Migration of earth surface deformation as a large earthquake trigger

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Methods of observing movements and deformations of the earth's surface using global navigation satellite systems are now being used more and more widely and efficiently. This is especially true for regions of high seismic activity, such as the US West Coast, for example, or the islands of the Japanese archipelago. In these regions, dense networks of continuous GNSS observations have been operating for more than a decade, which contributes to the accumulation of significant amounts of data on the course of deformations of the earth's surface years before strong earthquakes at their sites. In this regard, there is a special interest in the analysis of long-term changes in the deformation process, in order to register possible deformation precursors and to assess the degree of accumulation of deformations before strong earthquakes.

The report examined studies of spatial and temporal changes in the horizontal deformations of the earth's surface in the San Francisco region over a period of more than eleven years with daily time resolution.

Deformations of dilatation, total shift, as well as horizontal and vertical displacements of permanent GPS stations are analyzed. The initial data were the time series of coordinate changes published by the Nevada Geodetic Laboratory of the University of Nevada, Reno, USA (Blewitt et al., 2018). The evolution of deformations and movements of the earth's surface is tracked using kinematic visualizations that demonstrate the change of the deformation field over time. The created animations make it possible to track the qualitative nature of the deformation in connection with the course of the seismic process and fault tectonics. The region under study in recent years has been the subject of special attention due to the possible occurrence of a catastrophic earthquake. The visualization of the evolution of deformation demonstrated the zones of activation and the propagation path of the deformation fronts. It is shown that the propagation of total shear deformation, expanding from the middle of the strike area of the Highward fault, migrates to the West Napa fault and provokes a large Napa earthquake, M = 6. Moderate earthquakes with M$>$ 5 also occurred as the deformation front approached their future epicenters. The speed of propagation of the deformation front is about $\sim$ 7 km / year. The magnitude of the deformation provoking an event is about 0.3 * 10^{-5}. The registered phenomenon is regarded by the authors as the trigger of the crust seismic event. It is concluded that the Highward fault zone is currently less seismic as the most mobile one.

Blewitt, G., W. C. Hammond, and C. Kreemer (2018), Harnessing the GPS data explosion for interdisciplinary science, Eos, 99, https://doi.org/10.1029/2018EO104623.