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Comparison between three methods for determining principal stress directions from focal mechanisms inversions

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Direct stress determination through boreholes can only be conducted within the first kilometres of the crust and other means must be considered for determining the state of stress at greater depth. The interpretation of the motion on a fault in terms of stress can provide further information. Hence, focal mechanisms inversion may be used to determine the principal stress directions orientation at seismogenic depths. A major problem in these inversions is that it is not always possible to differentiate between the fault plane and the auxiliary plane.
We compare three method that deal with this problem: Michael (1984), Gephart and Forsyth (1984) and Angelier (2002). They all assume that the slip is in the direction of the resolved shear stress on the fault plane but differ slightly otherwise. Angelier (2002) uses a Tresca criterion and maximizes the sum of the shear stress slip component. Michael (1984) linearises the problem by supposing that the shear traction is the same for all the planes and perform a least square inversion. Gephart and Forsyth (1984) performs a grid search to find the stresses that minimizes the misfit between model and data. In view of the variations in theses methods we would, expect a difference in the results.
These methods are applied to two seismic crises in the East of France, Rambervillers and Sierentz, close to Basel. Since seismic crises occurs within a limited volume of the crust they are appropriate for the inversion assuming the events are independant from each other. We compare the orientation of the principal stresses directions and the shape factor that indicates the relative magnitude of the principal stresses components. We study the errors as well and the way they are calculated with each method.
These results are compared to the stresses determination conducted in a 5km deep well located in Basel city, a few kilometers away from the Sierentz epicenter.

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