CLASSIFICATION OF HAZARDS. POINT OF VIEW

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Abstract. **Classification of hazards. Point of view**. The classification of hazards is a necessity determined by the origin and the multitude of phenomena and processes approached in the study of risks, as well as by their location. The classification of hazards is very difficult due to the complexity of the underlying phenomena and the relationships at the level of geosystems. As a result, the first part of the paper analyses in detail the criteria for classifying hazards (genetic, typological phenomena, spatial, temporal, mode of manifestation, impact, effects produced, etc.), which allow the delimitation of types and subtypes. In the second part of the paper, starting from the mentioned criteria, we proceed to the classification of hazards.

INTRODUCTION

The classification of hazards is very difficult due to the complexity of the underlying phenomena and the relationships at the level of geosystems. As a result, the hazard classification criteria are multiple, allowing the delimitation of types and subtypes. The criteria used to classify hazards vary from author to author. By combining the various criteria, there is a multiplication of the categories of hazards. Depending on the number of criteria used, uni-criteria and multi-criteria classifications are distinguished.

RESULTS AND DISCUTIONS

Criteria used in the classification of hazards

The criteria used to classify hazards vary from author to author. Depending on the number of criteria used, there are uni-criteria and multi-criteria classifications. From the multitude of criteria used in the classification of risks in the first place are the genetic and typological criteria, which are, in general, related to the area in which they occur. By combining these criteria, there is a multiplication of hazard categories. Other criteria commonly used in the classification of hazards are the following: spatial, temporal, dynamic, the typology of the probable impact, the size of the induced effects and the environment in which they occur.

Bogdan Octavia (1996) developed a conceptual model that reflects the classification of hazards and risks by genesis. The model also includes the main subdivisions of major hazards (natural, anthropogenic and ecological) and even the effects they induce.

Table 1. Classification of hazards after Bogdan Octavia (2007), with additions

Criterion	Type of hazard	Subtype of hazard	Phenomena and processes associated with the type of hazard
1	2	3	4
Genetic and type of agents	Endogenous	Volcanism	Burning clouds, falling solid materials, toxic gas emissions, basic and acid lava leaks, lahars
		Earthquakes	Oscillatory movements, fractures and deformations of the bark, Soil liquefaction, landslides, underwater movements, avalanches, tsunamis and earthquakes
	Exogenous	Pedo - geomorphic	Water erosion: surface and deep Erosion and wind accumulation Mass movement processes Sedimentation and clogging Processes of complex soil degradation (compaction, salinization, alkalization, sanding and stagnation)
		Hydro-climatic	Absolute extreme temperatures and thermal anomalies Torrential rainfall Drought and drought phenomena Thunderstorms, tornadoes and cyclones Other phenomena with special impact Floods
		Biogeographic and biomedical	Diseases caused by various pathogens. Invasion or proliferation of pests
		Environmental	Ozone depletion, Global warming, Climate anomalies, Desertification
	Extra-terrestrial	Astrophysical	Meteorites, comets
Spatial	Affected surface	Global and systemic	Trend of climate heating, reduction of ozone layer, trend of Planetary Ocean level rising
		Global with regional effects	Desserts, soil erosion
		Local or punctual	Hail, rain showers
Temporal	Duration	Rapid	Earthquakes, tornadoes, floods
		With long development in time	Droughts, rising of Planetary Ocean level
Dynamic	Speed and precision of propagation in due time	Natural hazards which can be forecasted with high, medium and low precision	Slow flooding
		Natural hazards which cannot be forecasted or	Flash flooding

		only a few moments before its beginning	
1	**2**	**3**	**4**
Typology of probable impact	Way of manifestation	With rapid impact	Earthquakes, Plinian and Ultralpine eruptions
		With progressive impact	Slow floods, landslides, drought
		With slow cumulative impact	Soil erosion, the greenhouse effect and global warming, the destruction of the ozone layer
	Intensity	Low	Which do not exceed the internal recovery capacity of any system with medium vulnerability
		Medium	Exceeding the internal recovery capacity, but not the tolerance limits of a medium vulnerability system
		High	Exceeding the tolerance limits of a socially economic system with medium vulnerability
	Area of manifestation	Local	Landslides, liquefaction of shallow deposits
		Regional	Earthquakes, droughts, tropical cyclones, etc.
		Global	The greenhouse effect and global warming, Destruction of the ozone layer
Size of effects produced	Reduced		
	Severe		
	Disaster (Catastrophe)		
The environment in which they occur	Atmospheric		
	Marine		
	Continental		
	Costal		

Classification of hazards.

Most authors accept, depending on the **genesis**, several categories of hazards: natural, anthropogenic and complex. Depending on the genesis, the hazards were classified by Bogdan 0ctavia (1996) in: natural, anthropogenic, ecological and complex. Mitchell and Cutter (1999) cited by Dana Goţiu and V. Surdeanu (2007), using the same criteria, classify hazards into: natural hazards, caused by extreme and common natural phenomena, by biological agents (epidemics, pest invasions, etc.). Based on the same genetic criterion, the hazards were classified by Bălteanu and Rădiţa (2001), Bălteanu and Şerban Mihaela (2005) and Stângă (2007) into natural (endogenous, exogenous), anthropogenic and complex, which in turn were grouped in both depending on the systemic element whose dynamics induce the manifestation of hazard, as well as depending on the agent that triggers and maintains it (Table 1). The category of endogenous hazards includes volcanism and earthquakes or earthquakes. The

phenomena and processes associated with these types of hazards are multiple (Table 1). The category of **exogenous hazards** includes several types and subtypes: geomorphic and edaphic (degradation of lands by displacement and soils by erosion and complex processes associated with excess moisture and compaction, salinization and acidification processes), atmospheric (wind, thermal, pluviometric and associated with electrical atmospheric phenomena, condensation and freezing processes), continental water (extreme, dynamic, stationary and interference), and coastal and oceanic (dynamic, mechanical and interference). Environmental hazards include two subtypes: global (global warming and desertification) and regional (drought and wildfires).

Spatial and temporal criteria are also commonly used in hazard classification. Thus, according to the affected area, Bălteanu and Rădiţa (2001), Bălteanu and Şerban, Mihaela (2005) classify hazards into: global systemic (climate warming trend, ozone depletion, planetary ocean rising trend); global with regional effects (desertification, soil erosion); local or occasional (hail, showers, volcanoes, landslides).

The used temporal criteria include duration, speed and frequency. According to the duration, the hazards were classified into: rapid (earthquakes, tornadoes, floods) and over time (droughts, raising the level of the Planetary Ocean).

Depending on the **speed, the accuracy of the propagation in due time**, the natural hazards were grouped by Florina Grecu (2004) in: natural hazards that can be predicted (with high, medium, low precision); natural hazards that cannot be predicted or are predicted shortly before triggering.

Depending on the frequency in an area, natural hazards can be categorized into: very frequent, frequent, relatively frequent, medium frequency, rare and very rare (Florina Grecu, 2004). The average annual number of natural hazards is the highest in Asia and the lowest in Oceania and Europe.

Newer and more complex classifications have been made based on the **impact** on humans, using combinations of different scales (in the case of earthquakes the Simson, Mercalli and Richter scales). This method can include either a damage index, which incorporates loss of life: property damage ratios or a damage index based on the magnitude and frequency of unforeseen events. The typology of the impact probably represents an important criterion in the classification of hazards, because it highlights the way of manifestation, the intensity and the area of manifestation of the impact produced by an extreme natural phenomenon. According to the mode of manifestation (appearance and propagation over time), natural hazards were grouped into three categories: hazards with rapid, progressive and cumulative impact.

Depending on the likely area of impact, the hazards were grouped into hazards with local, regional, and global impacts. Depending on the magnitude of

the effects produced (people affected, economic damage, environmental damage) the hazards can have small and severe effects.

Depending on the **environment** in which the natural hazards occur, they have been grouped into atmospheric, marine, continental and coastal.

Bryant (1991) elaborates a classification according to characteristics and impacts, ordering the events according to their gravity. Drought, tropical cyclones, regional floods follow the first places, and the last places are muddy and rocky flows, excess moisture and rock falls.

The most popular multi-criteria classification is based on 9 criteria and was developed by E.A. Bryant (1991) and is a ranking of the 31 most important extreme events. The criteria used were: the severity of the phenomenon, the duration, the total area affected the total loss of life, the total economic loss, the social effect, the long-term impact, the rate of onset, the number of associated hazards.

The ranking was made by assigning grades for each natural event, from 1 to 5, in which 1 is the most severe situation, and 5 is the least severe situation. These grades were awarded for each of the 9 chosen criteria, and the hierarchy number was obtained by mediating the 9 grades.

CONCLUSIOS

The complexity of the underlying phenomena and the relationships at the level of geosystems make the classification of hazards very difficult.

The criteria used in the classification of hazards are numerous and differ from one author to another. Most authors appeal to the genetic criterion and typology of agents. Other criteria are used: spatial, temporal, dynamic, the typology of the probable impact, the size of the effects produced, and the environment in which they occur.

Multi-criteria classifications and the ranking of hazards are relatively few, although they are very useful in practice because they represent the concrete situations in the field that extreme phenomena can induce.

REFERENCES

1. Alexander D. (2002), *Natural Disasters,* Ediţia a IV-a, Routledge, London and New York, 632 p.
2. Armaş, Iuliana (2006), *Teorie şi metodologie geografică*, Edit. Fundaţia "România de Mâine", Bucureşti.
3. Bogdan Octavia, (2017), *Bazele teoretice ale climatologiei*, Edit. Transversal, Târgovişe. 508 p.
4. Bryant, E. (2005), *Natural Hazards,* Second edition Cambridge Univ.Press, 312 p.
5. Cheval, S.,(1999),*Clasificarea hazardelor naturale*, în "Comunicări de geografie", III, p. 269-276

6. Ciulache, S., Ionac, Nicoleta. (1995), *Fenomene geografice de risc,Partea I-a,* Edit. Universităţii din Bucureşti, 152 p.
7. Dauphiné A. (2001), *Risque et catastrophes*,*Observer, spatialiser comprendre, gérer* Armand Colin, Paris, 288 p.
8. Goţiu, Dana, Surdeanu, V. (2007), *Noţiuni fundamentale în studiul hazardelor naturale*, Edit, Presa Universitară Clujeană, Cluj-Napoca, 142 p.
9. Grecu, Florina (2009) *Hazarde si riscuri naturale*, Editura Universitară. Bucureşti
10. Hewitt, K. (1997), *Regions of risk. A geographical introduction to disasters,* Longman.
11. Hyndman, D., Hyndman, D. (2006), *Natural Hazards and Disasters*, THOMSON Brooks-Cole, Belmont, SUA, 510 p.
12. Ianoş, I. (1994), *Riscul în sistemele geografice*, S.C.G.G.G-Geogr. XLI.
13. Ianoş, I., (2000), *Sisteme teritoriale. O abordare geografică*, Editura Tehnică, Bucureşti,
14. Keller, E.A., Blodgett, R.H. (2008), *Natural Hazards. Earth's Processes as Hazards, Disasters, and Catatrophes*. Pearson, Prentice Hall, 395 p.
15. Moldovan Fl. (2003), *Fenomene climatice de risc.* Edit. Echinox, Cluj-Naopuca, 209 p.
16. McGuire, L. C., Mason, I. and Kilburn, C.(2002), *Natural hazards and Environmental changes,* Oxford University Inc.New York, 147p.
17. Rădoane, Maria, Ichim, I., Rădoane, N., Dumitresu, Gh., Ursu, C. (1996), *Analiza cantitativă în Geografia fizică,* Edit. Universităţii "Al.I. Cuza", laşi, 250 p.
18. Smith K. and Petley, D.N. (2009), *Environmental hazards. Assessing risk and reducing disaste*r, Fifth Edition, Routledge, London, 383 p.
19. Skinner, M.(2003), *Hazards*, Hodder Murray, London, 134
20. Sorocovschi, V., (2016), *Riscuri naturale, Aspecte teoretice şi aplicative*, Edit. Casa Cărţii de Ştiinţă, Cluj-Napoca, 174 p.
21. Sorocovschi, V., (2017), Fenomene şi procese hidrice de risc. Partea I. Domeniul continental, Edit. Casa Cărţii de Ştiinţă, Cluj-Napoca, 363 p.
22. Sorocovschi, V. (2018), Fenomene şi procese hidrice de risc. Partea II. Domeniul costier şi oceanic, Edit. Casa Cărţii de Ştiinţă, Cluj-Napoca, 225 p.
23. Sorocovschi, V. (2021), Fenomene şi procese naturale de risc, , Edit. Casa Cărţii de Ştiinţă, Cluj-Napoca, 516 p
24. Stângă I. C. (2007), *Riscurile naturale, Noţuni şi concepte*. Edit. Universităţii "Alexandru Ioan Cuza ", Iaşi, 112 p.
25. Tobin, G. A., Montz, B. E. (1997), *Natural Hazards. Explanation and Integration.* The Guildford Press, New York,.388 p.
26. Voiculescu, M. (1995), *Tipologia fenomenelor geografice de risc*, Analele Universităţii din Oradea, Geografie, t. **V**, p. 37-43.
27. White, G. F. (ed.) (1974), *Nature Hazards Research: Concepts, Methods and Policy Implications*. In White, G.F (Ed.), Natural Hazards: Local, National, Global, Oxford Univ. Press, London, Toronto, New York, 290 p.
28. * * (2010*), Natural Hazards and Natural Disasters The Economics of Effective Prevention,* The United Nations, the World Bank Washington, DC, 254 p.