P-wave tomographic model from local bulletin data for improved seismic location in and around Israel

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For the past 40 years, the Geophysical Institute of Israel has been in charge of the recording, monitoring and relocating of local earthquakes. Due to the variety of data analysts and data sources, as well as several network upgrades, the resulting bulletin data has to be completed and homogenised, and station metadata needs to be tracked down, and sometimes corrected. For those reasons, as well as because of the lack of consensus on an accurate model for seismic velocities in the area, published source locations are often poorly constrained. We present a homogenised Israeli bulletin, including natural and man-made explosion data. We extract sets of seismic sources with location accuracy greater than 5 km (GT5), as well as GT0 explosions. We select a set of events with the highest network coverage, comprising (1) natural earthquakes, (2) man-made quarry or mine blasts, (3) GT5 earthquakes or explosions, and (4) GT0 explosions. We relocate them altogether using the BayesLoc package, a Bayesian, hierarchical, multi-event locator which produces, after source relocation, event-, station- and phase-specific correction terms. We put different a priori constraints on the different categories of seismic events, allowing poorly constrained origin parameters to improve thanks to the more accurate GT locations. BayesLoc also produces traveltime correction terms that can be used to correct systematic errors in the dataset, as well as error estimates.

Eventually, we invert this homogenised local traveltime dataset in order to invert for a P-wave crustal velocity model of Israel and its surroundings. To do so, we use the Fast Marching Tomography package, which allows the representation of a wide variety of input structures (starting model and geometry of layer boundaries) and can take many different types of input data. We show preliminary inversion tests and results that are in good agreement with past local studies.

This crustal model of Israel is ultimately to be used as a starting model in a larger tomographic study of the Eastern Mediterranean and Middle East region, where the Regional Seismic Travel Time approach is to be expanded, in order to improve the CTBT’s capabilities in monitoring the regional seismicity. Eventually, such a velocity model could also be used to relocate the whole earthquake catalogue more accurately, and improve the Earthquake Early Warning System currently in development in Israel.