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Assessment of CLIGEN precipitation and storm pattern generation under four precipitation depth categories in China

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CLIGEN (CLImate GENerator) is a widely used stochastic weather generator to simulate continuous daily precipitation and storm pattern information for hydrological and soil erosion models. Although CLIGEN has been tested in several regions in the world, thoroughly assessment before applying it to China is still necessary due to the unique climate system affected by the East Asian Monsoon. The applicability of uncalibrated CLGEN was assessed using long-term precipitation data at 1-min interval from 18 sites in eastern and central China. The model performance was evaluated in terms of daily precipitation, storm duration and peak intensities in 1-min (I1), 5-min (I¬5) and 30-min (I30) for all storms and four categories grouped by daily precipitation: light (< 10mm), moderate (10-25 mm), heavy (25-50mm), and intense (> 50mm) storms in this article. Besides, the applicability of CLIGEN in preparing climate inputs for the Revised Universal Soil Loss Equation (RUSLE) in China and calculating the intensity-duration-frequency (IDF) values for series of duration intervals (5-min to 24-h) and return periods (2 to 100-years) were assessed. Results showed that CLIGEN is able to reproduce accurately the statistics and the probability distribution of daily precipitation depth for all storms and four categories. The mean storm duration is underestimated for overall storms, and the moderate, heavy and intense storms, but overestimated for light storms. CLIGEN underestimated I1 and overestimated I30 in general, whereas no obvious bias is found in I5 for these 18 sites. In addition, the relative error between the measured and generated duration and peak intensity increased as the magnitude of precipitation increased from moderate to intense storms, which means the model performance on simulating intense storms was the worst. Rainfall erosivity generated with CLIGEN outputs was systematically larger than, but well correlated with, the measured erosivity values (slope=0.547, R2=0.96 for the R-factor; slope=0.576, R2=0.81 for the 10-year storm erosivity). Extreme intensities for given duration intervals and return periods were systematically over-predicted using the output from CLIGEN, and the bias between measured and CLIGEN generated intensity-duration-frequency (IDF) values varied with duration intervals. The average of regression slopes for six return periods (2-year to 100-year) between measured (X) and generated (Y) intensities (Y = b X) increased from 1.19 (5-min) to 1.43 (1-h), then decreased to 1.01 (12-h) and 0.96 (24-h). Future research is suggested to improve the simulation of the storm duration and peak intensity, especially for those poorly simulated heavy and intense storms, which were more critical in erosion and hydrological process.