Developing an Algorithm for Detecting Noises of Differential Phase in Rain Observed by the Mirai Polarimetric Radar

◯Biao Geng and Masaki Katsumata

(Japan Agency for Marine-Earth Science and Technology)

Differential phase Φ_{DP} and specific differential phase K_{DP} are readily contaminated by noises in scales ranging from gate-to-gate fluctuations to low-frequency oscillations of a few tens of kilometers in the range direction. Previous studies have illustrated several methods mainly suitable for removing high-frequency flucturations. The purpose of this study is to develop an algorithm to detect the low-frequency oscillations of Φ_{DP} and K_{DP} in rain measured by the Mirai polarimetric radar.

The algorithm developed in this study processes radar data on a radial-by-radial basis, which is applied after high-frequency noises in Φ_{DP} have been removed. The algorithm utilizes a simple threshold fiter to detect spurious Φ_{DP} and K_{DP} measured by the Mirai polarimetric radar in rain. The main procedures in construcing the algorithm include (1) utilizing an empirical relationship between K_{DP} and radar reflectivity at horizontal polarization Z_H in rain, (2) designing an objective function, and (3) obtaining experimentally optimal thresholds of the objective function and its standard deviation.

Data used to construct and validate the algorithm were observed by the Mirai C-band polarimetric radar at an elevation of 0.5 degrees from 23 November to 17 December 2015, when an intensive observation was conducted by the research vessel Mirai in the tropical Indian ocean around the Island of Sumatra in Indonesia. These data covered a variety of precipitation systems, which developed with distinct environmental conditions and evolved over both the open ocean and coastal regions.

Figure 1 shows an example related to the performance of the algorithm. It is found that the algorithm can efficiently detect spurious Φ_{DP} and K_{DP}, while realistic Φ_{DP} and K_{DP} have been less affected after the application of the algorithm, which helps improve the accuracy of Φ_{DP} and K_{DP}. An improvement of the estimation of rainfall by using K_{DP} is also achieved through the application of the algorithm. It appears that the algorithm facilitates the quality control of the data observed by the Mirai polarimetric radar

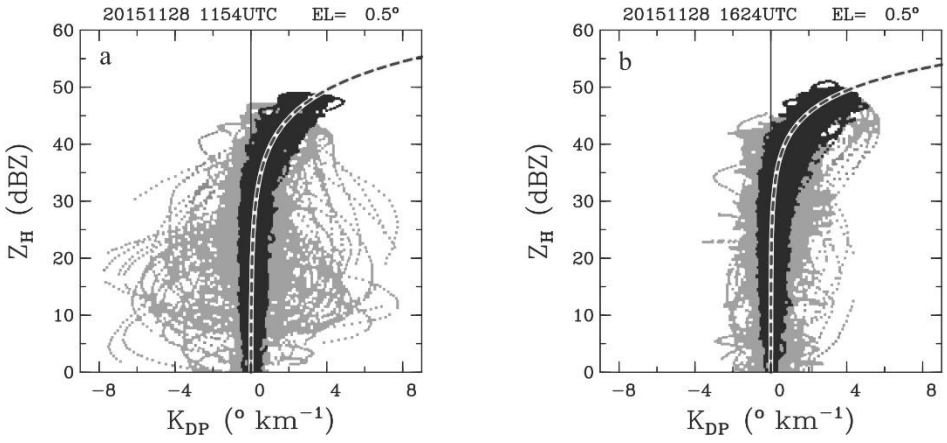

Figure 1. Scatterplots of K_{DP} versus Z_H for (a) 1154 UTC and (b) 1624 UTC 28 November 2015. The dashed curve was obtained by a least-square fit to Z_H and log (K_{DP}). Spurious K_{DP} as detected by the algorithm developed in this study is shown in grey color.