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RESEARCH

Vegetation Index (NDVI) reconstruction from western Himalaya through dendrochronological analysis of *Cedrus deodara*

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Abstract

The high-resolution temporal records (1738–2018 CE) of the dendrochronological analysis on *Cedrus deodara* from Uttarakhand and Himachal Pradesh in the western Himalayan region were generated. An analysis of the association between the Normalized Difference Vegetation Index (NDVI) and tree-ring radial growth indicated a significant positive relationship from April to July. The association between tree rings and other hydroclimatic variables was used to further evaluate this relationship. Based on the observation, mean April–July NDVI variability since 1790 CE was reconstructed based on the regional tree-ring chronology. Comparisons of the reconstructed NDVI with gridded precipitation, drought records, and proxy-based hydroclimatic reconstructions revealed a consistent agreement over a large spatial domain extending beyond the study region. We observed a correlation between the region's NDVI browning (reduction) and past droughts and famines. Comparison has been made to the regional proxy-based hydroclimatic reconstruction and stable oxygen isotope datasets with the present NDVI reconstruction. This revealed the commonalities in the regional hydroclimatic scenario recorded in these data sets over the last few centuries. This first tree-ring-based NDVI reconstruction from the western Himalayas infers regional climate-vegetation dynamics during the past two centuries. This reconstruction provides valuable input for modeling vegetation dynamics for predicting vegetation changes due to climate variations in the western Himalaya.

1 Introduction

Mountainous areas throughout the globe are known for their rich diversity of flora and fauna. This is, to a large extent, a result of sudden change in climate with the increase in elevation, which provides suitable conditions for a wide range of plant and animal species (Körner and Paulsen 2004). Besides functioning as a repository of biodiversity, it incorporates socio-cultural aspects through using raw materials from these areas (Stepp et al. 2005). The Himalayas are considered as one of the essential ecological hotspots of natural diversity globally (Tiwari 2000; Mishra and Chaudhuri 2015; Sarkar and Kafatos 2004). The concurrent changes in the land use pattern in the Himalayas, known as the hotspots for biodiversity and natural resources, thereby depleting these reserves mainly utilized by the largely populated regions of the Indo-Gangetic basin (Pandey et al. 2018). Human-induced changes, more precisely anthropogenic activities, are the major contributing factors, the impacts of which have been witnessed at local, regional, and global levels in the form of changes in the climate (Joshi et al. 2012). It was evident in the change in regional vegetation cover, type, phenology, density, and flora, as well as in the reduced amount of forest cover and altered biodiversity (Shrestha et al. 2012; Sarkar and Kafatos 2004). These changes are responsible for the alteration of the environmental conditions in the high-elevation parts of the Himalayas (Haigh et al. 1995; Munsi et al. 2012; Batar et al. 2017).

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