

Research on the Application and Development Trend of Ecological Environment Remote Sensing Monitoring Technology

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Abstract

This paper discusses the application status and future development trend of ecological environment remote sensing monitoring technology. By analyzing the application of remote sensing technology in land use, vegetation coverage, water resources and atmospheric environment monitoring, the important role of remote sensing technology in ecological environment protection is expounded. The paper also discusses the application prospects of emerging technologies such as high-resolution remote sensing, multi-source data fusion, artificial intelligence and cloud computing in the field of ecological environment remote sensing. Research shows that remote sensing technology has become an important means of ecological environment monitoring. In the future, it will develop in the direction of higher precision, more intelligence and more integration, and provide more powerful technical support for ecological environment protection and management.

Keywords

Ecological Environment; Remote Sensing Monitoring Technology; Multi-Source Data Fusion.

1. Introduction

With the increasingly serious global environmental problems, the monitoring and protection of ecological environment has become the focus of attention of all countries. As an efficient and macroscopic environmental monitoring method, remote sensing technology plays an increasingly important role in the field of ecological environment protection. Ecological environment remote sensing can quickly and accurately monitor and evaluate the ecological environment by acquiring and analyzing the electromagnetic wave information on the earth's surface, and provide scientific basis for environmental management and decision-making.

The purpose of this study is to explore the application status and future development trend of remote sensing monitoring technology for ecological environment. By analyzing the application of remote sensing technology in land use, vegetation coverage, water resources and atmospheric environment monitoring, this paper expounds its important role in ecological environment protection. At the same time, the article will also explore the application prospects of emerging technologies such as high-resolution remote sensing, multi-source data fusion, artificial intelligence and cloud computing in the field of ecological environment remote sensing, and provide ideas and references for the future development of ecological environment remote sensing technology.

2. Overview of Ecological Environment Remote Sensing Monitoring Technology

Ecological environment remote sensing refers to the process of monitoring and evaluating the ecological environment elements on the surface of the earth by using remote sensing technology. The basic principle is to obtain the electromagnetic wave information reflected or emitted by surface objects through sensors, and to extract various parameters and indicators related to the ecological environment through processing and analysis. Remote sensing monitoring of ecological environment has the advantages of wide coverage, fast information acquisition and relatively low cost, which can realize large-scale and long-term continuous monitoring.

The main methods of ecological environment remote sensing monitoring include optical remote sensing, thermal infrared remote sensing and microwave remote sensing. Optical remote sensing mainly uses visible and near-infrared bands, which is suitable for monitoring vegetation and land use. Thermal infrared remote sensing can be used to study urban heat island effect and soil moisture by detecting the thermal radiation of the surface. Microwave remote sensing has the ability to penetrate clouds and is suitable for all-weather monitoring. It has unique advantages in soil moisture and vegetation structure. These methods have their own characteristics and can be used or combined according to specific monitoring needs.

3. Application Field of Ecological Environment Remote Sensing Monitoring Technology

In terms of land use and cover change monitoring, remote sensing technology can provide large-scale, multi-temporal land use information and provide an important basis for land resource management and planning. By analyzing remote sensing images in different periods, we can monitor the changes of land use types, evaluate the impact of human activities on the ecological environment, and provide decision support for sustainable land use.

Vegetation coverage and biodiversity monitoring is another important application field of ecological environment remote sensing. Remote sensing technology can quickly obtain a wide range of vegetation information, including vegetation type, coverage, leaf area index and other parameters. This information is of great significance for assessing ecosystem health, monitoring vegetation dynamics, and studying biodiversity distribution patterns. In addition, remote sensing technology can also be used to monitor ecological problems such as deforestation and grassland degradation, and provide scientific basis for ecological protection and restoration.

Water resources and water environment monitoring is one of the important applications of ecological environment remote sensing. Remote sensing technology can monitor water area, water quality parameters, water level changes and other information, and provide data support for water resources management and water environment protection. For example, remote sensing images can be used to monitor the change of water area of lakes and rivers, and evaluate the impact of drought or flood. Hyperspectral remote sensing technology can be used to invert water quality parameters such as chlorophyll and suspended solids in water bodies, providing a basis for water environment quality assessment.

Atmospheric environment and climate change monitoring is a new application field of ecological environment remote sensing. Remote sensing technology can monitor aerosols, greenhouse gases, ozone and other components in the atmosphere, and provide data support for air pollution control and climate change research. For example, satellite remote sensing data can be used to monitor the spatial and temporal distribution of PM_{2.5} and assess air pollution;

through long-term remote sensing observation, the trend of atmospheric composition can be studied to provide a basis for climate change prediction.

4. The Development Trend of Ecological Environment Remote Sensing Monitoring Technology

The application of high resolution and hyperspectral remote sensing technology is an important direction for the development of ecological environment remote sensing in the future. With the advancement of remote sensing sensor technology, spatial resolution and spectral resolution have been continuously improved, and more detailed surface information can be obtained. High-resolution remote sensing images can identify smaller features and improve monitoring accuracy. Hyperspectral remote sensing can obtain richer spectral information and improve the accuracy of ground object recognition and parameter inversion. The application of these technologies will greatly improve the ability and level of ecological environment remote sensing monitoring.

Multi-source remote sensing data fusion and collaborative analysis is another important development trend. The data obtained by different remote sensing platforms and sensors have their own advantages and limitations. Through multi-source data fusion, the advantages of various data can be comprehensively utilized to improve the accuracy and comprehensiveness of monitoring. For example, combining optical remote sensing, radar remote sensing and lidar data can more comprehensively monitor vegetation structure and biomass. In addition, the integration of remote sensing data and other geospatial data will also become a trend, providing more abundant information for ecological environment monitoring.

The application of artificial intelligence and machine learning in remote sensing data analysis will greatly improve the efficiency and accuracy of data processing. Traditional remote sensing image interpretation methods often rely on manual work, which is inefficient and subjective. Artificial intelligence technology, especially deep learning algorithms, can automatically extract features from remote sensing images to achieve fast and accurate feature classification and information extraction. This will greatly improve the automation level of ecological environment remote sensing monitoring and provide technical support for large-scale and real-time ecological environment monitoring.

The application of remote sensing cloud platform and big data technology will change the processing and analysis mode of ecological environment remote sensing data. With the rapid increase of remote sensing data, the traditional stand-alone processing mode has been difficult to meet the demand. The remote sensing cloud platform can provide powerful computing and storage capabilities to support the processing and analysis of large-scale remote sensing data. At the same time, big data technology can mine hidden information in massive remote sensing data and discover the laws and trends of ecological environment changes. The application of these technologies will promote the development of ecological environment remote sensing to a more efficient and intelligent direction.

5. Conclusion

Remote sensing monitoring technology of ecological environment plays an important role in the fields of land use, vegetation coverage, water resources and atmospheric environment, and has become an indispensable tool for ecological environment protection. With the development of new technologies such as high-resolution remote sensing, multi-source data fusion, artificial intelligence and cloud computing, remote sensing monitoring of ecological environment will move towards higher accuracy, intelligence and integration. In the future, ecological environment remote sensing technology will play a greater role in global change research,

ecosystem assessment, environmental disaster warning, etc., and provide more powerful technical support for ecological environment protection and management. However, we should also note that remote sensing technology still has some limitations, such as being affected by weather conditions and difficult to obtain three-dimensional information. Therefore, in the future, it is necessary to further strengthen the combination of remote sensing technology and other monitoring methods to improve the comprehensiveness and accuracy of ecological environment monitoring.

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