New stress inversion method based on 3D fault movements

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This contribution presents new technique for determining contemporary stress states from three-dimensional displacement of active tectonic faults situated near the ground surface. The development of the method was motivated by availability of the precise measurements of displacement between fault planes in all three orthogonal directions. These measurements are made using a range of instruments spanning from traditional three-dimensional crackmeters such as the moiré extensometer TM 71 (Košťák 1991) to new technologies such as those based on magnetoresistance (Rinaldi-Montes et al. 2017).

Input data fundamental for presented method are orientation of the fault surface represented by the down directed fault normal $\mathbf{n} = [n_x, n_y, n_z]^T$ and the vector of displacement between the particular fault blocks $\mathbf{P} = [P_x, P_y, P_z]^T$. Character of input data – 3D total vector of displacement from open faults situated near the ground surface – enables to propose three major assumptions, which lead to the numerical calculation of reduced stress tensor $[\mathbf{T'}_\sigma]$, i.e. the orientation and relative magnitudes of principal stresses (Angelier 1994).

The first assumption is generalization of Wallace–Bott (Wallace 1951, Bott 1959) hypothesis and it states that movement of fault blocks (**P**) occurs in the direction of stress vector (**S**) acting on fault surface. The second assumptions states that isotropic stress at the surface or at shallow crustal depths is negligible. Third assumption is based on Anderson's theory (Anderson 1951) and it states that one of the principal stresses close to the ground surface must be vertical. Based on these assumptions it has been possible to develop a relatively simple numerical approach for determining contemporary stress states using displacement data recorded across a single fault. The outlined method therefore does not require a set of fault slip data, as needed in order to use classical inversion techniques.

Developed method has been tested on fault displacement monitoring data which have been recorded at seven sites in in the Eastern Alps since 2013. An example of presented stress inversion is demonstrated using displacement data which evidence a single fault reactivation event on 7 November 2014 in Obir Cave. The outlined method is thought to have a considerable number of future applications in the many fields which use stress analysis, e.g., earthquake monitoring, landslide monitoring, and active-tectonic research.

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Late Cretaceous evolution of NE Poland – new insight based on regional seismic data

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The main objective of this study was to recognize gross depositional architecture of the Upper Cretaceous succession in the NE Poland formed in response to regional uplift of various segments of the European crust. The study area is located in the western part of the Mazury-Podlasie Monocline and Płock Trough, in