

Shedding light on the earthquake situation

February 20 2013

Researchers from the Swiss Seismological Service have worked together with the Seismology and Geodynamics group at ETH Zurich and with local support in Bhutan to install a temporary seismological network. They plan to use the network to close a gap in geophysical research of the Himalayas.

Switzerland has a strong tradition of geological research in Bhutan. The famous geologist Augusto Gansser compiled the first geological map of the Kingdom, published in 1983. In November 2010, researchers from ETH Zurich and the University of Montpellier carried out extensive measurements of the Earth's [gravity field](#) in Nepal and Bhutan. This data made it possible for the first time to create a model on how the Indian and Asian [continental plates](#) collide beneath the Eastern Himalayas. Between January 7th and February 3rd 2013, the ETH Zurich team collaborated with [seismologists](#) from Bhutan to install a temporary [seismic network](#) there. In an interview with ETH Life, György Hetényi, head of the project and senior research associate at the Swiss Seismological Service (SED) of ETH, explains the objectives of and the background to the project.

Mr. Hetényi, you have just come back from Bhutan with your team. How many seismometers did you install during the fieldwork?

After the project funding was approved by SNF last September, we prepared the instruments at ETH Zurich over the autumn and in

November and December we sent 38 seismometers to Bhutan by [airplane](#). We have now installed all instruments. Bhutan is about as big as Switzerland. We aligned the seismometers in two lines running from North to South with 14 and 16 stations; eight stations are located between these lines.

In geophysical terms, Bhutan is like a blank spot on the map. There are scarcely any seismological measurements of this region to date. You plan to use the temporary network to bridge this gap?

Exactly. We want to get an insight into the structure of the Earth's crust and get an idea on how the mountains' root underneath the surface looks like. The Earth's crust in India, to the South, has a normal thickness of ca. 35 kilometres. In Tibet, to the North, the crust is twice as thick. It is not known what the geometry of the thickening crust looks like in between, i.e., where Bhutan is. And that's what we are interested in. We plan to find out whether the differences in crustal thickness give indications for major thrust faults. Possible movements could cause very large earthquakes there. We image these structures using seismic records with which we can also help assessing earthquake hazard.

Our second objective, which is equally important, is to measure and describe Bhutan's day-to-day earthquake activity. The people living there notice smaller and medium-sized tremors on a regular basis, but we do not know how many earthquakes there are, how strong they are and where in Bhutan do they take place.

Unlike in other regions of the Himalayas, there have been no significant earthquakes in Bhutan in the past 120 years. What is your explanation for this?

This is the timescale we usually talk about because that's how long [seismometers](#) exist and have been recording earthquakes. In that time, four strong earthquakes with a magnitude 8 or above have been registered in the Himalayas, but none in Bhutan. Nor do historical sources provide any clear indication of strong earthquakes in Bhutan. Statistically, however, [major earthquakes](#) can take place every couple of centuries or millennia in a region, which is why the fact that there have been no larger earthquakes in recent times does not necessarily mean that the hazard is low. We are trying to better understand the earthquake activity in Bhutan with the help of the network we installed. In western Nepal, there is a similar gap in the occurrence of major earthquakes. At the moment it seems that there are regions in the Himalayas that are less susceptible to major quakes.

Do you have any explanation at present for this exceptional situation in Bhutan?

We have two general explanations as to why major earthquakes have not been recorded yet. One is that stresses have been accumulating over years and centuries along the large thrusts where earthquakes can take place and that one day this will result in a huge earthquake. Longer periods without major tremors thus do not mean that it is not possible to have major earthquakes in this region. The second and for Bhutan the better scenario is that the plates are very slowly but continuously sliding, creeping along each other. As a result, no major stresses are accumulating at those locations. At the moment we do not yet have any idea what the situation in Bhutan is.

Don't the field observations give any indication of earlier earthquakes?

Our colleagues from Montpellier are currently searching through the

deposits of the past millennia at the foot of the Himalayas to determine whether there are abrupt changes on the surface or larger disruptions along geological strata, with several metres offset. These would indicate strong earthquakes of which we could determine the date.

Does the pioneering work carried out by the Swiss Augusto Gansser form the basis for your fieldwork today?

Gansser once charted the geology of Bhutan, and our [project](#) is named after him. His geological map shows us how the mountains in Bhutan developed over millions of years. It is very important for us because it shows the long-term development of the region and gives us all of the geological information about the surface and a few hundred metres deep. With our seismological study, we are now going to image the structures down to 70 to 90 kilometres depth. This allows us to examine the deep structure of the crust. Both dataset together will help us to understand the development of the Himalayas.

For how long will you operate the seismic network?

The plan is that the network will carry out measurements until the spring of 2014, so for approximately 16 months. Temporary measurements have to run for at least a year so that we can get meaningful data. After that the mobile instruments will be used for other projects.

Wouldn't it be important for Bhutan to have a permanent network?

That's an important point. We are currently discussing the options for a permanent network with the Department for Geology and Mines and the

Department for Disaster Management. The permanent network we have in Switzerland is a very good example. If the discussions go well, we will try to obtain funding together with other countries so that we could install a permanent network of 12 or 15 stations in a couple of years. Bhutan currently does not have the necessary financial means and expertise to establish the network without foreign assistance.

How do you get the collected data?

At the moment, minicomputers record the data for each station locally. We will travel to Bhutan three times during the measurement period to check that everything is in order and to copy the data. If we have the time in April and the necessary instruments, we will install a communication system at some stations. This would allow us to receive the data through wireless or via satellite.

What is the working relationship like with scientists from Bhutan?

The experts in Bhutan help us a lot. As already in the past years, they provide extensive assistance to us and they understand very rapidly and well what we need. We have a friendly relationship, right up to the heads of the Geology and Disaster Management departments. This results in a valuable and lasting working relationship that I appreciate very much.

What were the biggest obstacles in the project?

Getting in touch with the right people in Bhutan and securing funding. Bhutan was a closed country that only gradually started to open up in the 1960s. Even today, if you want to travel there as a tourist, you have to pay 250 USD per day visa fee. It was also difficult to organize the logistics of our expedition. We had to send two tons of material by

airplane from Zurich to Bhutan, and that was a real challenge. You can only get into the country with one airline, and that airline has only one type of large aircraft. We had to pack smaller boxes so that they fit in the aircraft. And although the Bhutanese geologists were very welcoming of the collaboration, the project had to be first examined and approved by the "Gross National Happiness Commission".

How long did it take from the preparation to the work in the field?

It took a year from the first contact until starting the work on site. That's not very long, but for us it was a new experience. It was also a challenge to get all the material we needed and wanted to buy there. All consumer goods that are sold in Bhutan come from India and the road conditions for transportation are often difficult. For example, the batteries for the stations arrived later than planned, and we were always unsure whether everything would work out. But in the end there were no major delays. We are really very happy that there were no problematic situations or accidents.

You are also working with scientists from France and the USA on this project...

...that's right, in 2010 we carried out gravity measurements with our colleagues from Montpellier. We are now doing the [seismology](#), and are also getting help from a colleague from Montpellier. Additionally, as I mentioned, scientists from France are examining the geological layers for traces of past large earthquakes. They are also planning to set up a GPS network. We are working hand in hand, but each university has the lead for a certain aspect. We are receiving support from the USA from an expert who has already installed seismological stations around the globe and can teach us a lot.

You did your master's project and PhD dissertation on the Himalayas. What draws you back there again and again?

That's a good question. I really like being in the outdoors. Where I come from, in Hungary, the mountains are very small (laughs). I am not a climber or a real fan of very high peaks, but I like to hike and do orienteering races. In the end I came to this region through my scientific advisors, who were doing research in the Himalayas and Tibet. Since then I have been fascinated by this topic. Another thing is that I was very impressed by Buddhism the first time I was in the Himalayas. I found it very interesting to discover the eastern cultures and their ways of thinking and to compare those with the European, Judeo-Christian traditions and ways of living.

Provided by ETH Zurich

Citation: Shedding light on the earthquake situation (2013, February 20) retrieved 10 April 2024 from <https://phys.org/news/2013-02-earthquake-situation.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--