[EE] Evening Poster | S (Solid Earth Sciences) | S-IT Science of the Earth's Interior & Tectonophysics

[S-IT26]Stress geomechanics integrations: Observations, Modelings and Implications (OMI)

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Sun. May 20, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)

Stress geomechanics specifies how rocks respond to strain, fluid and heat that provide essential information on understanding seismic behaviors. Thus, some outreach researches address the stress state in the geological structures or along plate boundaries through geophysical, geodetic, geothermal and/or hydrological approaches, especially after recently great earthquakes. Such studies have raised the importance on the stress analysis, including stress evolution by seismic and volcanic activity, in-situ stress measurements, crust heterogeneity, and geodetic modeling for earthquake cycle. This session is to bring the multi-disciplinary studies together on stress geomechanics, including but not limited, to inland/ocean drilling, borehole measurement, focal mechanism of crustal and volcanic earthquakes, subsurface anisotropy analysis and geomechanical model applications. We focus our discussion not only on the observation in association with physical models, but also interdisciplinary cooperation in each research field.

[SIT26-P01]Dissimilarity classes of reduced stress tensors

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Keywords:stress inversion, reduced stress tensor, statistics

Here, we redefine the dissimilarity classes of reduced stress tensors, which was proposed by Orife and Lisle (2003) for the practical convenience to interpret the results of stress inversion. The inversion of orientation data from faults, focal mechanisms, dikes, etc., determines the stress axes and stress ratio, Φ = (*σ*$_2$ – *σ*$_3$)/(*σ*$_1$ – *σ*$_3$), that best explain the data. The inversion result is represented by a reduced stress tensor, the eigenvalues of which are normalized in a certain manner We proposed the normalization using the first and second basic invariants of stress tensor, J_1 = *σ*$_1$ + *σ*$_2$ + *σ*$_3$ = 0 and J_2 = –*σ*$_1$*σ*$_2$ – *σ*$_2$ *σ*$_3$ –*σ*$_3$*σ*$_1$ = 1, for the inversion to attain isotropic resolution (Sato and Yamaji, 2006). The normalization results in the one-to-one correspondence of a reduced stress tensor and a point on a unit hypersphere in 5D space.

Orife and Lisle (2003) regarded the Euclidean distance between points on the hypersphere as the dissimilarity of the tensors corresponding to the points; and used the mean (*μ*) and standard deviation (*s*) of the dissimilarities of randomly chosen tensors to define the dissimilarity classes. That is, reduced stress tensors are called ‘very similar’ if their dissimilarity is smaller than *μ* – 2*s*. Likewise, the ‘similar,’ ‘different’ and ‘very different’ classes were divided by the dissimilarity values *μ* – *s*, *μ* and *μ* + *s*. However, their definition of the classes depends on the choice of a dissimilarity measure of reduced stress tensors. If angular distance between points on the hypersphere is chosen as the dissimilarity measure, the mean and standard deviation of this distance are different from those of Orife and Lisle (2003).

Accordingly, we propose to use the probability for arbitrarily chosen reduced stress tensors to fall into a dissimilarity class. That is, the class boundaries are defined with the 5, 15 and 95 percentiles of the probability density function of the angular distance of the tensors. As a result, reduced stress tensors are called ‘very similar’ if the angular distance between the points corresponding to the tensors is smaller than 43.17°. When ‘very similar’ stresses are obtained through the inversion from two areas, it is highly probable that the areas are affected by the same stress condition, because the probability for the stresses to fall into the ‘very similar’ class by chance is only 5%. The boundaries of the ‘similar,’ ‘different’ and ‘very different’ classes are the angular distances of 59.26° and 136.83°. Arbitrarily chosen stress tensors usually falls into the ‘different’ class at the probability of 80%. Stresses of the ‘very different’ class has the angular distance between 136.83 and 180°.