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2.5 years of spatio-temporal postseismic deformation from GPS following the 2016 Mw 7.8 Pedernales earthquake

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In subduction zones, slip along the plate interface occurs in various modes including earthquakes, steady slip, and transient accelerated aseismic slip during either Slow Slip Event (SSE) or afterslip. We analyze continuous GPS measurements along the central Ecuador subduction segment to illuminate how the different slip modes are organized in space and time in the area of the 2016 Mw 7.8 Pedernales earthquake. The early post-seismic period (1 month after the earthquake) shows large and rapid afterslip developing at discrete areas of the megathrust and a SSE Mw 6.8 remotely triggered (about 100 km) south of the rupture of the Pedernales earthquake. We find that areas of large and rapid early afterslip correlate with areas of the subduction interface that had hosted SSEs during the years prior to the 2016 earthquake. Regardless of whether they were locked or not before the earthquake, these areas appear to persistently release stress by aseismic slip throughout the earthquake cycle. The areas hosting regular SSEs and large afterslip had a dominant aseismic slip mode that persisted throughout the earthquake cycle during several years and decades: they regularly experienced SSEs during the interseismic phase, they did not rupture during the 2016 Pedernales earthquake, and they had large aseismic slip after it. Two of these areas further appear to have acted as a barrier to the seismic rupture propagation during the Pedernales earthquake. We investigate the spatio-temporal evolution of afterslip in the 2.5 years following the Pedernales earthquake. The cumulative moment released by the afterslip is equivalent to Mw 7.8 and thus is as much as the moment seismically released by the Pedernales earthquake. Therefore aseismic slip, SSE and afterslip, has a strong impact on the slip budget at the Ecuadorian subduction interface.