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Assimilating Stress and Strain in an Energy-Based PSHA Workflow

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The advent of data science augurs complementing catalog-based probabilistic seismic hazard assessment (PSHA) with hitherto unused but relevant geophysical data. Especially in regions of low seismicity, where catalog data acquisition rates are limited by occurrence rates, additional data sources may provide crucial information.

Stress and strain, quantifying the driving physics of seismicity, are obvious candidates to incorporate into seismic hazard assessment. With rapidly growing geodetic data sets and stress data assimilation efforts, their data set quality may rapidly increase in near future.

We demonstrate how energy conservation, elasticity, and the assumption of stationarity can be used to integrate stress and strain data into the existing PSHA workflow, yielding boundary conditions on the magnitude-frequency distribution. The resulting energy-based seismic area source model constitutes a component of an energy-based PSHA framework.

The workflow is demonstrated using the San Andreas Fault as a well-researched and tectonically homogeneous test region. Strengths, limitations, and methods for the assimilation of different geospatial data sets are discussed. Specifically, this includes data processing techniques for the homogenization of differently-sampled strain rate and stress data sets.