SEISMIC NETWORK PERFORMANCE ANALYSIS:

MAGNITUDE DETECTION THRESHOLD AND SPATIAL LOCATION ACCURACY

Specialized software is used to compute, for a given station geometry and noise level at each station, contours of the minimum detectable moment magnitude event and contours of the errors in spatial coordinates of these events. The ray tracing is performed in a 1-D model of constant velocity layers. These contours of equal-value parameters are represented as maps. For example, for a hypothetical distribution of stations in the corners and center of an equilateral triangle, with all stations experiencing the same noise levels of 0.1 micron/s, the map with the minimum detectable moment magnitude event at 1 km depth is presented in Figures 1 and 2.

For the same hypocenter depths of 1 km, with P-wave arrivals reading errors of 0.02 s and S-wave arrivals reading errors of 0.04 s, the maps with the vertical and total horizontal location error at 95% confidence level are presented in Figures 3 and 4, respectively.

By changing the number and the relative position of the stations and/or their noise levels, new maps can be generated and used for:

- the final and successful design of a new seismic network
- optimizing station locations when adding more stations to an existing network
- presenting a quantitative estimate of what size events could be expected to be detected at which parts of a network
- presenting a quantitative measure of the errors of hypocenter locations across the network
- producing 3-D contour maps of the minimum detectable event and location errors.
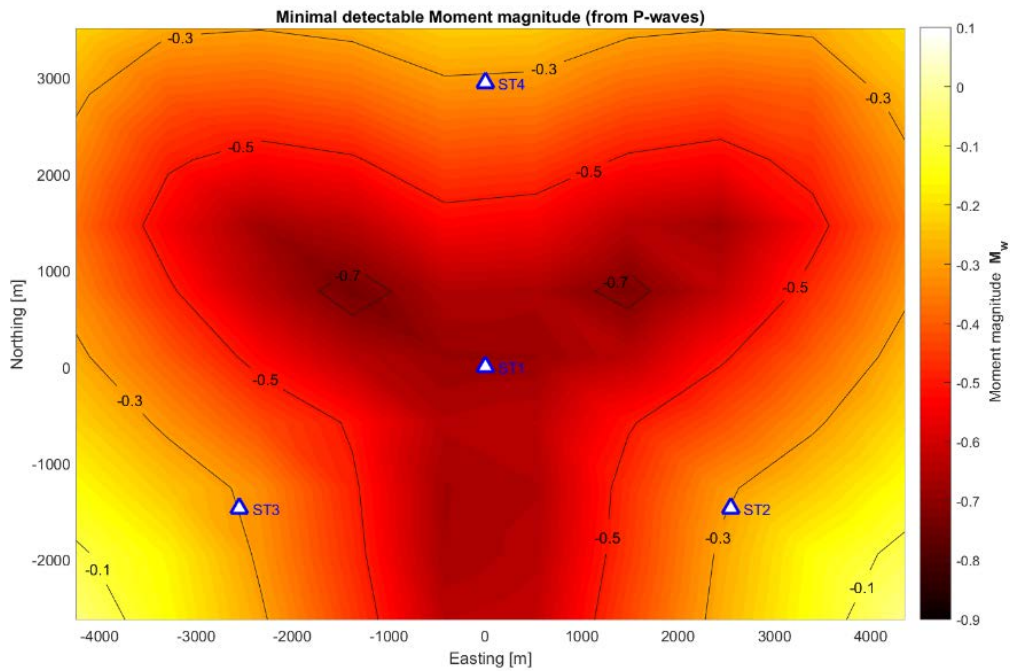
Figure 1. Minimum detectable moment magnitude event at 1 km depth (from P-waves only).
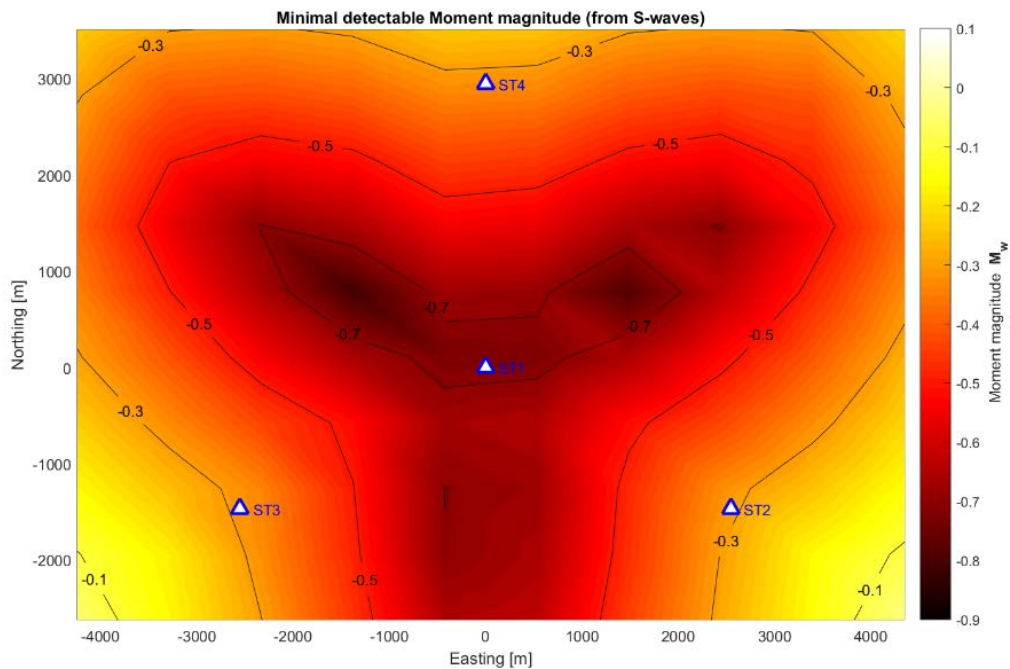

Figure 2. Minimum detectable moment magnitude event at 1 km depth (from SP-waves only). Note that the minimum magnitude of -0.7 occupies a larger area because the energy radiated as S-waves is higher.
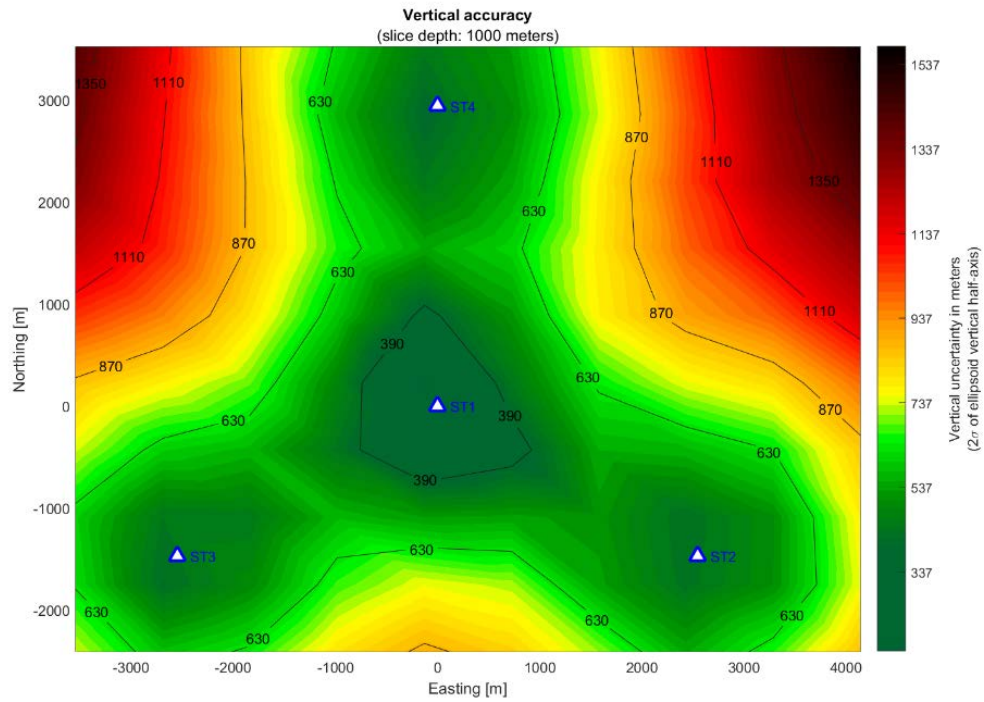
Figure 3. Distribution of vertical error (in meters) in the location of events at 1 km depth, at 95% confidence level.
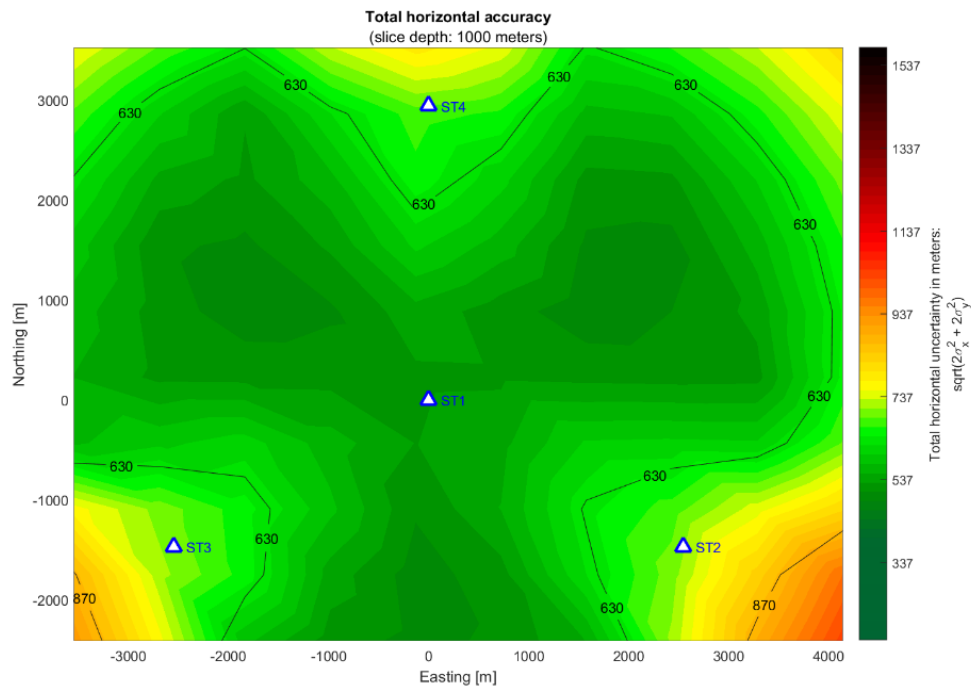

Figure 4. Distribution of total horizontal error (in meters) in the location of events at 1 km depth, at 95% confidence level.