

Moment Tensor and Source Characteristics of Nuclear Explosions at the Lop Nor Test Site, China

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We investigate historical nuclear tests from the Lop Nor region, China, using waveform-based source inversions and three-dimensional waveform modeling. Despite sparse data distributions and low signal-to-noise ratios, we recover isotropic moment tensor solutions for historical explosions and obtain detailed uncertainty information from likelihood evaluations over magnitude, depth, and the entire space of moment tensor source type and orientation parameters. We identify a one-dimensional (1-D) Western China Earth model that provides improved waveform fits, reduced cycle skipping, and drastically improved uncertainty estimates compared with spherical-average Earth models. Preliminary 3-D forward modelling results show yet further promise for improving source constraints. By exploring the entire source parameter space, we account for tradeoffs that become important for the determination of source type, depth of burial, and yield in sparse monitoring scenarios. Subsequent likelihood-based uncertainty analysis shows the importance of accounting for differences in data variance between body waves, Rayleigh waves, and Love waves and allows for straightforward data fusion between waveform, travel time, and polarity measurements.

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Promotional text

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Oral preference format

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