2) Tropical Cyclones
Tropical Cyclones

- Occur in tropical and subtropical zones
- They range in intensity from a mild disturbance to highly destructive hurricanes or typhoons
- Multiple bands of inspiriling thunderstorms fuel the storm with large amounts of latent heat
- They move westward in the tropics due to the NE/SE trade winds
Weather of the Tropics

- Dominated by a single air mass – mE
- No frontal activity – midlatitudes only
- Easterly flow of air converging at the ITCZ
- Isobars should be parallel with lines of latitude
- Disturbances in isobars forms an equatorial trough, called an Easterly Wave
- Circulation around the easterly wave is cyclonic
- When coupled with surface heating and convection, the rising air and cyclonic rotation can be increased
- If this circulation becomes more well defined, we have a Tropical Depression
Tropical depressions are frequently seen from August to October (NH)

- Fueled by warm tropical waters which enhance convection and moisture content

- If the tropical depression develops further with maximum sustained winds at 35 mph (56 kph) and closed isobaric flow, then we have a Tropical Storm
Further development of the tropical storm may result from continued movement over warm, tropical waters or from a simple poleward movement (enhanced coriolis).

- If maximum sustained winds reach 74 mph (118 kph) we have a Tropical Cyclone.
- Also called a hurricane (N. America), a typhoon (eastern Pacific), a Cyclone (Indian Ocean), or a WillyWilly (Australia).
Easterly waves have surface convergence and cloud cover east of the axis and divergence to the west.
Redrawn from NOAA, National Weather Service.
A cross section of a typical hurricane.
Weather of the Tropics

- Characteristics of a hurricane include:
  - Inward flow of rising air
  - Inward spiral of air characterized by cloud bands
  - An area of strong low-pressure
  - A well-defined eye-wall with weak *descending* air in the center

- Hurricanes will move from east to west in the tropics and curve toward the east as they move into mid-latitudes
Weather of the Tropics

- As long as there are warm waters beneath them, hurricanes will continue to develop.
- As they move inland, they dissipate rather quickly due to:
  - Friction with the land surface
  - A loss of the warm supply of moisture
# Saffir-Simpson Hurricane Scale

<table>
<thead>
<tr>
<th>Category</th>
<th>Winds</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74 - 95 mph</td>
<td>Minimal</td>
</tr>
<tr>
<td>2</td>
<td>96 - 110 mph</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>111-130 mph</td>
<td>Extensive</td>
</tr>
<tr>
<td>4</td>
<td>131-155 mph</td>
<td>Extreme</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 155 mph</td>
<td>Catastrophic</td>
</tr>
</tbody>
</table>

(Category 5 – Labor Day Hurricane, 1935 – FL Keys
Hurricane Camille, 1969 – LA, MS)
New Castle County, Delaware

Hurricanes; 1900-1996
Plaquemines County, Louisiana

Hurricanes; 1900-1997

Year


Landfalling Hurricanes Per Year

1909 1915 1947

Betsy-1965 Camille-1969

Category 1&2 Hurricanes Major Hurricanes
Hurricanes

- Widespread Flooding
  - even weak storms can produce heavy rains

- High Winds
  - winds can exceed 100 mph

- Storm Surge
  - coastal areas affected by water pushed ashore

- Tornadoes
  - not as severe as tornadoes in the Midwest
Hurricanes

- Over the last 30 years, more than half of the hurricane-related deaths have occurred due to inland flooding.
- Storm surges are a potential threat, but most people evacuate.
- Rainfall totals are *not* proportional to the wind speed – most heavy flooding occurs with minor storms that stall over an area.
Hurricanes

- Storm Surge – 6000 people killed by the Galveston Hurricane of 1900
- Storm Surge – Hurricane Camille (1969) produced a 25 foot storm surge
- Storm Surge – Hurricane Hugo (1989) produced a 20 foot storm surge
- Heavy Winds – Hurricane Hugo (1989) produced 100 mph winds in Charlotte, NC
The storm surge is a combination of the wind-driven surge and the pressure surge. The wind-driven effect is by far the most significant.
Wind speed variations by quadrant

- Wind on left-hand side of hurricane
- Hurricane movement
- Net wind
- Speed and direction of hurricane movement
- Hurricane movement
- Wind on right-hand side of hurricane
- Net wind
Average tornado locations relative to hurricane storm center
HUGO
21 SEP 89
0000 UTC

FEMA/NWS/NOAA
Gulfstream IV/SP

Lockheed WP-3D Orion