Geosistemy perehodnykh zon = Geosystems of Transition Zones / Геосистемы переходных зон

2024, vol. 8, No. 3, pp. 161–173

URL: http://journal.imgg.ru/archive.htm ; https://elibrary.ru/title_about.asp?id=64191

https://doi.org/10.30730/gtrz.2024.8.3.161-173; https://www.elibrary.ru/nbfges

http://journal.imgg.ru/web/full/f2024-3-1.pdf (In Russian)

On the possible relationship between magnetic storms and earthquakes in certain tectonic conditions (using the example of Sakhalin Island)

Zakupin, Alexander S., https://orcid.org/0000-0003-0593-6417, a.zakupin@imgg.ru

Kazakov, Artem I., https://orcid.org/0000-0002-1378-185X, legn@inbox.ru

Stovbun, Nikolai S., https://orcid.org/0009-0004-1927-798X, nikolay19972016@gmail.com

Gulyakov, Sergei A., https://orcid.org/0009-0001-7924-6972, gulyakov_97@mail.ru

Andreeva, Marina Yu., https://orcid.org/0000-0002-7851-3311, andreeva-mu@mail.ru

Zherdeva, Olga A., https://orcid.org/0000-0003-4814-0865, o.zherdeva@imgg.ru

Institute of Marine Geology and Geophysics of the Far Eastern Branch of RAS, Yuzhno-Sakhalinsk, Russia

Abstract PDF RUS Full text PDF ENG PDF RUS

Abstract. The paper considers topical issues of geophysics related to the possible influence of disturbances in the magnetosphere on seismicity. The study was conducted based on a detailed catalog of seismic events in southern Sakhalin for the period from 2003 to 2023. The paper aims to test the assumption that such an influence can manifest itself in individual seismogenic zones during their proximity to discharge. The testing was carried out in randomly selected segments of the West Sakhalin (WSF) and Central Sakhalin (CSF) faults. The coincidence of the moments of some seismic events (with $M > 2.7$) and magnetic storms with a high index (G1 and higher) was revealed in these segments. The LURR (load-unload response ratio) method was used to identify periods when fault segments were in a subcritical stress-strain state. It was shown that the main part of the coincidences occurred during the periods of increased abnormal activity of the LURR parameter.

Keywords:

earthquake, magnetic storm, LURR, correlation, fault segment

For citation: Zakupin A.S., Kazakov A.I., Stovbun N.S., Gulyakov S.A., Andreeva M.Yu., Zherdeva O.A. On the possible relationship between magnetic storms and earthquakes in certain tectonic conditions (using the example of Sakhalin Island). *Geosistemy perehodnykh zon = Geosystems of Transition Zones*, 2024, vol. 8, No. 3, pp. 161–173. https://doi.org/10.30730/gtrz.2024.8.3.161-173; https://www.elibrary.ru/nbfges

***Для цитирования*:** Закупин А.С., Казаков А.И., Стовбун Н.С., Гуляков С.А., Андреева М.Ю., Жердева О.А. О возможной связи между магнитными бурями и землетрясениями в определенных тектонических условиях (на примере о. Сахалин) [Electronic resource]. *Геосистемы переходных зон*, 2024, т. 8, № 3. http://journal.imgg.ru/web/full/f2024-3-1.pdf

References

1. Qin P., Yamasaki T., Nishii R. **2014.** Statistical detection of the influence of solar activities to weak earthquakes. *Pacific Journal of Mathematics for Industry*, 6(6). https://doi.org/10.1186/s40736-014-0006-9
2. Guglielmi A.V., Lavrov I.P., Sobisevich A.L. **2015.** Sudden onsets of magnetic storms and earthquakes. *Solar-Terrestrial Physics*, 1(1): 98–103. https://doi.org/10.12737/5694; EDN: VHATNJ
3. Kozyreva O.V., Pilipenko V.A. **2020.** On the relationship between geomagnetic disturbance and seismic activity for the Alaska region. *Geophysical Research*, 21(1): 33–49. https://doi.org/10.21455/gr2020.1-3
4. Zakupin A.S., Boginskaya N.V. **2022.** Medium-term earthquake forecasts by the LURR method on the example of the strongest earthquakes of the 21st century. *Lithosphere*, 22(6): 872–881. (In Russ.). https://doi.org/10.24930/1681-9004-2022-22-6-872-881
5. Chen H., Wang R., Miao M., et al. **2020.** Statistical study of the correlation between geomagnetic storms and $M \geq 7.0$ global earthquakes during 1957–2020. *Entropy*, 22(11), 1270. https://doi.org/10.3390/e22111270
6. Marchitelli V., Harabaglia P., Troise C., et al. **2020.** On the correlation between solar activity and large earthquakes worldwide. *Scientific Reports*, 10, 11495. https://doi.org/10.1038/s41598-020-67860-3
7. Sobolev G.A. **2021.** The influence of large magnetic storms on the occurrence of large earthquakes. *Physics of the Earth*, 1: 24–40. https://doi.org/10.31857/S0002333721010087; EDN: XHEZYW
8. Takla E.M.H., Samwel S.W. **2023.** Possible connection between solar activity and local seismicity. *Terrestrial, Atmospheric and Oceanic Sciences*, 34(9). https://doi.org/10.1007/s44195-023-00042-6

9. Novikov V.A., Sorokin A.K., Yashchenko A.K. **2019.** [Can a solar flare trigger an earthquake?]. *Vestnik Obyedinennogo instituta vysokikh temperatur*, 2(3): 15–21. https://doi.org/10.33849/2019203; EDN: IYEHAP
10. Novikov V.A., Sorokin V.M., Yashchenko A.K., Mushkarev G.Yu. **2023.** Physical model and numerical estimates of telluric currents generated by X-ray radiation of a solar flare. ***Dynamic Processes in Geospheres***, 1(15): 23–44. https://doi.org/10.26006/29490995_2023_15_1_23; EDN: MEMWRN
11. Tarasov N.T., Tarasova N.V. **2004.** Spatial-temporal structure of seismicity of the North Tien Shan and its change under effect of high energy electromagnetic pulses. *Annals of Geophysics*, 1(47): 199–212. https://doi.org/10.4401/ag-32722013
12. Zeigarnik V.A., Bogomolov L.M., Novikov V.A. **2022.** Electromagnetic initiation of earthquakes: field observations, laboratory experiments, and physical mechanisms (review). *Physics of the Earth*, 1: 35–66. https://doi.org/10.31857/S0002333722010100; EDN: VUPKUV
13. Novikov V., Ruzhin Y., Sorokin V.M., Yaschenko A. **2020.** Space weather and earthquakes: possible triggering of seismic activity by strong solar flares. *Annals of Geophysics*, 64(5): 554. https://doi.org/10.4401/ag-7975
14. Zakupin A.S. **2006.** *Issledovaniye elektrostimulirovannykh variatsiy akusticheskoy emissii pri deformirovanii obraztsov geomaterialov* [*Study of electrically stimulated variations of acoustic emission during deformation of geomaterial samples*]: extended abstr. of diss. ... Cand. Sci. (Phys. and Math.). Moscow, NS RAS in Bishkek. EDN: NOKZRZ
15. Sorokin V., Novikov V. **2024.** Possible interrelations of space weather and seismic activity: An implication for earthquake forecast. *Geosciences*, 14(5), 116. https://doi.org/10.3390/geosciences14050116
16. Zakupin A.S., Stovbun N.S., Gulyakov S.A., et al. **2024.** The manifestation of geomagnetic activity (solar flares and storms) in the change of electrotelluric potentials according to measurements at the Yuzhno-Sakhalinsk geophysical test site. *Geosystems of Transition Zones*, 8(2): 91–103. https://doi.org/10.30730/gtrz.2024.8.2.091-103
17. Zakupin A.S., Dudchenko I.P., Bogomolov L.M., et al. **2024.** Short-term variations of the electrotelluric field near the source of the earthquake on the Sakhalin Island. *Bull. of KRAESC. Physical and Mathematical Sciences*, 46(1): 134–164. https://doi.org/10.26117/2079-6641-2024-46-1-134-164; EDN: FIGWJO
18. Yin X.C. Chen X.Zh., Song Zh.P., Yin C. **1995.** A new approach to earthquake prediction: The Load/Unload Response Ratio (LURR) theory. *Pure and Applied Geophysics*, 145: 701–715. https://doi.org/10.1007/bf00879596
19. Zakupin A.S., Boginskaya N.V. **2021.** Mid-term earthquake forecasts using the LURR method on Sakhalin: a summary of retrospective studies for 1997–2019 and new approaches. *Geosystems of Transition Zones*, 5(1): 27–45. https://doi.org/10.30730/gtrz.2021.5.1.027-045; EDN: PBJTCV
20. Kamenev P.A., Degtyarev V.A., Zherdeva O.A., Kostrov Yu.V. **2024.** Kinematics of Sakhalin faults based on geological and seismological data. *Geosystems of Transition Zones*, 8(1): 37–46. https://doi.org/10.30730/gtrz.2024.8.1.037-046
21. Rebetsky Yu.L. **2021.** To the theory of deterministic earthquake forecasting using the LURR method. *Geosystems of Transition Zones*, 5(3): 192–222. https://doi.org/10.30730/gtrz.2021.5.3.192-208.208-222
22. Smirnov V.B. **1997.** Experience in assessing the representativeness of earthquake catalog data. *Volcanology and Seismology*, 4: 93–105.
23. Molchan G.M., Dmitrieva O.E. **1993.** A targeted approach to the problem of aftershock identification. In: *Seismicity and Seismic Zoning of Northern Eurasia*. Moscow: OIEP RAS, vol. 1: 62–69.