

A SERIES OF ATLASES ON METHODS OF SPACE IMAGES INTERPRETATION

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**ABSTRACT:**

Space images have become an indispensable staff for geographical research and thematic mapping. To provide for deeper and broader utilisation of space images specialized atlases of space pictures are being compiled as scientific and methodological manuals. A series of such atlases is being compiled now by the geographers of Moscow State University in cooperation with the USSR Academy of Sciences Space Research Institute and some other institutions. The following triad is on the basis of data representation in the atlases: space pictures - interpretation techniques - interpretation results. The methods of interpretation include visual and automatized ones. The recommendations on image interpretation techniques are given for various directions of thematic research and mapping.

Recently two fundamental atlases were compiled and the third one is going to be completed. The first two volumes are devoted to interpretation of multispectral images as new kinds of remote sensing materials, which had been widely introduced into life along with the development of space exploration. The first volume entitled "Atlas of interpretation of multispectral aerospace photographs. Methods and results" deals with space photography and it is based on high quality images obtained by means of the MKF-6 camera. The 2-nd volume is based on high resolution multispectral scanner images obtained from the "Fragment" scanning system installed on the "Meteor-30" satellite. The both volumes include dozens of images and about 150 thematic maps, their subjects covering the whole spectrum of Earth sciences. The atlases have been elaborated within the confines of the "Intercosmos" consil International cooperation and published jointly by the "Nauka" (Moscow) and "Academie Verlag" (Berlin) publishing houses in 3 languages - Russian, German and English. These publications have been widely referred to in the world press and used in education and training specialists in remote sensing in countries belonged to USSR.

The laboratory of aerospace research methods of the Moscow State University Geographical faculty Department of Cartography and Geoinformatics has taken the initiative of compiling the 3-rd ecologically directed volume. The new atlas will have 2 parts. The scientific-methodological part will include image representations of Man's impacts on nature in various geographical zones for various kinds of land use, as well as methods of ecological mapping and imagery interpretation. The 2-nd, "applied" part of the atlas, will be devoted to the prospects of space images' utilisation for solving global, regional and local ecological problems. Atlases are very useful for scientific, practical and educational purposes.

**KEY WORDS:** Space pictures, Multibund, Interpretation, Methods, Atlases, Ecology

Space images became indispensable for geographic research and thematic mapping. Special scientific-methodical manuals in the form of atlases of space images are prepared in order to provide their more deep and variable use. Geographers team of the Moscow State University together with the Space Research Institute Academy of Sciences in cooperation with other organisations are working at a series of such atlases. Three main things: image - methods of interpretation - results - comprise the base of materials presentation. Methods of interpretation include visual interpretation and automatized one; methodical recommendations are given for different field of thematic investigation and map compilation. Two major atlases have been published already and the third is being prepared. The first two volumes were devoted to multiband images processing, which are new kinds of remote sensing materials widely distributed due to cosmic research work. They were prepared in the international cooperation within the frame of "Intercosmos", published by "Nauka" (Moscow) and "Academie Verlag" (Berlin) publishing houses in three languages: Russian, German and English. The Atlases received approval in the world press and are widely used for training of specialists in remote sensing

The first volume of the "Atlas of interpretation of multispectral aerospace photographs. Methods and results" deals with space photographs and based on high quality materials received by means of the MKF-6 camera, worked out by specialists in GDR and USSR. Methods of multispectral images interpretation are presented in it - successive interpretation of series in different bands, comparative interpretation using remote sensing objects spectral signature. Advantage of multispectral method of survey for investigations and map compilation of different natural and economic objects is exemplified by 10-12 standard territories in the USSR and GDR. These investigations include the following fields of geographical research and themat-

tic maps compilation: shallow-water shelves sea-bed relief explorations, investigations of submarine vegetation, submarine landscapes; terrestrial relief and tectonics studies, glacial and hydrologic studies - glaciation, stream processes, sediments flow of rivers flowing into water basins investigations; landscape, soil-vegetation cover research and map compilation; natural regionalisation; agricultural research - land use and agricultural plants maps compilation, settlements and types of settlements distribution investigations; antropogenic environmental impact and nature conservations studies.

Methods of interpretation and map compilation of these objects are exemplified by the north-eastern Caspian sea, coasts of the Baltic and the sea of Okhotsk, Central Yakutia, the Western Baikal area, the Pamir-Alay mountains chain, the South-Eastern Kazakhstan and the Middle Asia, the central part of GDR.

Original methods of multispectral image processing are recommended for each of the directions of investigations, comprised by the Atlas subjects. Methods for both terrestrial and shallow water basin natural resources studies are presented. Multispectral images for the latter give especially valuable data.

The second volume of the Atlas is based on multispectral scanner images of high resolution received by scanner system "Fragment" from the satellite "Meteor-30". It illustrates broad possibilities of thematic multispectral scanner images interpretation and diversity of methods and means of processing used for this purpose, beginning with visual interpretation up to automatized map compilation. Since materials of operational scanning survey, received in digital form, are intended for computer processing, automatic images interpretation methods and objects classifications in the course of thematic map compilation are presented in more details in this volume than in the first one. Se-

veral dozens (more than 30) of zonal and colour composite images received by the system "Fragment" for different in nature and economy territories of the European part of the USSR, as well as for GDR and Bulgaria, results of their thematic interpretation (fragments of more than 100 maps) and recommendations for visual and automatic interpretation are presented in the Atlas.

The Atlas has thematic structure and reveals opportunities and methods for images use for the sake of studies and map compilation of geologic and geomorphologic structure of a territory, river deltas, water reservoirs, soil cover, forest vegetation, landscapes, agriculture, antropogenic environmental impact, for solving of environmental and social economic monitoring problems. Complex studies, conducted particularly for agricultural purposes dealing with the idea of agricultural landscapes are distinguished specially. The two published volumes are widely used as scientific-methodics manual for multispectral scanner images interpretation and their use for the Earth natural resources studies. They are adopted for educational purposes in high school for training of specialists in different fields of Earth sciences and remote sensing. Now the laboratory of air-cosmic methods of the department of cartography and geoinformatics of the Geographical faculty, Moscow University showed the initiative to prepare the third volume of this series - an atlas "Cosmic methods in geoecology". The planned third volume is marked by all-directed use of cosmic information for solving of ecological problems using various materials and methods for their processing and interpretation for these purposes. The Atlas will promote space information supply of the national program "Nature conservation", which includes an academic biosphere and ecologic investigations programme, as well as the international geosphere-biosphere programme MGBP.

The scientific-methodics part of the Atlas

stipulates revealing of possibilities of space information use for antropogenic impact studies and monitoring, control of negative consequences of such impact. They are chosen for different natural zones and types of land use. Special attention is paid to unstable to antropogenic impact natural complexes. Technogenic impact on soil-vegetation cover on permafrost is shown for tundra regions - oil and gas extraction, oil pipes construction, not rational transport use of territories, traffic outside roads. Influence of intensive land use for timber production on changes in forest types inevitable without suitable measures for forests restoration are presented for taiga regions. Control possibilities of timber felling rules violation are shown; results of mass forest diseases and pests outbreaks, forests fires, possibilities of forest restoration at ashes and cuttings control are shown.

Development of erosion processes are shown for forest-steppe mainly agricultural regions as well as images of linear erosion intensity, soil sheet erosion, humus losses. Possibility of control filling and water quality of small water reservoirs, ponds, waterbasins comprising typical characteristics of landscapes experiencing precipitation deficit in the steppe zone are demonstrated. Possibility of control soil deflation, sand storms are shown for arid steppe and semidesert regions.

Pasture digression as the result of excessive grazing, formation of spots near wells and strips of desertification of cattle-routes, soil destruction and deflation development center the influence of overgrazing, transport use of a territory, mineral resources exploitation images are foreseen for desert and semidesert pastures regions. Processes of secondary soils salinization as the result of irrigation waters discharge, processes of bogs formation and salinization under the influence of water percolation from irrigation canals, desertification of shriveling wa-

ter basins are analysed using images for irrigated agriculture regions of the desert zone.

In mountain regions images are used for showing natural catastrophic destructive processes both endogenic seismic activity, volcanism and exogenic, first of all avalanches-mudflows activities, landslides, stone falls, rock falls as well as for studies of their.

Connections with antropogenic impact besides this complex of negative processes, developing in different natural zones with different economic use, azonal industrial impact of different types of mining industry are shown at space images.

It is supposed to show ecological situation in heavy populated regions and city agglomerations reflected at images as well as main recreation zones and territories.

The second part of the Atlas connected with solving of specific ecological problems - global, regional and local - will contain analysis of ecological situations with the help of images, their map compilation and samples of cosmic information use not only for showing some situation but for solving of the emerged problems. The following "hot spots" of the country - the Aral and the Aral area; region of ecological disaster because of overgrazing - Kalmykya; regions of erosion processes development in Central Chernosem part of Russia; industrial regions of Southern Ural, Kuzbass and the Center of European Russia; regions of mining industry, non ferrous metallurgy at the North - at Kola peninsula and around Norilsk with their damage at forest vegetation; regions of oil extraction at the North and in the Western Siberia; regions of deforestation and industry impact at forests in European part of Russia and Siberia; the Baikal region and the BAM route; the Moscow and Sanct-Peterburg agglomerations and other regions will be presented as examples.

Now we have finished to compile some blocks of sheets from the second, "applied" part of Atlas. Ecological problems, connected with desertification, are shown at the Aral area and Kalmykya examples. For the wide zone of Aral impact - Kyzylkum desert - a series of maps in scale 1:8 000 000 is compiled, including maps of modern landscapes, processes of desertification, degree of desertification and recommendations for it preventing, and the map of geoecological estimation of landscapes. Analogue series will be given for near-Aral area in scale 1:2 500 000. For Southern Aral area with Amudarya delta landscapes dynamics have been analysed by multitemporal space pictures in scale 1:1 000 000 and 1:200 000 and maps of hydrogenic ecosystems for different dates and their dynamics have been compiled.

For Kalmykya region space pictures show types and factors of desertification in this area - overgrazing and pasture digression; sand storms at areas of sand soils ploughing; sand dunes moving at roads and buildings; salinization due to irrational melioration and hydroengineering constructions. Maps of land use, processes of desertification and desertification forecast on 20-30 years are compiled.

Another block of sheets connects with problem of deforestation. Old maps for European part of Russia (1870), compared with space pictures, give the possibility to analyse forest-boundaries dynamics and to compile maps of forests dynamics for some standard sites (1:1 000 000). Man's impact at forests, such as cutting, fires, agriculture and industry damage is shown at space pictures of Siberia.

The Atlas will serve for ecological education of workers from different branches of Earth sciences and economy and for population. It will become a scientific methodics manual for use of cosmic information for ecological map compilation, environmental impact assessment and solving of ecological problems for specialists.