

## CONCERNING THE CONNECTION OF GEOLOGICAL EVENTS AND GLOBAL ECONOMIC PROCESSES: HISTORY AND THE PRESENT

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### ABSTRACT

The paper is submitted for considering the relationship of geological changes and global economic processes. The authors have confirmed that hazardous geological events are a significant factor in influencing world economic processes. The argument is based on the results of consideration of historical and contemporary facts of world socio-economic development. The historical context of the problem is considered on the basis of a generalization of the historical facts of catastrophic events of geological origin, which changed the social movement path. It has been related that disasters caused by geological changes have repeatedly been an obstruction for global economic development. The modern specifics of an influence of dangerous geological events on world economic processes has been established. Thus, it has been determined that the degree of globalization of the world economy has increased so much that the centers of dominance of developed economies naturally determine the influence of major disasters in these regions on the world economic system as a whole. The novelty of this effect has been noted. Thus, prior to our assessment of the impact of the Tahku earthquake on March 11, 2011 on the world economy and regional markets, there were no studies in considered indicators confirming the impact of a major catastrophe in local territories of highly developed states on indicators of the world economy and large regions of the world. That is, before then, global influence from catastrophes of geological nature was determined by large eruptions that changed the planet's climate, which led to significant social changes. At present besides the events of this class, there is one more class of events - powerful catastrophes on local territories of highly developed states.

**Keywords:** global economic processes, geological changes, disasters, socio-economic development

### 1. INTRODUCTION

The relevance of the research is determined by existing contradiction. On the one hand, no doubt that the geological changes largely determine the specifics of evolutionary processes on Earth, as well as the specifics of social development on the whole. On the other hand, a number of researches aimed at studying and assessing an influence of geological changes on social processes, including economies of individual countries and

regions of the world, are rare. We believe it is because of the following factors: interdisciplinary nature of the research; lack of reliable predictions of geological changes that can affect social processes of major world regions; rarity of events that could change the nature of world economic processes. However, it is important to understand the magnitude of possible social changes, in particular the global economy from catastrophes caused by the events of geological nature.

The aim of the study was to confirm that dangerous geological events are a significant factor of the influence on global economic processes.

The research objectives:

1. To determine whether disasters caused by geological changes are in fact a potential obstacle to socio-economic development.
2. To reveal factors that determine the extent of influence of catastrophic events of geological nature on global economic processes.

## **2. METHODOLOGY**

The paper is generalizing, therefore, the methodology is complex and interdisciplinary in nature. The historical context of the problem is considered both by methods of generalization of the historical facts of catastrophic events that changed the trajectory of social movements and by methods of these facts correlating with latest scientific research. To look into determinants of losses from catastrophic events of geological nature for global economic processes the following methods have been used: firstly, both traditional methods and seismological and volcanological theoretical developments. Two approaches are used to clarify the factors that determine the losses from a catastrophic event of geological nature for world economic processes. The first approach – the traditional methods and theoretical developments of seismology, Volcanology, which allow you to accurately determine the place of occurrence of a dangerous event of geological nature. The paper uses the well-known fact that most earthquakes and volcanoes are localized along oceanic depressions confined to subduction zones. Moreover, the strongest earthquakes and volcanic eruptions are also correlated with these zones. To demonstrate this phenomenon, we placed on the world map earthquakes with a magnitude greater than 5 ( $M > 5$ ), which occurred in the period from 1973 to 2018 (built by the authors according to the USGS, shown in figure 1). We also placed strong earthquakes on the world map (built by the authors according to the USGS, shown in figure 2).

Medium-size on strength and weak earthquake occur quite often. Thus, the probability of correct determination of the time of occurrence of the average strength or weak earthquake is high. Strong earthquakes and volcanic eruptions are rare and isolated phenomena. Currently, there are no reliable ways to determine the time of occurrence of such events. But it is the strong earthquakes and volcanic eruptions that pose the greatest danger to the economies of countries and regions of the world.

To understand the potential impact of such earthquakes can be used an analogy the transfer of the facts of the incident of earthquakes in the future. To accumulate such facts, it is important to know the consequences of strong earthquakes for the economy. The need for an accurate assessment determined the feasibility of the second approach - a series of standard methods of financial analysis, summarized in the methodology

applied to the assessment of the Tohoku earthquake effects near Japan 11.03.2011. The study includes comprehensive evaluation with three positions 1) from the standpoint of the impact on Japanese economy (analysis of the national currency, an analysis of GDP dynamics); 2) from the standpoint of the world stock exchanges reaction (analysis of the dynamics of stock market indices and the value of shares of the largest companies in the USA, Japan, and Europe are considered); 3) from the standpoint of the reaction of the global economy branches (the analysis of the behavior of the composite index of industrial activity in sectors of Japan, American, and European).

The substantiation of the initial principles of research, taking into account the problems of interdisciplinary research, was important in the development of the methodology.

1. The principle of dualism is the unity of narrow disciplinary and interdisciplinary approaches and research methods. Thus, both types will be used. The main thing is their constructive interaction for joint understanding, substantiation and production of new knowledge.
2. The principle of adaptation is the process of familiarization of the research participant with the views of participants from other branches of knowledge, adaptation, often, to a fundamentally new content of concepts, processes, and, at the same time, the readiness and search for modifications of disciplinary approaches, methods to the conditions and positions of other project participants.
3. The principle of interdisciplinary tolerance is tolerance to a different worldview, a different system of knowledge and initial settings. It is interpreted not only as tolerance to scientific disciplines, but also to new methodological approaches, non-standard perceptions and hypotheses..

### **3. MAIN RESULTS OF THE RESEARCH**

#### **3.1. The historical facts of the influence of disasters of geological nature on social processes.**

As it has been emphasized in the introduction, it is important to understand the expected scale of changes in the global economy from possible disasters caused by geological changes. Can the disasters of natural character be in fact a potential obstacle to socio-economic development? The generalization of modern geological, historical and economic data has shown that human history is determined by relatively small geological events. Thus, the latest data show that there is reason to believe these events to be the determining factors which interrupted progressive civilizational development and caused the occurrence of cold snap and the plague (hypothesis correlates an epidemic with cold) in the mid-6th century period of the "dark ages" (in historians' terms) [1].

The reason for cooling is described in the Chronicles as the "dusty fog" that enveloped Europe, the Middle East, part of Asia in 536 A.D., caused the beginning of the coldest decades of late 2300 years (the summer temperature in Europe fell to 1.5-2.5 degrees, the snow fell in China). The results of the latest research of ice cores and the results of modeling of air masses movement indicate the cause of the "dusty fog" – the volcanic eruption in Island in 536 A.D. and the re-eruption in 540 and 547 A.D. [2].

The climate disaster caused by the volcanic eruption in Iceland in many respects determined the geopolitical redivision of the world and marked the fall of several civilizations. For example: famine in North China reduced the population by 80 %. It **predetermined the inability to stand up to nomads' raids and long-term** rendering tribute to the Turkic Khaganate; the death and re-formation of sylvula in Eastern Europe (Moshinskaya, etc.); the decline of Teotihuacan (Mesoamerica) - the world's great metropolis as a result of the famine; the decline of the Western Roman Empire etc.

Analysis of ice cores for the purpose of contamination, typical for metal production **revealed the fact that Europe's socio-economic economy** began to rehabilitate itself only after 100 years after the famine in 536 A.D. and the plague epidemic in 541 A.D. [3, 4].

The coldest year in the history of documentary weather observations was 1816 which caused the famine in Europe and America. The increase in grain prices ten times more is also linked to the consequences of the Tambora volcanic eruption (in the island of Sumbawa in Indonesia) [5].

Modern research **concerning the Arctic ice isotopic composition confirm the reason of** such extraordinary cold. It is volcanic eruption [6].

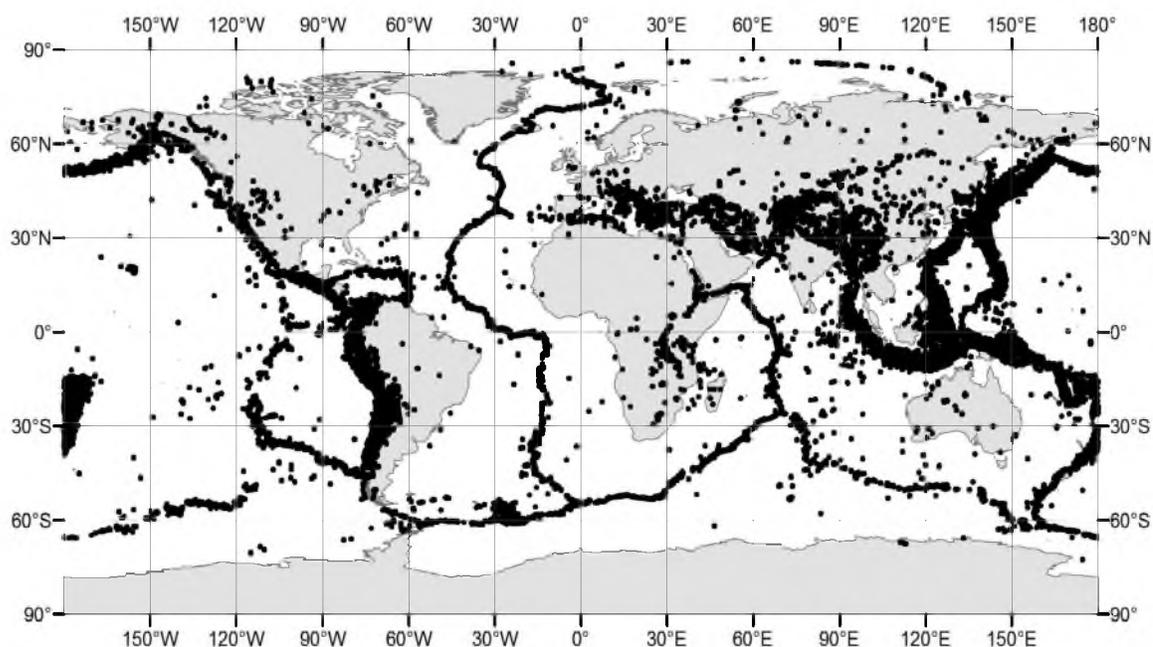
Modern physics describes the mechanism of physical factors and their dependence on the basis of detailed research of eruptions which caused such climatic changes as: ash and sulfur dioxide emission in the upper atmosphere; sulphur dioxide reacts with water vapor, and as a result dense fog forms and it may be present in stratosphere for years; the fog absorbs some solar radiation, but even more one reflects in outer space; the result is the following: rise of temperature of the stratosphere and cooling of the underlying troposphere.

The carried out research make possible to draw up a list of eruptions, which caused global temperature reduction: Tanchoco (1680), Mayon (1766), Pacaya (1755), Cotopaxi (1803), Tambora (1815), hay (1878), Krakatau (1883), a group of volcanoes Mont Pelee (1902), Katmai (1912), Agung (1963), El Chichon (1982) Pinatubo (1991). The studies show that the duration of climatic changes depends on eruption power, its area and atmospheric circulation. A number of research shows that climatic changes usually last for 1.5 - 2 years or more [7].

We should note, that climatologists believe that eruptions can restrain present-day climate warming trend. An example: 1991, The Philippines. The eruption of mount Pinatubo (**according to climatologists' data global atmospheric temperature dropped by 0.25°C.; high aerosol content in the atmosphere persisted for at least 2 years, slowing down the process of global warming**).

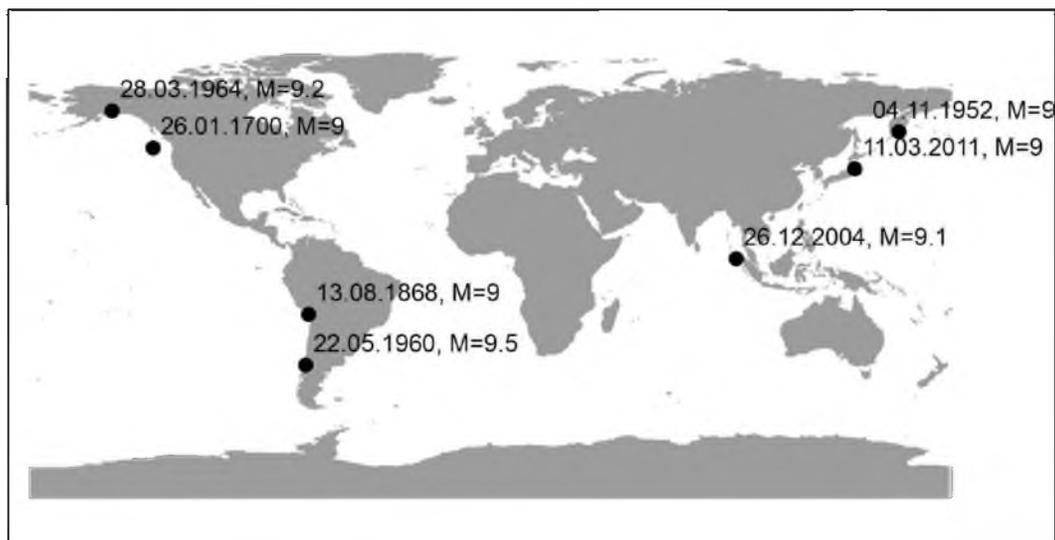
### **3.2. The factors that determine the extent of the influence of disastrous events of geological nature on global economic processes.**

Scientific achievements in the fields of seismology and volcanology make possible to determine places of onset of potential hazardous events of geological nature closely enough. Thus, most of tangible earthquakes and volcanoes are localized along oceanic depressions confined to subduction zones (Fig. 1, 2). The time of occurrence of these events is unknown, but there is no doubt that one day they will occur.



**Figure 1.** Earthquakes from  $M > 5$  occurred from 1973 to 2018 (created by the authors according to the USGS data)

Subduction zones also pass by the most industrialized regions of the world (the west coast of the United States and Canada, the east coast of Japan). In order to prove the increased risks for the entire world economic system from a geological event which is catastrophic for a highly developed state, we appraised the impact of the Takhok earthquake near Japan on March 11, 2011 on the world economy [8].



**Figure 2.** Earthquakes with a magnitude of 9 and higher, occurred since 1700, (created by the authors according to the USGS data)

The assessment was carried out with three positions:

- 1) from the standpoint of the impact on Japanese economy;
- 2) from the standpoint of the world stock exchanges reaction (dynamics of stock market indices and the value of shares of the largest companies in the USA, Japan, and Europe are considered);
- 3) from the standpoint of the reaction of the global economy branches.

The estimates have shown that the earthquake affected not only regional markets deeply, but the entire world economic system as well. The reason is globalization. Thus, it is precisely the place of the catastrophe that determines the extent of its influence on world economic processes.

## **CONCLUSION**

We have confirmed that hazardous geological events are a significant factor in influencing world economic processes. This statement is based on historical and modern facts of world socio-economic development. In fact, our studies have shown that the degree of globalization of the world economy has increased so much that the centers of dominance of developed economies naturally cause the impact of major disasters in these regions on the global economic system as a whole. The novelty of this effect is worth noting.

Thus, prior to our assessment of the impact of the Tahku earthquake on March 11, 2011 on the world economy and regional markets, there were no studies in considered indicators confirming the impact of any major catastrophe (concerning local territory of a highly developed state) on indicators of the global economy and large regions of the world. That is, before then, global influence was determined, for example, by large eruptions that changed the planet's climate, which led to crop failures on a substantial part of the planet. At present besides the events of this class, there is one more class of events - powerful catastrophes on local territories of highly developed states that can affect the global economic system. Thus, the extent of influence of dangerous events of a geological nature on world economic processes depends on places of disasters.

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