Late Season Tropical Cyclone Formation in the Northeastern Atlantic Ocean: 1975-2005

Rachel Grant Mauk
Department of Geography, The Ohio State University, Columbus OH 43210

An Atypical Area
- Late season tropical cyclones (LSTCs) not uncommon
- Twenty LSTCs formed in NE Atlantic from Oct-Dec in 1975-2005 seasons
- Ten formed from 2000-2005
- Nine tropical storms, eleven hurricanes, no major hurricanes
- High wind shear, low sea surface temperatures (SSTs) common
- Environment usually unfavorable for tropical cyclone development

Why Study LSTCS?
- Tropical cyclone genesis in any environment not completely understood
- Transition from extratropical or subtropical to tropical cyclone not understood
- "Hybrid" systems (between subtropical and tropical) also not understood
- Affect shipping, occasionally land
  - US, Canada, Bermuda, Caribbean, Azores, Europe
- Ten LSTCs since 2000: influence of climate change?

Project Details
- Systems selected for:
  - Location: north of 20°N, east of 60°W
  - Time: after 1 Oct. from 1975-2005
  - Consistent satellite classification after 1975
  - National Hurricane Center (NHC) designation:
    - Tropical AND Maximum wind 23 knots FOR >6 hours
    - Wind data from NCEP/NCAR Reanalysis II (Kalnay et al. 1996)
  - SST data from Reynolds Weekly SST fields v. 2 (Reynolds et al. 2002)

Basic Types of Cyclones

<table>
<thead>
<tr>
<th>TROPICAL</th>
<th>SUBTROPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Organized clouds at center</td>
<td>• Limited clouds at center</td>
</tr>
<tr>
<td>• Non-frontal</td>
<td>• Non-frontal</td>
</tr>
<tr>
<td>• Warm at upper-level center</td>
<td>• Cold at upper-level center</td>
</tr>
<tr>
<td>• Maximum winds close to center</td>
<td>• Maximum winds away from center</td>
</tr>
<tr>
<td>Scale &lt; 500 km</td>
<td>Scale &lt; 750 km</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXTRATROPICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Variable cloud patterns</td>
</tr>
<tr>
<td>• Frontal or non-frontal</td>
</tr>
<tr>
<td>• Cold at upper-level center</td>
</tr>
<tr>
<td>• Maximum winds away from center</td>
</tr>
<tr>
<td>Scale &lt; 2000 km</td>
</tr>
</tbody>
</table>

Classification of LSTCs

<table>
<thead>
<tr>
<th>TYPE I (6)</th>
<th>TYPE II (7)</th>
<th>TYPE III (3)</th>
<th>TYPE IV (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial system is non-tropical, non-frontal, and pre-existing. Convection fires near center of system, wind radii contract.</td>
<td>Initial system is a frontal low. Front stalls in central Atlantic, low spins up as frontal structure dissipates.</td>
<td>Initial system is an occluded extratropical cyclone. Frontal structure dissipates, convection fires around low.</td>
<td>Initial system is tropical wave or circulation. Development occurs by typical tropical process.</td>
</tr>
</tbody>
</table>

Conclusions
- LSTCs develop from four unique origins
- Spatial correlation with type
  - Type II near (30N,50W)
  - Type III in high latitudes
  - Type IV in SW sector
- Average SST is 24.7°C
- Wind shear highly variable within types
  - Area of lower shear co-located with Type I, II, III genesis location

Future Work
- Project will be continued as Master’s thesis
- Continue analysis of local environment
  - Vertical temperature gradients
  - Horizontal vorticity (tendency to rotate) anomalies
- Move from genesis to persistence
  - How do LSTCs survive in low SST/high shear environments?

References

Acknowledgments
This project was funded by an Undergraduate Research Scholarship from the Colleges of the Arts and Sciences. Their generosity is greatly appreciated. I would like to thank the Honors College for all the opportunities they have provided during my time here. I also thank my Honors adviser, Joanna Spanos, and my thesis adviser, Dr. Jay Hobgood, for supporting me in academics and in life. I would not be what I am without your guidance.