ICIMOD

#SaveOurSnow

HKH snow update 2024

The seasonal snow assessment in the Hindu Kush Himalaya (HKH) region offers valuable insights into the snow persistence anomaly over the past twenty-two years. Snow persistence is the fraction of time that snow is on the ground. Through this analysis of data from 2003 to 2024, we have observed significant fluctuations in snow persistence during the snow accumulation season (November–April). The primary objective of this report is to provide vital information for water resource management strategies and to offer crucial insights into implementing adaptation measures that can help mitigate the forthcoming impacts of rapid snowmelt on downstream communities.

Introduction

The Hindu Kush Himalaya (HKH) region heavily depends on the cryosphere – frozen water on the earth's surface, including snow, permafrost, and ice from glaciers, lakes and rivers. This frozen water is a critical source of freshwater for approximately 240 million people living in the HKH region and has far-reaching benefits for around 1.65 billion individuals downstream. Ongoing observations and projections indicate significant changes in the timing and intensity of stream flows in the area. Among these components, snow plays a particularly important role in ensuring seasonal water availability, especially during the initial melt season. Snowmelt contributes the majority of the meltwater to streamflow in all HKH river basins ranging from 5.1% in the Irrawaddy River to 77.5% in the Helmand River (ICIMOD, 2023). On average, snowmelt contributes approximately 23% of the annual runoff in the 12 major river basins of the HKH region. The contribution of snowmelt runoff increases from east to west (ICIMOD, 2023).

Over the last twenty-two years, this report assesses winter snow accumulation in the HKH region. We used a similar methodology to that based on ICIMOD's improved snow data from the Terra and Aqua combined cloud-free snow product developed by Muhammad and Thapa (2019, 2020). By comparing the persistence of seasonal snow in the current year with historical records, this report examines the anomaly of seasonal snow persistence. The HKH region experienced a significant anomaly in 2024 (see Figures 1–2). Figure 3 presents the annual changes in snow persistence (percentage) between 2020 and 2024 for all 12 major river basins. The below normal snow persistence may also affect water availability in early summer this year, requiring the implementation for drought management strategies. Furthermore, there is an observable trend of decreasing below-average snow persistence from east to west in the region.

The below-average snow persistence in the HKH region this winter, raises the possibility of decreased water supply downstream in the early summer. It is imperative for relevant agencies to take proactive measures to address the upcoming issue. In order to notify populations about droughts and water shortages, it is important to effectively communicate the situation and update water management plans to accommodate water stress, as well as to promote collaboration amongst responsible national agencies. Furthermore, drought response strategies are crucial to initiate and organize relief activities during emergencies to ensure clean water supply. Promote rainwater collection from the

upcoming rainfall for irrigation and other relevant utilization. Establishment of local water committees could play a major role in resource allocation and coordinate activities. These solutions may help to lessen the immediate effects of below normal snowfall on the water supply in the HKH region, but to ensure long-term resilience to climate change, there should be collaboration among countries sharing transboundary rivers to update their water management laws. These actions could cope with the water shortage in south Asia depending on snowmelt and mitigate their effects on relevant sectors.

FIGURE 1: SNOW COVER PERSISTENCE ANOMALY DURING NOV 2023–APRIL 2024 (COMPARED TO HISTORIC OBSERVATIONS DURING THE REFERENCE PERIOD 2003–2023).

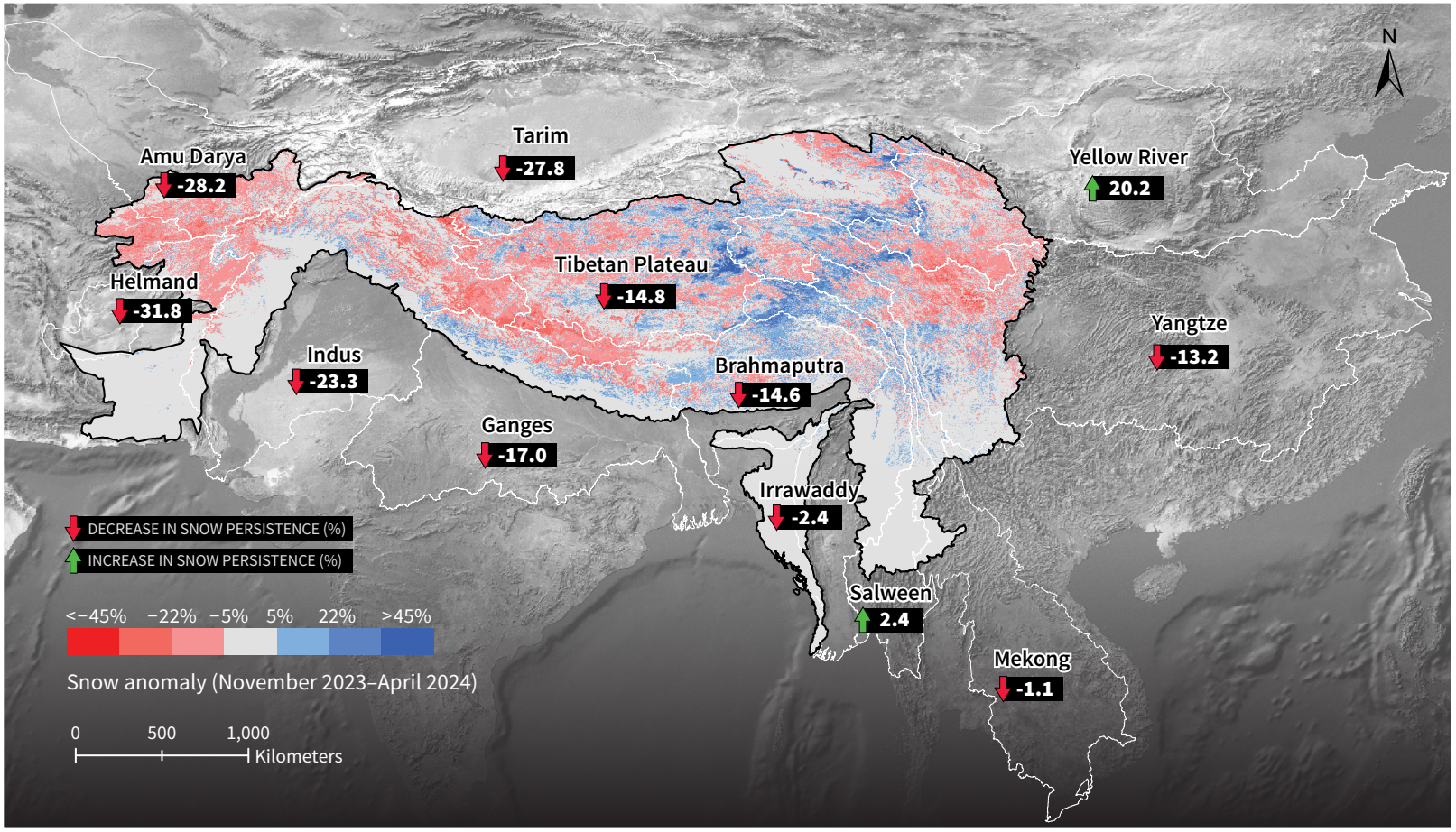


FIGURE 2: SEASONAL SNOW COVER PERSISTENCE ANOMALY FOR EACH YEAR BETWEEN 2003 AND 2024 (COMPARED WITH 2003-2023)

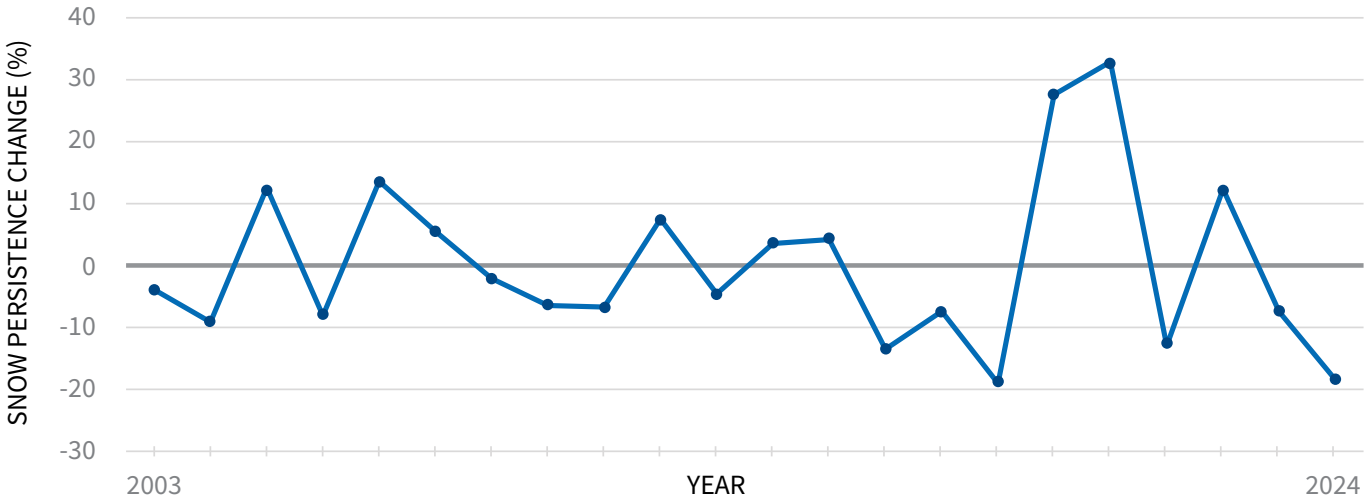
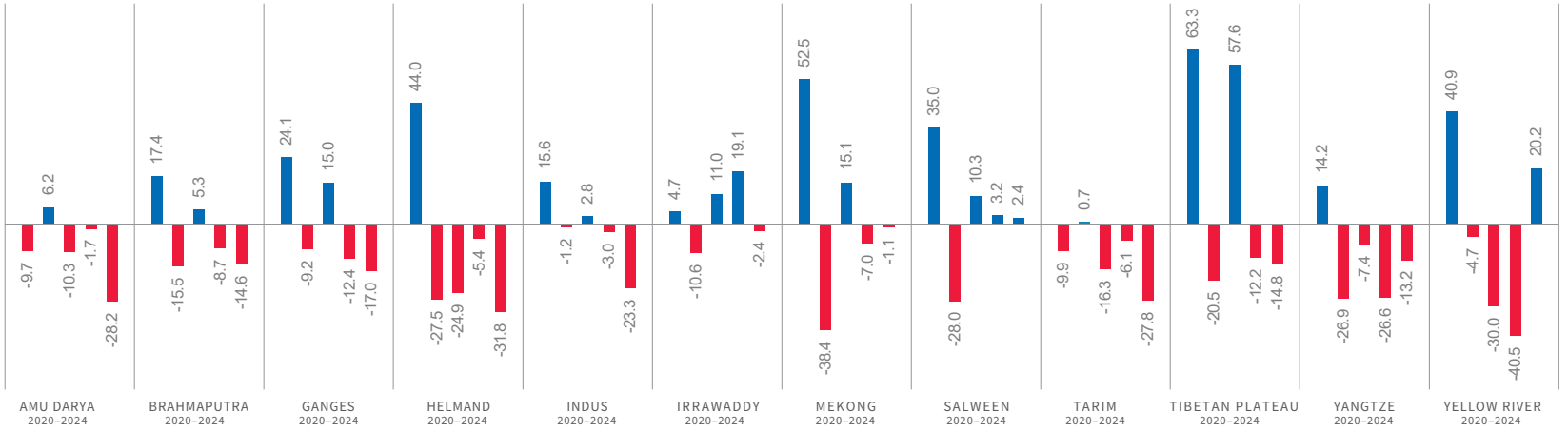


FIGURE 3: SNOW PERSISTENCE (%) CHANGES BETWEEN 2020 AND 2024 IN MAJOR RIVER BASINS OF THE HKH (COMPARED WITH 2003-2023). THE YEARS ARE FROM LEFT TO RIGHT FOR EACH SUB-BASIN. THE VALUES ON THE BAR ARE THE % CHANGES IN THE YEAR.



Basin-scale seasonal snow assessment

In the Amu Darya River basin, the percentage change in seasonal snow persistence previously reached its lowest point in the last twenty-two years in 2018, with a 17.7% reduction. Conversely, in 2008, the changes in snow persistence reached its highest level, peaking at 32.1%, suggesting a significant increase in snowfall during that period. The current year exhibits the lowest snow persistence, with 28.2% below normal. This assessment highlights the dynamic nature of seasonal snow in the region and emphasises the need for continued dissemination of snow information to better understand and manage the impacts of these long-term changes.

In the Brahmaputra River basin, the year 2021 experienced the lowest seasonal snow persistence, dropped well below average at 15.5%. The highest recorded snow persistence occurred in 2019, reaching 27.1%. This year, the current snow persistence is also notably below normal at 14.6%.

In the Ganges River Basin, there has been significant fluctuations in the past twenty-two years. Prior to 2024, the year 2018 had the lowest snow persistence at 15.2%, while the highest snow persistence of 25.6% was recorded in 2015. The current year has shown the lowest snow persistence, with a value of 17%, which sharply contrasts between the southern and northern sides.

The Helmand River basin experienced a remarkably low snow persistence during the 2018 season, significantly below the average by a margin of 41.9%. However, in stark contrast, the year 2020 showcased the highest snow persistence in the past twenty-two years, surpassing the average by a notable 44%. This year stands as the second lowest in terms of snow persistence, with a decrease of 31.8% below normal levels and some spatial variations on the western side.

In the Indus River basin, there was a notable decrease in seasonal snow persistence in 2018, with a deviation of 9.4% from the average. In contrast, the highest snow persistence above normal was recorded in 2020 with a value of 15.5%. However, this year, there has been a remarkable decrease in snow persistence, falling 23.3% below normal levels with some positive patterns on the southern sides mostly in the lower altitudes.

In the Irrawaddy River basin, the seasonal snow persistence fluctuates every year in the past twenty-two years. The changes remain below 15% except the year 2023 with above normal snow of 19.1%. In 2017, the snow persistence fell below the average by 12.5% which is the lowest in the past twenty-two years. This year's snow persistence is slightly below normal with a value of 2.4% having significant spatial heterogeneity.

In the Mekong River basin, the variability in seasonal snow persistence has increased in the last few years. The most negative snow persistence was observed in 2021, falling below the average by 38.4%. The year 2019 and 2020 have witnessed a significant increase in snow persistence, surpassing the normal levels by 68.8% and 52.5% respectively. This year, the snow persistence is slightly below normal of 1.1%.

The Salween River basin has also experienced an increased heterogeneity in snow persistence over the past few years. Like the Mekong River Basin, the most notable decrease in snow persistence was observed in 2021, with a deviation of 28% from the normal levels. The year 2019 and 2020 have witnessed a significant increase in snow persistence, surpassing the normal levels by 30.6% and 35% respectively. Conversely, the current year has seen a slightly below normal snow persistence, average by 2.4%.

The Tarim River Basin witnessed a significant decrease in long-term snow persistence in the past twenty-two years. The trends in snow persistence over the past twenty-two years, with 2003 and 2006 displaying the most positive values, 26.6% and 28.5% respectively. Notably, this year, there is a significant decrease in snow persistence with a value of 27.8%, lowest in the past twenty-two years.

In the Tibetan Plateau, the year 2018 experienced the lowest seasonal snow persistency, reaching a value of 34.7%. Conversely, the highest snow persistence was observed in 2020, reaching 63.3%. This year, the snow persistence is below normal with a value of 14.8% and exhibits considerable spatial variability throughout the basin.

In the Yangtze River basin, the year 2017 experienced the lowest seasonal snow persistency, reaching a value of 27.9%. In contrast, the highest snow persistence was observed in 2008 with a remarkable increase of 50.6% above normal. The long-term trend in snow persistence is significantly negative with this year also showing 13.2% below normal.

In the Yellow River basin, the seasonal snow persistence reached its lowest point in 2015, remaining significantly below average with a deviation of 42.2%. Conversely, the highest snow persistence was observed in 2008, surpassing the normal levels by an impressive 74.5%. In 2024, the snow persistence remains above normal, exceeding the normal value by 20.2%.

Citation

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