Ecological environment quality evaluation based on remote sensing ecological index

Nan Chen
Shandong Vocational and Technical University of Engineering, Jinan 250200, China

Abstract: With the rapid development of social economy, human's demand for natural resources continues to grow, and ecological environment problems are becoming increasingly prominent. In order to better protect and improve the ecological environment, the evaluation of ecological environment quality based on remote sensing ecological index has become the focus of current research. This report will introduce the ecological environment quality assessment based on remote sensing ecological index in detail, and discuss its application value and prospect.

Key words: Remote sensing; Ecological index; Quality evaluation

Real-time monitoring and evaluation of ecological environment can help people better grasp the environmental characteristics of the monitoring area. Remote sensing technology, as an advanced information collection method, has the characteristics of large amount of information, low cost and rapid, and is a very important technical means in ecological environment monitoring. First of all, due to the large coverage area of landsat, the remote sensing images acquired can reflect a large area of ground object information. Secondly, due to the fast operating speed of the satellite, the image information can be updated in time. Finally, since there is no physical contact, remote sensing images can be obtained in any kind of natural environment with few restrictions. Remote sensing images can be used to quickly, repeatedly and dynamically obtain a variety of information in a large area, and provide technical support and accuracy assurance for large-scale, dynamic and periodic ecological environment dynamic monitoring. Satellite remote sensing technology is developing in the direction of high precision, multi-spectrum and high resolution. The application analysis of remote sensing information has transitioned from single remote sensing data to multi-temporal and multi-data source fusion and analysis, from static analysis to dynamic monitoring, from qualitative investigation of resources and environment to computer-aided quantitative automatic mapping. From the surface description of various phenomena to the quantitative exploration transition. This just meets the requirements of large-scale, dynamic and periodic monitoring of resources and ecological environment, thus providing technical and achievement accuracy assurance for ecological environment monitoring.

I. The concept and calculation method of remote sensing ecological index

Remote sensing ecological index is an index to evaluate ecological environment quality based on remote sensing technology. It collects a large amount of remote sensing data and comprehensively analyzes the land cover, land use, vegetation coverage and leaf area index, so as to obtain the evaluation results of ecological environment quality. The calculation method of REI mainly includes the following steps: data preprocessing, feature extraction, weight allocation and index calculation. Among them, data preprocessing is to perform radiometric correction, geometric correction and other processing on remote sensing data to improve data quality; Feature extraction is to extract useful ecological and environmental features from remote sensing data; Weight distribution is to assign different weights according to the importance of ecological environment features; The index calculation is to multiply the eigenvalue and the weight and sum to get the remote sensing ecological index.

II. The application of remote sensing ecological index in ecological environment quality evaluation

The application of remote sensing ecological index in ecological environment quality assessment is mainly reflected in the following aspects:

1. Ecological environment monitoring: Through regular acquisition of remote sensing data, ecological environment quality can be dynamically monitored, ecological environment problems can be found in time, and decision-making basis for environmental protection can be provided. For example: air quality monitoring, remote sensing technology can monitor the concentration of pollutants in the atmosphere, such as sulfur dioxide, nitrogen oxides, particulate matter and so on. These pollutants may come from industrial emissions, automobile exhaust and so on. Through regular acquisition of remote sensing data, air quality can be dynamically assessed, pollution problems can be detected in time, and effective measures can be taken to protect public health. Water quality monitoring, remote sensing technology can monitor the physical, chemical and biological indicators of rivers, lakes, reservoirs and other water bodies. This includes pH, dissolved oxygen, total phosphorus, ammonia nitrogen, etc., as well as the concentration of various heavy metal ions and toxic organics. Through the regular acquisition and analysis of remote sensing data of water bodies, the health status of water bodies can be assessed, water pollution can be prevented, and water resources security can be guaranteed. Soil quality monitoring: Remote sensing technology can monitor heavy metals, pesticide residues, nitrates and other pollutants in the soil. These pollutants may originate from agricultural activities and industrial emissions. Through regular access to remote sensing data, soil health can be assessed, soil pollution can be prevented, and agricultural products can be protected. Climate change monitoring: Remote sensing technology can monitor changes in meteorological elements such as temperature, precipitation and wind speed. Through continuous climate change monitoring, we can understand the trend of global climate change, assess its impact on the environment and human life, and provide a basis for formulating strategies to deal with climate change. The

remote sensing technology can be used to monitor and record the emissions of fixed pollution sources such as enterprises and factories in real time. This includes the data acquisition of pollutant discharge, type and concentration. The application of remote sensing technology will help improve the efficiency and accuracy of ecological and environmental monitoring, and play an important role in building a beautiful China and realizing the sustainable development goals.

2. Ecological function regionalization: Based on the remote sensing ecological index, the ecological and environmental functions of different regions can be divided to provide scientific support for land use planning and ecological protection. The ecological function regionalization based on remote sensing ecological index first needs to collect remote sensing data of different regions, and then calculate the remote sensing ecological index of each region. Next, using geographic information system (GIS) and other tools, spatial analysis of the ecological index of each region is carried out to identify the regions with different ecological environment functions. Finally, according to the different ecological environment functions, the region is divided into different ecological functional areas. Ecological function zoning has wide application value in land use planning, ecological protection and restoration, nature reserve demarcation and so on. By understanding the ecological and environmental functions of different regions, planners can formulate more scientific and rational land use policies to ensure the sustainable development of the region. At the same time, for ecological protection and restoration projects, targeted protection and restoration measures can be formulated according to the ecological environment characteristics of each district.

3. Ecological restoration effect assessment: By comparing the changes of remote sensing ecological index, the effectiveness of ecological restoration projects can be assessed, and provide references for the optimization of ecological restoration programs. To assess whether the ecosystem structure has been restored, the main observation is whether the quantity ratio of each component in the ecosystem is reasonable, whether the spatial distribution is uniform, and whether there is the loss or overreproduction of key species. The assessment of ecosystem function refers to the ability of an ecosystem to circulate materials, flow of energy and transfer information. To assess whether the ecosystem function has been restored, the main observation is whether the material circulation, energy flow and information transmission of the ecosystem are smooth, and whether the ecosystem has the ability of self-maintenance and self-repair.

For example, in the assessment of ecological environment quality in a certain place, researchers adopt the method of remote sensing ecological index. By processing the remote sensing data in 2020 and 2023, it was found that the vegetation coverage and leaf area index of the region had increased, indicating that the ecological environment quality had been improved.

III. Using remote sensing ecological index to monitor and assess ecological degradation is a complex process involving multiple steps. Here is a simplified description of the steps:

Data collection: First, multi-period remote sensing data needs to be collected, which should cover the study area and contain information of different spectral and spatial resolutions. Such data can be obtained from satellites or drones.

Data processing and preprocessing: The collected data is preprocessed by radiation correction, atmospheric correction, geometric correction, etc., to ensure the accuracy and comparability of data. In addition, it is also necessary to format conversion, cropping and splicing of the data to meet the needs of subsequent analysis.

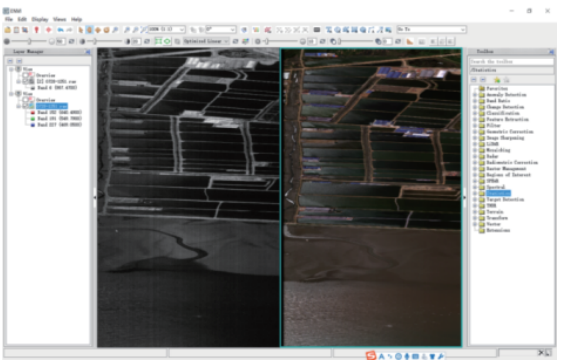

Figure 1- Display of remote sensing images in ENVI

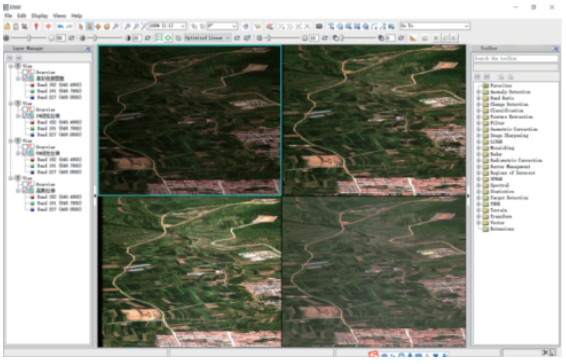

Figure 2- Stretched images of different proportions

Ecological index calculation: Select the appropriate ecological index, such as NDVI, EVI, SAVI, etc., to characterize the biophysical parameters of surface vegetation. These indices can be calculated by remote sensing data, and can reflect the coverage, growth status and biomass of vegetation.

Change detection and trend analysis: After the ecological index is calculated, image processing and computer vision technology are used for change detection to find out the area and degree of ecological degradation. The difference value or rate of change of the index can be calculated by comparing the remote sensing data of different periods, and then the distribution and trend of these differences or rate of change can be analyzed.

Analysis of causes of degradation: Causes of ecological degradation may include overdevelopment, pollution, climate change, etc. By combining geographic information systems (GIS) and other environmental monitoring data, the causes of degradation can be further analyzed and corresponding countermeasures developed.

Results expression and visualization: The results of monitoring and assessment are expressed in charts, maps and other forms for easy

understanding and decision-making. Visual presentation of results can be performed using geographic information systems (GIS) or other visualization tools.

Feedback and continuous monitoring: The monitoring and evaluation results are fed back to relevant departments and the public to promote actions for ecological protection and restoration. At the same time, continuous remote sensing monitoring is needed to regularly assess the status and development trend of ecological degradation to provide support for long-term ecological protection.

In practical application, the use of remote sensing ecological index for ecological degradation monitoring and assessment requires the comprehensive application of remote sensing technology, geographic information system, ecology, environmental science and other disciplines of knowledge and technology. In addition, issues such as the time cost of data acquisition and processing, data accuracy, data privacy and security need to be considered.

IV. Advantages and Disadvantages of Remote Sensing Ecological Index Remote sensing ecological index has the following advantages in ecological environment quality assessment:

1. Wide coverage: Remote sensing technology can obtain a wide range of ecological and environmental data, which is suitable for regional ecological and environmental quality assessment.

2. Strong timeliness: Remote sensing technology can obtain data regularly to realize dynamic monitoring of ecological environment quality.

3. Rich information: Remote sensing data contains rich ecological and environmental information, such as land cover, land use, etc., which provides a basis for ecological and environmental quality evaluation.

Conclusion: Prospect of future development trend Although the remote sensing ecological index has certain limitations in the evaluation of ecological environment quality, with the development of remote sensing technology and the reduction of cost, its application prospect in ecological environment protection and construction is still broad. In the future, the remote sensing ecological index will be further combined with other ecological environment assessment methods to improve the accuracy and practicability of ecological environment quality assessment.

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