

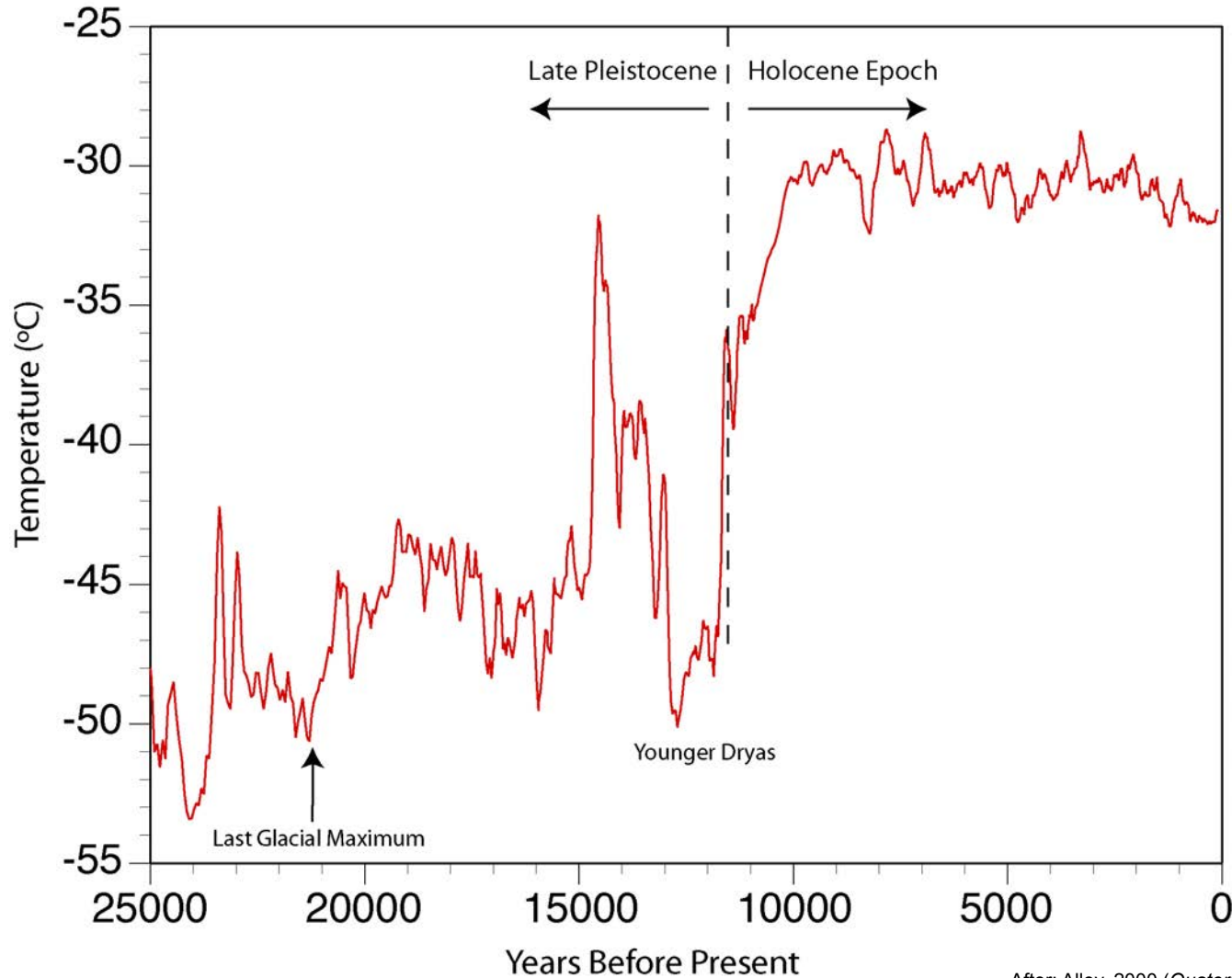


Global Warming:

Hurricanes

Holocene Paleoclimate

Central Greenland: GISP2



What is a tropical cyclone?

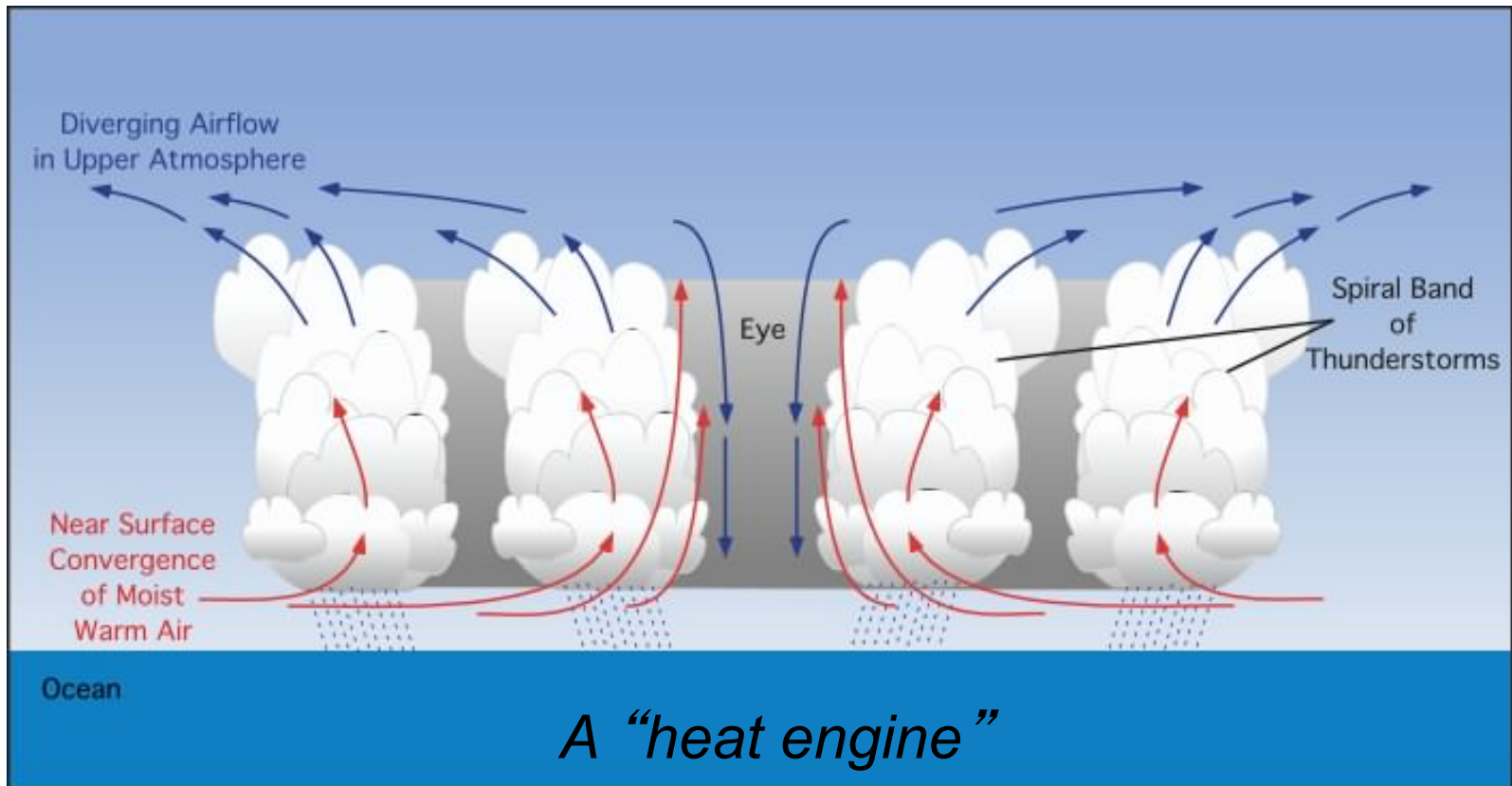
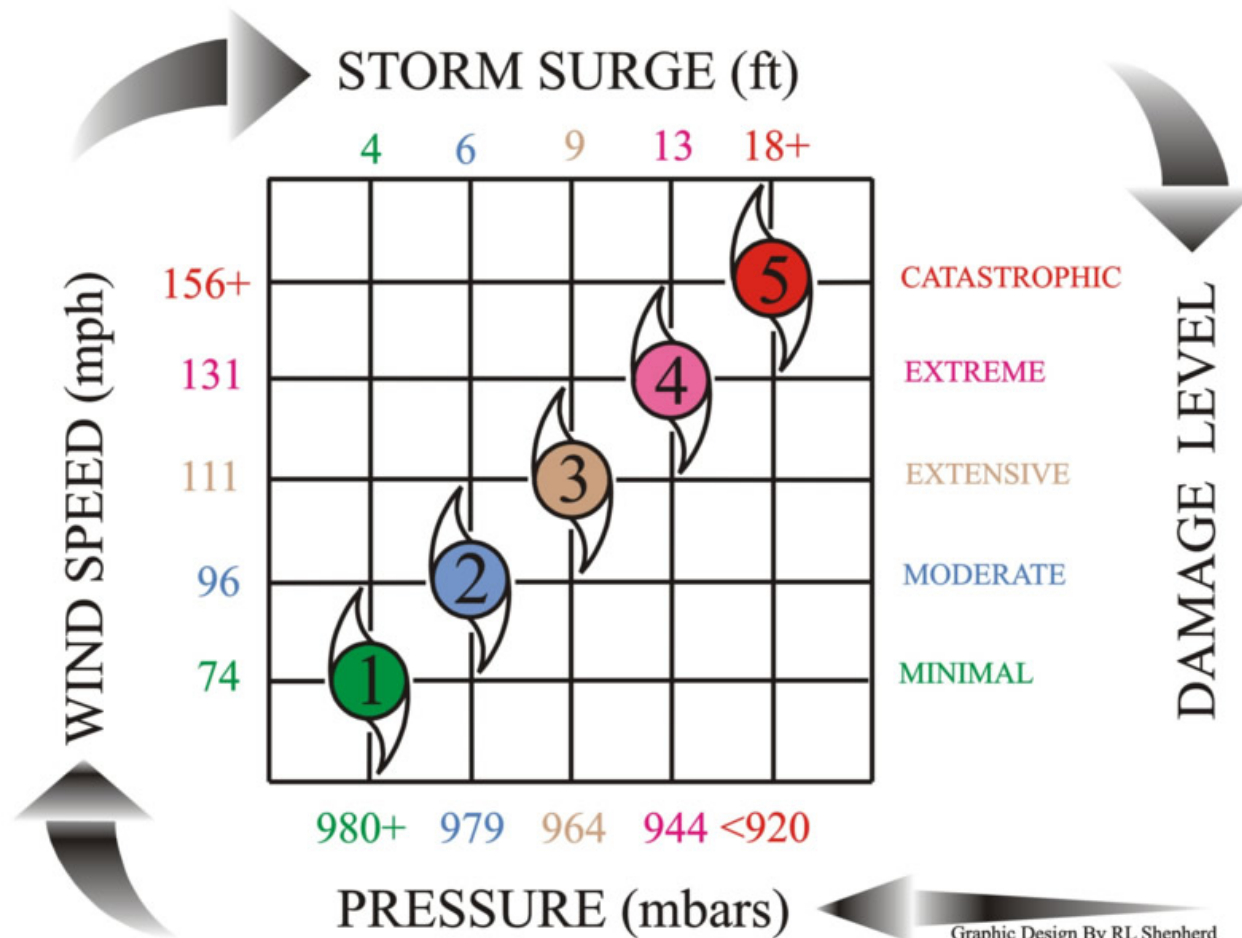


Image: Dr. Michael Pidwirny, University of British Columbia

Hurricane FAQ: <http://www.aoml.noaa.gov/hrd/tcfaq/tcfaqHED.html>

Understanding and attributing hurricane variability

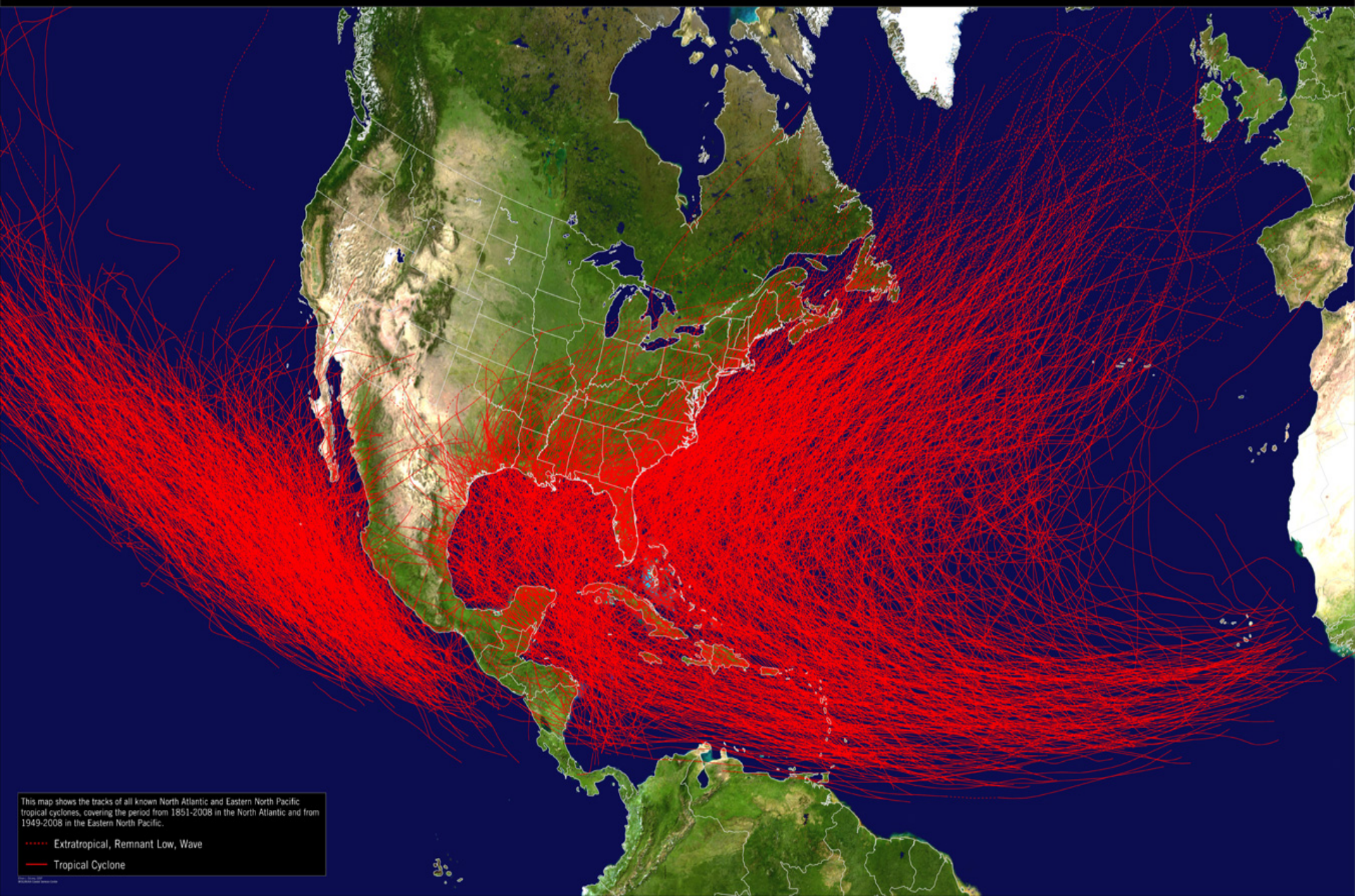
SAFFIR-SIMPSON HURRICANE SCALE



Tropical Cyclone History



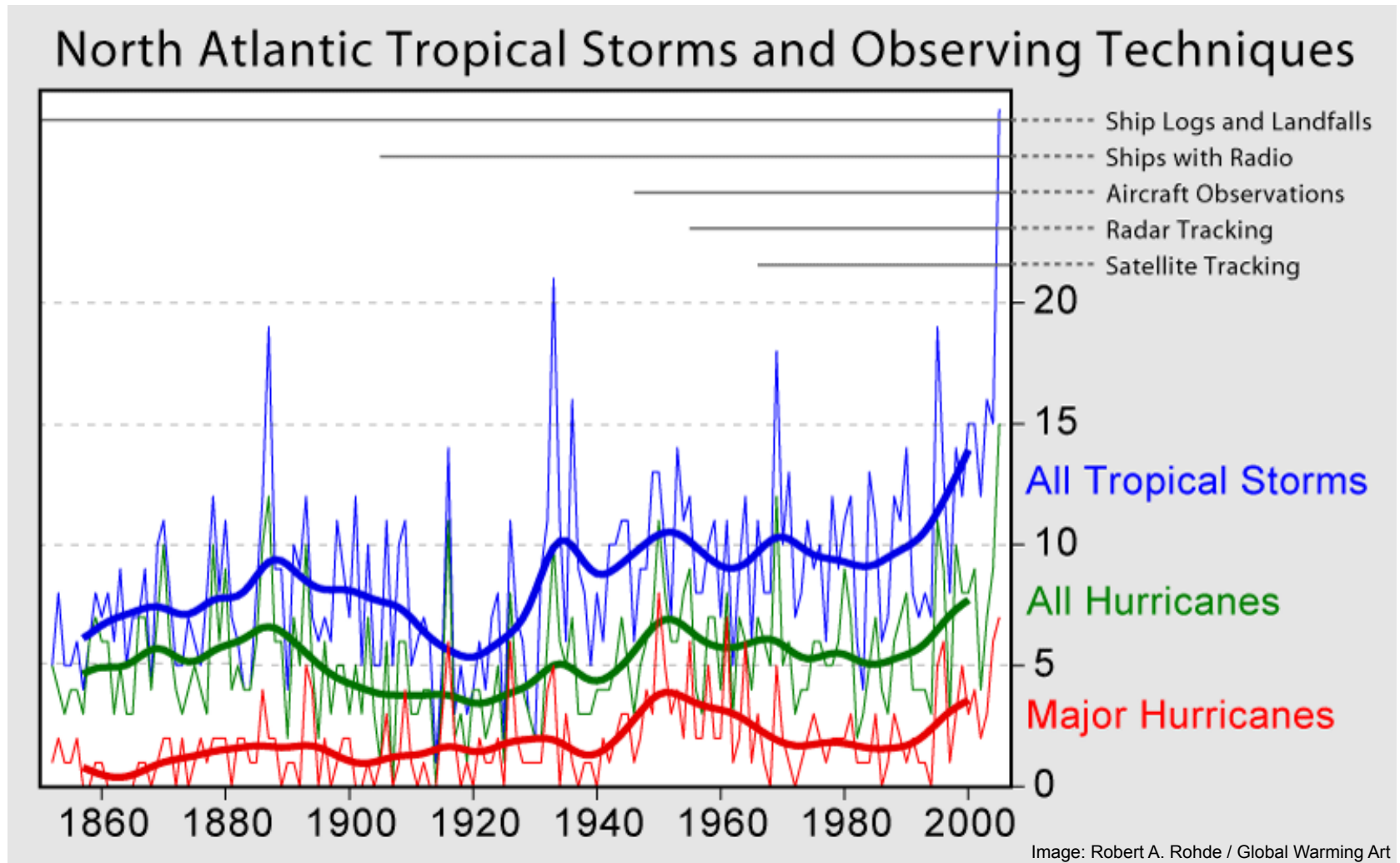
Data from 1949 in the Pacific, from 1851 in the Atlantic



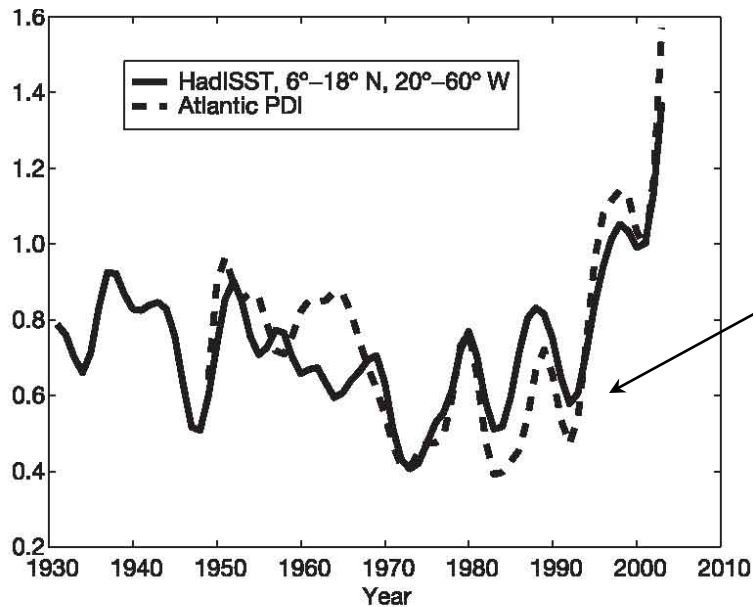
This map shows the tracks of all known North Atlantic and Eastern North Pacific tropical cyclones, covering the period from 1851-2008 in the North Atlantic and from 1949-2008 in the Eastern North Pacific.

----- Extratropical, Remnant Low, Wave
—— Tropical Cyclone

Atlantic Hurricane Database since 1851



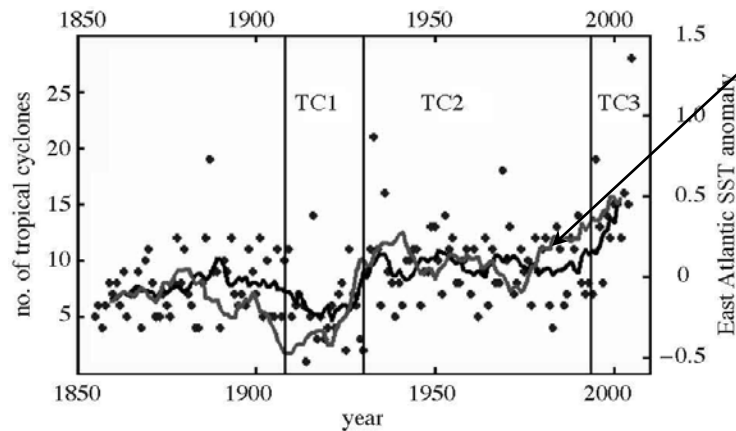
Is recent variability due to GCC.....



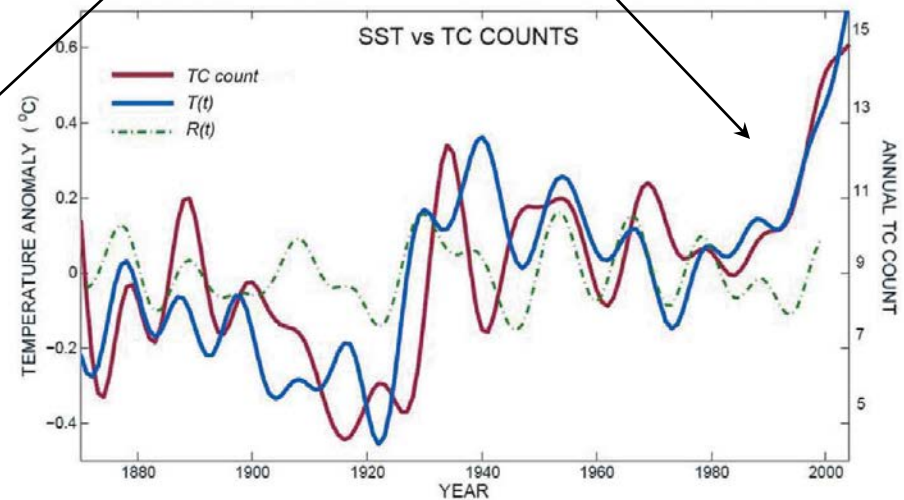
Emanuel, 2005 (*Nature* v.436)

Increasing Intensity

Increasing Frequency



Holland and Webster, 2007 (*Phil. Trans. R. Soc.* doi:10.1098)



Mann & Emanuel, 2006 (*Eos* v.87)

Return Period In Years For Category 3 Hurricanes

Table 7. Average number of tropical cyclones* which reached storm, hurricane and major hurricane status. Updated from Blake et al. (2005).

PERIOD	Number of Years	Average number of Tropical Storms	Average number of Hurricanes	Average number of Major Hurricanes
1851 - 2006	156	8.7	5.3	1.8
1944 [#] - 2006	63	10.6	6.1	2.7
1957 - 2006	50	10.7	6.0	2.4
1966 [§] - 2006	41	11.1	6.2	2.3
1977 - 2006	30	11.4	6.3	2.5
1987 - 2006	20	12.6	6.8	2.9
1997 - 2006	10	14.5	7.8	3.6

*Includes subtropical storms after 1967

[#]Start of aircraft reconnaissance

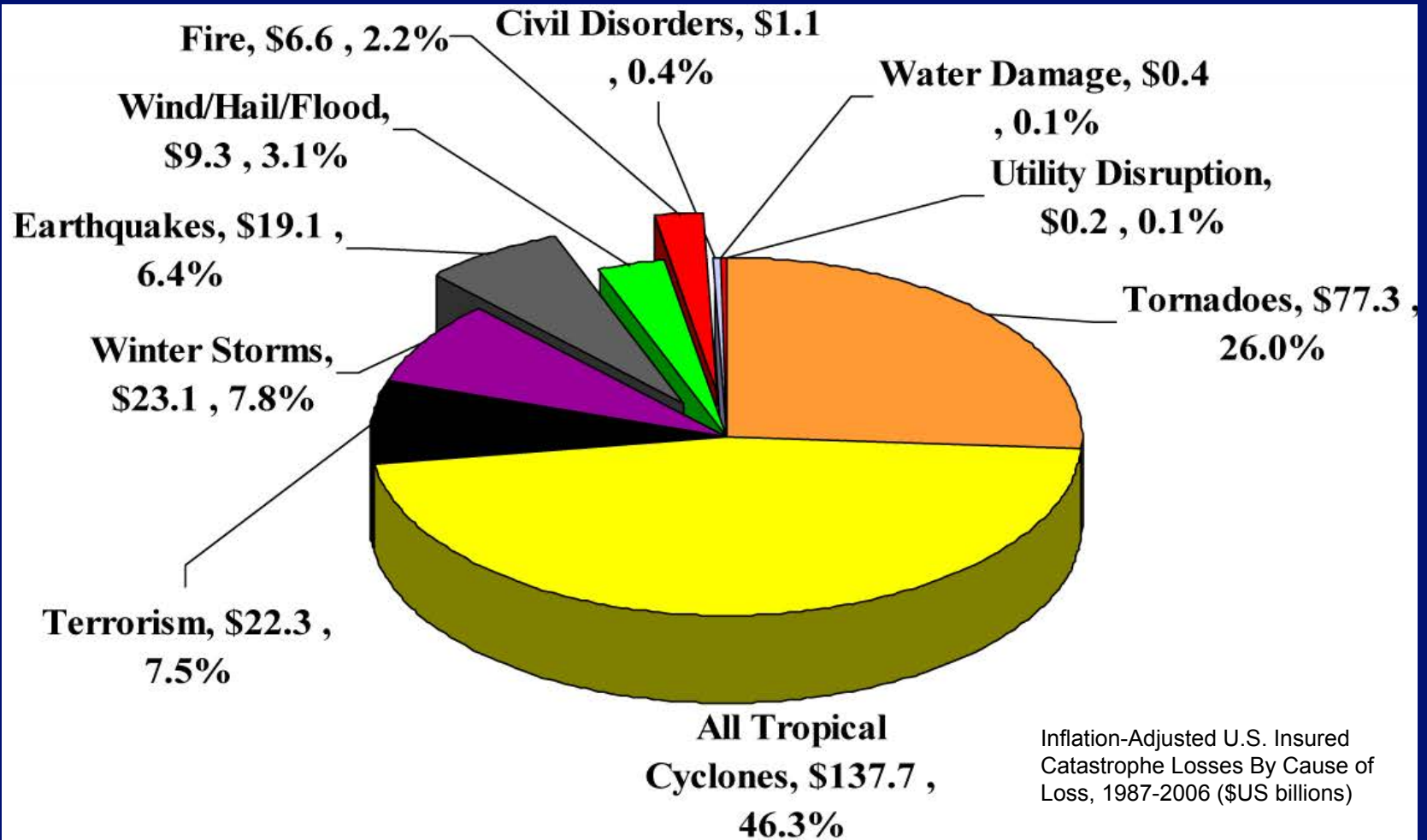
[§]Start of geostationary satellite coverage

Category 3 (years)

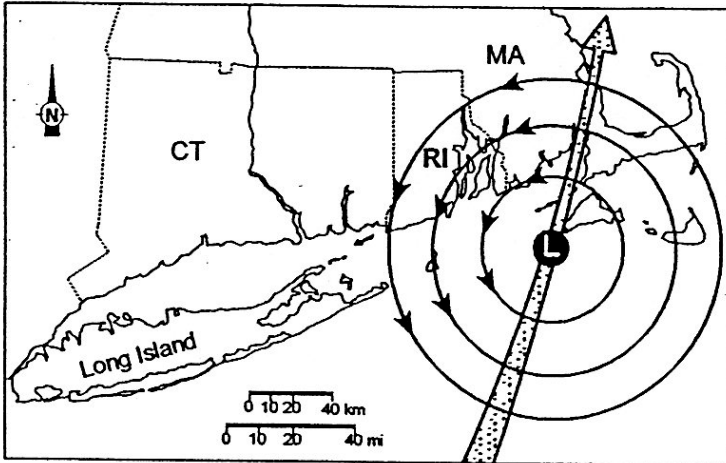
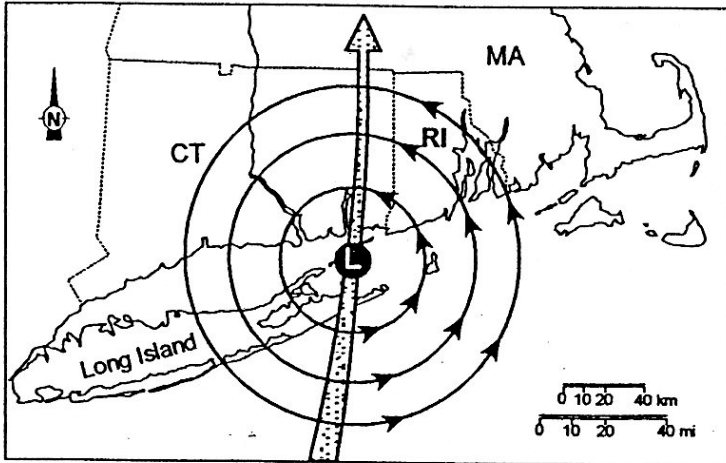
- 9 - 22
- 24 - 32
- 33 - 44
- 46 - 74
- 79 - 370

Landfall Return Periods: The frequency at which a certain category of hurricane is expected within 75 nm (86 miles) of a given location.

Assessment of Hurricane Risk



Impacts of Landfalling Storms



Wright & Sullivan, 1980

- Strong winds
- Coastal flooding
 - Large waves and swells
 - Storm surge
- Inland flooding
 - Heavy precipitation
 - Severe thunderstorms
- Tornadoes

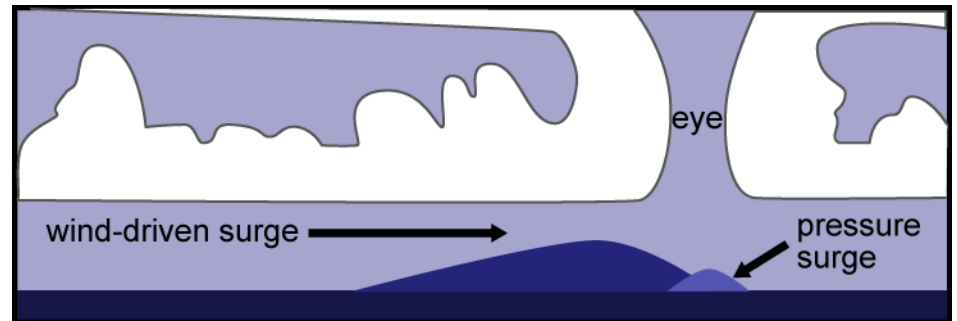
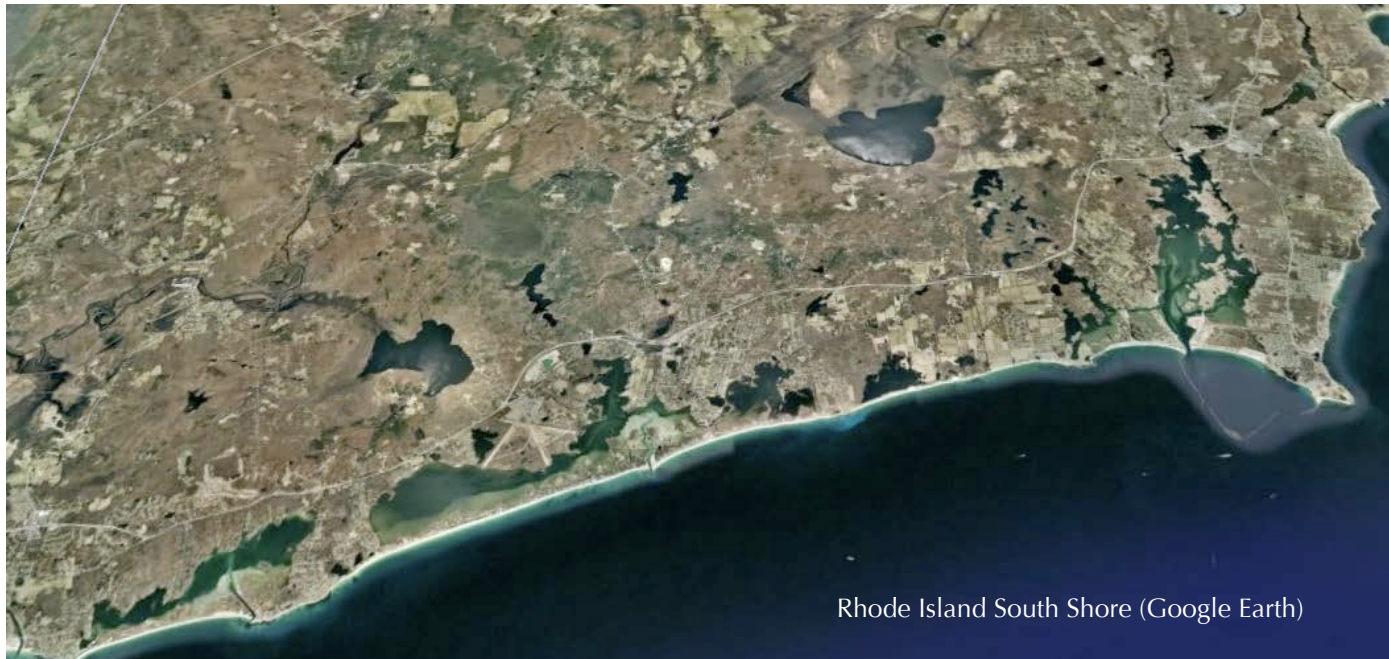


Image: NASA Earth Observatory

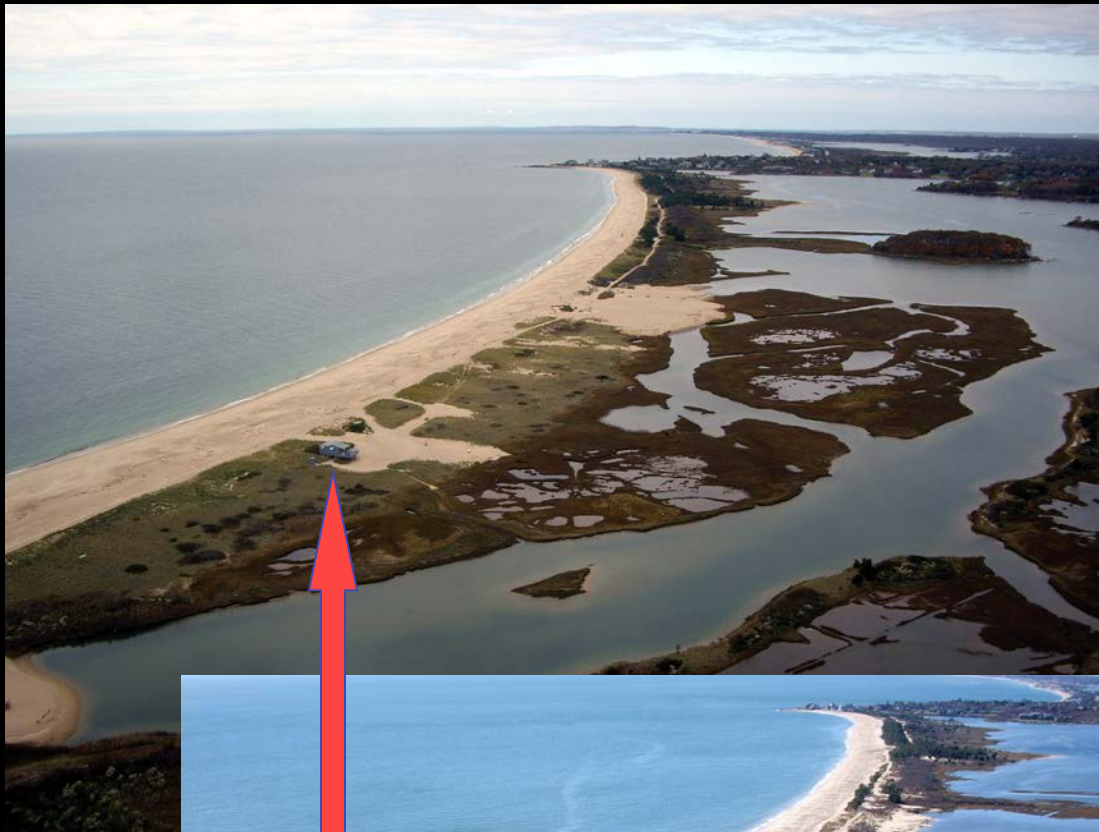
Records of coastal flooding



Overwash of barrier beaches



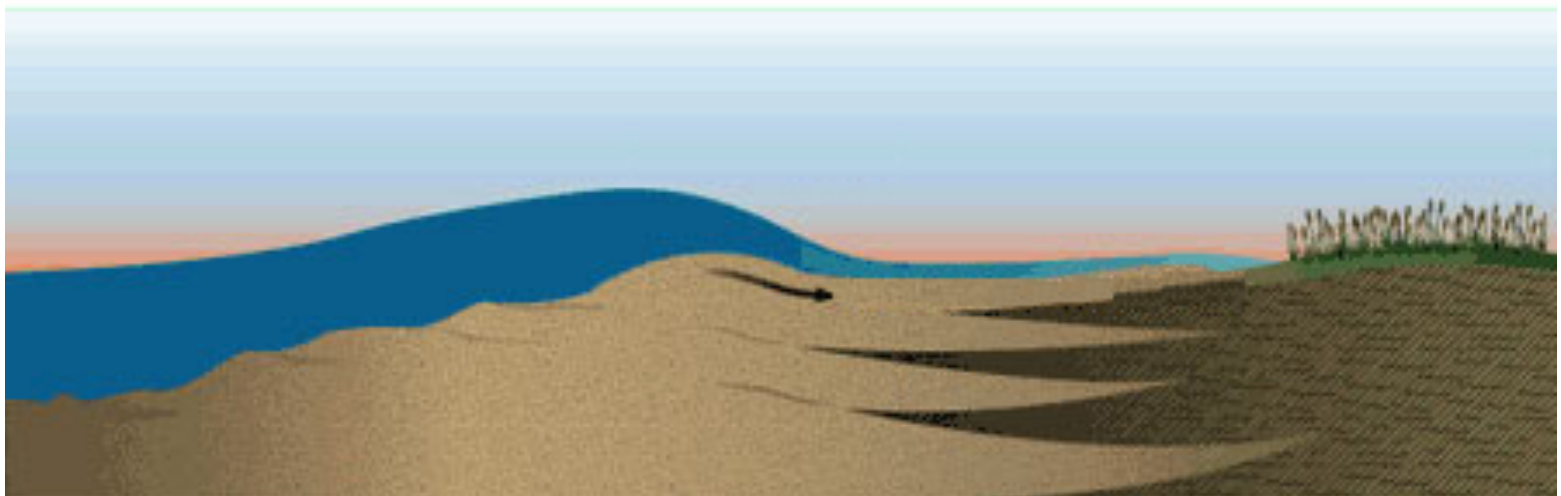
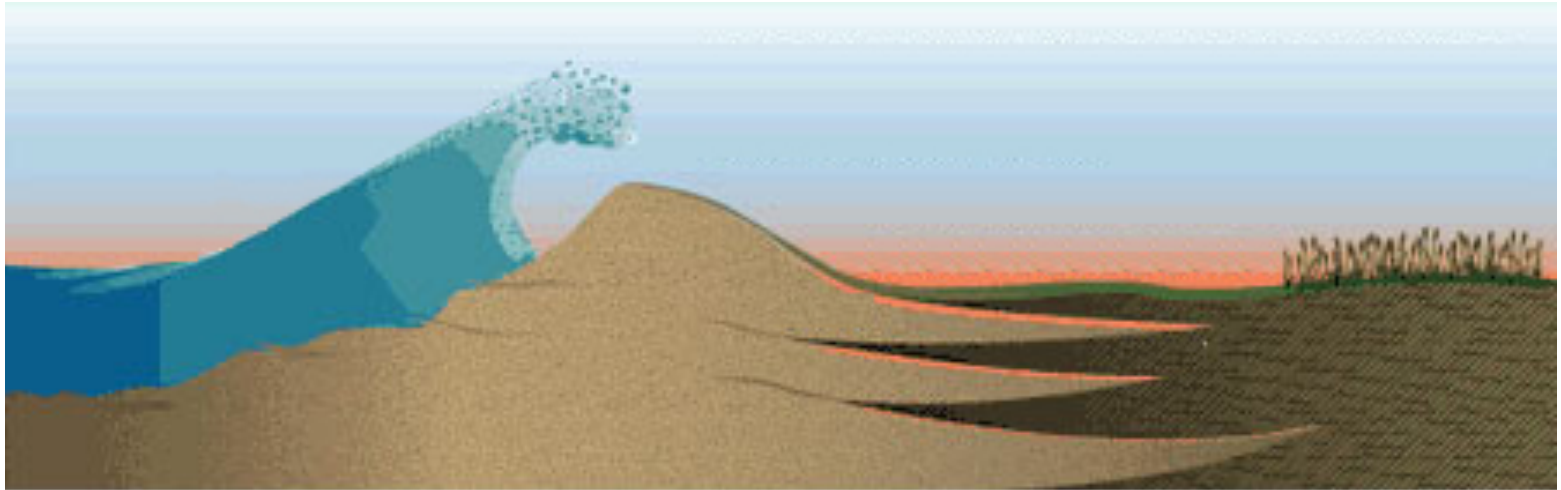
Before



After



Overwash of barrier beaches



Shallow Water Coring

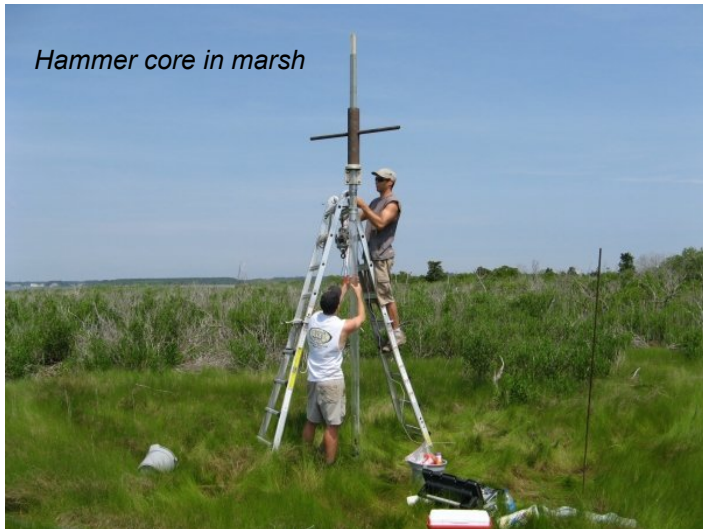
Fixed piston push core



Coring platform



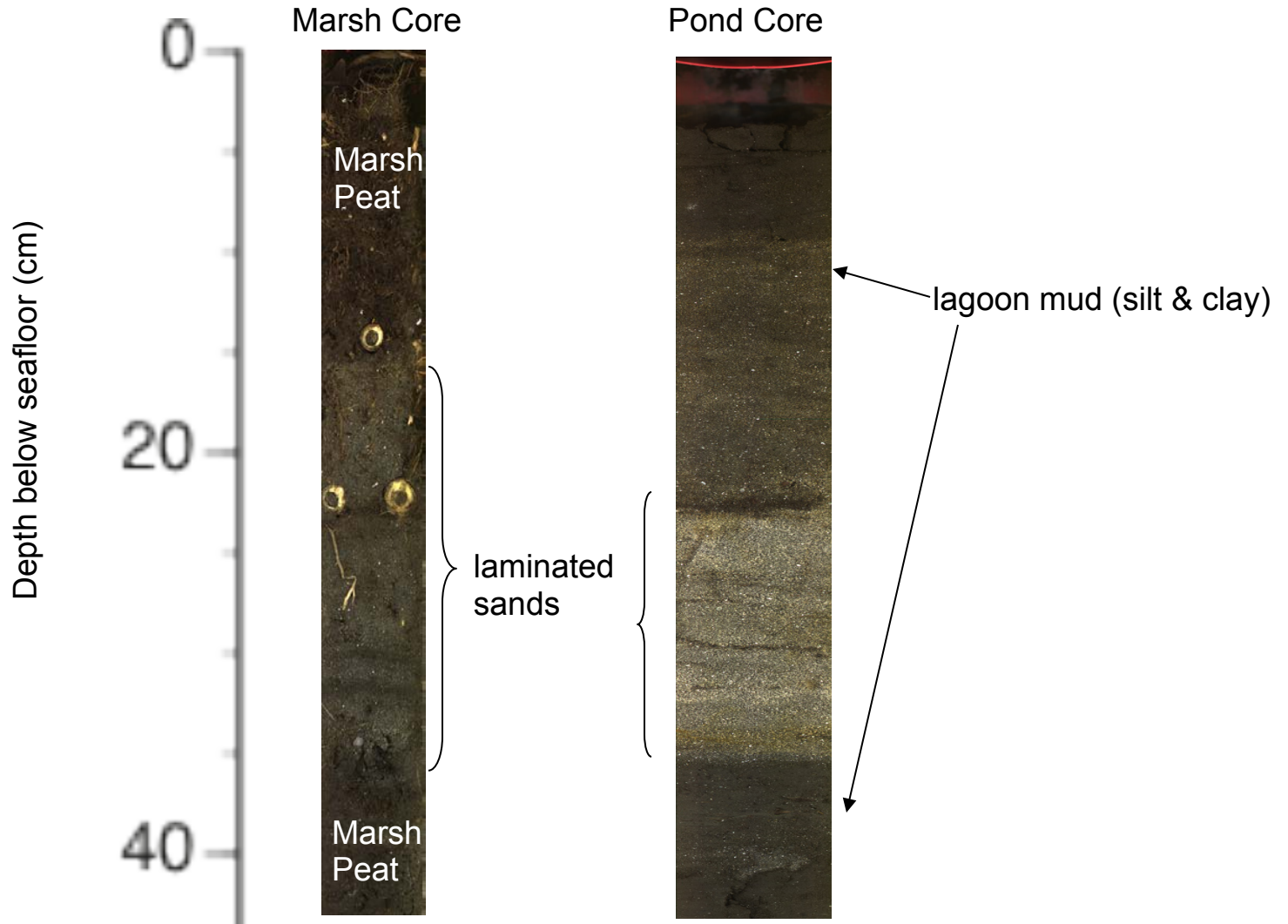
Hammer core in marsh



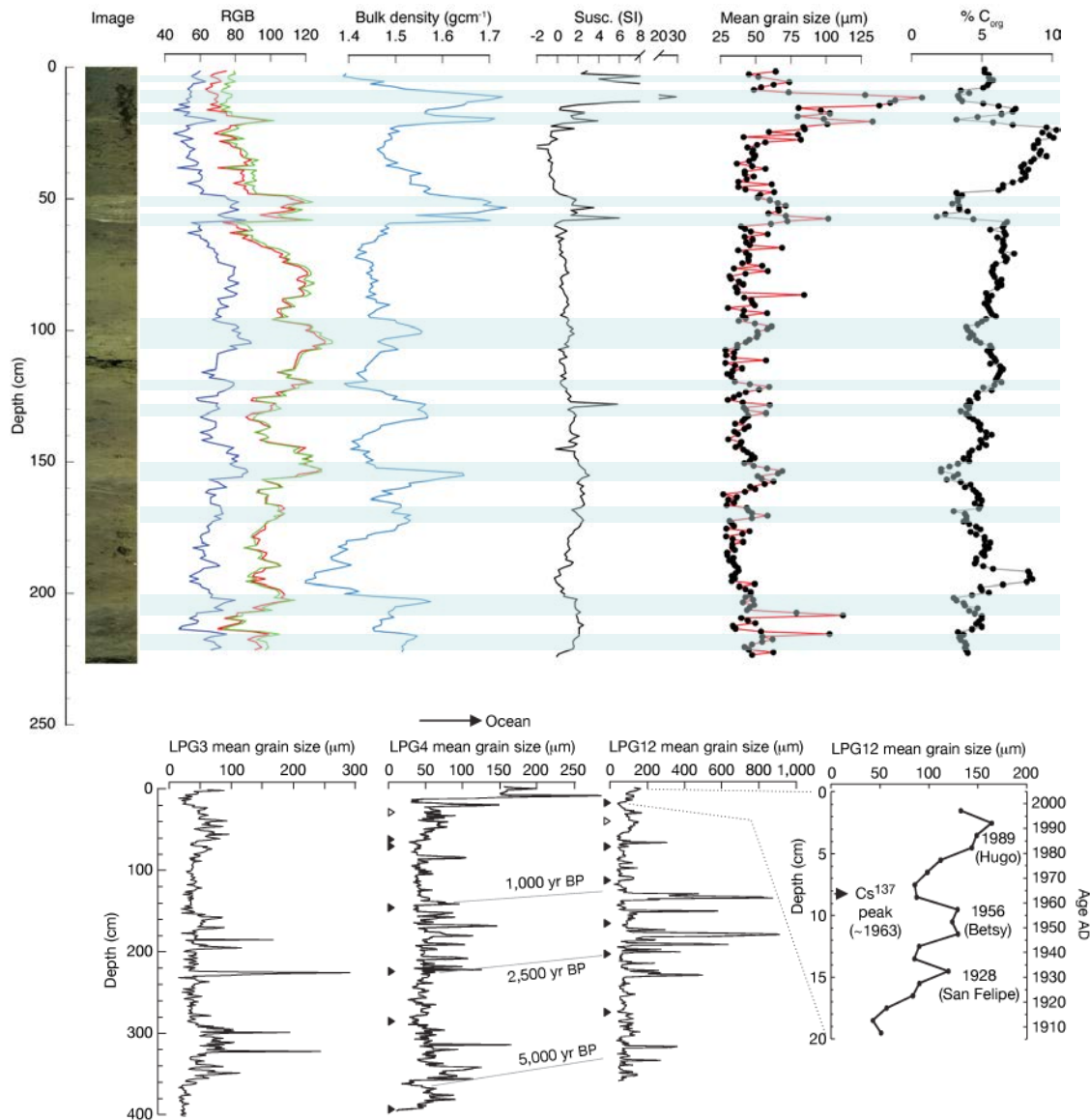
Geologists excited to find storm deposits



Identification of storm deposits

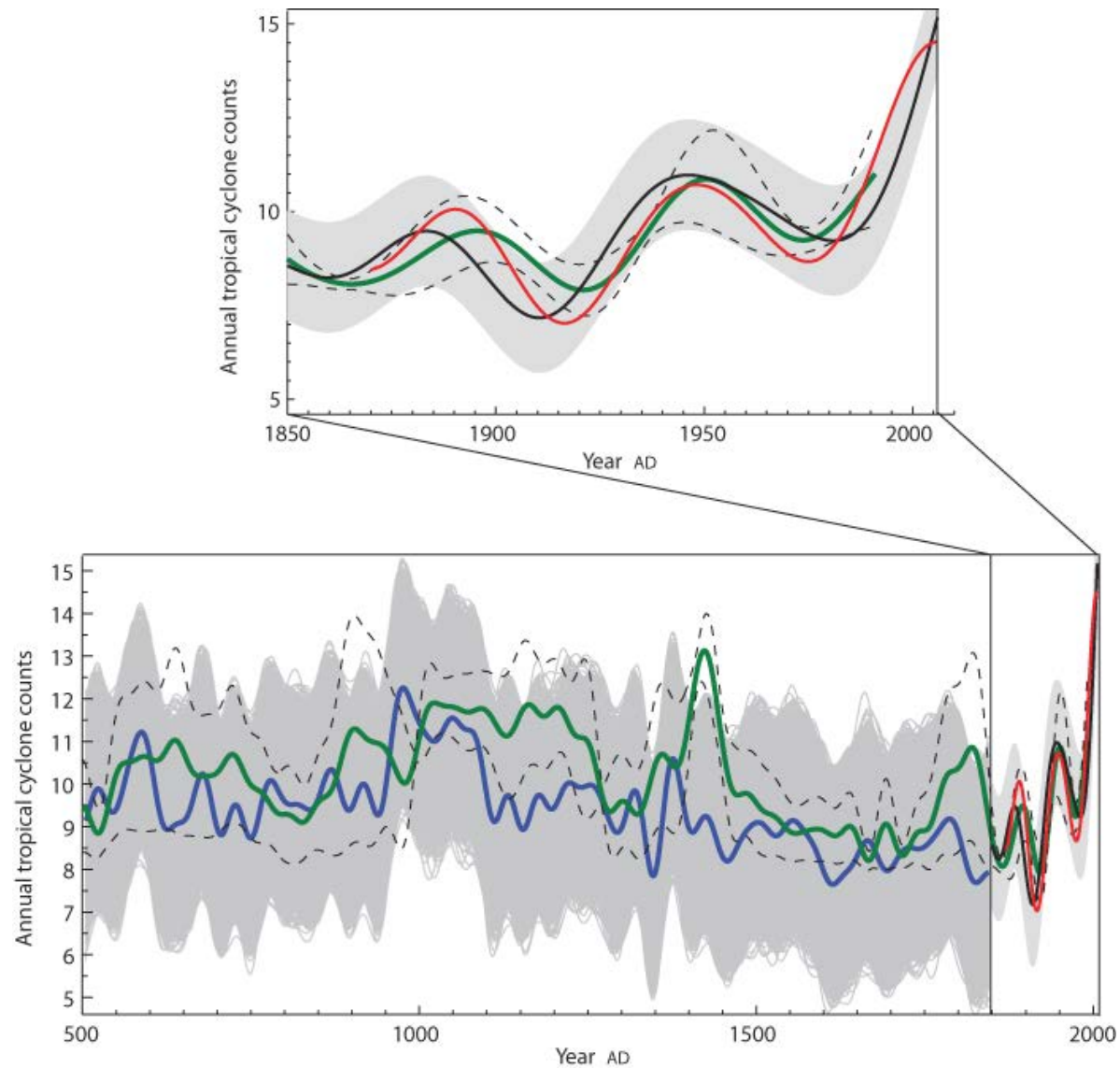


Sedimentary record of hurricane strikes



1. Overwash layers identified
physical properties (density, color)
grain size
organic carbon content
microfossils
2. Layers correlated between
cores
3. Sediments are dated
radiocarbon
210Pb, 137Cs
4. Record compared to period of
instrumental and historical
overlap

Atlantic hurricanes and climate over the past 1,500 years



Achieved Storm Intensity Under Idealized Conditions

