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Spatial distribution of clustered seismicity in Khibiny Montains

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Using long-term mining-induced earthquake statistics of the Khibiny Mountains (Kola Peninsula, Russia) we studied the spatial peculiarities of clustered seismicity. To declutter the earthquake catalog, we used the nearest neighbor method by Zaliapin and Ben-Zion, 2016, DOI: 10.1093/gji/ggw300. It was shown that the distribution of distances from triggering event to triggered earthquakes obeys a power law with a parameter independent of the trigger magnitude. This result is consistent with distribution of mainshock-aftershock distances obtained for tectonic seismicity by many researchers (e.g., Huc M., Main, DOI: 10.1029/2001JB001645; Felzer and Brodsky, DOI: 10.1785/0120030069; Richards-Dinger et al., DOI: 10.1038/nature09402). Combining the spatial power distribution and the law of earthquake productivity by Shebalin et al. 2020 (DOI: 10.1093/gji/ggaa252), confirmed for the seismicity of the Khibiny Mountains (Baranov et al., 2020, DOI: 10.1134/S1069351320030015) we derived a distribution of maximal distances from trigger to triggered earthquake.

Using this distribution, we suggest a probabilistic model of zone where triggered earthquakes are expected. The zone is a cylinder centered on the trigger hypocenter, its size (radius and height) depends on the probability of containing triggered earthquakes. The model validation was performed using Molchan’s error diagram. Applying the method of three strategies (Baranov and Shebalin, 2017, DOI: 10.1134/S1069351317020021) to the error diagram, we identified three limiting points on the error trajectory, corresponding to "soft," "neutral," and "hard" strategies. These strategies reflect the prediction importance.

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