

EXPERIENCE OF CREATING AN ATLAS OF HAZARDS AND EMERGENCIES IN THE RUSSIAN FEDERATION

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Abstract: The specialists of the Ministry of Emergency Situations of Russia together with scientists from the Russian Academy of Sciences conducted an analysis of possible crises and threats that are relevant to Russia at the beginning of the XXI century: natural hazards, man-made hazards, environmental risks, social risks, risks arising from the military operations, as well as terrorist threats. As the result an atlas of hazards and emergency situations in Russia was created, which allows the assessment of the risks and extent of emergencies in specific areas. The appearance of the atlas was preceded by the release of individual maps on the territory of Russia: the maps of fires, floods, earthquakes and other hazards. In Russia in the natural area the most dangerous are floods, hurricanes, typhoons, storms, earthquakes and droughts; in the man-made area – large fires, accidents at potentially hazardous facilities and electric power systems. The situation is complicated by the significant depreciation of productive assets and a reduction of the technological discipline in large industrial plants.

Keywords: atlas, emergencies, natural hazards, Baikal Nature Territory

Introduction

The maps of natural disasters are widely used by geographers all over the world (Berz et al 2001). Natural disaster is an extraordinary natural phenomenon that leads to the disruption of the ordinary activity of the population, loss of life, and destruction of property. Natural disasters can be both independent and interrelated, one of them may cause the other. Some of them are often the result of human activity, for example, forest and peat fires, industrial explosions in the mountainous area during the construction of dams and quarrying, which often leads to landslides, avalanches etc. Regardless of their origin, natural disasters are characterized by substantial size and different lengths – from a few seconds

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and minutes (earthquakes, avalanches, limnological catastrophes) to several hours (mudflows), days (landslides) and months (floods).

In modern Russia, there is a trend of increasing rate of production in the industrial sectors of the economy, especially in material ones. However, the scientific and technological progress connected with commercializing of the increasing number of natural resources, the use of increasingly complex technological systems, energy consumption growth, at the same time increases the probability of natural and man-made disasters and accidents. Petrova E. (2005) rightly points out the increase of environmental risk of natural disasters.

The range of developing modern strategic risks that require an adequate response at the national or international level is quite wide: from global climate change and upsetting of military-political parity to the national demographic decline and problem of deterioration of productive assets. The ability of the state and society to recognize the prerequisites of crisis in time and to deal with them effectively is a key task of ensuring national security in the strategic planning of the socio-economic development (Porfiriev, 1996).

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Research Methods

Rodkin M.V. (2003) gives a complete classification of natural disasters. Among all the natural processes and disasters there are many linkages. One disaster can influence and cause the others. The closest interaction is observed between earthquakes and tsunamis, volcanic eruptions and fires. Earthquakes can also cause landslides. Those, in turn, can block the river valleys and cause flooding. There is interrelation between earthquakes and volcanic eruptions: there are earthquakes caused by volcanic eruptions, and, conversely, volcanic eruptions caused by the rapid movement of the masses under the surface of the Earth. Tropical cyclones almost always cause both river and sea flooding. Atmospheric disturbances and heavy rains can affect the heel-creep. Dust storms are a direct result of atmospheric phenomena.

In the List of hazards and their criteria, approved by Roshydromet (Federal Service for Hydrometeorology and Environmental Monitoring), there are the main criteria of the processes and phenomena as hazardous. The notes to this list indicated that the territorial departments of Roshydromet must make updated

lists based on the characteristics of the region. Analysis of the criteria of the risk of the hydrometeorological events over all territorial departments of Roshydromet shows that the differentiation of the hazard criteria of all phenomena, except the temperature ones, is not performed.

Mapping of natural hazards and emergencies results in fixing of their place, severity and action force, impact of natural hazards on the one or the other branch of human activity, the risk of hazardous processes and phenomena in the future.

The main content of maps in the atlas, their general geographic basis, the thematic content, the principles of localization of emergencies vary depending on the function of a map. Maps for assessment of the natural conditions of emergency can be used by Roshydromet, scientific and project organizations. In this case, the determination of only general laws of emergency in a variety of physical and geographical conditions is possible. To analyze the causes of hazards that led to the emergencies it is necessary to accurately reflect the boundaries of the area affected by emergencies.

Maps for estimation of the parameters of emergencies and their analysis have practical significance. Evaluation of emergencies, such as the dynamics in time, the magnitude of the impact of the distribution on the territory of Russia, can be used by different organizations - the Ministry for Emergency Situations, Roshydromet, insurance companies. These maps are highly informative and based on the most current information.

Maps for the economic evaluation of consequences of emergencies are the most important for insurance companies, administrations of the federal subjects, the Ministry of Emergency Situations. They allow economic assessment of damages from natural emergencies.

General maps of the distribution of emergency situations have informational and educational purpose and can be used by a wide audience of non-specialists, including schoolchildren and students. Neither social nor a natural component of the phenomenon is a priority, the map should be highly informative, but easy to read and not overloaded with content.

Question of spatial localization of emergency is closely connected with the way of information mapping. Localization of emergencies in the points is possible by using the icons, which are used for mapping objects, localized in points, and not reflected in the scale of the map. With a large number of emergencies of different origin in a limited area, their localization in the points and display by

icons can lead to difficulties in the perception of cartographic material. The icons usually show the severity of the emergency.

If there is information about emergencies in the federal subjects, there is binding to the entire area of the administrative region using the method of cartodiagram for absolute indexes or cartogram for relative ones. In cases where there was more information about the location of emergency situations, as a way of mapping the habitats were used. In some cases, there was a linear localization of emergencies, so linear maps signs were used. It is applied for emergencies caused by events such as complex deposition or flooding.

The authors participated in the summer and winter expeditions in the Baikal Nature Territory. Researches in the field are focused on the identification of areas of activation of exogenous geological processes – landslides, mudslides, collapsing of river banks and reservoirs, and mud-streams of quarries and pits, chasms, soil erosion, and enhance areas of geodynamic processes and permafrost deformation processes – heaving, thermokarst, solifluction.

When creating maps of the atlas the methods related to remote sensing of the Earth were used (Joyce et al, 2009),

Hazards and natural disasters in Russia in the Baikal Nature Territory

The most common cause of natural emergencies in Russia are: floods – 35%, hurricanes, tornadoes, storms – 19%, heavy rains – 14%, earthquakes – 8%, heavy snowfall, blizzards – 7.5%, landslides, mudflows – 5%, i.e. emergencies of hydrometeorological origin dominate in Russia – more than 82%.

On the territory of Russia the seismic belt runs across virtually over the entire south of the Caucasus to Kamchatka (Razumov et al, 2010). About 40 percent of the country, where more than 20 million people live, is seismically unsafe. There is high probability of earthquakes with an intensity of more than 6 points. The situation is exacerbated by the fact that more than 20 percent of the territory of the Russian Federation, where nuclear, hydro and thermal power plants and other facilities with high environmental risk operate, is in areas of high seismic risk. In the ten-point zone there are Chirkeytsky, Miatlinsky, Chiryutsky hydroelectric power plants, in the nine-point zone – Bilibinsky nuclear power plant, Sayano-Shushinsky, Belorechensky, Irkutsk, Kolyma and Ust-Srednekansky plant, in eight-point zone – Zeysky hydroelectric power plant. Dozens of hydro and thermal power plants are located in the seven-point zone, including alpine Krasnoyarsk hydroelectric power station, Novovoronezh and Kolsky nuclear power plant.

Exposure of the territory of our country to dangerous exogenous geological processes and phenomena, as well as the intensity of these processes increases from north to south and from west to east. Landslide-prone areas cover about 40 percent of the area of Russia. The most dangerous are landslides on the territory of 725 cities in the North Caucasus, Kamchatka, Sakhalin, in the Trans-Baikal region, the Volga region. As for avalanches, the emergencies most often occur from December to March in the North Caucasus, the Altai, Sakhalin and in the Trans-Baikal region. The maximum amount of snow avalanches in the North Caucasus and the Altai can reach several million cubic meters. In areas of high snowfall (the North Caucasus, the Altai, the Sayan Mountains, Sakhalin, Khibiny, Northern Urals, Sikhote Alin, Kamchatka, Koryak Highlands) there is a risk of several avalanches in the winter from one avalanche catchment. The greatest risk of avalanche mass, a kind of "avalanche disaster". In all mountain areas, they may occur on average once every 7-10 years.

Hazardous slope processes include mudflows, which are divided by experts according to their composition into water and snow, mud and debris flows. 20 percent of the country is mudflow dangerous districts, most mudflow areas - the North Caucasus, the Altai, the Sayan Mountains, Baikal and Trans-Baikal, Kamchatka and Sakhalin. Surging glaciers are also very dangerous. Thus, the sharp movement of the Kolka glacier in the Karmadon canyon in North Ossetia, which occurred in September 20, 2002, caused a huge water-ice-stone rural sweeping through the valley of the Genaldon river for almost 15 kilometres. Then more than a hundred people were killed, the village of Nizhny Karmadon and several recreation centers were destroyed.

Dangerous erosion processes are widespread in Russia. The sheet erosion is widespread, where there are intense rainfalls, it has already affected 56 percent of farmland. The most intensively gully erosion is developing in the Central Black Earth region of the European part of Russia.

Almost every year in our country there are major floods, and by the area of covered territories and property damage inflicted by these natural disasters they are superior to all others. There is a risk of flood to the territory of 400,000 square kilometres, the area of about 50,000 square kilometres is flooded every year, i.e. more than 300 cities, dozens of thousands of small towns with a population of over 4.6 million people, many commercial facilities, more than 7 million hectares of farmland may be under the water at different times. According to experts, the average annual flood damage is about 43 billion rubles.

Among meteorological natural hazards there are squalls, hurricanes, typhoons, hail, tornadoes, catastrophic storms, thunderstorms, blizzards, snowfalls. Most often heavy snowfalls occur in mountainous and coastal areas characterized by intense cyclonic circulation. Such areas include the North Caucasus, the Altai and Western Sayan Mountains, Primorye, Kamchatka, and the Sikhote Alin mountain range. Repeatability of heavy snowfalls is here more than once a year, and in Kamchatka 5-8 times per year. In the European part of Russia frequency of snowfall is much less – every 2-10 years.

Droughts are very dangerous by their consequences. Most of all the Volga Region and North Caucasus suffer from these dangerous natural phenomena observed there every 2-3 years. Droughts are usually accompanied by large-scale fires, causing enormous material damage, especially to the regions of Siberia and the Far East. The situation is aggravated by the ineffective response – all fire prevention measures are expensive, and local authorities are not always willing to spend money on preventative measures. For this reason, monitoring of forest fires is conducted only in the zone of active protection of forests, covering 2/3 of the total forest area of the country. The average area of a fire is several times larger than in Western Europe and North America, which only confirms the low level of fire protection of forests in our country.

The increased level of vulnerability of the area to natural emergencies is typical for the Irkutsk region and the Republic of Buryatia, Trans-Baikal region. The largest number of emergencies in the Siberian Federal District is in the Trans-Baikal region (wildfires and strong winds), the Republic of Buryatia (wildfires), Irkutsk region (wildfires and spring tide).

High seismicity is typical for different mountain areas of Trans-Baikal and Baikal rift zone. The last major earthquake in the Baikal natural territory occurred in August 27, 2008 with force of 8.5-9 points in the epicentre. The danger of avalanches is estimated from medium to very high in the north-eastern and south-western part of the Baikal Nature Territory. These same areas are under the risk of mudslides. Manifestations of dangerous landslides are observed on the southern shore of Lake Baikal. The largest areas affected by karst processes are located in the Irkutsk region. Thermal karst formation is possible in areas of permafrost (Anisimov & Reneva, 2006), also due to the climate change (Nelson et al, 2002).

Conclusion

One of the biggest challenges today is to bring together specialists of different levels, researchers and practitioners in the development of organizational, theoretical, methodological and technological basis of prediction and prevention of catastrophic natural phenomena, man-made disasters, accidents, and potential emergency situations caused by these phenomena and threatening of severe economic, social and environmental impacts.

The reliability of maps of natural emergencies depends on the source of information about them and ways of displaying emergencies on the maps. Improper positioning of emergency situations can lead to an underestimation of exposure of the region to natural hazards and to errors in the analysis of spatial and temporal distribution of emergencies, serious economic losses.

The Atlas of natural and man-made hazards and risks in the Russian Federation has become an important component in the prevention of accidents and disasters. The material presented in this Atlas will enable managers at federal, regional and municipal levels, specialists and scientists, insurance companies, investors, students to use them in their daily work and study, to carry out socio-economic planning and management of territories and sectors with taking into account natural and man-made hazards and risks of emergencies.

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References

- Anisimov, O., & Reneva, S. (2006). Permafrost and changing climate: the Russian perspective. *AMBIO: A Journal of the Human Environment*, 35(4), 169-175.
- Berz, G., Kron, W., Loster, T., Rauch, E., Schimetschek, J., Schmieder, J., ... & Wirtz, A. (2001). World map of natural hazards—a global view of the distribution and intensity of significant exposures. *Natural hazards*, 23(2-3), 443-465.
- Joyce, K. E., Belliss, S. E., Samsonov, S. V., McNeill, S. J., & Glassey, P. J. (2009). A review of the status of satellite remote sensing and image processing techniques for mapping natural hazards and disasters. *Progress in Physical Geography*, 33(2), 183-207.
- Nelson, F. E., Anisimov, O. A., & Shiklomanov, N. I. (2002). Climate change and hazard zonation in the circum-Arctic permafrost regions. *Natural Hazards*, 26(3), 203-225.
- Petrova, E. (2005). Natural hazards and technological risk in Russia: the relation assessment. *Natural Hazards and Earth System Science*, 5(4), 459-464.

International Conference “Natural Hazards – Links between Science and Practice”

Porfiriev, B. N. (1996). *Social Science Research on Mitigation of and Recovery from Disasters and Large Scale Hazards in Russia*.

Rasumov, V. et al (2010). *The Atlas of hazards and emergency situations in the Russian Federation*.

Rodkin, M. V. (2003). Classification of catastrophic impacts due to natural hazards. *Natural hazards in Russia*, 6, 85-102.