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Earthquake mechanism extended for rupture propagation estimate: West Bohemia/Vogtland swarm 2014

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The mechanism is an inherently point-source attribute of an earthquake focus containing no information on the rupture propagation. The traditional description by the moment tensor offers little chance to absorb additional parameters related to finite-extent focus. Its alternative - the shear-tensile crack - is advantageously more flexible thanks to the fact that it is a physical model. It is the simplest extension of the traditional pure shear-slip model represented by complementing it with a phenomenon describing an opening or closing within the focal zone. This is achieved just by allowing a deviation of the slip off the fault plane. As extreme cases of the oblique slip, the model involves both the pure shear and the tensile crack. Technically, its advantage is a smaller number of parameters needed for its description: there are 5 parameters only, i.e. one parameter less than for an unconstrained moment tensor. Smaller number of parameters is an advantage in the inverse process, expressed in its greater robustness, which is important especially in sparse monitoring configurations. From this reason and thanks to a grid search approach to the inverse task, we can optimize additional parameters during the search for the mechanism. The rupture velocity vector modifying the radiation pattern by the directivity effects is the first one at hand. We search for its direction constrained to lie within the fault plane marked by the mechanism. The speed of the rupture is considered either as fixed or free parameter. The grid search applied allows a detailed mapping of the model space with the advantage of constructing the confidence regions of all the source parameters involved – related both to the mechanism and to the rupture propagation. In this way, the error of the determination of the individual features of the source can be estimated. The synthetic experiments performed indicate that while the mechanism is resolved well even with an inexact knowledge of the velocity structure, resolution of the rupture propagation is mostly poor. Especially its speed remains rather uncertain. Nevertheless, rough information on the direction of the rupture propagation can be retrieved, which may help, e.g., in detecting the fault from the couple of nodal planes. The crucial demand for the approach is a good geometry of the network. We apply the procedure to the data of the West Bohemia/Vogtland swarm in 2014, where an excellent configuration of the monitoring is available.