

Conducting Pasture Monitoring Based on Remote Sensing Data

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Abstract

The article addresses the necessity of pasture monitoring, the procedure for its implementation, remote sensing data used in conducting monitoring, and issues related to land monitoring based on these data.

Keywords: Pasture, remote sensing data, raster digital values, software, raster maps.

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1. Introduction

Currently, the issue of Earth remote sensing is becoming increasingly popular. Remote Sensing (RS) is a scientific field based on acquiring information about the Earth's surface without practical contact with it. The process of gathering data about the surface includes sensing and recording the energy reflected or emitted by objects for subsequent processing, analysis, and practical application.

A number of specialists [1,2,3,4] utilize remote methods to observe our planet from space, allowing the researcher to obtain information about the studied object from a distance. Remote sensing methods are usually indirect, meaning that instead of directly measuring the parameters of interest to the observer, quantities related to them are measured. For example, if we need to evaluate the state of forest stands in the Ussuri taiga, satellite equipment involved in monitoring records only the intensity of light flux emitted from radiating objects across several spectral bands. To decipher such data, preliminary studies involving various on-site experiments on individual trees are required. Next, it is

necessary to determine how those same objects appear from an aircraft, and only after that can the state of forests be evaluated based on satellite data [5].

2. Methods and Discussion

One of the most important advantages of aerial and satellite images and digital data obtained through remote sensing is that they can simultaneously cover huge areas under identical natural conditions.

Through Earth remote sensing, it is possible not only to process aerial and satellite images acquired in different years, but also to study vegetation cover using various spectral intervals. A modern single-lens reflex camera focuses infrared and ultraviolet light reflected from an object to form an image on film.

In other visual imaging systems, detectors or receivers are utilized. These detectors and receivers have the ability to sense specific wavelengths of the spectrum. Combining photoelectronic multipliers, semiconductor photodetectors, and optomechanical scanners makes it possible to register and convert ultraviolet, near, mid, and far-infrared radiation into signals. These signals create an

image on film. Microwave energy is transformed using radiometers or radars.

Instruments used to generate visual images are mounted on ground platforms, aircraft, balloons, and space vehicles. Special camera and television systems are continuously used for imagery of objects on land, in water, in the atmosphere, and in space.

The core component of remote sensing is image analysis. Such analysis is carried out visually, or using partial or full computer automation.

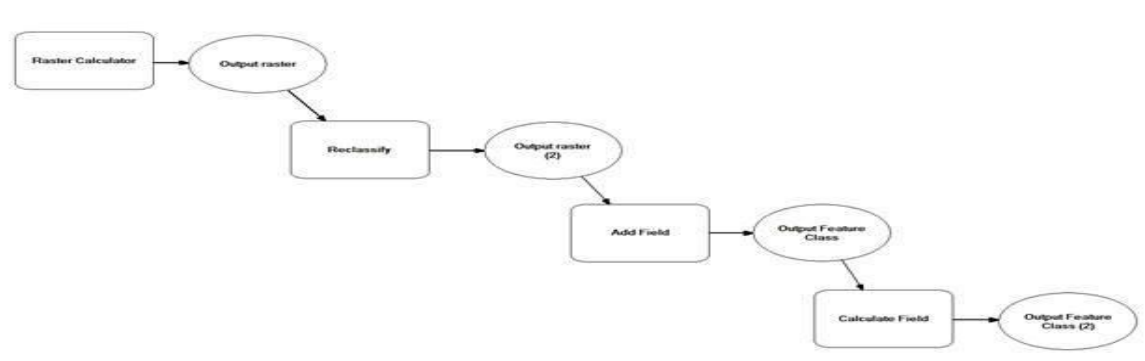
Remote sensing data serves as the primary source for

remote sensing data obtained from aircraft and satellites, it is possible to accurately measure vegetation cover in natural grasslands and forestry, as well as to determine its temporal changes.

3. Results

Let us analyze the remote sensing method that is optimal for conducting monitoring work (Table 1).

To automate the observation of annual changes in pasture vegetation conditions based on NDVI indicators, a model containing a sequence of these processes was developed. For this, the ModelBuilder functional extension of



constructing land-use maps and topographic maps. Using

ArcGIS software was utilized (Figure 1).

Figure 1. Sequence of steps in the remote sensing method optimal for monitoring work

This model represents a sequence of GIS functions starting with input NDVI rasters for a specific year and leading to output rasters that express the corresponding changes and contain areas categorized by change.

The initial stage of the model begins with analyzing the input NDVI rasters from two different years using the Raster Calculator function. Here, the difference between the digital values of the two compared rasters is determined through subtraction (Figure 2).

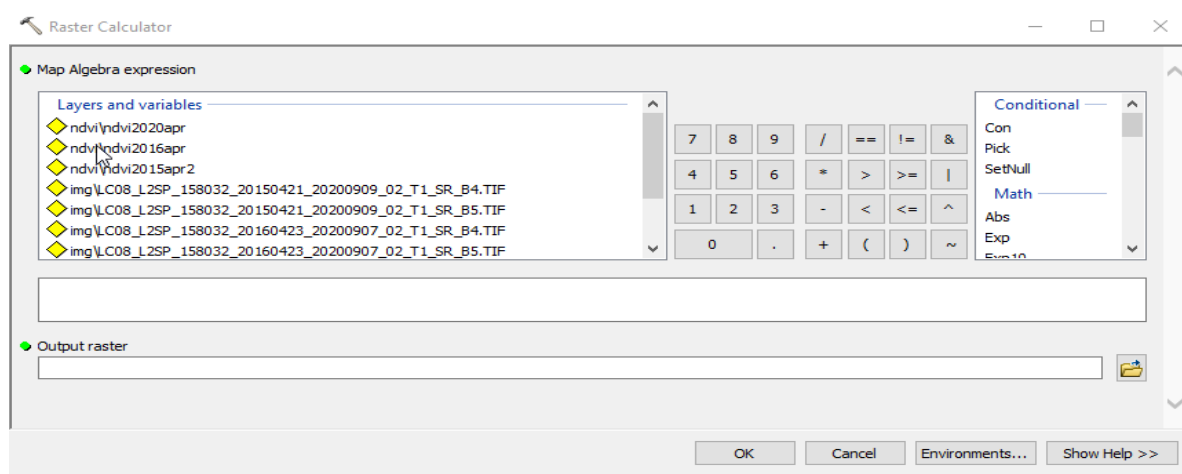


Figure 2. Analysis using the Raster Calculator function

In the next stage, the Reclassify function is used to divide the raster resulting from the comparison into appropriate gradations representing changes. Here, the obtained

raster digital values are categorized into groups according to the degree of vegetation cover change in the selected area (Figure 3).

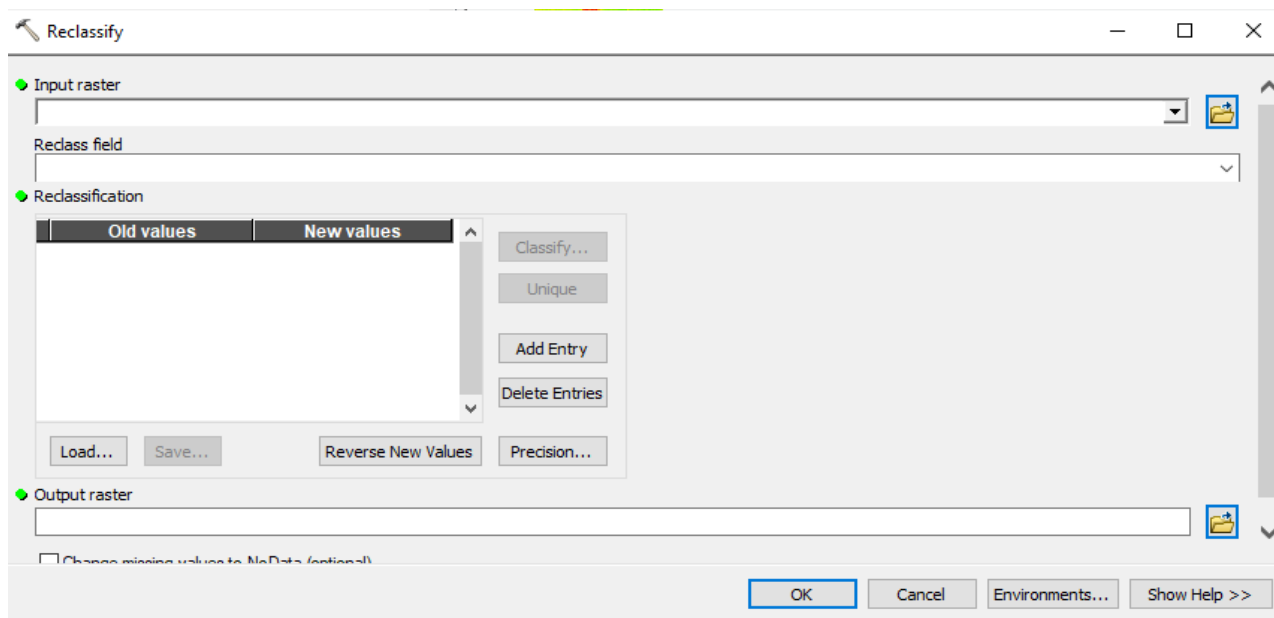


Figure 3. Utilizing the Reclassify function

Subsequently, to determine the extent of changes occurring in the studied area, a area attribute value is added to the corresponding raster to compute the area for

each group. The Add Field function is used for this purpose (Figure 4).

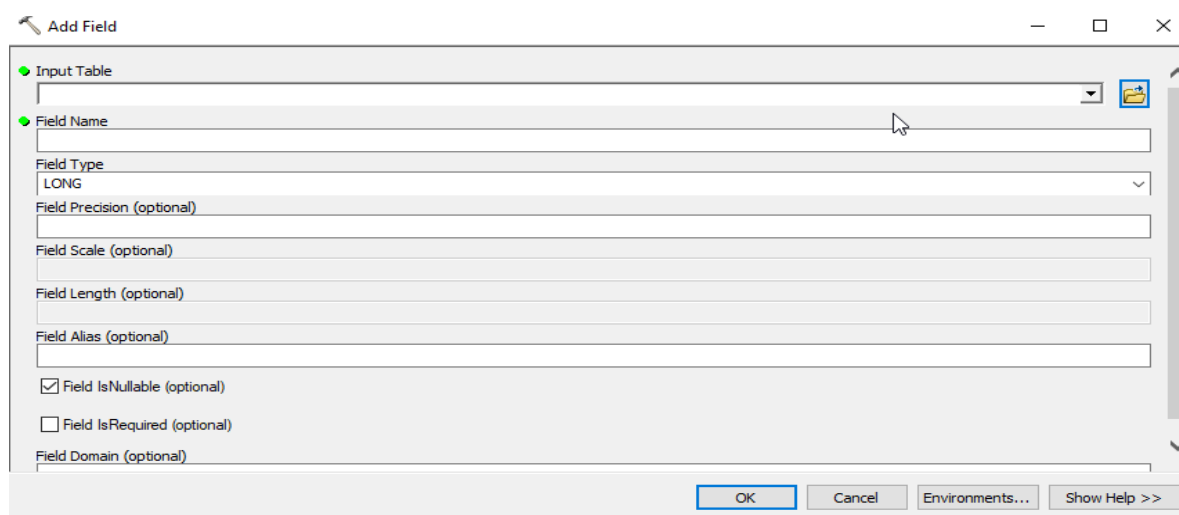


Figure 4. Utilizing the Calculate Field function

After executing all the steps mentioned above, a raster reflecting the quantitative and qualitative characteristics of vegetation cover across different years is generated as the final result.

Then, to calculate the respective areas, the Field Calculator function is used to calculate the area for each degree. These data are presented in Table 1.

Table 1

Areas of the studied territory calculated using Field Calculator

Raster values	Raster color	Gradation level	Area (hectares)	%
1		Significantly decreased	9.20	0.01
2		Decreased	1159.96	0.97
3		Unchanged	116220.35	97.54
4		Increased	1752.50	1.47
5		Significantly increased	14.77	0.01

As can be seen from the data in Table 1, no changes occurred in 97.54% of the pasture area occupied by the research object, grass cover decreased in 0.98% of the pasture area, and grass cover increased in 1.48% of the pasture area.

4. Conclusion

It is no coincidence that satellite-based methods for studying pasture areas on the Earth's surface are classified among high-tech methods. This is associated not only with the use of complex optoelectronic instruments, computers, and high-speed data networks, but also with a new approach to acquiring and interpreting measurement results. Although these studies are conducted over relatively small areas, they offer the possibility of generalizing data to large areas and even to the entire globe. Remote sensing methods generally make it possible to obtain results within a relatively short period of time.

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