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Simulations & Predictions of the Source Physics Experiments SPE Phase III (RVDC): Impact on explosion monitoring & discrimination

The Source Physics Experiments (SPE) are a series of controlled chemical explosions at the Nevada National Security Site to gather observations to verify and validate explosions' physics-based numerical models and understand the genesis of shear waves to improve nuclear discrimination and monitoring capabilities. Executed between 2011 and 2016, Phase I encompassed six collocated chemical explosions executed in the hard granite with different yields at different depths. Phase II included four chemical explosions and was executed in 2018 & 2019 in soft dry alluvium geology. Phase III includes two chemical explosions in a dolomite geology and co-located with a 1997 earthquake. LLNL has developed a numerical framework to simulate from source-to-receivers the waves generated from the non-linear explosion source-region to linear-elastic distances. We will present SPE Phases I & II observed data with comparison to predictions and emphasize the main mechanisms of generating shear motions in granite and alluvium. For SPE III we expanded the capability to include fault activation and more non-linear source mechanisms to be able to predict the radiation patterns of the near field. Moreover, we developed schemes of uncertainty propagation of the geological characterization and geophysical parameters. We present impacts of those uncertainties on enhancing source discrimination.

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