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CRYOSPHERE PROJECT | in Central Asia

POLICY BRIEF

MELTING SNOW, RISING RISKS: SECURING CENTRAL ASIA'S WATER FUTURE

Climate insights for water resilience in Central Asia

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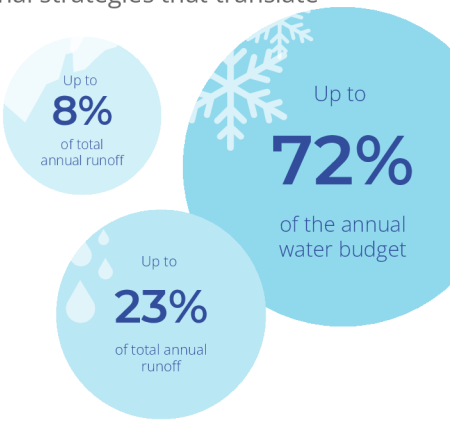
Central Asia's Water Security Under Threat

Central Asia's water security is increasingly threatened by rapid and uneven changes in the region's mountain cryosphere. Seasonal snow cover, a primary contributor to annual runoff, is declining in both depth and duration, particularly at lower elevations, disrupting water availability. These trends, combined with shifting snowmelt timing and significant data gaps in snow monitoring, underscore the urgent need for coordinated regional strategies that translate climate science into actionable policies.



Snow: A Vital Source of Water

Seasonal snow cover contributes over 50% to the annual water budget in major basins and as high as 65–72% for smaller basins in Central Asia. This contrasts with the 23% contribution of rainfall and 2–8% contribution of glacier ice to annual runoff.

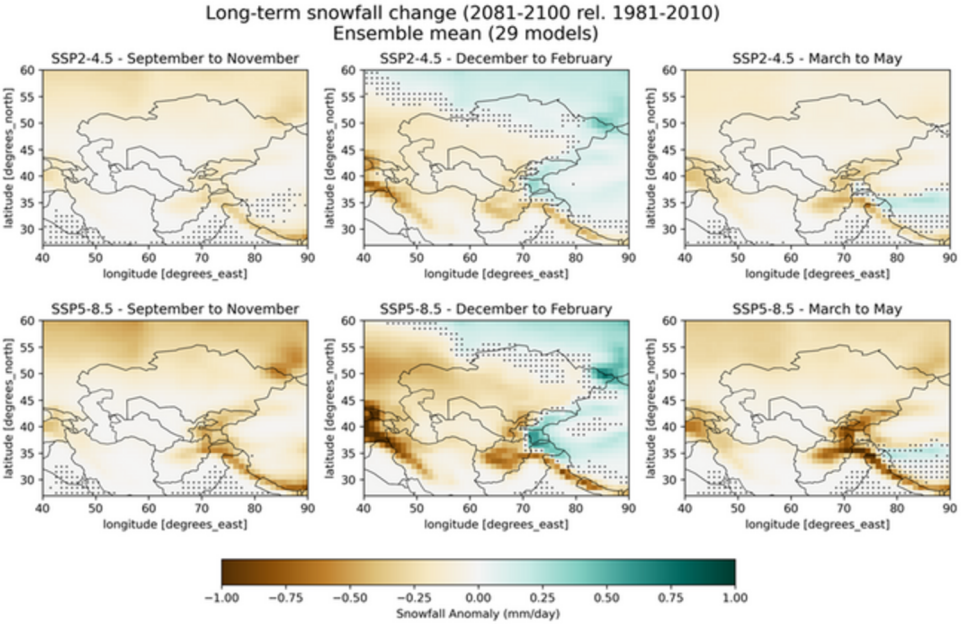
Declining Snow Cover: What the Data Show

Based on remote sensing studies a significant decrease in snow cover duration and maximum snow depth in western/eastern Tien Shan but increased snow depth in Central Tien Shan due to higher winter precipitation has been shown from 1986 to 2008. Earlier snowmelt and reduced snow cover days at lower altitudes affect summer water availability.

Climate Projections in Central Asia

Warming is projected across all seasons, elevations, and emissions scenarios, with the most pronounced increases in temperature occurring during winter (DJF), particularly at higher elevations and latitudes. Precipitation projections remain uncertain; however, an overall increase in winter precipitation is expected, especially in the Northern Tien Shan, the Tibetan Plateau, and the Eastern Pamir.

Snowfall is anticipated to decline in all regions during the transitional seasons of autumn (SON) and spring (MAM). In contrast, winter (DJF) may see increased snowfall in high-latitude areas, as well as in the Eastern Pamir and Northern Tien Shan. Notably, under the high-emission scenario SSP5-8.5, spring snowfall (MAM) is projected to experience a particularly severe reduction.



CMIP6 climate projections for snowfall over the model domains for moderate (SSP2-4.5) and high (SSP5-8.5) emission scenarios and three seasons (SON, DJF, MAM).

From Science to Policy

The development of **National Action Plans (NAPs)** and a ministerial-level **Strategic Action Program (SAP)** is critical for ensuring science-policy coherence and transboundary alignment in Central Asia's cryosphere management. This coordinated approach transforms scientific findings into actionable policies while ensuring transboundary alignment on water resource management.

About the Study:

The University of Fribourg's snow modeling team, led by Dr. Joel Fiddes, developed high-resolution climate scenarios for Central Asia's snow cover (1981–2100) as part of the GEF-UNDP-UNESCO Cryosphere project titled "Strengthening the resilience of Central Asian countries by enabling regional cooperation to assess glacio-nival systems to develop integrated methods for sustainable development and adaptation to climate change".

Using the TopoCLIM model (Fiddes et al. 2022) chain, the study projected elevation-specific changes under four SSP scenarios (SSP1-2.6 to SSP5-8.5), revealing critical thresholds: 50% snow water equivalent (SWE) loss below 2,000m in Syr Darya and 3,000m in Amu Darya basins by 2100, alongside 1-month earlier snowmelt peaks under high emissions. These scenarios provide actionable insights for transboundary water management, infrastructure planning, and agricultural adaptation in snow-dependent regions.

The project titled "Strengthening the resilience of Central Asian countries by enabling regional cooperation to assess glacio-nival systems to develop integrated methods for sustainable development and adaptation to climate change" is funded by Global Environment Facility (GEF), implemented by UNDP and executed by the UNESCO Regional Office in Almaty.

To learn more about the project visit:
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