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Rapid identification of rupture and auxiliary planes from focal mechanism data for the 2016 Ecuador and Kumamoto earthquakes

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Until now the separation of the two nodal planes of a focal mechanism solution into the rupture plane and the auxiliary plane needs further information from geology, aftershock distribution or a directivity analysis of the seismic waves. Here we present the method ACE (Angular Classification with Expectation-Maximization) that results in both the classification of the Style-of-Faulting (SoF) and the separation of the two nodal planes without further assumptions. The additional information comes from a cluster analysis of a sufficiently large focal mechanism data set using the properties of the cluster.
ACE is based on an extension of the classical Expectation-Maximization (EM) algorithm to cover the optimization of the number of clusters as well, as this is unknown a priori in the classical sense of EM. We evaluated the extended EM-algorithm on the principles of information entropy. The ambiguity of the nodal planes is resolved by analysing the identified clusters, thus providing the identification of the fault plane orientation and also the Style-of-Faulting. We apply the ACE method to focal mechanism data sets from recent earthquake sequences in April 2016 from Ecuador and Kyushu and show its potential for rapid assessment of rupture plane identification.