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Optimal time windows length to study frequency content of a record after a big earthquake: case study of KHZ (Geonet network)

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After a big earthquake, signal-to-noise ratio (SNR) for majority of smaller events is inappropriate. However, once we study frequency-dependent SNR, the opportunity to observe high-frequency content of aftershock series rises. During the week of 2016 November 13–20, more than 400 earthquakes of M4+ has been recorded within radius of 2 degrees [ISC, 2018] by the KHZ accelerometer, of Geonet network [Petersen et al., 2011]. The median interval between origin times is 7 min 51 sec, and about 18% of earthquake recordings intersects.
We applied a new procedure of SNR determined considering a big pre-event. At the next step, spectra of those aftershocks which are recoverable at some frequencies, can be studied.
To estimate SNR variations during a week, at first, time windows of 60 and 30 min were used (with 50% overlap, band filtering and hanning window were applied). Then, we used several time windows lengths, of 60, 50, 40, 30, 20, and 10 sec, considering the resolution of the Fourier amplitude spectrum and number of wavelengths of 1–0.05 s period in it [Perron et al., 2018]. And two versions of estimating noise level were implied. The first one is a classical approach (noise spectrum of the same length right before the S-wave group, and ratio of 3 is a minimum considered) what removes about 25% of aftershocks out of study. The second approach is normalizing noise level on an averaged one within longer periods, such as 24 and 12 hours, 60 and 30 mins. While averaging the group of max values corresponding to the biggest events were excluded. Using a set of ratios, the decision about appropriateness of SNR was taken.
Thus, using of normalized noise spectra allowed recovering of bigger portion of higher frequencies for about 10% of earthquakes, recorded by KHZ (one of the closest stations to the epicenters), during the week of 2016 November 13–20.
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