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Analysis of Spatial Characteristics of Rainfall for Optimal Observation Network in Korea

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Accurate prediction of high impact weather phenomena can reduce damages to people as well as property. Among the meteorological disasters occurred in Korea, heavy rainfall causes the second largest damage, next to typhoons. Therefore, proper observation network of rainfall is important for better understanding of the rainfall characteristics and for more accurate rainfall forecast over Korea. Precipitating weather systems in Korea are highly influenced by East Asian Monsoon, hence they have not only high seasonal variation in rainfall, but also high spatial variation due to complex topographic characteristics. In this study, we identify the spatial characteristics of rainfall in Korea with the geostatistical analyses, including autocorrelogram, variogram, Moran's I, and general G. We develop a testbed system to design an appropriate observation network for rainfall, which can be applied to other high impact weather systems. Geostatistical analyses are conducted using data sets collected from Automatic Weather Stations (AWS; ∼600 rain gauge data), global/regional numerical weather prediction outputs (i.e. temperature, geopotential height and humidity), Himawari satellite measurements (i.e. water vapor) over Korea in a period of 2013 – 2015. A heavy rainfall is defined as a case with the rainfall rate larger than 80 mm/24 hr over at least one station. In order to consider different characteristics of heavy rainfall systems, we have classified them into several groups: isolated thunderstorms, convective bands, squall lines, cloud clusters, migratory cyclones, typhoons, Changma (monsoon) frontal systems, and showers. We also perform the spatial analyses of rainfall by dividing Korea into several areas based on topographic characteristics. Our results show different properties for different heavy rainfall systems in terms of correlation distances, separation distances, clustered vs. random patterns, and hot vs. cold spots; thus suggesting clues for optimal observation networks.