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Improving 2-km drought monitoring by assimilating satellite and in-situ soil moisture into a distributed hydrological model in the Yangtze River basin

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Hydrological drought is increasing due to the collaborative influence of climate change and human activities, especially in populated river basins. Despite drought monitoring skills are improved over the last decade for the development of satellite technology and global measuring networks, there are still challenges for an accurate simulation and prediction of hydrological drought in small spatial scale. In this study, in order to improve small scale drought monitoring, soil moisture datasets with different spatial scales, including multi-satellite-retrieved soil moisture dataset released by the Europe Space Agency's Change Initiative (ESA CCI) with a spatial resolution of 0.25° and in-situ soil moisture dataset measured in dots, are considered to assimilate into the 2-km Digital Elevation Model (DEM) based distributed rainfall-runoff model (DDRM). The 2-km soil moisture simulations coupled with outlet streamflow simulations are used to identify hydrological drought in the Yangtze River basin. Three assimilation scenarios, including (i) only assimilating satellite soil moisture; (ii) jointly assimilating satellite and in-situ soil moisture; (iii) correcting satellite soil moisture by in-situ data firstly, and assimilating the corrected satellite soil moisture into the model, are developed to identify the influence of different scenarios on drought monitoring. Results indicate that all assimilation scenarios significantly improve 2-km soil moisture drought monitoring, and slightly improve streamflow drought monitoring. The scenario of assimilating corrected satellite soil moisture dataset into the model has the best performance, and the scenario of only assimilating satellite data has the worst. This study recommends a valuable assimilation scenario of the distributed hydrological model for better improving drought monitoring in a small spatial scale.