National-scale Distributed Hydrological Model WEP-CN and the Evolution of Water Cycle Fluxes in China

Prof. Yangwen Jia
State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin, China Institute of Water Resources and Hydropower Research (IWHR), Beijing 100038, China.
E-mail address: jiayw@iwhr.com

Abstract: To realize dynamic assessment of national water resources under impacts of climate and land use changes, expansion of a detailed hydrological modelling from catchment-scale to national-scale is of important theoretical and practical significance, yet faces many challenges. We developed a high-resolution, physically-based hydrological model named WEP-CN (Water and Energy transfer Processes in China), in which different climatic and hydrological conditions and geological structures as well as their impact on infiltration and runoff were examined and incorporated. The study area (9.6 million km^2) was divided into 19,406 sub-watersheds and 81,687 contour belts. Continuous simulations of hydrological processes were conducted for 62 years from 1956 to 2017. We demonstrated the efficacy of our model by comparing simulated and statistical monthly streamflow at 203 hydrological stations across the country. Our result highlights the benefit of incorporating new mechanisms on the special vadose zone water movement and accounts for the impact of elevation change on meteorological and vegetation variables. By applying WEP-CN, calculating water footprint and virtual water and adopting the knowledge-mapping concept, 128 water fluxes maps of vertical-horizontal two directions were drawn to demonstrate flow patterns of real water and virtual water among various regions of China and their spatial-temporal evolution characteristics. The results show obviously-different change trends of water resources in 10 river basins of China in the past 62 years and in the future (2030-2050). The study provides technical supports to the national water resources assessment, monthly bulletin of national water resources, and scientific planning and refined management of water resources in China.