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Hydroclimatic changes in the Core Monsoon Zone of India since the Last Glacial Maximum: An overview of the palynological data and correlation with the marine and continental records

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ABSTRACT

The Indian Summer Monsoon (ISM) is one of the major components of the Asian Monsoon System that exhibits a complex ocean-atmospheric-coupled mechanism of the tropics, which is indispensable in inter-hemispheric heat transfer on Earth. The ISM causes ~80% of the total rainfall over India and nearby regions, thereby influencing the agricultural productivity and socio-economic growth of India, which is one of the most densely populated regions of the globe. The interannual ISM variability over the Indian landmass remains highly correlated with the ISM rainfall over the core monsoon zone (CMZ) of India, thereby underscoring the CMZ region as the critical part of the country representing the appropriate measure of the annual ISM rainfall. The present review aims to investigate the response of the ISM over the Indian subcontinent, primarily in the CMZ, and its peripheral regions for delineating the association of CMZ with regional and global records since the Last Glacial Maximum (LGM). The response of vegetation to the ISM rainfall variability, as manifested by the palynological records, forms the basis of the study in the central Indian CMZ. Here, we have also attempted to address the influence of natural forcings and climate variables on the ISM variability over the CMZ region in order to provide a better understanding on the global climate dynamics. The present review demonstrated that like other regional records, though the CMZ also witnessed weak ISM during LGM, however, the central CMZ witnessed a cool and dry climate, while the peripheral CMZ showed the influence of winter precipitation caused by the Northeast Monsoon linked with the enhanced Siberian High. Further, a weak ISM has been also observed during the Younger Dryas (YD) which plausibly linked with the increased El Nino like events. The onset of the Holocene witnessed a strong ISM due to high solar insolation over the entire CMZ; nevertheless, selected studies reveal a delayed intensification of the ISM in the central CMZ region. The present review demonstrated that the CMZ has been more responsive towards the stronger ISM phases [Holocene Climate Optimum (HCO); Roman Warm Period (RWP); Medieval Climate Anomaly (MCA) and Current Warm Period (CWP)] than the weaker ISM periods [Dark Age Cold Period (DACP) and Little Ice Age (LIA)].

1. Introduction

The core monsoon zone (CMZ) of the Indian landmass, despite representing the intensity of the annual Indian Summer Monsoon (ISM) rainfall over the sub-continent, hitherto remained poorly understood for its paleomonsoonal history, as well as for the identification of break or active spells. The ISM rainfall during June to September contributes most of the annual rainfall over India and plays an important role in Indian agriculture and, thus, the economy. It exhibits high spatio-temporal variabilities forced from both internal and external factors, which are important for a better understanding and prediction of the ISM rainfall. Hence, understanding the major climatic drivers (forcing

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