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Review of seismic gaps and gap model for the South American subduction zone

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The seismic gap hypothesis describes a long-period decrease of the probability of earthquake occurrence after major earthquakes, as a consequence of the induced stress shadow. The gap model assumes that the continuous build-up of tectonic strain and stress is released by characteristic major earthquakes. The size of the characteristic earthquakes is for instance controlled by structural heterogeneities or the geometry of the plate boundaries. The gap model is commonly accepted by geologists and a fundamental assumption of our approaches to estimate seismic hazard and time dependent earthquake probability. Interestingly, systematic and rigorous tests to verify the seismic gap model have often failed.

In this study we analyze the historical record of major earthquakes at the South American plate boundary with a special look to seismic gaps. The aim of our study is to compare and proof different seismic gap models. We discuss whether the characteristic earthquakes assumption is justified for the South American plate boundary. Two different gap models are discussed: (a) a traditional quasi-periodic recurrence model involving time dependent conditional occurrence probabilities, and (b) a new model describing earthquake rates by rate and state seismicity models considering the estimated spatial pattern of stress drop during major earthquakes.