Using Geographic Techniques to Investigate Tropical Cyclone Rain Fields

Combining a background in art with her meteorological research allows Corene Matyas, of the University of Florida Department of Geography, to consider the shapes and spatial patterns of rain fields associated with tropical cyclones (TCs). Her research goals are to use geographic techniques to evaluate these shapes and patterns, determine their evolution, and couple the patterns and shape representations to better forecast locations of heavy rainfall in tropical systems. Her examination of these patterns of TC rainfall was the topic of discussion for the September meeting of the West Central Florida Chapter.

Matyas began with the question, "Where is the rain falling: Close to the center or in the outer rain bands of TCs?" She started her presentation by examining the spatial characteristics of TC rainfall patterns in Florida. She cited previous studies that describe different types of grids to characterize TC rainfall patterns, including both multicell and circular grids. She noted that the limitation with grids is that some properties of the storm may be lost. Instead of grids, Matyas used shape analysis where one can consider a feature (in this case the rain field) as a mathematical representation. In system analysis, different measures are considered, including edge, perforation, and elongation features. She noted that shape analysis is used not only in the field of meteorology [e.g., on satellite images, using elongation measure to differentiate between circular and linear thunderstorm clusters and symmetry to distinguish between weaker TCs (comma shapes) and strong TCs (circular shapes with small eyes)] but also in other fields, such as geology, astronomy, and urban geography.

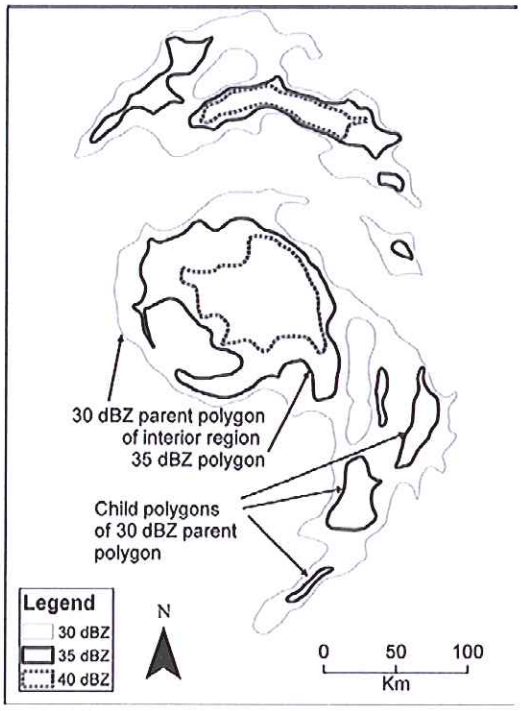

Fig. 1. Shape measures to define stratiform and convective regions in hurricanes.

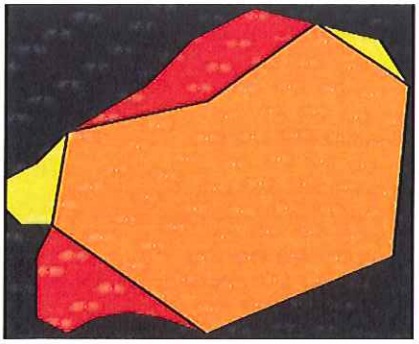

Fig. 2. Overlay of two polygons to calculate their areas of intersection.

Matyas uses a number of geographical analysis tools in her studies, including ArcGIS 9.2. Beginning with radar data, she converts reflectivity values to polygons and then finds measures such as centroid, perimeter, and area to describe the shape of the rain bands. Figure 1 shows shape measures that define stratiform and convective regions in hurricanes. Figure 2 illustrates how Matyas can overlay two polygons and calculate their areas of intersection, which is important because it links shape measures to atmospheric forcings such as vertical wind shear or topographic obstructions.

Matyas' research work is central to investigating and predicting areas of heaviest rainfall, not only at the point of landfall in a tropical system, but perhaps even days later (and many kilometers away) as the storm moves inland. Her work, identifying where this heavy rain will form, is of particular importance to flood forecasting.

Matyas's presentation can be viewed on the chapter's Web site at www.wcflams.org. Click on the "Past Meetings" tab and choose "2008," then the "September 30, 2008 meeting" link. More information on her research can be found at www.geog.ufl.edu/faculty/matyas.html.

—Jennifer Collins
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