AVALANCHE ACCIDENTS IN RUSSIA

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ABSTRACT: We have collected information about avalanche disasters on the territory of Russia for the period of 1996-2017. The analysis of spatial distribution, the social structure of the victims is carried out. Time dynamics of avalanche disasters is determined. The meteorological conditions of avalanches formation caused victims are estimated.

KEYWORDS: avalanche disasters, avalanche victims, hazard, risk

1. INTRODUCTION

In Russia avalanches regularly occur in mountain regions with an area of 3,077,800 square kilometers (18% of its territory). Another 4.8% of the Russian territory are potentially avalanche hazard regions where relief is favorable for avalanching and avalanches can appear in case of deforestation or increase of solid precipitation. Avalanches also happen on the plains on natural as well as artificial slopes.

The first avalanche disaster in Russia, described in the chronicles, occurred in the winter of 1370, far from the mountains - in the center of the European part of the country in Nizhny Novgorod (the Volga river basin) (Borisenkov and Pasetskiy, 1988). The avalanche released from the river terrace and destroyed the buildings of the Annunciation Monastery.

The largest avalanche accidents occurred in the Soviet period of the country's history - during the active development of mountain regions. Single avalanches claimed the lives of more than 50 people each time: in Khibiny mountains in 1935; in Sakhalin in 1945; in Kamchatka in 1948. No more than 20 people perished in an avalanche at one time in the next years. However, the avalanches still claim the lives of people every year in different regions of Russia.

In modern Russia (since 1992), the most tragic events occurred in the 1992/1993 winter season. According to the data of the Ministry of Emergencies of Russia, 55 people died in the avalanches caused by heavy snowfalls in the end of January - the beginning of February on the Transcaucasian highway (North Ossetia-Alania). The total number of victims in the country was 66.

2. METHODS

The official statistics on avalanche accidents in Russia is absent. We present the analysis results of data which was collected from various sources. These sources include: reports of avalanche warning and rescue services; the prosecutor's office and police; news of information agencies; specialized chats; social networks, etc. The dates and locations of avalanche accidents, social status and activity of the victims were determined. Detailed descriptions of avalanches and snow cover characteristics, as usual, are not available in such sources. Therefore, it is not possible to make their analysis. The description of weather conditions before and during the avalanches release was complicated due to the sparseness of the weather stations network in the country especially in mountain regions. Therefore, it was performed using small-scale monthly surveys of the Hydrometeorological Center of Russia (URL: // https://meteoinfo.ru/climat-tabl3). These reviews contain descriptions of weather anomalies in different regions of Russia in different periods. The time series of avalanche accidents and their spatial distribution were investigated. The investigated seasons correspond to hydrological years. The collected by us data is presented in the National Atlas of Russia (2008), Atlases of the Ministry of Emergencies of Russia (2007) and other publications (Seliverstov et al., 2006).

3. AVALANCHE CATASTROPHES

The most complete data on avalanche accidents that was collected correspond to the period of 1996-2017. During this time at least 219 avalanches led to human victims in Russia. The total amount of 669 people got to avalanches, 413 of them died. Thus, every season there are 10 avalanche accidents on average and the average number of victims is 20 people in our country.

3.1 Spatial distribution

Avalanche accidents happened on the territory of 39 subjects of the Russian Federation (from 85) (see Figure 1). Most often (38% of accidents and 43% of victims of the total amount in the country) people were killed by avalanches in the Caucasus Mountains. The greatest number of avalanche victims (72) is in Kabardino-Balkaria Republic. A lot of avalanche accidents (17%) also

occurred in Western Siberia (18% of victims) and in the Far East (14% of catastrophes and 17% of victims). In Western Siberia, the most of victims are in the Republic of Altai – 36; in the Far East - in the Kamchatka Peninsula - 41.

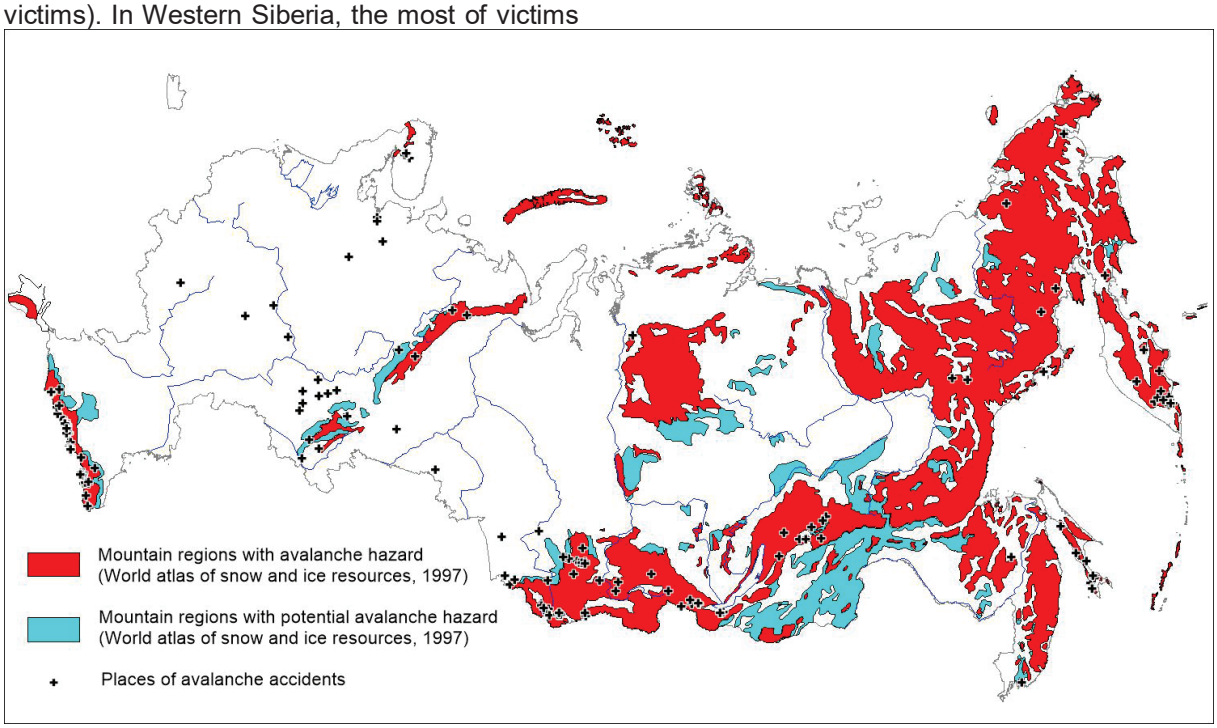

Figure 1: Spatial distribution of catastrophic avalanches in Russia from 1996-2017.

There is no correlation between the number of victims and the population, as well as the area of the subjects of the Russian Federation. The correlation coefficients between their values are -0.22 and -0.18. The correlation coefficient practically does not change considering the number of tourists in the structure of population in the region.

By the ratio of the number of avalanche victims / the population, the areas of active tourism development are leading - the Republic of Altai, the Kamchatka and Kabardino-Balkaria Republic. Large values are noted in the Magadan Region and Chukotka. These regions are very sparsely populated, but the rate of avalanche prone territories of the total area in then is extremely high - 0.9 and 0.7 respectively.

33 people have died in 26 avalanches occurred far from the mountains - on the plain. Such accidents were recorded in Arkhangelsk, Novosibirsk and Tyumen regions, Tatarstan, Bashkortostan, Chuvashia and in other regions of the Russian Federation. Avalanches released on river terraces, in gullies, quarries, etc. As a rule, children become victims of such avalanches. The nonrandomness of such events is indicated by repeated releases of avalanches on the same slopes in Nizhny Novgorod and the Altai. According to the collected descriptions of the avalanches, their release lines were located on the altitudes from about 50 to 320 meters above sea level. The relative height of the avalanches descents was from 10 to 40 m. In the only available detailed avalanche description provided by the Ministry of Emergencies of Russia, the avalanche volume was determined as 360 cubic meters. This avalanche released from the railway embankment in Bugulma town on January 28, 2008 and killed 4 children.

Most often (33% of cases) local residents and workers were captured by avalanches on the slopes. This category of social activity corresponds to the largest number of victims (28%). 27% of the victims are mountaineers and mountain tourists. The amount of avalanche accidents with them is 27% of the total amount of cases.

The distribution of avalanches victim's location during the accident and the type of their activities is different in different regions of Russia.

In the Caucasus, most of victims (28%) are among the mountaineers and mountain tourists. Then skiers follow - 26%. Most often, avalanche accidents with skiers occur in the western part of the region. In the central part - in the Republic of North Ossetia - Alania, most of avalanche accidents occurred on the Transcaucasian highway. In the eastern part of the Caucasus (Ingushetia, Chechnya, Dagestan), all avalanche victims are among local residents, workers and

military personnel. Most of them (66%) died on the slopes, the rest - on the roads.

In the north of the European territory of Russia, skiers and local residents on the slopes predominate among the victims - 29% each. In Western Siberia and in the Far East, the largest number of victims are local residents on the slopes - 38% and 24%.

3.2 Temporal dynamics

The number of victims of avalanches varies significantly from season to season - from 9 to 35 (see Figure 2). The range of changes in the number of avalanche accidents is from 4 to 19. The presence of peaks in the number of victims is explained by cases of single mass death of people in avalanches, as well as exceptional events in the mountain areas, such as the conducting of active combat operations in winter in the North Caucasus (December 2003), i.e. social causes.

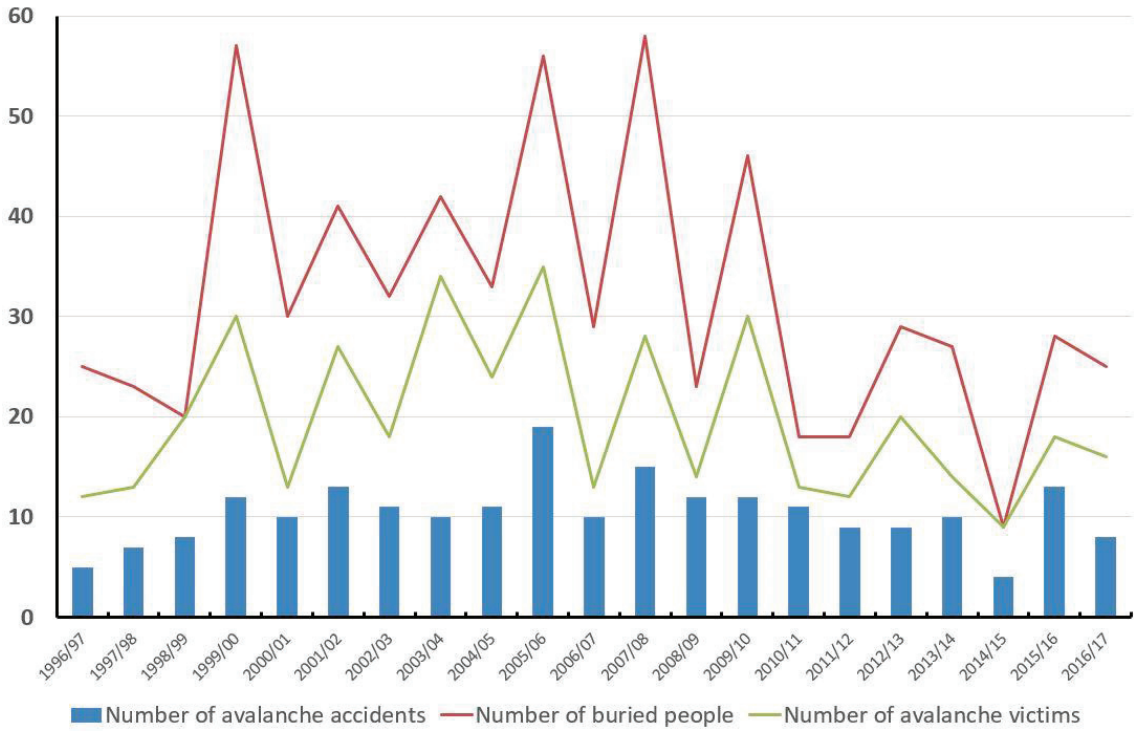

Figure 2: Avalanche time series. Russia.

Annually avalanche disasters are recorded in the Caucasus with the largest population density and the maximum number of tourists. Almost every year, avalanches take lives of people in the Far East where mountainous occupy the significant part of the territory. In other regions of Russia avalanches become catastrophic less often. As an exception, in the long-term series, the avalanche season 2005/06 can be considered. Avalanche accidents occurred in almost all mountain regions of the country from the Murmansk region to Kamchatka. 35 people have died in 19 avalanches. According to the data of the Russian Hydrometeorological Center unusually cold weather was established almost everywhere throughout this winter, which contributed to the active development of constructive metamorphism in the snow cover and weak layers formation. In January and February in many mountain regions precipitation exceeding the norm by 2-3 times has been registered. Exceptional weather anomalies of the winter period have become the backdrop for the formation of significant number of catastrophic avalanches during this winter.

Before the winter of 2008/2009 the local residents and people working in avalanche areas were dominating in the list of victims. In the following period the balance has changed – tourists began to make the largest number of victims.

In the last decade (including the winter season 2016/2017), there has been a decrease in the number of victims compared to the previous decade. 17 victims against 23. Most likely, this is connected primarily to the tightening of the requirements for providing avalanche safety during the development of territories and increasing the application of avalanche protection measures. For example, about 20 billion rubles have been spent in the Transcaucasian highway for the protection of people over the past decade and avalanche accidents don't happen now. A number of factors hinder large decrease in the number of victims. Among them is the popularization of a relatively

new type of winter tourism for Russia - snowmobiling. Since a 2008/2009 winter season, snowmobile drivers die in avalanches almost every year. The popularity of mountain tourism does not decrease. As a rule, the routes of mountain tourists are located far from the forecast and rescue centers without connection and up-to-date information about avalanche situation. Assistance in cases of avalanche accidents comes too late. And also, always and everywhere there are people who are ready to get a charge of adrenaline on the snow-covered slopes, not paying attention to the possibility of avalanches. The number of such people is not accountable, and their sanity raises considerable doubts.

An intraseasonal dynamics of avalanche disasters has its own features (see Figure 3). The first deaths were recorded in October. The final avalanche accidents occurred in August. The number of avalanche accidents and their victims gradually increases during the season and reaches a maximum in March. 30% of catastrophes occur in this month, in which 26% of the victims die. The increase in the number of victims accompanies the increase of the snow cover height to a maximum value in March in a large part of the territory of Russia. At the same time, March is a period of high season in winter resorts. Avalanche accidents during the study period were not recorded only in September. Mountaineers and mountain tourists die every month. The greatest number of victims among them (32 dead) happened in March, when long-time routes are popular. The second peak of the number of victims (11 dead) is in July - the period of active mountaineering. In February there is a maximum of victims on the roads – 19 dead. In January, during the winter holidays, the greatest number of victims is among local children - 23 dead.

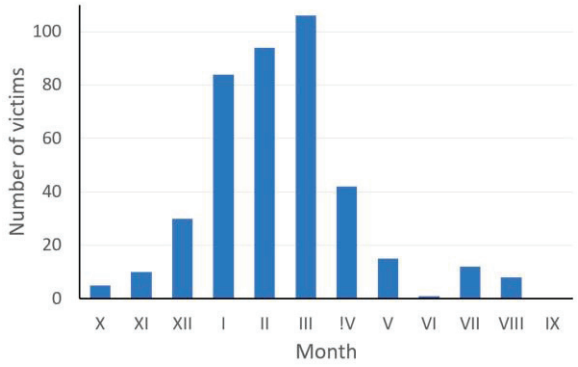

Figure 3: Intraseasonal dynamics of avalanche victims (1996-2017).

Meteorological conditions during the avalanche accidents in Russia are characterized most often as abnormal, but not always exceptional. Abnormal precipitation is noted in 38% of avalanche accidents. Less than normal level of precipitation was in 12% of cases. Abnormal heat accompanied 36% of avalanche accidents. An abnormal cold was noted in 28% of cases. The combination of anomalously large precipitation with heat anomalies was observed in 31% of cases.

In the absolute majority of avalanche accidents on the plain, the snow cover height was close to the average long-term values. Avalanche accidents on the plain were always preceded by snowfalls and snowstorms lasting from 2 up to 12 days. More than a month there were no thaws. During the long cold period, weak layers could be formed in the snow cover. Additional stress on such layers led to their release.

4. CONCLUSION

We can distinguish the following special aspects of modern statistics of avalanche accidents in Russia:

- a slight decrease in the number of avalanche victims in the last decade;

- regular avalanche accidents occurring far from the mountains - on river terraces, gullies, quarries, etc.;

- regular cases of death of children in avalanches, which make 16% of the total number of victims.

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