Current snow depth and expected changes in the Hindu-Kush Karakoram Himalaya mountains from CMIP5 Global Climate Models

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The Tibetan plateau and the Hindu-Kush Karakoram Himalaya mountains, with mean elevation above 4000 m a.s.l., are the world's largest snow and ice reservoir outside the polar regions and they are often referred to as the "Third Pole" [1]. The snow/ice melting from the mountains assures continuous streamflow to the main rivers of South-East Asia such as, among others, the Indus, Gange, and Brahmaputra rivers, providing water to about 1.5 billion people [2]. Glacier and snow melt provides a fundamental contribution to streamflow especially in the dry areas.

In the Hindu-Kush Karakoram and Western Himalaya mountains, that are not exposed to monsoon precipitation, for instance, during summer meltwater is the only significant contribution to the river flow, upon which agriculture and economical activities rely [3]. In these areas, changes in the snow dynamics, including the spatial and temporal snowfall distribution, the snowpack thickness and duration, the snowmelt timing and speed, would impact heavily on water availability for population living in the valleys.

Despite its importance, the knowledge on the snow dynamics in the Third Pole region is still incomplete, also owing to difficult and sporadic surface observations [4]. The few available meteorological stations are located in the valley floors, at relatively low elevation. High elevation areas are not monitored due to unfavorable conditions in accessing and maintaining the sensors.

Given the lack of surface observations, in this study we explore and compare the existing snow depth datasets obtained by the Global Climate Models (GCMs) simulations [5]. We consider the GCMs included in the Coupled Model Intercomparison Project phase 5 (CMIP5) and we analyse how they represent the snowpack climatology in the Third Pole environment. In particular, we explore the snow seasonal cycle in the CMIP5 ensemble comparing the results to the output of the ERA Interim/Land reanalysis [6] and to the 20th Century reanalysis [7]. Finally we analyze the expected behaviour of the snow depth in the future decades using an ensemble of GCM projections under different climate change scenarios.

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