The Possibility of Earthquake Forecasting: Learning from Nature

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Abstract

We present approach based on physically substantiated short-term precursor's selection to provide the real-time multiparameter monitoring having as a purpose the short-term forecast of earthquakes. Three main principles should be fulfilled: 1. We register natural phenomena for which we have multi-year experience demonstrating their connection with the earthquake preparation process 2. All these phenomena have very high statistical confidence in relation to post-phenomena earthquake occurrence 3. We have the physical explanation of these anomalous phenomena generation and their interrelation within the framework of earthquake preparation process. It is important to note that precursors are registered in different geospheres (lithosphere, atmosphere, ionosphere and magnetosphere) what confirms the fact of geospheres coupling during the earthquake preparation period. For the first time we included in consideration the role of triggers and their relationship with precursors. One of the well confirmed triggers is the Space weather evens changing the global atmospheric circulation. The arising large-scale irregularities of atmospheric pressure may serve as earthquake triggers while their linear borders coincide with the active tectonic fault. Another recently revealed effect is existence of earthquake retarders when earthquake happens later (up to month) in comparison with our procedure of earthquake time determination. Complications created by triggers and retarders in developed procedure of short-term earthquake forecast should be resolved in future development of our research. All these ideas are presented in the book which just published by Institute of Physics (IOP) and has the same title as abstract. This work was supported by RSF (project No 18-12-00441)





Summary

We present approach based on physically substantiated shortterm precursor's selection to provide the real-time multiparameter monitoring towards the short-term forecast of earthquakes. Three main principles should be fulfilled: 1. We register natural phenomena for which we have multi-year experience demonstrating their connection with the earthquake preparation processes; 2. All these phenomena have very high statistical confidence in relation to post-phenomena earthquake occurrence; 3. We have the physical explanation of these anomalous phenomena generation and their interrelation within the framework of earthquake preparation processes. It is important to note that short-term precursors related to major earthquake (M>6) are in different geospheres (lithosphere, registered atmosphere, ionosphere and magnetosphere) what confirms the fact of geospheres coupling during the earthquake preparation period. For the first time we included in consideration the role of triggers and their relationship with precursors. One of the well-studied trigger phenomena are the Space weather evens changing the global atmospheric circulation. The arising large-scale irregularities of atmospheric pressure may serve as earthquake triggers while their linear borders coincide with the active tectonic fault. Another recently revealed effect is existence of earthquake delayers when earthquake occurrence has been delayed (up to months) in comparison with the our time interval. The complex interaction



between triggers and delayers driven processes requires additional research and should be included into the procedures of short-term earthquake forecasting framework. All these ideas are presented in the upcoming book "The Possibility of Earthquake Forecasting: Learning from Nature" published by Institute of Physics (IOP)



Radon anomalies before M9.0 Tohoku 2011?



a) Hourly variations in 222Rn activity. (b) Variations in 4-hour averaged 220Rn activity. (c) Variations in air temperature during the monitoring period, both inside and outside the cave. (d) Energy (unit: erg = 10-7 J) of earthquakes with magnitudes greater than M6.0 in Japan and Malaysia during the monitoring period.



Radon Anomalies started on Feb 15, 20 24 days prior to the March 11 2011







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Thermal anomalous signals before the largest seismic events in Chile since 2010



Thermal anomalies maps (OLR) related to latest M8 earthquakes in Chile. (A) M8.8 of February 27, 2010, Maule. Anomalous map of February 8, 2010, 19 days in advance (retrospective analysis). (B)M8.1 of April 1, 2014, Tarapaca. Anomalous map of March 20, 2015, 12 days in advance (retrospective analysis). (C) M8.3 of September, 2015, Illapel, 2015, 15 days in advance (prospective analysis). The epicenter is marked with a black star, the tectonic plate boundaries with a red line, and the major faults with brown

11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 Days, March

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seen over FDNPP.



Time series of daytime anomalous OLR observed from

NOAA/AVHRR (07.30 LT) time of the equatorial crossing)

March 14-March 31, 2011 over Honshu, Japan. Tectonic

plate boundaries are indicated with red lines) and major

faults by brown. The location of FDNPP is indicated by a

black star. The maximum rate of change for OLR been















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LAIC-Plasmachemistry-Thermal interface

Plasmachemistry-Electromagnetic interface

Ionospheric precursors of strong | Typical variations of ACP before earthquakes at Kamchatka region



veraged correction of chemical potential, arising rom external forcing of the environment. The diurnal ariations in the intensity of solar radiation can be expressed as the square of cosine of time. Also, the alue of U_0 corresponds to the boiling temperature. ΔU is a complex parameter reflecting the formation of cluster ions. The larger the ΔU , the higher the energy of water molecule binding with ions and the more sta ble the cluster ions (the more lifetime before recomb nation), and the larger they can become due to the addition water molecules to them. At present, the size

