Vegetation Phenology Characteristics and Their Response to Climate Change in the Kaidu-Kongque River Basin from 2001 to 2017 (Post-print)

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Abstract

Investigating the response of vegetation phenology to climate factor variations is crucial for understanding the complex relationship between vegetation and climate. This study takes the Kaidu-Kongque River Basin as an example, utilizing MOD13Q1 data from 2001 to 2017, combined with temperature, precipitation, and sunshine duration data, to explore the spatiotemporal variation characteristics of vegetation phenology in the basin and its response to altitude and climate element changes. The results indicate: The start of the growing season (SOS) for vegetation in the basin is primarily concentrated between days 90–150, the end of the growing season (EOS) is mainly concentrated between days 270–315, and the duration of the growing season (DOS) is primarily concentrated between 120–220 days. With increasing altitude, vegetation SOS shows an overall delayed trend, EOS shows an advanced trend, and DOS shows a shortened trend.

Over the past 17 years, vegetation SOS and EOS in the study area have mainly exhibited an advancing trend, with the area of advancing pixels accounting for 60.81% and 61.83% of the total vegetation area in the study area, respectively; DOS has mainly exhibited a shortening trend, accounting for 52.11%. April temperature has a significant influence on the advancement of vegetation SOS (negative correlation); the factors with substantial influence on the advancement of vegetation EOS are June precipitation (negative correlation) and November temperature (positive correlation); June precipitation has the greatest influence on the shortening of vegetation DOS (negative correlation). Overall, the start of the vegetation growing season is primarily affected by temperature factors, while the end of the vegetation growing season and the growing season length are mainly affected by precipitation.

Full Text

Preamble

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Phenological Characteristics of Vegetation and Its Response to Climatic Change in the Kaidu-Kongqi River Basin, Xinjiang, During 2001-2017

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Abstract

Studying the response of vegetation phenology to climatic factors is vital for understanding relationships between vegetation and climate. Based on MODIS normalized vegetation index (NDVI) data from 2001 to 2017, phenological parameters of vegetation in the Kaidu-Kongqi River Basin were extracted using Savitzky-Golay (S-G) filtering and dynamic threshold methods. Combined with mean temperature, precipitation, and sunshine duration data, we analyzed the spatiotemporal characteristics of vegetation phenology and its response to elevation and climate change using trend analysis, ANUSPLIN interpolation, and correlation analysis.

The results reveal the following: (1) The start of growing season (SOS) in the basin occurs primarily between the 90th and 150th days of the year, while the end of growing season (EOS) occurs mainly between the 270th and 315th days. The duration of growing season (DOS) is predominantly concentrated between the 120th and 220th days. Vegetation phenology is significantly affected by elevation: with every 100 m increase in elevation, SOS is delayed by 0.81 days, EOS is advanced by 2.23 days, and DOS is shortened by 3.05 days. (2) Over the past 17 years, both SOS and EOS in the basin have shown mainly advancing trends, with the area of advancing pixels accounting for 60.81% and 61.83% of the total vegetation area, respectively. DOS exhibited a predominantly shortening trend, accounting for 52.11% of the region. (3) April temperature has a strong negative influence on SOS timing, explaining 13% of total SOS variation. As April temperatures have increased, SOS timing has shifted earlier. The primary factors affecting EOS change are June precipitation (negative effect) and November temperature (positive effect), which together explain 9% of total EOS variation. When June precipitation increases and November temperatures decrease, EOS occurs earlier. June precipitation negatively impacts DOS and can explain 11%

of total DOS variation; as June precipitation increases, DOS decreases. Overall, vegetation greening is primarily affected by temperature, whereas vegetation growth and senescence periods are mainly influenced by precipitation.

Keywords: phenology; NDVI; climatic factors; Kaidu-Kongqi River Basin; Xinjiang

Note: Figure translations are in progress. See original paper for figures.