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analysis and simulations of the Source Physics Experiments: Impact on explosion discrimination & monitoring

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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 to understand, in particular, the genesis of shear waves to improve nuclear monitoring capabilities. Executed between 2011 and 2016, SPE Phase I included six chemical explosions conducted in the same Climax Stock granite borehole with different yields and different depths. Phase II, however, includes only four chemical explosions and are being conducted in dry alluvium geology (DAG). The first two, DAG-1 and DAG-2 have been successfully executed in 2018. In a multi-laboratory effort, we developed a comprehensive nested numerical framework to simulate from end-to-end, source-to-receivers, the waves generated from the non-linear explosion source-region to linear-elastic seismoacoustic distances. We present the analysis of all SPE collected data, summarize how modeling predictions compare to observed data and draw lessons learned. We also share insights on the main mechanisms of generating shear motions in granite and alluvium. Moreover, the team has developed schemes of uncertainty propagation of the geological characterization and geophysical parameters pertinent to denied access and remote sites. We present the impacts of those uncertainties on enhancing source discrimination.

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