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Using seismograms to investigate earthquake determinism

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It is relatively simple to calculate the magnitude of an earthquake after it has happened. However, it is unclear if an earthquake 'knows' its final magnitude before rupture ends. We are interested in whether earthquakes are deterministic: whether features of the initial stages of an earthquake make accurate predictions about the earthquakes' final size.

A major piece in the puzzle of determinism was proposed around 15 years ago by Olson and Allen (2005), who found a relationship between the predominant period of the early stages of an earthquake and its final magnitude. However, the results remain controversial, partly because Olsen and Allen (2005) analysed only 71 events. Here we aim to test their prediction in a statistically robust way using many more earthquakes, from a variety of settings.

We calculate the predominant and average periods for several thousand earthquakes from around the world. Our preliminary results find a deterministic relationship, where both parameters increase with earthquake magnitude, but with a large scatter. They highlight the importance of filtering, and the parameters used to filter, as these have a significant effect on your final result. We are therefore now analysing the spectra of these earthquakes to look for patterns amongst them, and to better understand the physical basis of the predominant and average period calculations.