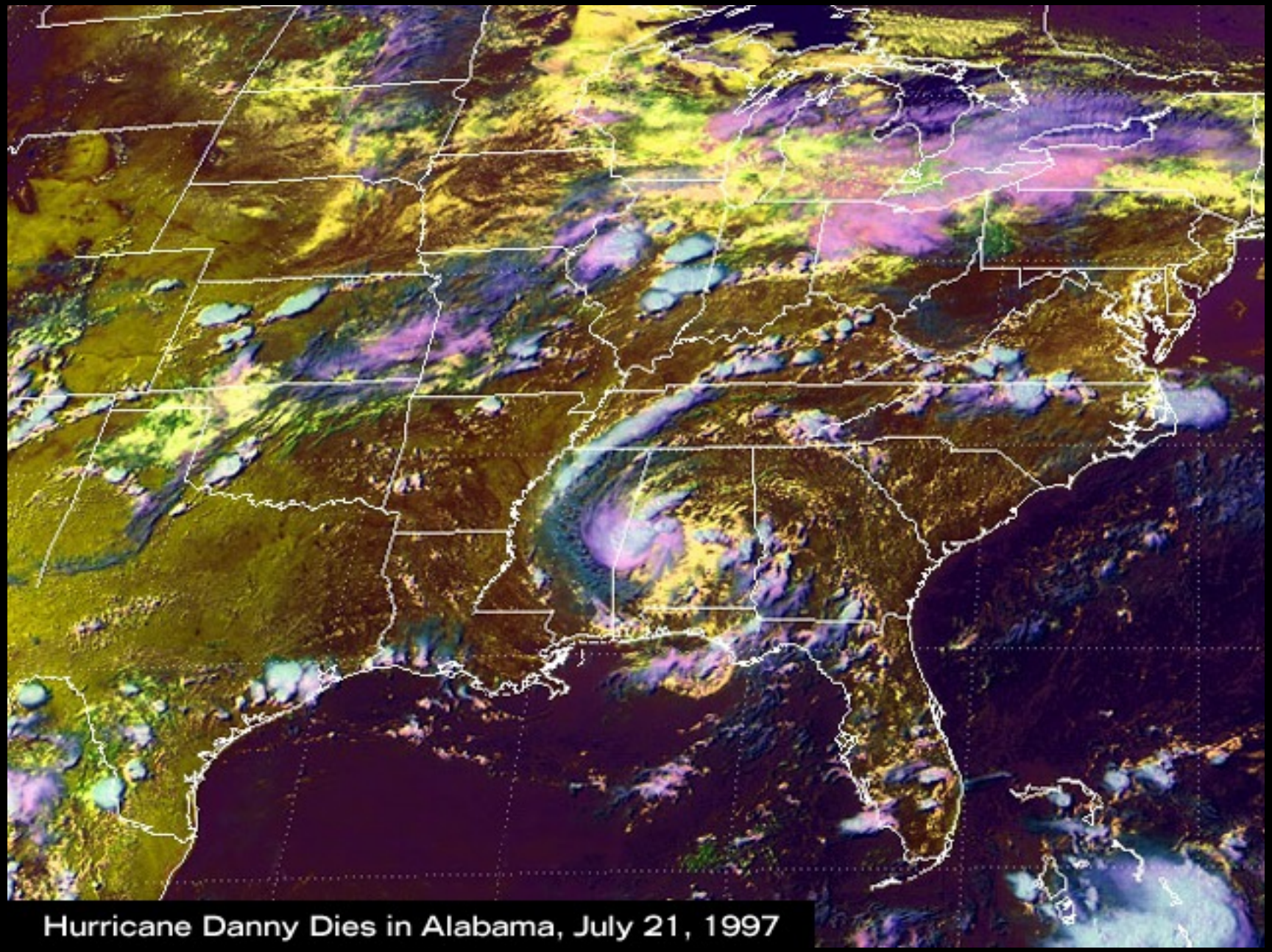


The “eye” of the hurricane develops as the hurricane becomes more organized. Conditions in the eye are mostly calm, although tornados can spin off the inner eye wall. The greater the pressure gradient, the more powerful the storm.



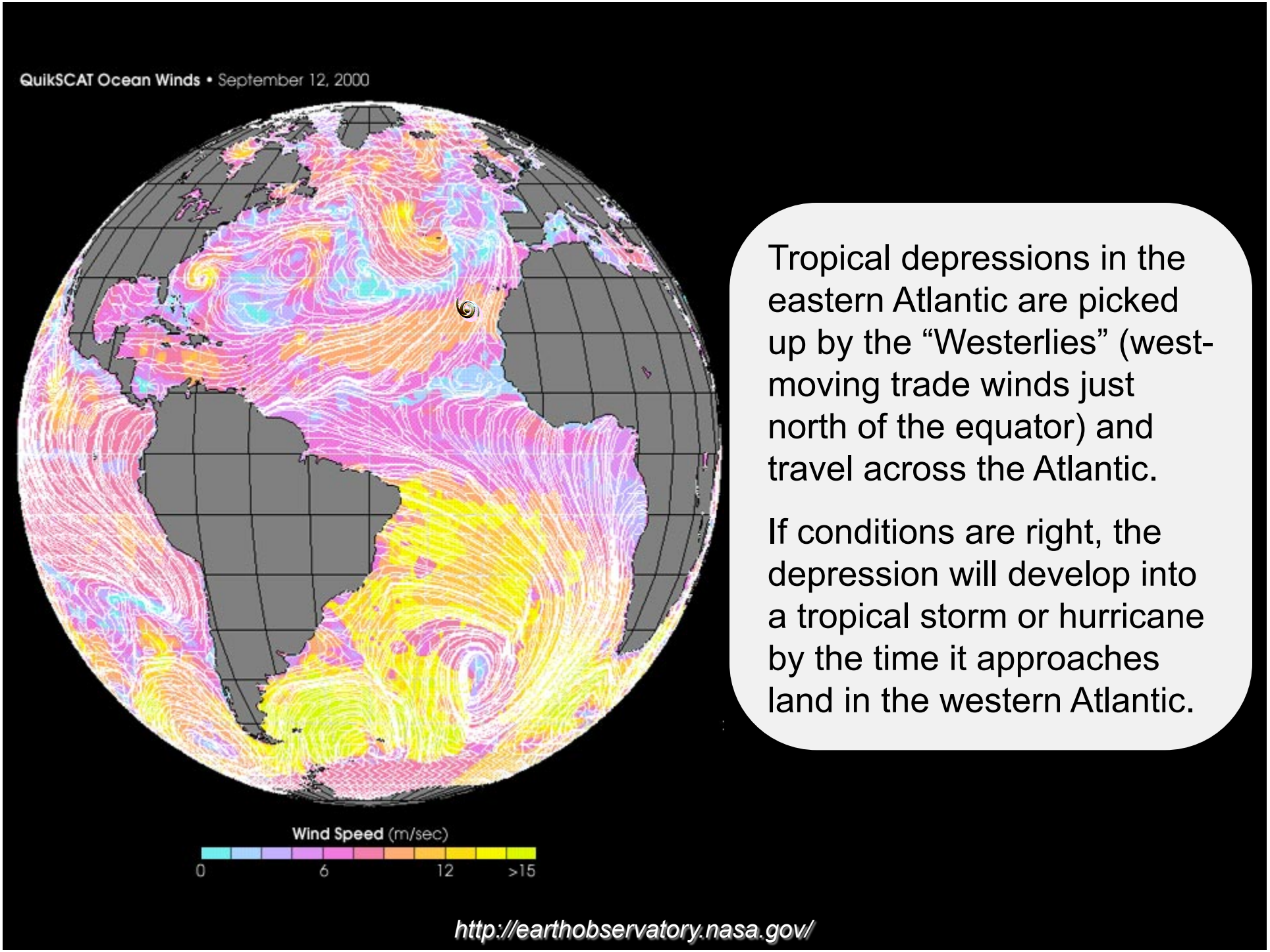
Hurricanes require warm water (~81^{o}C or higher). If the hurricane moves over cooler water or land, it will lose its organization and eventually become a tropical storm.

Fast-moving storms (e.g., Hugo) can track hundreds of miles inland before losing coherence.



Hurricane Danny Dies in Alabama, July 21, 1997

http://www.earth.nasa.gov/



Tropical depressions in the eastern Atlantic are picked up by the “Westerlies” (west-moving trade winds just north of the equator) and travel across the Atlantic.

If conditions are right, the depression will develop into a tropical storm or hurricane by the time it approaches land in the western Atlantic.

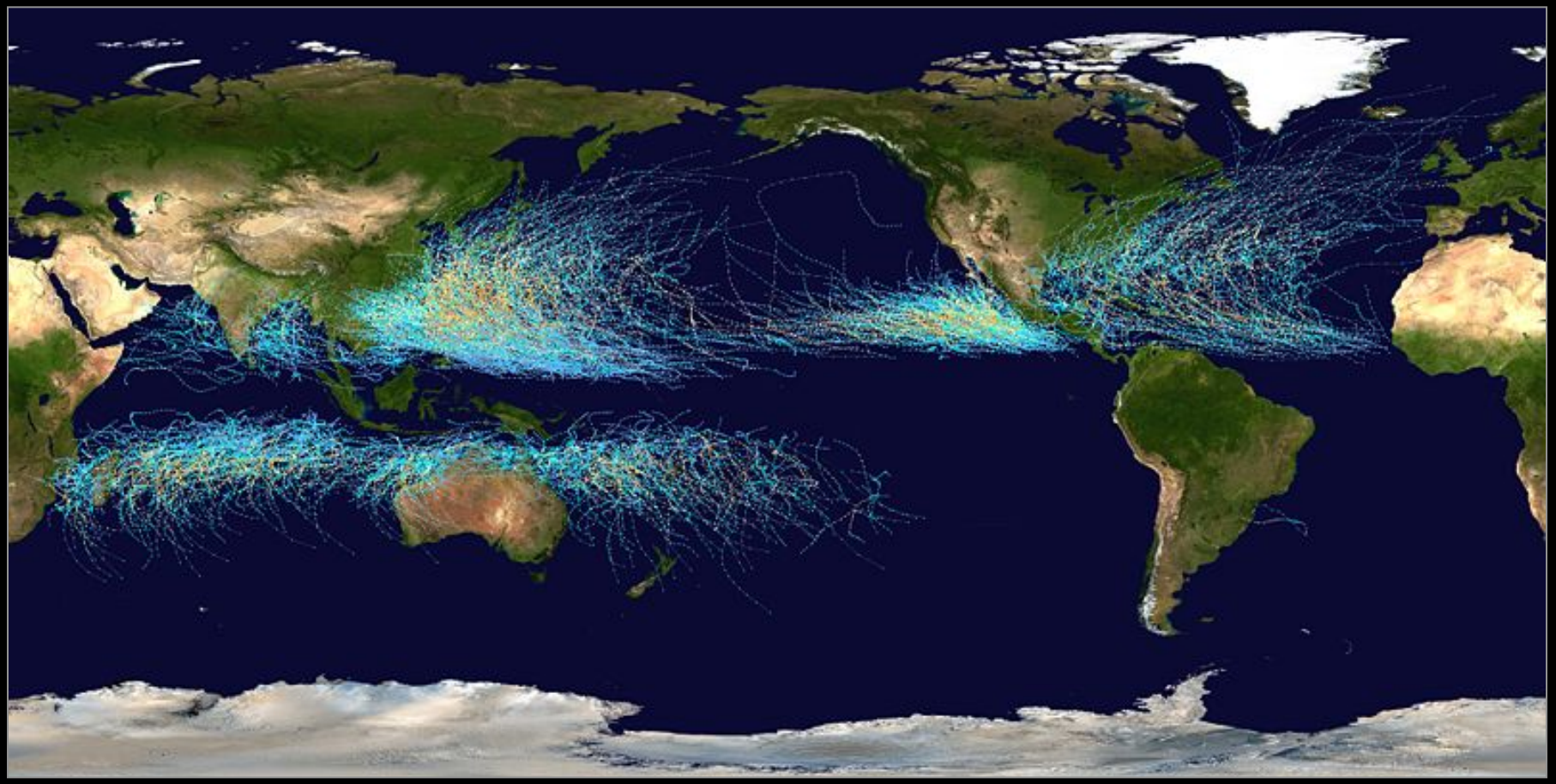
http://earthobservatory.nasa.gov/

Saffir-Simpson Hurricane Scale

One	74-95 mph	No real damage to building structures. Damage primarly to unanchored mobile homes, shrubbery, and trees. Also, some coastal road flooding and minor pier damage
Two	96-110 mph	Some roofing material, door, and window damage to buildings. Considerable damage to vegetation, mobile homes, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of center. Small craft in unprotected anchorages break moorings.
Three	111-130 mph	Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain continuously lower than 5 feet ASL may be flooded inland 8 miles or more.
Four	131-155 mph	More extensive curtainwall failures with some complete roof strucutre failure on small residences. Major erosion of beach. Major damage to lower floors of structures near the shore. Terrain continuously lower than 10 feet ASL may be flooded requiring massive evacuation of residential areas inland as far as 6 miles.
Five	>155 mph	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Major damage to lower floors of all structures located less than 15 feet ASL and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5 to 10 miles of the shoreline may be required.

http://www.aoml.noaa.gov/general/lib/laescae.html

Twenty Years of Tropical Cyclones (1985-2005)



Blue – tropical stroms and depressions

Yellow through red - hurricanes

Deadliest Atlantic Hurricanes

Storm	Year	Category	Deaths
Galveston, TX	1900	4	8,000-12,000
Lake Okeechobee, FL	1928	4	1,836
KATRINA	2005	4	>1,400
FL Keys/Texas	1919	4	600
New England	1938	3	600
FL Keys	1935	5	408
AUDREY	1957	4	390
NE U.S.	1944	3	390
Louisiana	1915	4	275
Galveston, TX	1915	4	275
CAMILLE	1969	5	256

U.S.A. 20th and 21st Centuries

1. MAR, STE, BAR, offshore	1780		20,000 - 22,000
2. Galveston (Texas)	1900		8,000-12,000
3. *FIFI*: Honduras	1974		3,000-10,000
4. Dominican Republic	1930		2,000-8,000
5. *FLORA*: Haiti, Cuba	1963		7,200
6. Pointe-a-Pitre Bay (GUA)	1776		>6,000
7. Newfoundland Banks	1775		4,000
8. Puerto Rico, Carolinas	1899		3.064-3,443
9. FL, GUA, PR, TUR, MAR	1928		3,375-4,075
10. Cuba, CI, Jamaica	1932		>3,107

Americas

http://www.aoml.noaa.gov/hrd/Landsea/deadly

Hurricane Floyd

Flooding during and after hurricanes usually cause more damage and injuries than wind.

Dogs rescued from flooded rooftops

http://www.wildweather.com/

Hurricane Katrina Before and After