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Repeating aftershocks of the 2016 Mw 7.8 Pedernales (Ecuador) earthquake highlight interactions between afterslip and seismicity

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Repeating earthquakes represent recurrent slip on a single, time-invariant fault patch. Often found in creeping faults, these earthquakes are commonly interpreted as resulting from rupturing asperities that are constantly loaded by surrounding aseismic slip. As such, their study can shed a light on frictional fault mechanics, with implications for earthquake triggering, loading rates and predictability.

In this study we use data recorded by permanent and temporary seismological networks in Ecuador to detect and analyze the occurrence of repeating events during the 1-year period following the April 2016 Mw 7.8 Pedernales megathrust earthquake, offshore Ecuador. We focus on a small area north of the mainshock containing about 900 catalogued events, where previous studies have brought to light the close relationship between seismic and aseismic slip processes, observed both during the inter-seismic and the post-seismic periods.

We first calculate waveform cross-correlation coefficients (CC) for events extracted from a published catalogue of aftershocks. Using a minimum CC of 0.9 between family members, we obtained 84 families of two or more events. From these events we produced stacked templates for all families, which we used to scan the continuous waveform records using a template-matching code in order to look for similar uncatalogued events.

A total of 321 aftershocks were classified into families during one year of the post-seismic period. The repeating earthquakes are mostly concentrated in a cluster spatially related to afterslip release. Furthermore, we observe an increase in the recurrence time of repeating events with time after the mainshock for some of the families. Our preliminary results suggest that post-seismic slip in the area is dominated by slow slip on the megathrust, which induces repeated rupture in persistent fault patches. The presence of repeating earthquakes beyond the first month after the mainshock further suggests that the afterslip migrates from the early postseismic areas, while the increase in repeating earthquakes' recurrence times with time highlights a possible timeframe for the afterslip's deceleration. Our next steps consider extending the search for repeating earthquakes to the southern area and back in time during the inter-seismic period.