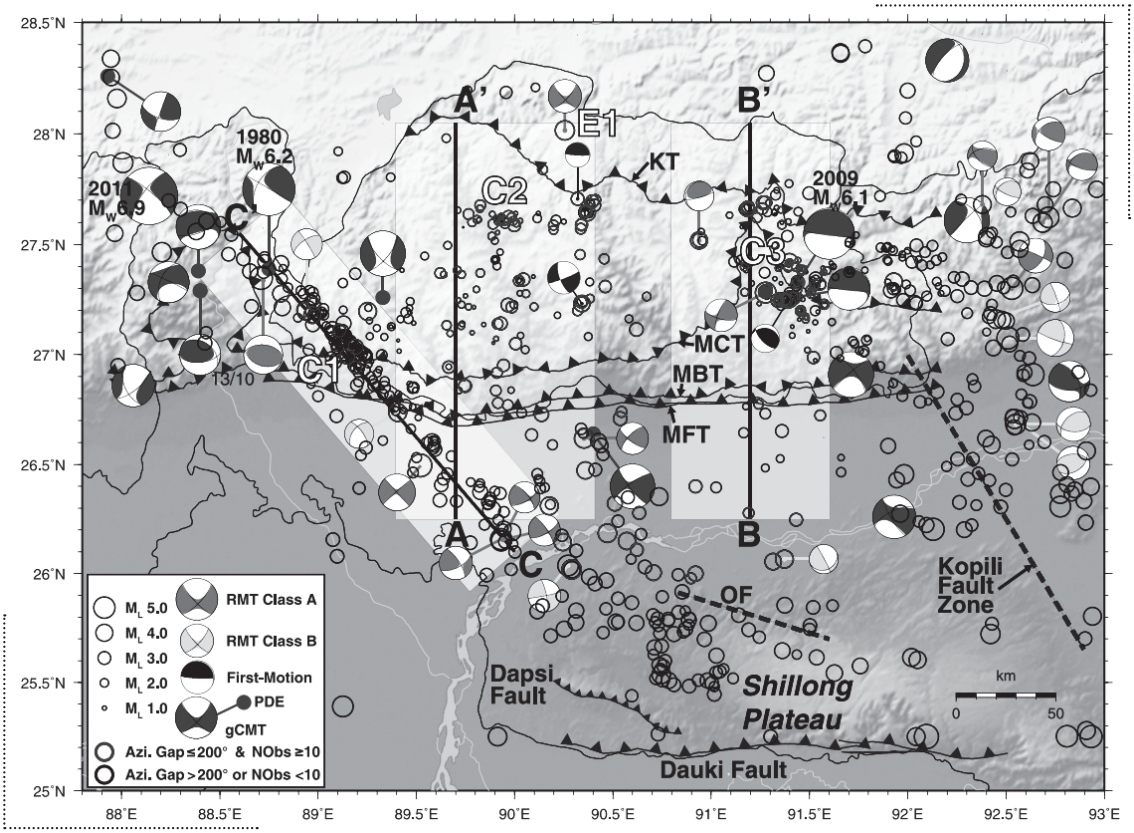
What we have learnt about Bhutan earthquakes in recent years

People's awareness to earthquake hazard always increases after a big earthquake. This is certainly the case for the inhabitants of the Himalayan region who vividly recall the destruction after the April 2015 event in Nepal.

While general public attention usually fades with time, there are scientists who constantly study the long-term behaviour and geological history of the Himalaya. Bhutan was the focus of such geophysical research activities since 2010, in frame of a collaboration between the Department of Geology and Mines and universities in France and Switzerland. The field observations included 38 temporary seismometers, hundreds of gravity measurements, a GPS network, very detailed analysis of the main fault in southern Bhutan, and extensive data processing and calculations. The results of these works were published in scientific journals, but they are not easily accessible and understandable by the general public. We here summarize the most important findings of our research:



Seismicity of the Bhutan Himalayas as recorded by the GANSSER seismic network from 2013-2014 (After Diehl et al., 2017)

1 The widely held belief that there cannot be big earthquakes in Bhutan is not true. We now know that Bhutan was struck by a major, magnitude 8 event in May 1714, which is larger than the 2015 Nepal earthquake. This powerful event caused many causalities, destroyed a large number of houses, and caused damage even in India. Around the year 1100 there was another major earthquake, and very likely there were other big historical events.

2 The seismic activity in Bhutan over the recent years is lower than in Nepal. This does not mean this is always the case. The time period between major earthquakes is typically hundreds of years long, and the frequency of smaller earthquakes varies during that time. Therefore a few years of observations may not be representative of the entire seismic cycle. Monitoring over the past few years have shown higher seismic activity in Samtse and Mongar, and relatively low activity in Bumthang. On average, in the region of Bhutan, there is one earthquake felt per week.

3 Earthquakes occur in the Himalaya mostly due to convergence between the India plate and Tibet. This plate velocity is approximately the same in Nepal and in Bhutan. However, it seems that these two countries sit on different segments of the Himalayas. These segments are different in their topography, deep geological structure, mountain building processes and earthquake patterns.

4 This separation has also been documented by a deep fault, starting in northern Sikkim (where the 2011 earthquake occurred), crossing Samtse, and reaching the Shillong Plateau. This is the only such known fault, dissecting the Himalaya and going further south. This supports the idea that Nepal and Bhutan do not necessarily behave the same way for earthquakes and geological processes. East of this line, in Bhutan and in Arunachal Pradesh, the situation seems to be more complicated. But maybe it is only apparent because, at the moment, we know less about Bhutan than Nepal.

Continuously monitoring earthquakes in Bhutan is of primary importance, not only to better understand them, but also in the hope of building an early warning system for the region. With financial support from Japan Policy for Human Resources Development (PHRD)/World Bank project, the Earthquake and Geophysics Division of the Department of Geology and Mines has installed 6 earthquake monitoring stations at different locations in the country. Additionally, through a project supported by the Regional Integrated Multi-hazard Early Warning System (RIMES), a regional institute based in Bangkok, Thailand, further 8 stations are in various stages of completion. Once fully established, the national earthquake monitoring system is expected to enhance understanding of seismic activity and provide critical long-term information for strengthening seismic building codes. In addition, under the PHRD/World Bank project, shaking intensity meters have been installed in each of the 20 dzongkhags with the aim to provide important information such as the potential level of damage following a significant earthquake. This information is expected to enable quick and efficient response during post-earthquake emergency, as well as to facilitate appropriate damage assessment as part of "built-back-better" strategies.

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