# Testing Earthquake Nucleation Models from the Response of Himalayan Seismicity to Secular and Periodic Stress Variations

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Shortening across the Nepal Himalaya proceeds at a rate of about 2 cm/yr and is mainly absorbed by one major fault, the Main Himalayan Thrust fault (Lavé and Avouac, 2000). Geodetic measurements show that, over the last few decades, this fault has remained locked from the surface to a depth of about 15-20 km.

The background seismicity is driven by the slow motion of India into Eurasia, responsible for the interseismic stress buildup in the period separating big (M > 8) earthquakes. In addition to this secular motion, strong seasonal variations in the seismicity have been reported (Bettinelli and others, 2008), with the number of events about 30% higher in the winter. Similar seasonal variations have been observed in various contexts and related to factors such as snow load or variations of the water level.

We analyze the relationship between seismicity and temporal stress variations in the Himalaya to constrain earthquake nucleation process. In addition to the secular stress load induced by crustal shortening across the range, the Himalayan arc is also submitted to 2 periodic stress variations of comparable 3-5 kPa amplitudes but different periods: 12.4 hours period variations are induced by earth tides, while 1-year period variations are induced by surface load variations associated with the seasonal hydrological cycle (the monsoon). The seismicity shows no apparent correlation with earth tides, but does show prominent seasonal variations. These observations are used to test models of earthquake nucleation and infer frictional properties of natural faults. We find that the model of Dieterich (1994) can reproduce the correlation between seasonal variations of seismicity and hydrological cycle, but fails at explaining the absence of correlation with earth tides.

#### References

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