

## ENVIRONMENTAL AND GEOMORPHOLOGICAL MAPPING BY REMOTE SENSING METHODS

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We worked out methods and application of environmental and geomorphological mapping by remote sensing. They include mapping method, assessment criteria and indicators of sharpening environmental situations, principles of compiling maps.

### 1 Research tasks

Environmental and geomorphological mapping by space images is just started. It needs further studies. We develop some methodical and practical tasks. They are mapping methods and their remote sensing provision; criteria and indicators of sharpening environmental situations that are efficiently detected by space images depending on geographical conditions; principles of compiling maps and map legends.

### 2 Remote sensing sections for thematic maps

We have proposed a new method as a result of the studies on the example of mountains and plains at the world's various landscape conditions. It is based on the combination of the advantages of remote sensing and mapping. On this basis, synthetic products are compiled, i.e., environmental and geomorphological maps (and other environmental maps) supplemented by blocks of annotated space images.

The procedure of compilation includes selection of space images required to fulfil a task, their primary processing and interpretation, selection of remote sensing and cartographic bases, design of a map legend and its drawing, compilation of a thematic block of space images, i.e., photoportraits of mapped objects (with expanded annotations), to illustrate, complement, and develop map contents according to the map concepts.

The idea of the block of space images (principles and criteria of selecting space images and their analysis) is worked out while compiling such sections for small-scale maps of natural resources of the atlas of Nature and Resources of the World [1].

Maps with a block of space images can be compiled at three spatial and hierarchical levels such as global, regional, and local. An example of the global level is the atlas of Nature and Resources of the World, which is a database for various survey environmental maps (with a block of space images on 1:10,000,000-1:1,000,000 scales).

The regional and local levels are studied by middle and large-scale mapping of some areas of the North Caucasus (a block of space images on 1:2,500,000 and 1:200,000 scales).

### **3 Principles and methods of environmental and geomorphological mapping**

Exogenic processes are principal natural factors to affect an environmental state. They frequently create hazardous, threatened, and catastrophic situations in the active tectonic orogenic areas. Rockfalls, taluses, landslides, mud flows, erosion, and other processes were explored and mapped with both analysing different space images and traditional geomorphological cameral and field works, as well as aerovisual observations. Multizonal scanned images of the high-orbital satellite Resurs-O, multizonal and spectra-zonal images of the low-orbital satellites Resurs-F and Landsat were used.

The traces of exogenic processes are indicated on space images mostly by morphographic steps of relief, a structure of altitudinal belts, different types of a vegetation cover, an acreage of a herbaceous cover, etc. The main indicator of slope processes in the North Caucasus is a vegetation cover.

The mapping of slope processes in middle and large scales is most efficient by summer spectra-zonal space images on a 1:1,000,000 scale with following enlargement, and on a 1:200,000 scale. Particular colours and hues of spectra-zonal images correspond to different types of wood and herbaceous covers. Intensity of colour indicates density of a vegetation cover and, hence, intensity of sheet and linear erosion, and other processes. The boundaries of these areas are most accurate. The accuracy cannot be provided by

other traditional methods of exploration. Hence, we developed the most efficient method to detect and assess intensity of slope processes by spectra-zonal images.

The information value of environmental and geomorphological maps is much higher when compiling them by "basic indicative" maps including landscape, lineament-block tectonic, and different morphostructure maps [2]. The environmental and geomorphological maps of the North Caucasus were compiled by the data of the morphostructure map of the Great Caucasus made by us [3].

The environmental state of an area is assessed by two criteria. They are comfortability of human life (a sum of endogenic and exogenic factors) in the middle-scale mapping, and occurrence of hazardous exogenic processes threatening human life and economy of an area in the large-scale mapping. The principles to design a matrix legend of a map on a 1:200,000 scale are worked out.

#### 4 Results of regional explorations

The assessment colour map of hazardous slope processes in Mountainous Osetia (Russia), a most geodynamic region, was compiled by spectra-zonal images on a 1:200,000 scale. The areas of prevailing hazardous slope processes (mud flows, rockfalls, taluses, landslides, intensive linear and incising erosion, etc.) are shown on the map by coloured background. The threats of these processes are shown by coloured shading of different density. Moreover, local occurrence of the processes and some elements of fault tectonics and various morphostructures affecting the occurrence (for example, mud flows or landslides) are marked.

The matrix legend of the map contains both the characteristics of the processes and physical-geographical preconditions. The processes in the altitudinal belts are classified on the map into three categories including catastrophic and threatened causing material losses, threatened and hazardous, comparatively non-hazardous.

The remote sensing map of slope processes in Mountainous Dagestan (Russia) on a 1:250,000 scale was compiled by spectra-zonal images. The secondary environmental and geomorphological schematic map of Mountainous Dagestan on a 1:1,500,000 scale was

laid out on this base [4]. The maps of Mountainous Osetia and Dagestan (Russia) are supplemented by blocks of multizonal and spectra-zonal space images, of various scales and seasons as well as airphotographs of "hazardous" places complemented by annotations.

## 5 Recommendations

The method to compile environmental and geomorphological maps by space images can be successfully used mostly for humid and arid active tectonic orogenic areas with particularly pronounced landscape belts. The examples are the mountains of South Siberia, Middle and Central Asia, the Alps, the Andes, Sierra Nevada (Pyrenees Peninsula), the Cordilleras of North America (the Fraser river basin in the Coast Range, Sierra Madre), West and East Cuba, Kimberley Plateau (Australia), etc.

## References

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