On seismic clusters, swarms and repeating earthquakes in Central Chile.

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Along the Chilean subduction segment, the seismicity tends to display characteristics of mainshock-aftershocks sequences. However, besides large and destructive earthquakes, central Chile has also been characterized by the occurrence of localized seismicity clusters with weak to moderate magnitudes, appearing either in form of repeated short-duration swarms or in form of sustained long-lasting activity. Seismic swarms were observed prior to large earthquakes and were hypothesized as possible precursors, although they did not always develop into major earthquakes. The origin and driving processes of this localized seismic activity have not yet been identified. Here, we characterize the seismicity at two seismic clusters in Central Chile, by analyzing hypocentral locations, spatio-temporal migration, magnitude, and inter-event time distributions and moment tensors. Both clusters are characterized by weak to moderate seismicity and manifest as clear seismicity rate and Benioff strain anomalies. We discuss these seismic clusters over a period of 18 years (2000-2017) and investigate their interactions with the Maule earthquake. We find repeating thrust earthquakes on the slab interface at one cluster beneath Vichuquén slipping at a rate comparable to the tectonically accumulated one. At the offshore Navidad cluster, the seismicity occurs in forms of swarms, with the largest episodes in 2001, 2002, 2004, 2012, 2014, 2016 and 2017 showing some rough temporal recurrence. Moment tensor indicates the occurrence of similar thrust mechanisms along a west-dipping structure across the subducting plate. Clusters persist before and after the Maule earthquake. However, at the Vichuquén cluster, the increased seismicity rate following the Maule earthquake remains to date higher than the background rate and the system is still far from recovery.
