Confronting integrated fault activity with recent seismicity in metropolitan France. Any consistency?

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Abstract

Earthquake rupture forecasts models, as UCERF-3 in California (Field et al., 2013), and more
generally physically based hazard approaches are among the latest evolutions to assess seismic hazard in active tectonic regions. The most advanced of these models require a good knowledge of the active fault segment geometry as well as well resolved geodetic measurements in order to estimate the faults behavior at depth and the slip deficit they accumulate. Similar approaches are out of reach in metropolitan France where active faults are cryptic and the seismic slip deficits at depth remain unresolved by geodesy, given the slow deformation rates involved. In such intraplate environments, the faults behavior is often limited to a single neotectonic slip rate integrated on the Holocene, quaternary or Plio-quaternary derived from rare neotectonic and paleoseismological offsets. It is one of the main reasons why very little attention has been paid at testing how the French seismicity compares to the predictions of tectonic models.
In this work, focused on South-Eastern France, we confront the potentially active faults database (France BDFA; Jomard et al. 2017) with a recently published catalog of the historical and instrumental seismicity (FCAT-17, Manchuel et al. 2017). The biases associated
to the seismicity rate determined from the catalogue are corrected after estimating the year of completeness for each magnitude bins allowing to determine a Gutenberg Richter distribution tied over a large magnitude range. The seismicity rates are then compared to the prediction of several tectonic models.
We point out a substantial difference between the prediction of the models and the seismicity catalogue. Indeed, the rates of earthquake predicted by the tectonic models appear six times higher than the observations.
Such a difference could be explained by an overestimation of the seismogenic potential of the faults or by different average seismicity rates at historical and quaternary time scales. This variation, if genuine, could be implied by clustered seismicity due to tectonic or non-tectonic external modulation of large earthquakes occurrence during Quaternary.

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