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Title: Revisiting seismic magnitudes of Soviet UNEs to investigate the mb-MS discriminant.

Abstract

Seismic magnitudes remain the main measurements from which the yield of an underground nuclear explosion (UNE) can be estimated remotely. Observed differences between the magnitude measured from short-period body waves (m_b) and that from long-period surface waves (M_S), calculated for the same event, are also key data for the discrimination of explosive sources from regular earthquakes. Recent work that compares the yield information for USSR UNEs announced by the Russian Federation with those that can be calculated using revised and homogenized body-wave magnitudes (m_b) of Peacock et al. (2017) strongly indicate that m_b is a good predictor of explosive yield. However, the surface-wave magnitude M_S displays a large scatter for a given m_b , indicating a more complex relationship to yield. In recent work, we used data from a subset of UNEs at the Semipalatinsk Test Site to show that the scaled depth of burial modulates the excitation of long-period surface waves in a predictable way that explains part of the scatter.

Here, we collect and analyze the available magnitude and depth-of-burial information for all USSR UNEs to search for correlations and physical explanations for the scatter in m_b - M_S . We have compiled data from 437 UNEs in the FSU, and have found 115 explosions for which m_b , M_S , and depth of burial are all reported in the literature. Using m_b to estimate explosive yield, we calculate the scaled depth of burial. We observe a weak trend in agreement with our earlier findings, consistent with the general notion that, in terms of the m_b - M_S difference, a UNE looks more like an earthquake when the scaled depth of burial is large. However, this potential correlation explains only a small fraction of the observed m_b - M_S scatter.

Our work is pertinent to an understanding of the m_b - M_S discriminant and its potential limitations.