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Fundamental for self-developing processes model and problems of its application to earthquakes prediction in the Far East region

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Abstract. Seismic activation in the period of foreshocks (prior to the mainshock) described by the model of self-developing processes (SDP) is possibly a manifestation of explosive instability of low frequency straining waves in metastable medium. To highlight so nontrivial relationship of continuous wave motions and discrete seismic events flow is a goal of this narrative. Thus, the rationale of the SDP model (the equation, in reality) has been modified, which is of importance in relevance with the article by the Malyshevs in the current issue (A.I. Malyshev, L.K. Malysheva. Precedent-extrapolation estimate of the seismic hazard in the Sakhalin and South Kurils region) which is to improve the seismic hazard estimates by means of this model. A new way to reveal the very beginning of blow-up regime after quasi-stationary one is proposed.

Keywords:
equation of the self - developing processes model, foreshock sequence,
seismic events accumulation, waves interaction,
metastable medium, explosive instability

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References

1. Bers A., Kaup D.J., Reiman A.H. **1976.** Nonlinear interaction of three wave packets in a homogeneous medium. *Physical Review Letters*, 37(4): 182–185. https://doi.org/10.1103/physrevlett.37.182
2. Bowman D.D., Ouillon G., Sammis C.G., Sornette A., Sornette D. **1998.** An observational test of the critical earthquake concept. *J. of Geophysical Research: Solid Earth*, 103(B10): 24359–24372. https://doi.org/10.1029/98jb00792
3. Bykov V.G. **2005.** Strain waves in the Earth: theory, field data, and models. *Russian Geology and Geophysics*, 46(11): 1176–1190. (In Russ.).
4. Bykov V.G. **2018.** Prediction and observation of strain waves in the Earth. *Geodynamics & Tectonophysics*, 9(3): 721–754. (In Russ.).
5. Cianchini G., De Santis Ang., Giovambattista R.D., Abbattista C., Amoruso L., Campuzano S.A., Carbone M., Cesaroni C., De Santis Anna, Marchetti D. et al. **2020.** Revised accelerated moment release under test: Fourteen worldwide real case studies in 2014–2018 and simulations. *Pure and Applied Geophysics*, 177: 4057–4087. https://doi.org/10.1007/s00024-020-02461-9
6. Das S., Scholz C. H. **1981.** Theory of time-dependent rupture in the Earth. *J. of Geophysical Research: Solid Earth*, 86: 6039–6051. https://doi.org/10.1029/jb086ib07p06039
7. Debate on evaluation of the VAN Method: Editor's introduction. **1996.** *Geophysical Research Letters*, 23(11): 1291–1293. https://doi.org/10.1029/96gl00742
8. Geller R. **1997.** Earthquake prediction: critical review. *Gephysical J. International*, 131(3): 425–450. https://doi.org/10.1111/j.1365-246x.1997.tb06588.x
9. Hardebeck J.L., Felzer K.R., Michael A.J. **2008.** Improved tests reveal that the accelerating moment release hypothesis is statistically insignificant. *J. of Geophysical Research*, 113(B08310). doi:10.1029/2007JB005410
10. Jaumé S., Sykes L. **1999.** Evolving towards a critical point: A review of accelerating seismic moment/energy release prior to large and great earthquakes. *Pure and Appl. Geophysics*, 155: 279–305. https://doi.org/10.1007/s000240050266
11. Kharakhinov V.V., Gal'tsev-Bezyuk S.D., Tereshchenkov A.A. **1984.** [Sakhalin faults]. *Tikhookeanskaya geologiya = Geology of the Pacific Ocean*, 2: 77–86. (In Russ.).
12. Kuksenko V.S. **1986.** [Transition model from micro- to macro-destruction of the solids]. In: (Ed. S.N. Zhurkov) *Fizika prochnosti i plastichnosti* [*Physics of strength and plasticity*]. Leningrad: Nauka, p. 36–41.

13. Malinetskiy G.G., Potapov A.B. **2002.** [*Modern problems of nonlinear dynamics*]. 2 ed., revised and enlarged. Moscow: Editorial URSS, 358 p.
14. Malyshev A.I. **1991.** Dynamics of self-developing processes. *Volcanology & Seismology*, 4: 61–72. (In Russ.).
15. Malyshev A.I., **2019**. The predictability of the seismicity and large earthquakes: Kamchatka 1962 to 2014. *J. of Volcanology and Seismology*, 13: 42–55.
16. Malyshev A.I. **2020.** Predictability of the seismic energy flux: Southern Europe and the Mediterranean. *J. of Volcanology and Seismology*, 14(1): 30–43.
17. Malyshev A.I., Malysheva L.K. **2018.** Predictability of seismic energy rate in northwest frame of Pacific Ocean on the base of USGS catalogue. *Geosistemy perehodnykh zon = Geosystems of Transition Zones*, 2(3): 141–153. (In Russ.). https://doi.org/10.30730/2541-8912.2018.2.3.141-153
18. Malyshev A.I., Tikhonov I.N. **1991.** [Regularities of the dynamics of the foreshock and aftershock sequences in the region of South Kuril Islands]. *Doklady AN USSR = Proceedings of the USSR Academy of Sciences*, 319(1): 134–137. (In Russ.).
19. Malyshev A.I., Tikhonov I.N. **2007.** Nonlinear regular features in the development of the seismic process in time. *Izv. Physics of the Solid Earth*, 43(6): 476–489.
20. Myachkin V.I., Kostrov B.V., Sobolev G.A., Shamina O.G. **1975.** [Fundamentals of the source physics and earthquakes precursors]. In: *Fizika ochaga zemletryaseniya* [*Physics of earthquake source*]. Moscow: Nauka, p. 6–29.
21. Nikolaevsky V.N. **1996.** *Geomechanics and fluid dynamics*. Moscow: Nedra, 447 p.
22. Ostrovskiy L.A., Rybak S.A., Tsimring L.Sh. **1986.** Negative energy waves in hydrodynamics. *Soviet Physics Uspekhi*, 29(11): 1040–1052. https://doi.org/10.1070/pu1986v029n11abeh003538
23. Prudnikov A.P., Brychkov Yu.A., Marichev O.I. **1984.** *Integraly i ryady* [*Integrals and series*]. Moscow: Nauka, 800 p.
24. Rabinovich M.I., Reutov V.P., Tsvetkov A.A. Coalescence of wave pulses or beams in explosive instability. *Soviet Physics – JETP*, 40(2): 260–263. URL: http://www.jetp.ac.ru/cgi-bin/dn/e_040_02_0260.pdf
25. Ryskin N.M., Trubetskov D.I. **2017.** [*Nonlinear waves*]. Moscow: LENARD, 312 p.
26. Sobolev G.A., Zav'yalov A.D. **1980.** [On the concentration criterion of seismogenic ruptures]. *Doklady AN USSR = Proceedings of the USSR Academy of Sciences*, 252 (1): 69–71. (In Russ.).
27. Tikhonov I.N., Mikhaylov V.I., Malyshev A.I. **2017.** Modeling the Southern Sakhalin earthquake sequences preceding strong shocks for short-term prediction of their origin time. *Russian J. of Pacific Geology*, 11(1): 1–10. https://doi.org/10.1134/s1819714017010092
28. Trubetskov D.I., Rozhnev A.G. **2001.** [*Linear oscillations and waves*]. M.: Fizmatlit, 416 p.
29. Tikhonov I.N., Kim Ch.U. **2010.** Confirmed prediction of the 2 August 2007 Mw 6.2 Nevelsk earthquake (Sakhalin Island, Russia). *Tectonophysics*, 485: 85–93. https://doi.org/10.1016/j.tecto.2009.12.002
30. Tikhonov I.N., Rodkin M.V. **2012(2011).** The current state of art in earthquake prediction, the typical precursors, and the experience in the earthquake forecasting at the Sakhalin Island and the surrounding areas. In: (Ed. Sebastiano D'Amico) *Earthquake Research and Analysis – Statistical Studies, Observations and Planning*. Book 5, p. 43–79. doi:10.5772/28689
31. Varnes D.J. **1989.** Predicting earthquakes by analyzing accelerating precursory seismic activity. *Pure and Applied Geophysics*, 130(4): 661–686. https://doi.org/10.1007/bf00881603
32. Vere-Jones D., Robinson R., Yang W. **2001.** Remarks on the accelerated moment release model: problems of model formulation, simulation and estimation. *Geophysical J. International*, 144: 517–531. https://doi.org/10.1046/j.1365-246x.2001.01348.x
33. Voeykova O.A., Nesmeyanov S.A., Serebryakova L.I. **2007.** [*Neotectonics and active faults of Sakhalin*]. Moscow: Nauka, 187 p. (In Russ.).
34. Voight B. **1989.** A relation to describe rate-dependent material failure. *Science*, 243(4888): 200–203. https://doi.org/10.1126/science.243.4888.200
35. Volegov P.S., Gribov D.S., Trusov P.V. **2017(2015).** Damage and fracture: classical continuum theories. *Physical mesomechanics*, 20(2): 157–173. https://doi.org/10.1134/s1029959917020060
36. Zakharov V.E., Manakov S.V. **1976(1975).** The theory of resonance interaction of wave packets in nonlinear media. *Soviet Physics – JETP*, 42(5): 842–850. URL: http://jetp.ac.ru/cgi-bin/dn/e_042_05_0842.pdf
37. Zakupin A.S., Boginskaya N.V., Andreeva M.Yu. **2019.** Methodological aspects of the study of seismic sequences by SDP (self-developing processes) on the example of the Nevelsk earthquake on Sakhalin. *Geosistemy perehodnykh zon = Geosystems of Transition Zones*, 3(4): 377–389. (In Russ, abstr. in Engl.). https://doi.org/10.30730/2541-8912.2019.3.4.377-389
38. Zavyalov A.D. **2005.** From the kinetic theory of strength and fracture concentration criterion to the seismogenic fracture density and earthquake forecasting. *Physics of the Solid State*, 47(6): 1034–1041. https://doi.org/10.1134/1.1946852