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Long-term flood analysis by coupling the last millennium scenarios from Global Climate Models with a hydrological model in the Yangtze River basin, China

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As the third longest river in the world, the Yangtze River flows across the vast area of China from west to east. However, the uneven spatial and temporal distribution of precipitation makes it frequently affected by droughts and floods since ancient times. By means of a statistical downscaling method named DBC (Daily Bias Correction) and a global water-balance model called WASMOD (Water and Snow Balance Modeling System), this study aims to analyze the extreme flood events in the Yangtze River basin over the period of 850-2100 using CMIP5 ensemble simulations (past1000+historical+ RCP45/RCP85). Totally six GCMs are adopted, including BCC-CSM1.1, CCSM4, MRI-CGCM3, MIROC-ESM, MPI-ESM-P and IPSL-CM5A-LR. Meanwhile, with a focus on extreme floods, we present an assessment of flood simulation accuracy with reference to existing paleo-flood research results. Firstly, the DBC method is employed to provide regional results from GCM outputs, and the error distributions of each GCM are analyzed. Secondly, using downscaled precipitation from 850 to 2100, the design storms (1, 3, 7 and 15-days maximum precipitation) with different return periods are deduced and compared with the results of existing paleo-flood frequency analysis. Then the WASMOD is established for runoff simulation from 850 to 2100 which is calibrated and verified by using the recorded data from 1900 to 2015 in the study region. Finally, based on simulated hydrological series, the extreme flood events (1, 3, 7 and 15-days annual maximum flood) with different return periods are deduced and compared with the existing paleo-flood research results. This study will provide systematic insight into the mechanisms of hydrological evolution on a millennium time scale by reconstruction of hydrological series using CMIP5 simulations in the Yangtze River.