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Observing seismic signatures of slow slip events with unsupervised learning

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Slow slip events are observed in geodetic data, and are occasionally associated with seismic signatures such as slow earthquakes (low-frequency earthquakes, tectonic tremors). In particular, it was shown that swarms of slow earthquake can correlate with slow slip events occurrence, and allowed to reveal the intermittent behavior of several slow slip events. This observation was possible thanks to detailed analysis of slow earthquakes catalogs and continuous geodetic data, but in every case, was limited to particular classes of seismic signatures. In the present study, we propose to infer the classes of seismic signals that best correlate with the observed geodetic data, including the slow slip event. We use a scattering network (a neural network with wavelet filters) in order to find meaningful signal features, and apply a hierarchical clustering algorithm in order to infer classes of seismic signal. We then apply a regression algorithm in order to predict the geodetic data, including slow slip events, from the occurrence of inferred seismic classes. This allow to (1) identify seismic signatures associated with the slow slip events as well as (2) infer the the contribution of each classes to the overall displacement observed in the geodetic data. We illustrate our strategy by revisiting the slow-slip event of 2006 that occurred beneath Guerrero, Mexico.