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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 consider the effect of the considerable uncertainty in magnitude, epicenter, rupture location and length. Additionally, we compare a simple, statistical 1D approach of seismic gaps in characteristic segments with a modified rate and state gap model which considers the along strike variability of rupture segments. Our results indicate that recurrence times of major earthquakes in South America are rather random and not quasi periodic. Our modeling shows that catalog uncertainties lead to apparent finite values of the probability density function (pdf) for small fractions of the earthquake recurrence times, and additionally to shifts of the peak of the pdf.