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Influence of spatial resolution of radar images on the parameterization and performance of SWAT model

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ABSTRACT

Recent advances in environmental monitoring improve data quality and availability in space and time, but questions about their beneficial use in water resources analysis and modeling still remain. This study assesses the dependency of the parameterization and performance of a watershed-scale simulation model, the Soil and Water Assessment Tool (SWAT), on high-quality (rainfall) data at different spatial resolutions. The SWAT model was applied to the upstream of the Yeongsan River in Korea which remained relatively unexploited, and was calibrated and validated with the observed daily flow and monthly sediment data for the periods of 2012–2013 and 2014, respectively. Results showed that the radar rainfall estimates, derived using bias adjustment factors A_1 and A_2 which allowed the number and magnitude of storm events to be corrected, respectively, fitted excellently with the standard gauging data (R^2 = 0.97–0.98). Interestingly, the recommended parameter sets for steam flow were significantly different among the rainfall data-sets at different resolutions, but not for sediment concentration. The prediction accuracy of the model was, on average, higher not only during the calibration period than for the short-term validation period, but also using all the radar data-sets than using the standard gauging data. These results demonstrate that although we cannot recommend the best input among the new rainfall products in this preliminary study, the optimal parameter sets developed from many local and regional studies using the SWAT model need to be revisited fundamentally.

Keywords: Rainfall radar image; Digital image processing; Soil and Water Assessment Tool; Advanced environmental monitoring; Bias correction; Calibration parameter sets

1. Introduction

Environmental monitoring data in surface waters support scientific analysis and modeling of water resources impairment at different spatial and temporal scales, assisting in developing sustainable watershed management plans [1,2]. Climate and land use changes were found to regulate watershed processes such as stream flow regime, soil erosion, and chemical transport, along with a mix of other human activities [3]. The watershed response, however, significantly differed depending on the intensity, frequency, and duration of these factors as well as environmental settings that had different interactions among physical, chemical, and biological processes [4]. Simulation models for watershed management have been a cornerstone for integrating these complex relationships, no matter how

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