Afterslip and slow slip events in the postseismic deformation of the 2016 Pedernales earthquake, Ecuador

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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 Events (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 zone 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 slow slip event remotely triggered (≈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 in years prior to the 2016 earthquake. Areas along the Ecuadorian margin 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, they had large aseismic slip after it. Four years after the Pedernales earthquake, postseismic deformation is still on-going. Afterslip and SSEs are both involved in the postseismic deformation. Two large aftershocks (Mw 6.7 & 6.8) occurred after the first month of postseismic deformation in May 18, and later in July 7 2016 two other large aftershocks (Mw 5.9 & 6.3) occurred, all were located north east of the rupture. They may have triggered their own postseismic deformation. Several seismic swarms were identified south and north of the rupture area by a dense network of seismic stations installed during one year after the Pedernales earthquakes, suggesting the occurrence of SSEs. Geodetically, several SSEs were detected during the postseismic deformation either in areas where no SSEs were detected previously, or in areas where regular seismic swarms and repeating earthquakes were identified. The SSEs may have been triggered by the stress increment due to aftershocks or due to afterslip.