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NEW RUSSIAN ATLAS "SPACE METHODS FOR GEOECOLOGY"

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The methods of remotely-sensed images usage for ecological applications have been developed and presented in the new scientific-methodological atlas "Space Methods for Geoecology", prepared by geographers of Moscow State University.

Special manuals in the form of atlases of satellite images are within the best tools for support of the geographical and ecological research and thematic mapping. The team of Moscow State University geographers, in cooperation with other organisations, have developed and edited a series of such atlases. The first two volumes were devoted to processing of multispectral imagery; they were prepared in the international cooperation within the frame of "Intercosmos" and published in 1982 and 1988 in Berlin in three languidges: Russian, English and German. The following triad is the presentation basis in the atlases: satellite images - interpretation techniques - interpretation results.

Now Faculty of Geography MSU had compiled the third - ecologically oriented - volume. The new atlas reflects the interaction of astronautics and ecology. It generalises the experience and achivements on space methods application in geoecology up to the middle 1990's, shows the ways of satellite images use in geoecological monitoring and for investigation and solution the ecological problems. It has been compiled in cooperation with specialists of 15 organisations in Russia; there were 96 specialists involved in its compilation. The Atlas was printed by financial support of Russian Space Agency.

The new atlas consists of 108 sheets which includes dozens of colour images, mainly from Russian spacecraft, as well as the results of their interpretation, thematic ecological maps, compiled on the base of the imagery, and short explanation text on methods of interpretation and possibilities of satellite images usage in investigations of ecological problems and decision making.

The issue covered range from global ecological problems, represented in quite general manner, up to the more specific regional and local problems, characterised in more detail.

A short section of the Atlas is devoted to global ecological problems investigation: global climate warming, vegetation biomass loss, phitoplanktone concentration, ozon layer depletion.

In the group of regional problems, the common problems for all geographical zones are presented first, within them : sea level fluctuations, air pollution and water contamination. Ecological problems of coastal regions connected with sea level fluctuations are shown through the examples of Aral sea area, where they are stipulated by sea receiding, and Caspian sea coastal zone, where they are provoked by sea level rise. One of examples is Sulak River delta, where erosion and flooding processes have lead to ecological problems of Sulak settlement.

Remotely sensed images usage for water contamination control is examined for sea waters at example of influence of the flood prevention dam in Neva Bay, Baltic sea. Inland water bodies contamination is shown on the example of Imandra Lake, where water contamination decreased with changing the process of apatyte ore enrichment to inside watercicle. Another example is Angara River, the clearist in the past, but now satellite image show streeps of dirty water coused by gold exploration along right side and by timber cutting and transportation - along left side.

Air pollution indicated by dirty snow cover areas in winter imagery is studied for industrial central part of the European Russia, Siberia, Urals regions, where dirty snow cover areas much bigger than areas of towns and factories.

More detail description is given for regional ecological problems of Russia and neighbouring territories in different geographical zones - tundra, forests, steppes, and deserts. Problems of deforestation,
erosion and desertification are the main subject of this part of the Atlas.

In tundra zone, under technogenic impact on soil and vegetation cover on permafrost, activation of cryogenic processes takes place. Natural tundra landscapes of Eastern Siberia North are compared with damaged landscapes of Western Siberia in regions of oil and gas extraction, oil pipelines construction and the off-road traffic impact.

Scale of deforestation in boreal forests is investigated in the Atlas by comparison of recent satellite imagery with the old maps, compiled in the middle of last century. It was carried out for 15 test sites in European part of Russia and interesting phenomena were discovered, in particulary the widening of forests areas in some regions. Within the topics shown for Siberian and Far Eastern taiga regions are: cutting control, monitiring the observation of timber felling rules, results of pests outbreaks, forests fires and post-fire forest restoration control.

Ecological problems of steppe zone, with its' intensive agricultural land use, cousing development of erosion processes - linear and soil sheet erosion, humus losses - are characterised using the examples of Central Chernozem area and Northern Caucasus.

Ecological problems, connected with desertification, are shown for Aral area, Tadzhikistan and Kalmykia. For the wide area of Aral impact - maps of modern landscape, processes of desertification, degree of desertification, reccomendations for its prevention are compiled using satellite images. For Amudarya delta maps of hydrogenic ecosystems for different dates and their dynamics have been compiled. For Tedzhen and Murgab subaeral deltas in Tadzhikistan with irrigated agricultural land use the following issues have been studied: processes of secondary soil salinisation as the result of irrigation water discharge, marshland formation under the influence of water percolation from irrigation canals, pasture desertification of

water basins. For Kalmykia region maps of land use, processes of desrtification and desertification forecast for 20-30 years ahead are presented.

Technogenic impact in mining and industrial regions, problems, connected with urbanisation and nature management, nature hazards and nature conservation are examined in concluding section of the Atlas. Environmental impact of mining and mineral processing can be seen at images of Kola Peninsula and Central Caucasus. Damage to environment due to coal mining is analysed using images of Southern Yakutia, Nerungry, due to gold mining - for Aldan and Patomskoe mountain plateau. Much attention is paid to peateries exploration and recultivation problems in Moscow region. Impact of oil exploration on landscape is shown for some Western-Siberian regions, in particular for Samotlor Lake, where planty of grounds and platforms of exploration, dams, pipes, roads, contamination of lands and water, flooding, disastrous of vegetation are seen. Severe damage to nature caused by nickel and cupper ore processing due to sulfur dioxide and heavy metals emissions to atmosphere are shown for Norilsk area in North Siberia and Monchegorsk area in Kola Peninsula. Here zones with different degree of damage are distingueshed by satellite images, their interpretation signs are characterised and algorithms of computer processing are developed for damaged vegetation mapping.

In solving the ecological problems of urbanised areas, shown at examples of Moscow and Saint-Petersburg, satellite images can help in estimation and mapping of buildings density, presence and state of green vegetation, settlement recreation resources, dynamics of town land use.

In addition to antropogenic ecological problems the Atlas characterises the potential of remote sensing for natural hazards investigations. Monitoring of flooding is described for Lower Volga region. In mountain regions imagery is used for studies of natural catastrophic destructive processes both endogenic (seismic activity in Big Caucasus, volcanism in Kamchatka) and exogenic (landslides, stonefalls in Caucasus, surging glaciers in Pamir). The example for Big Caucasus shows the influence of earthquakes on activisation of landslides activity.

Also the materials of the Atlas are mainly Russian-oriented, the proposed methods can be successfully applied for solution of similar problems in other countries. The Atlas will serve for ecological education of people from different fields of Earth sciences and business, as well as for general public. It will become a manual for use of remote sensing information in compilation of ecological maps, environmental impact assessment and solving of ecological problems.

The Atlas may be used by university teachers, by specialists in Earth sciences, especially geoecologists; it will be also interesting for anyone, who would like to know more about ecological problems and their solutions using remote sensing methods.