ONE-TWO

# From large-scale experiments to pop-up tests

Controlled triggering of avalanches, measurement of debris flows and rock caught in protective nets – what for? An interview with Perry Bartelt, WSL, and Lorenz Meier, Geopraevent, about large-scale experiments.

Lorenz Meier is the CEO of Geopraevent, which develops warning and monitoring systems for natural hazards. He worked at SLF from 2009 to 2013.

Perry Bartelt heads the 'Rapid Mass Movements RAMMS' program at WSL. The eponymous software models avalanches, rockfalls and debris flows.

**What role have large-scale experiments played in your professional career?**

**PB:** A major role. We started by observing; we made and watched videos of avalanches, debris flows and rockfalls to see what we could uncover. Now we look into selected aspects, such as powder clouds. We say, "We should see x, y and z in an avalanche" – and then we test it at the avalanche test site in Vallée de la Sionne (VdlS).

**LM:** I learned a lot about sensors at VdlS – and I still work with sensors today. Once, I was in the bunker at VdlS with the measurement devices, but the avalanche did not go off. That's one of the disadvantages of large-scale experiments: They're expensive and involve a lot of technology, but events are rare.

**How often do you successfully trigger an avalanche in VdlS?**

**PB:** A major avalanche, every two or three years.

**LM:** When they occur, avalanches provide a lot of very good data. But you have to be able to wait. It's a somewhat passive form of research. As a small start-up, we cannot afford to wait three years. We have to be able to bring our product to market quickly. So we go where something is happening, such as Brienz (Graubünden), where rockfalls regularly occur. We have a simplified measuring concept with just a few devices; in this case, a camera and a radar. This allows us to obtain data quickly.

**PB:** We also do not want to wait too long if there are specific questions. But in order to be able to develop a natural hazard simulation program at all, such as RAMMS, we need data from the large-scale experiments. Now we can quickly and flexibly collect data in field situations, such as Brienz, using small mobile tests – which we call pop-up tests – and thus check RAMMS at other sites.

**How important are the findings of large-scale experiments to Geopraevent?**

**LM:** They are indirectly important. For example, to ensure that we identify the correct path of an avalanche for an alarm system, our partners simulate where it will flow using a computer. The computer programs used for this are based on the findings from the large-scale experiments. And we can use large-scale experiments to test new technologies, such as radar, that we use later on. We are not able to develop completely new technologies ourselves.

**WSL has stopped conducting large-scale experiments in recent years. Are pop-up tests the future?**

**PB:** Rockfalls can be better investigated using field experiments;

Photos: Birgit Ottmer, WSL

A 19-meter measurement tower in the middle of an avalanche track in the Vallée de la Sionne. It has a number of measurement devices to check the speed, pressure, density and temperature of an avalanche.

Photo: Martin Hiller, SLF

More information about large-scale avalanche experiments is available at: *www.slf.ch/more/vdls-en*

A video on this topic can be viewed at: *www.slf.ch/more/film-avalanche*

for example, on grassland, in forests, on scree slopes and with various rock formations.

**So large-scale experiments will be phased out?**

**PB:** I think they will be for rockfalls, but not for avalanches. If the climate changes and there are more avalanches in the future, it will be good to have data from the VdlS.

**LM:** Another factor in favor of pop-up tests is that computers nowadays are much smaller and more powerful. It's no longer necessary to have an entire rack in a bunker. And with laser scans, you

can get an accurate terrain model in an hour. I don't think any new large-scale experiments will be performed at a fixed location.

**PB:** But there are still unresolved problems. For example, we get a lot of questions about ice and powder avalanches in the Himalayas. The enormous differences in altitude, the quick movements, the powder clouds that behave completely differently at 6,000 meters: in order to understand the physics, we use data from powder avalanches in VdlS. Or debris flows, which are much less common and more difficult to predict than avalanches. We are not as far with this research and, in particular, we still do not understand the mass balance. So we will still need large-scale debris flow experiments in Illgraben.

For more information about the RAMMS research program, please go to: *www.slf.ch/more/ramms-en*

**Does this also correspond to your needs as practitioners?**

**LM:** You focus on the basics. We want to be sure that people understand these as well. To that extent, it corresponds to our needs. But I have a provocative requirement: I think that RAMMS should be open source.

**PB:** But we do not have the resources to do this. The money that we earn with RAMMS goes directly into further development and user support; for example, through training.

**LM:** Then you have to sell the training programs! Or certifications: Those who want to use RAMMS must be trained by you. That way, you will have quality control to ensure that the models are used correctly and the results interpreted accurately.

**Fifty years ago, 88 people working on the Mattmark dam were killed by a glacier avalanche. Could such a tragedy be avoided today through large-scale experiments?**

**PB:** Nowadays, modeling would probably be used to determine where to place worker housing.
I would like to simulate it to be able to answer this question.

**LM:** You can see how we deal with unstable glaciers today by looking at Weissmies in Valais. In the summer of 2014, falling ice became more frequent as part of the glacier had become unstable.

Scientists and technicians monitor measurements in the observation bunker at the avalanche test site; radars measure the speed of avalanches.

Photo: Martin Hiller, SLF

Large-scale experiments are now supplemented with mobile systems. Here, a researcher measures an avalanche using a drone in order to later calculate the precise distribution of snow.

RAMMS simulations showed how much ice had to break off before it fell on to the slope or even down into the valley. Since then, we have been monitoring the glacier with radar. We can identify when larger chunks will break off a few days in advance based on the increased flow velocity. We can also estimate the size of the chunk that will break off. Then the authorities can take protective measures.

**This would not have been possible 50 years ago?**

**LM:** No, because the models were not available, in part because there was still no data from large-scale experiments, nor was the measurement technology as advanced.

**PB:** There was also a lack of terrain models and computing power at the time. But the main problem was that the processes were not understood well enough to be modeled – today, thanks to large-scale experiments, they can be. So the benefits of large-scale experiments for society are great. *(bio)*

Photo: Julia Wessels, SLF

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