



## **Space–time relations in recent clustered seismic series in Spain: Source and stress evolution analyses.**

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The South-Eastern and Northern-Pyrenean regions in Spain are two of the most active seismic regions in the Iberian Peninsula. In the last 15 years, at least three clustered seismic series with moderate to small magnitude earthquakes have occurred in the Adra region and the Alborán Sea, causing several damages to population and infrastructures. On the other hand, a recent clustered series beginning in 2004 also occurred near the Itoiz Reservoir, Northern Spain.

In this work, we study the space-time relations among the three seismic series in southern Spain and compare their characteristics with the other one located near the reservoir. Two of the series occurred on December 1993 and January 1994 in the Adra-Berja region and another one in the Alborán Sea in November–December 2008. These three series are all located within a relatively compact region where the seismicity is mainly associated with different transform and normal faults, located near the tectonic boundary between the African and the Euro-Asian plates. The other series was located close and under the newly constructed Itoiz dam.

The analysis is performed taking into account the regional tectonic loading, the coseismic stress transfer due to the main earthquakes of each series and the postseismic effects due to the pore pressure diffusion produced by the mainshocks and the reservoir load. Dynamical stress transfer is also considered. Results show several space-time stress relations within each seismic series and the possible stress interaction among the series in the southeastern region. These series can also be associated to different mapped active faults in the Alborán sea and the Adra-Berja region. The series near the reservoir could be also associated to a set of shallow faults near the reservoir and the possible relation with the impounding of the dam is discussed. These results could be taken into account in the seismic hazard analysis in Spain.