

A satellite image of a hurricane, showing a distinct eye and spiral cloud bands over a dark blue ocean. The image is slightly faded to allow text to be overlaid.

# **RENCI Renaissance Bistro: North Carolina and Hurricanes**

**Jessica Proud  
Meteorologist  
RENCI**

# What is RENCI?

- **RENCI: *Renaissance Computing Institute***
- **State organization with locations around NC**
- **Brings together expertise from around the state**
- **Goal: apply technology to solve problems in NC**
  - **Do exploratory, proof of concept applications**

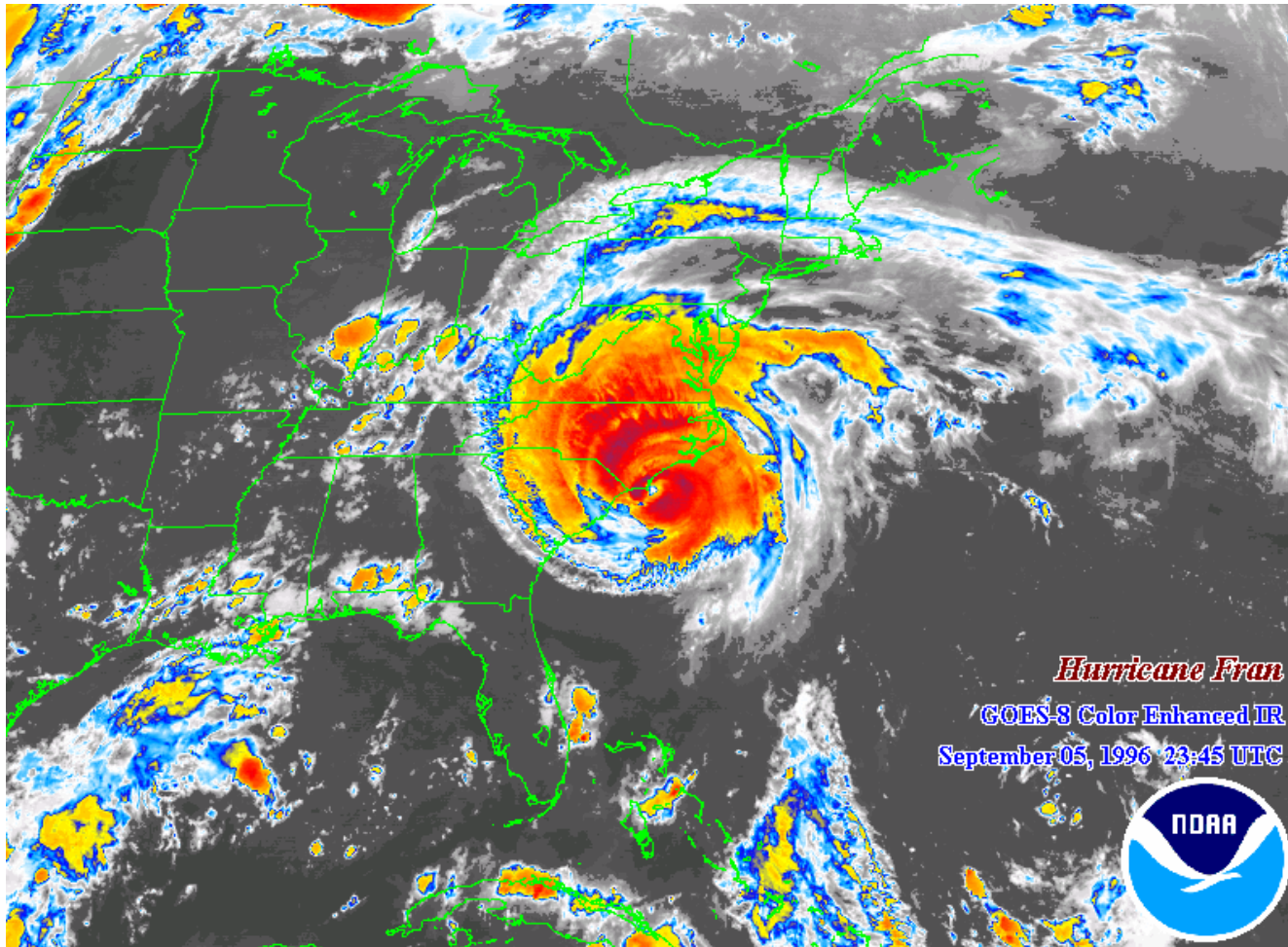
# RENCI Activities

- One focus: disaster studies and EM
- Talk to state and county EMs to find “bottlenecks” in system
- Use technology to solve bottlenecks
  - Flooding, storm surge, icing
  - Communication issues
  - Data sharing



# NC History of Hurricanes

- Have you experienced a hurricane?



# Hurricane Basics

- **Hurricane or tropical cyclone**
  - Low pressure system, no front attached
  - Forms over tropical or subtropical waters
  - Organized circulation



Hurricane Mitch, 1998 Central America  
([www.sciencepolicy.colorado.edu](http://www.sciencepolicy.colorado.edu))

# Favorable Conditions

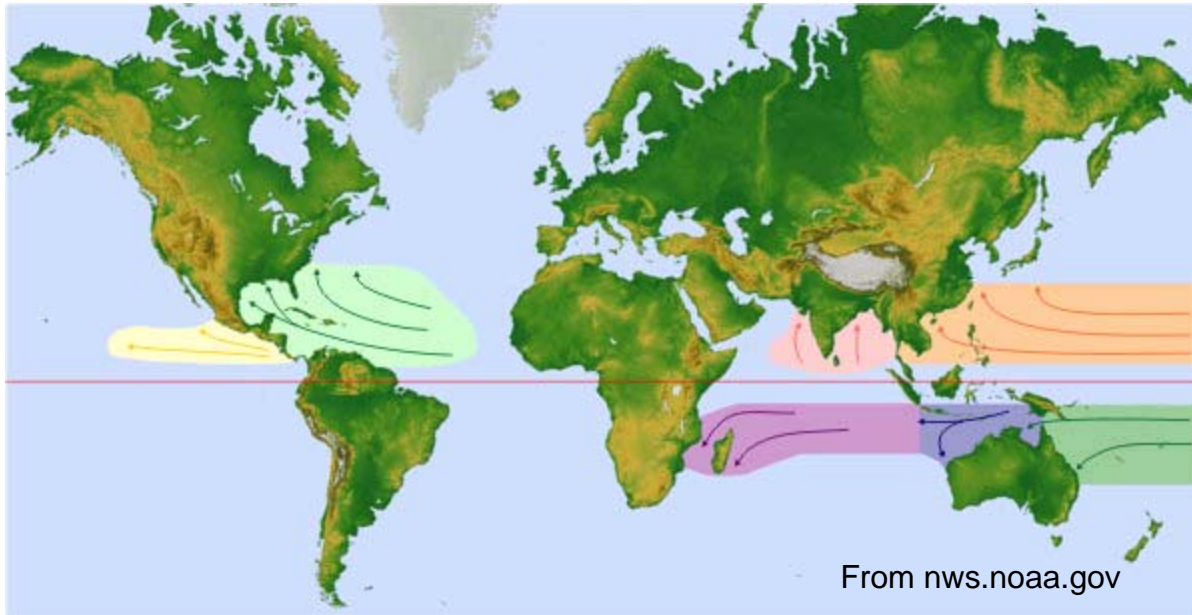
- Ocean temp: at least 80°F for 150 ft
- Atmosphere allows for instability
- At least 300 miles from equator
- Disturbance at the surface
- Not much change in wind speed with height



From NASA, Hurricane Wilma  
in October 2005

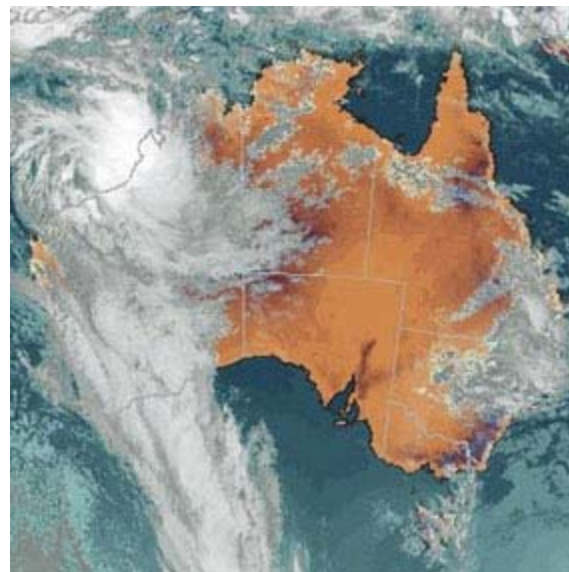
# Where Storms Form

- 7 basins



# Other names

- Hurricane
- Tropical cyclone
- Typhoon
- Willy-willy: Australia



Tropical cyclone Isobel over W Australia  
(from Australia Bureau of Meteorology)

# Disturbances Can Come From...

- **Easterly Waves  
(majority)**
- **West African  
Disturbance Line**
- **Tropical Upper  
Tropospheric Trough**
- **Old Frontal Boundary**



# Purpose of Tropical Cyclones

- **Weather: keeps balance of Earth's energy budget**
  - Cyclones take heat stored in the ocean and transfer it to the upper atmosphere
  - Upper level winds carry that heat to the poles
  - Polar regions: not as cold
  - Tropics: do not overheat



# Modify Storms?

1. Seed storms with silver iodide
2. Place substance on ocean surface
3. Nuke the storm
4. Add water absorbing substances
5. Cool surface waters with icebergs
6. Harness a storm's energy

**Problem: storms are too big and too powerful to modify**

- Entire human race used energy at a rate less than 20% of the power of hurricane (1993 World Almanac)



# Saffir-Simpson Hurricane Scale

- Where do the winds come from?
  - Rising air in storm needs to be replaced
  - More air moves in near the surface

- Category 1: Minimal
- Category 2: Moderate
- Category 3: Extensive
- Category 4: Extreme
- Category 5:

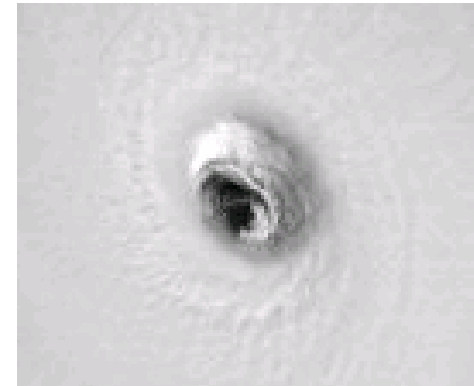
Catastrophic (winds > 155 mph)

- [Category clip](#)



# Main Parts of Tropical Cyclone

- **Eye**
  - Relatively calm
  - Winds ~ 15 mph, 20-40 miles across
  - Birds can be trapped
- **Eyewall**
  - Produces heavy rains, strongest winds
  - Indicator of storm's intensity
- **Rainbands**
  - Curved bands of clouds and t-storms
  - Trail away from eyewall
  - Heavy bursts of rain, wind, tornadoes



[Hurricane Isabel satellite loop](#)

# Size of Tropical Cyclones

- **Average: 300 miles wide**
- **Size is NOT an indication of intensity**
- **Largest: Typhoon Tip (1979), 675 mi radius**
- **Smallest: T.C. Tracy (1974), 30 mi radius**



From [nhc.noaa.gov](http://nhc.noaa.gov)

# Why Name Storms?

- Less chance for error than lat/lon method
- Using female names became widespread during WWII
- Male and female names in 1979
- Name retired when storm is very deadly or costly

Retired hurricane Names: Atlantic Basin

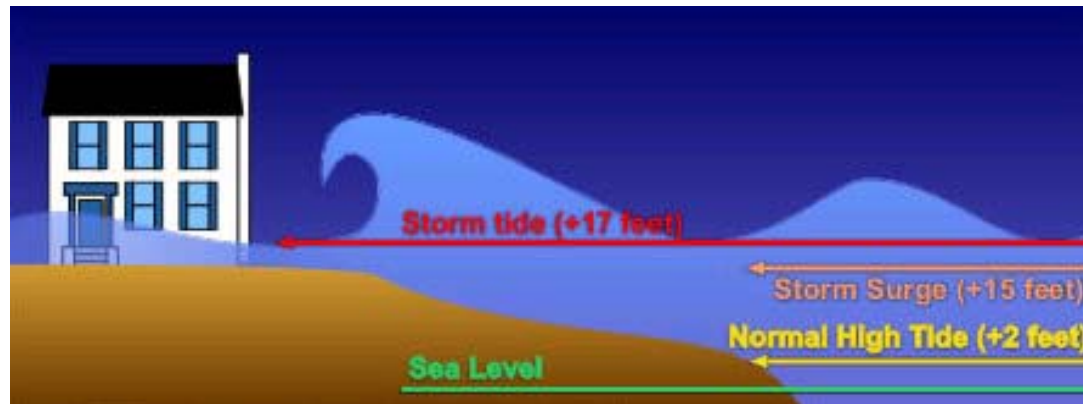
<b>A's</b>	Agnes (1972), Alicia (1983), Allen (1980), Allison (2001), Andrew (1992), Anita (1977), Audrey (1957)
<b>B's</b>	Betsy (1965), Beulah (1967), Bob (1991)
<b>C's</b>	Camille (1969), Carla (1961), Carmen (1974), Carol (1965), Celia (1970), Cesar (1996), Charley (2004), Cleo (1964), Connie (1955)
<b>D's</b>	David (1979), Dennis (2005), Diana (1990), Diane (1955), Donna (1960), Dora (1964)
<b>E's</b>	Edna (1968), Elena (1985), Eloise (1975)
<b>F's</b>	Fabian (2003), Fifi (1974), Flora (1963), <u>Fran (1996)</u> , Frances (2004), Frederic (1979), <u>Floyd (1999)</u>
<b>G's</b>	Gilbert (1988), Gloria (1985), Gracie (1959), Georges (1998)
<b>H's</b>	Hattie (1961), Hazel (1954), Hilda (1964), Hortense (1996), Hugo (1989)
<b>I's</b>	Inez (1966), Ione (1955), Iris (2001), <u>Isabel (2003)</u> , Isidore (2002), Ivan (2004)
<b>J's</b>	Janet (1955), Jeanne (2004), Joan (1988), Juan (2003)
<b>K's</b>	<u>Katrina (2005)</u> , Keith (2000), Klaus (1990)
<b>L's</b>	Luis (1995), Lenny (1999), Lili (2002)
<b>M's</b>	Marilyn (1995), Michelle (2001), Mitch (1998)
<b>O's</b>	Opal (1995)
<b>R's</b>	<u>Rita (2005)</u> Roxanne (1995)
<b>S's</b>	<u>Stan (2005)</u>
<b>W's</b>	<u>Wilma (2005)</u>

From [nhc.noaa.gov](http://nhc.noaa.gov)

# Tropical Cyclone Hazards (1/4)

- **Storm surge**

- Water pushed towards the shore by the force of winds swirling around the storm
- Can increase avg water level > 15 ft
- Wind driven waves are superimposed on storm tide
- Level of surge determined by slope of continental shelf



From [nhc.noaa.gov](http://nhc.noaa.gov)

# Tropical Cyclone Hazards (2/4)

- Wind and category do not include gusts or longer squalls
- Much damage in windstorms is caused by flying debris
- Most typical type of debris: wooden planks in tornadoes
  - 15 lb 2x4 would travel at 100 mph in a 250 mph squall or tornado that can occur during a hurricane

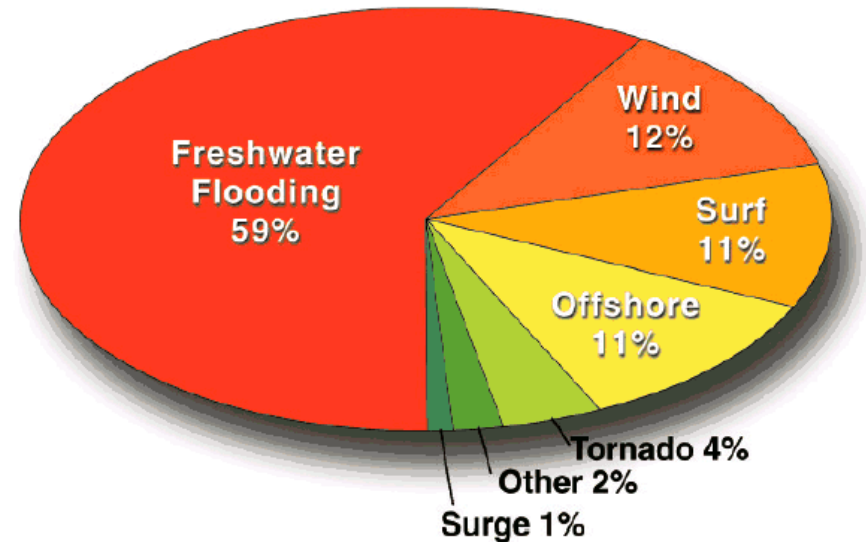


From [nhc.noaa.gov](http://nhc.noaa.gov)

# Tropical Cyclone Hazards (3/4)

- **Inland flooding**
  - Before and after arrival of winds from storm, flooding potential from rain can occur
  - Ex: Houston, 3 ft of rain over 5 days
- **78% of children killed by T.C. drowned in freshwater floods**
- **Types of flooding**
  - Flash
  - Urban
  - River

Leading Causes of Tropical Cyclone Deaths in the U.S 1970-1999



Source: Edward Rappaport—Chief, Technical Support Branch, Tropical Prediction Center

# Tropical Cyclone Hazards (4/4)

- **Tornadoes**
  - Most likely to occur in right-front quadrant of hurricane
  - Also found embedded in rainbands
- **More than half of landfalling hurricanes produce at least 1 tornado**
- **Tornado winds + winds from hurricane = substantial damage**



From [nhc.noaa.gov](http://nhc.noaa.gov)

# Where Does Storm Info Come From?

- **NOAA's National Hurricane Center in Miami, FL**
  - Maintains a continuous watch on tropical cyclones over the Atlantic, Caribbean, Gulf of Mexico, and Eastern Pacific from May 15-Nov 30
  - Issues watches and warnings on tropical cyclones
  - Watches and warnings reported through the media and NOAA weather radio

# NC FIRST

The logo features the letters 'NC' in a large, bold, teal font. To the right of 'NC' is a black icon of a satellite dish with a signal line and three small lines radiating from the top, suggesting a signal or connection. To the right of the icon is the word 'FIRST' in a bold, black, sans-serif font.

# Why NC-FIRST?

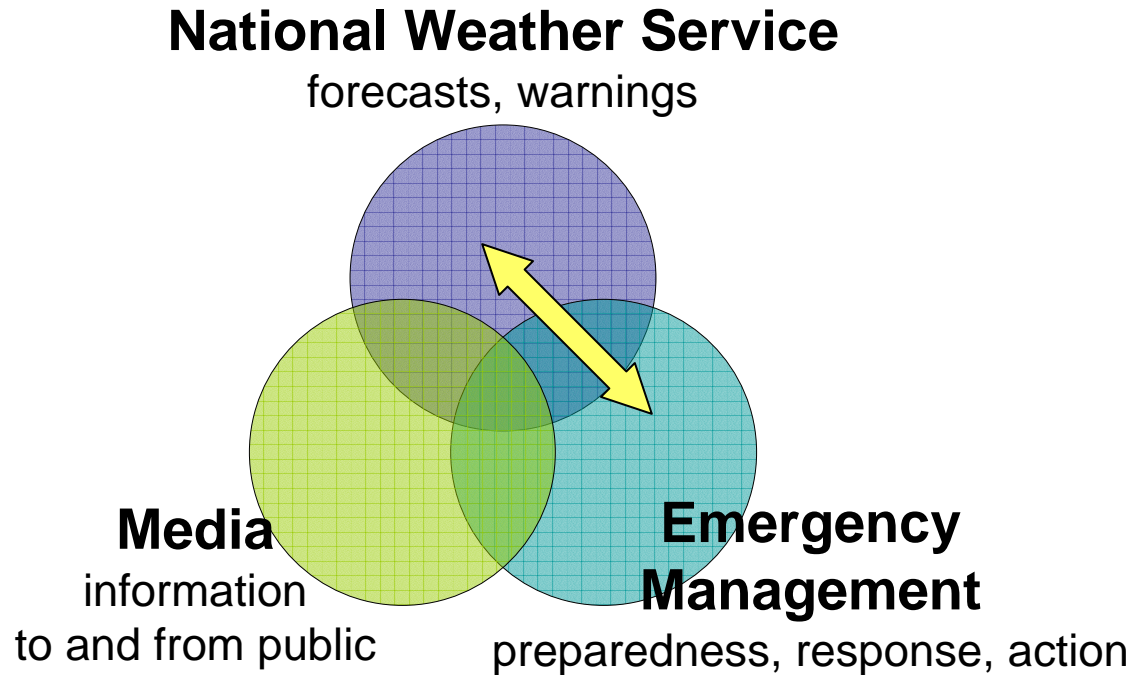
- We want to help EMs in decision making process by making weather info more available, intuitive
- Talked to a sampling of EMs
  - Difficult going to multiple weather pages and searching for data
- Modeled after OK-FIRST

# What is NC-FIRST?

- **Two components**
  - Classroom training on weather data
  - Weather data portal
- **Developed for NC EMs**
- **Working with partners at NWS and State Climate Office**



# What NC-FIRST Hopes to Achieve



- **Enhanced communications**
- **More informed decisions**
- **Education, preparation, and response on the LOCAL level**

# NC-FIRST: Classroom Training

- **Classroom training**
  - Meteorologists teach EMs how to interpret weather data
  - **Other classes to follow**
    - T-storms/tornadoes
    - Winter weather
    - Flooding
    - Drought/Fire Weather



# NC-FIRST: Weather Data Portal

- Weather Data Portal
  - Accumulates weather data in one place
  - Tailored to EM's county
  - Divided by disaster type
  - Once participant takes class, granted password access to page
- Tropical weather section of portal is complete

