Attribution of Changes in streamflow impacted by climate change and multiple land cover/land use change in a high elevated catchment, Qinghai-Tibetan Plateau

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Abstract

Quantitative attribution of changes in streamflow due to the non-linear relationship between climate change (CC) and land cover/land use change (LCLUC) in a hydrological system of the Yangtze River Source Region (YZSR) in the Qinghai-Tibetan Plateau (QTP) was measured. A combination of the SWAT model and a statistical technique known as One Factor At a Time (OFAT) and Innovative Trend Analysis (ITA) was carried out to achieve the study objectives. The hydro-climatic data from 1961-2016 and land cover/land use data of 1985, 1990, 1995, 2000, 2005, 2010, and 2015 were used. The results revealed that changes in annual streamflow during 1985-1990 were contributed by CC (+11.4 mm) and LCLU (+9.4 mm), accounting for 54.8 % and 45.2 % of the total combined impact of +20.7 mm. A more dominant effect of CC than LCLU also occurred for the periods between 1995 and 2000, 2000 and 2005, 2005 and 2010, 2010 and 2015, where CC and LCLU contributed to increasing the annual streamflow of 5.9 mm and 0.3 mm, respectively. However, a different pattern was observed in 1990-1995 where changes in streamflow were mainly attributed to LCLU rather than CC. It was observed that major LCLUC were found in 1990-1995 where low grassland decreased (-13,353 km2), bare land increased (+9,048 km2), medium grassland increased (+2,485 km2), water increased (+1,391 km2), high grassland increased (+2,329 km2), and wetland decreased (-1,927 km2). The ITA results showed that there is a rise in temperature, precipitation, and streamflow monotonically in the second half (1990-2016) as compared to the first half (1961-1989). In addition, it was found that temperature and precipitation were positively correlated ($P<0.05$) in high flow months (July and August), whereas negatively correlated in low flow months (November-March). The results of SWAT model simulation showed that CC (i.e. warmer climate) is the primary source of variations in streamflows of the Yangtze River Source Region.

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