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Reservoir-induced synchronization in local seismicity

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We present the evidence of reservoir-induced changes in regional seismicity around the Enguri high dam reservoir. It is shown that under the influence of a large water reservoir, regional seismic activity increases according to the well known concepts of reservoir induced seismicity (RIS). After a period of reservoir-induced initial increase of regional seismic activity, the released energy value essentially decreases when the variation of the water level in the lake became periodic.

We base our assumption on the analysis of the water level variation data sets of Enguri high dam reservoir and the seismic data sets recorded by the special local network. As a model of natural seismicity we also analysed laboratory acoustic emission data obtained during stick-slip experiments with superimposed weak periodic perturbations.

Statistical, linear, nonlinear and phase synchronization analysis methods have been applied to field and laboratory data in order to obtain quantitative assessment of synchronization strength.

Based on field and laboratory data analysis we suppose that decrease of probability of large earthquakes occurring around large reservoirs may be explained as synchronization of complex seismic process under small periodic influences caused by change of water level.

Increase of order in earthquakes temporal distribution at proposed phase synchronization was revealed by the method recurrence quantitative analysis (RQA). Analysis was carried out on data sets of water level daily variation and released daily seismic energy.

It was shown, that when external influence on the earth crust caused by reservoir water become periodic extent of regularity of earthquake daily distribution essentially

increases. The calculation of load-unload response ratio (LURR) shows that there is clear asymmetry in seismicity rates during filling and discharge phases of lake exploitation