Aftershock signature of the M7.5 Palu 2018 supershear rupture from a rapidly deployed nodal array

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Supershear earthquakes have significant implications for seismic hazard, in terms of ground shaking and aftershock pattern. It has been suggested that supershear ruptures are associated with fewer aftershocks on the supershear rupture segment, however this needs to be tested using high resolution event locations. Current aftershock catalogues for the M7.5 Palu 2018 supershear rupture are not of sufficient resolution to identify any characteristic aftershock pattern. Additionally it is unclear whether the supershear rupture speed occurred from the time of earthquake initiation, or at a later time on a certain segment of the fault.

We deployed a nodal array to record aftershocks following the main event. The array comprised of twenty short-period nodes, which can be deployed rapidly, making them ideal for post-rupture investigations in areas of sparse coverage. We expand the earthquake catalogue by applying template matching to the nodal array data. We then relocate seismicity recorded by the array using a double difference method. We also relocate seismicity that occurred before the array was active, using a relative relocation method. To do this, we calibrate the more distant permanent stations using events well-located by the nodal array. We further derive moment tensors for the largest events by waveform modelling using short-period and broadband records.

Our results show that the aftershocks cluster at the northern and southern extents of rupture. There is a relative dearth of aftershocks in the middle part of the rupture, particularly in the Palu valley, where rupture terminated to the surface. The fault here is a long and straight distinctive geomorphic feature. Many secondary faults were triggered, particularly in the southern Sapu valley fault system. An earthquake swarm was triggered 1 month after the main event on a strike-slip fault 200km away.