

# Earthquake Forecast—Vain Expectations?

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## Abstract

There are a few people on our planet who have not heard the amazing stories that happened to Baron Munchausen, described in the book by the German writer Rudolf Erich Raspe, “The Return of Baron Munchausen” [1]. He published these stories back in 1786. In 1791, the book was translated into Russian under the title “If You Don’t like It, Don’t Listen”. This title comes to mind when we read scientific articles in which geophysicists discuss various methods and hypotheses for predicting earthquakes. Here, it should be noted that all serious geophysicists are familiar with the article in the journal *Nature* [2], and from the text of the article, they know that predicting earthquakes is impossible. Still, they, in the spirit of the character of Baron Munchausen, continue to amuse us with amusing stories. At the same time, geophysicists who follow Baron Munchausen claim that all their numerous ideas for successful earthquake forecasting rest on a solid scientific foundation established by Mr. Reid’s Elastic Recoil Theory. And the most astonishing thing about this story is that some geophysicists reject the conclusions drawn from global earthquake forecasting experience and attempt to challenge the fundamental laws of science, while sincerely believing in the possibility of predicting seismic events. This leads to taxpayer money from many countries being spent on ideas and developments that discredit the fundamental principles of science. We have no choice but to demonstrate, once again, the futility and hopelessness of the numerous attempts of those scientists who continue to carry on the work of the oldest geophysicist on Earth, the ancient Greek king of Corinth, Sisyphus, by developing ever-new ideas for predicting seismic events. In this article, we will attempt to refute the conclusions of the followers of King Sisyphus using the theories of self-organizing systems SOC and Lorenz’s “Butterfly,” which have never, anywhere, and by anyone, been refuted.

## Keywords

Earthquake, Earthquake Forecast, Energy, Self-Organized Systems, “Butterfly” by Lorenz

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## 1. Introduction

We've already written about similar works and their creators, even asking the question: who are these noble knights of geophysics, uncompromisingly tilting at windmills, like Alonso Quijano from Miguel de Cervantes' Don Quixote? Are they these magnanimous geophysical romantics, spending their lives pursuing an unattainable victory over the subterranean elements, or are they shrewd businessmen and scientists, living on research grants paid to them from taxpayers' pockets? [3] Despite the contradictions between earthquake forecasting and the fundamental laws of science, there are still scientists who not only believe in the possibility of predicting earthquakes, but also strive with all their might to prove to us the impossible. They believe with every fiber of their being that they hold a joker that will disprove the skeptics and bring them good luck. Let's figure out what this joker's power lies in. What is this card that can ensure not just a win, but a guaranteed victory over the subterranean elements? A closer look at this joker reveals that it is based on a common geophysical hypothesis about the long-term accumulation of deformation energy in rock by the earthquake source. Based on this assumption, forecasters logically conclude that the elastic deformation energy accumulated in some part of the subsurface should cause anomalies that we can detect and respond to. Some forecasters point to the release of large volumes of gases (radon, hydrogen, etc.) before earthquakes. Other researchers point to changes in the ionosphere that can be detected with instruments, thus predicting the timing of tremors. Some geophysicists base their ideas on the strange behavior of insects and animals, such as the shrill croaking of frogs in a local swamp, the barking of dogs, and the panicked expression of cats. Meanwhile, others report the restless behavior of hippos in the Congo River bed before seismic activity in the East African Rift Valley, a 6000-kilometer-long fault where the Nubian and Somali plates are moving apart at a rate of 6 - 7 mm per year. These scientists typically state: "Anomalies can propagate into the surrounding space due to energy generated around the epicenter in the lead-up to the earthquake. All these anomalies suggest the presence of enormous energy production around the epicenter." [4] [5] In other words, they claim that before an earthquake occurs, elastic energy from rock deformations must accumulate at its source, which can be recorded and used to predict the seismic event. But this is not true! Good counterbalances to this assertion are impact earthquakes, in which earthquake energy is generated instantly. They don't realize (or they understand it too well to receive scientific grants) that Mr. Reid's theory, on which all seismology is built, doesn't actually postulate the accumulation of elastic energy in mountain range rocks. Such a thing simply can't happen in nature, because it contradicts the fundamental laws of science—the principle of Minimum System Energy. Otherwise, any 4-billion-year-old tectonic plate could accumulate enough energy to split our planet into several pieces. But the planet's rocks successfully shed excess energy, and our planet thrives, while seismic prediction researchers fail to understand that the principle of Minimum System Energy prevents catastrophic earthquakes. And what leads to a misunder-

standing of the principle of Minimum System Energy? To erroneous conclusions and predictions. The cost of such mistakes is enormous: significant financial resources and years of research wasted that could have been spent on solving the problem of energy and the mechanism of earthquakes, and only then addressing the issue of utilizing this energy [6] [7].

## 2. Theoretical Justification of the Impossibility of Earthquake Forecasting

If a sudden influx of energy appears in the rock mass system, which may occur for various reasons, a non-equilibrium zone will appear in the rock massif. Nature, in accordance with the fundamental principle of Minimum energy of any system, in order to stabilize this zone, will try to return the system to its previous equilibrium state by utilizing “extra” energy through an earthquake or volcanic eruption. This energy is the source of seismicity, *i.e.*, a change in the thermodynamic state of the system leads to the formation of “extra” energy in the rocks of the massif. The problem of understanding the thermodynamic conditions of earthquake energy formation rests on the problem of the subjectivity of the inertial thinking of the geophysical society: the thing is that to this day there is a stereotype in the geophysical environment that accompanies the Second Law of Thermodynamics from the first day it was introduced into the world of science by R. Clausius [8] - supposedly the Second Law of thermodynamics is strictly applicable to isolated equilibrium systems when the mass, energy and configuration of the system do not change, and the time of the system change does not matter. Until the middle of the twentieth century, it was believed that seismic processes were not equilibrium systems, and it was on this basis that the Second Law of Thermodynamics allegedly did not concern seismic processes in any way, which allowed the earthquake source to accumulate energy of elastic deformations for centuries, like an ordinary accumulator. And although the principle of operation of this magic accumulator has in no way been explained by any branch of science (chemical, gravitational, physical, mechanical) or modern geophysics, it is this misconception that has allowed some geophysicists to lead a scientific problem into a dead end. Being at a dead end, the idea of accumulating an array of energy of elastic deformations by rocks has been “multiplying” for more than a hundred years now, in the form of a huge number of different theoretical works that directly and unequivocally contradict the fundamental laws of thermodynamics. By the way, it is precisely this misconception in the foundations of the Second Law of Thermodynamics that has led some scientists, both in the past and in the present, to predict the thermal death of the universe. To be fair, it should be noted that the seemingly simple Second Law of Thermodynamics is actually not as obvious as it seems at first glance, and more than one great scientist has “broken his teeth on it.” The same great Planck, the same great Vernadsky... Currently, this long-standing mistake has finally emerged from the shadow of misunderstanding and has become apparent thanks to the modern development of the theory of nonequilibrium sys-

tems. The pioneer in this direction was the Nobel laureate Lars Onsager and his work in the field of nonequilibrium thermodynamics [9] [10]. It was the Reciprocity Ratio he discovered that changed the idea of equilibrium in the world of science, which unequivocally states that, despite the fact that the molecules of absolutely any system considered on the planet can behave as randomly as possible (chaos), but nevertheless the whole system as a whole can be in an orderly state! Later, another Nobel laureate, Ilya Prigogin, made a significant contribution to the development of nonequilibrium thermodynamics. [11], who developed the concept of spontaneous and spontaneous transition from chaos to the order of open systems far from thermodynamic equilibrium. In 1988, based on their work, a revolutionary model of the transition from chaos to order [12] called the Sandpile was described, which well-illustrated and described the process of self-organization of thermodynamic systems. These systems are called SOC—Self Organized Criticality. Based on this very well-known work, more than 6000+ articles have already been written, which has made it one of the most cited in physics. In the Sandpile model, a stream of sand is poured onto a horizontal plane and when a critical slope angle is reached, the process switches to self-organization mode: “avalanches” slide off the sand slide, and a new portion of sand compensates for sand losses caused by “avalanches”, while the shape of the slide remains constant, *i.e.* chaos spontaneously turns into order. Let’s consider another simple example of self-organization of a Humboldt Prize-winning system [13]: *“Let’s take a resting liquid. It is isotropic, and its properties are the same in all directions. Now let’s make the liquid flow through the mesh screen at a certain speed. Behind the grid, the flow will become turbulent, but the liquid will move in one direction and will cease to be isotropic. If we start increasing the flow velocity, the turbulence in it will increase and eventually reach a level at which the liquid will no longer flow strictly in one direction and will become isotropic again. Thus, the liquid will first change from an isotropic state to an anisotropic one, and then switch back to an isotropic state, and each subsequent stage will be characterized by a time period, process speed, system scale, and a number of additional variables that can be fully determined.”* Based on these examples and the laws of thermodynamics, we can confidently conclude that upon the occurrence of a seismic event, an array of rocks behaves like a Sandpile—SOC system capable of self-organization, in which chaos spontaneously turns into order.

### **3. Theoretical Modeling of Seismic Events Using Sandpile—SOC Systems in the Field of Earthquake and Avalanche Forecasting**

Currently, the SOC system has become one of its main contenders for explaining the mechanism of earthquakes, because tremors demonstrate the results of a power-law distribution of earthquakes according to the Gutenberg-Richter earthquake distribution law, which corresponds to the power-law distribution of SOC systems. Compare:

$$N(s) \propto S - \alpha \quad (1)$$

where,  $N$  is the number of avalanches,  $S$  is the number of grains of sand, and  $\alpha$  is a constant.

In mathematical form, the Gutenberg-Richter law:

$$\text{Log}_{10}N = a - bM, \quad (2)$$

Or

$$N = 10^{a - bM} \quad (3)$$

where,  $N$  is the number of earthquakes,  $M$  is the magnitude, and  $a$  and  $b$  are constants specific to each region. If we express the Gutenberg-Richter law in terms of earthquake energy:

$$E(N) \propto N - \beta \quad (4)$$

where  $\beta$  is a constant and  $N$  is the number of earthquakes with energy  $E$ , we get a mathematical similarity:

$$\langle E(N) \propto N - \beta \sim N(s) \propto S - \alpha \rangle \quad (5)$$

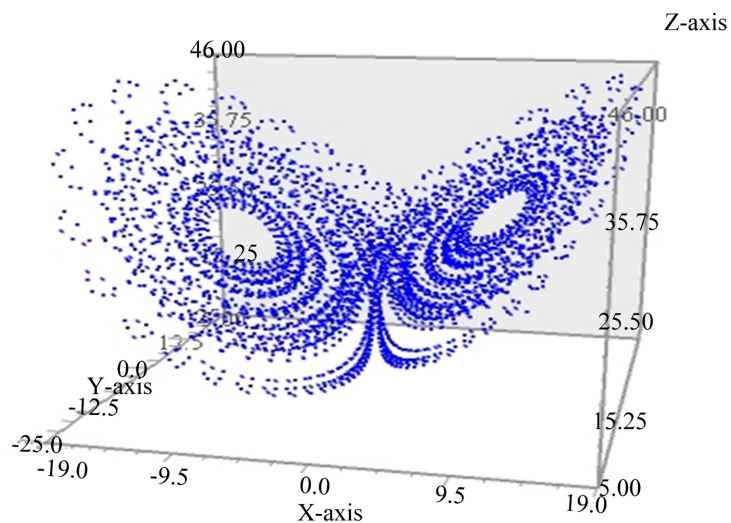
The  $N(s) \propto S - \alpha$  algorithm of the proposed SOC model is easily implemented by computer modeling, which made it possible to widely adopt it for various systems, because the idea of SOC is simple, and most of the models used in its modeling do not pose difficulties for specialists, and “games” in a children’s sandbox do not require financial costs. At the end of the 20th century, with the boom in SOC development, there was hope that within a short time, an earthquake prediction model would be developed based on the Gutenberg-Richter law, and the coveted earthquake algorithm would finally be developed. But it was all in vain. It turned out that it is not possible to create a computer program for a spontaneously organized system, because the SOC model is focused on non-integrated systems. Such systems do not allow the decomposition of the entire system into subsystems, which excludes self-organization. Consequently, the distribution of energy released during earthquakes according to the Gutenberg-Richter power law can be explained by the self-organization of the critical state of the earth’s crust, but it is unrealistic to build a computer program for determining the forecast and strength of earthquakes. Therefore, the Gutenberg-Richter law is a law about the number of earthquakes of different magnitudes, and not the basis for predicting where and when a particular earthquake will occur. At the end of the 20th century, large-scale SOC system modeling projects were carried out, such as the Limits to Growth project, which aimed to create forecasts of global population growth and its impact on natural resource reserves. The project failed. Another project, Global Warming, also “successfully” failed. And this is despite the fact that we have hundreds of weather satellites in Earth orbit, we have a good understanding of weather physics, the aerodynamics of air currents, and we have serious financial support for the implementation of meta-projects. But the project could not be completed, because the result was critically dependent on unpredictable factors. Earthquake forecasts belong to the same category of unpredictable phenomena, despite the

fact that we have a good understanding of solid state physics, geology, the law of Elasticity, calculations of mechanical stresses and the kinematics of plate movement. And all this is because we are dealing with forecasts in a complex system, because even simple mechanical systems, such as pendulums, can behave unpredictably and we do not know where the pendulum will end up after a long time, no matter how easily we solve the equations of its motion and starting position. And then what about the movement of tectonic plates and the reaction of the earth's crust to this process, when one part of the system from the distant past can today affect thousands of other subsystems on the domino principle? On the other hand, the fact that catastrophic earthquakes follow the same laws as weak ones indicates that these events do not have specificity and, despite the fact that earthquakes occur with a well-defined probability according to the Gutenberg-Richter law, this does not mean that such phenomena are periodic. The fact that there has not been an earthquake for a long time does not mean that it should happen in the near future. To think like that is to make a grave mistake, which is clearly demonstrated by the casino and our life experience. For example, after ten consecutive drops of red, there is a 50% chance that black will fall for the eleventh time. The same applies to earthquakes. The fact that events occur at an average interval does not mean that they are cyclical. The recent catastrophic earthquake of 30.07.2025 M8.8 in the Kuril Islands occurred 70 years earlier than predicted by earthquake statistics in this area and claimed by seismologists misled by these statistics. Then why does the topic of earthquake forecasting never leave the pages of scientific journals? It's all about our underestimation of the complexity of the system. We hope and think that the earthquake forecast will comply with our knowledge. We say that we know the complexity of the planet's structure, the complexity of the dynamic interaction of rocks of the earth's crust, mantle and core, the hydrodynamics of underground fluids, etc., but in fact we do not even know the complexity of the forecasting problem and do not understand the main thing—it is impossible to predict earthquakes and even the descent of elementary avalanches in principle. To think otherwise is like arguing with the law of Conservation of energy.

#### **4. Self-Organized Systems and Earthquake Forecasting**

Self-organized systems evolve to a complex critical state without the intervention of any external agent. The process of self-organization takes place over a very long transitional period. The complexity of the behavior of systems, whether in seismology or a plant cell, is always created as a result of a long process of evolution. By studying the development of three generations of chimpanzees, it is impossible to understand the evolution of animal life. The laws of seismicity are also impossible to understand by studying earthquakes that occur only in our foreseeable history, because it is necessary to take into account the geophysical processes that took place over hundreds of millions of years in the past and created conditions for earthquakes in our time. But we don't even know the past of the rock massif,

and until recently, we didn't realize that without this knowledge, the idea of predicting earthquakes is utopia. This was proved by Edward Lorenz, a meteorology and teacher instructor at the U.S. Air Force Engineering Weather Service. In the course of his research, he discovered that the slightest changes in the initial conditions cause large changes in the final result. The discovery was given the name Lorenz and it proved that meteorology, studied before the "holes", cannot accurately predict the weather even today. As it turned out, self-organizing systems are subject to the "Lorenz butterfly" effect, **Figure 1**, and are extremely dependent on initial conditions: small changes in the environment can lead to various consequences, which makes predicting their behavior extremely difficult. Sensitivity to initial conditions in such a system means that there exists a number  $\nu > 0$  such that for any point X and any neighborhood UX there is a point  $Y \in UX$  and numbers  $n \in \mathbb{N}$  such that  $\|f^n(x) - f^n(y)\| \geq \nu$ . Consequently, a minuscule change in the current trajectory can lead to a significant change in its future location and behavior, where the only movement of a butterfly's wing represents a negligible change in the initial state of the system, and causes a chain of events leading to large-scale changes in the distant future.



**Figure 1.** Vogel (Tsiberkin K.B). "The Lorenz Butterfly".

The x, y, and z axes represent weather components, and the graph depicts possible weather conditions. The graph is a function of time, which theoretically means that following the curve in one direction reveals past weather conditions, while following the curve in the other direction predicts future weather conditions. However, practically indistinguishable points can correspond to completely different weather eras, denoted by two separate "wings."

Superimposed on it are not only a sand slide, an avalanche, and an earthquake. Snow on the mountainside exhibits intermittent equilibrium behavior, where periods of rest are interrupted by periodic avalanches. Avalanches are caused by the domino effect, in which one snowflake pushes another or several other snowflakes

and causes them to move other snowflakes. In turn, these snowflakes can interact with other snowflakes in a type of chain reaction (thermodynamics of chain processes). Here, strangely enough, we must realize that the forecast of avalanches currently depends on specific minor events that occurred in the very distant past: when the landscape of a mountain valley was formed millions of years ago, when a steep slope was formed, when this slope was formed by rocks with a low coefficient of friction, when the slope it smoothly passed into the valley when the wind, weather, rains and snow eroded the rocks, when over many millions of years the water of melting snow made its way into the valley and polished the surface of the rocks. Even these initial conditions of an avalanche today, not to mention yesterday's and the day before yesterday's events in the mountains, such as changes in humidity and temperature, ice freezing on the slope wet from the rain before the snowfall, the presence of weak soil brought by water into the valley before the snowfall, is more than enough to make a forecast of avalanches unpredictable. It may happen today, it may happen tomorrow, or it may never happen at all in the next decade. The same picture is emerging for earthquake forecasting. Did seismologists have the opportunity to make a forecast of the Kuril earthquake on 07/30/2025 M8.8? No, because the foundation of this earthquake, according to SOC theory, was laid by nature many millions of years ago with the beginning of the formation of the Kuril Ridge and the Kamchatka Peninsula. Are we aware of the formation features and the geological structure of this region? No! Plus, we did not know the mass of the Pacific Ocean surge on the day of the earthquake, the presence of magnetic storms or solar flares last week, because these and other numerous factors could well have triggered an earthquake. Based on the material presented, we simply have to recognize the unpredictability of earthquakes. And stop spending financial resources on earthquake forecasting projects, and use these funds to design buildings with a high degree of safety. For example, with mechanisms for shock absorption of seismic energy.

## 5. Conclusion

Self-organized systems, in accordance with the "Lorentz Butterfly", evolve to a complex critical state without the intervention of any external agent. Paradoxically, this means that an earthquake can occur at any time for no reason. In fact, there is a reason, but it is hidden from us by events that took place millions of years ago, which we do not know about and will never know. Spontaneous self-organization explains the patterns that exist in nature in a huge range: from the study of the universe and stars to the evolution of life, living cells, volcanism, and earthquakes. Unfortunately, it is not possible to create a computer or mathematical model of such a system with forecast points, since SOC is focused on non-integrated systems, and such systems do not allow the decomposition of the entire system into subsystems, which excludes self-organization and the transition of chaos into order. Based on this, it can be concluded that it is fundamentally impossible to make an earthquake forecast, and the proof of our words is that no one

has yet refuted the conclusions of the theorists of nonequilibrium systems and the Lorentz Butterfly, neither by theoretical modeling nor by practical means. We hope that modern researchers of seismic processes will finally admit that they have no chance of inventing a method for predicting earthquakes, because this contradicts the fundamental laws of science. We do not impose our opinion, but we believe that the funds allocated for earthquake forecasting projects could be used to design a more comfortable living environment, including improving the earthquake resistance of buildings.

### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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