CHAPTER

10 Application of tree rings in understanding long-term variability in river discharge of high Himalayas, India

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10.1 Introduction

Rivers providing the hydrological needs of mankind have been the backbone of human civilization. The societal relevance of rivers is well recognized through food production, hydropower generation and providing trade routes. However, excess/reduced river water supplies bring ecological catastrophe causing immense loss of life and property. Extreme hydrological events, the frequency of which is expected to increase in the future (IPCC, 2012; Visser et al., 2014) with global warming, may have severe socioeconomic impacts. Vulnerability to extreme hydrological events has further increased in recent times due to increased human settlements and developmental activities along the river courses. In view of this, better understanding of the recurrence behavior of extreme hydrological events in long-term perspective is important to adopt appropriate mitigation measures.

The Himalayan mountain system is unique due to its mid-latitude geographical location as well as dynamic geological characteristics. The mountain system having vast climatic, ecological and biodiversity ranges is vulnerable to climate change. High mountain ranges of the Himalaya, an abode of large number of glaciers, have the largest amount of snow/ice cover outside the polar regions. These glaciers are the source of several rivers, which are the lifeline of the downstream population. The high-altitude glaciers in the western Himalaya generally come under the monsoon shadow zone where Indian Summer Monsoon does not reach due to leeward monsoon shadow effects, whereas in the central and eastern Himalaya glaciers are largely fed by summer monsoon precipitation (Lang and Barros, 2004; Bookhagen and Burbank, 2010; Azam et al., 2016). The glaciers in the monsoon shadow zone are replenished by precipitation largely brought by western disturbances (WDs) during the winter and spring seasons (Yadav and Bhutiyani, 2013). In the western Himalaya snow and ice meltwater of glaciers largely contribute to the discharge of rivers. However, climatic warming and changes in precipitation pattern across the Himalaya is of growing concern to society due to its impact on river discharge and water availability on sustained basis. Observational discharge data of rivers originating from the Himalaya, though limited to the past few decades, show decreasing trend in recent decades (Bhutiyani et al., 2008; Romshoo et al., 2017). However, such short-term instrumental records restrict our understanding of the natural variability of river discharge on multidecadal-to-centennial

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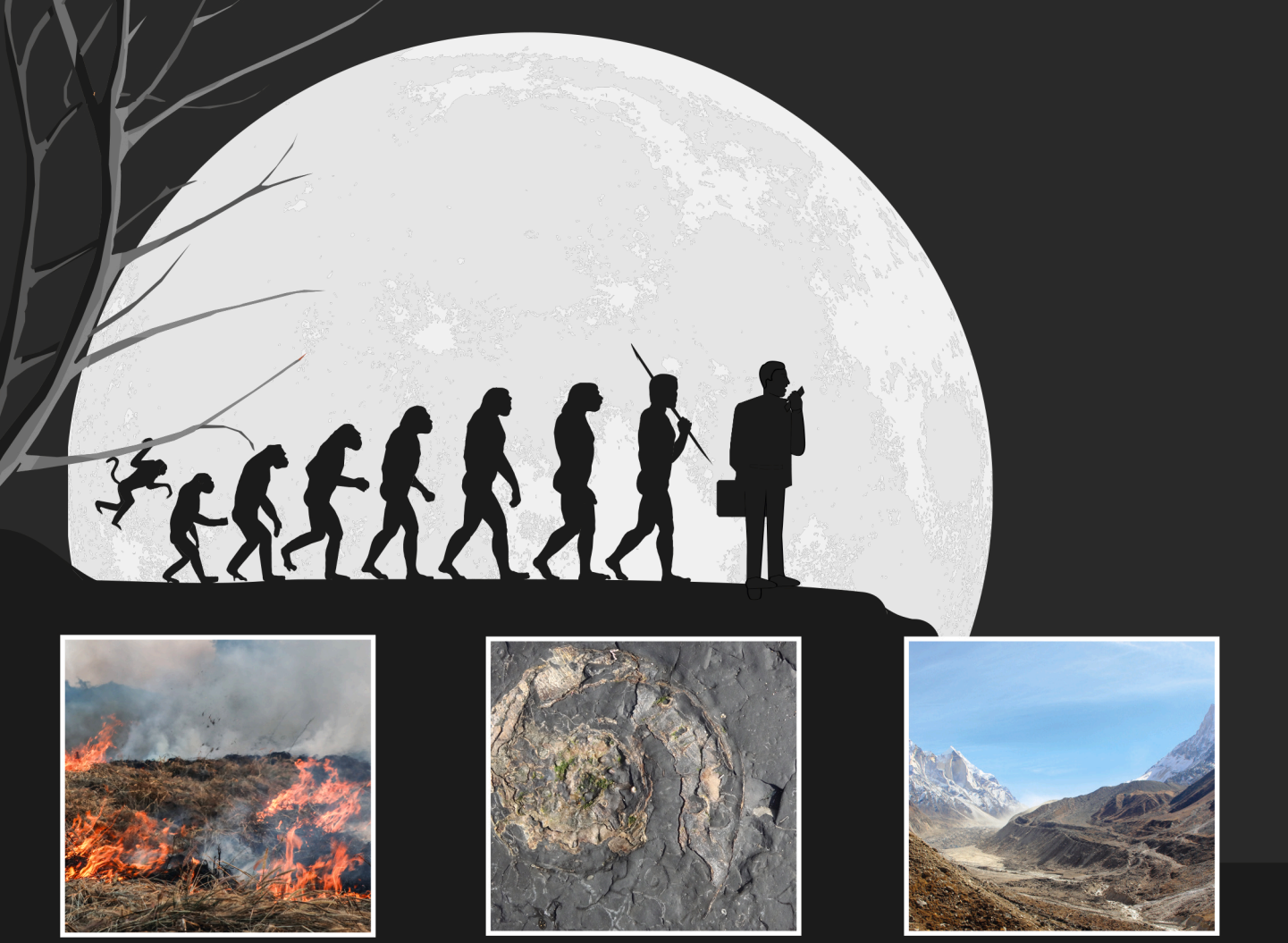

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