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Remote Sensing Extraction of Agricultural Disaster Information Based on Temporal and Spatial Statistics of Vegetation Index

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Abstract: Traditional methods of agricultural disaster monitoring not only lag information, but also cause inaccurate damage determination due to manual survey methods. Therefore, timely and accurate access to agricultural disaster information is of great significance for disaster relief, agricultural insurance claims, optimization of planting structure adjustment, and precision poverty alleviation. This paper proposes a remote sensing extraction method for agricultural disaster information based on the temporal and spatial statistical characteristics of vegetation index. This method can quickly and accurately extract agricultural disaster information. This method uses the two Meng cities in the Inner Mongolia Autonomous Region as the research area, extracts the agricultural disaster information of the region in 2019, and calculates the disaster area and level of the Meng city in the region. The long sequence of agricultural disaster information extraction avoids the problems of lagging and inaccurate information of traditional agricultural disaster monitoring methods. In the experiment, the MODIS reflectivity products from late June to late September were used to distinguish the geographical location and the type of cultivated land, and the information on agricultural disasters in the key growth period of the crop in 2019 in the study area was obtained. The total affected area reached about 4.3 million mu. The method of this paper is used to extract agricultural disaster information. The overall accuracy Pc is 0.97 and the Kappa coefficient is 0.59. Compared with the traditional method, the accuracy of the extraction results is improved by nearly 15%, which indicates that the agricultural disaster information based on the vegetation index space and time is proposed in this paper. The remote sensing extraction method is suitable for agricultural disaster monitoring with wide space and long time series.

1. Introduction

Agricultural development is of great significance to China. Only by maintaining the improvement of agricultural production can we ensure the sustainable and healthy development of our economy and make China a world-class power as soon as possible. A key part of agricultural development is the ability to quickly and accurately monitor agricultural disasters. However, traditional methods of agricultural disaster monitoring are mostly manual, which not only requires a lot of manpower and financial resources to conduct on-site surveys, but also due to operational risks. And moral hazards lead to certain human subjective factors, especially for large-scale agricultural disasters. Traditional monitoring and loss determination methods are even more inadequate.

Remote sensing technology has developed rapidly in the 1960s. It has the advantages of wide monitoring range, abundant spectral information, easy access, fast update frequency, small restrictions, and timing positioning. This also makes remote sensing technology gradually become a dynamic and efficient target. The necessary means of monitoring, and put into practice have obtained good economic and social benefits [1-2]. With the launch of domestic high-resolution remote sensing satellites such as high-scoring series, resource series, and sky painting series, satellite resources have become more abundant, and remote sensing processing and application technology have been improved. The use of remote sensing technology for qualitative and quantitative monitoring of agricultural disasters has gradually increased. Accepted by people, and able to provide objective and accurate agricultural disaster monitoring results, provide disaster data to farmers, provide data guarantee for scientific and reasonable planting, agricultural insurance claims, and avoid conflicts between the insured farmers and agricultural insurance companies due to claims disputes . Therefore, the rapid acquisition of accurate agricultural disaster information is of great significance to many aspects such as departmental supervision, protection of the legitimate rights and interests of agricultural insurance companies and insured farmers, and is to promote early warning of agricultural disasters, solve the last mile of agricultural informatization, and ensure agricultural availability. The only way to build a sustainable and environment-friendly society.

With the continuous progress of human society, the occurrence of extreme weather has become more frequent, and the frequency and severity of various natural disasters have become higher and higher. Scholars and researchers have gradually deepened their attention to disasters, and the research methods and contents have become scientific. Many scholars have accumulated a lot of experience in the fields of agricultural disasters, such as spatio-temporal changes, disaster monitoring methods, disaster analysis, climate impact factor analysis, and disaster defense. . Danni W et al. [3] used Guangdong's high temperature disasters as an example to predict agricultural meteorological disasters and their extent. The fuzzy clustering algorithm (FCM) is used to establish the rules of high temperature disaster levels. Bin W U et al. [4] developed a Huzhou characteristic agricultural meteorological disaster monitoring and early warning platform based on the demand for meteorological services for characteristic agricultural production in Huzhou. The platform integrates meteorology, agricultural information monitoring, disaster identification and early warning, fine weather forecast product display, data query and management functions, effectively enhancing the ability of agricultural meteorological disaster monitoring and early warning. Xingsheng X et al. [5] established a crop drought disaster index system and real-time risk monitoring model to comprehensively consider the hazards of disaster factors, the vulnerability and stability of disaster subjects in order to achieve operational monitoring of drought disaster risks. Correlation coefficient method and entropy weight method were used to determine the weight of drought disaster risk index. The risk of crop drought disasters is estimated using weighted sums and power product models. Shi Z et al. [6] introduced the historical and theoretical background of agricultural remote sensing technology. In-depth analysis was made on four aspects of production estimation, agricultural resource survey, agricultural disaster monitoring, and precision agricultural management. Yi F et al. [7] aimed at the unique terrain of the hilly area, and it is difficult to extract image information using current image analysis techniques. According to the classification characteristics, a k-nearest neighbor classifier and a decision tree classifier are used to interpret the remote sensing image of the paddy field in the hilly area, and then the information related to the distribution of the paddy field in the hilly area is identified.

Based on the above background, this article aims to achieve rapid extraction of agricultural disaster information for key growing seasons of large-scale crops. An attempt was made to use MODIS reflectivity products with high time resolution and wide coverage to construct a NDVI time series of key growing seasons of crops in the study area. Based on the NDVI characteristics of the crops at the time of the disaster, select appropriate time phase image data and monitoring methods to extract agriculture For disaster information, the accuracy and applicability of the method are explained through accuracy verification. Solve the problems of lagging information, inadequate accuracy, unsuitable large-scale range, and high risks of traditional agricultural disaster monitoring methods, and provide scientific and reasonable technical support for the healthy and sustainable development of agricultural production in the cities of Inner Mongolia, and also provide remote sensing technology for agricultural disaster The development of the monitoring field has contributed its own meagre strength.

2. Proposed Method

2.1. Theory of Agricultural Disasters

(1) Definition of agricultural disasters

Agricultural disasters mainly refer to incidents that suddenly cause large-scale damage and destruction to agricultural production, planting, and aquaculture, and that have severely affected agriculture and farmers' income. Agricultural disasters mainly include the following characteristics: First, the losses caused by agricultural disasters are relatively large. Whether natural disasters, alien biological invasions or major animal diseases, they will cause huge losses once they occur. Second, the frequency of agricultural disasters is increasing, and the results are difficult to grasp. The results of global integration and China’s foreign exchanges are increasing, socio-economic development is accelerating, environmental pollution is increasing, and the interval between agricultural disasters is getting shorter and shorter on Sundays. At the same time, the frequency is getting faster and easier. The speed of the spread and spread of the impact of agricultural disasters has accelerated, making it difficult to control agricultural emergencies, and it is difficult to predict the results of agricultural disasters. Third, agricultural disasters have spread more and more widely. The impact and losses caused by early agricultural disasters are mainly confined to the agricultural sector. With the economic development and the development of information, the occurrence of agricultural disasters will usually have corresponding impacts on different fields such as economy, industry, transportation, and electricity. Widespread in a short period of time, causing a national or global crisis.

(2) Classification of agricultural disasters

According to the threats and characteristics of agricultural disasters, such as natural disasters, exotic animal diseases, pests, and potential biological terrorism, agricultural disasters can be divided into three types:

1) Agricultural natural disasters, including flood and drought disasters, meteorological disasters (storm, hail, etc.), earthquake disasters, geological disasters (mountain collapse, mudslides, ground fissures, etc.), marine disasters (giant waves, tsunami, etc.), forest fires;

2) Alien pest invasion disasters. With the acceleration of China's globalization process, economic and trade exchanges with different countries in the world are increasingly developed, and the risks of alien pest invasion are increasing. As of now, more than 380 species of alien pests have been introduced China, which includes 108 species of weeds, more than 40 species of animals, and 23

species of microorganisms;

3) A major animal epidemic disaster has occurred. Since SARS in 2003, diseases affecting animals such as bird flu and swine flu have brought great harm to agricultural production and severely affected agricultural development. In this study, the main subject of agricultural disasters is agricultural natural disaster emergency events. Based on factors such as the degree of harm caused by or about to be caused by agricultural disasters, development and urgency, agricultural disasters can be divided into four levels: particularly severe (Level I), Major (Level II), Larger (Level III), and Fair (Level IV).

2.2. GIS Technology Introduction

(1) GIS architecture

Geographic Information System (GIS) is based on geospatial data. With the support of computer software and hardware, it collects, manages, operates, simulates, analyzes, and displays space-related data, and uses geographic model analysis methods. Provide a variety of spatial and dynamic geographic information in a timely manner, a computer technology system established for geographic research and geographic decision-making services [8]. As a new fringe discipline integrating computer science, geography, surveying and remote sensing, environmental science, urban science, space science, information science, and management science, it has risen and developed rapidly. GIS is composed of five parts: computer hardware system, computer software system, geospatial data, application model and system application personnel.

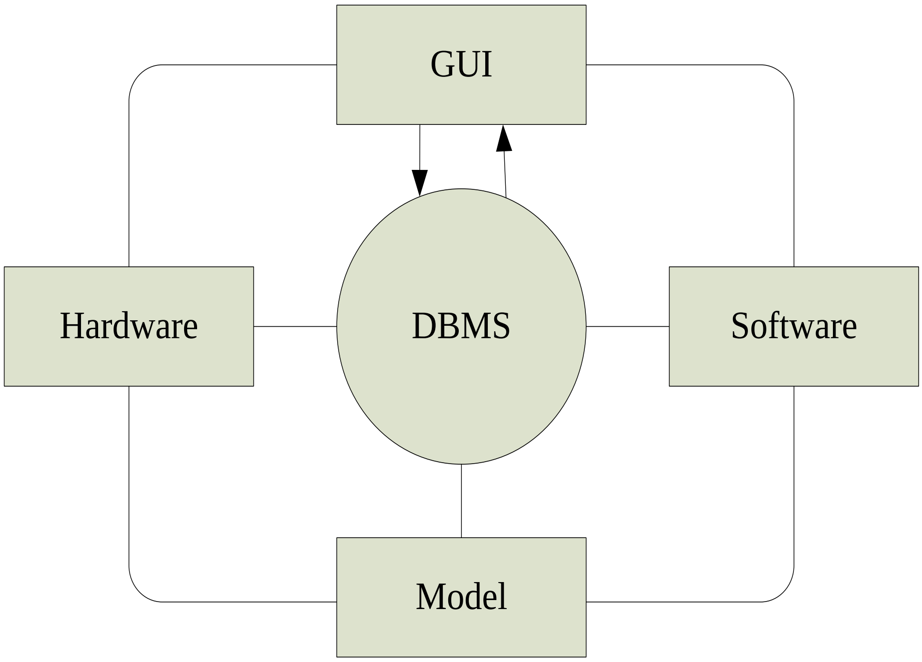

Figure 1. GIS architecture

(2) Functions of GIS

Different from CAD and other drawing software, data management system and office automation software, CIS can organically integrate the graphics and attribute data of the research object for data management and application. Its main functions are shown in Figure 2.

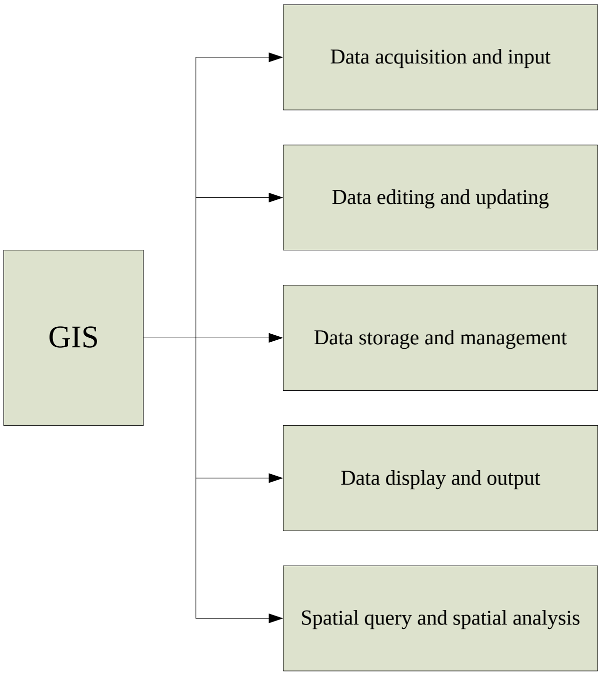

Figure 2. Main functions of CIS

Data acquisition and input. In the data processing system, the process of transferring the original data outside the system to the inside of the system, and converting these data from the external format to the internal format that the system can handle easily. For multiple forms and multiple sources of information, multiple ways of data entry can be achieved. There are mainly graphic data input, raster data input, data input, attribute data input, etc.

Data editing and updating. Data editing mainly includes graphic editing and attribute editing. Attribute editing is mainly completed in combination with database management. Graphics mainly include functions such as topology relationship establishment, graphic editing, graphic decoration, image stitching, graphic transformation, projection transformation, and error correction. Data update is to replace the corresponding data items or records in the data file or database with new data items or records. It is implemented through a series of operations such as deletion, modification, and insertion. Since the spatial entities are all in the development time series, the data obtained by people only reflect the characteristics of a certain instant or a certain time range. As time progresses, the data will change. The data update can meet the needs of dynamic analysis and make regular predictions on the occurrence and development of natural phenomena.

Data storage and management. Data storage, that is, recording data in a certain format on a computer internal or external storage medium. The storage method is related to the organization density of data files. The key lies in establishing the logical sequence of records, that is, determining the storage address, so as to improve the speed of data access. Attribute data management is generally managed directly using relational database software such as ORACLE and MySql. Spatial data management is the core of GIS data management. All kinds of graphics or image information are stored in a spatial database with a strict logical structure.

Data display and output. Data display is an on-screen display of the intermediate processing process and the final result. Usually, the objects and forms to be displayed are selected in the form of human-computer interaction. For graphic data, you can choose to zoom in or out according to the amount and density of the element information. GIS can not only output full-element maps, but also can output various thematic maps, various statistical maps, charts and data according to user needs.

Spatial query and spatial analysis. The user-oriented application function of GIS is not only manifested in that it can provide some static query and retrieval data. It is more meaningful that users can establish an application analysis mode according to their needs. Through dynamic analysis, it can be used for evaluation, management and decision-making service.

Figure 3 shows the implementation of basic GIS functions.

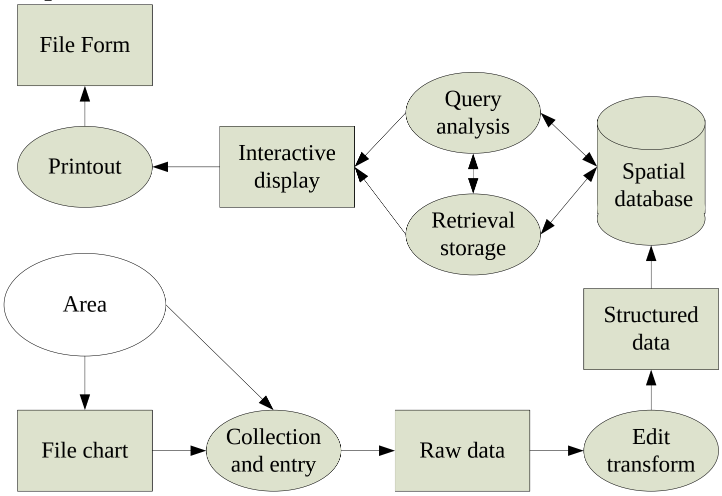

Figure 3. The realization process of GIS basic functions

(3) Introduction to ArcGIS

ArcGIS geostatistical analysis software is a spatial statistical analysis software developed by the American ESRI company. As an extension module of ArcGIS geostatistical analysis of geographic information system software, it can use deterministic and geostatistical methods for advanced surface simulation [9]. This software extends the core module of ArcGIS, ArcMap, and adds an advanced toolbar, which contains many spatial data analysis tools and a geostatistical analysis wizard, which can guide users to create a statistically effective surface, during which users can participate in the data. Inspection, model selection, model parameter setting, accuracy analysis, model comparison and surface prediction. The prediction surface generated by the geostatistical analysis module can be easily applied to many GIS models, as parameters of application models in many fields, to achieve comprehensive application and information sharing of data, and can also be used in other extension modules of ArcGIS such as spatial analysis and 3D analysis modules. Is used for auxiliary analysis and visualization.

The geostatistical analysis module is groundbreaking because it builds a bridge between geostatistics and GIS. Geostatistics have existed for a long time, but they have never been closely integrated with the GIS model environment, which can not only expand the functions of GIS, but also have very good analysis tools and visual expression methods for geostatistics. The combination of the two is very important. By measuring the statistical error of the predicted surface, GIS professionals can quantify the quality of their surface model for the first time.

Surface fitting using geostatistical analysis includes three main steps. One is exploratory spatial data analysis. Use known samples in the study area to evaluate the statistical properties of the data such as distribution, trend, and variation. The second is structural analysis. According to the calculation results of the variogram, select a suitable model for modeling, simulate the surface properties of the sample points and their neighboring points, and look for the heterogeneity between the samples of regionalized spatial variables and the inherent rules of the changing trend. The third is surface prediction and result evaluation. According to the results of structural analysis, the spatial surface of the fitted regional variables is determined, and the accuracy of the prediction results is analyzed and analyzed.

2.3. Agricultural Disaster Monitoring

(1) Theory of spectral features

The feature theory of ground features is a composite analysis theory developed based on the research of cartographic theory. It is a kind of electromagnetic radiation law that all ground features have in nature. It also means that ground features can absorb visible light, infrared, and some bands in microwave. It has the characteristics of reflecting certain wave bands [10-11]. The reflection spectrum refers to the rule that the spectral reflectance changes with the change of wavelength. Different ground features have different reflection curves of the ground features that show their respective characteristics. Judging the nature of the ground features based on this difference is the basic principle of remote sensing identification. Under normal circumstances, only a few ground features have strong transmission power for visible light. For example, the transmission of most water bodies in the blue and green wave bands is 10-20 m, and the transmission of turbid water is only 1-2 m. The transmission will reach 100 m. Some opaque ground features cannot transmit visible light, and can only transmit electromagnetic waves with extremely short wavelengths. Therefore, each ground feature has a unique spectral reflectance. Generally, the electromagnetic waves of the same type of ground features are similar, as shown in Figure 4. Different types of ground objects have different reflectances in each band. Analyzing the similarities and differences between various land types based on this principle is one of the basic principles of remote sensing monitoring, and is therefore used in the identification and extraction of disasters.

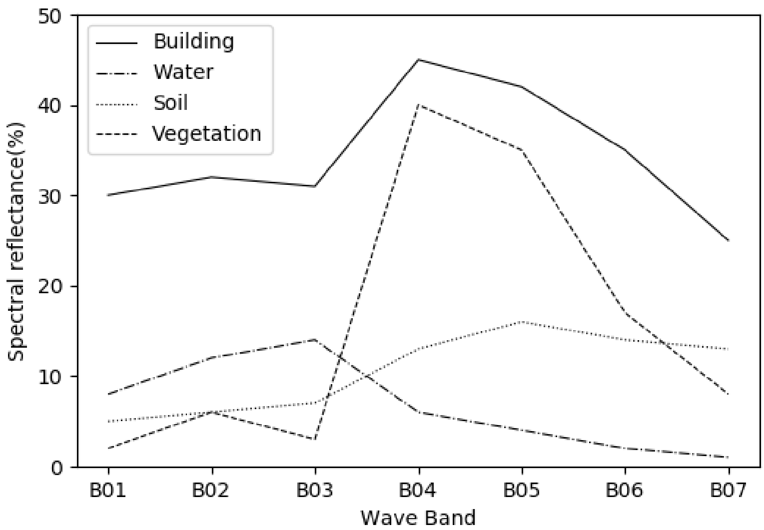

Figure 4. Spectral reflection spectra characteristics

(2) Vegetation index time series

Throughout the plant's growth cycle, different wavelength bands have different manifestations of their growth status: the visible red band is located in the main chlorophyll absorption region and has spectral characteristics of the absorption valley characteristic; the near infrared band is located in the highly reflective region and has spectral characteristics of high transmission characteristics, The two form a sharp contrast [12]. Because these two bands contain a lot of plant information at the same time, by operating these two bands, you can get a variety of indicators that are important to the entire growth process of the plant. Equation 1 shows the normalized vegetation index NDVI through effective calculation of two bands. This index can reduce the influence of the sun height angle and satellite observation angle, and then effectively monitor the growth status of vegetation. It is suitable for medium or medium coverage of vegetation development. Degree monitoring.

$$\mathrm{NDVI} = \frac{X_{mr} - X_r}{X_{mr} + X_r} \quad (1)$$

Among them, X_{mr} is the reflectance value of pixels in the near-infrared band, and X_r is the reflectance value of pixels in the red band. In order to facilitate research and analysis, it needs to be normalized. The value range of the processed NDVI is [-1, 1], when NDVI is negative, it means that the ground surface is covered by clouds, rain, etc .; 0 means rock or bare soil, etc .; positive value means that the surface is covered by vegetation, which is positively correlated with coverage.

Vegetation spectral characteristics are a comprehensive reflection of vegetation and its environment, and are affected by atmospheric changes. Therefore, the vegetation index is dynamic. By analyzing the change of time curve, it is possible to effectively and accurately understand the temporal and spatial changes of vegetation and fully reflect the background information. Each MODIS_NDVI image reflects the NDVI value of each pixel in the area in a period. By superimposing the NDVI images in different periods, and then extracting the same pixel value in each image, it can form the surface coverage dynamics. A continuous time series of information.

In this study, 23 MODIS_NDVI images in one year were obtained through pre-processing. Due to different background information, each pixel has a time series curve representing the information about the vegetation growth status in this pixel. Figure 5 shows the NDVI curve. Express the growth trends of all types of crops in different regions during the year, and explore the changing law of NDVI.

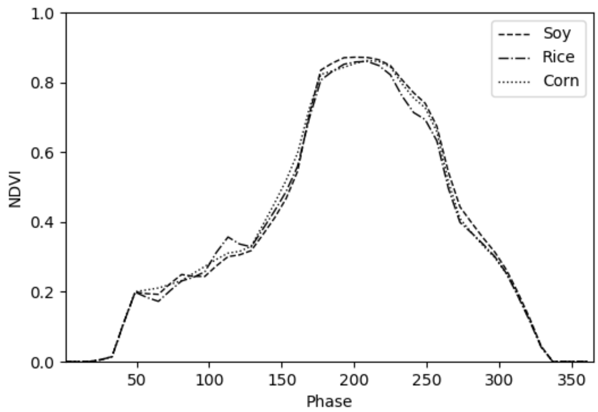

Figure 5. Time series curves of different crops in the same area

(3) Disaster monitoring process

Disaster monitoring theory is a three-dimensional monitoring theory system that combines the practice of disaster theory and the application of remote sensing technology. The monitoring elements can objectively describe the research entity. Due to the diversity of disasters, the parameters of remote sensing images are also different. In the field of agricultural disaster monitoring, the leaves of crops determine their main spectral characteristics. The leaves of healthy vegetation are rich in sufficient water, chlorophyll and other pigments. When a crop is damaged, the external morphological and structural characteristics and its own physiological characteristics will change accordingly. The external morphological and structural changes are mainly due to the mechanical damage caused by the disaster, such as morphological characteristics such as withering, fragmentation, lodging, etc .; the changes in internal physiological characteristics include There are two aspects of mechanism change and function decline, such as chlorophyll decline, water content decrease, and poor absorption capacity. After the disaster of the crop, whether it is a change in the macro structure or the change in the micro characteristics, these characteristics will directly affect the spectral response of the crop. From the perspective of spectral reflectance, it shows that the reflectance in the red band becomes stronger, and the reflectance in the near-infrared band decreases significantly, and the longer the disaster, the more severe the disaster, and the greater the decrease. Therefore, the spectral characteristics in the visible to near-infrared range are representative. Based on the above rules, the normalized vegetation index, which is sensitive to changes in these two main bands, is selected as a parameter, which can fully reflect the difference in changes in crops before and after the disaster, and then use the MODIS vegetation index time series to reveal the correlation between crop growth season and disaster Sex.

3. Experiments

3.1. Experimental Data Set

The main remote sensing data used in this paper is MODIS data. In 1999, the United States launched the terra and aqua satellites. MODIS, as an important sensor of this series of satellites, has achieved global high-frequency coverage with a time period of 1-2 days. At present, MODIS data is distributed to the world for free, and it is applied to the industry of remote sensing technology. It has played a positive role in promoting and played a significant role in many fields such as land use, vegetation health monitoring, and climate change. The MODIS data used in this article was provided by NASA and can be downloaded at https://reverb.echo.nasa.gov. Download MOD09Q1 data and MYD09Q1 data respectively from this website, a total of 180 original MODIS data.

The main reasons why MODIS data are widely used are due to the following characteristics:

1) Suitable for large area monitoring. MODIS data has 4 spatial resolutions of 5600 meters, 1000 meters, 500 meters, and 250 meters, all of which are suitable for large-area remote sensing monitoring;

2) The data is easy to obtain, and it is currently open to the world for free;

3) Time resolution is rich. Contains multiple data sources including 8-day synthetic products, 16-day synthetic products, monthly synthetic products, quarterly products, and annual products.

4) Large amount of spectral information, including 36 bands. This article uses MOD09Q1 and MYD09Q1 reflectance products with a time resolution of 8 days and a spatial resolution of 250 meters. This data was released in 1998, combining EOS-AM (morning orbit) and PM (afternoon orbit). Use can well eliminate interference factors such as radiation effects and cloud noise caused by different time.

In addition to the MODIS remote sensing data, this paper also uses data on field sampling points of cultivated land types and on-site survey data of crops affected by disasters, which are provided by agricultural insurance companies.

3.2. Preprocessing

The MODIS projection conversion software (MODIS Reprojection Tool, MRT) is used to perform pre-processing such as projection transformation, resampling, mosaicking, and band reflectance extraction on the acquired data. After inputting the original data in HDR format, the spectral reflectance information is retained, where QC is the quality data, reflecting the quality of the data, which can be decided according to the specific circumstances; when selecting the output path, change the file suffix to the tif format; Enter 250 meters at the pixel size (that is, the image spatial resolution); this paper uses the Albers Equal Area Conical Curve Projection (1984 World Geodetic Coordinate System (WGS84), the South Standard Parallel (STDPR1) is set to 25, The North Standard Parallel (STDPR2) is set to 47 and the Central Meridian (Cent Mer) is set to 105.

After all the original data have been processed as described above, the sur_relf_b01 and sur_relf_b02 of the four row and column numbers of the same phase are stitched separately using the Mosaic to new raster function of Arc GIS software to obtain near-infrared band data and multiple time phases covering the entire research area. Infrared band data. The model of NDVI calculation formula was built in Arc GIS software, and the near-infrared and infrared data obtained by MRT software were used to calculate the NDVI values of the four row and column number images h25v03, h25v04, h26v03, and h26v04 for each time phase. Stitching and mosaic processing of NDVI values to obtain NDVI data covering each phase of the entire study area.

4. Discussion

4.1. Extraction of Cultivated Land Information

In this paper, field verification points in the study area provided by the agricultural insurance company are used as verification data, and the sampling points are evenly distributed in the study area. Because only cultivated land is extracted in this article, the verification points only include two types of land: cultivated land and non-arable land. Building land, forest land, grassland, unused land, and water are all classified as non-arable land. 1600, with less verification points for non-cultivated land, 300.

In the extraction results of cultivated land in this study, n is the total number of verification points, s is the total number of correctly classified verification points of different land types, a1 is the total number of cultivated verification points, and b1 is the correct classification of cultivated verification points Number, a0 is the total number of non-arable land verification points, and b0 is the number of correct classifications in non-arable land verification points. Finally, the overall accuracy Pc and Kappa coefficients are used to reflect the accuracy of the classification results. The classification accuracy evaluation details are shown in Table 1.

Table 1. Cultivated land information extraction results

Extracting results	Arable land	Non-arable land	Total
Arable land	1523	29	1552
Non-arable land	77	271	348
Total	1600	300	1900

From Table 1, it can be seen that among 1,600 cultivated land verification points, 1523 verification points are consistent with the extraction results of the cultivated land range of this MODIS, and there are 77 misclassifications and omissions; among 300 non-arable land verification points, 271 The results are consistent with the extraction results, and there are 29 misclassifications and omissions. The overall accuracy Pc is 0.94 and the Kappa coefficient is 0.72. Existing studies have shown that when the accuracy of image classification is verified, when the Kappa coefficient is between 0.60 and 0.80, the classification results belong to a very good level, which indicates that the method is suitable for extracting cultivated land with a wide spatial range and the accuracy of the extraction results is high.

Figure 6 shows the comparison between the traditional method and the method of this paper on the extraction of cultivated land information under the same conditions. From the figure, it can be seen that the accuracy of the method and the Kappa coefficient of the method of this paper are improved compared to the traditional method.

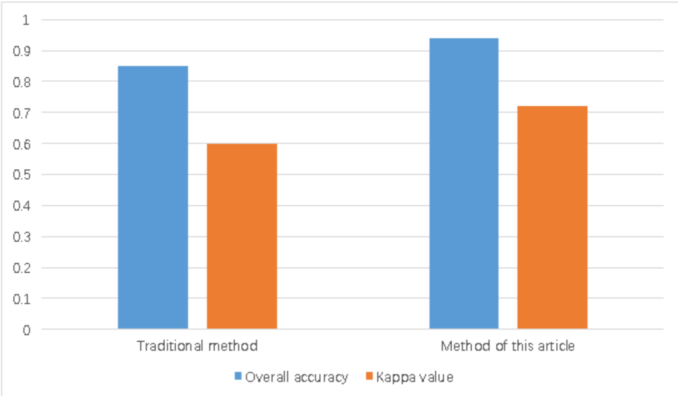

Figure 6. Comparison of the results of farmland information extraction

4.2. Dryland and Paddy Field Information Extraction

Accuracy verification was performed according to 1,900 farmland verification points provided by the agricultural insurance company, including 1,534 dryland crop verification points and 366 paddy field crop verification points. In the classification results of this dryland and paddy field, 1494 dryland verification points were consistent with the extraction results. There are 40 misclassifications and omissions; 352 paddy field verification points are consistent with the results, and there are 14 misclassifications and omissions; the overall accuracy Pc is 0.97, the Kappa coefficient is 0.68, and the accuracy of the classification results is high, indicating the use of remote sensing in this period The data and classification methods are applicable to distinguish between dry land and paddy field. The classification accuracy evaluation details are shown in Table 2.

Table 2. Dry land and paddy field information extraction results

Extracting results	Dry land	Paddy field	Total
Dry land	1494	14	1508
Paddy field	40	352	392
Total	1534	366	1900

Figure 7 shows the comparison between the traditional method and the method of this paper on the extraction of dry land and paddy field information under the same conditions. It can be seen from the figure that the accuracy and Kappa coefficient of the method of this paper in the extraction of dry land and paddy field information compared to the traditional method improve.

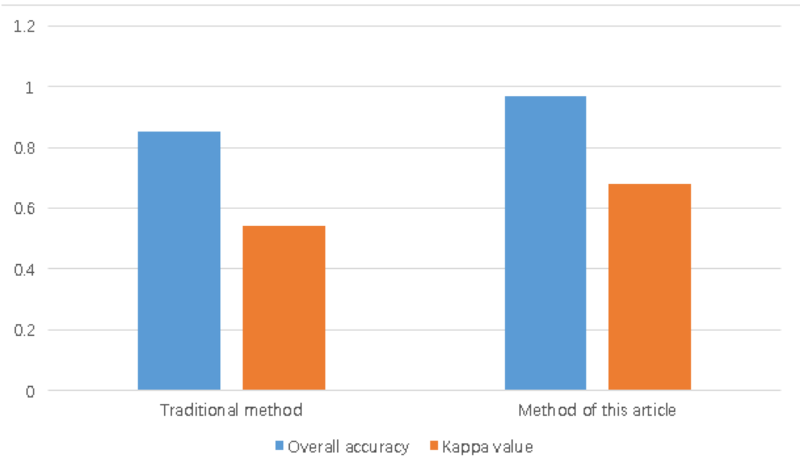

Figure 7. Comparison of dry land and paddy field information extraction results

4.3. Comparative Analysis of Disaster Information Extraction Accuracy

Based on the above methods and theories, the monitoring results of agricultural disasters in the study area in 2019 are extracted. The disaster monitoring results are divided into 6 levels. Level 1 indicates the most severe level of disaster. Details of the affected area are shown in Figure 8.

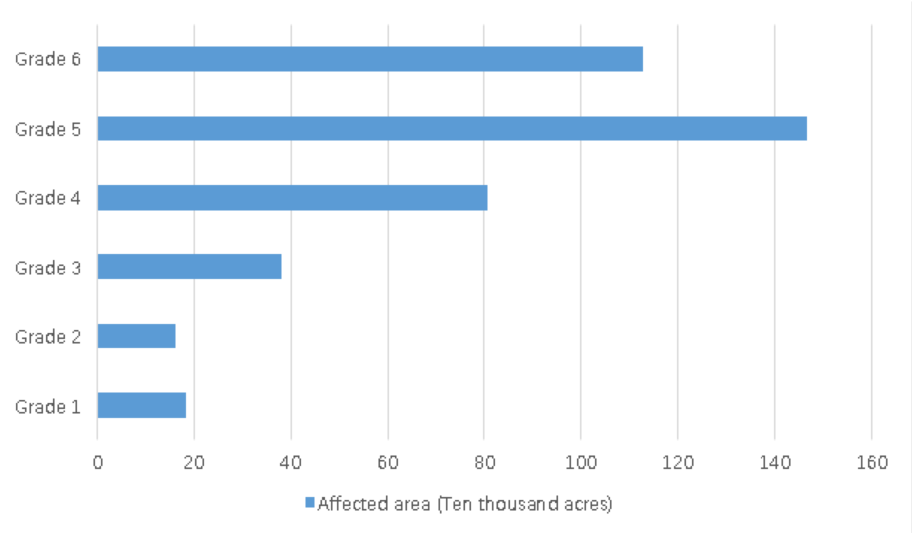

Figure 8. Disaster area by level

This article uses agricultural disaster sampling points provided by the agricultural insurance company as verification data, including 280 disaster-sampling samples and 720 non-disaster-sampling samples, which are evenly distributed in the study area. The accuracy of the disaster extraction results is verified by calculating the kappa coefficient and the overall accuracy, as shown in Table 3.

Table 3. Agricultural disaster information extraction results

Extracting results	Affected site	Not affected	Total
Affected site	258	25	283
Not affected	22	695	717
Total	280	720	1000

In this disaster extraction result, 258 agricultural disaster collection points are consistent with the extraction results, and there are 22 misclassifications and missing points, and 695 non-disaster points are consistent with the extraction results. It is 0.95, Kappa coefficient is 0.59, and the accuracy of the extraction results is high, indicating that the method is suitable for extracting agricultural disaster information with a wide spatial range and a long time series.

Figure 9 shows the comparison between the traditional method and the method of this paper on the extraction of agricultural disaster information under the same conditions. It can be seen from the figure that the method of this paper has improved the accuracy and Kappa coefficient of agricultural disaster information compared to the traditional method.

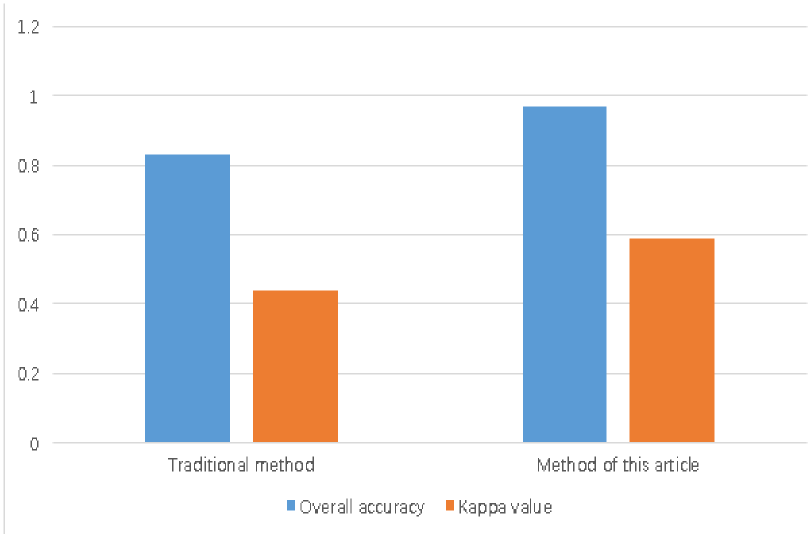

Figure 9. Comparison of agricultural disaster information extraction results

5. Conclusion

Traditional agricultural disaster monitoring methods are mainly based on field surveys and sampling, which consume a lot of human and material resources, and have certain subjective factors. The assessment of disaster information is not accurate, and the acquired information is seriously lagging behind. With the advent of remote sensing technology, timely and accurate monitoring of large-scale disasters has become possible, which is more suitable for agricultural disaster monitoring.

At present, with the continuous improvement of remote sensing technology and the gradual enrichment of data sources, more and more research in the field of agricultural disaster monitoring has been gradually put into practice, which has produced greater social and economic benefits. However, most of them are researches on short-term short-term disasters on a small scale, and there are few researches on disaster monitoring for a wide range of space and long time series.

In this paper, MOIDS reflectivity products are used to extract information on agricultural disasters in the summer study area in 2019. Using six consecutive phases of MODIS reflectivity products from late June to late September, in the case of distinguishing geographical locations and cultivated land types, the standardized processing, NDVI classification, disaster information integration, and noise elimination steps yielded information on agricultural disasters in the key growing seasons of the crop in 2019 in the study area. The total area affected was approximately 4.3 million mu. The overall accuracy of the monitoring results is 0.97 Pc and the Kappa coefficient is 0.59. The accuracy of the extracted results is high, which shows that the method is suitable for agricultural disaster monitoring with wide space and long time series.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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