Quantitative Precipitation Estimation Algorithm Using an Overlapped Observation Area between Radars

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The density of domestic radar observation network is about 8,000 km2 per unit (99,720 km2 in the land area, 13 S and C-Band Radars. As the observation range of radars is mostly 200 km or longer, the density of radar observation network is quite high. For this reason, overlapped observation area (overlapped area) between radars takes a larger portion of each radar observation area. Meanwhile, as numerous radars are installed in the coastal area, it is advantageous to (storm) observation of torrential rains induced inland on the sea.

However, the current domestic qualitative precipitation estimation (QPE) algorithm failed to make the most of characteristics of the radar observation network. The greatest cause of this is that Z-R relationship can be estimated only when it is possible to collect data from a ground rain gauge with the currently operating qualitative precipitation estimation algorithm alone. As for the time when it is difficult to collect data from ground rain gauges or when information is insufficient, radar rain rate is estimated based on a constant single Z-R relationship. In fact, as Korea is a peninsula, most storms pass through the sea where it is hard to collect data from ground rain gauges to come inland. Accordingly, it is difficult to accurately estimate radar rain rate in the coastal areas where it is tricky to collect data from ground rain gauge in the initial stage of a heavy rainfall. In addition, radar rain rate is often underestimated due to application of the Z-R relationship. After all, it is impossible to estimate very accurate radar rain rate based on the present qualitative precipitation estimation algorithm.

In this regard, this study aimed to suggest qualitative precipitation estimation algorithm that is advantageous in the coastal area in consideration of characteristics of domestic radar observation network and problems in the existing qualitative precipitation estimation algorithm. The qualitative precipitation estimation algorithm aims to determine parameters of the Z-R relationship in the coastal area and calibrate the Z-R relationship on a real-time basis at a time when there are insufficient ground rain gauge data. Toward this end, two single polarization S-band radars installed in the southern coast and Jeju-island, respectively, were used. This study conducted two things in general. First, it established qualitative precipitation estimation algorithm based on overlapped observation areas and past data. Second, it estimated the performance of qualitative precipitation estimation algorithm suggested in relation to actual heavy rainfall. The southern coastal areas frequented by typhoons and rainy seasons were selected as subject areas. In conclusion, it was possible to estimate reasonable parameters of Z-R relationships prior to a heavy rainfall. In addition, the performance of the suggested qualitative precipitation estimation algorithm turned out to better than that of the conventional algorithm. In particular, qualitative accuracy of radar rain rate was clearly improved in the initial stage of a heavy rainfall.