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An enhanced version of the NESTORE software for strong aftershock forecasting

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In this work, we present a new and improved version of the NExt STrOng Related Earthquake (NESTORE) software, originally released as NESTOREv1.0 and publicly available as a MATLAB-based package. The original version of NESTORE was specifically designed to forecast the occurrence of strong aftershocks in the first few hours following a mainshock, providing a valuable tool for short-term seismic hazard assessment.

The newly developed version introduces several methodological and computational improvements aimed at increasing the robustness and reliability of the forecasting framework. Among the main upgrades is the integration of the REPENESE (RElevant features PErcentage class weighting NEighborhood detection SElection) algorithm, an advanced outlier detection method explicitly designed to handle class imbalance and skewed datasets, which are characteristic of the seismicity features we used. This integration enables a more effective identification and treatment of anomalous events, thereby improving classifier performance.

In addition, the new version implements a k-fold cross-validation strategy to estimate model performance. This approach allows a more stable and unbiased evaluation of predictive capabilities compared to single-split validation methods, especially with limited or heterogeneous data. Overall, the combination of these enhancements results in a more flexible, accurate, and reliable tool for the analysis of earthquake clusters and the early forecasting of strong aftershocks.

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