Lecture 30 Hurricanes II

Cross-sections through Hurricane Alicia (1983)

Emanuel 1994

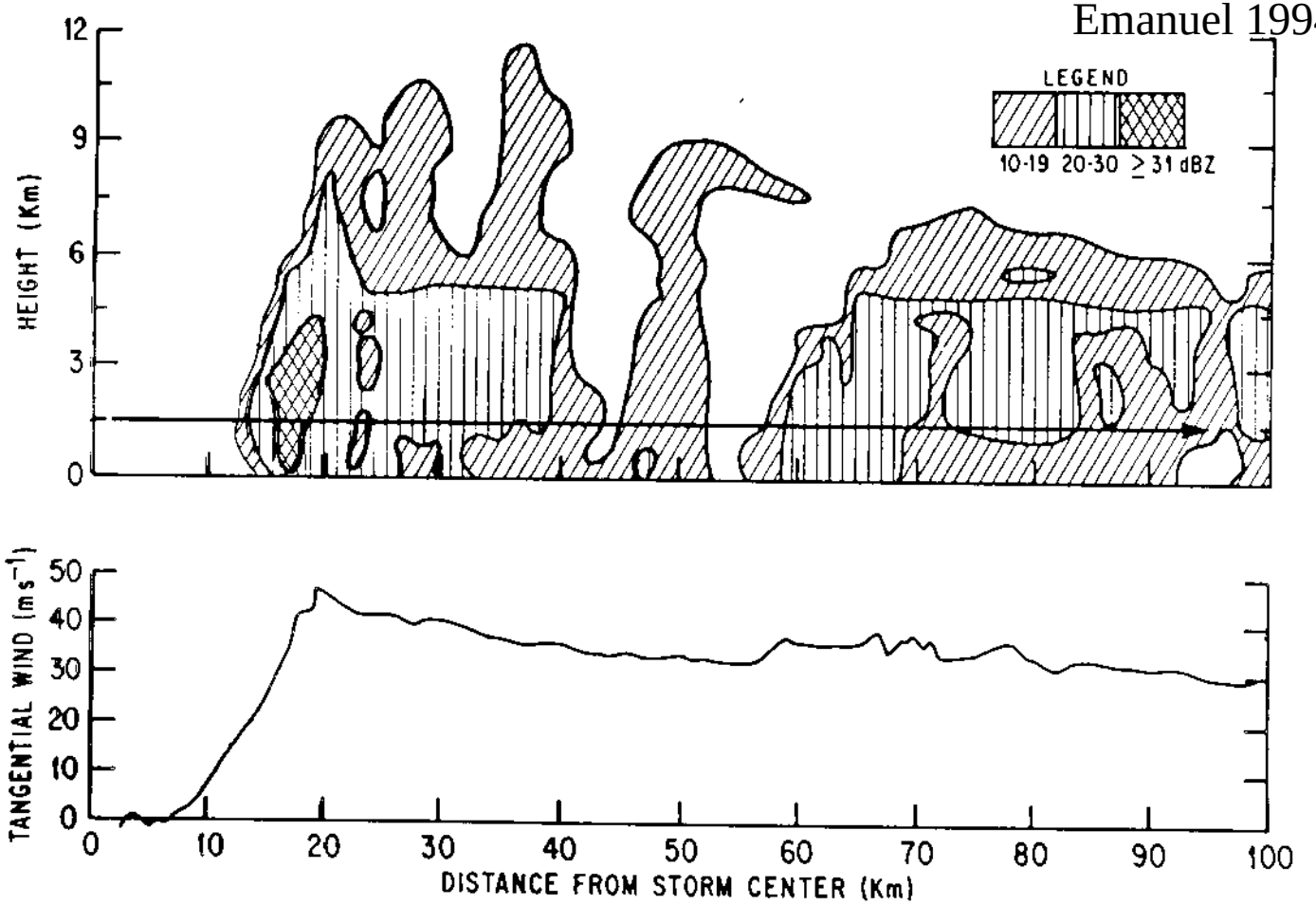
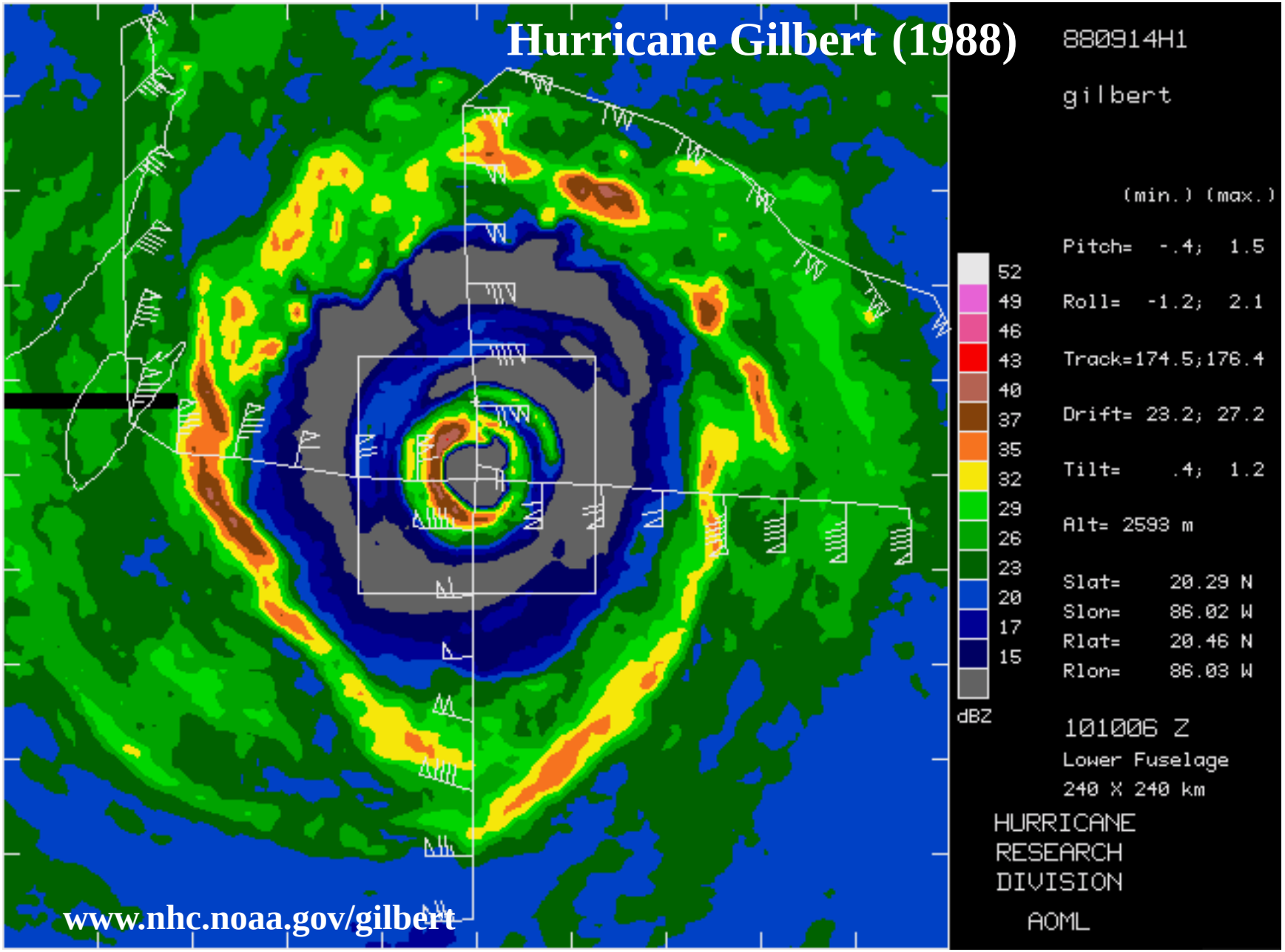


Figure 14.7. Profiles of radar reflectivity and tangential winds in Hurricane Alicia. The data were recorded from 0109 to 0128 GMT, 18 August 1983. The radar reflectivity cross section was obtained by compositing vertical rays from the tail radar at four samples per minute. The horizontal arrow indicates the altitude of the aircraft.


Hurricane Gilbert (1988)
880914H1
gilbert
(min.) (max.)
Pitch= -.4; 1.5
Roll= -1.2; 2.1
Track=174.5;176.4
Drift= 23.2; 27.2
Tilt= .4; 1.2
Alt= 2593 m
Slat= 20.29 N
Slon= 86.02 W
Rlat= 20.46 N
Rlon= 86.03 W
101006 Z
Lower Fuselage
240 X 240 km
52
49
46
43
40
37
35
32
29
26
23
20
17
15
dBZ
HURRICANE
RESEARCH
DIVISION
AOML
www.nhc.noaa.gov/gilbert

Tropical Cyclone Formation Regions

- Form over water of temperature 26 C or above, at 5-25 degrees from equator

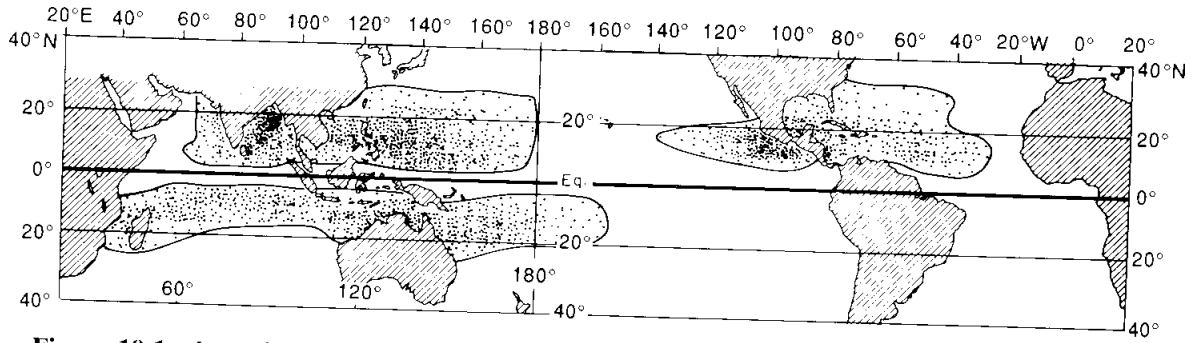


Figure 10.1 Locations of tropical cyclone formation over a 20-year period. (From Gray, 1979. Reprinted with permission from the Royal Meteorological Society.)

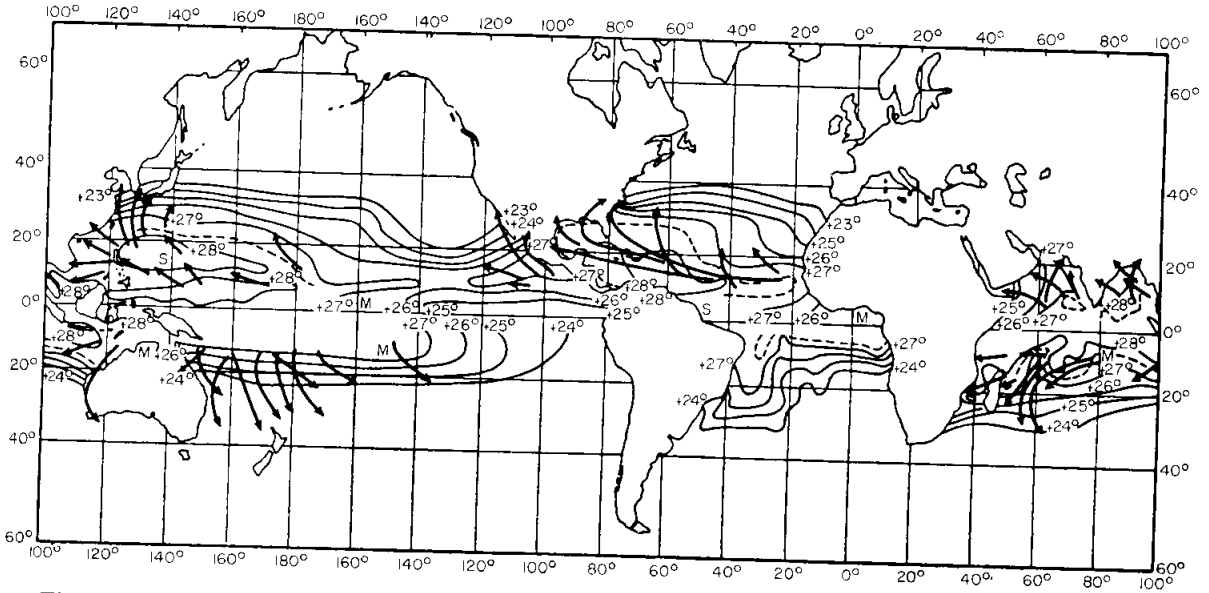
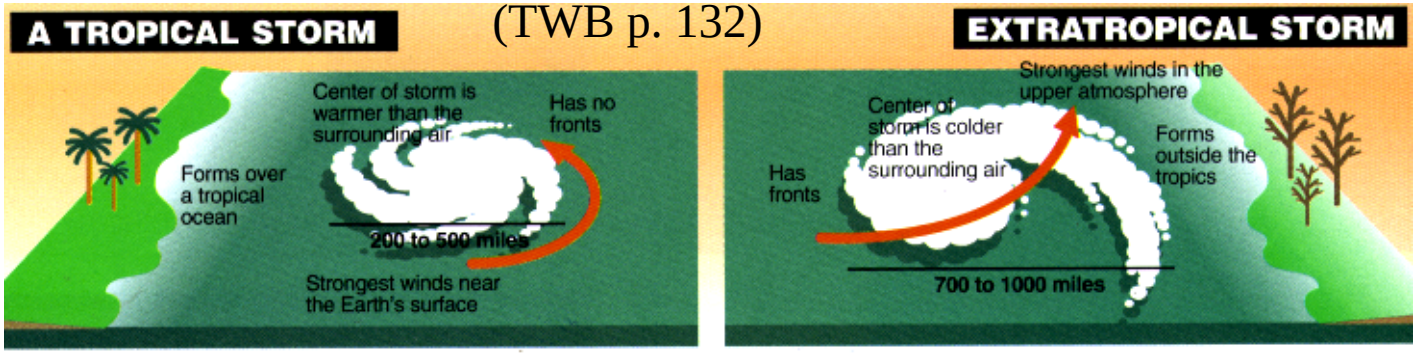


Figure 10.2 Tracks of tropical cyclones in relation to mean sea-surface temperature (°C). September temperatures are taken for the Northern Hemisphere. March temperatures are taken for the Southern Hemisphere. (From Bergeron, 1954. Reprinted with permission from the Royal Meteorological Society.)

(Houze, *Cloud Dynamics*, 1994)

Comparison of Tropical, ET Cyclones

(TWB p. 132)



Tropical Cyclone	ET Cyclone
Warm at center	Cold at center
Forms over tropical oceans	Forms at boundary between warm, cold midlatitude airmasses
Energy source: latent heat from water evaporated off warm ocean	Energy source: horizontal temperature contrasts
Strong winds at surface	Strong jet stream aloft
No fronts	Cold and warm fronts
500 km diameter	1500 km diameter

Hurricane lifecycle

Easterly waves form in subtropics.

- In a few strong easterly waves, a tropical depression with 20-40 mph circulating winds develops.
- May amplify to tropical storm (gets a name), then hurricane in a couple of days.
- Hurricane moves with the average winds in troposphere, typically lasting up to a week.
- Most hurricanes die after ‘recurv-ing’ into midlatitude westerlies, or dissipate over land (flooding).

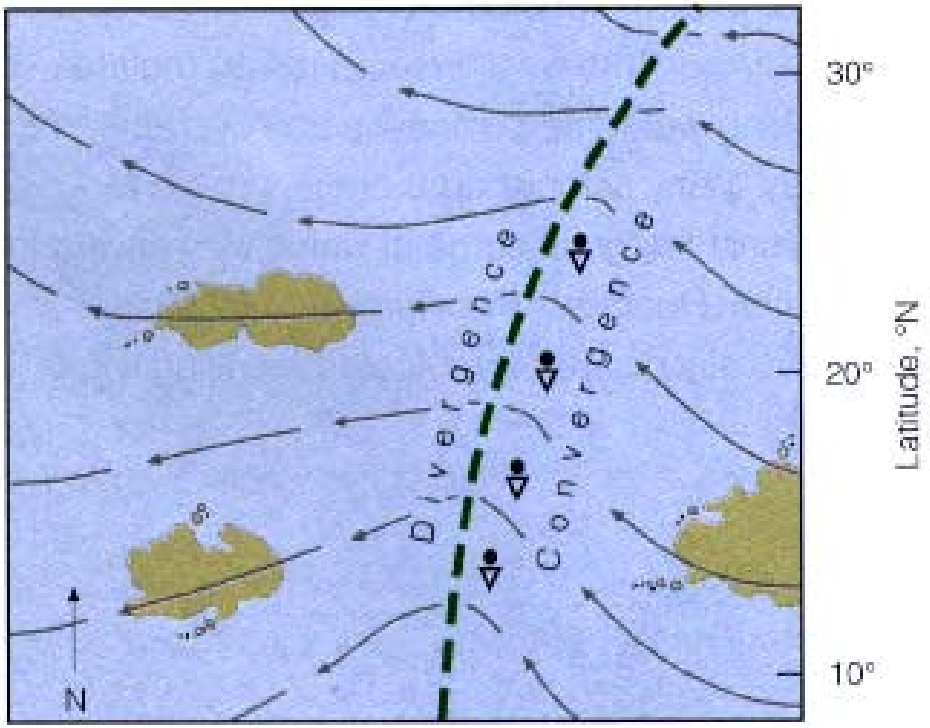
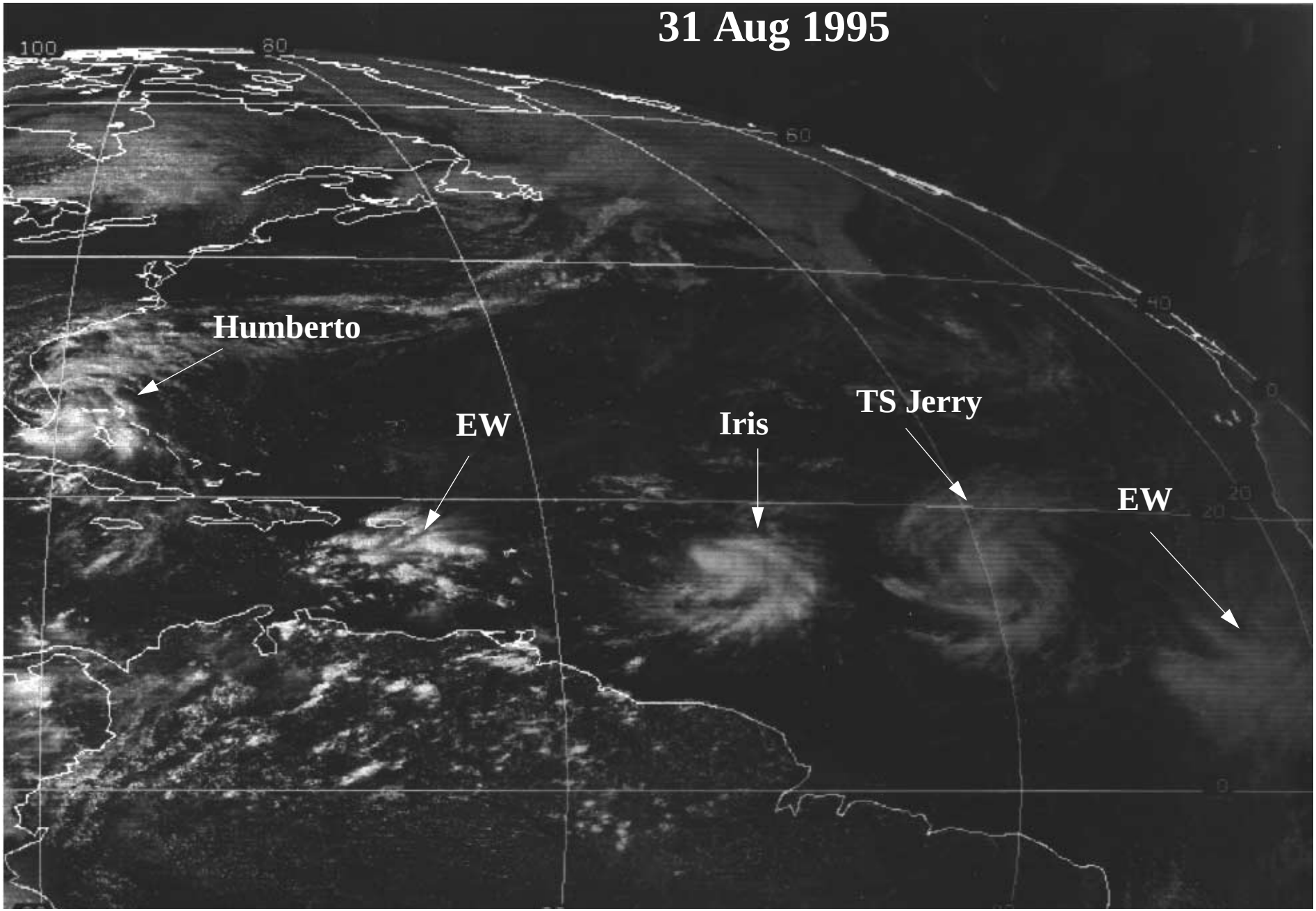


Figure 11.1 (EOM)
An easterly wave as shown by the bending of streamlines. (The heavy dashed line is the axis of the trough.) The wave moves slowly westward, bringing fair weather on its western side and showers on its eastern side.

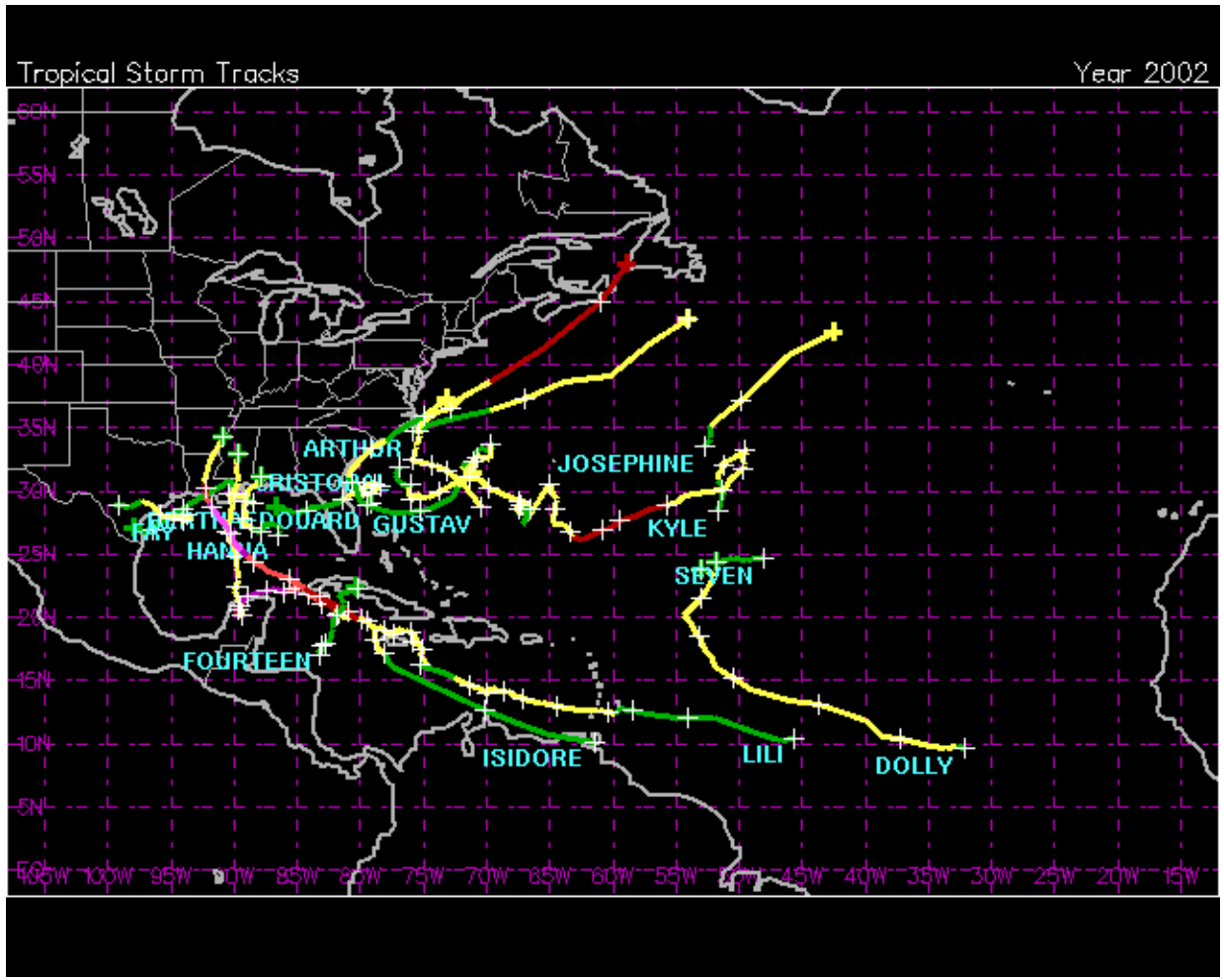

31 Aug 1995
100
80
60
40
20
0
Humberto
EW
Iris
TS Jerry
EW

Hurricane Tracks

URL: weather.unisys.com
under Hurricane Data

Green	tropical depression
Yellow	tropical storm (named)
Red	Category 1 hurricane
Light Red	2
Magenta	3
Lt. Magenta	4
White	5

...also E and W Pacific,
Indian Ocean maps.



Hurricane Intensification Feedback

- Requires a *preexisting* surface cyclone with 10-30 mph winds.
- Circulations, pressure variations are weaker aloft, so low surface pressure overlying warm air

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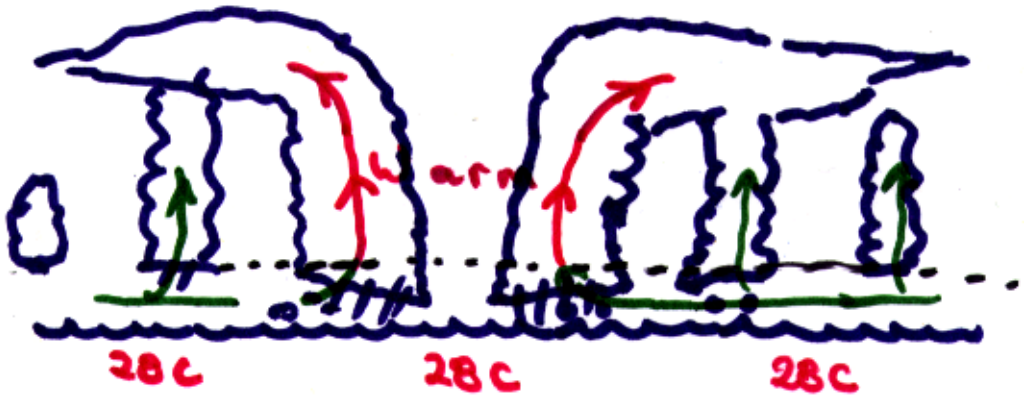
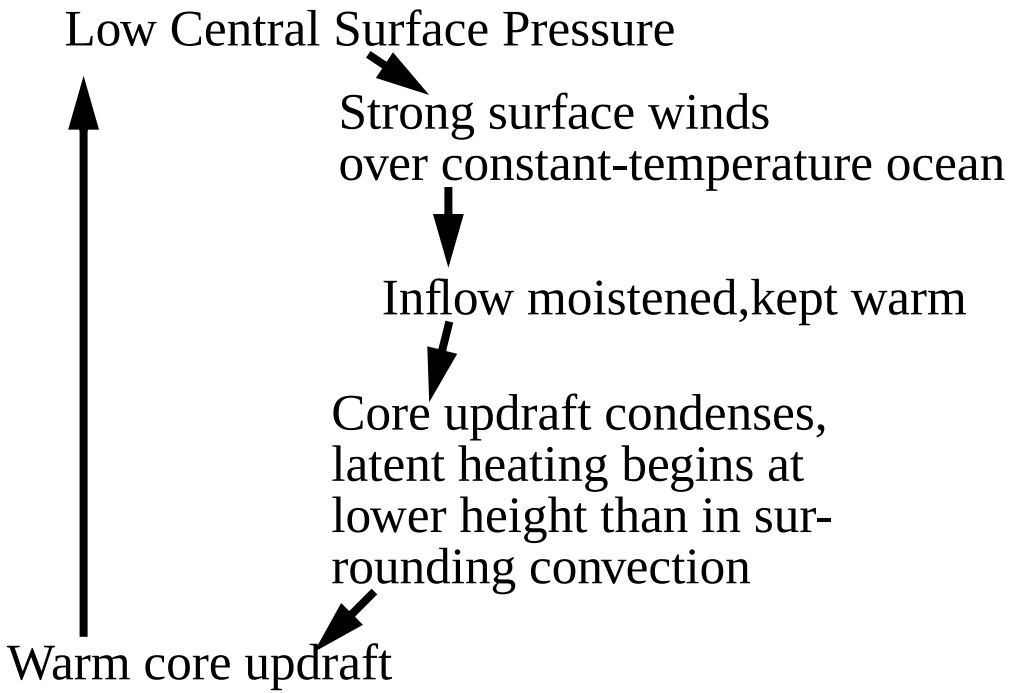
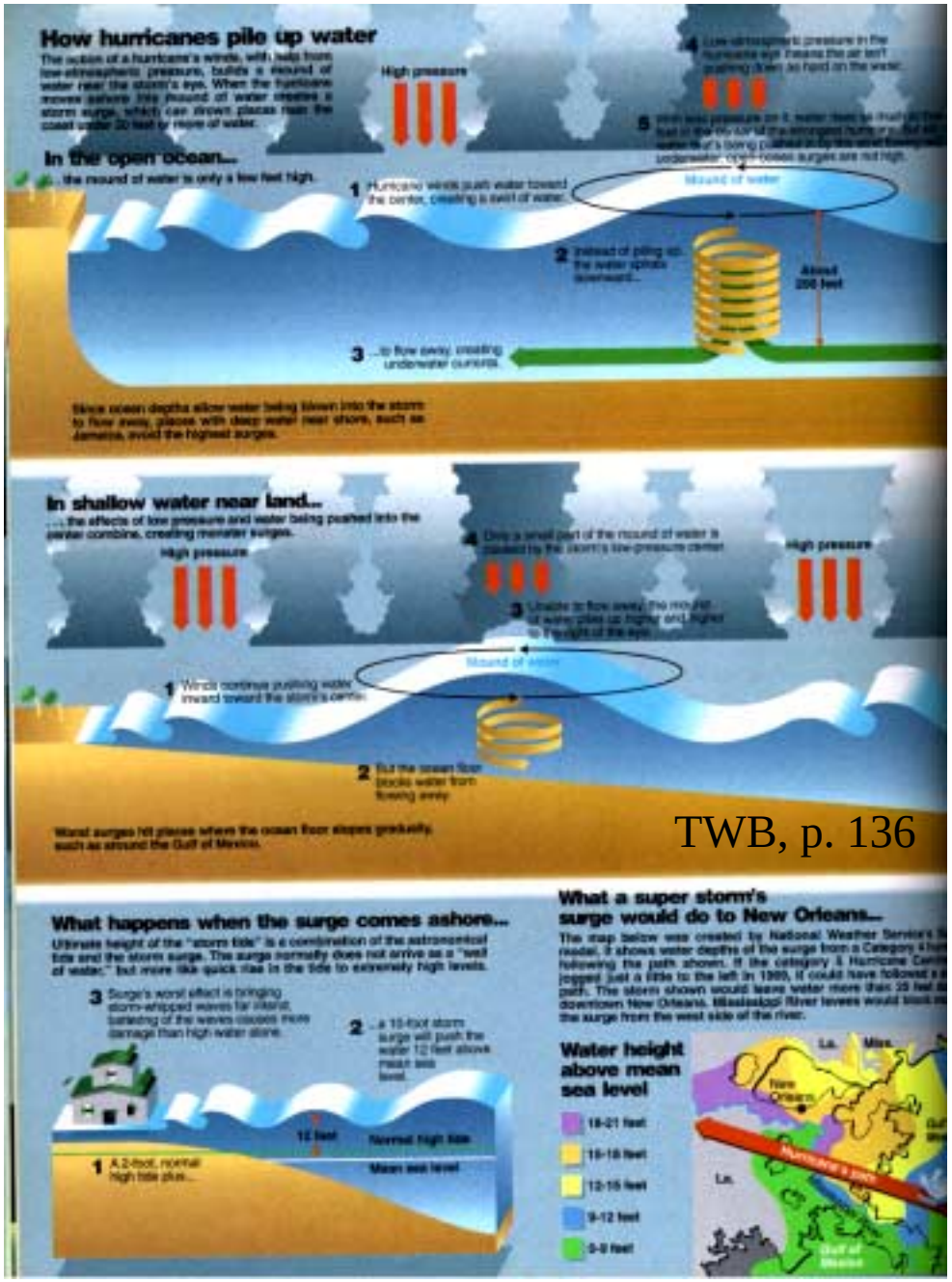




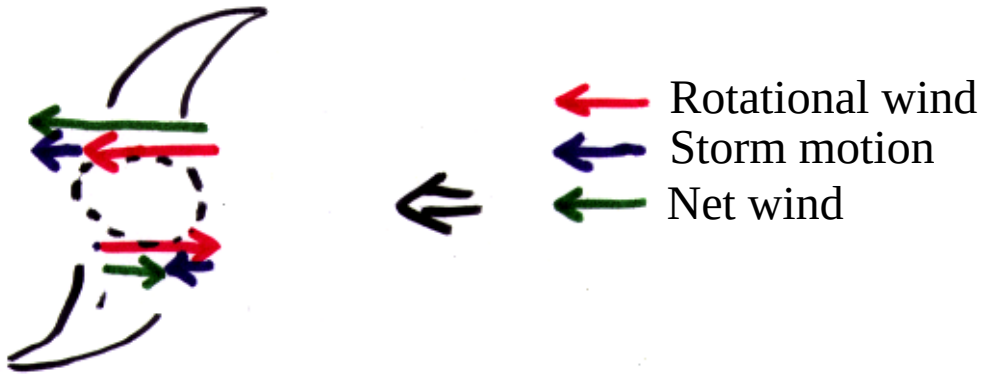
Hurricane storm surge



TWB, p. 136

Wind Damage

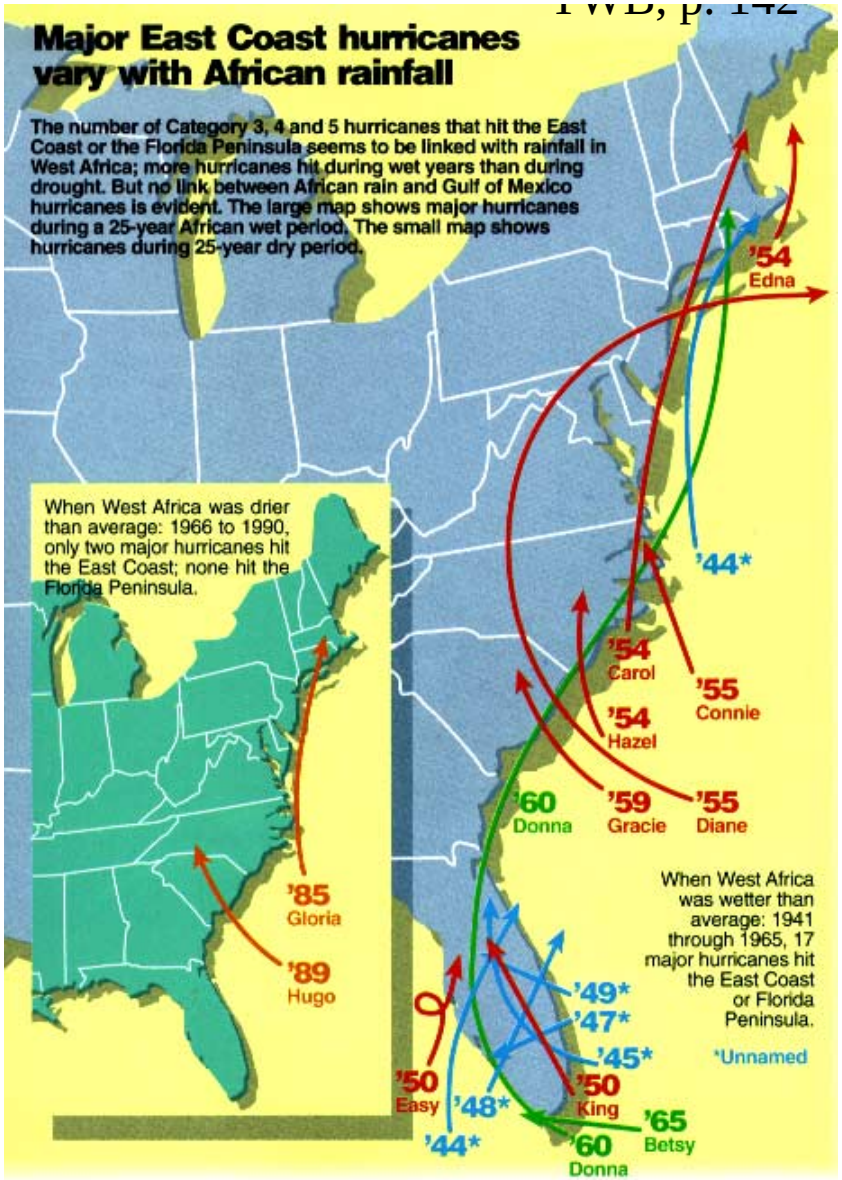
- Facing in direction of hurricane motion (5-10 m/s),strongest winds are in the right eyewall, where rotational and translational winds add together.
- Damage increases rapidly with wind speed



Hurricane Damage vs. intensity

Category	Damage
1 (74-95)	Limb damage to trees
2 (96-110)	Some trees blown over, major damage to mobile homes
3 (111-130)	Large trees blown over, mobile homes destroyed, bldg damage
4 (131-155)	Considerable building, roof damage, flooding to 15 ft ASL
5 (156+)	Roofs removed, small bldgs collapsed, flooding to 25 ft ASL

Hurricane Prediction



- Lots of decadal variability, less hurricanes with Sahel drought, El Nino