

Application of Radar-Measured Rainfall in Ungauged Basins

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The accuracy of rainfall-runoff estimates is critical for hydrologic and environmental modeling, especially in ungauged basins where rainfall and streamflow data are absent or insufficient for calibration and validation of the hydrological model. Therefore, weather radar is used to estimate rainfall over the ungauged or poorly gauged watersheds due to its ability to provide spatial and temporal rainfall estimates. The purpose of this study is to use radar-measured rainfall for runoff simulation in an ungauged basin which is located in a mountainous region in the north of Thailand.5-min radar reflectivity values (Z) with 1x1 km2 spatial resolutions and 5-min gauge rainfall intensities (R) from 13 rain gauges data over the Mae Chaem watershed with a geographical area of 3, 853 km2 are used to calibrate Z-R relationship for radar rainfall estimates in this area. The results indicate that the accumulated mean areal radar rainfall for a four-day period using calibrated Z-R relationship (Z = 18R1.45) is close to the Thiessen polygon method applied to 13 rain gauges data. The rainfall-runoff simulation is carried out by the quasidistributed HEC-HMS model based on hourly data. Gridded SCS Curve Number, ModClark and Muskingum methods are used in this model. The simulation results for four days show that the model calculated runoff volume and peak discharge with radar and 13 rain gauges-measured rainfall data are close with a difference of 8% and 7% with the observed data respectively. This Z-R relationship is then used to predict the rainfall for two rain gauge stations, namely Chiang Mai and Mon Chong stations, that are located outside the Mae Chaem watershed with distances from the Mae Chaem watershed of approximately 45 and 80 km respectively. The difference between observed and estimated rainfall over the Chiang Mai and Mon Chong stations during four days are found to be 5% and 11% respectively. This estimated radar rainfall is being used in rainfall-runoff model for an ungauged basin located near the Mae Chaem watershed. Based on the study results, it is concluded that the calibrated Z-R relationship can be used to provide rainfall estimates that are as good as rain gauges measurements. The study results also prove the ability of radar in the prediction of rainfall in ungauged basins for improved input for rainfall-runoff modeling.