Using Cloud-to-Ground Lightning Climatologies to Initialize Gridded Lightning Threat Forecasts for East Central Florida

Winifred Lambert
AMU/ENSCO, Inc.

David Sharp, Scott Spratt, and Matthew Volkmer
National Weather Service, Melbourne, FL
Current Lightning Threat Index

- Cloud-to-Ground (CG) Lightning Threat Index Map at NWS Melbourne
  - Issued daily at 1200 UTC
  - 5 color-coded threat levels at 5 x 5 km
    - Probability of thunderstorm occurrence
    - Expected amount of CG activity
- Created manually on AWIPS/GFE from a blank field
- Current map based on subjective assessment based on distribution of thunderstorm formation parameters
### Lightning Threat Indices

<table>
<thead>
<tr>
<th>Threat Level</th>
<th>Threat Level Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Extreme</strong></td>
<td>50% probability with excessive CG</td>
</tr>
<tr>
<td></td>
<td>60 - 70% probability with frequent CG</td>
</tr>
<tr>
<td></td>
<td>80 - 90% probability with occasional CG</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>30 - 40% probability with excessive CG</td>
</tr>
<tr>
<td></td>
<td>50% probability with frequent CG</td>
</tr>
<tr>
<td></td>
<td>60 - 70% with occasional CG</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>10 - 20% probability with excessive CG</td>
</tr>
<tr>
<td></td>
<td>30 - 40% probability with frequent CG</td>
</tr>
<tr>
<td></td>
<td>50% probability with occasional CG</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>10 - 20% probability with frequent CG</td>
</tr>
<tr>
<td></td>
<td>30 - 40% probability with occasional CG</td>
</tr>
<tr>
<td><strong>Very Low</strong></td>
<td>10 - 20% probability with occasional CG</td>
</tr>
<tr>
<td><strong>None</strong></td>
<td>No Threat</td>
</tr>
</tbody>
</table>

- Threat levels in map depend on:
  - Probability of thunderstorm occurrence
  - Expected amount of CG

Ranges of probabilities and CG amounts within each level.
First Guess Threat Index Map

Climatological Probability of Lightning Occurrence

Climatological Number of Strikes

First Guess Lightning Threat Index Map
Motivation

- NWS MLB requested climatologies of CG probability and amount to create first guess field
  - Increase efficiency
  - Improve consistency

- Climatologies stratified by synoptic flow regime and time intervals
  - Previous work shows connection between flow regime and CG occurrence
  - Increase time resolution of map to show threat for different time periods of the day
Flow Regimes

- 1000–700 mb average wind direction 1200 UTC soundings at MIA / TBW / JAX
- Combination of 3 directions determined flow regime
- 7 flow regimes:
  1) Ridge south of MIA
  2) Ridge between MIA/TBW
  3) Ridge between TBW/JAX
  4) Ridge north of JAX
  5) Ridge over Florida Panhandle
  6) Northwest flow
  7) Northeast flow

Map showing locations of Miami (MIA), Tampa (TBW), and Jacksonville (JAX) in relation to the Gulf of Mexico and Atlantic Ocean.
Data

- Warm season (May – September) 1989 – 2004
- Previous studies at Florida State University (FSU) and NWS Tallahassee (TAE) with similar goals
- FSU and NWS TAE provided:
  - Lightning data grids
    - Created from NLDN data
    - Hourly CG counts on 2.5 x 2.5 km grid
    - Covers state of Florida and adjacent waters
  - Flow regime dates of occurrence
  - Code to read and process lightning grids
Climatologies

- Stratified gridded CG data
  - By daily flow regime
  - 24- and 6-hour intervals
- Calculated values for each 2.5 x 2.5 km grid box
  - Probability of CG occurrence per regime
  - Mean number of CG strikes per regime

Probability of CG Occurrence
Climatologies

• Stratified gridded CG data
  – By daily flow regime
  – 24-, and 6-hour intervals

• Calculated values for each 2.5 x 2.5 km grid box
  – Probability of CG occurrence per regime
  – Mean number of CG strikes per regime

Mean Number of CG Strikes

24-Hour
0000-2400 UTC

6-Hour
0600-1200 UTC
Flow Regime Differences
1800-2400 UTC

Ridge North of JAX (E – SE flow)
Ridge South of MIA (W – SW flow)
Future Work and Summary

• Future work (AMU tasking meeting 6 March):
  – Use offset time intervals (e.g. 1500–0300 UTC)
  – Consider strength of flow
  – Stratify by month as more data are collected over time

• Created gridded climatologies of CG probabilities and number of strikes stratified by
  – Large scale flow regime
  – 24- and 6-hour time intervals

• Used to create a first-guess lightning threat index map


AMU Website: [http://science.ksc.nasa.gov/amu](http://science.ksc.nasa.gov/amu)