Fault complexity and interaction: evidence of static and dynamic earthquake triggering

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Despite substantial advances in our understanding in the last decades on mechanical properties of the faults and their interaction through the stress field, there is still a long way to achieve reliable estimates of the recurrence times of the stronger earthquakes associated with the major faults in a given area. This highlights the requisiteness for intensifying our efforts towards identification of the location and occurrence time of the anticipated strong earthquakes. Substantial progress has been made in identifying the source regions of future earthquakes by stress interaction modeling, which led to the assessment that stress changes caused by the coseismic slip of an earthquake increased the likelihood for the occurrence of nearby earthquakes.

Calculations of static Coulomb stress changes associated with the coseismic slip of the strong earthquakes associated with specific faults and fault segments in a fault population were confirmed ample to explain many seismic observations, including aftershock locations, the spatial evolution of earthquake sequences, and the lack of anticipated earthquakes in active regions following strong earthquakes. Although static stress changes may be an important trigger for near field aftershocks, the influence of static stress changes has remarkable impact in distances of two or three fault lengths from the source, even though they are negligible even compared to tidal stresses. Remote triggering at great distances (from several fault lengths to hundreds of km, depending upon the magnitude of the causative earthquake) has been observed, however, after a strong earthquake and best explained by the transient (dynamic) passage of seismic waves, which either immediately induce Coulomb–type failure or initiate a secondary mechanism that induces delayed triggering. The passage of seismic waves may also play a significant role in the triggering of near–field earthquakes.

Fault interaction investigation was performed in several cases on a regional scale by evaluating stress patterns for different configurations based on specific natural fault arrays. Coseismic Coulomb stress changes that are induced on the surrounding receiver faults by the earthquake on the source fault and in several cases the accumulated stress changes that included the long–term tectonic loading have revealed. Triggering occurs as a redistribution of stress induced by an earthquake. One of the primary reasons to study earthquake triggering is to work toward being able to predict where the next seismic event will occur. Triggered event can happen very fast, after several years, or after decades. Research results that successfully highlighted triggering effects are accumulated from several cases from Greece and other areas and for different faulting types.