

Hurricanes: Part II Impact

by Professor Steven Businger



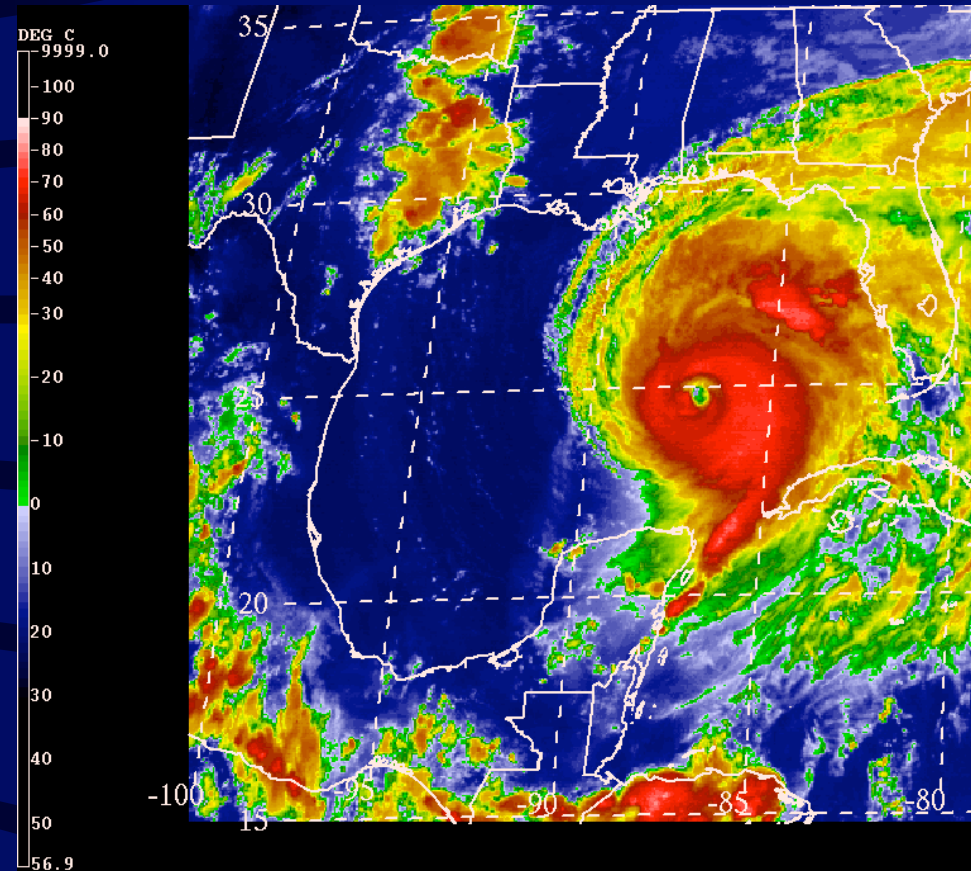
Damage from Hurricane Katrina

Hurricanes

Part II Impact

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- Hurricane impact
- The Triple Threat
 - Storm Surge
 - High Winds
 - Rains and Flooding



IR 08:15 pm EDT Tue 14 Sep 2004 (0015 UTC Wed 15 Sep 2004)

Hurricane Ivan

Hurricane Impact



- Energy of winds = wind velocity squared: $E = V^2$
- A doubling of the wind speed from (e.g., from 70 to 140 mph) results in four times the destructive energy.

Saffir/Simpson Hurricane Scale

Category 1	74 - 95 mph	Storm surge 4 - 5 ft
Category 2	96 - 110 mph	Storm surge 6 - 8 ft
Category 3	111 - 130 mph	Storm surge 9 - 12 ft
Category 4	131 - 155 mph	Storm surge 13 - 18 ft
Category 5	> 155 mph	Storm surge > 18 ft

Energy of winds = wind velocity squared: $E = V^2$

A doubling of the wind speed from (e.g., from 70 to 140 mph) results in four times the destructive energy.

Triple Threat

High winds
flying debris



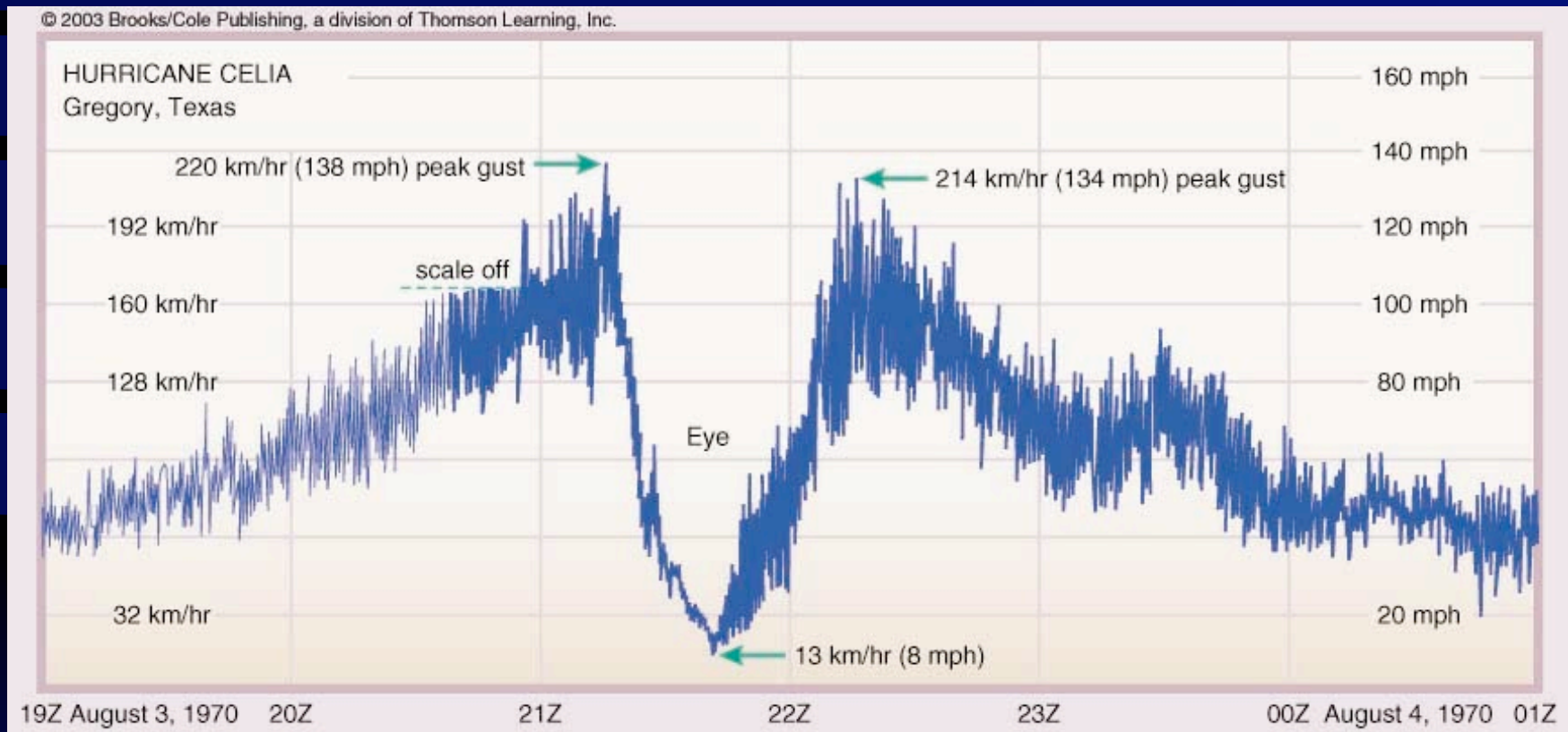
Flash Floods



Storm Surge
Large Surf

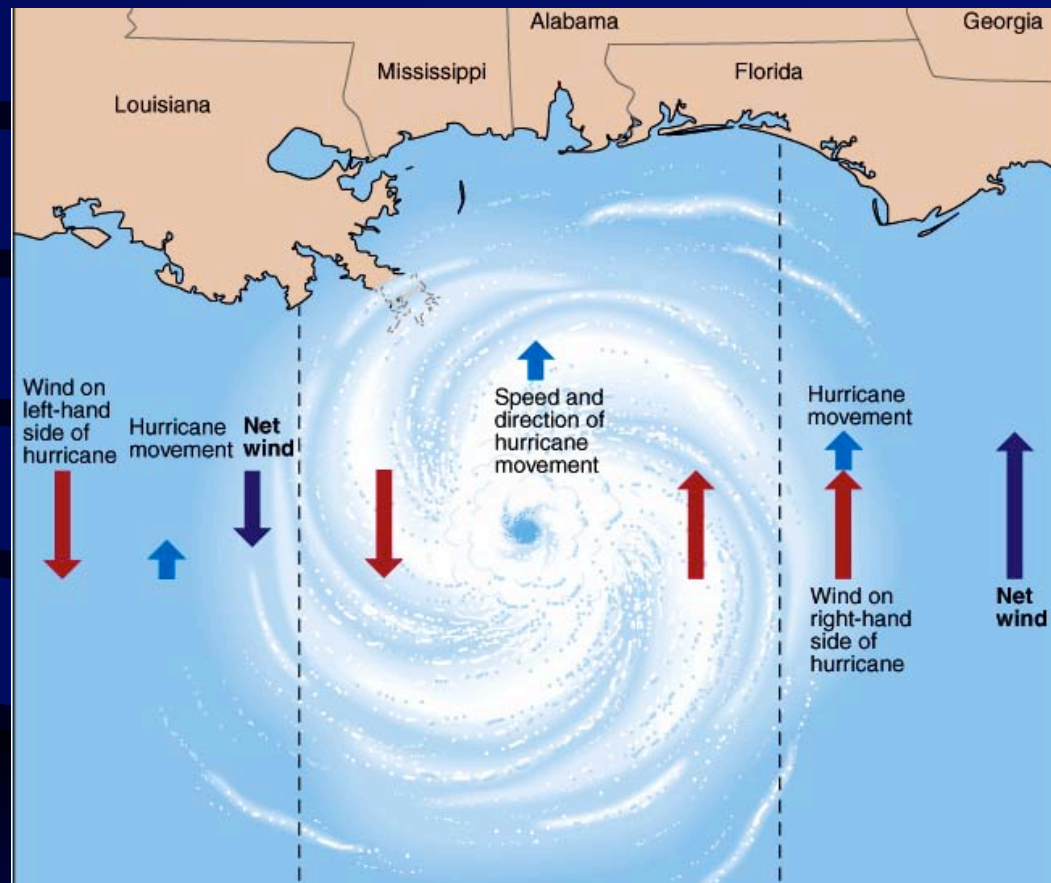


Anamometer Trace



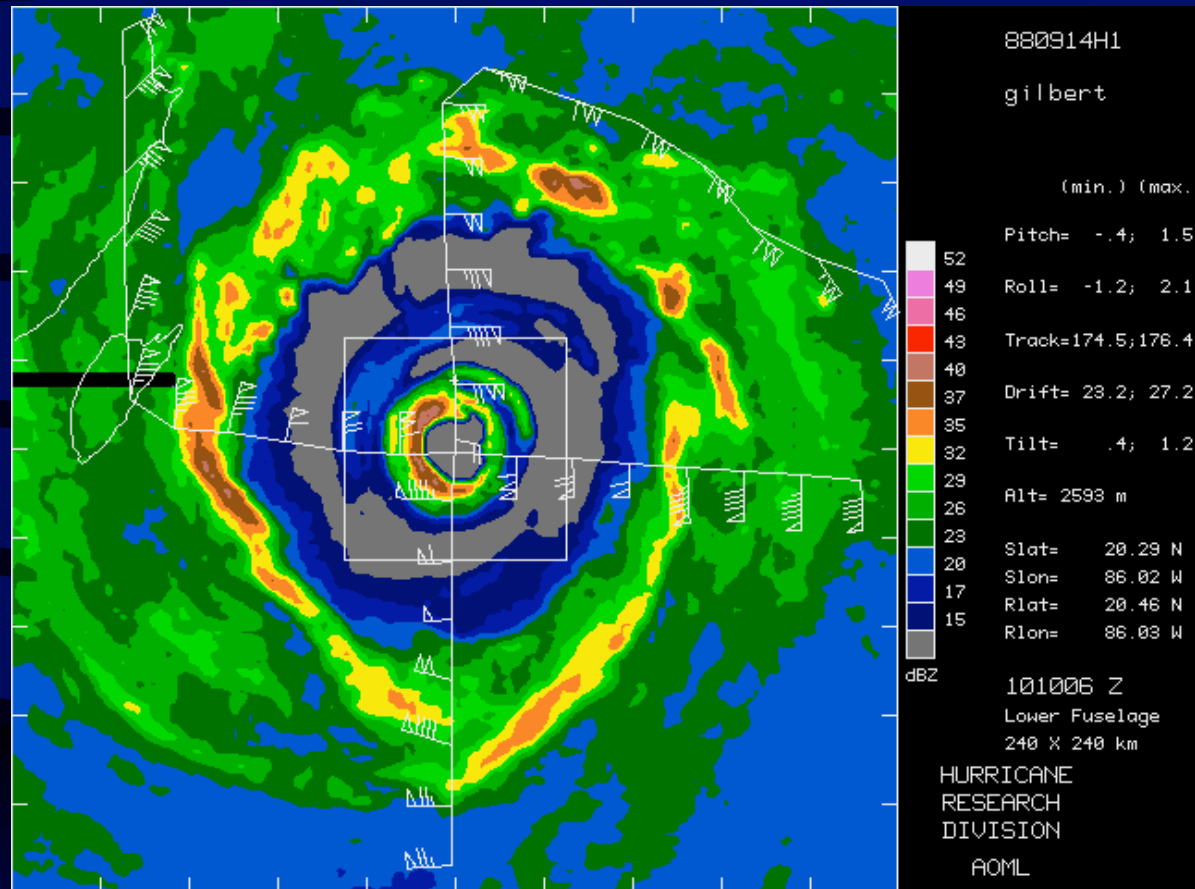
Wind Speed in hurricane Celia as it passed Gregory, TX.

Hurricane Hazards



The storm surge and storm waves are greatest just to the right of the storm track. Why?

Hurricane Gilbert



In what direction is Gilbert moving?

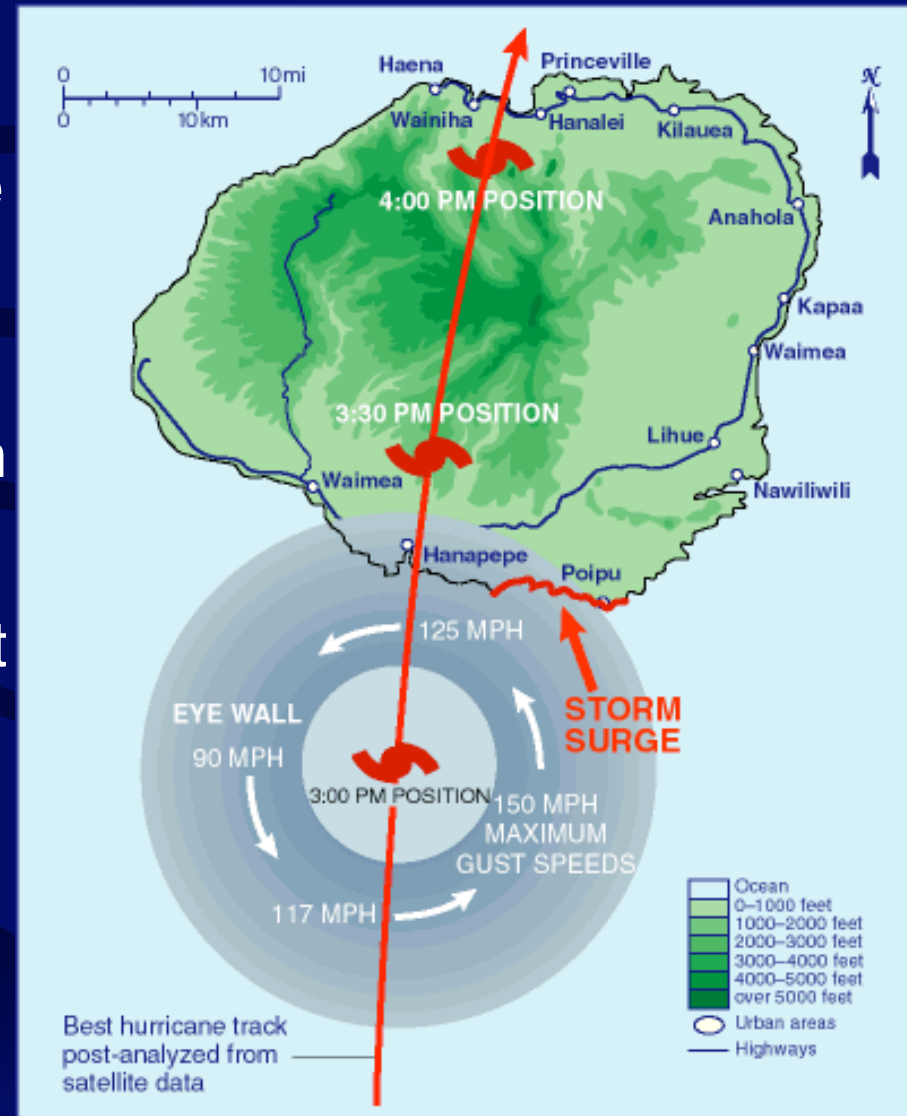
Answer: In direction of strongest wind: Westward

Hurricane Hazards in Hawaii

The storm surge and storm waves are greatest just to the right of the storm track.

Wind hazard is greatest on exposed ridges and mountain slopes.

Flash flood hazard is greatest near stream beds.



TRIPLE THREAT FROM TROPICAL CYCLONES

TRIPLE THREAT

Storm Surge →
(winds & low pressure)

High Winds →

Heavy Rains →

Injuries and Loss of Life

Structural Damage

Destruction of vegetation/crops

Flooding of coastal areas

Erosion of Beaches

Saline Intrusion—loss of fertility

Loss of Power/Communications

Fires - Urban and Brush

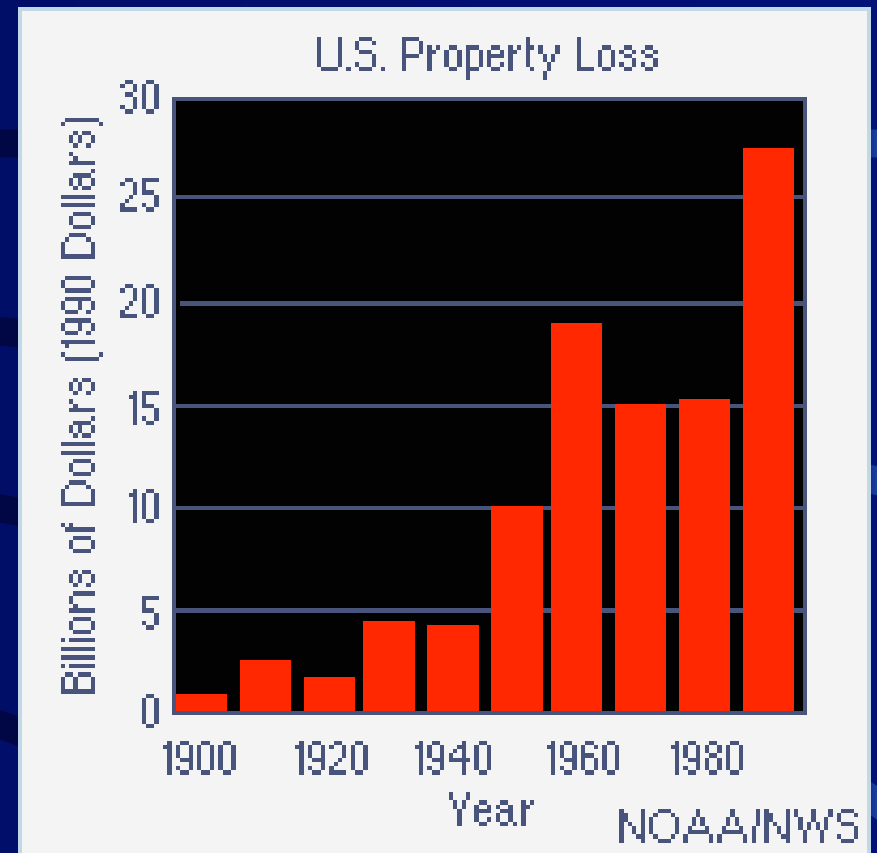
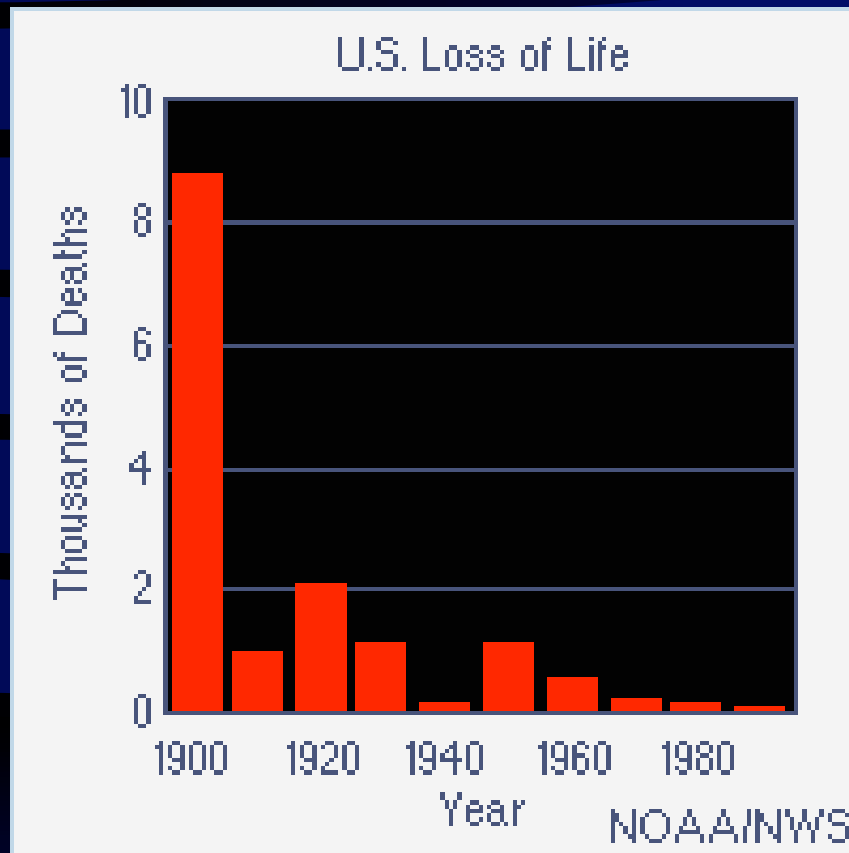
Contamination of Water Supply

Land Subsidence

Flooding of Inland Areas

Mud and Landslides

Past Hurricane Impact



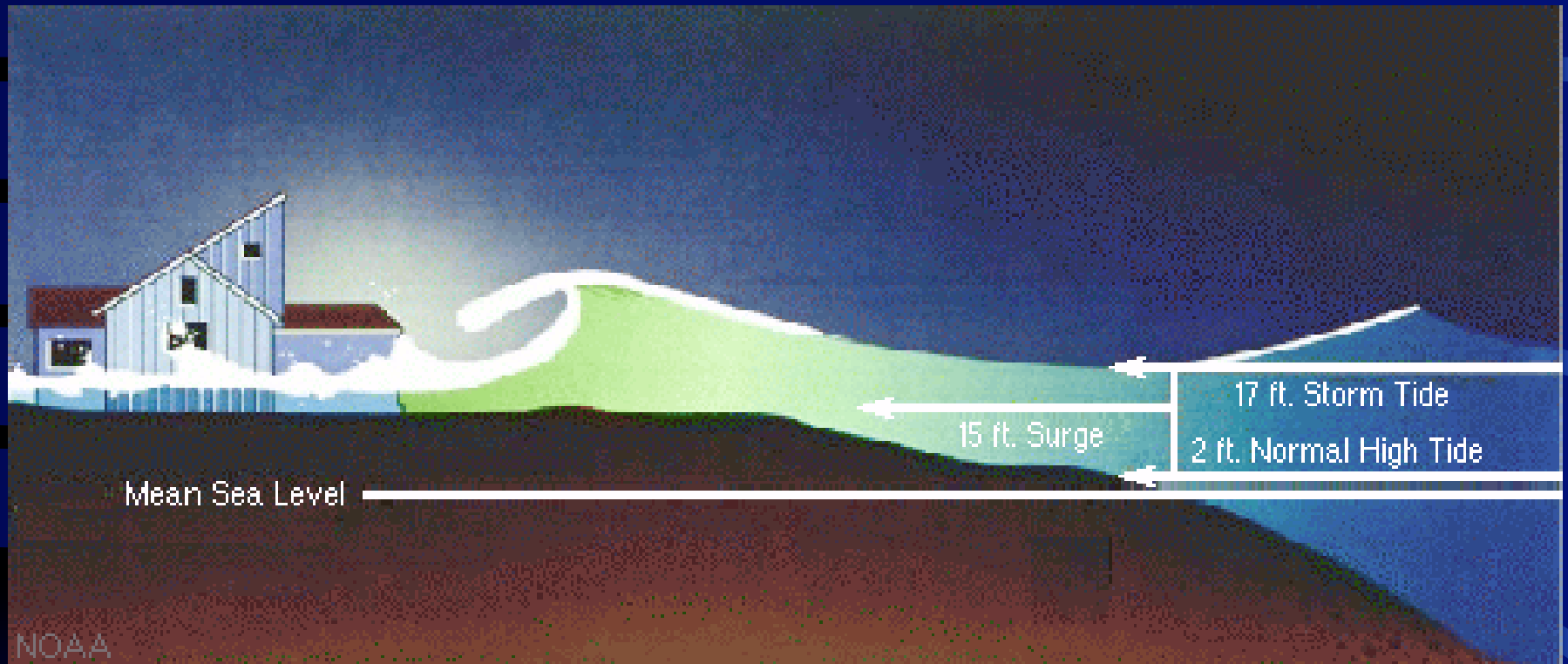
The record is dominated by a few extreme events:
Galveston hurricane of 1900, Iniki and Andrew in 1992.

Storm Surge - Elevated Sea-Level



Flooding of coastal areas
Erosion of Beaches
Saline Intrusion—loss of fertility

Storm Surge



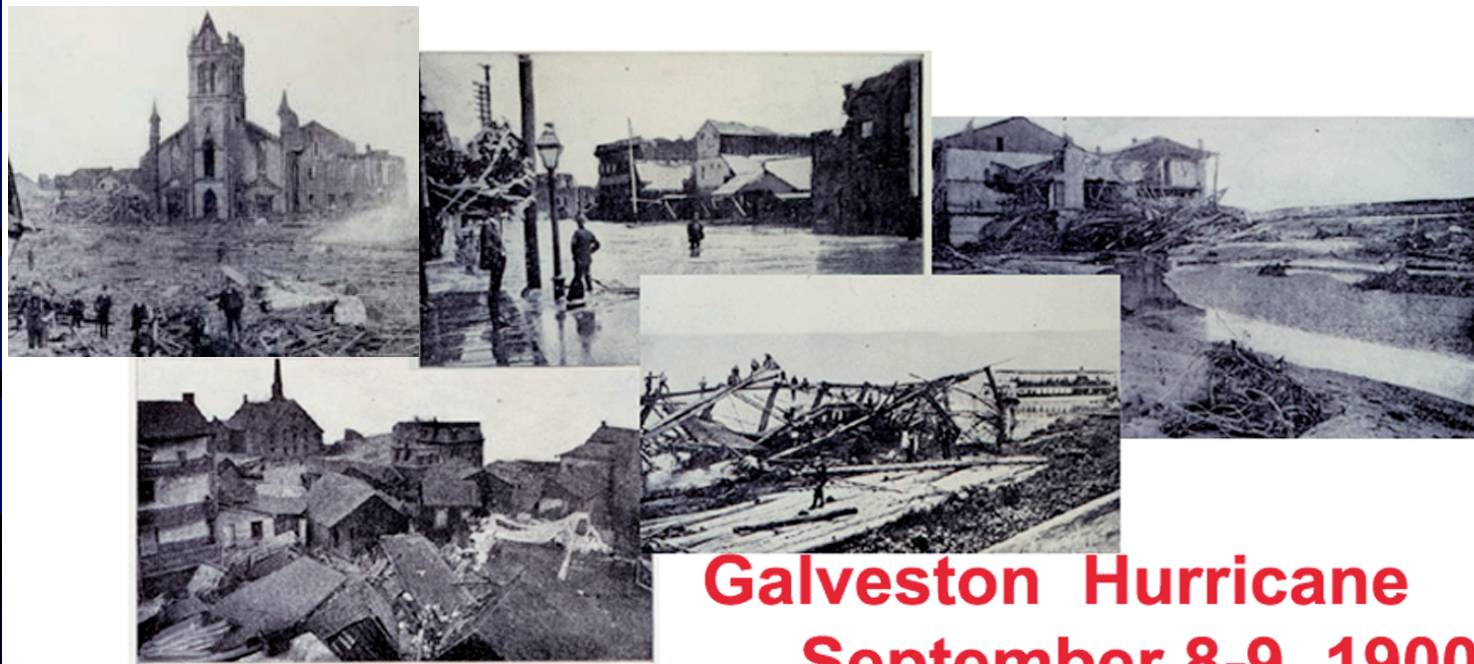
Storm surges are historically responsible for the greatest numbers of deaths and they cause some of the worst damage.

Storm Surge



Debris line from Iniki storm surge

Storm Surge



**Galveston Hurricane
September 8-9, 1900**

6000 people died in the storm surge

Storm Surge



Storm surge, before and after hurricane Camille.

Ivan Aftermath

- 52 deaths in US
- 70 deaths in Caribbean

Storm Surge



Hurricane Wind Damage

High Winds



Iniki Wind Damage





Hurricane Wind Damage

Wind damage to Darwin,
Australia from hurricane
Tracy. Similar wind damage
occurred in Andrew.

Katrina Rains and Flooding

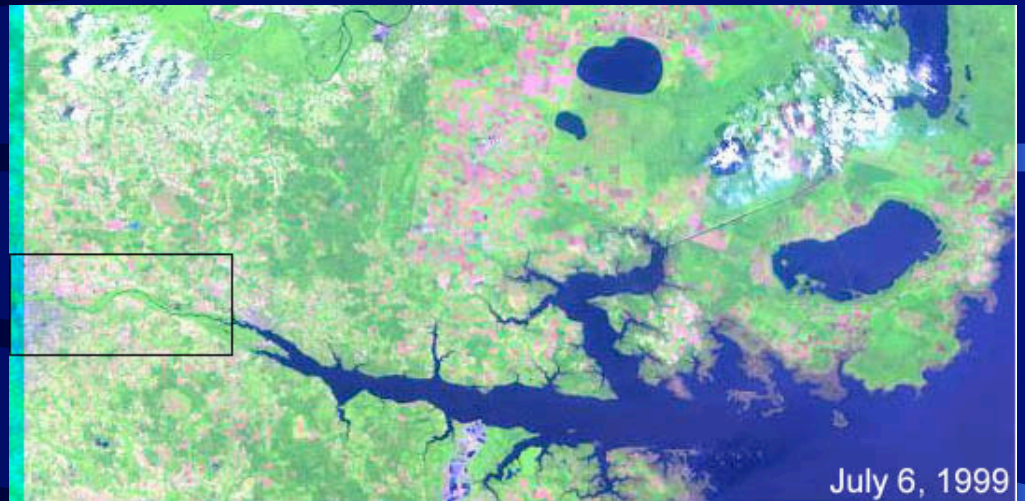


Ivan Aftermath

Heavy rains &
Flooding in NC

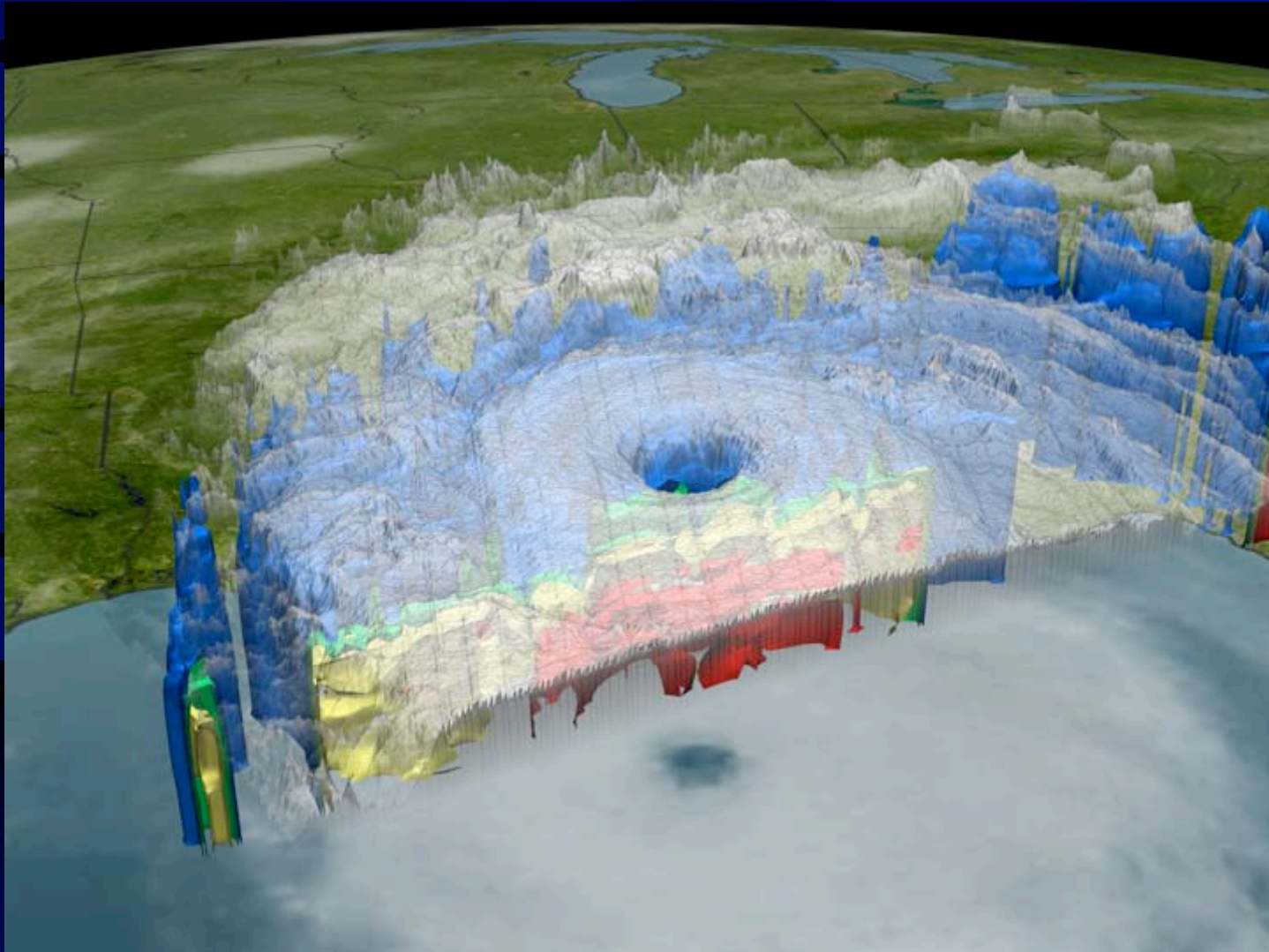


North Carolina Flooding



Slow moving tropical cyclones result in very large rainfalls.

Questions?



Hurricane Katrina