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Joint Regional Waveform, First Motion Polarity, and Surface Displacement Inversion Using a Layered Elastic Model with Topography for the People's Democratic Republic of Korea Nuclear Explosions

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On 7 September 2017, the Democratic People's Republic Korea carried out its latest and largest nuclear test (DPRK6). Recent efforts have been made to increase understanding of this and previous nuclear tests using seismic waveform, and synthetic aperture radar (SAR) geodetic deformation data (e.g. Wei 2017, Chiang et al. 2018, Myers et al. 2018, Wang et al. 2018). In our previous work (Chi-Durán et al. 2021) we performed a joint regional waveform, first-motion polarity, and surface displacement inversion demonstrating improved discrimination of the source type of the event. In this work, we have applied the aforementioned joint inversion with a layered velocity model based on satellite observations of discontinuities and inferred lithology (e.g. Pabian and Coblentz, 2015) and published ranges of seismic velocity for the inferred lithology to DPRK6 and an earlier event (DPRK4, 2016/01). We find that the consideration of the layered velocity model improves the recovery of source depth, and in both cases the joint inversion is found to provide better discrimination of the source type and better constrain the scalar seismic moment needed for downstream yield estimation.

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Promotional text

We performed a joint seismic waveform, first-motion polarity, and geodetic ground deformation for two different North Korean nuclear tests. We improve discrimination of these events as explosions and reduce the uncertainty in their location, scalar moment and estimated yield.

Oral preference format

in-person

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