Strong aftershock occurrence and seismic activity preceding the mainshock

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We test a hypothesis that seismic activity preceding a large earthquake is one of the factors controlling occurrence of strong aftershocks. We consider the global statistics of large earthquakes of magnitude Mm 6.5 and above in 1975-2017 using ANSS comprehensive catalogue. Aftershocks of magnitude $Ma >= Mm-1$ are considered as strong. In a circle of radius $R = cf \times 10^{(Mm/2)}$ centered at the epicenter of the main shock and an interval of length T prior to the main shock we tested simple functions measuring seismic activity relative to the size of the main chock. We consider the task of forecasting, using a function value, will the earthquake have a strong aftershock or not. Both cases, high function value, above a threshold, for the main shock with strong aftershock ("true positive"), and the function value below the threshold for the main shock not followed by strong aftershock ("true negative"), are considered as successful forecasts. Symmetric cases, "false positive" and "false negative" are considered as failures. To measure the effectiveness of forecasts we introduce a value SFR, the ratio of the total success rate (number of true positives and negatives) to the total failure rate (number of false positives and negatives). We found that the ratio of cumulative seismic moment of the preceding seismicity to the seismic moment of the main shock (measured using available magnitudes, taking into account that seismic moment is proportional to $10^{(1.5Mm)}$) is the most informative in this task with optimal parameters cf=0.07 km and T=3.5 years and SFR=1.7. The research was supported by Russian Foundation for Basic Research (Project 16-05-00263).