

## Editorial

Switzerland's glaciers are melting. In less than 40 years, their surface has shrunk by almost 30 percent. Linked directly to an increase in greenhouse gas emissions, this relentless retreat can be observed around the globe, impacting negatively on the economy, the environment and society.

As an Alpine country itself, Switzerland has always been engaged in mountain regions, which are too often marginalised, neglected, and afflicted by great poverty. It also conducts projects on the slopes of the highest mountain summits to help communities adapt to the effects of climate change or to prevent natural disasters. This commitment is crucial as the number of food insecure people in mountain areas rose 30 per cent over 12 years, while global hunger figures are declining. The SDC is also active at the international level: it played for example a key part in helping to draft Chapter 13 of Agenda 21, on sustainable mountain development, at the Earth Summit in Rio in 1992.

This Global Brief shows specific examples of our activities with regard to glacier melt. You will read how Switzerland is recognised for its expertise in this field, thanks to its universities and to a dynamic and innovative private sector.

I wish you an enjoyable read.

Dominique Favre  
Deputy Assistant Director General

## Melting glaciers: danger ahead!



**The retreat of glaciers is one of the most dramatic signs of global warming and has a major impact on security and how millions of people live their lives. Strategies to reduce risks and adapt to the new conditions are being implemented.**

Ishaq Khan, a 68-year-old farmer sporting a thick white beard, lives in the mountainous region of Gilgit-Baltistan in northern Pakistan. He used to grow maize and potatoes and kept an orchard of fruit trees until August 2010 when a flash flood buried his home and crops under a thick layer of mud and boulders. In just one hour, Ishaq lost almost all of his possessions. Five years on, he is still scraping by with a herd of goats and sheep in the Damaas valley, with neither the means to clear his land nor to leave it.

This story, which was picked up by the IPS news agency, is emblematic of the risks faced by the millions of people who live below glaciers. Gilgit-Baltistan has 4,000 of them. Flash flooding surges in the summer when temperatures rise. "For 200 years,

there wasn't a single flood in the Damaas area," explains Musa Khan, who works at the Pakistan Meteorological Department. "But there were flash floods in 2006, 2010 and 2015. This is really surprising for us."

### The mountains – vulnerable areas

Climatologists are less surprised. Flash floods are linked to global warming, whatever the underlying causes. Agenda 21, which was adopted in Rio in 1992, classifies mountains as "the areas most sensitive to all climatic changes in the atmosphere." Mountain glaciers and their delicate ecosystem are among the most sensitive indicators of these changes. In the short term, these changes are manifested in modifying snowmelt runoff

patterns; in the medium term, in the glacier retreating; and in the long term, in the thawing of the coldest layer of soil – the permafrost. These three phenomena are exacerbated by global warming and are becoming visible within the span of a human lifetime.

The most dramatic, immediate threat is the rupture of an ice shelf or till damming a glacial lake which is created and sustained by the glacier melting rapidly. This results in a sudden, violent and often devastating flood known as a glacial lake outburst flood (GLOF). And Ishaq Khan, the farmer in Pakistan, may very well have been one of its victims.

Other effects of the glaciers melting are less clear, and in some instances cause and effect may be too complex to determine – such as the periods of high water flow shifting throughout the seasons, impacting directly on irrigated farming. These connections can only be established on the basis of long-term scientific observation, but there is a lack of data in a number of countries. The SDC supports the Swiss programme CATCOS, which promotes training and data collection on the climate including the impacts of climate change on glacier retreat in Ecuador, Colombia and Kyrgyzstan.

Switzerland is recognised for its long-standing tradition in the study of glaciers and is home to the World Glacier Monitoring Service at the University of Zurich.

## Glaciers under observation

Glaciers act as reservoirs. The more they melt, the less ice reserves remain. In certain parts of the world, glaciers have retreated more than 30% in less than 50 years. More than two-thirds of the earth's fresh water comes from mountain glaciers. In the Himalayas, for example, the glaciers feed the seven major rivers in Asia which provide water to more than 2 billion people – almost a third of the world's population.

That is why it is vital to understand and try to predict the global impact of melting glaciers. Tremendous efforts have been made in the last 15 years to collect data, in particular by satellite. This cannot however replace proven methods of observation in the field such as placing markers on the glaciers to record their movement or new technologies such as using drones.

Once processed, this large body of information stimulates reflection at the international level. It also provides political decision-makers with the information needed to plan and finance national climate change policies.

## Climate change and the fight against poverty

Climate change adaptation strategies rely on the social and natural sciences, but they also need hard scientific data from glaciologists to be effective. Glaciologists, for their part, have to understand peoples' needs to be able to provide information that is useful. It is therefore essential that all these stakeholders, who come from different walks of life and training backgrounds, work together better and integrate their approaches.

"It's like a watch, where all the cogs have to work together" explains Daniel Maselli, policy advisor on climate change and the environment at the SDC. "But this is not yet the case. Improving our understanding of how the different fields are connected would help us find more robust solutions and make the right investments."

Indeed, the effects of global warming reach far beyond the scope of emergency measures. Over time, they weaken communities that are already vulnerable. The ecosystem of the mountain valleys is changing rapidly. Glacial retreat and rising temperatures are causing wildlife and plants to move to higher latitudes. Changing our habits and behaviour is no longer enough. Knowing that the availability of water resources will change dramatically in the next few decades requires new policies for agriculture and pastoralism, new methods for retaining surface water, new efforts in training and education, and more. In short, it is time for us to adapt. In some cases, there is already a need to change production methods and economic models. Switzerland understands these issues very well as it is directly affected by them.

In India for example, people living in the foothills of the Himalayas – who depend entirely on farming and the water supplied by the glaciers – have already adopted new varieties of rice and wheat that consume less water, dug out reservoirs to store water reserves, and replaced bulls with cows, which need less fodder and produce milk that can be sold to compensate for lost income from crops. When there is not enough land left for the cows to graze, people keep poultry instead.

This is threatening the food security of mountain populations. Farmers are used to adapting, but traditional knowledge is not always enough to meet the rapid pace of change we see today. And the impoverishment this causes forces men to leave their homes in search of work, leaving all the responsibilities to the women.

"These days, you can't talk about the eradication of poverty without tackling climate change issues and vice-versa" says Yuka Greiler, co-head of the SDC's Global Programme Climate Change. "That is why the climate issue has to be systematically incorporated into development projects." ■



The Rhône glacier. Image taken from the 'Agonie d'un glacier' series, part of the SMARt collection.

Photo: Laurence Piaget

# An early warning system in Peru sets the standard

Switzerland maintains a number of links with Peru with regard to climate change, in particular melting glaciers. Thanks to collaboration between the universities of Zurich and Fribourg, a postgraduate training course in glaciology was set up at the Peruvian universities of Huaraz, Cuzco and Lima in 2012. There had been no courses dealing specifically with this topic before. Glaciers in the Andes have lost 42% of their surface area in the last 40 years, and experts predict that this is set to continue. Peru is therefore very much in need of expertise in this field.

When in 2010 an enormous block of ice broke away from 'Glacier 513' in the Cordillera Blanca and landed in the surrounding lake, the urgency of the situation became

clear. The resulting tsunami and scale of the disaster that could have ensued for the downstream communities led the Peruvian authorities to approach Switzerland to help set up an early warning system to monitor the tongue of the glacier. Supported by the SDC, the project involved the University of Zurich, the Swiss Federal Institute of Technology in Lausanne, Meteodat (an ETH Zurich spin-off company) and the Research Centre on Alpine Environment (CREALP) based in Valais.

Although the studies focused on risk reduction, they are also intended to deal with the effects of dwindling water resources, in particular the management of catchment areas (water needs for the local people, natural disaster risks, potential use

of meltwater, etc.). Climate adaptation issues in the Andes are similar to those in the Alps, where Switzerland has gained considerable expertise. One difference is that tropical glacier dynamics are much faster, and a number of them are set to disappear entirely within a short space of time.

The work that is being carried out in the Carhuaz region where Glacier 513 is situated is intended to serve as a model for the Peruvian government. It is currently being replicated in two other places and a number of projects are in the planning phase. The retreat of glaciers has become a major concern for Peru, which is why the country established a National Institute of Research on Glaciers and Mountain Ecosystems in August 2014. ■

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## Three questions for...



**Christian Huggel**, glaciologist and researcher at the Department of Geography of the University of Zurich. This institution takes part in different programmes on glacier retreat supported by the SDC.

### **Are disasters related to glacial lake outburst floods becoming more common and extreme?**

It's hard to say. There aren't enough data to make such a generalisation. But we are seeing changes in the number and size of lakes which are related to global warming. Certain effects are visible, like the retreat of glaciers or the formation of lakes. But there are other factors that can trigger a GLOF, such as avalanches or the topography of an area.

### **What are the main difficulties in studying glaciers and the effects of their retreat?**

The study of glaciers is highly developed: we know how to measure the surface, thickness and movements of glaciers, and more. The main problem is access, which is challenging when the site is remote or has crevasses and slopes. To measure the impact of melting glaciers on water resources we need long-term records. In Switzerland we have built up quite a precise picture of our water system over time. But in some countries this information is lacking. However, these data are crucial in deciding policy measures for climate change adaptation.

### **Do the different disciplines involved in this field integrate data collection and the implementation of adaptation measures well enough?**

The study of glaciers is in itself interdisciplinary, involving geographers, physicists, geologists, engineers and so forth... But it is very important to link these disciplines to other areas too. It is essential to work with the local communities, to find out how they look at the issues and how they can adapt. We work a lot with colleagues from the natural and social sciences. It's a real challenge. There's a growing awareness, but we really should be doing more.



# Effective cooperation in China

What triggers a glacial lake outburst flood, such as the one in the Kyagar Glacier in western China's Xinjiang province, cannot be fully explained. The consequences, however, are well known: a lake forms underneath the glacier, which blocks the water from entering the valley. But when this barrier is lifted, it releases a gigantic tidal wave that threatens more than one million people living 560km away in the plains of the Yarkan River, and causes losses equivalent to more than CHF 10 million every year.

Monitoring the glacier and lake is problematic, however, because of the inaccessibility of such a remote region at almost 5,000 metres altitude. In 2009, China and Switzerland signed a cooperation agreement to set up a monitoring and early warning system, a risk management programme for the downstream communities, climate change monitoring and training for local specialists.

This programme demonstrates the importance of pooling efforts and resources from different sources: the Swiss and Chinese governments, national offices in both countries, the scientific community and the private sector.



Installation of an early warning system 200 kilometres downstream from the Kaygar glacier in 2011. It forms part of an automatic network which succeeded in preventing a disaster in July 2015. Photo: Geotest

The system combines satellite monitoring, measuring points around the glacier that provide daily indications on the climate and amount of glacial ice, and warning stations along the Yarkan River. All data are transmitted by satellite. The information makes it possible to forecast lake outbursts a few weeks in advance. When a GLOF occurs, the authorities have about 20 hours to warn people to take cover.

In July 2015 the fully automatic system predicted precisely the moment and scale of the lake outburst, which allowed the Chinese authorities to take the planned measures in good time. One of the Chinese officers on site stated that the damage was largely limited thanks to the early warning system. ■

## The SDC's focus

### The SDC

- Helps mountain populations to the expected reduction in the availability of water as the glaciers melt. This includes constructing reservoirs to mitigate periods when water levels are low, careful resource management, and making changes to agricultural practices.
- Supports data-gathering on glacier melt in various mountain ranges. This data will help achieve a better understanding of the phenomenon, and allow action to be taken to forestall its effects.
- Helps to prevent disasters associated with glacial lake outburst floods (GLOF) by installing early warning systems.

Based on Swiss expertise, these systems are an excellent example of collaboration between governments, higher education and the private sector.

- Pursues a range of activities intended to raise public awareness of sustainable development in mountain regions, such as the SMart (Sustainable Mountain Art) initiative from the Valais-based Foundation for Sustainable Development in Mountain Regions (FDDM).
- Has been very active at the international level ever since the Rio summit in 1992. It also leverages a network of institutional partners in a number of regions around the world to promote sustainable development in mountain regions and to stimulate cross-border cooperation.

### Imprint

#### Editor:

Swiss Agency for Development and Cooperation  
SDC, Global Cooperation Department  
Freiburgstrasse 130, CH-3003 Berne  
deza@eda.admin.ch, www.sdc.admin.ch

This publication is also available in German and French.