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Modeling and future prediction of spring phenology in grassland on the Qinghai-Tibetan Plateau

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The Qinghai-Tibet Plateau (QTP) is an important ecological barrier in China and even East Asia, and its main vegetation cover type is grassland. With the global climate change, the phenological period of grassland on the QTP is constantly changing, which affects the climate and ecosystem through carbon cycle, hydrothermal cycle, etc. The influencing factors of phenology and its future change trend have become the key issues. In this paper, the spring phenological model of the QTP grassland was constructed by using the start of growing season (SOS) extracted from MODIS NDVI, air temperature and soil moisture data from 2000 to 2020. Combined with CMIP6 climate data, the future phenological changes of the QTP grassland under the SSP245 scenario were predicted. The results showed that: (1) The cumulative temperature and cumulative soil water threshold model was effective in simulating spring phenology of grassland on the QTP, and the root-mean-square error was only about 8 days. (2) The climatic thresholds at SOS of different vegetation types are closely related to their spatial distribution locations. Vegetation growth in the eastern and southern parts of the QTP requires higher hydrothermal conditions. (3) The QTP showed an overall warming and wetting trend in the future, with greater changes in the first half of the 21st century than those in the second half of the 21st century. (4) The advance of SOS in the northwest grassland was significantly higher than that in the southeast grassland. By the end of the 21st century, most grasslands on the QTP began to grow before mid-June.