



## **Evidence for external forcing temporal clustering of great earthquakes**

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It is shown by Bufe and Perkins [2005, BSSA, doi:10.1785/0120040110] and Shearera and Stark [2012, PNAS, doi: 10.1073/pnas.1118525109] that clustering of great earthquakes in 1950–1965 and 2004–2011 years is highly significant, with a 0.5% probability of random occurrence. Lutikov and Rogozhin [2014, Physics of the Solid Earth] reported on a similar clustering in the end of 19th – beginning of 20th centuries as well, when strongest earthquakes occurred in Tien Shan (1889,  $M=8.3$ ; and 1911,  $M=8.2$ ); Alaska (1899,  $M=8.0$ ); Kashgaria (1902,  $M=8.2$ ); Mongolia (1905,  $M=8.2$ ); San Francisco (1906,  $M=8.3$ ), China (1906,  $M=8.3$ ); Columbia (1906,  $M=8.6$ ). Shearera and Stark [2012] have found that clustering of great earthquakes is analogous to seismic swarms that occur for a limited time. Simultaneously, they mentioned that at present no physical mechanism has been proposed to explain possible global seismicity swarms. Our results suggest that a mechanism responsible for temporal clustering of great earthquakes could be an external one related to the processes in the whole solar system including the Sun. We pay attention that the three marked periods of great earthquake clustering are related closely to the extreme phases of the recent Solar Centennial Gleissberg Cycle, which minimums occurred around of 1913 and 2008 years, and maximum – around of 1960 year. In particular, the great earthquake clustering in 1950–1965 coincides closely with the extremely high 19th eleven year solar cycle lasting from February 1954 to October 1964, while a great earthquake clustering after 2004 year coincides closely with the recent prolonged solar minimum developing after 2000 year. Also, we demonstrate that depending on the structure and composition of the lithosphere, strongest earthquakes may prefer to occur either in high or low solar activity. In particular, data analysis for 32 strongest ( $M \geq 7.0$ ) earthquakes occurred in 1973–2014 years in the orogeny region of Eurasia, restricted by coordinates of 30–45N and 0–110E, showed that at the European part, the strongest earthquakes occurred mainly during increased level of solar activity (14 events out of 16, i.e. 87.5%), while at the Asian part of area, the strongest earthquakes occurred mainly during decreased level of solar activity (13 events out of 16, i.e. 81.25%). In 1973–2014 years, the largest event in considered area was the Sichuan earthquake in Asia in 2008 year ( $M=7.9$ ), which occurred exactly in the minimum of the recent Centennial Gleissberg Cycle.