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Local stress field variations derived from high precision locations of Yellowstone earthquake swarms

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Seismicity of the Yellowstone volcanic field, Wyoming, is characterized by swarms of earthquakes. Earthquake swarms are thought to be caused by variations in the local stress field due to migration of fluids. For example, the occurrence of the largest historic earthquake swarm in Yellowstone in 1985 has been explained with migration of hydrothermal fluids radially outward from the Yellowstone caldera. High-precision earthquake locations are a prerequisite to derive local stress field variations since migration rates of fluids are often smaller than errors associated with individual hypocenter locations. We will show the spatial and temporal evolution of selected earthquake swarms in Yellowstone and how they can be related to local stress field variations.

To obtain high-precision hypocenter locations of earthquake swarms in Yellowstone, we first apply a clustering procedure based on waveform-correlation to reduce picking inconsistencies, and to considerably improve accuracy of arrival time picks. We incorporate these corrected arrival times into a nonlinear inversion approach and calculate precise and consistent absolute hypocenter locations. Considering the geologically and tectonically complex Yellowstone region, we use a 3D-velocity model, which was derived by local tomography. Finally we apply a common double-difference earthquake location method to obtain precise relative hypocenter locations. Composite focal mechanisms are computed for each earthquake cluster to infer variations in the local stress field.