

Characteristics and regional differences of summer warm rain over the tropical and subtropical Pacific Ocean observed by TRMM

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Based on the merged measurements from the TRMM Precipitation Radar and Visible and Infrared Scanner, refined characteristics (intensity, frequency, vertical structure and diurnal variation) and regional differences of the warm rain over the tropical and subtropical Pacific Ocean (40°S-40°N, 120°E-70°W) in boreal summer are investigated for the period 1998-2012. The results reveal that three warm rain types (phased, pure and mixed) exist over these regions. The phased warm rain, which occurs during the developing or declining stage of precipitation weather systems, is located over the central to western Intertropical Convergence Zone, South Pacific Convergence Zone, and Northwest Pacific. Its occurrence frequency peaks at midnight and minimizes during daytime with a 5.5-km maximum echo top. The frequency of this warm rain type is about 2.2%, and it contributes to 40% of the regional total rainfall. The pure warm rain is characterized by typical stable precipitation with an echo top lower than 4 km, and mostly occurs in Southeast Pacific. Although its frequency is less than 1.3%, this type of warm rain accounts for 95% of the regional total rainfall. Its occurrence peaks before dawn and it usually disappears in the afternoon. For the mixed warm rain, some may develop into deep convective precipitation, while most are similar to those of the pure type. The mixed warm rain is mainly located over the ocean east of Hawaii. Its frequency is 1.2%, but this type of warm rain could contribute to 80% of the regional total rainfall. The results also uncover that the mixed and pure types occur over the regions where SST ranges from 295 to 299 K, accompanied by relatively strong downdrafts at 500 hPa. Both the mixed and pure warm rains happen in a more unstable atmosphere, compared with the phased warm rain.

Keywords: warm rain, frequency, diurnal variation, radar reflective factor, trade wind