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Precipitation efficiency of hurricanes over Gulf of Mexico and Caribbean Sea basins

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In recent years, various observational and modeling studies have resulted in an improved understanding of tropical cyclones forming over the Atlantic, Gulf of Mexico and Caribbean Sea (GM-CS) basins. While there are selectively successful predictions of cyclone tracks and intensity, predictions of total rainfall and feedback of rainfall on the large-scale environment remain inadequate and often without suitable explanation. Severe flooding, mostly along but not restricted to coasts, and the accompanying death and destruction from tropical cyclones and hurricanes passing through or incipient to the GM-CS basins, clearly call for improved understanding and predictability of the underlying precipitation physics and precipitation processes.

Two aspects of hurricane rainfall within the GM-CS basins that have received scant attention are their precipitation efficiency, and rainfall production in terms of a scale-dependent process. Total rainfall production from a given storm is a product of its precipitation efficiency (PE), given by several measures of the fraction of available moisture (arising from atmospheric mass convergence and surface moisture flux) converted to precipitation by storm system dynamics and microphysical processes. The PE of any storm depends on interactions between large-scale, storm-scale, cloud-scale, and microscale processes, each of which plays a crucial role in partitioning the water budget across and within the scales. It is crucially important to understand these pro-

cesses for improving quantitative precipitation estimates. The main objective of this study is to investigate some of these processes within a cloud-resolving, numerical model simulations of GM-CS hurricanes.

In this investigation, the University of Wisconsin Nonhydrostatic Modeling System (NMS) cloud-mesoscale modeling system is used to simulate two major hurricanes, i.e. Hurricane Ivan (September 13-17, 2004) and Hurricane Katrina (August 26-30, 2005), that intensified over the GM-CS region and devastated the southern Unites States through heavy rains and severe flooding. The model simulations of precipitation and calculations of brightness temperatures at TRMM Microwave Imager frequencies resulting from NMS thermodynamical/microphysical states are compared with the same quantities obtained from TRMM orbital overpass measurements. In the presentation, the following questions will be addressed : (1) How do cloud-scale (a few kms) PEs relate to and storm-scale (several hundred kms) processes, and how do the PEs depend on large-scale water budget? (2) Do PEs vary significantly between land and ocean and if so, why?, and (3) What are the similarities and differences between the PE properties of the two hurricanes?