Engaging the Public to Fight the Consequences of Terrorism and Disasters
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Increasing Public Awareness of Different Types of Geophysical Catastrophes, Possibilities of Their Initiation as a Result of Terrorist Activity, Methods of Protection and Fight With Their Negative Consequences

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Abstract. General information about natural disasters is outlined. Special attention is given to the description of geophysical type catastrophes (including in Georgia), possibilities of their artificial initiation for military purposes, measures for prevention and methods of reduction of their negative action on the living environment of peoples.

Keywords. Geophysical catastrophes, geophysical weapon, prevention of catastrophes.

Introduction

A natural catastrophe is a complex and interrelated manifestation process of simultaneously or consecutively whole series of associated dangerous phenomena and processes.

Emergency situations of natural character threaten inhabitants of our planet since the beginning of civilization. The extent of damage depends on intensity of natural disasters, a level of development of society and activity conditions.

75,000 people perished yearly average in the last decade, as a result of natural catastrophes in the world. Natural catastrophes are terrible by their unexpected contingency - for the short time interval they can devastate territory, destroy dwellings, property, communications. Others can follow one catastrophe: hunger, infection, disease.

In the recent years, the number of emergency situations of natural character tends to grow. Actions of volcanoes become more active, their destructive force increases. Almost regular are floods, landslides along rivers and in mountain areas are frequent. Ice, snow drifts, storms, hurricanes and tornadoes in different places of the earth occur

annually. A number of accidents can be predicted, and some of them may be even successfully prevented. However, it requires a profound knowledge of the reasons of their emergence and manifestation nature.

A role of anthropogenic influence on manifestation of natural emergency situations should be mentioned without a doubt. According to the international statistics, about 80% of landslides are connected with human activity. As a result of deforestation activity, a number of mudflows increases, as well as the flood volume.

Nowadays a scale of use of natural resources has significantly increased, as a result of still noticeably to be shown lines of global ecological crisis. Thus, if in manifestation of natural disasters it is possible to regulate level of anthropogenic intervention, their purposeful initiation in the terrorist purposes constitutes a special danger.

Therefore, an important task of the relevant government institutions and experts is to raise public awareness of various types of natural disasters, possible dangers of their initiation as a result of economic activity of a person and terrorist attacks on environment, and also measures of protection and fight against negative consequences of these accidents in case of impossibility of their prevention [1-5].

Some general information about natural disasters is given below. Special attention is paid to the description of accidents of geophysical type (including in Georgia), opportunities of their artificial initiation, measures of prevention and ways of decrease in their negative impact on habitat of the person.

1. Short characteristic of natural disasters

Emergency situations of natural character can be of the following types: geological, meteorological (atmospheric), hydrological, heliogeophysical, space – further – geophysical; natural fires, biological.

To geophysical hazards belong the following: earthquakes, eruptions of volcanoes, landslides, mudflows, avalanches, mountain collapses; strong wind (storms, hurricanes, tornadoes, blizzards, etc.), intensive or long precipitation (rain, snow, hail), fogs, thunder-storms, high level of ultra-violet radiation, extreme air temperatures, droughts, etc.; floods, sea storms, typhoons, tsunami, intensive drift of ices, etc.; magnetic storms, falling of meteorites, cycles of solar activity, etc. [1].

It is possible to add a smog to the group of geophysical accidents of natural and anthropogenic character. In the cities with high level of air pollution there can be very hazardous to health and lives of people smog types, depending on atmospheric conditions (the London type of smog, photochemical smog, etc.) [6, 7].

Natural fires can be forest fires, fires of steppe and grain massifs, peat and underground fires of combustible minerals. Forest fires - the most widespread phenomena. People appear responsible for disaster in 90 – 97%. The share of fires from lightning makes no more than 2% of total.

Natural emergency situations submit to some general regularities:

- each form of the emergency situation has a specific three-dimensional confinement;
- the more intensive (power) natural hazard, the less often it happens;
- each emergency situation of natural character is preceded by some specific signs (harbingers);

- unexpectedness of a particular natural emergency situation in its manifestation can be predicted;
- in many cases passive and active protective measures from natural dangers can be provided.

Usually, there are interconnection natural disasters. The closest dependence between earthquakes and tsunami, earthquakes and landslides, etc. Tropical cyclones almost always cause floods. Floods, avalanches, mudflows, landslides are also closely connected with a plentiful or long atmospheric precipitation (fig. 1). To the listed accidents other influences connected with human activity are added too. Earthquakes cause fires, gas explosions, breaks of dams. Volcanic eruptions lead to poisoning of pastures, death of cattle, hunger.

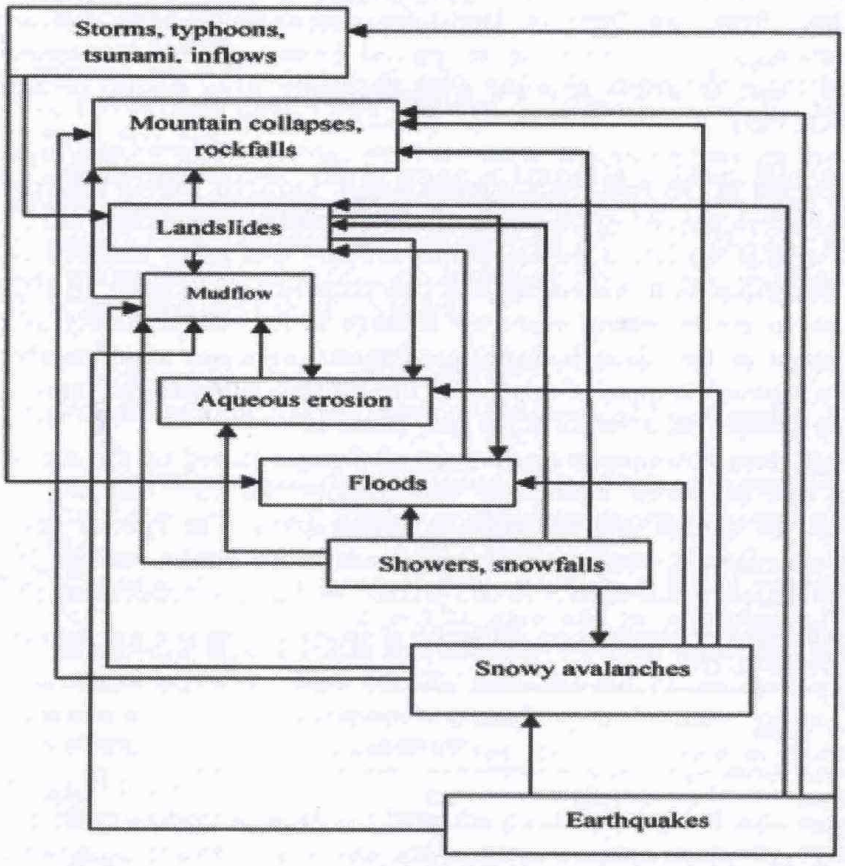

Figure 1. Scheme of interaction of the natural spontaneous phenomena.

Planning protective measures against natural disasters, it is necessary to limit as much as possible secondary consequences, and thus, by corresponding preparation try to exclude them completely.

The timely and exact forecast of the dangerous phenomena is the most important condition of effective protection. Protection against natural dangers can be active (construction of technical buildings, intervention in the phenomenon mechanism, mobilization of natural resources, reconstruction of natural objects, etc.) and passive (the timely prevention, evacuation, use of shelters, etc.). In most cases active and passive methods are combined.

2. Some data on geophysical accidents in Georgia

Georgia is a small mountainous country with 15 climatic zones, in the territory of which from time to time a majority of the enumerated geophysical catastrophes take place. Therefore, special attention has always been and still is paid to the study of dangerous geophysical phenomena in Georgia. The results of one of the important last studies on this problem are represented in this article [8].

In particular, a quantitative investigation of magnitude–frequency and spatiotemporal regularities of twelve types of natural disasters (drought, hurricane, lightning, hail, frost, fog, freezing, landslides, debris flows, snow avalanches, flash floods, earthquakes) and estimation of natural hazard zoning was undertaken. An attempt was made to assess multiple risks emerging from natural disasters for the territory of Georgia.

The work on weather modification has been carried out for several decades during the Soviet period in Georgia (fight against a hail, artificial calling of a precipitation, regulation of storm activity of clouds, artificial descent of avalanches, etc.). Within the framework of that activity a rocket, plane, artillery and other methods of an active impact on dangerous hydrometeorological processes have been used. In 1989 the work was stopped. In the following years the damage to national economy as a result of negative impact of the listed hydrometeorological processes significantly increased. Therefore, a renewal stopped a quarter of the century ago, but the work on weather modification is expected to begin in the near future [9].

In recent years government institutions of Georgia stirred up the activities for the solution of the problems connected with actions for fast response to negative consequences of natural and technogenic catastrophes. The special department on emergency situations is created, timely assistance to the victims can be provided, the account of all cases of accidents is in compliance with their nomenclature [10, 11].

Table 1. Quantity of emergency situations and number of victims in connection with geophysical accidents in Georgia in 2006-2011 [10]

Years	Quantity of emergency situations	Number of victims: deaths (injure)
2006	32	6 (6)
2007	19	2 (2)
2008	43	22 (10)
2009	72	2 (14)
2010	165	7 (15)
2011	153	8 (17)
In total (2006-2011)	484	47 (64)
Average in a year	81	8 (11)

The data on quantity of emergency situations in Georgia, connected with geophysical accidents, both a death toll and injures in these accidents in 2006-2011 in table 1 is presented. In table 2 the data on quantity of emergency situations by types of geophysical accidents and a death toll and injuries in these accidents in % in relation to their average value is presented.

In particular, from table 1 follows that during the specified period of time in Georgia on average in a year there were 81 geophysical accidents, 8 people perished, 11 were wounded. From table 2 follows that the dangerous meteorological phenomena most often repeated (32.6%). However, the observation shows that the largest death toll was caused by dangerous geological phenomena (63.8%).

Table 2. Quantity of emergency situations and number of victims of different type of geophysical accidents in Georgia in 2006-2011 [10]

Type of geophysical accidents	Quantity of emergency situations, %	Number of victims: deaths (injure), %
Earthquakes	18.8	0.0 (14.1)
Geological hazards - lundslides, debris flows etc.	25.4	63.8 (15.6)
Meteorological hazards - hurricane, snow avalanches etc.	32.6	19.2 (53.3)
Hydrologica hazards - flash floods etc.	23.1	17.0 (14.1)

For comparison, we will note that in 2006-2011 in Georgia 1,250 road accidents were recorded, 703 persons died, 1,800 - injured – (respectively on the average in a year: 208, 117 and 300) [10].

About 1,700 people annually die of smog in Tbilisi in addition, that undoubtedly demands special attention and undertaking of special measures [6]. Unlike the natural geophysical disasters having bright visual and physical effect of influence, the smog is a 'silent killer' whose number of victims incommensurably prevails over the number of victims of all technogenic and natural disasters.

3. The possibilities of artificial initiation of geophysical catastrophes

In different years in various countries the issues of artificial initiation of dangerous geophysical phenomena in military wholes (geophysical weapon) have been and still are examined [3-5].

Geophysical weapons are weapons of mass destruction based on manipulating processes that occur in the earth's crust, and its liquid and gaseous mantle for military purposes. An atmospheric layer lying at an altitude of 10 to 60 kilometers is of special importance for this kind of warfare. Means, with the aid of which are stimulated geophysical factors, can be different, but the energy, spent by these means, always is considerably less than the energy, isolated by the forces of nature as a result of the caused geophysical process.

Atmospheric (weather) weapon has been the most investigated until today type of geophysical weapon. In connection with atmospheric weapon, its damaging factors are different kinds of atmospheric processes and the weather and climatic conditions connected with them, on which life may depend, both in a region(s) and on the entire planet. The studies show that many active reagents, for example, silver iodide, dry ice and other substances being scattered in the clouds, are capable of causing pouring rains over the large areas. On the other side, such reagents, as propane, carbon dioxide, iodide lead, ensure scattering fogs. The dispersion of these substances can be achieved with the aid of the ground-based generators and onboard devices, installed on the aircraft and rockets. In the regions, where the moisture content of air is high, using the above-indicated method makes it possible to cause cloudbursts and, thus, to change the aqueous regime of rivers, lakes, swamps, and considerably worsen the pass-ability of

the roads and terrain, while in the low regions to cause floods. Therefore, if we ensure artificial precipitation on the approaches to the regions with the large scarcity of moisture, it is possible to attain the removal of a significant quantity of latter from the atmosphere and cause drought in these regions.

Lithospheric weapon is based on the use of energy of lithosphere, i.e., the external sphere of "solid" earth, which includes the earth's crust and the upper layer of mantle. In this case the damaging effect is manifested in the form of such catastrophic phenomena as earthquake, volcanic eruption, displacement of geological formations. The source of energy is separating in this case the intensity in the tectonic hazardous zones. Conducting by the number of the researchers of experiments they showed that in some earthquake-hazard regions of the Earth with the aid of the ground-based or underground nuclear explosions of relatively small power it is possible to initiate the earthquakes, which can lead to catastrophic consequences.

Hydrospheric weapon is based on the use of energy of hydrosphere for military purposes. Hydrosphere is the intermittent aqueous shell of the Earth, which is located between the atmosphere and the solid earth's crust (lithosphere). It is the totality of oceans, seas and surface water. The use of energy of hydrosphere for military purposes is possible under the influence on the water resources (oceans, seas, rivers, lakes) and the hydraulic construction not only nuclear explosions, but also large charges of conventional explosive. Strong waves and floods will be the damaging factors of hydrospheric weapon.

The biospheric weapon (ecological) is based on a catastrophic change of the biosphere. The biosphere covers part of the atmosphere, hydrosphere and the top part of a lithosphere, which are interconnected by difficult biochemical cycles of migration of substances and energy. Now, there are some chemical and biological means, the application of which in large territories can destroy a vegetable cover, superficial fertile layer of earth, food stocks etc. Artificially causing the soil erosion, death of vegetation, irreparable injury to flora and fauna, owing to different application of chemical means, the incendiary weapon can lead to catastrophic change of the biosphere and, as a result, mass defeat of people.

Ozone weapon is based on the use of energy of the ultra-violet radiation which is let out by the Sun. The shielding ozone layer stretches at the height from 10 to 50 km with a concentration maximum at the height of 20-25 km and sharp decrease up and down. In normal conditions of a surface of Earth, the insignificant part of ultra-violet radiation with a length of wave of 0.01 — 0.2 microns reaches it. Its main part, passing through the atmosphere, is absorbed by ozone, dissipates molecules of air and dust particles. Ozone is one of the strongest oxidizers, kills microorganisms, and is poisonous. Its destruction is accelerated in the presence of a number of gaseous impurity, in particular bromine, chlorine, fluorine and their connections, which can be delivered to the ozone layer by rockets, planes and other means. Partial destruction of the ozone layer over the territory of the opponent, in a protective ozone layer may lead to the artificial creation of temporary "windows" to defeat population, animals and flora in the planned area of the Globe, due to influence of big doses of hard ultra-violet radiation and other radiations of a space origin.

The specified types of the geophysical weapon can be used in terrorist attacks. Masking attack with natural on-going processes makes it possible. It is necessary to strengthen only it (for example, to initiate an earthquake, to redistribute or strengthen a precipitation for initiation of floods, etc.). In local scales there can be explosions for the purposes of triggering an avalanche, landslides etc. for destruction of communications,

power lines, gas and oil pipelines, people etc. In global scales practically all types of the geophysical weapon can be used in the terrorist purposes by some countries with authoritarian regime for intimidation or submission to the interests of other states.

4. Prevention of geophysical catastrophes and fight against their negative consequences

As it was already noted above, warning and fight with the dangerous geophysical processes are used passive and active methods [1, 3-5, 9, 12-15]. The following can be attributed to the passive methods:

- Raising awareness of the local population of the risks of natural catastrophes, their repetition, intensity in this territory. In particular, the population, which lives in the landslide, mudflow, and mountain collapse zones, should be aware of its seat, possible directions and characteristics of these dangerous phenomena. This decreases the action of stresses and panic, which can arise during the transmission of special information about the direct threat. As shows the experience of the last years, the population of Georgia is weakly informed about the risks of geophysical catastrophes in the medium of its inhabiting (building of houses in the zones of risk, etc.).
- The timely notification of population about the natural calamities, if necessary the organization of temporary shelters, evacuation, etc. Thus, for instance, protection from the tsunami consists in the timely prognostication of their appearance, the output of vessels from the zone of active action, evacuation of inhabitants from the zone of destruction. The creation of the automated system, based on the network of seismic stations and the contemporary channels of communications, contributes to warning of tsunami, including satellite. Unfortunately, in Georgia the united network of early warning of dangerous geophysical phenomena at present is absent (including radar tracking stations of the meteorological processes). The corresponding information is taken from the worldwide data network and it does not frequently correspond to real situation, which substantially changes because of the special features of physics - geographical conditions of the territory of Georgia.

The active methods of fight with the dangerous geophysical processes can include both the creation of the engineering systems for protection from these processes and use of methods of the artificial regulation of geophysical phenomena (for example - weather modification). In particular:

- anti-avalanche systems of protection, which provides that the arrangement of snow-fence panels are developed and installed, cutting down the forests is forbidden and trees on the avalanches prone slopes are planted, firing of dangerous slopes from the artillery instruments is conducted, the erection of the anti avalanches shafts and ditches is achieved;
- the main measures of fight with the mudflow are connected with the fastening of soil and plant cover on the mountainous slopes, with the preventive descent of the mountain reservoirs threatening with breach, with the construction of weirs and different mudflow-protection facilities;

- the most effective methods of fight with the floods are: regulation of the drain of rivers, regular clearing of river bed, building of shielding weirs and dams, the redistribution of the precipitations via cloud seeding by the corresponding reagents;
- the fight with hail can be achieved by active actions on the clouds, and also with the suppressor grids.

The population of dangerous mountainous regions should take measures on strengthening their houses and territory, in which they are elevated, participate in the works on erection of protective hydrotechnical and other engineering structures. With the appearance of dangerous geophysical situations it is important to adhere to the following general rules:

- In the case of notification about the threat of dangerous situations or appearance of their signs, it is necessary to act rapidly, quietly, confidently and without panic.
- If it is necessary to leave an apartment (house), one should turn off the water pipe, electricity and gas, if it was heated to bake - to put it out; any mobile property from the yard or balcony must be transferred into the house; most valuable items, in case that if they cannot be taken, should be covered against the action of moisture and contamination; door, window, vent and other openings should be tightly shut; the inflammable and poisonous substances have to be removed from the house and placed in some distant pits or separate cellars. Also, it is necessary to dress children, old men and dress oneself, take the necessary things, small reserve of food products, drugs, documents and leave the house.
- If there was no early warning about the danger and the inhabitants were warned about the threat directly before the approach of the natural calamity or noticed its approach on their own, everyone, without worrying about the property, produces special output into the safe place independently. In this case, the close ones, neighbors and all encountered along the way people should get warned. For the special output it is necessary to know the paths of motion into the nearest safe place, which previously should be known on the basis of data about natural catastrophes in this populated area. If necessary, it follows to help victims.

Besides general rules, for the concrete type of geophysical catastrophes the are specific rules. Thus, for instance:

- If an earthquake began unexpectedly, when to be gathered and leave the apartment (house) is impossible, it is necessary to occupy place (to arise) in the door or window aperture, as soon as the first pushes of earthquake will calm down, one should rapidly leave to the street. When on the street one should as fast as possible go away from the buildings and construction in the direction of areas, squares, wide streets, sport sites, vacant sections, strictly observing established social order.
- In the case, when people and construction occur on the surface of the moving landslide section, one should be moved as far as possible upward, to be warned the rolled up chunks, stones, fragments, constructions, earthen shaft, taluses. Strong push with its stoppage is possible at the high speed of

landslide, and this presents large danger to the people located on the landslide. After the end of landslide, mudflow or mountain collapse people, who left the zone of calamity before and waited out the danger in the nearest safe place, after being convinced in the absence of repeated threat, should return to this zone for the search and rendering aid to victim.

- With the flood, if organized evacuation of your region is not conducted, prior to the arrival of aid or prior to the beginning of the withdrawal of water necessarily remain on the upper levels of buildings, on garrets and roofs of houses, trees and other high units. It is regularly necessary to signal about the calamity by swinging any width, and with the onset of dark - by voice and with the aid of a lantern or torch, are the actions on which your survival might depend. With the approach of rescuers it follows quietly, without forgetting about the caution, pass into the rescue transport. It is not necessary to attempt to be selected from the flooded region independently, if there are no serious reasons for doing so. But if the level of water continues to rise, threatening to flood your refuge, or there are victims, who need urgent medical aid, then it is necessary to take the swimming means, capable of maintaining you and victims, of being selected with the flow and of selecting direction of motion. It is necessary to remember about distress signals - they must be used until you are detected by rescuers.
- With the hurricane, if you happen to be on the street, you should be held further from buildings and structures, high posts, trees, masts, supports and electric leads; you should not be located on a bridge, over-bridges, piers, in the places of storage of the inflammable and poisonous substances; as far as possible it is necessary to hide under the bridge, the ferroconcrete shed, in the basement, cellar. It is possible to lie into the pit or any deepening. Eyes, mouth and nose protect from the sand and the ground; one should not climb up the roof and hide on the garret. If you are in a car, stop, but do not leave the vehicle. More densely shut its doors and windows. If you are in the urban transport, immediately leave it and search for refuge. If element caught you at the elevated or open place, crawl to the side of any shelter (to the forest), which could extinguish wind force, but cause the falling branches and trees. When wind calms down, do not leave immediately your shelter, since within several minutes the squall can be repeated.

The fight with the smog requires taking specific measures, which are in detail presented in the mentioned below source [6].

Let us note in conclusion that population should know the terrain of its stay, be informed about the potential risks of geophysical catastrophes, the possibilities of their initiation by terrorists and be vigilant. In the case of appearance of the suspicious persons or detection of unknown objects, not to enter with them into the contact and to report them to the responsible authorities.

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