Global distribution of Hot Towers in Tropical Cyclones Based on 11-year TRMM Data

Cheng Tao, Florida International University, Miami, FL; and H. Jiang

Using a 12-year (January 1998 - December 2009) Tropical Rainfall Measuring Mission (TRMM) tropical cyclone precipitation feature (TCPF) database, hot towers in 13,677 individual TRMM overpasses of 1013 tropical cyclones are identified by five different reference heights, i.e., 14 km, NCEP reanalysis derived tropopause height, Level of Neutral Buoyancy (LNB) calculated using NCEP sounding, surface equivalent potential temperature (theta-e) θe, LNB calculated using θe at 925 and 1000 mb, and level of potential temperature θ equal to 380K. The common properties of these extreme convective systems are examined in terms of geographical locations, different TC regions(i.e., the inner core, inner rainband , and outer rainband regions) different TC intensities (i.e., tropical depression , tropical storm, and hurricane), and different TC intensity stage changes (i.e., rapid intensification, slow intensification, neutral, and weakening). The most overshooting TCPFs are found when using the level of potential temperature equal to 380K as the reference height, while the least overshooting TCPFs are found for 14 km reference height. For example, 316 overshooting TCPFs in 290 TRMM orbits are identified using the level of NCEP reanalysis tropopause as the reference height. It is found that 1.6% of deep convection systems reach 14 km and 0.1% of them may even penetrate the 380K potential temperature level. Hot towers in TCs are more frequent in the Western North Pacific basin than any other TC-prone basins, while the strongest TC convection is found in the North Indian Ocean basin. The geo-distribution patterns of hot towers show little sensitivity to the definition of the reference level. On the other hand, the convective properties of overshooting are dependent on TC regions, TC intensities, and TC intensity stage changes to various degrees. The population occurrence and convective intensity of overshooting TCPFs are also compared with overshooting non-TCPFs. Using the level of NCEP reanalysis tropopause as the reference height, 3446 overshooting non-TCPFs are identified over ocean in 3195 individual TRMM orbits, while 10903 overshooting non-TCPFs in 8014 orbits are found over land. Overshooting convection is more frequent and stronger over land than over water in non-TCPFs, with its frequency and strength in TCPFs in between.