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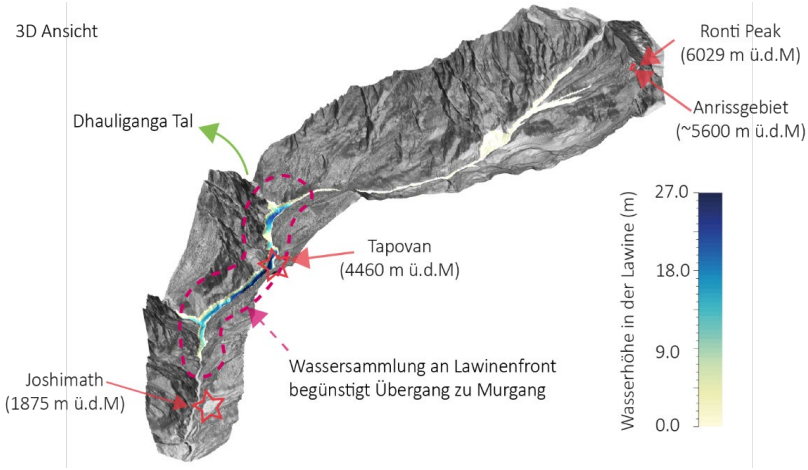
Spotlight on natural hazards research

The complex modeling of ice-rock avalanches



Simulation of the Chamoli landslide in India. 27 million m3 of rock and ice turned into a debris flow. Graphic: SLF

Jessica Munch, a geophysicist at the WSL Institute for Snow and Avalanche Research SLF in Davos, studies the behavior of ice-rock avalanches in the European Alps, but also in Kyrgyzstan or India. Although such avalanches are not as common as snow avalanches, their impact can be significant, as shown by the example of an ice-rock avalanche in the Chamoli district of India in February 2021. A massive rock and ice wall collapsed there at about 5,600 meters above sea level and turned into a debris flow as the ice melted on its way downhill. The avalanche spread over twenty kilometers and destroyed two hydroelectric power plants, bridges and roads. Two hundred people were killed. “Since ice-rock avalanches may become more common due to climate warming and thawing permafrost, it is very important that we better understand the processes involved in such an avalanche,” Munch emphasizes.

The scientist is part of the RAMMS research group led by Perry Bartelt. The RAMMS software developed by the SLF can be used to model natural hazard processes such as avalanches, rockfall and debris flows. Engineering firms and government agencies around the world also use RAMMS to generate hazard reports. The software includes several modules, Munch explains, “With the rockfall module, we can predict trajectories by defining different rock sizes and shapes and then running the simulation to determine possible trajectories. Modeling ice-rock avalanches is challenging because there aren’t that many events and it’s better not to be on site when they happen. However, we try to reconstruct as many events as possible with the aim to train the parameters of the software correctly. To do this, we use satellite imagery, film footage, and observations made by people on the ground, among other things. For example, we have trained the software with events at Pizzo Cengalo (Aug. 2017), Flüela Wisshorn (March 2019), and Chamoli (Feb. 2021). We plan further reconstructions and simulations with the avalanche in the Tian Shan region in Kyrgyzstan (July 2022) and the Marmolata in Italy.”

When Munch models scenarios for potentially hazardous sites, she has to make assumptions about the soil and the amounts of rock, ice, water and other materials that could be released in an ice-rock avalanche: “I ask, what might it look like if the event happens in the winter, when there’s a lot of snow, or if it happens in the summer? I create several models. Then experts in the field can assess

what they think is or is not relevant to the area. We're just beginning to understand the interactions between the different materials within the ice-rock avalanche and the physics behind it."

On Saturday, June 24, from 10 a.m. to 5 p.m., the SLF will host an "Open House". An interactive program will present research on natural hazards in the alpine region, snow, avalanches, permafrost and mountain ecosystems: www.slf.ch/tdot.

Jessica Munch and Daniela Heinen

About the SLF
The SLF conducts research on snow, avalanches, other alpine natural hazards, permafrost and mountain ecosystems. Its best-known service is the avalanche bulletin. Within the framework of the CERC research center, the SLF investigates the effects of climate change on extreme events and natural hazards. www.slf.ch

Jessica Munch. Image SLF