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Estimation of Typhoon Rainfall in Northwest Pacific Using TRMM/TMI Data

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In recent years, there were a lot of natural disasters in Taiwan, especially caused by torrential rainfall from typhoons. The major reason for these disasters was the huge amounts of rain falling in short periods. People need real time rain information to prepare for disasters and to reduce the damage and loss of lives and properties. It is the aim of this study to provide accurate rainfall estimations for severe weather systems.
The Bayesian approach was used in this study. At first a prior probability distribution was created by using about a total of 4 million rain rate retrievals from Precipitation Radar (PR) data during 2002-2010 period over Northwest Pacific. A conditional probability distribution was then derived by simulating the 9 channel brightness temperatures of TMI using a microwave radiative transfer model (RTM), in which vertical hydrometeors were obtained from the Weather Research and forecasting Model (WRF) outputs. Finally, a posterior probability distribution of rain rate was calculated by multiplying a prior probability distribution by conditional probability distribution.
In addition, 9 channel-brightness-temperature thresholds for non-raining cases was obtained by using more than one hundred thousand data pairs of TMI brightness temperatures and PR rain rates. An attenuation index, defined as the ratio of the polarization difference between the vertical and the horizontal brightness temperatures at rainy case to that at clear sky case, was used to estimate rain rates over ocean. This index has great advantage in rain rate retrievals, because its value decreases with increasing rain rate but not being easily saturated. The retrieved rain rates were validated with the standard PR rainfall products.

Keyword: Bayesian approach, posterior distribution, radiative transfer model, WRF