Analog Processing Activity

This activity will guide you through the process of manually locating an earthquake and estimating its magnitude. After completing this process, you will have a greater appreciation for digital seismology.

This activity is to be done in groups. First, start by writing all the names of your group at the top of this sheet. Next, look at the station map. You are provided recordings from each station for an earthquake which occurred somewhere on the map.

Using the blue waveforms and the horizontal axis, estimate the P and S arrival times. Draw a vertical line for your chosen pick and write the time in seconds at the top of each plot. Then write the S – P time above those numbers.

Next, using the orange waveforms which have a simulated Wood Anderson response, estimate the peak-to-peak amplitude on the horizontal channels using the labeled vertical axis also write the amplitude estimates at the top of the paper.

To estimate the distance the event occurred from each station, use the following relationship:

$$d = \frac{(t_s - t_p)v_s}{1 - \left(\frac{v_s}{v_p}\right)}$$

Where d is the distance, t_s and t_p are the S and P pick times, v_s and v_p are the S and P velocities. For this exercise, assume $v_s = 3.0\ \frac{km}{s}$ and $v_p = 5.2\ \frac{km}{s}$. Write the estimated distance on each of the waveform sheets. Then estimate the local magnitude using the approach by Hutton and Boore, 1987:

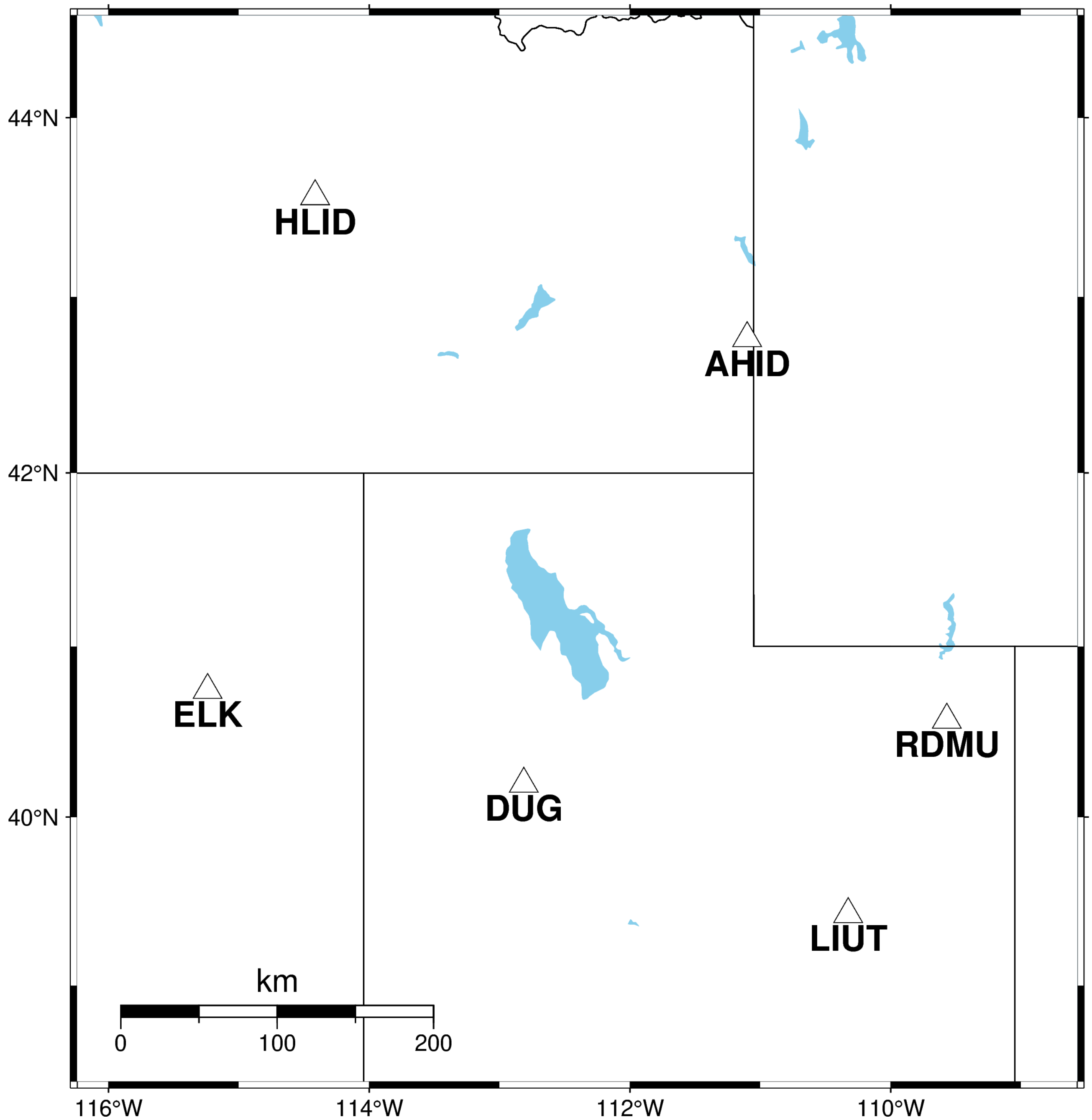
$$M_L = a\ \log_{10}(amp) + b\ \log_{10}\left(\frac{dist}{10}\right) + c\,(dist - 100) + d$$

Where amp is the average amplitude of the horizontal channels of the Wood Anderson seismograms (orange) and $dist$ is the source-station distance in km. The constants take the following form for Southern California, which we will assume is close enough:

$$a = 1;\ b = 1.1;\ c = 0.00189;\ d = 3\ (\mathbf{use\ 4\ instead})$$

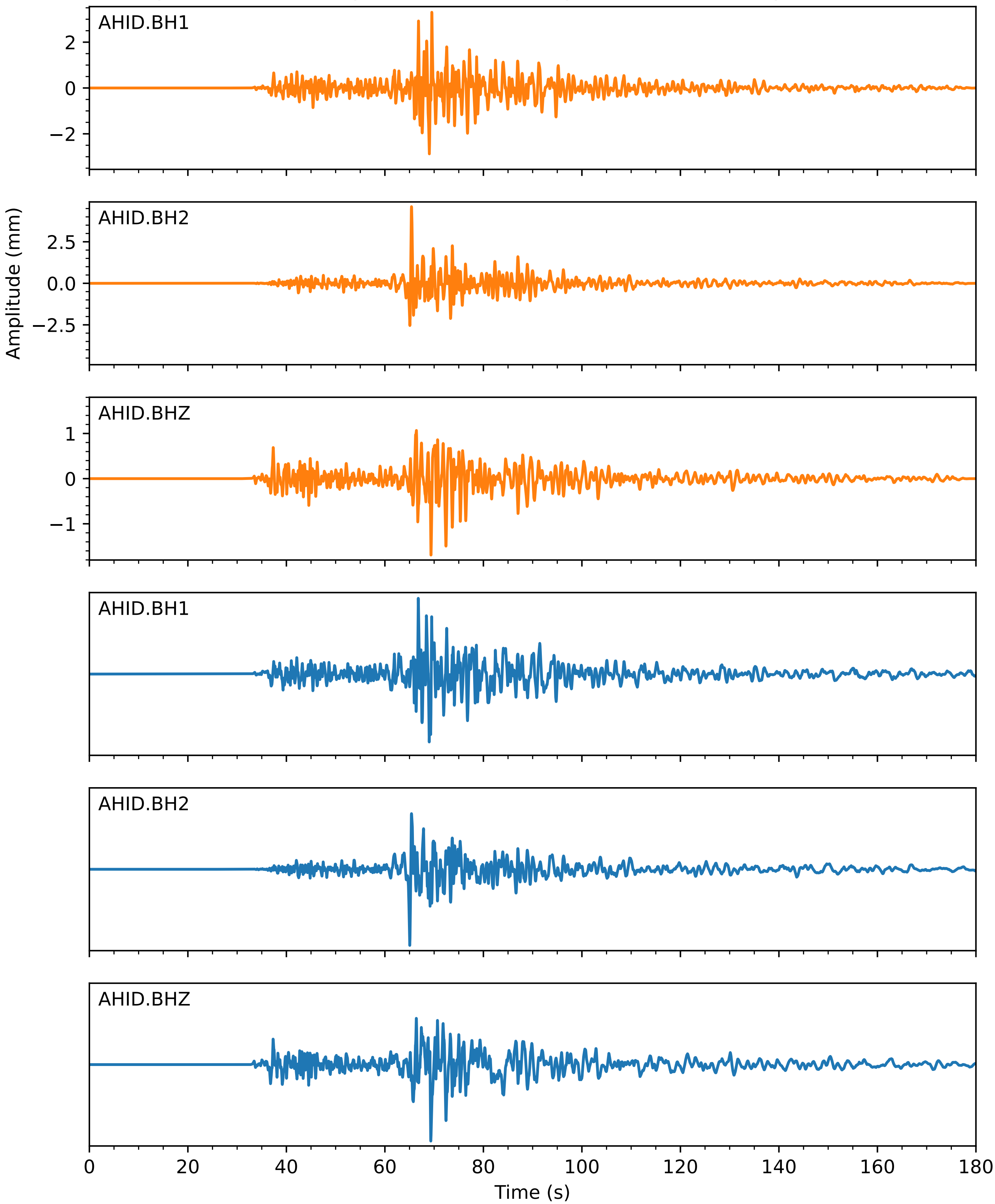
Next, use the distance scalebar and your compass to draw circles around each station with a radius equal to the estimated distance. In a noise-free 2D homogenous world these circles would intersect at the event hypocenter, but the real world is messier. Simply try to find closest place to their intersection and mark it with an X on the map. Then use the labeled latitude and longitude axis to estimate the location of the hypocenter and write it at the top of the map. Also, write the average of the station magnitudes at the top of the map.

Latitude: Longitude: ML:



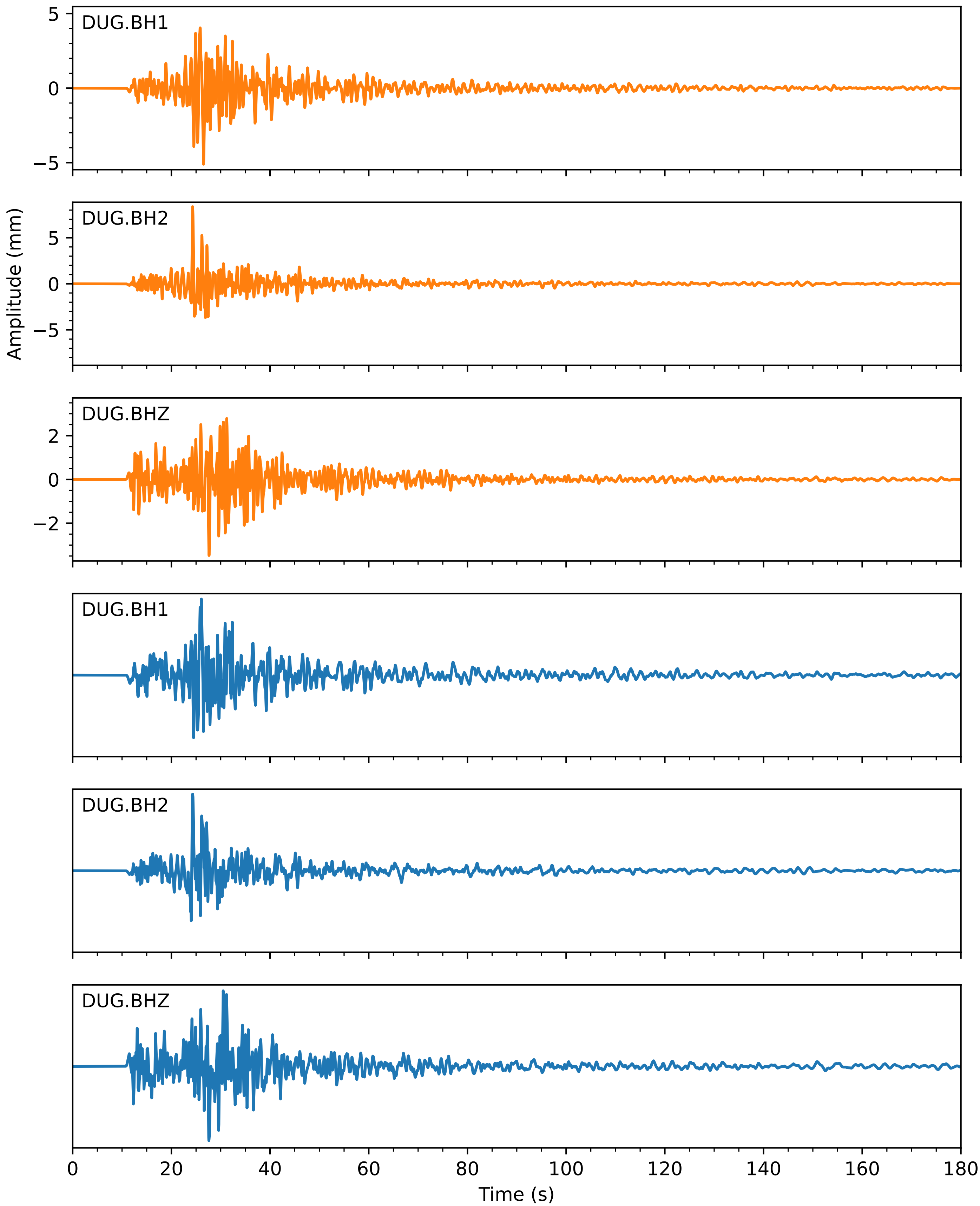
S-P time: Distance: ML:

P pick: S pick: Amp 1: Amp2:



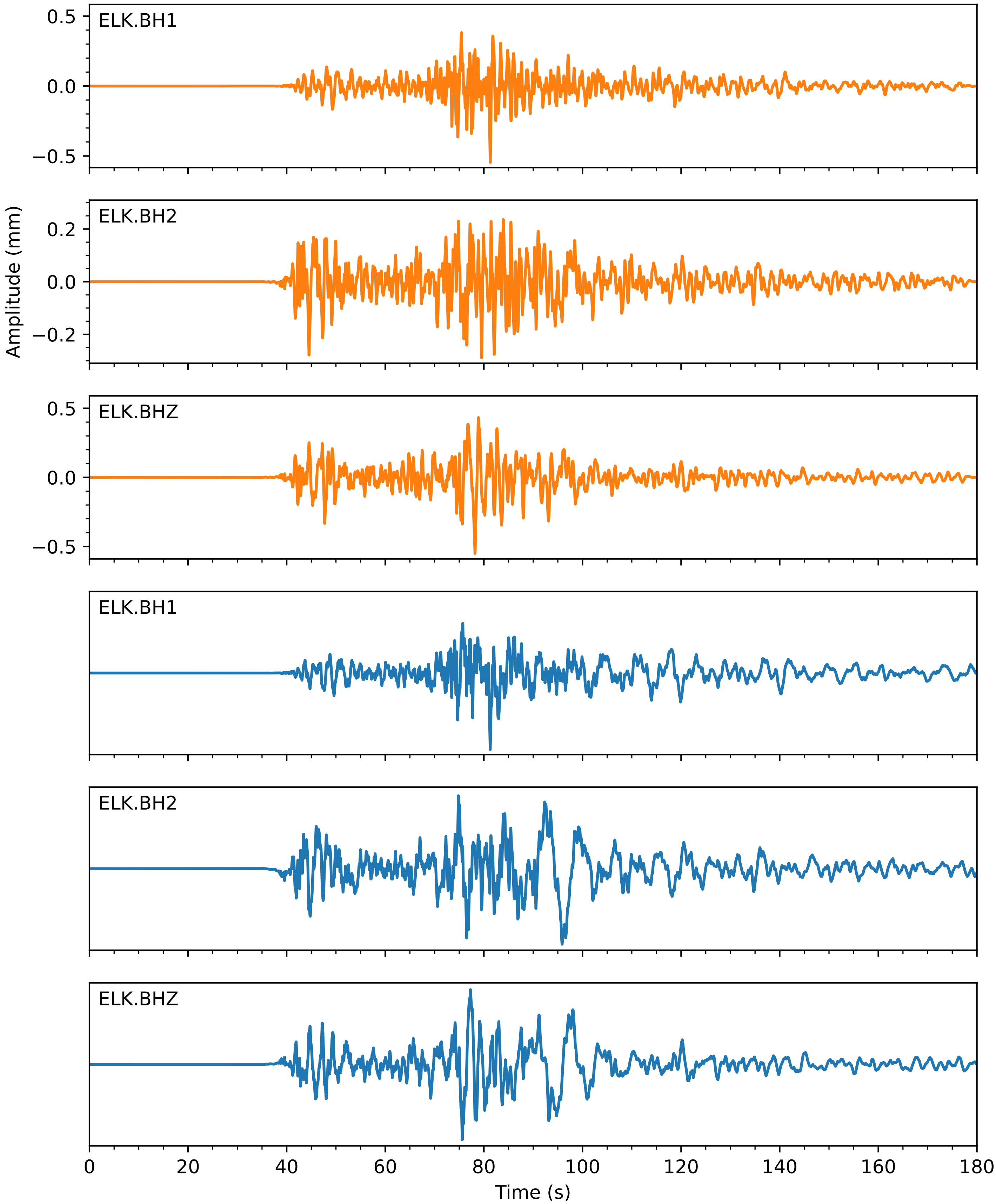
S-P time: Distance: ML:

P pick: S pick: Amp 1: Amp2:



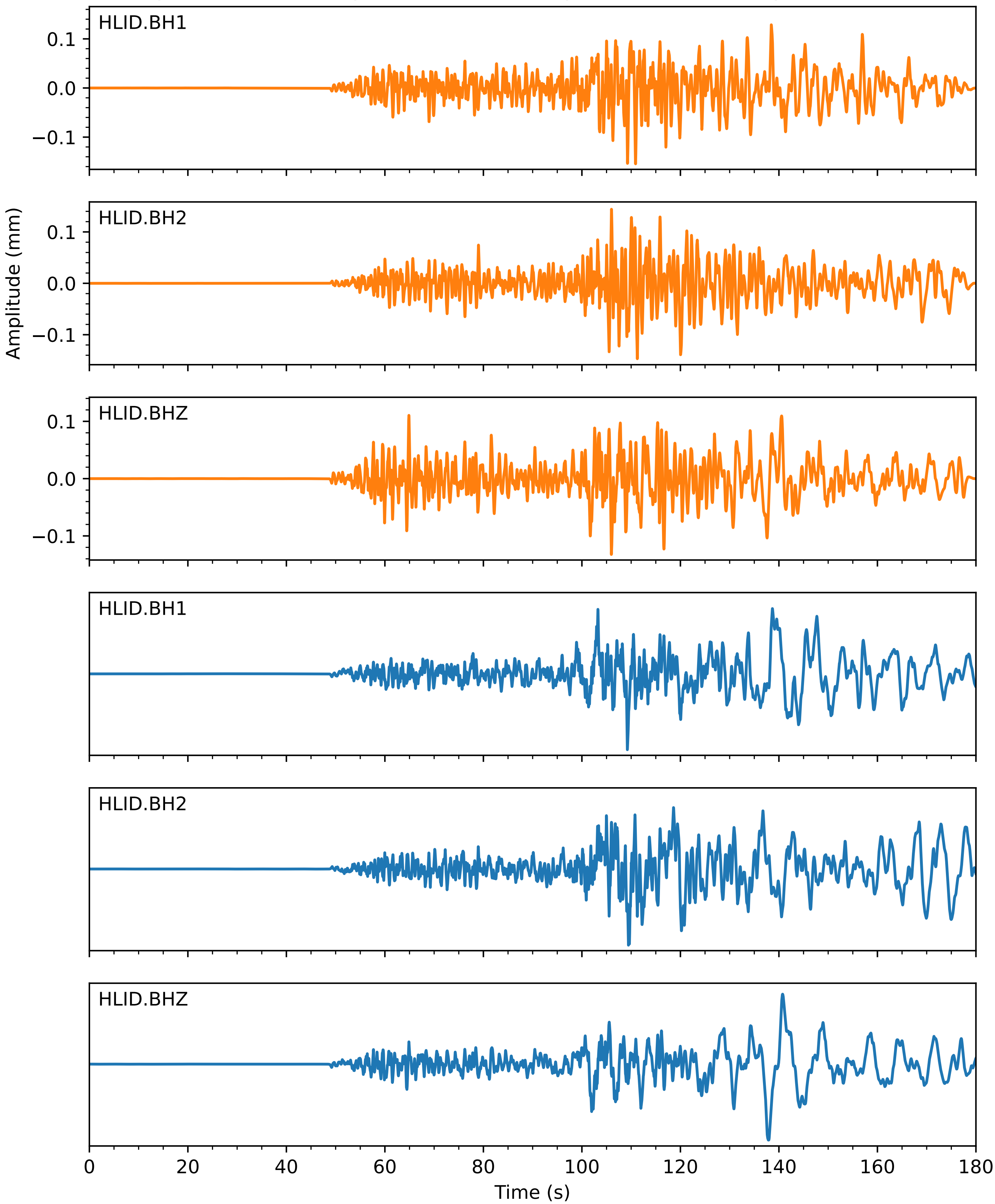
S-P time: Distance: ML:

P pick: S pick: Amp 1: Amp2:



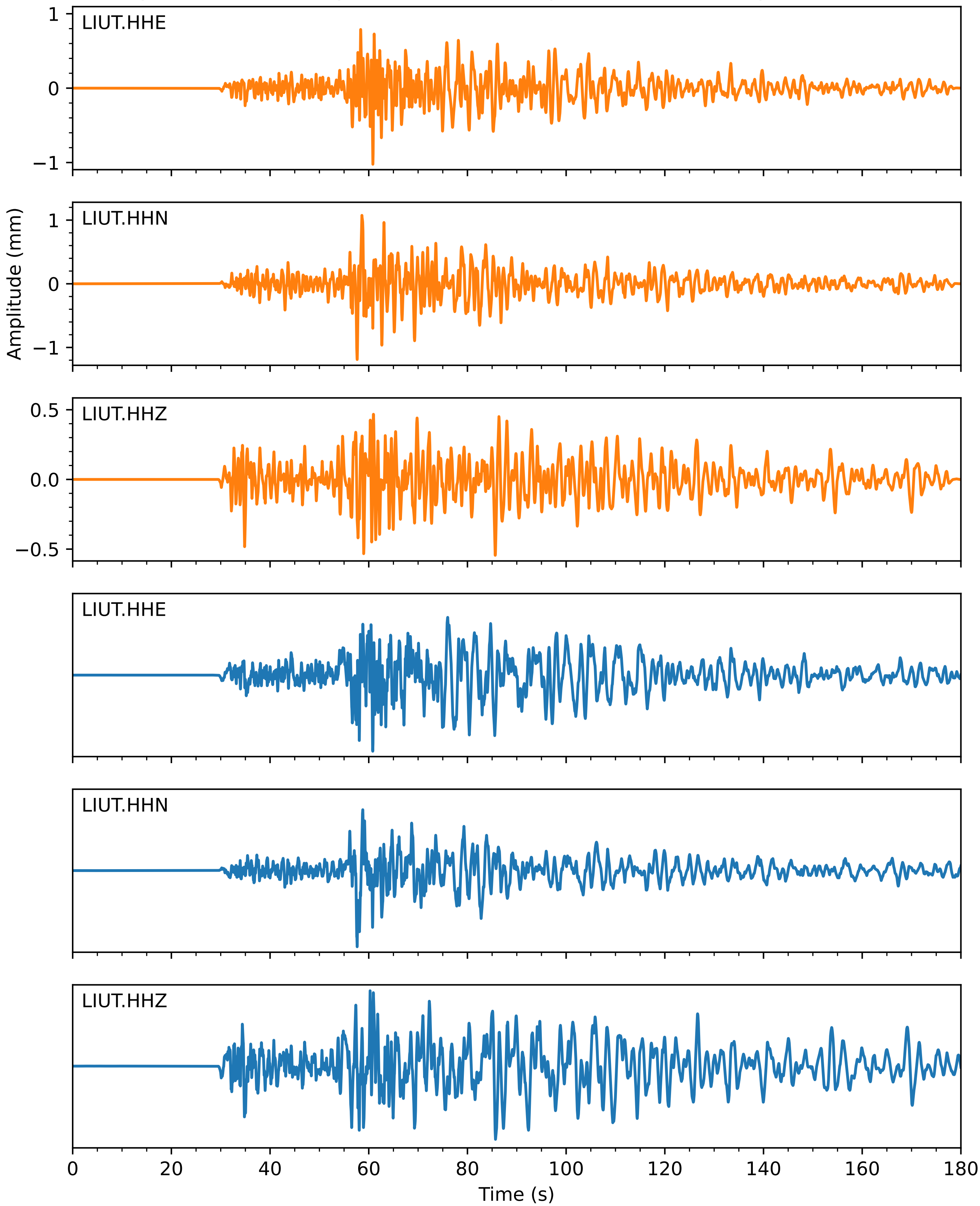
S-P time: Distance: ML:

P pick: S pick: Amp 1: Amp2:



S-P time: Distance: ML:

P pick: S pick: Amp 1: Amp2:



S-P time: Distance: ML:

P pick: S pick: Amp 1: Amp2: