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Effects of secondary static stress triggering on the spatial distribution of aftershocks, a case study, 2003 Bam earthquake (SE Iran)

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Immediate after a large earthquake, accurate prediction of spatial and temporal distribution of aftershocks has a great importance for planning search and rescue activities. Currently, the most sophisticated approach to this goal is probabilistic aftershock hazard assessment (PASHA). Spatial distribution of the aftershocks fallowing moderate to large earthquakes correlate well with the imparted stress due to the mainshock. Furthermore the secondary static stress changes caused by smaller events (aftershocks) could have effect on the triggering of aftershocks and should be considered in the calculations. The 26 December 2003 (Mw 6.6) Bam earthquake with more than 26000 causalities is one of the most destructive events in the recorded history of Iran. This earthquake was an interesting event and was investigated in a majority of aspects. Good variable-slip fault model and precise aftershocks data enabled us to impart Coulomb stress changes due to mainshock and secondary static stress triggering on the nodal planes of aftershocks to learn whether they were brought closer to failure.

We used recently published high-quality focal mechanisms and hypocenters to reassess the role of small to moderate earthquakes for static stress triggering of aftershocks during the Bam earthquake. By imparting Coulomb stress changes due to the mainshock on the nodal planes of the 158 aftershocks we showed that 77.8% (123 from 158) of the aftershocks received positive stress changes at least in one nodal plane. We also calculated Coulomb stress changes imparted by the mainshock and aftershocks ($1 \leq M \leq 4.1$) onto subsequent aftershocks nodal planes and found that 81.6% (129 of 158) of aftershocks received positive stress changes at least in one nodal plane. In summary, 77.8% of aftershocks are encouraged by the main shocks, while adding secondary stress encourages 81.6%. Therefore, by adding secondary stress the Coulomb Index (CI), the fraction of events that received net positive Coulomb stress changes compared to the total number of events, increased from 0.778 to 0.816.