



Severe Weather

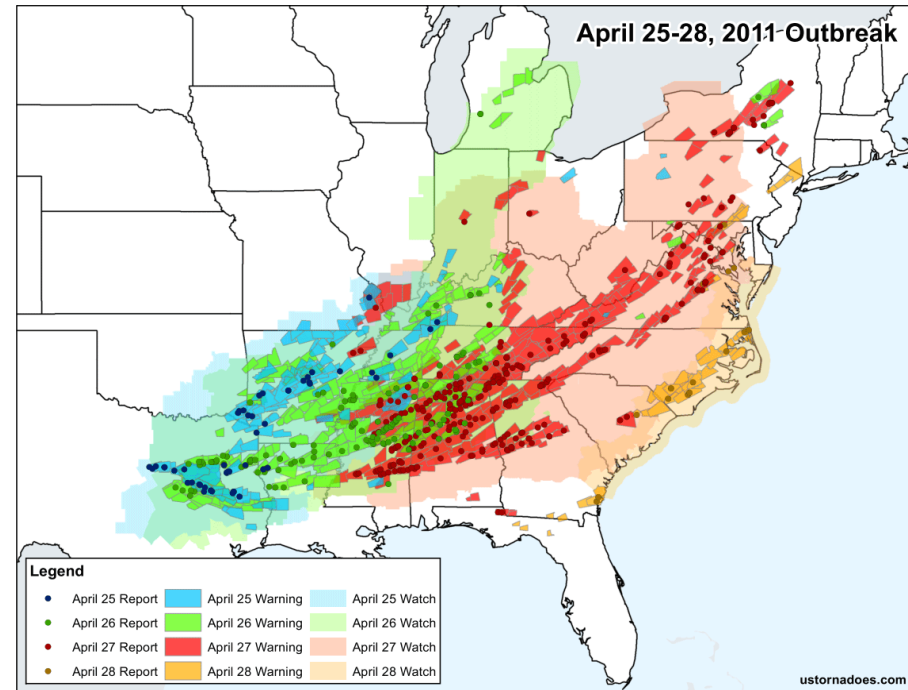


Part 2

2011 Tornado Outbreak

The **largest, costliest** and **one of the deadliest** tornado outbreaks ever recorded occurred between **April 25–28, 2011** affecting the Southern, Midwestern, and Northeastern United States and even southern Canada.

- Originating from a huge frontal storm system, roughly **90% of the supercell thunderstorms that day produced tornadoes** (“normal” rate is about 25%).
- **355 tornadoes** were confirmed (**37** of them **rated EF3 or higher**).
- April 27, the most active day: record of **211 tornadoes** (four rated EF5).
- **324 deaths** across six states.
- One of the costliest natural disasters in United States history, with total damages of approximately **\$11 billion**.



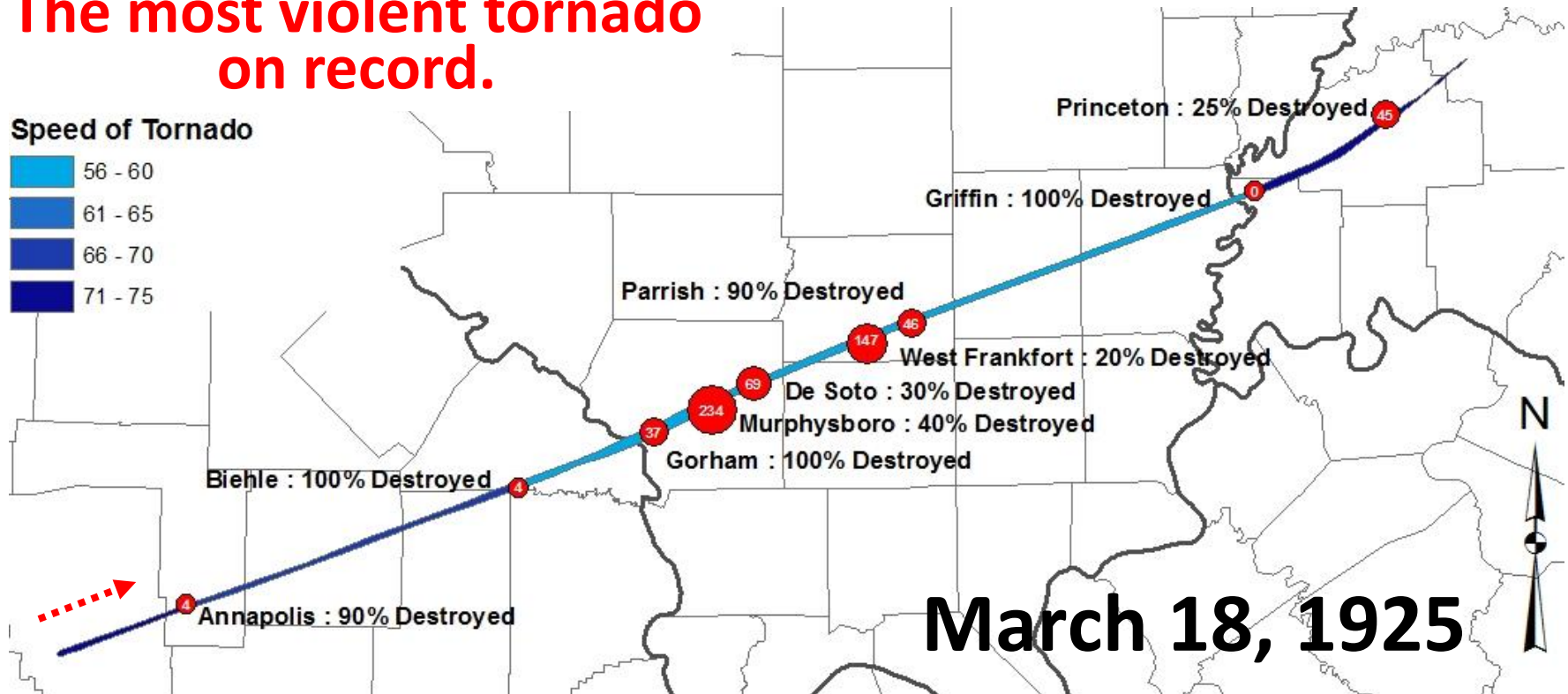
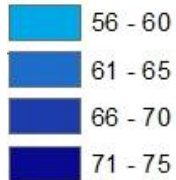
Tri-State Tornado



- Formed in **Missouri** and traveled **219 miles (352 km)** across **Illinois** into **Indiana**.
- It lasted **~3.5 hours** and **killed 695 people**.
- The funnel was up to **0.75 miles across** and traveled as fast as **73 mph (117 km/h)**.

The most violent tornado on record.

Speed of Tornado

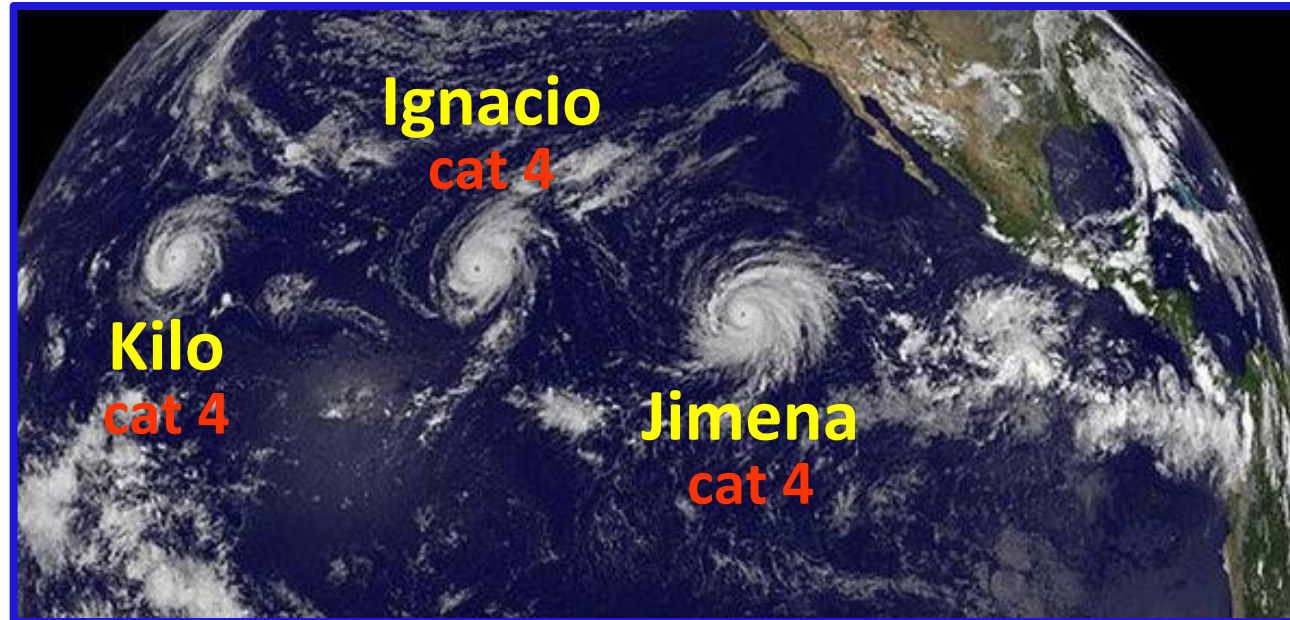
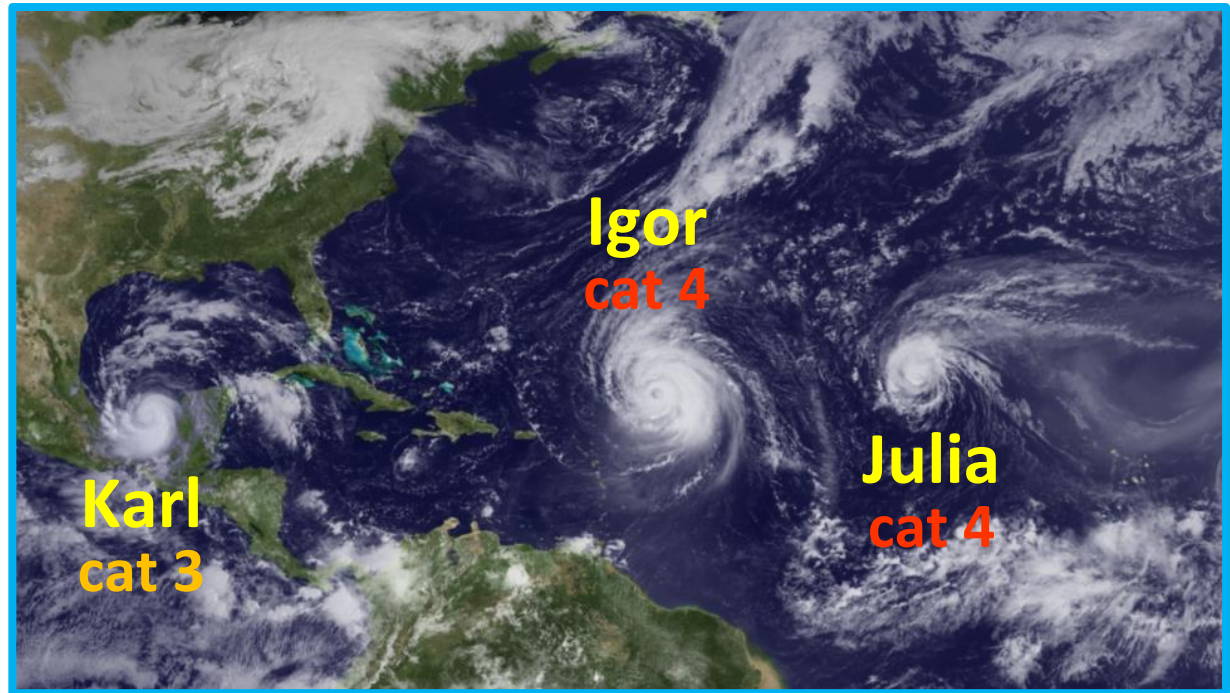


Examples of Real Tornadoes



Hurricane

North
Atlantic
Basin,
09/19/10



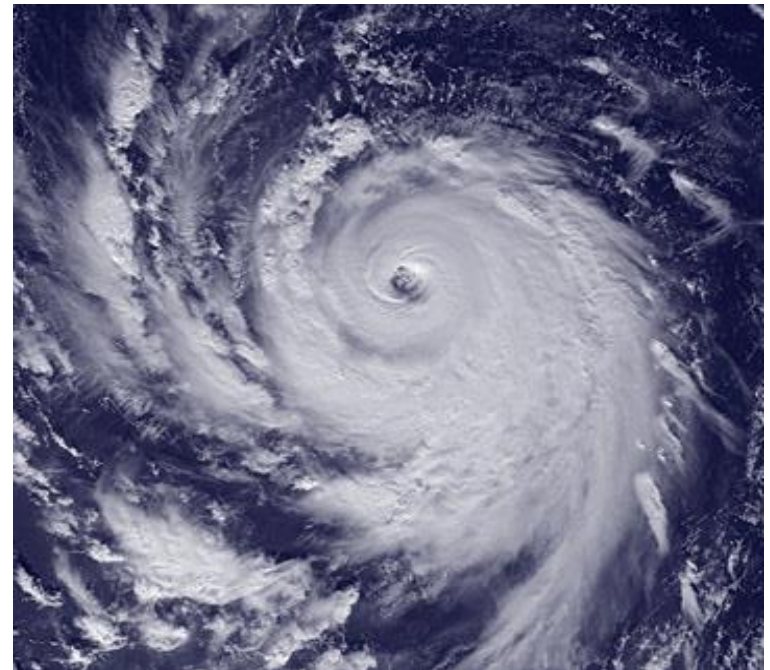
Pacific
Basin,
08/31/15

Cyclonic Storm

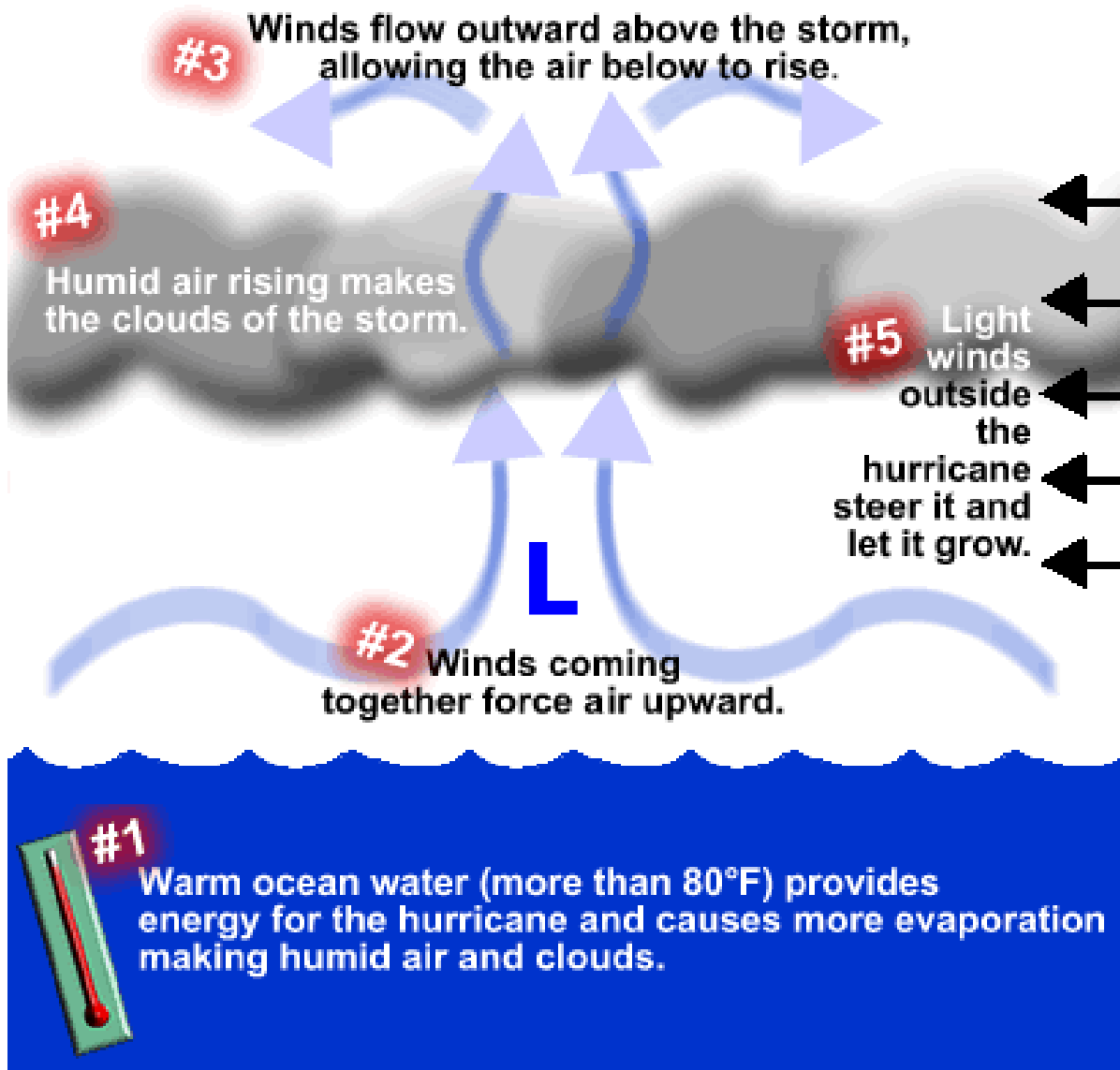
A cyclonic storm is a large-scale **rapidly rotating storm system** characterized by a **low-pressure center, strong winds**, and a spiral arrangement of thunderstorms that produce **heavy rain**.

- Formed from *organized groups of thunderstorms*.
- Classified depending on its strength and location:

- Tropical Depression
 - Tropical Storm
- } **< 74 mph winds**
- Tropical cyclone (Southern Hemisphere and Indian Ocean)
 - Typhoon (Northwestern Pacific)
 - Hurricane (Northeast Pacific or North Atlantic)

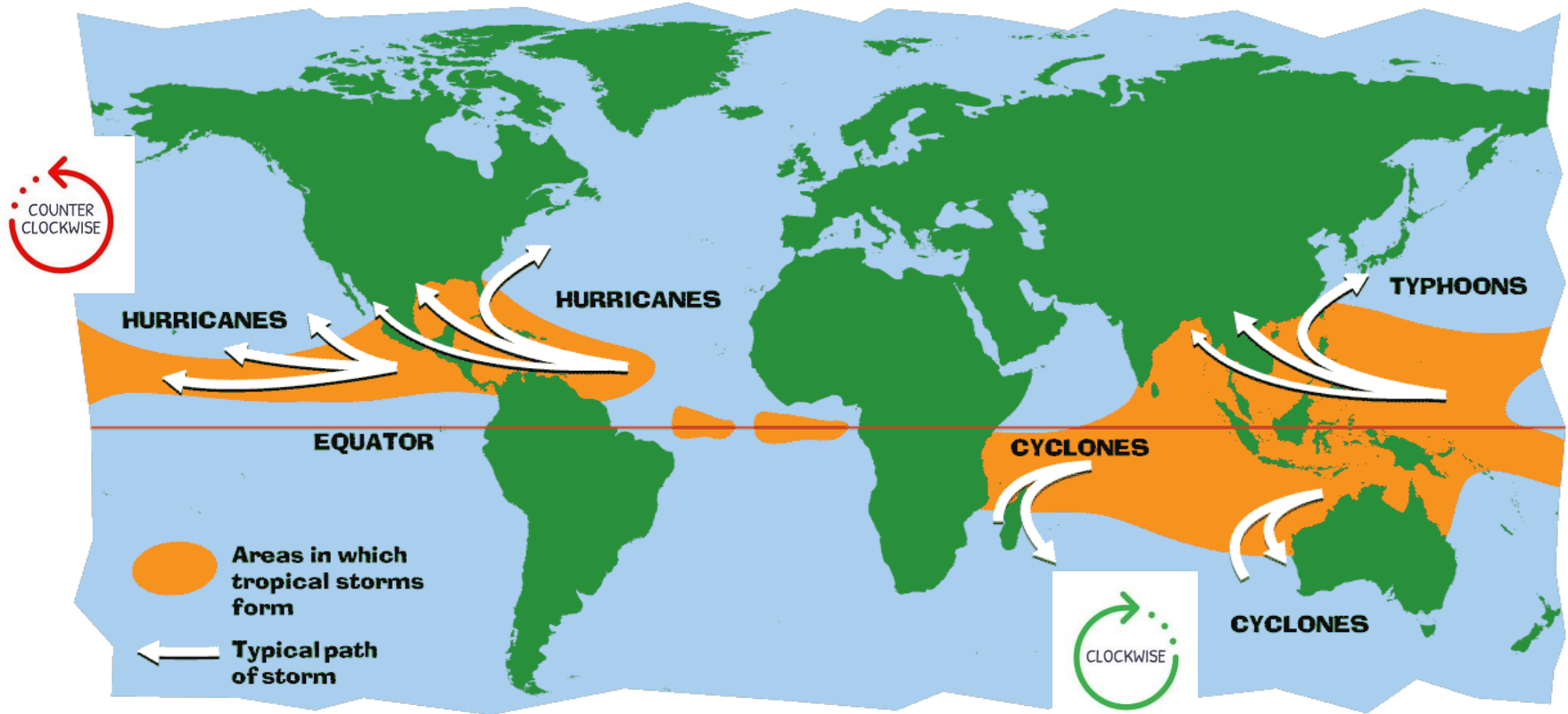


Ingredients of a Cyclonic Storm



- **Warm water**
(at least 26.5°C/
79.7°F are needed
down to a depth of
at least 50 m/ 160 ft)
- **Time to grow**
- **Conditions
to develop
circulation**
(location off equator)
- **Light upper
level winds**
(wind shear destroys
thunderstorm
organization)

Formation and Typical Paths



The majority of cyclonic storms **form between 10 and 30 degrees** of latitude away of the equator:

- **87%** between **10-20 degrees north or south**,
- **rarely** form or move **within 5 degrees** of the equator where Coriolis effect (responsible for storm rotation) is low.

Hurricane Structure

EYE WALL

Outflow

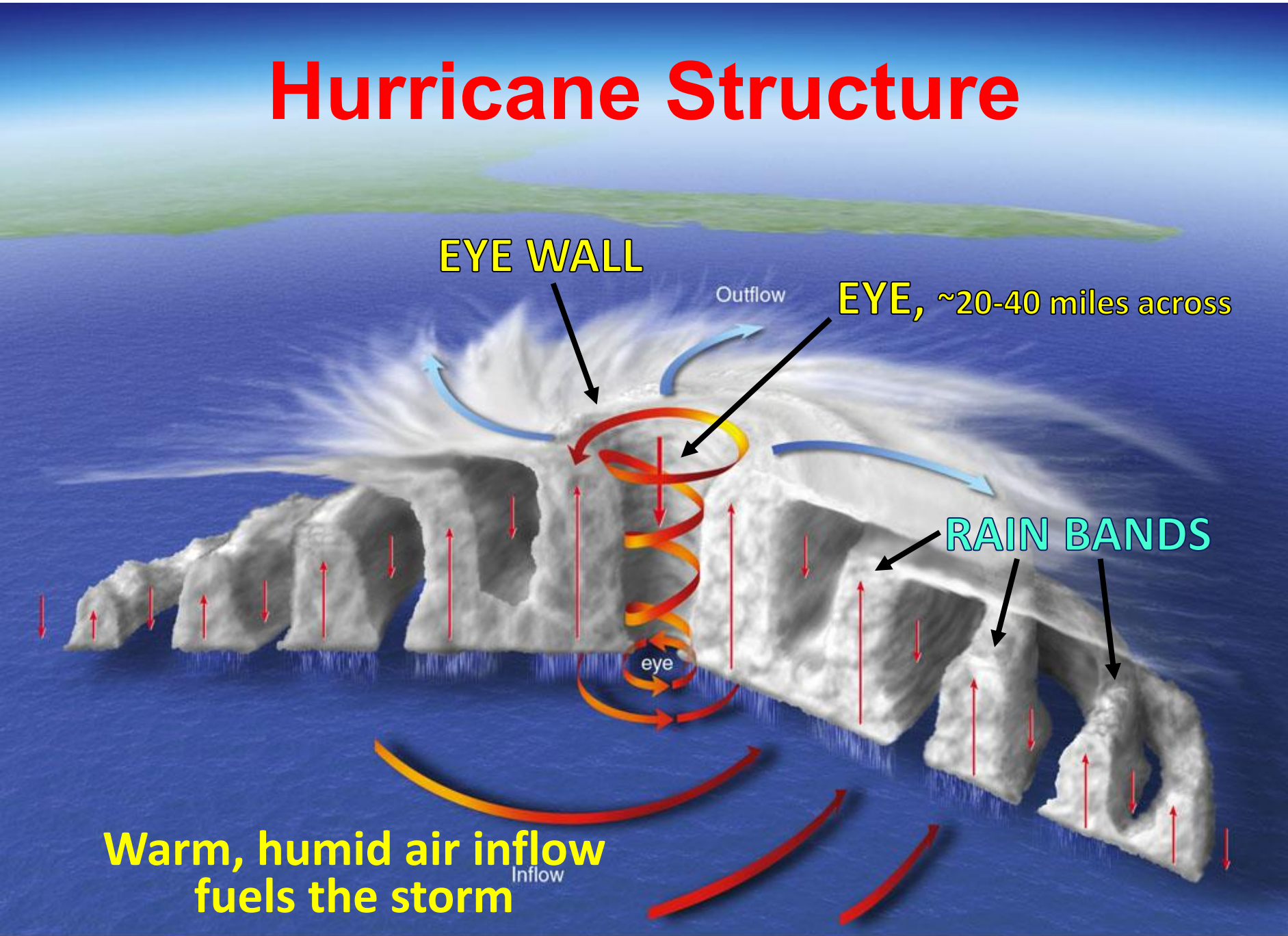
EYE, ~20-40 miles across

RAIN BANDS

Warm, humid air inflow
fuels the storm

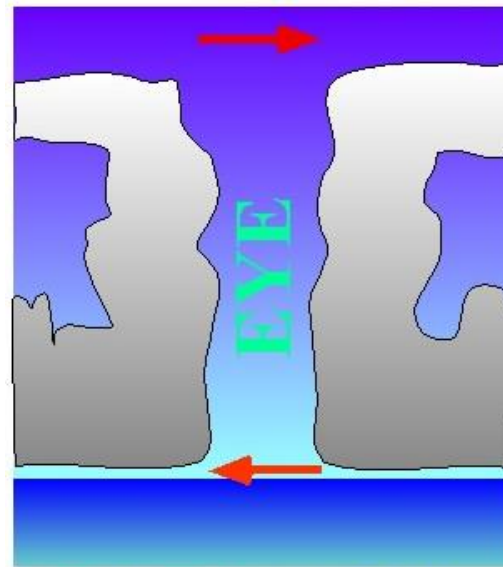
Inflow

eye

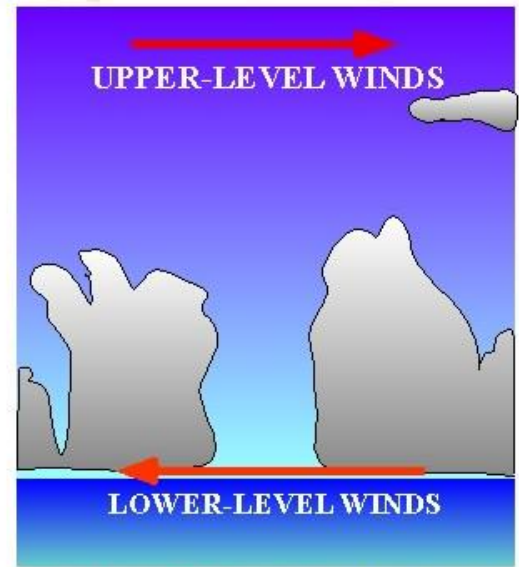


What destroys a hurricane?

- Strong vertical wind shear causes convection and loss of vertical storm organization.
- Cold water (moving over waters significantly below 26.5 °C/79.7 °F).



WEAK SHEAR = FAVORABLE



STRONG SHEAR = UNFAVORABLE



- Movement over land - most strong storms lose their strength very rapidly after **landfall** and become disorganized areas of low pressure within a day or two as a result of **friction** and **lack of moisture**.