Effect of spatial resolution of radar rainfall on hydrological simulation of urbanized river basin in Japan

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The use of accurate information in hydrological models regarding the spatial variations of rainfall is essential for monitoring river discharge, and may help to improve our understanding of water balances. Therefore, there has been a considerable interest in recent years in developing high spatial and temporal resolution gridded rainfall datasets. Many studies suggest that use of high-resolution rainfall data to the hydrological model may offer more realistic output, but there is not a clear guideline on the selection of appropriate scale of spatial resolution rainfall data to generate runoff data. Very high-resolution rainfall data may be sometime optional to the hydrological simulation in term of cost benefit assessment. On the other hand, accuracy of simulated results can be decreased using coarse resolution rainfall data. Therefore, it is very curious that what could be the optimal scale of spatial resolution of radar rainfall data can be suitable for the hydrological simulation. To get some idea about it, we used very high-resolution of X-band polarimetric radar network (XRAIN), which uses an operational data processing system developed by the National Research Institute for Earth Science and Disaster Resilience (NIED). XRAIN has spatial and temporal resolutions of 0.25-km and 1-min, respectively. This product is one of the best high-resolution radar rainfall systems in the world, and is available to the public and private sector. In this study, Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) model was set up over the Tsurumi river basin, located very close to Yokohama city of Japan. Total 10 independent convective rainfall events were considered to generate discharge data at the sub-basin scale and they were compared with the observed data. Then, calibrated HEC-HMS model was reconfigured for the basin using different rescaled XRAIN data separately. The study revealed that a close relationship found with simulated discharge using 0.25 - 1.0 km spatial resolution rainfall data at the outlet of basin, but such scenarios did not appear in the case of sub-basin outlets.

Keywords: Spatial resolution, Convective rainfall, Hydrological simulation, XRAIN, HEC-HMS, Urbanized river basin