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Effects of past land cover change on hydrological regime under future climate scenario in Three-North Region of China.

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Hydrological regimes in arid and semi-arid areas can be significantly affected by climate and land cover changes. Due to urban expansion and ecological restoration programs, the Three-North Region in China has experienced dramatical conversions in land cover, which may result in changes in regional hydrological regime. Previous studies have demonstrated that compared to the effects of climate change, those of land cover change were less observable in recent decades. However, whether those effects may be intensified by future climate or not still remain unclear. In this study, a macro-scale hydrological model was employed to simulate the hydrological regimes in 2020-2099 under a Representative Concentration Pathway (RCP8.5) climate scenario, and remote sensing datasets of land use and leaf area index in 1983-1986 and 2011-2015 were used to generate two different vegetation parameters, which are assumed to reflect different land cover conditions for the two periods. The model was run twice based on the two vegetation parameters, and the differences between the simulations are considered as the hydrological effects of past land cover change in future. The results indicated that from 1986 to 2015, the forest area increased in northwest and north China, by 11691 km2 and 69 km2 respectively, while declined by 30042 km2 in northeast, and the total urban area has expanded by 1.3%. Based on land use condition in 2011-2015, annual evapotranspiration, runoff will both increase steadily due to the increasing temperature and precipitation in 2020-2099, and mean soil moisture will rise at first, then keep nearly unchanged at 505mm over the entire region. Compared to the simulation based on land use condition in 1983-1986, we find that the effects of land cover change will be growing significant in future and at the end of the century, runoff will be promoted by more than 3 mm/year and evapotranspiration will be decreased by more than 3 mm/year. Moreover, the spatial distribution of alteration in hydrological cycle is extremely uneven. The changes in humid zones are more obvious than those in arid and semi-amid zones. As a result, land cover change may cause more problems like dryland expansion in arid area and flooding in humid area than climate alone. Despite there are still remaining uncertainties in datasets and methods, this study provides new insights into the future impacts on hydrological regime of ecological programs and urbanization in Three-North Region.