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Finite-frequency effects for imaging underground cavities

Felix M. Schneider[1,2], Petr Kolínský[2], and Götz Bokelmann[2]
[1]Helmholtz Center Potsdam, Seismology, Potsdam, Germany (felix.schneider@gfz-potsdam.de)
[2]Department of Meteorology and Geophysics, University of Vienna, Vienna, Austria

We study finite-frequency effects that arise in cavity detection. The task comes along with the Onsite-Inspection part for the Comprehensive Nuclear Test Ban Treaty (CTBT), where the remnants of a potential nuclear test need to be identified. In such nuclear tests, there is preexisting knowledge about the depths at which nuclear tests may take place, and also about sizes that such cavities can attain. The task of cavity detection has consistently been a difficult one in the past, which is surprising, since a cavity represents one of the strongest seismic anomalies one can ever have in the subsurface. A conclusion of this study is that considering finite-frequency effects are rather promising for cavity detection, and that it is worthwhile to take them into account. We utilize an analytical approach for the forward problem of the a seismic wave interacting with a underground cavity in order to develop an inversion routine that finds and detects an underground cavity utilizing the transmitted wave-field.