Synoptic and Regional Influences on the Development of Convective Rainfall Patterns in South Florida

Raul E. Lopez
Patrick T. Gannon, Sr.
David O. Blanchard
NOAA/Office of Weather Research and Modification
Boulder, Colorado

Reviewers Abstract

Convective rainfall in the South Florida peninsula during the summer is strongly modulated by the local sea-breeze circulation. The diurnal heating cycle that the land undergoes produces moisture convergence during the day and divergence toward the ocean during the night. This periodic fluctuation in the wind field controls the timing and location of convective cloud activity over the region. In spite of this very regular forcing cycle, the development of the convective cloud field varies greatly from day to day in regards to space and time patterns and intensity. The principal source of variation is thought to be the synoptic disturbances and regional circulation situations occurring during the summer. This paper describes the principal patterns of the diurnal convective development occurring over South Florida during summer.

Radar and synoptic data routinely taken during the Florida Area Cumulus Experiments (FACE) has been used for this study. A WSR-57 10-cm radar was operated from Miami and the video data was digitized and recorded on magnetic tapes for PPI scans every 5 minutes. Radiosonde information from Miami, Tampa, and special FACE releases was used together with regular NWS synoptic depictions of the region.

Time series of total echo cover over lands within 200 km of the radar were constructed for each day for the period of 9 a.m. to 9 p.m. from PPI scans taken at 5-min intervals. Similarly, time series of average reflectivity and volumetric rainfall data were produced. The daily echo cover series were stratified in terms of the magnitude of the maximum area covered by echoes. This parameter was found to describe well the overall degree of convective activity during the day. The distribution of days was then divided into four quartiles. The synoptic data for each of the days in each quartile was then examined. Several parameters were utilized to characterize the days. These parameters describe the humidity, stability, and wind vector characteristics prevalent in the region.

The paper describes each of those quartiles from both the radar and synoptic data points of view. Apart from synoptically disturbed cases, the different quartile types depend mostly on the position of the Atlantic Ridge relative to the Florida peninsula. This controls not only the wind speed and direction but also the thermodynamic properties of the air mass in which the clouds, forced by the sea breeze, are trying to form. The result of this regional/sea-breeze scale interaction is reflected in the way that the convective cloud field starts, develops, and decays over the region, and its spatial distribution. Average time series of various radar parameters are presented for each of the cloud field development patterns; these summarize the resulting development cycle. Correspondingly, a description of the flow and thermodynamics of the

atmosphere over the region are provided for each quartile. Typical soundings and generalized synoptic maps are also shown.

Short Abstract

Using radar observations from two summers in South Florida, the convective activity during each day has been stratified in terms of the magnitude of the area covered by echoes. The resulting distribution of days was then divided into quartiles. The available synoptic data for each of the groups was composited resulting in four different types of flow and thermodynamic regimes. This paper describes these four basic types from both the radar and synoptic points of view.