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CROSS-BORDER MAPS AND DISASTER MANAGEMENT

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ABSTRACT

In the last twenty years Europe was frequently and highly affected by natural and man-made disasters. Although European Disaster Management programs are in progress the realization of cross-border cooperation between two or a group of neighboring countries in crisis situations still faces some challenges because of lack of harmonized data and detailed and accurate maps of the cross-border regions. This paper examines some problems that arise in cross-border mapping due to the various types, structure and classification of the data provided by various organizations as well as the multilinguality. The paper presents a map of a cross-border region intended to facilitate disaster prevention and preparedness activities.

KEYWORDS

cartography, cross-border mapping, disaster management.

1. INTRODUCTION

Disaster management is a complex and responsible process. In the last five years the Bulgarian disaster and crisis management acts are often being modified in order the decision-making process in case of natural or man-made disaster to become more efficient. Despite the boundaries disasters often occur in cross-border areas. There should be not only regional but also international cooperation towards an effective disaster management in the geographical regions traversed by national borders. For taking efficient measures of protection and for avoiding severe consequences decision-making process should be supported by detailed and accurate maps of these cross-border areas.

2. CARTOGRAPHY AND DISASTER MANAGEMENT IN CROSS-BORDER REGIONS

In 2006 a Disaster Management Act was introduced in Bulgaria. According to this Act disaster management should be planned at municipal, district and national level. Each Municipal Disaster Management plan includes two main sections: *Geographic characteristics of the municipality* (physiographic, climatic, demographic, economic, hydrological characteristics) and *Measures for disaster prevention or mitigation of the effects of disasters* (risk assessment; risk monitoring; early warning system, planning of rescue operations; evacuation routes; evacuation centres; rehabilitation and reconstruction of facilities; etc. (Disaster Management Act, 2006). A main component of both sections of the municipal plan is the graphical part that depicts the characteristics and peculiarities of each municipality, the critical infrastructure, etc.

To reduce the number of human loss and property damages and to improve the decision-making process in case of emergency the Disaster Management plans at municipal, district and national level should be supported by detailed cross-border maps.

Disasters often occur in two or more neighbouring countries despite the borders. Therefore the graphical part of the Disaster Management plans of border municipalities should include cross-border maps. These maps would facilitate the cooperation of the national and regional authorities in efforts to mitigate shared disasters and that is the reason why cross-border maps should account for the national peculiarities as well as the type, classification and accuracy of the data provided by various organizations.

The Bulgarian Disaster Management Act makes no provision for including cross-border maps in the municipal plans. Some organizations are awake to the importance of availability of spatial data of cross-border areas so some cross-border projects for risk reduction and disaster protection are in progress. The PHARE project entitled *Green and Safety Forests – Business Responsibility* (BG 2004/016-785.01.01.01-13) between Bulgaria and Serbia started in 2007. Its main goal is creating maps and Geographic Information System (GIS) for prevention and planning the activities in case of forest fire. This project aims to establish a public-private committee for forest monitoring in the cross-border region. The head offices are in Zajecar (Serbia) and Vidin (Bulgaria). The maps are designed to support fire-fighting operations. They depict the main objects of infrastructure in the area, as well as land cover, rivers, lakes and other water sources.

Disaster management is being realized by a series of activities such as:

• **preventive activities**, including analysis, assessment and prediction of disaster risks; scenarios; categorizing the territory according to disaster risks; planning the disaster protection; planning the emergency aid; implementation of preventive measures to avoid or mitigate the effects of disasters;

• **preventive activities**, including early warning, organizing rescue plans and rescue operations, evacuation, etc;

• **coordination** of the operations of the **Integrated Rescue System**, defined by the Disaster Management act;

• **recovery**, including human help, economic support, rehabilitation, reconstruction, strategic development;

• other activities (Kotter, 2004)

Cartography plays an important role in all stages of Disaster Management (figure 1) (Bandrova, Marinova, Milanova, 2009)

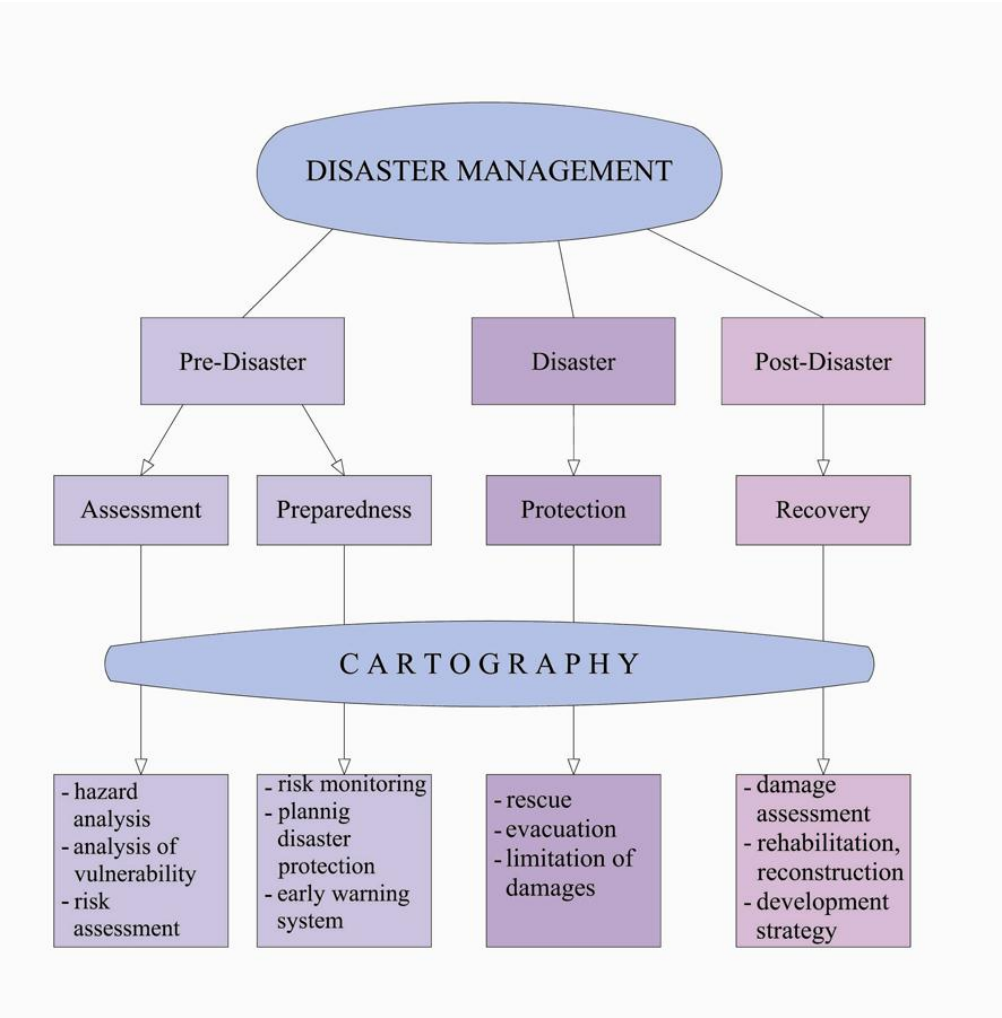


Figure 1 The role of cartography in disaster management

Hazard analysis, analysis of vulnerability and risk assessment are based on maps. Coordination of evacuation, coordination of rescue operations and other post-disaster activities are also supported by maps. Konecny and Bandrova (2006) explain that the role of cartography in disaster management is to simplify and well-arrange required spatial data thus, the decision-making process to become quicker and better and to lead to damage minimization. Maps show information about geographical features, critical infrastructure as well as hazards and risks in a particular area. Cross-border maps could ensure that all actors in disaster management have the same information about the region.

3. MAP CONTENT

The methodology for developing a disaster management plan at municipal level requires the maps accompanying the plan to enable examination of:

• location, boundary and area of the municipality;

• relief and water resources;

• technical infrastructure, including transport system; hydrotechnical structures;

The maps to Disaster Management plans should contain the following elements:

• **Hydrography**

- rivers, channels, reservoirs, lakes
- type of dams

• **Relief**

- contour lines, hill shading, hypsometry

• **Settlements**

• Classification according to:

- number of population
- administrative status
- type

• Type of built-up areas

- densely built-up areas
- sparsely built-up areas
- industrial areas

• Unified Classification of Administrative-Territorial and Territorial Units in Bulgaria (UCATTU)

• **Railway system**

- railways, railway stations
- single track, multiple track
- normal gauge, narrow gauge

• **Roads**

- motorways, I-st, II-nd and III-rd grade roads, municipal roads, paved roads
- road number – international and national
- highway bridges, tunnels

• **Pan-European transport corridors**

• **Borders and administrative boundaries**

- national borders, first order administrative division, second order administrative division

• **Forest**

• **Special elements**

• border crossing points (figure 2a)
• airports (figure 2b)
• ports (figure 2c)
• electric stations
• factories using dangerous materials (figure 2d)
• international gas pipelines, oil pipelines, electric transmission lines
• population protection

- Emergency Medical Service (figure 2e)
- Police (figure 2f)
- Fire Service (figure 2g)
- Civil Protection (figure 2h)
- Mountain Rescue Service (figure 2i)

Figure 2 Map symbols

The presentation of all these elements is based on integration and harmonization of data provided by various organizations.

4. DATA HARMONIZATION

Cross-border maps usually combine international, national and regional data. Heterogeneous basic, statistical and thematic data provided by various services, agencies and organizations should be combined (Witschas 2009). The information sources could be:

• geographic database
• topographic maps
• thematic maps
• Unified Classification of Administrative-Territorial and Territorial Units (UCATTU)
• specific information
• statistical data, etc.

All this data should be harmonized in order to be integrated and presented on a map.

One of the main goals of the Infrastructure for Spatial Information in Europe (INSPIRE) Directive is to ensure harmonization of spatial databases and services in Europe (Boes, 2009). The realization of the requirements of the Directive would f cross-border mapping significantly. The definition of data harmonization given by INSPIRE Drafting Team "Data specifications" (2008) is "providing access to special data through network services in a representation that allows for combining it with other harmonised data in a coherent way by using a common set of data product specifications". According to Villa, Reitzb, Gomarasc (2008) "harmonization refers to the standardization of data so that they can be matched with other data and information regardless of the format."

The main aspects of data harmonization for cross-border mapping are:

• georeferencing the information into a geographical reference system;
• standardizing the attribute structure;
• standardizing the object classification;
• standardazing the level of detail;
• unifying the cartographic visualization (Gruber, Moser, Pitacco, Benvenuti, Cucek-Kumelj, Schabl, 2006)

Cross-border mapping supposes also geonames standardization.

5. GEONAMES AND MULTILINGUALITY

Main aspects of cross-border mapping are presentation of geographical names and multilinguality.

5.1. Geonames

The choice of geonames of features located in cross-border regions takes into consideration reliable sources such as topographic maps, geographical dictionaries, indexes of geographical names, gazetteers.

The United Nations Group of Experts on Geographical Names (UNGEGN) considers the problems of standardization of geographical names. It aims "to emphasize the importance of the standardization of geographical names at the national and international levels and to demonstrate the benefits to be derived from such standardization" and "to study and propose principles, policies and methods suitable for resolving problems of national and international standardization". (UNGEGN, 2009)

Some of the main functions of UNGEGN are:

- "To develop procedures and establish mechanisms for standardization in response to national requirements and particular requests
- To make mapping organizations aware of the importance of using standardized geographical names
- To work at the highest possible national, international and United Nations levels to interrelate toponymy and cartography;
- To make standardization principles and standardized geographical names available as practical information for as wide as user community as possible, through all appropriate media." (UNGEGN, 2009)

Geographical names can be presented either by their endoyms or by their exonyms. UNGEGN defines endonym as a "name of a geographical feature in an official or well-established language occurring in that area where the feature is located" and exonym as a "name used in a specific language for a geographical feature situated outside the area where that language is spoken, and differing in its form from the name used in an official or well-established language of that area where the geographical feature is located". (UNGEGN, 2007)

Table 1 presents endonyms of geographical features located both in Bulgaria and Turkey.

Table 1 Endonyms in Strandzha mountain region

Bulgarian endonym (transliteration in Roman)	Turkish endonym
СТРАНДЖА (STRANDZHA)	YILDIZ
Марица (Maritsa)	Meric

All geonames in cross-border maps should be presented in a coherent way. The usage of endonyms in case of disaster in cross-border region aims to support the national authorities of the affected countries in the decision-making process.

5.2. Multilinguality

The names of geographical features located in cross-border regions should be presented both in the official language of each country in which they are located and by their transliteration into Roman. Thus, decision-makers in neighbouring countries would be supported to plan cooperative protection activities across the national border (figure 3)

Figure 3. Geonames in Bulgarian and in Roman

In 2009 a Translieration Act was introduced in Bulgaria. The transliteration rules determined in this Act should be applied by each juridical and natural person who use transliteration of geographical names. The transliteration system of Bulgarian letters into Roman, in accordance with the act is presented in table 2.

Table 2 A transliteration system - Bulgarian-Roman (Transliteration Act, 2009)

Bulgarian alphabet	Roman version
А, а	A, a
Б, б	B, b
В, в	V, v
Г, г	G, g
Д, д	D, d
Е, е	E, e
Ж, ж	Zh, zh
З, з	Z, z
И, и	I, i
Й, й	Y, y
К, к	K, k
Л, л	L, l
М, м	M, m
Н, н	N, n
О, о	O, o
П, п	P, p
Р, р	R, r
С, с	S, s
Т, т	T, t
У, у	U, u
Ф, ф	F, f
Х, х	H, h
Ц, ц	Ts, ts
Ч, ч	Ch, ch
Ш, ш	Sh, sh
Щ, щ	Sht, sht
Ъ, ъ	A, a
Ь, ь	Y, y
Ю, ю	Yu, yu
Я, я	Ya, ya

6. A MAP OF OSOGOVSKA PLANINA MOUNTAIN REGION

Osogovska Planina is a mountain in South-Eastern Europe. It lies across the border of Bulgaria and FYROM and occupies territories of the municipalities of Kyustendil, Nevestino (Bulgaria) and Kriva Palanka, Makedonska Kamenitsa, Delchevo (FYROM). The highest peak of the mountain is Ruen (2251 m).

The Osogovska planina mountain region is highly affected by disasters such as forest fires, avalanches, flood rains, etc. Therefore the Municipal Disaster Management plans of the border municipalities should include detailed cross-border maps. The availability of such kind of maps would support the cooperation of the authorities of the neighbouring countries in case of emergency.

A suggestion of a cross-border map for disaster management is presented on figure 6. It is based on a map of Osogovska Planina mountain (figure 4) produced in a cross-border cooperation between Bulgaria and FYROM in 2009. The new map depicts the main disaster dangers for the region – fire danger, avalanche danger, etc.

A map of fire-fighting arrangement (figure 5) in scale 1:25 000 is used as a main source of information about forest fire danger. It is produced for the needs of DLS Osogovo, Regional Forest Directorate Kyustendil and shows five fire danger classes: I - very high, II - high, III - moderate, IV - low, V - very low.

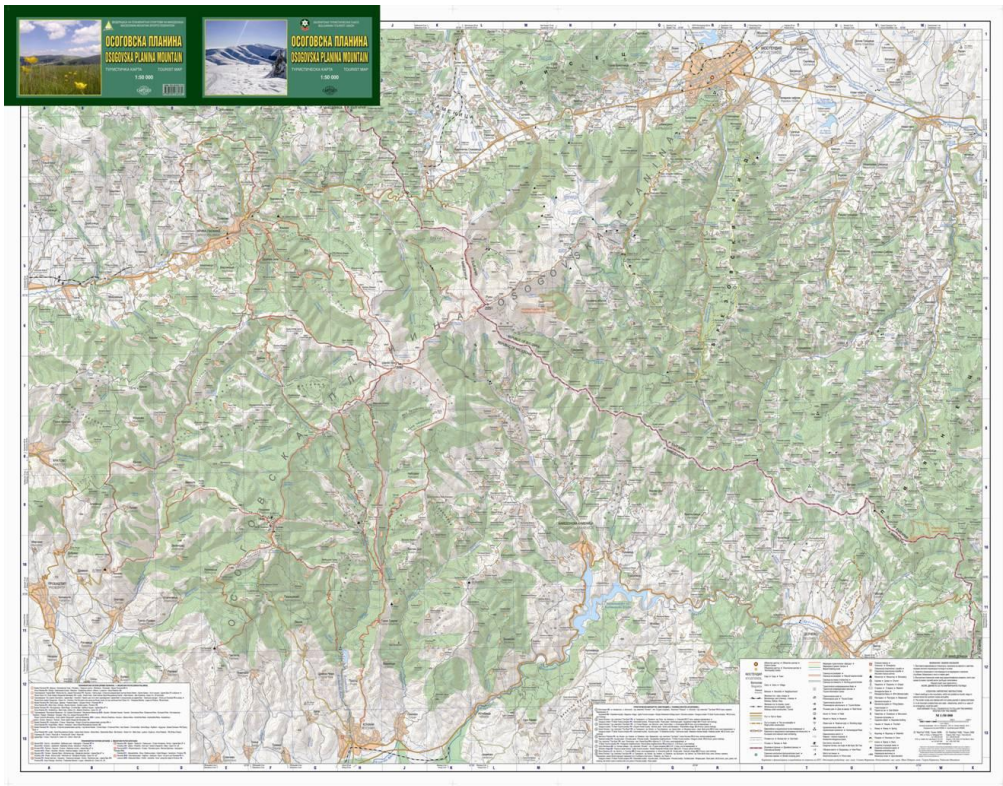


Figure 4 A Map of Osogovska Planina Mountain, CartGeo Ltd, 2009

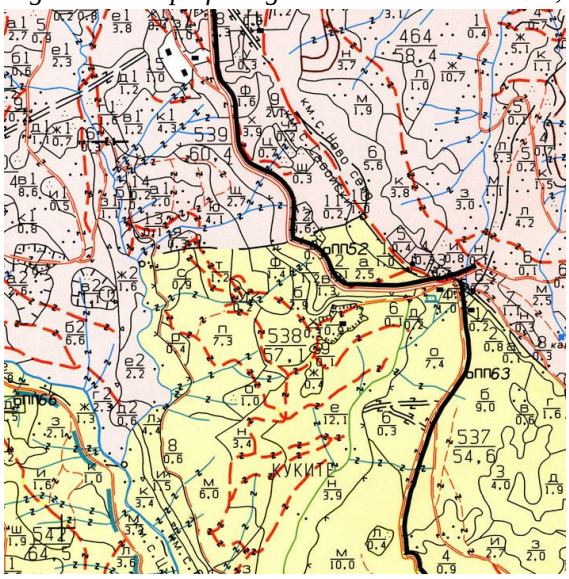
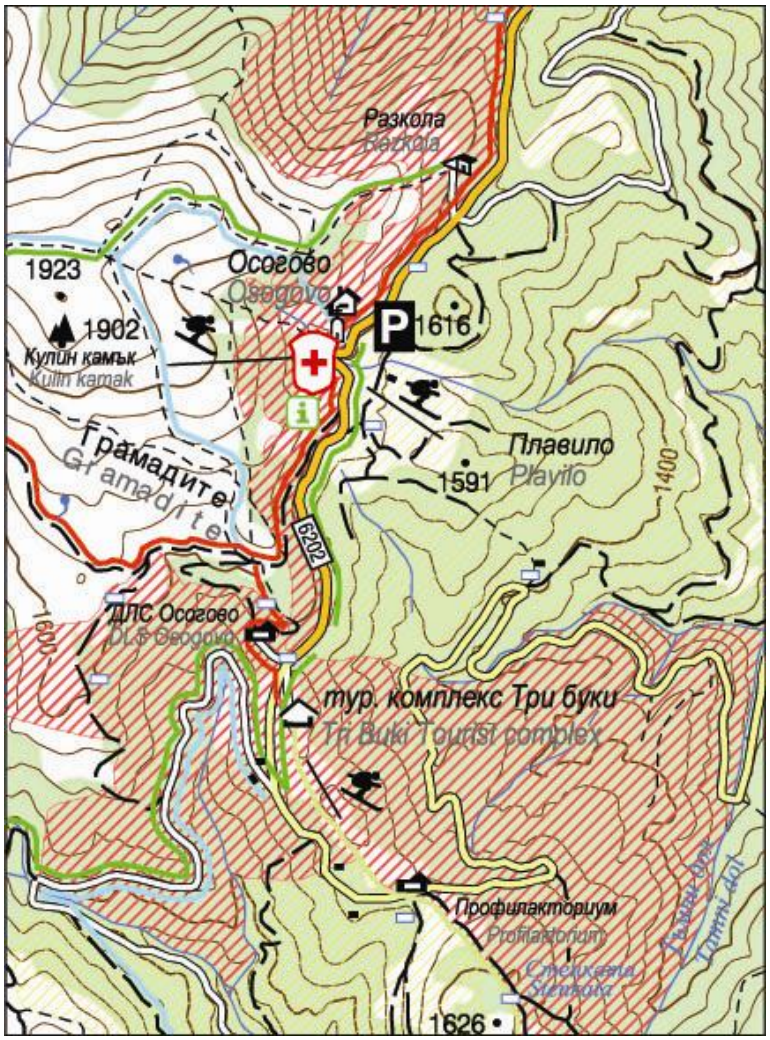


Figure 5 A Map for Fire-Fighting Arrangement, Agrolesproekt EOOD, 2010

The map of fire-fighting arrangement is also used as a source of information about the forest roads passable by fire trucks as well as the areas adapted for fire trucks parking. The forest roads located both in Bulgaria and FYROM are presented on the map in order to facilitate the fire-fighting operations in case of wild fire near or across the border.



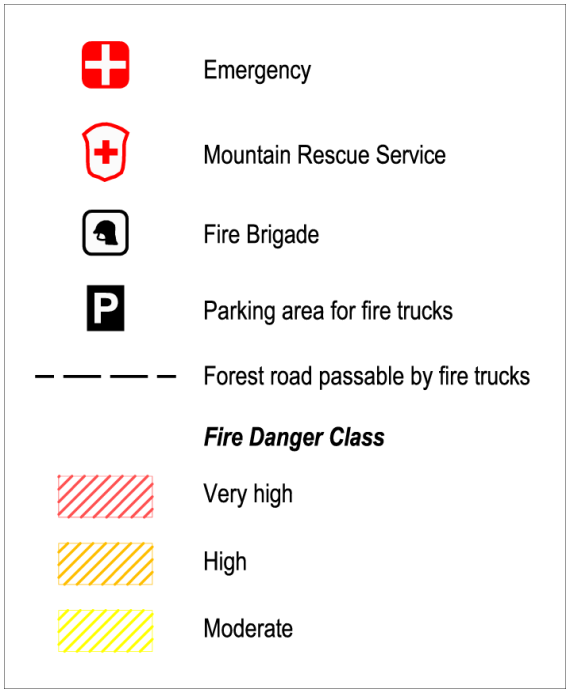


Figure 6 A Map of Osogvska Planian mountain region for disaster management (a) and a part of its map key (b)

The Osogovksa planina is a mountain at high avalanche risk. In the last fifty years avalanches often occur both in Bulgarian and FYROM parts of the mountain. So it is necessary the slopes at avalanche risk to be presented on the cross-border map for disaster management.

The main characteristics of an avalanche-prone slopes are:

• slope steepness – avalanches most frequently occur on slopes of 28º and 45º, but they may also occur on gentler and steeper slopes (figure 7)

• slope profile and slope aspects (Bulgarian Red Cross, 2009)

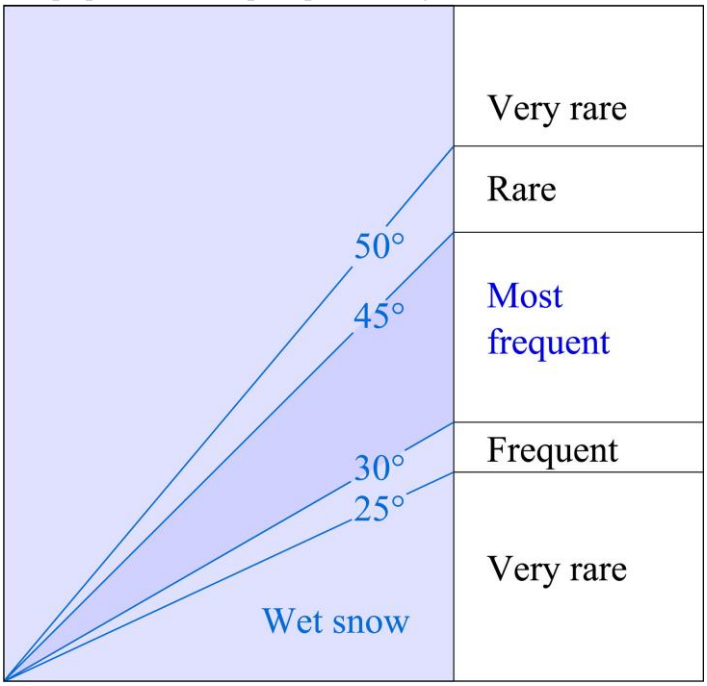


Figure 7 Slope angles where avalanches most frequently start

The avalanche-prone slopes in the Osogovska planina mountain are determined on the base of a Digital Terrain Model of the region, a slope map and information provided by the Mountain Rescue Service (Bulgaria), The Bulgarian Tourist Union and the Macedonian Mountain Sports Federation. The avalanche-prone slopes are presented by a symbol showing the possible direction of the avalanche (figure 8). Such kind of symbols may be used not only on maps for disaster management but also on tourist maps of mountain regions. Thus, the mountain walkers would be provided with additional information about the avalanche risk through the tourist routes.

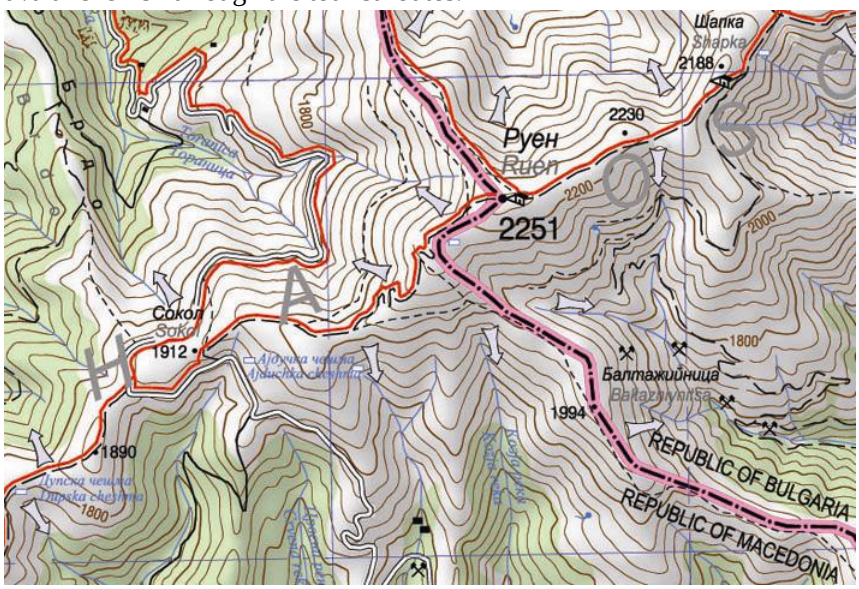


Figure 8 Avalanche-prone slopes

7. CONCLUSION

Cartography plays a central role in all main stages of disaster management. The cooperative prevention, preparedness and planning activities of the authorities of two or more neighbouring countries could be supported by detailed cross-border maps. The map content should represent the peculiarities of the region and provide information about the structure, characteristics and classification of the features. Cross-border maps combine heterogeneous data provided by various services, agencies and organizations. In order all this data to be integrated and presented on a coherent map it should be harmonized. The paper presents a map of a cross-border mountain region intended to support disaster management activities. The map is designed in accordance with the main aspects of data harmonization. The names of all geographical features are presented by their endonyms and respective transliterations in Roman. Thus, the map would be usable by the regional and national authorities in the neighbouring countries and would facilitate significantly the cooperative disaster management strategy.

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