Geophysical Research Abstracts
Vol. 17, EGU2015-7956, 2015
EGU General Assembly 2015

Global Distribution of Different Forms of Convection as Seen by TRMM

Robert Houze, Kristen Rasmussen, Manuel Zuluaga, and Stella Brodzik
University of Washington, Seattle, WA 98195 USA, rahouze@gmail.com

For 17 years the Tropical Rainfall Measuring Mission (TRMM) satellite collected data with its Ku-band Precipitation Radar (PR) over the low latitudes, where convective clouds dominate rainfall. The three-dimensional character of the radar data allows echo objects to be defined that indicate the different forms taken by convection. Analysis of these echo objects over the entire tropics indicate that the nature of convection and its lifecycles vary regionally, with respect to ocean, land, mountains, and the large-scale meteorological environment. This study is based on three types of echo objects representing extreme forms of convection: Deep convective cores (DCCs), which are three-dimensional towers of radar echo exceeding a high intensity threshold and extending high into the upper troposphere; wide convective cores (WCCs), which are three-dimensional elements defined by a high reflectivity threshold and covering horizontal area of mesoscale proportions; and broad stratiform regions (BSRs), for which a contiguous region of stratiform echo covers an especially large area. These echo objects are not isolated but rather are embedded within larger storms or mesoscale convective systems (MCSs). Embedded DCCs characterize storms in an early stage of development. The presence of WCCs indicates MCSs that are maturing, growing upscale to become MCSs. Embedded BSRs are found in robust mature MCSs in late stages of development.

Some patterns that emerge from the global distribution of DCCs, WCCs, and BSRs in the 17-year TRMM dataset are that the behavior of these forms of convection varies between land and ocean. DCCs and WCCs are not as deep, wide, or intense over tropical oceans as observed over land, with the exception of Amazonia, where these forms of convection are similar to those over oceanic regions. Over tropical continents (Africa and South America) and the South Asian subcontinent, these echo objects are generally deeper and more intense. Over land regions, storms containing DCCs initiate near major mountain ranges (viz. the Himalayas and Andes).

Global patterns of the forms of convection containing DCCs, WCCs, and BSRs are strongly affected by large-scale environmental and topographic conditions. Near the Andes and Himalayas, midlevel flow over mountains caps moist low-level flows until strong convection can be triggered to break through the cap. As a result, storms containing the most extreme DCCs occur close to these mountain ranges. Large-scale flow patterns are key to whether storms can grow upscale to form the most intense MCSs. This fact is illustrated most strongly over the oceans by the Madden-Julian Oscillation (MJO), wherein storms achieve maximum maturity with the largest BSRs in active phases of the MJO. Over land the influence of large-scale motion patterns is indicated by the fact that systems with embedded WCCs and BSRs are favored by African easterly wave troughs over equatorial Africa, while over subtropical South America, baroclinic waves extending into lower latitudes favor such development of MCSs initiating near the Andes.