IDENTIFICATION CRUCIAL COMPONENTS OF NATURAL ECOSYSTEMS

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Abstract
The article presents the results of a study of spectral signatures of the main three types of plant communities: Saline lands, Salty steppes, Pine grass forests from the Altai region (Russia). Earth remote sensing data from the spacecraft Kanopus-B and data from the unmanned aerial vehicle were used. The results of the experimental study showed partial effectiveness of satellite data for decoding selected vegetation types. As a result of the carried out researches the technique of joint use of satellite data and data from the unmanned aerial vehicle for regional mapping of vegetation was tested. The results of the experiments have shown the possibility of efficient allocation of certain types of communities according to the data obtained from the satellite. The data obtained from the unmanned aerial vehicle is well used to identify local anthropogenic disturbances.

Keywords: geobotanical mapping, natural landscapes, ecosystems, remote sensing, unmanned aerial vehicle, multi-spectral image, spectrometric research, spectral signatures.

INTRODUCTION
Remote sensing is the science of obtaining information about an object by analyzing data obtained by sensors of a device that does not interact with the object of study. When electromagnetic energy is supplied to any object on the Earth's surface, three energy responses are possible: reflection, absorption and transmission (Lillesand et al. 2004). Part of the reflected, absorbed and transmitted energy can vary from the type and state of the earth's surface. Thus, for two objects of the same type, the spectral characteristics can be identical in one spectral range and vary greatly in another wavelength range. The necessary element of Remote Sensing (RS) natural ecosystems are the spectral characteristics of the objects of the earth's surface. At the same time, a set of attributes describing the objects should provide a level of information and detail that allows distinguishing one object from another by its spectral properties (Chandra, Kosh, 2008).

MATERIALS AND METHODS
Investigations were carried out on three model sites: Saline lands, Salty steppes, Pine grass forests located in the Altai region of Western Siberia, Russia (Fig. 1). Expedition investigations conducted route geobotanical methods (Korchagin, 1964). Description of plant communities are made on sites of 25×25 m – in forests and 10×10 – in steppes. At the sites considered, the abundance of species detected floristic composition, determined by type of community, etc. Vegetation Classification made on the basis of the dominant approach (Alexandrova, 1969). The location coordinates of the sites are determined by navigation GNSS equipment with an error of about 10 m.

Simultaneously with ground-based research performed survey of model sites using multi-rotor UAV such as the DJI Phantom 3 Professional aerial photography were performed. Shooting steppe grassy vegetation was made from a height of 50 m in total 5 plots with a total area of 1 km² were shot. In addition, experiments were carried out to determine the shooting height suitable for visual decoding of individual plants. When shooting foresery vegetation photography height was about 100 m. A standard RGB camera with a focal length of 4 mm and a matrix resolution of 3000×4000 pixels is
used for shooting. Pix4D capture was used as an autopilot. Materials processing executed in the software Agisoft Photoscan.

To identify the spectral characteristics of objects, remote sensing data from the Kanopus-V satellite (date 02 August 2017) were used. Spectral ranges (channels): 1. Blue-0.46-0.51 µm; 2. Green 0.51-0.60 µm; 3. Red-0.63-0.69 µm; 4. Near infrared 0.75-0.84 µm. In the study of spectral characteristics, descriptive statistics of spectral signatures of pixels within the selected polygons of a raster image are used.

RESULTS AND DISCUSSION

On the experimental sites located in three different types of vegetation, a geobotanical survey was carried out, community dominants and their cover were revealed, which creates the same picture in the picture. When solar radiation passes through the atmosphere, its intensity changes caused by the influence of gases and aerosols present in the atmosphere. As a result, satellite remote sensing data contain information not only on the surface but also on the state of the atmosphere. We carried out the elimination of this distortion factor and the transfer of the image from the units of spectral brightness to the units of spectral reflectance using the atmospheric correction procedure.

The spectral characteristics of Remote sensing data obtained from Kanopus-V and UAV were measured as a result of the performed camera treatment. Examples of the spectral characteristics of the satellite are presented in Fig. 2, and with UAV – on Fig.3. Satellite imagery in different spectral ranges are designed to capture current changes in the structure of the vegetation (Fig. 2). Changes related to anthropogenic influences and other natural factors can be recorded on high-resolution images (Fig. 3), as well as in the conjugate analysis of low spatial resolution data. It should be noted that the materials of satellite imagery become more informative as they accumulate over the years and in different phenological periods. These data are indispensable for monitoring ecosystem functioning. Spectrum variability and mixed pixels are the main obstacles that need to be considered when solving the problems of thematic processing of spectral information.

Based on the analysis of data from four channels of satellite Kanopus-V, a study of spectral characteristics on test sites was carried out. Mean intensities and dispersion for each spectral channel were obtained. Spectral profiles are averaged over all test areas of each vegetation type. Analysis of the obtained data shows that, with the exception of Saline lands, spectral profiles represent the classical spectral profile of green vegetation. Saline lands intensity values differ slightly from others. The greatest differences are observed in the green and near infrared bands (2 and 4 channels). Thus, multispectral data of satellite Kanopus-V can provide the possibility of automated decryption of Saline lands. In the analysis of multispectral data, in some cases, use of index image. To obtain them on the basis of various combinations of intensity values in certain channels, the most informative for the selection of the object under study, and the calculation of these values of the "spectral index", an image corresponding to the index value in each pixel is constructed.

It should be noted that the identification of the studied objects is problematic, since the accuracy of determining the coordinates does not allow to uniquely identify the site in the pictures. Meanwhile, a 1-pixel error can significantly affect the results of the definition (Fig. 3, A-B and C-D). If the site is bordered by features of other classes, the discrepancies can be very significant.

The conducted researches show possibilities of allocation of the main structural elements of natural landscapes. With the help of UAV, it is possible to accurately determine the projected coverage of forest vegetation, as well as to determine the composition of growing rocks. These data can be extrapolated to areas with similar conditions. The allocation of types of forest vegetation and their structure is possible only in the cameral processing of geobotanical descriptions obtained as a result of expedition research, and remote sensing using UAV allows to obtain and identify the spatial structure of vegetation, as well as to obtain additional cenotic parameters of vegetation.

CONCLUSION

Studies have shown the possibility of identifying vegetation in Remote sensing data of medium spatial resolution. The spectral characteristics of vegetation have differences in reflectivity in the visible and near canal. An important role in the near canal is the composition of vegetation. It was found that more radiation is transmitted in pine forests, and more reflection is observed in the steppes. The considered spectral characteristics of objects can be applied to the information received from the spacecraft Kanopus-V.

In conclusion, it should be noted that the use of unmanned aerial systems in the study of vegetation provides additional material to determine the statistical significance of both abiotic and biotic environmental factors. Shooting with UAV allows you to confidently determine the height of trees and species composition, but does not allow to identify shrubs and even more so is not suitable for decoding grassy vegetation. Experiments have shown that the results of large-scale
quadcopter shooting are poorly suited for automated decoding using classical algorithms based on spectral brightness analysis. Under these conditions, the obtained data are better used for visual decryption.

The experiments are part of the research aimed at developing a methodology for regional assessment of the ecological state of vegetation of natural landscapes. An integrated approach using field observations, satellite and ground-based data is needed. In further studies, a multispectral camera mounted on the UAV is supposed to be used to obtain vegetation characteristics. The use of such a camera will allow to correlate the values of reflectivity of plant communities obtained from the surface of the Earth without the influence of the atmosphere with the values of brightness obtained from the satellite Kanopus-V, which will improve the reliability of automated methods of decoding used for images from this satellite. Further GIS analysis of the results will reveal the quantitative relationship between the remote indicators of the state of vegetation and the factors of anthropogenic load on the territory of the region.

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ILLUSTRATIONS, FIGURES

Figure 1. Study area
Figure 2. Registration sites and spectral signatures under the data to remote sensing from satellite Kanopus-V. A1-2. Saline lands, B1-2. Salty steppes, C1-2. Pine grass forests. The diameter of the outer circle is 100 meters, the inner - 20 meters.

Figure 3. Registration sites and spectral signatures under the data to remote sensing from UAV. A-B. Saline lands, C-D. Salty steppes, E. Pine grass forests. The size of the square pads is equal to 20×20 meters.
REFERENCES


BIOGRAPHY

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