

HAVE YOU EVER HEARD  
THE SOUND  
OF FALLING ROCKS ?

by Tomaso Clavarino



Renato Alberti has been running the Casati mountain lodge on Monte Cevedale, at an altitude of 3,269 metres, for exactly 40 years. He's never before experienced weather conditions such as those seen in 2022, and this year, after celebrating 40 years of running the lodge, he'll have to turn his attention to the new building that will replace the historic one, rendered unsafe as a result of the thawing permafrost.



The village of Pontresina in Switzerland, on the border with Italy, has been under threat for years due to a rock glacier that is moving further and further down the valley. As a result, an innovative engineering project, with a limited impact on the surrounding environment and landscape, has installed a series of stone dams to protect the village and its community from debris, rockfalls and landslides.

## HAVE YOU EVER HEARD THE SOUND OF FALLING ROCKS?

“Have you ever heard the sound of falling rocks?” is a six-month journey across the Alps, taking in Italy, France, Switzerland and Austria. A visual investigation of a phenomenon that is as important as it is little known: the degradation of the permafrost. This project is a story about an ecosystem that’s changing and the work of those who’ve dedicated a significant portion of their lives to seeking possible solutions. The principal themes that emerge are resilience, a spirit of adaptability and a commitment to scientific research that highlights the human and professional qualities of those involved: important testimonies and models for future generations. Over the course of the 20th century, temperatures in the Alps increased by 2°C, twice the average for the entire planet. Shorter winters, reduced snowfall and melting glaciers are just some of the effects that global warming has had on the Alps. However, there are also a number of less visible effects, those

that are more difficult to perceive but which have a dramatic impact on the health of one of the most important, and most fragile, ecosystems on Earth. Included among these is the degradation of the permafrost, the surface section of the Earth's crust that's closest, and therefore most impacted by, all the phenomena occurring within the atmosphere. Its degradation, caused by the thawing of the ice it contains, leads to slope instability and changes in the hydrogeological balance with serious repercussions for the surrounding area.

The ice contained within rock fissures acts like cement, holding parts of the mountain together, but as temperatures rise and the frozen ground thaws the stability is reduced leading to a potential increase in landslides and collapses, events that are becoming increasingly common throughout the Alps.



The Matterhorn is perhaps the most iconic mountain in Italy and one of the most popular among Alpine mountaineering enthusiasts. In recent years, a number of rockfalls have already occurred on the mountain and this summer, in August, a portion of it completely fell away. The many people who were climbing the mountain at the time had to be evacuated by helicopter, and the mayor of Valtournenche imposed a ban forbidding anyone from climbing the Matterhorn; a ban which lasted more than a month. This situation, in addition to a severe water shortage caused by one of the driest summers in decades, led to the early closure of the Orione Duca degli Abruzzi mountain lodge, which is situated along the normal route to the mountain's summit and is a popular stop-off point for many hikers.



The data collection techniques and instruments used by the researchers, who are part of the SLF Suisse (Institute for Snow and Avalanche Research), are extremely accurate and state-of-the-art; they have to calculate the movement of entire slopes to the millimetre, like this laser device which, once activated, is able to scan an entire section of mountain in just a few minutes.

The effects of these changes are not only impacting the environment, they're also having an impact on the Alpine communities that have lived within this delicate ecosystem for centuries. "Mountains, and the Alps in particular", the photographer explains, "have always played a major role in my life. On foot, on skis, with crampons and an ice axe or hanging from a rope, I've traversed them far and wide for years.

The loneliness you can breathe there, the sensation of being powerless in the face of their sheer size, but also their hidden fragility, are just some of the things that have enchanted me about the alpine environment ever since I was a child. But I've seen them change over the years. I've seen slopes collapse, streams swell fiercely, snowfalls change dramatically,

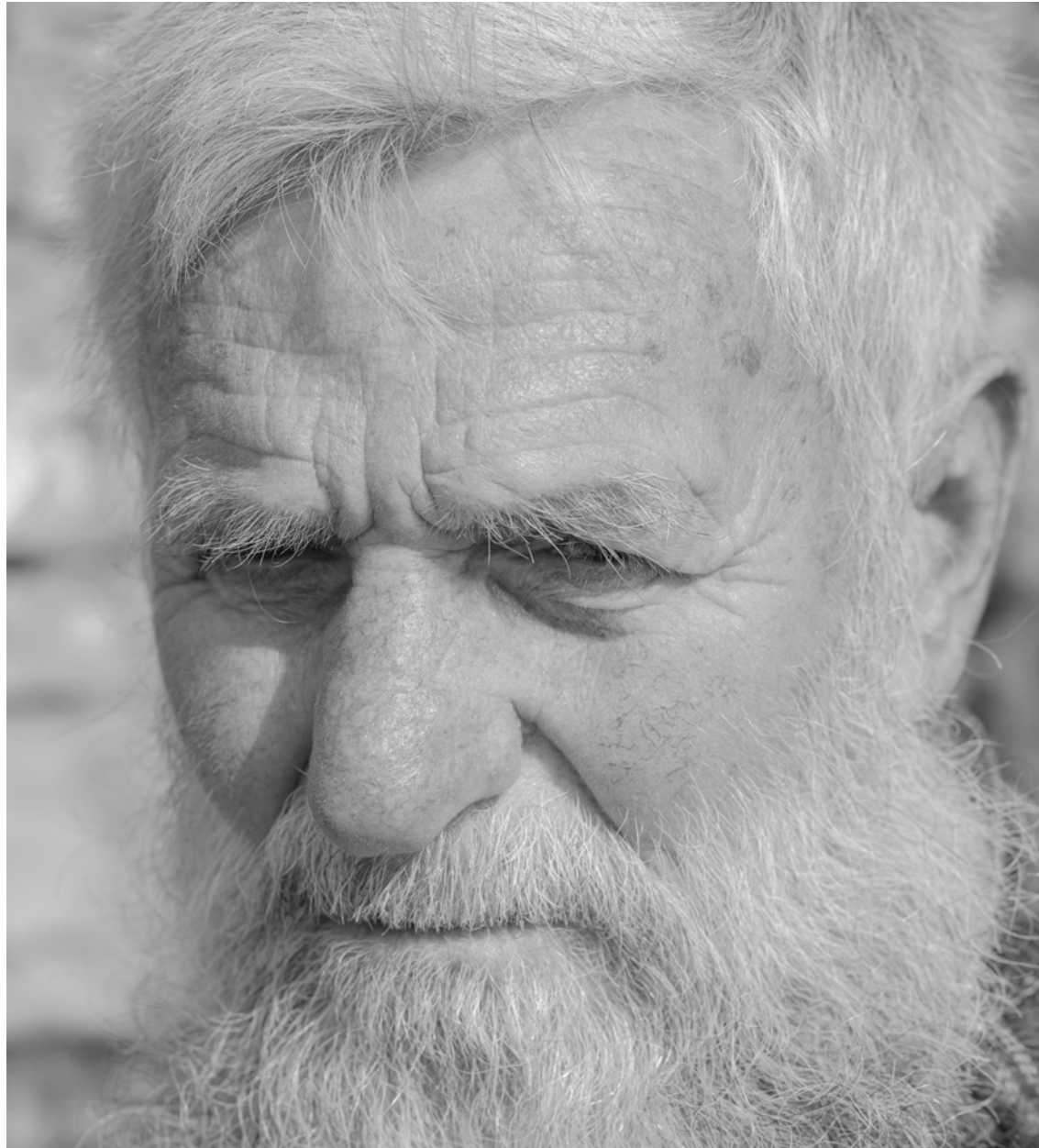
glaciers retreat, the rock face become more unstable, animals change their habits, and humans having to adapt to different weather conditions and increasingly extreme weather events."

"Have you ever heard the sound of falling rocks?" was supported by ISPA and developed in collaboration with various organisations and public administrative bodies, including: ARPA Piemonte (Regional Environmental Protection Agency of Piedmont), the University of Bozen-Bolzano, the Edmund Mach Foundation, the Savoy Mont Blanc University, Provincia di Trento (Trento Provincial Council), Museo di Scienze Naturali di Verona (Verona Natural Sciences Museum), SLF Suisse (Institute for Snow and Avalanche Research), the University of Milano-Bicocca.



Friuli, in the Julian Alps, is home to some of the most interesting and studied karst caves. One of the organisations studying them is CERN, which monitors their condition and assesses the impact of the thawing permafrost on water reserves and mountain stability. In the photo: a view of the Julian Alps at an altitude of 2,500 metres.





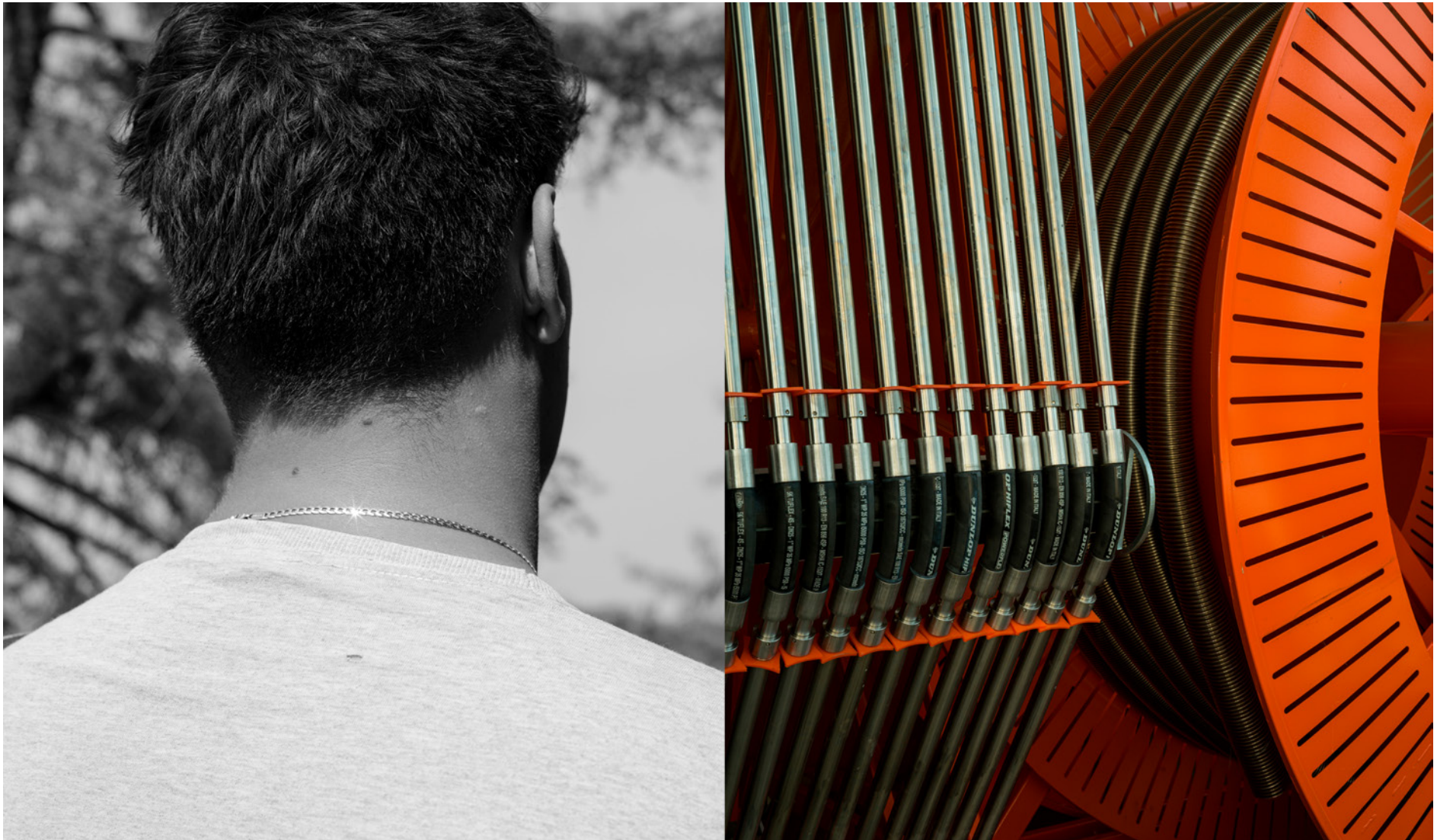
Climate change, the thawing of the ice and the degradation of the permafrost are threatening entire Alpine communities, who are being forced to adapt to the changes and modify their habits and ways of living in the mountains. The older generation in particular is the first to notice how much things have changed.



Bondo is a small hamlet in the municipality of Bregaglia, Switzerland. On 23 August 2017, a landslide completely destroyed it. A portion of rock broke away from Piz Cengalo, a mountain on the border between Italy and Switzerland, and it was sufficient to provoke a landslide that subsequently caused the river to flood the area. Since then, work has been under way to rebuild the village and make it safe to continue living there.



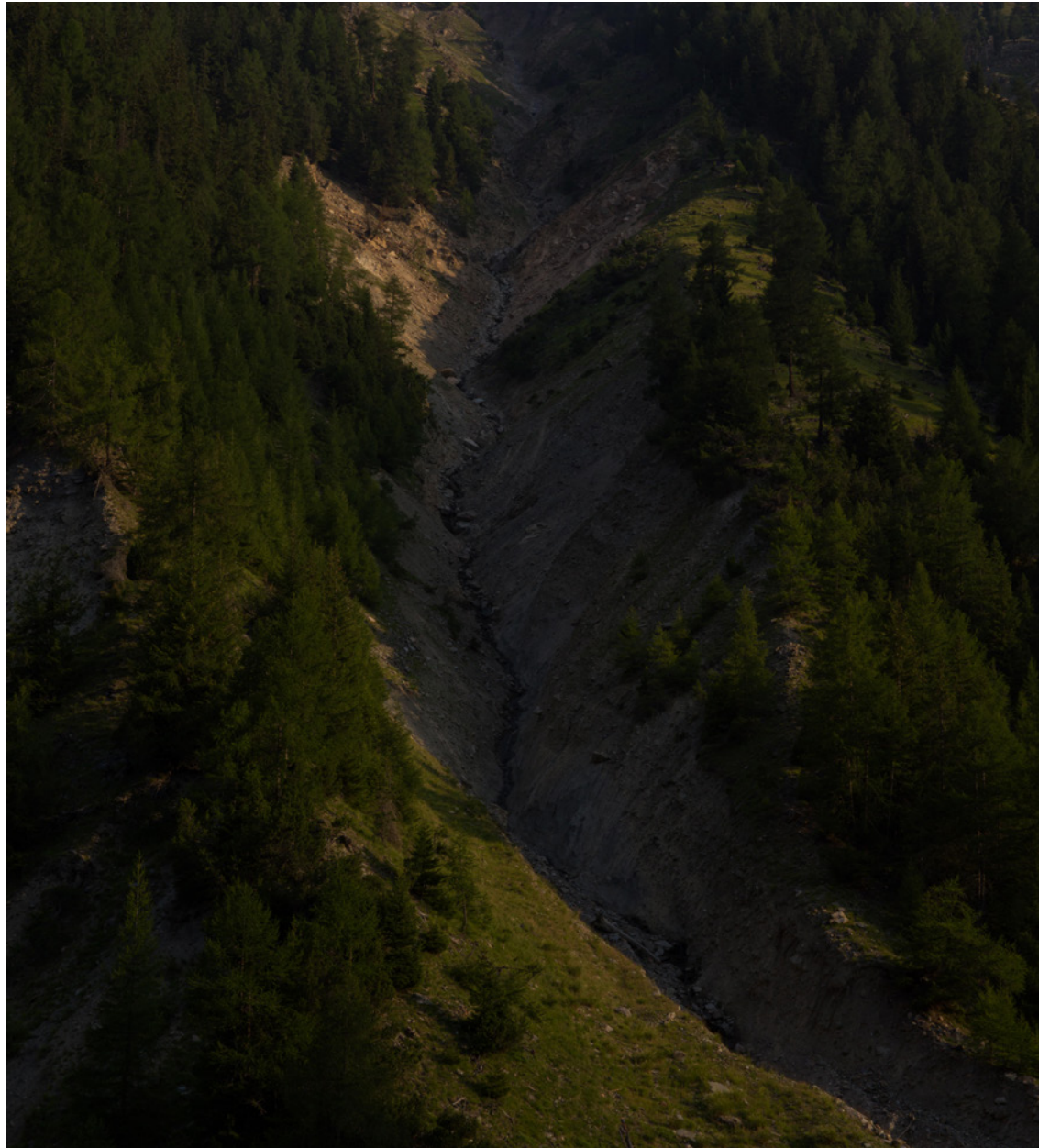
Rock glaciers are distinctive geomorphological landforms composed of rock, ice, snow, mud and water that move slowly down the mountain under the force of gravity. The existence of the permafrost ensures their stability, which otherwise would be severely compromised. They provide the perfect study site for those conducting the field research, and one of the most investigated and most impressive is undoubtedly the Lazaun rock glacier in Val Senales, Trentino.



CSG from Ricaldone, in the province of Alessandria, is one of the leading companies in Italy for geoenvironmental and geotechnical environmental monitoring. They work on projects in the Amazon and in Norway, as well as in the Alps where, in partnership with various research centres and universities, they conduct high-altitude monitoring that's vital for assessing the condition of the permafrost and how it's changing over time.



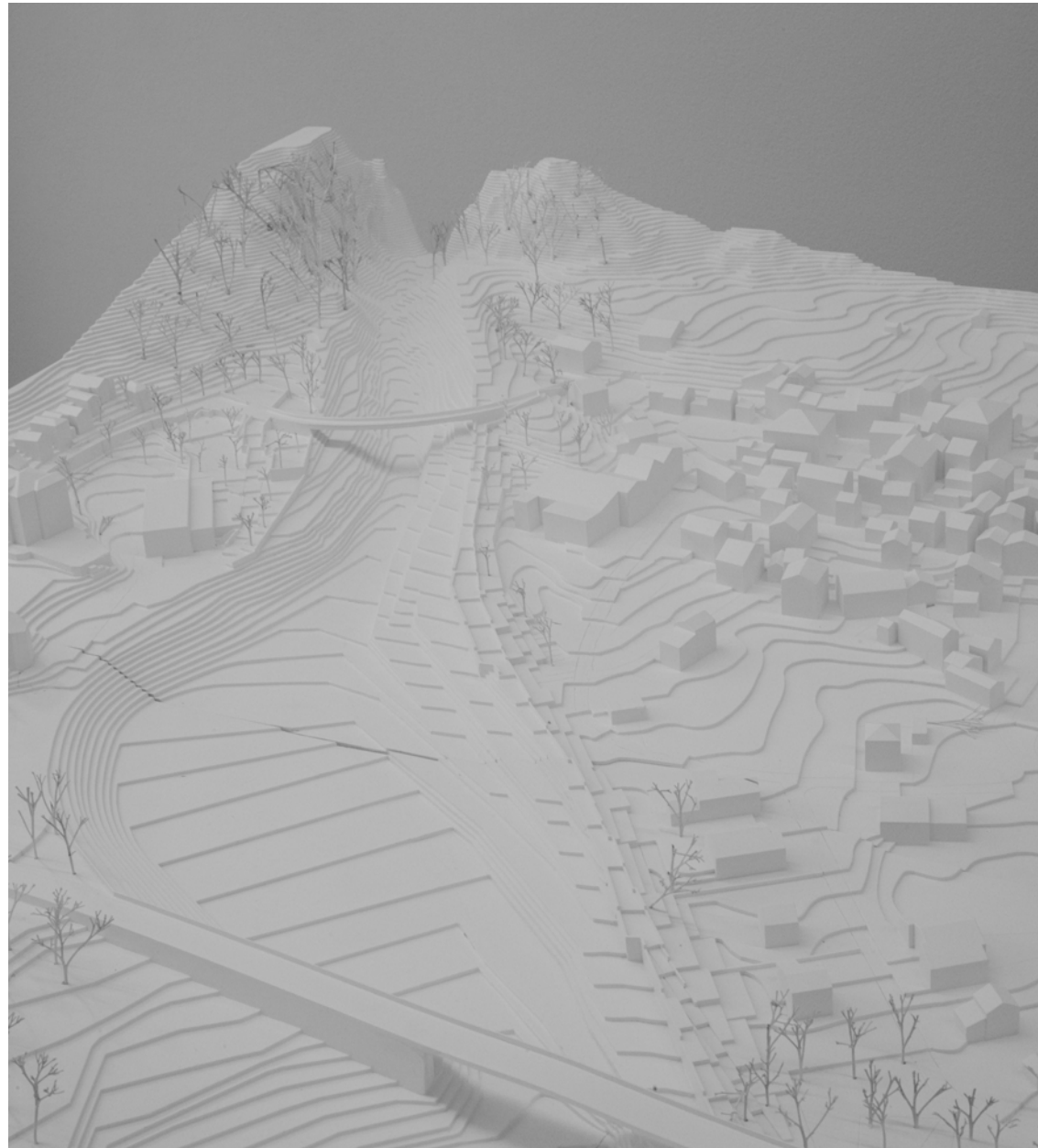
The locations that the researchers need to visit are often in remote, difficult to access areas that can only be reached after a long trek up to moderately high altitudes of around 2,700 to 3,000 metres. In this image, a group of Arpa Piemonte (Regional Environmental Protection Agency of Piedmont) researchers are descending from Monte Mondolè (in the province of Cuneo).



Slope instability and increasingly frequent extreme weather events are behind the many landslides that have occurred in Alpine valleys in recent years. This summer, Val Zebrù (province of Sondrio) was closed for several days due to a landslide that reached the road at the bottom of the valley and made it difficult to access the mountain huts and Alpine pastures.



Jean Marc Peillex - the mayor of Saint Gervais Les Bains in Haute-Savoie, France - has always been on the front line in the battle for the sustainability of the Alpine environment and to guarantee safety in the mountains. Fully aware of the changes that are taking place in the high-altitude areas, over the years he hasn't hesitated to take drastic decisions which have resulted in him being heavily criticised by his colleagues and the mountaineering community, for example limiting the number of people who can access Mont Blanc via the normal route on the French side, or closing it completely when certain weather conditions are forecast.



The reconstruction of Bondo, a hamlet in the municipality of Bregaglia, Switzerland, which was completely destroyed by a landslide, is an extremely complex engineering project due to the problems occurring on the Piz Cengalo and the consequent risk of further landslides and floods. A model of the “new” Bondo is on display in the lobby of the town hall.





The Eurocold Lab at the University of Milano-Bicocca is a controlled-atmosphere laboratory that reaches temperatures of  $-50^{\circ}\text{C}$  and is where ice cores from Antarctica and numerous glaciers and caves in the Alps are stored and analysed, such as the Rem del Ghiaccio cave, in Valcasotto, in the province of Cuneo. Claudio is one of the researchers who work in this laboratory every day, such low temperatures can only be withstood for a maximum of 20 minutes at any one time.



The sustainability of the Alpine environment is also inextricably linked with tourism, which continues to increasingly drain its resources. In 2022, a year of record droughts, Alpine lakes experienced unprecedented low water levels and many mountain lodges had to close early due to a lack of water.



If you consider the sectors that are most affected by climate change in the Alps and the mountain environment more generally, skiing and tourism immediately come to mind, but there are less obvious industries and groups of people that depend on the Alpine environment and its climate, for example shepherds, farmers, and mountain lodge keepers.



The instrumentation that's used to collect data, such as the piece of equipment shown in the photo positioned on the summit of the Corno del Camoscio mountain in the Monte Rosa massif, must withstand high winds, lightning and extreme weather conditions.



Buso del Valon is one of the few karst cavities in the Verona area where perennial ice continues to be preserved. Each year, researchers from various universities across Italy visit the site to study its evolution and verify the presence of permafrost. To get into the cavity, it's necessary to abseil approximately fifty metres down a rope.



An old illustration shows the Casati mountain lodge on Monte Cevedale; in the background is the summit of the Gran Zebrù. As a result of climate change and the subsequent changes that are occurring at high altitude, work will begin at the end of the year to rebuild the hut. With the permafrost degrading, the stability of the rocky outcrop on which the lodge currently stands is under threat, meaning it has to be moved.



As a result of the low rainfall and high temperatures, the entire Alpine region has suffered water shortages in recent years. According to the shepherds who've lived in these mountains for decades, this small Alpine lake in the upper Valle dei Forni (province of Sondrio) has never dried out during the summer.

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