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Diurnal cycle of precipitation revealed by TRMM sensors

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The diurnal cycle of precipitation was revealed by a precipitation radar, microwave and visible/infrared radiometers onboard the Tropical Rainfall Measuring Mission (TRMM) satellite over the period of June, July, August from 1998 to 2003, in other words, six year average for boreal summer. The near surface rain rates were obtained as the PR2A25 standard products of version 5. From the microwave radiometer (TMI), the standard product of 2A12 was used. For the visible/infrared radiometer, high cloud distribution was obtained as the proxy of precipitation activity from the product of VIRS1B02. The global maps of the local time for the peak rainfall derived by rain/cloud sensors were compared. Generally, the peak local time coincides with each other: strong afternoon peak appeared in tropical land, strong morning rain peak appeared over ocean near the coasts. Distinct early morning peak over the southern foot of Himalayas and eastern foot of Andes mountain range exist. Over ocean where the diurnal cycle is generally weak, clear morning rain appeared over the Bay of Mexico and subtropical western Atlantic Ocean. There also appeared small but clear differences in the peak local times. The peak local time derived from the precipitation radar was the earliest followed by the one using the microwave radiometer by about a few hours. The last was using the visible/infrared radiometer. These characteristics were more clear over land region. This may be due to more significant diurnal cycle in precipitation over land. Split window technique which is effective to eliminate the cirrus clouds and water vapor contamination was applied in the infrared data, and it was found that significant difference of the peak local time appeared in the map from infrared data: afternoon peak became much clear particularly over North and South America and Africa. The rain height derived from the precipitation radar data was also compared with the rain from the radar, and there found no significant difference.

These characteristics can be understood as the stage of precipitation systems. In the development stage, precipitation is strong, and after that high clouds extend. These characteristics are important for the production of global map of precipitation distribution using several satellite-borne sensors.