E3 DTP ORVCF report – Roseanne Clement

With the help of the E3 DTP ORVCF, I was able to attend the American Geophysical Union's Centennial Fall Meeting in Washington, D.C., USA in December 2018. This is the largest earth and space meeting in the world, and so it was incredibly useful for me to network with those in my research area as well as talk about my research with them. I presented a poster and received a tremendous amount of feedback which I will work into my last few months of the PhD. My abstract and conference logo is seen below, as well as a picture of me with my poster.

Small Signals from Big Data: Using Repeating Earthquakes to Explore Pre-Earthquake Mainshock Rupture Processes

Numerous catastrophic failure events, e.g. large earthquakes, landslides and volcanic eruptions, occur after multiple sets of smaller repeating earthquakes (also known as multiplets). Such events also occur when no larger event follows. Nevertheless, they have the potential to reveal underlying processes such as the nucleation of large events, or stable repeated slip, and hence could improve probabilistic forecasts of the likelihood of catastrophic events. The problem with finding these repeating earthquakes is that they are often small, hidden within the ambient noise, and sometimes only picked up by one seismometer.

We have developed an optimised algorithm to extract a catalogue of repeating earthquakes and determine their temporal evolution in different seismic signals. By enhancing the short-time-average/long-time-average (STA/LTA) approach for finding events with a moving cross-correlation window, we discover new events automatically. Subsequent temporal tracking of these events then allows us to resolve the processes taking place, allowing us to determine their interaction to the mainshock as foreshocks, aftershocks or independent processes.

The algorithm's success in finding events is evaluated statistically with hits, false alarms and misses, like clinical trials. Our method works significantly more successfully than the conventional STA/LTA approach on its own, with more hits and more accurate pick times in different catastrophic failure settings.

We demonstrate the success of our algorithm in real cases of past earthquake sequences and other catastrophic failure type events. From this, we can identify large earthquakes which have had (or not had) nucleating foreshocks in the form of repeating earthquakes, aiding to our understanding of the pre-earthquake mainshock rupture processes.