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Rethinking policy on high mountain cascading hazards

A recent series of high-mountain disasters foretell a future in which Earth's destabilized cryosphere will more frequently induce chains of multiple hazards in which one process triggers the next. This emerging norm was illustrated in May 2025 by a sequence of large rockfalls (totalling 10 million tonnes) onto the Birch Glacier in the Lötschental, Switzerland, part of which consequently collapsed, setting off a devastating ice–rock avalanche[1] (Fig. 1a,b). This temporarily dammed a river and buried much of the village of Blatten, which had been evacuated because of a timely warning. The same cannot be said for prior disastrous instances of hillslope failures from permafrost degradation triggering ice–rock avalanches and debris flows (for example, Seti Khola, Nepal in 2013[2] and Chamoli, India in 2021[3]), in some cases also temporarily damming rivers (for example, Sedongpu, Tibet in 2023[4] (Fig. 1c,d)). These cascading hazard events exemplify how rising temperatures and intensified rainfall in high mountain regions result in hazards reaching further downstream with greater momentum than ever before, ultimately threatening densely populated lowlands[5].

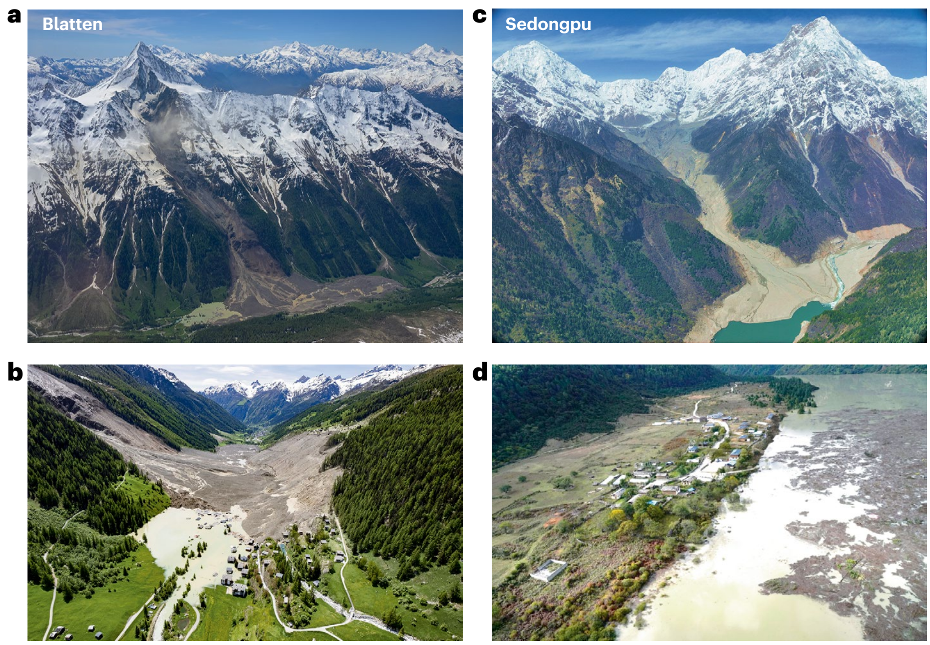

Fig. 1 | Examples of cascading hazards. a,b, Rock–ice avalanche triggered at Birch Glacier in Switzerland, burying and flooding Blatten (**b**). **c,d**, Repeated cascading hazards at Sedongpu (Tibet), China, showing the dammed Yarlung Tsangpo River (**c**) and the flooded village of Jiala (**d**).

In light of these disasters, we suggest current responses are not keeping pace with the increasing vulnerability of mountain communities. Global frameworks such as the Sendai Framework and the United Nations' Sustainable Development Goals still treat multi-hazards as coexisting individual events, rather than as cascading interactions[6,7]. Just as critically, policy also fails to adequately account for the frequency and magnitude of extremes changing with climate, meaning that hazard recurrence intervals estimated from historical statistics no longer accurately represent risk. Without a fundamental shift in perspective, policies and thus their implementation will continue to underestimate the scale and complexity of cascading hazards, especially in high mountain regions.

We recommend a pivot towards impact-based, scenario-led hazard assessment and forecasting that begins with the identification of an upstream trigger and traces its propagation effects. For critical and particularly vulnerable locations, experts would develop and regularly re-evaluate scenarios, warning levels and mitigation actions, while re-assessing and communicating uncertainties. This approach could be supported by event trees, which map out all plausible outcomes of a series of scenarios arising from an initiating event, and have proven useful in volcanic hazard assessment, for example of the Teide–Pico Viejo stratovolcanoes on Tenerife[8].

Crucially, any hazard assessments and forecasts need to be communicated to decision makers and involve communities from the start: local authorities and residents should be guided by experts and report local observations. Community participation is most effective when it is sustained and institutionalized rather than occasional, for example through regular drills and integration into local governance and education systems. Such structured engagement not only builds trust and ensures responses are timely and practical, but also creates feedback loops in which local observations complement expert monitoring, thereby enhancing preparedness and adaptive capacity.

Geographic context also matters. Policies must recognize that disaster response capacity is limited by state resources. Where strong institutional capacity exists, hazard assessment and risk mitigation should be conducted by transdisciplinary groups, including geomorphologists, geologists, hydrologists, and engineers. In developing regions, the priorities should be knowledge transfer, capacity development and sharing of responsibilities for cascade-process training and public engagement, overseen by a regional advisory body. Safety can be achieved through cooperation between all groups of actors responsible for natural hazards, such as civil servants from all political levels, engineers and the public.

Correspondence

To incentivize action, we urge funding agencies to create ring-fenced, multi-year funding with the aim of empowering mountain communities vulnerable to cascading hazards[9,10].

We suggest national reporting under the Sendai Framework and the United Nations' Sustainable Development Goals should incorporate cascade indicators, such as the proportion of alerts involving multiple hazard types and counts of near-miss cascades (for example, controlled breaches), in addition to publishing post-event reviews. Such reporting would ensure policies remain agile and responsive to scientific advances, and event trees and scenario sets are documented and improved. Policies must move beyond reliance on static hazard maps and instead integrate cryosphere-specific risk assessments that capture permafrost thaw, slope destabilization, and cascade potential. Unfortunately, delivering such assessments is too often hampered by the fragmentation and competition of responsibilities between various national agencies[11]. Addressing this gap should build on international agreements that foster coordination, including joint expertise and data-sharing along with transboundary response protocols. Finally, convening scientific communities will be important to produce regular, cascade-focused reports that directly help bridge research and policy.

At Blatten, we witnessed successful mitigation of a cascading hazard event, enabled by integrated monitoring, clear command chains, and community readiness. This experience should be read as a template, not an outlier. Climate change is making mountain hazards more interconnected; we urge policy to do the same, by codifying interactions, stress-testing scenarios, transmitting warnings across domains, mapping dynamic corridors and aligning incentives with foresight. Without such action, multi-hazards will remain a static label in a dynamic world.

Xuanmei Fan[1]✉, Kushanav Bhuyan[1], Xin Wang[1], Kristen L. Cook[2], Ugur Ozturk[3], Simon Loew[4], Pema Gyamtsho[5], John D. Jansen[6] & Qiang Xu[1]

[1]State Key Laboratory of Geohazard Prevention and Geoenvironment Protection, Chengdu University of Technology, Chengdu, China. [2]Institut de Recherche pour le Développement, University Grenoble Alpes, Grenoble, France. [3]Department of Geography and Regional Research, University of Vienna, Vienna, Austria. [4]Department of Earth and Planetary Sciences, ETH Zürich, Zürich, Switzerland. [5]International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal. [6]GFÚ Institute of Geophysics, Czech Academy of Sciences, Prague, Czechia.

✉e-mail: fxm_cdut@qq.com

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Competing interests

The authors declare no competing interests.