Two-Element Keyboard-Block Model Of Megathrust Earthquakes Generation For Central Kurils

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The strongest subduction earthquakes (M≥8) lead to the release of the huge amount of elastic stresses accumulated over hundreds or even thousands of years. Prediction of such earthquakes, causing significant socio-economic and environmental damage, is one of the most important and urgent tasks of geophysics.

To date, significant advances have been made in the field of earthquake prediction using models based on the concept of a continuous geophysical medium that ruptured coseismically along the main fault. As an alternative, models are proposed that take into account the fault-block structure of the continental margin, confirmed by seismological and oceanographic studies. In our study, we consider one of such models - a keyboard-block model (single-element) which combines the ideas of possible synchronous destruction of several adjacent asperities, mutual slip along a plane with variable friction depending on velocity, and subsequent healing of destructed portions of the medium under high-pressure conditions. This concept made it possible to simulate the displacement of surface points of frontal seismogenic blocks at all stages of the seismic cycle.

GNSS observations in subduction regions are carried out mostly on islands situated on the rear massif far from the seismogenic blocks. Strong multidirectional motion registered on GNSS stations during the seismic cycle, as well as seismological and geological data, clearly indicate that the rear part of the arc also has a complex structure and is divided into separate segments by large faults rooted into the contact zone of interacting lithospheric plates. We made a generalization (double-element) of the original model to consider the discontinuity of not only the frontal but also the rear part of the island arc.

We compared the earth's surface displacements during the seismic cycle in the Central Kurils, obtained within the framework of the continuous model, as well as the single-element and two-element keyboard models, to establish the influence of various configurations of the fault-block structure of the continental margin on the seismic cycle. We constructed the continuous model on the basis of our slip distribution model for the 2006 Simushir earthquake which indicates the interplate coupling patches prior to this earthquake.
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