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Preliminary results of determination of most probable earthquake focal mechanism for the Kuril-Kamchatka subduction zone

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The distribution of earthquake focal mechanisms was analyzed using the Kuril-Kamchatka subduction zone as an example.

The GCMT database for 1976–2020 was used as a source of earthquake focal mechanism data, without magnitudes M > 7.5. Though, information on large earthquakes was used in this study to validate the resulting maps of most probable focal mechanisms.

The area was divided into four segments based on slab geometry changes and the classification by [1]: Hokkaido, South Kuril Islands, North Kuril Islands, and Kamchatka. Seismicity in each segment was then divided into layers, similar to [2]: interplate seismicity – earthquakes at the boundary of the Okhotsk and subducting Pacific Plates; intraslab seismicity – earthquakes within the subducting slab; surface seismicity of the Okhotsk Plate; and surface seismicity of the Pacific Plate. Earthquake focal mechanisms were analyzed for each layer separately.

To estimate the most probable mechanisms of future earthquakes, a statistical spatial smoothing method [3] was applied to each of the identified groups. This method uses the sum of normalized seismic moment tensors within a given radius (a radius of 100 km was used in this study).

The resulting mechanism distribution maps are generally consistent with the mechanisms of the largest earthquakes recorded in the corresponding regions of the subduction system. However, problematic areas have been identified, particularly in the Kuril Islands and South Kuril Islands, where a wide variety of mechanisms are observed at close distances. Averaging focal mechanisms is not a sufficient approach to describing the actual seismicity of subduction zones. The pair of Simushir earthquakes, as well as the aftershocks of the Tohoku event, demonstrate the need to move from the Kagan-Jackson averaging method to a stochastic (probabilistic) model.

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References

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