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Estimating seismic source depths using body and surface wave observations

The ability to confidently estimate the depths of small-to-medium sized (mb < 5) seismic disturbances is important when monitoring compliance with the CTBT. Source depths can be determined by identification of teleseismic depth phases pP and sP, and by modelling surface-wave amplitude spectra. The radiation pattern of pP and fundamental-mode Rayleigh amplitudes show the effectiveness of these methods for earthquake depth estimation depends on the orientation of the focal mechanism, local source structure, and recording station locations. For some focal mechanisms, predicted amplitudes of pP will only be large for stations in certain locations, and Rayleigh wave spectral nulls that tightly constrain the depth often only occur for a limited range of azimuths. We show that for sources where Rayleigh wave spectral nulls are not observed and the source depth cannot therefore be well constrained, the focal mechanism obtained can be used to predict the locations of stations where pP should have a large amplitude, and hence has the potential for positive identification by analysts. These stations could be IMS seismic stations, and/or open seismometer stations in other networks. These estimated source depths can also be used in a joint inversion of body and surface-wave data for the focal mechanism.

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