Time-space characteristics of diurnal rainfall over Borneo and surrounding oceans as observed by TRMM-PR

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Five years of Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (PR) data were used to investigate the time and space characteristics of the diurnal cycle of rainfall over and around Borneo, an island in Indonesia. The diurnal cycle of precipitation over the whole of the island and surrounding oceans is shown in Fig. 1. It is clearly shown that the daily maximum raifall over the island appears in the evening (18-22 LT) to mid night (0-4 LT), and the daily maximum over the coastal sea area appears early in the morning (6-10 LT). The diurnal cycle shows a systematic modulation that is associated with intraseasonal variability in the large-scale circulation pattern, with regimes associated with low-level easterlies or westerlies over the island. The lower-tropospheric westerly (easterly) components correspond to periods of active (inactive) convection over the island that are associated with the passage of intraseasonal atmospheric disturbances related to large-scale disturbances embedded in the Madden-Julian Oscillation.

A striking feature is that rainfall activity propagates at about 10 m s-1 to the leeward side of the island between midnight and morning. Propagation occurs over the entire island, causing a leeward enhancement of rainfall. However, the spatial characteristics of the propagation and of storm development are not symmetric for the easterly and westerly regimes. In the easterly regime (EE), rainfall persists over the island until midnight, and offshore convection off the west coast develops independent of convection over the land, starting before the activity over land ceases. In contrast, the strong westerly regime (SW) is characterized by rainfall activity that propagates directly from the island to offshore of the east coast of the island. Furthermore, the vertical structure of the convection/rainfall systems differs remarkably between the two regimes. In the easterly regime, stratiform rains are widespread over the island at midnight, whereas in the westerly regime, local convective rainfall dominates. Over offshore regions, convective rainfall initially dominates then gradually decreases in both regimes, while the storms develop into deeper convective systems in the easterly regime. In addition to leeward rainfall propagation, shallow storms develop over the South China Sea region during the westerly regime, resulting in heavy precipitation from midnight through morning. Overall time-space propagation feature of diurnal convection and rainfall is shown in Fig. 2. These results are summarized in Ichikawa and Yasunari (2005), J. Climate, under revision.

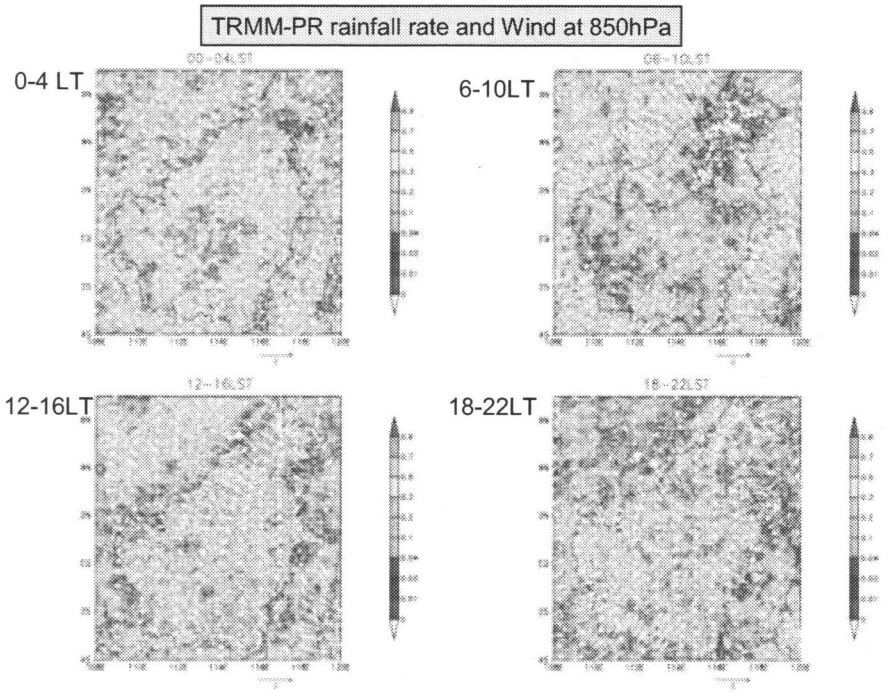

Fig. 1 Diurnal cycle of rainfall rate by TRMM-PR data and wind vector field in the lower troposphere (850 hPa).

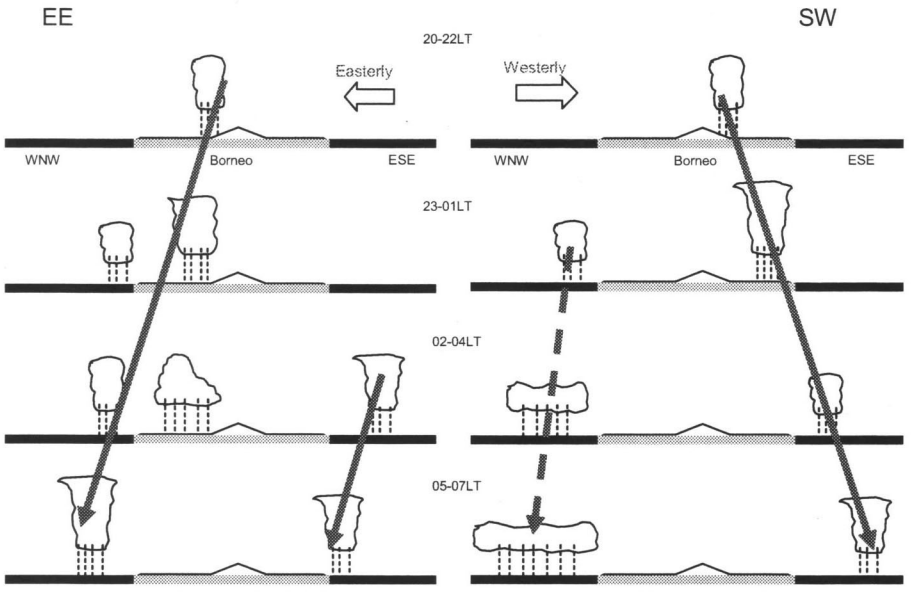

Fig.2 propagating feature of diurnal cycle of cloud/rainfall systems during the weak easterly (EE) and strong westerly (SW) phases. Blue arrows show phase propagation of cloud/rainfall systems from eveing to early morning. (Ichikawa and Yasunari, 2005)