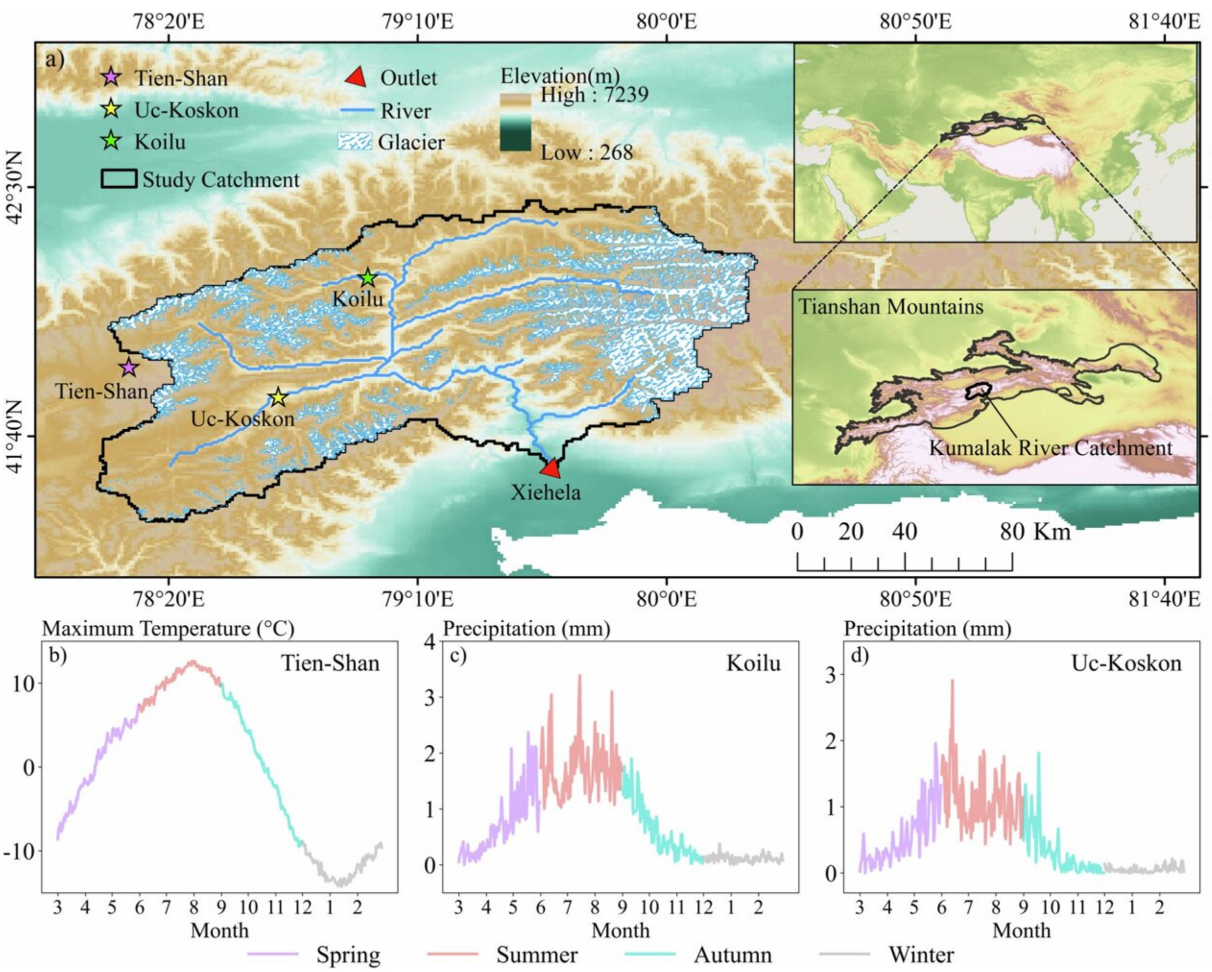
Researchers unravel flood dynamics in China's Kumalak River Catchment in Tianshan Region

February 20 2025, by Zhang Nannan



Overview of the study area. Credit: *npj Climate and Atmospheric Science* (2025). DOI: 10.1038/s41612-025-00918-z

A recent study published in *npj Climate and Atmospheric Science* has shed light on the factors influencing floods in the Kumalak River catchment, China.

The study, led by Prof. Chen Yaning from the Xinjiang Institute of Ecology and Geography of the Chinese Academy of Sciences, offers new insights into the complex interplay of environmental variables driving floods in this alpine, glacierized region.

The Kumalak River, located in the Tianshan Mountains, has long been known for its complex flooding patterns, influenced by glacier meltwater, snowmelt, and rainfall. However, the mechanisms behind these events have remained poorly understood, particularly as climate change continues to impact the region.

To investigate the relative contributions of these factors, the researchers employed the Soil and Water Assessment Tool (SWAT)—Glacier model and a degree-day factor model. They also introduced two Long Short-Term Memory (LSTM) models, LSTM-SG and LSTM-DDF, to enhance their analysis.

Using advanced techniques such as additive decomposition and integrated gradients, the team interpreted the results to better understand the flooding dynamics.

The study found that glacier meltwater is the dominant driver of annual maximum flood (AMF) events, contributing between 60.49% and 60.92% of the total runoff. Rainfall and snowmelt follow, contributing 26.86% to 29.50% and 10.01% to 12.21%, respectively.

In contrast, for spring maximum flood (AMFSp) events, snowmelt plays a more significant role, accounting for 48.49% to 56.08% of the total, with glacier meltwater and rainfall contributing 16.12% to 22.08% and

27.79% to 29.42%, respectively.

They found that glacier meltwater is the dominant driver of annual maximum flood (AMF) events, while snowmelt significantly influences spring maximum flood (AMFSp) events. From 1960 to 2018, glacier meltwater accounted for approximately 60.49% to 60.92% of AMF events, followed by rainfall at 26.86% to 29.50%, and snowmelt at 10.01% to 12.21%.

For AMFSp events between 1961 and 2018, snowmelt emerged as the leading factor, contributing 48.49% to 56.08%, with glacier meltwater and rainfall following at 16.12% to 22.08% and 27.79% to 29.42%, respectively.

"Interpretable deep learning can serve as a complementary tool, providing valuable perspectives on the analysis of flood formation mechanisms," said Liang Wenting, first author of the study.

This study offers critical insights that could significantly enhance flood prediction models and improve the management of water resources in glacierized catchments, particularly amidst the challenges posed by climate change.

More information: Wenting Liang et al, Shifted dominant flood drivers of an alpine glacierized catchment in the Tianshan region revealed through interpretable deep learning, *npj Climate and Atmospheric Science* (2025). DOI: 10.1038/s41612-025-00918-z

Provided by Chinese Academy of Sciences

Citation: Researchers unravel flood dynamics in China's Kumalak River Catchment in Tianshan

Region (2025, February 20) retrieved 3 October 2025 from
https://phys.org/news/2025-02-unravel-dynamics-china-kumalak-river.html