Geophysical Research Abstracts
Vol. 13, EGU2011-1238, 2011
EGU General Assembly 2011

Precipitation and Cloud Statistics in the Deep Tropical Convective Regime

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Precipitation and cloud statistics in the deep tropical convective regime is investigated through the analysis of grid-scale data from a two-dimensional cloud-resolving model simulation. The model is forced by large-scale vertical velocity, zonal wind, horizontal advection, and sea surface temperature observed and derived from the Tropical Ocean Global Atmosphere Coupled Ocean Atmosphere Response Experiment (TOGA COARE). The analysis is conducted by categorizing the grid-scale data into eight rainfall types based on precipitation processes: water vapor convergence, local vapor change and hydrometeor change/convergence. Among the eight rainfall types, the rainfall with local atmospheric drying, water vapor divergence and hydrometeor loss/convergence has the largest contribution (30.8%) to the total rainfall because of large rainfall coverage (35.3%). The hydrometeor loss is mainly caused by water clouds through precipitation and the evaporation of rain. For the three other rainfall types with water vapor divergence, each rainfall type contributes to the total rainfall by less than 5%. 61% of the total rainfall is attributed to the four rainfall types with water vapor convergence. Although the rainfall with local atmospheric drying, water vapor convergence and hydrometeor loss/convergence shows the largest surface rain rate (27.8 mm h^{-1}), it only accounts for a small part (10%) of the total rainfall due to its small rainfall coverage (1.2%). For the three other rainfall types with water vapor convergence, each rainfall type contribute to the total rainfall by 14-19%. This grid-scale precipitation statistics is significantly different from the model domain mean precipitation statistics, which suggests a spatial-scale dependence of precipitation statistics.

Keywords: two-dimensional cloud-resolving model; deep tropical convective regime; TOGA COARE; precipitation and cloud statistics

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This study is supported by the National Key Basic Research and Development Project of China under Grant No. 2011CB403405, the National Natural Science Foundation of China under Grant No. 41075039, the Chinese Special Scientific Research Project for Public Interest under Grant No. GYHY200806009, and the Qinglan Project of Jiangsu Province of China under Grant No. 2009.