SPATIAL RAINFALL ESTIMATION BY COKRIGING OF WEATHER RADAR AND RAIN GAUGE NETWORK DATA

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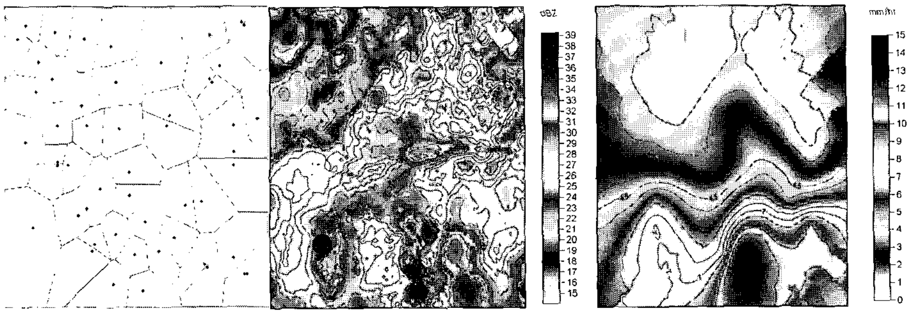
Rainfall forcing has the most critical influence on the performance of hydrologic models. Traditionally, hydrologic models have depended on rain gauge networks to provide the areal-averaged rainfall information. A dense rain gauge network could be an ideal approach to estimate rainfall amount for small areas, but rainfall estimates from gauges become inadequate for large areas due to their poor representation of areal rainfall, especially in situations with a sparse gauge network. It will provide incorrect representation of the spatial characteristics of rainfall fields, especially in convective weather systems where rainfall amounts vary significantly over small regions. The spatial variability of rainfall in mountainous regions is very large because of orographic influences (Li et al., 1995). Korea is mountainous and marked by deep, narrow valleys. A complex system of mountain ranges and spurs extends across the country. Therefore accurate spatial rainfall information is essential to analyze the rainfall runoff process appropriately.

Weather radar that covers much larger areas has become an attractive instrument for providing areal-averaged rainfall information (Fulton, 1999; Austin, 1987). Weather radar provides high resolution and more evenly distributed rainfall information. Despite of the limitations of the QPE(Quantitative Precipitation Estimation) using weather radar, we can get the better information of spatial variability of rainfall fields (Cassirage and Gomez-Hernandez, 1996; Smith and Krajewski, 1993). The radar derived rainfall data have the limitation of measuring the rainfall indirectly. The relationship between radar reflectivity and rainfall rate is strongly influenced by a number of factors (Zawadzki, 1984), including attenuation, the distribution of raindrop sizes (Smith, 1993), abnormal propagation etc. First of all, we filtered out the non-rainfall echo such as ground clutter (abnormal propagation), isolated echo (speckles), sea clutter, line echo (sun strobe). Even though the filtered radar reflectivity fields still need correction of attenuation, the spatial pattern of rainfall fields should be kept in those fields. It means that we need just the reflectivity data before collection of attenuation for merging radar reflectivity into rain gauge data. Despite the effort for improving geostatistical approach for spatial rainfall estimation (Velasco et al., 2004), ordinary cokriging is an approach for optimally incorporating radar reflectivity data into rain gauge data (Seo et al, 1990.; Krajewski, 1987).

The hypothesis of this study is that rain gauge networks give us the good quantitative accuracy of rainfall fields and weather radar gives us the good spatial distribution information of rainfall fields. Therefore, the objective of this study is to develop an improved spatial rainfall estimation methodology using an ordinary cokriging technique which optimally merges radar reflectivity data into rain gauge data. The advantages of this approach are that it is not influenced by the attenuation problem of C-band weather radar, which is main drawback of C-band radar at heavy rainfall estimation and it takes use of the advantageous dense rain gauge networks in Korea. Results show that rainfall fields estimated by ordinary cokriging give the improved results than that of traditional approach.



(a) (b) (c)

Fig. 1 (a) sample spatial rainfall estimate using Thiessen polygon method [mm/hr], (b) sample radar reflectivity data [dBz], (c) cokriged sample rainfall estimates [mm/hr] (10:00 a.m., August 31, 2002)

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