Rumbles in the Alps reveal rockslides

Researchers model scope of mountain landslides from Swiss seismic data.

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The ricochet of a rock fall resonates in the mind of anyone who has heard it. But it also sets off subterranean waves detectable by far-off seismic stations — and now researchers are using those signals to remotely model rockslides.

Franziska Dammeier, an engineering geologist at the Swiss Federal Institute of Technology in Zurich, and her colleagues linked five metrics of seismic waves to five physical characteristics of rockslides: volume, runout distance (how far the rocks travel), drop height, potential energy and the angle of reach. The researchers reported their model last week in the *Journal of Geophysical Research*[1].

A fast, remote estimate of rockslide traits could be valuable to civil-defence authorities, which must assess whether the redistributed rocks are unstable enough to threaten villages, roads or dams downhill. Some slides might trap water and later unleash a sudden flood. "The main point is that we can now use established seismic-sensor networks to quickly get first impressions," says Dammeier.

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Rockslides are hard to detect from seismic data, but a model could now let authorities quickly work out the size and impact of a fall.

Ugly signals

Until now, most seismic research on landslides has focused on how to identify individual slides among the general seismic din of the Earth. But in comparison with earthquakes, rockslides produce "kinda ugly signals", so they are difficult to detect, says Jackie Caplan-Auerbach, a geologist at Western Washington University in Bellingham.

To capture the seismic signature of rock falls, Dammeier combed through 15 years of archived Swiss seismic data and geological reports of rockslides and their characteristics.

She identified 20 major rockslides of various types that had occurred throughout the Alps, and found their 'ugly signals' in the seismic data. Dammeier and her team discovered patterns that related to each rockslide's character, and concocted a mathematical model to describe them.

The researchers tested the model's predictive powers by applying it to seismic data from three other rockslides. Their estimates of those rockslides' volumes were within the range of volumes reported by local geologists, but the model was worse at predicting the angle of reach.

Part of the problem is that there is not much hard data on the characteristics of existing slides. The scale and distribution of rockslides are often quantified by looking at a photograph, or through a passing geologist's best guess. "More ground truth with well known slides would help to improve Dammeier’s model, but I've had a honey of a time trying to find data on rockslides and avalanches," says Caplan-Auerbach.

Seismic rockslide analysis may not yet be very precise, but it is fast: a typical rockslide lasts less than three minutes, says Dammeier, and analysis with her model takes only slightly longer. So although the model can't predict primary rockslides, if it could be used to alert authorities to a rockslide in progress, it could enable a quick response to subsequent slides.

To do that, Dammeier must develop an algorithm to automatically spot rockslide signals from the background noise of Earth's seismic data. "Right now we have people saying, 'It kind of looks like a rockslide, can you check it out?'," says Dammeier.

References

1. Dammeier, F., Moore, J. R., Haslinger, F. & Loew, S. *J. Geophys. Res.* **116**, F04024 (2011).