Prediction of coastal rainfall trend and development of coastal leisure sports based on remote sensing image processing

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Received: 12 March 2021 / Accepted: 28 April 2021
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Abstract
With the continuous development of society, people have entered a new era. People’s material needs have been basically met, and people are paying more and more attention to spiritual life and ecological health. After the problem of food and clothing was solved, people began to pursue leisure sports, which is a brand new direction of consumption. The coastal area has taken the lead in developing the exciting experience of leisure sports. The leisure environment in this area is very romantic and can also bring people a very exciting experience. In recent years, many people have gone to the coastal area to experience this kind of leisure sports, which has also promoted tourism. The economic development of the city in the coastal area has promoted the change of its development mode. We monitor rainfall in coastal areas, which plays an important role in the development of leisure sports. If we can predict the weather changes in advance, we can make timely countermeasures, make reasonable plans for sports time, and make reasonable arrangements for sports content. In this paper, the relationship between cloud cover changes and rainfall data is obtained by monitoring remote sensing cloud images, and a corresponding model is established. This paper also designs some cloud image parameters, uses the corresponding algorithm to explore the relationship between cloud image and rainfall, improves and optimizes the algorithm combined with matrix characteristics, and finally proposes a more efficient algorithm. After a series of experiments, it is proved that the algorithm proposed in this paper has higher timeliness and better accuracy. The research results of this project have been applied to the forecast of rainfall trends in coastal areas. At the same time, certain suggestions and strategies have been put forward for the development of leisure sports activities in coastal areas, which also laid the foundation for the development of subsequent leisure activities.

Keywords Remote sensing image · Coastal area · Rainfall prediction · Leisure sports

Introduction
Based on the data of meteorological observations, we can apply some corresponding geographical knowledge to make certain predictions on the weather conditions of a certain area or region. At present, domestic weather forecasting is mainly based on the combination of ground observation and satellite monitoring for forecasting (Adeyeria et al. 2019). The acquired data will be unified and comprehensively analyzed, and then the future weather conditions will be obtained through simulation (Alexandre et al. 2011). The production of weather forecast is the result of people’s intelligent development, and it also provides an important guarantee for people’s social production (Asare-Nuamah and Botchway 2019). When forecasting the weather, our main concern is the forecast of rainfall. Before we go out, we usually know the weather of the day, especially whether it is raining. Predicting rainfall conditions is very important, especially in areas such as navigation and aviation. For the development of tourism and leisure sports, it is also necessary to predict the rainfall conditions. However, it is very difficult to predict rainfall conditions and the accuracy and precision requirements of the prediction are very high (Baez-Gonzalez et al. 2018).

Research on the development of coastal leisure sports
The pace of life of modern people is too fast and the pressure is too great. They need to relax appropriately and relieve their...
pressure by means of exercise. At this time, leisure sports came into being. Its relaxation method is very unique. It can not only meet people’s demand for leisure, but also reduce people’s pressure and soothe people’s body and mind. The coastal area has taken the lead in developing leisure sports, which makes leisure sports very representative of the region and can also meet the leisure needs of most residents and tourists (Bucchignani et al. 2016) (Cabos et al. 2019). Most scholars have begun to pay more and more attention to the research of leisure sports, and many literatures related to leisure sports have also emerged as the times require. By sorting out and analyzing these documents, we have further strengthened our understanding of leisure sports, which has also made our curiosity more and more vigorous and promoted the theoretical development of leisure sports. Some researchers have conducted a certain analysis on the development of leisure sports in the coastal area. They believe that the main reason why the coastal area can develop leisure sports is because the area is connected to the sea and can attract the development of tourism. Tourists come to this place and find that the area can also be used for recreation and fitness, which they can’t experience in other scenic spots. There are also other studies (Choi et al. 2009). The researchers believe that the reason why leisure sports can be established in this area is mainly because of its natural resources and humanistic characteristics. Some people think that the people in this area are very relaxed and contented, and if they actively develop some leisure activities, they will attract people from other areas to come and experience it (Christidis and Stott 2016).

**Research status of remote sensing images and rainfall trend prediction**

We use remote sensing imaging technology to shoot through meteorological satellites, which can form satellite cloud images, and we can intuitively see the changes in the clouds in the sky from the satellite cloud images (Chu et al. 2016). Satellite cloud images can be captured in a very large range, and they are also detected throughout the day. It can be seen in many weather forecasts that many meteorological experts predict the precipitation and weather conditions of the next day by analyzing satellite cloud images. However, the scope of satellite cloud image monitoring is very large, the information density is also very large, and the amount of data is very large. It is very difficult to obtain the information we need from satellite cloud images, which is also the focus of our research (Costa et al. 2020) (Fallah Ghalhari and Dadashi Roudbari 2018). We can use image mining technology to find out the meaningful information and ignore some useless information. Image mining technology is a very effective tool in the process of image analysis, but image mining technology alone cannot perform detailed analysis and processing on satellite cloud images. Since the amount of data contained in the satellite cloud image is too large, simply using image mining technology for processing will lead to the problem of too long time and low accuracy (Fallah Ghalhari et al. 2012).

**Materials and methods**

**Research methods for rainfall prediction of coastal satellite cloud images**

**Data association rules framework**

In the process of weather forecasting, satellite cloud images have played a very important role. In this study, we used the rainfall data of the Heihe River Basin and satellite cloud image data, and related the two together through the corresponding algorithm. In this way, we can directly predict rainfall through satellite cloud images (Fallah-Ghalhari et al. 2019). When we connect data and images, we need to describe the relationship between them. In the computer, the image usually exists as a string type, and we need to format it before proceeding to the next step. Figure 1 shows the process of associating satellite cloud images with rainfall data (Farjad et al. 2019).

**Preprocessing of rainfall data**

In the process of monitoring rainfall, we will set up some measurement base stations on the ground. In the base station, we will measure the rainfall at a fixed time. We divide the time, feedback the rainfall situation to the background data through the sensor, and then store the rainfall data in the
database. At present, the relevant technology in our country is not yet mature, and people mainly record data into the database manually. Table 1 shows the record table of rainfall data. From the data in Table 1, we can see that some of the data stored in the database has been lost, and some of the data is inconsistent. Therefore, directly using association rules to mine the data will result in large errors, and even possible get wrong data. For some missing table items in the database, we should delete the corresponding records to ensure the integrity of the information, so as to make subsequent research more convenient (Gasparrini et al. 2017).

**Parametric processing of satellite cloud images**

We process the parameters obtained from the satellite cloud image, and use the cluster separation method to obtain the rainfall characteristics. First, obtain the mean value of equivalent brightness temperature:

$$T_G = \frac{1}{n} \sum_{i=1}^{n} T_G(i)$$

The lowest can reach:

$$dT_G = T_{G\max}$$

The mean square error is calculated as:

$$f_G = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (T_G(i) - T_G)^2}$$

The brightness temperature gradient of the equivalent cloud top is:

$$\nabla T_G = \left( \left[ T_G(i+1,j) - T(i-1,j) \right]^2 + \left[ T(i+1,j) - T(i,j-1) \right]^2 \right)^{\frac{1}{2}}$$

The equivalent trend index can be defined as:

$$KT_G = \frac{1}{M} \sum_{i=1}^{N} KT_i$$

### Table 1 Rainfall data record

| STCD | TM    | DRP | INTV | PDR | DYP | WTH |
|------|-------|-----|------|-----|-----|-----|
| 40104000 | 2020-07-1909:00:00 | 0.0 | 0.4  | 0.0 | 0.0 | 9.0 |
| 40104050 | 2020-07-1809:00:00 | 1.1 |
| 40104050 | 2020-07-1809:00:00 | 0.1 | 1.0  | 7.0 |
| 40104150 | 2020-07-1909:00:00 | 0.0 | 0.4  | 60.7 | 9.0 |
| 40104150 | 2020-07-1909:00:00 | 0.0 | 0.4  | 0.0  | 9.0 |

The trend index is:

$$KT_i = \frac{2T_G - T_{G\max} - T_{G\min}}{T_{G\max} - T_{G\min}}$$

**Cloud map-rainfall multidimensional data structure**

For some relational databases, we can mine the data through the association rules in the table. Generally speaking, the tables of relational databases are two-dimensional data tables with certain structure. The satellite cloud image studied in this project is a hybrid data composed of images and rainfall data. After the two are mixed, the data type will become very complicated (Gibba et al. 2019) ( Giorgi et al. 2009). Figure 2 shows the multidimensional cube structure we built, which mainly includes three dimensions.

First, we need to partition the rainfall data. Generally speaking, the meteorological department will divide the rainfall into 7 grades, and what Table 2 shows is the basis for dividing the 7 grades.

After analyzing the rainfall data, we can classify it into a specific category. We conducted a detailed analysis of the rainfall data in the Heihe area and found that there are almost no micro-education and heavy rainstorms in the Heihe area. In the process of analysis, we can remove these two categories and only consider the other categories.

In the process of analyzing the gray data of cloud images, we mainly classify it according to its gray value. Table 3 shows the basis for the division of cloud image gray values. From the table, we can see that the gray levels of cloud images can be divided into 16 categories, corresponding to different attributes. However, because there are too many types of classification, the interval length of each type is too large, and there may be a problem of low support. In the process of using rules to match the content that users are interested in, some omissions and errors may occur. In response to the above problems, this research proposes a clustering technology to use this technology to partition, which can be divided according to the attribute value of the data, and some parts of the cells can be merged (Guo et al. 2019) ( Hansen et al. 2013). The intensive feature value will be used as the mining object of our experiment, using association rules for mining, so that the mined data can have better operability and practicability (Hao et al. 2020).
meteorology and predicting weather. We need to separate and extract the clouds from the satellite cloud image, which can be extracted by mathematical methods or artificial neural network algorithms (Houghton et al. 2001). Because the clouds in the sky are constantly moving and gathering together, it is very difficult to extract our information. Figure 3 shows the result of using clustering to separate the clouds (Ignacio et al. 2020).

Cloud image storage

Figure 4 shows the storage structure of the satellite cloud image. This structure can store the data obtained from the satellite cloud image. The master node stores a series of data and also maintains an extended index. The index includes the file name, size, and offset, and all data will eventually be saved in the back-end database (Imada et al. 2018).

If you want to store the acquired brand-new data in the database, you must first find the corresponding file to determine whether the storage capacity of the file has reached the maximum value. If the file does not reach the maximum value, write the data to the file; otherwise, we need to restart. Create a file and write data to the newly created file. Figure 5 shows this process.

When reading the stored data, we must first find the corresponding file, so we can determine the location and length of the file where the data exists, then read the file information, and finally get the data. Figure 6 shows the process of reading a file.

Cloud map retrieval

We can use content-based retrieval methods to manage the database more effectively. Among them, the structure of the retrieval module is shown in Fig. 7.

In the retrieval process, the user first enters the type of cloud image to be retrieved, then extracts the feature vector of the cloud image, compares the feature vector of the cloud image with the vector in the database, and then outputs similar cloud images in a certain order for the user to choose. Figure 8 shows this process.

| Table 2 | Rainfall data grade |
|---------|---------------------|
| Rain level | Rainfall          |
| Trace rainfall | Less than 0.1mm  |
| Light rain  | 0.1–9.9mm          |
| Moderate rain | 10.0–24.9mm       |
| Heavy rain  | 25.0–49.9mm        |
| Rainstorm   | 50.0–99.9mm        |
| Rain      | 100.0–200.0mm      |
| Heavy rain | Greater than 200mm |

| Table 3 | Cloud image gray data partition |
|---------|---------------------------------|
| Interval number | Interval | Interval number | Interval |
| 1           | [70, 91)   | 9               | [191, 201) |
| 2           | [91, 121)  | 10              | [201, 211) |
| 3           | [121, 141) | 11              | [211, 216) |
| 4           | [141, 151) | 12              | [216, 223) |
| 5           | [151, 161) | 13              | [223, 231) |
| 6           | [161, 171) | 14              | [231, 236) |
| 7           | [171, 181) | 15              | [236, 246) |
| 8           | [181, 191) | 16              | [246, 256) |
Principles of coastal rainfall trend prediction algorithm based on remote sensing image processing

Figure 9 shows the process of mining effective data according to the corresponding association rules.

Construction of experimental environment

We need to perform simulation experiments on related theories, which mainly include 5 virtual machines, two as the primary node and three as the secondary node. Different environments are configured on the host as shown in Table 4.

Results

In the course of the experiment, due to excessive memory consumption, we further optimized the corresponding algorithm to achieve parallel operation, and then went through a series of experiments to verify the effectiveness of the algorithm.

Analysis of simulation experiment results of rainfall trend prediction

Validity verification

There are as many as tens of thousands of meteorological data used in this experiment. We have introduced three different algorithms for information mining. The mining results are shown in Table 5.

From the table, we can see that the results of the first two algorithms are basically the same. In the case of different interval lengths, the difference in experimental results is also relatively large. Therefore, we need to divide a reasonable degree of support, which is a very important experimental factor.
In this research, we used three different algorithms to mine the data in the graph, and performed statistics and analysis on the mined data. The analysis results are shown in Fig. 10.

It can be seen from Fig. 10 that the second algorithm has greater advantages and the highest efficiency.

**Scalability verification experiment**

The test data is over 10,000, the algorithm has also been verified, and the hardware facilities are good. The final result of the experiment is shown in Fig. 16:

**Algorithm execution efficiency verification**

It can be seen from Fig. 11 that a reasonable configuration of the number of nodes will improve the performance of the system.

**Speedup evaluation**

It can be seen from Fig. 12 that in the case of different data volumes and node scales, there are differences in the operating efficiency of different algorithms.

Figure 13 shows the performance acceleration effect of using parallel algorithms. It can be seen that the algorithms proposed in this study can improve the efficiency of data mining.

**Remote sensing image cloud image-rainfall prediction rule mining**

It can be seen from Table 6 that after using the clustering technique to partition, we can get the centralized data format, and then we can use the algorithm to get the relationship between the cloud image and the rainfall.

Table 7 shows the mixed types of data obtained by partitioning cloud images.

**Cluster analysis design of remote sensing image cloud image**

Figure 14 is the original satellite cloud image; Fig. 15 and Fig. 16 and Fig. 17, respectively, show the effect of cloud separation.

Figure 18 shows a three-dimensional satellite cloud image. From the above image, we can see that the effect of using clustering to separate luck has achieved the expected effect.
Discussion

Coastal rainfall trend prediction strategy based on remote sensing image processing

Although our experiments have achieved certain successes, we still need to solve several problems. First of all, we must clarify what the data we want to mine is, and only after we have a certain understanding of the results of our own mining, can we conduct follow-up research.

In addition, we also need to design better ways to mine data. Satellite cloud image is a kind of image data, it is not conventional data, and conventional algorithms cannot be used for data mining. Therefore, we need to convert the image type so that it meets the conventional data standards before proceeding to the next step of analysis and processing.

Analysis of development strategy of coastal leisure sports

Development advantages

We have conducted a detailed understanding and in-depth analysis of the leisure tourism scene in the coastal area, and finally found that the tourism industry in this area is developing well and the scale is also constantly expanding. Many domestic tourists are very willing to come to this place for leisure and entertainment tourism, the number of people is increasing, and the income from tourism is also increasing. Most of the tourists who come to travel are tourists from this province, but there are also tourists from neighboring provinces. Most tourists come to this place for relaxation, leisure, and entertainment.

Development disadvantages

The development of the coastal area also faces many disadvantages. First of all, the development of tourism in the region is very single, and there will be some differences in different regions, and many tourism projects still have irregular behaviors. At present, the tourism projects in the coastal area are mainly based on some entertainment projects and scenic sightseeing. The government has also actively invested some funds to lead the establishment of some tourism products. There have also been some achievements in this area, but most of the tourism projects are everywhere, without the formation of local tourism culture, and there is no corresponding brand. Secondly, local products do not have regional characteristics, nor do

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Fig. 8 Schematic diagram of circular primitive acting on cloud block

Fig. 9 Flow chart of association rule generation

Table 4 Cluster software configuration

| Operating system          | CentOS |
|---------------------------|--------|
| Virtual machine           | UseVMware |
| Hadoop version            | 2.8.0  |
| JDK version               | 1.8.1-150 |
| Spark version             | 2.2.0-bin-hadoop2.5 |
| Zookeeper version         | 3.4.10  |
they have the characteristics of folk culture. Tourism products in the coastal area are very susceptible to restrictions, and many products are directly modeled on recreational facilities and projects in other areas. Various factors have led to the inability of rapid development of the leisure tourism industry in the coastal area, and the consumption level of people who come to travel cannot be improved.

The infrastructure construction in the coastal area is still relatively weak, and only some resorts have relatively complete facilities. The government should further invest funds to implement financial support for the region, solve the current problems and difficulties in the region, and create a better image of a tourist city.

The publicity of the area is not yet in place, and many tourists are ignorant of the development of tourism in the area. Most tourists retain their impression of the area on a traditional level, know nothing about the reform measures adopted by the area, and have not experienced these brand-new leisure projects immersively. The government should invest a certain amount of energy to publicize the tourism industry in the region, focusing on spreading its leisure and entertainment characteristics.

In addition to the above factors, the popularity of the region is relatively low, and the level of tourism development is relatively low. Compared with other coastal cities, there is a relatively large gap. Therefore, when people choose, they often choose a higher level of tourism development.

**Coastal leisure sports management strategy**

If the coastal area wants to develop a long-term leisure sports strategy, it must rely on local resources to achieve sustainable development. Although the natural resources in the coastal areas are relatively rich, the ecological environment in the coastal areas is relatively fragile, and once destroyed, it is difficult to regenerate. Therefore, in the process of developing and managing the coastal area, we also need to pay attention to the protection of the environment and resources. There should also be dedicated managers and responsible personnel in this area. Once there is a problem, the managers and responsible personnel will bear legal responsibilities and administrative penalties. The development of tourism in itself is a high-risk activity, which is also an inevitable characteristic of engaging in sports.

**Table 5** Running results of different support algorithms

| Algorithm minimum support | Apriori algorithm | SP_MC_Apriori algorithm | YAFIM algorithm |
|---------------------------|-------------------|-------------------------|----------------|
|                           | Frequent item sets | Number of rules         | Frequent item sets | Number of rules         | Frequent item sets | Number of rules         |
|                           |                   |                         |                   |                         |                   |                         |
| 0.2                       | 3725              | 66                      | 3715              | 64                      | 3721              | 65                      |
| 0.3                       | 1696              | 33                      | 1645              | 31                      | 1681              | 29                      |
| 0.5                       | 753               | 25                      | 765               | 30                      | 758               | 25                      |

**Fig. 10** Comparison of algorithm running time
Every tourist who comes to the area for leisure travel must understand this, and they must have a good understanding of their responsibilities and obligations. Once an accident occurs during leisure and entertainment, both the person in charge and the passenger should actively seek solutions and bear their own legal responsibilities. The management of leisure sports in this area requires talents in the corresponding management industry, and it is very important to recruit talents. Due to the relatively high risk of activities in coastal areas and the very special environment, talents recruited in this area must have theoretical knowledge of oceans and sports. Relevant talents should also have a comprehensive understanding of the tourism industry, and their own comprehensive qualities and abilities must be too strong. Only by constantly recruiting high-quality management personnel to work in the coastal area can we better manage the resources of the region and promote the long-term and stable development of the tourism industry in the region.

Fig. 11 The execution time of the three algorithms at different numbers of nodes

Development strategy of coastal leisure sports

There are many development models that can be adopted in the leisure sports industry for long-term and stable development. The first development model is a balanced development strategy. Under this strategic model, various regions will blindly invest in coastal areas, leading to the repeated construction of many projects in coastal areas. The industrial structure of each region will be very similar, and many resources will be lost. The second development model is to adopt an unbalanced development strategy. In this strategy, there will be gaps in the development level of different regions, and the gap will become larger and larger, eventually leading to some negative effects. The third development model is an unbalanced and coordinated development strategy. Under this strategy, the overall development level of each region is as consistent as possible, but it must be admitted that there will be certain differences between different regions. In the process of promoting development, we put energy and
funds into some key economic development regions to promote the development of other regions. Through related investigation and research, we can find that the third development strategy is very reasonable. We can give priority to the development of the leisure sports industry in the urban area, and then gradually drive the development of the surrounding county-level and district-level areas. Adopting such a development strategy is not only conducive to the deployment of resources and the management of talents but also promotes the development of the leisure sports industry in the region and increases the competitiveness of the region. Give full play to the characteristics and advantages of each region, learn from each other’s strengths, and make progress together as a whole.

In response to the problems in this area, we made the following suggestions:

Creating an excellent tourism environment and speeding up the construction of tourism infrastructure

In recent years, some tourist facilities have been launched in some tourist areas, and public service facilities have been constructed, and infrastructure construction has been improved.

Table 6  Cloud map-rainfall mixed table

| TID | Mean   | Mean square error | Cloud top brightness temperature gradient       | Cloud trend index | Cloud category | Rainfall level |
|-----|--------|-------------------|-----------------------------------------------|-------------------|----------------|----------------|
| 1   | smaller| Relatively even   | Convection is relatively weak                  | Dissipate phase   | stratus         | Light rain     |
| 2   | smaller| Relatively even   | Convection is relatively weak                  | development stage | cumulus         | Light rain     |
| 3   | bigger | Relatively even   | Strong convection                             | development stage | Cumulonimbus    | Moderate rain  |
| 4   | bigger | Uneven            | Strong convection                             | development stage | Cumulonimbus    | heavy rain     |

Table 7  Cloud map-rainfall experience zone mixed table

| Gray scale | Light rain | Moderate rain | Heavy rain | Rainstorm | Heavy rain |
|------------|------------|---------------|------------|-----------|------------|
| 101        | 126        | 16            | 11         | 5         | 0          | 30           |
| 126        | 131        | 13            | 20         | 7         | 0          | 36           |
| 131        | 138        | 18            | 25         | 12        | 2          | 64           |
| 138        | 146        | 23            | 35         | 12        | 0          | 76           |
| 146        | 151        | 29            | 50         | 6         | 0          | 156          |
| 151        | 157        | 56            | 73         | 16        | 1          | 74           |
| 157        | 164        | 28            | 34         | 20        | 21         | 100          |
These have achieved obvious results. But for today’s market, public service measures in many tourist areas are still relatively backward. Many tourists will pursue a more comfortable travel environment. Therefore, we should optimize the tourism environment, speed up the construction of infrastructure, meet the needs of tourists, enhance the satisfaction of tourists, and promote the long-term stable development of the local tourism industry.

**Excavate local resources and set up different tourism projects with characteristics**

We can also excavate local characteristic resources, set up some tourism projects with regional characteristics, and implement brand awareness in the tourism industry, so as to ensure the competitiveness of the tourism industry in the region and promote the development of the tourism industry. For the coastal area, their attraction to tourists is limited to browsing and swimming. Many inland tourists who have not seen the sea will yearn for the area and are willing to come and try to get close to the sea. But most of the tourists who come to the area will be relatively disappointed, because they can participate in very few tourism projects and the time is relatively short. From the above survey results, it can be seen that the area has not fully explored the local characteristics, and there are no specific tourism projects that can satisfy people’s pursuit of leisure and entertainment. In the future construction process, we should combine the local cultural characteristics, give play to the advantages of the ocean, and combine the surrounding villages to create entertainment projects that are more in line with the needs of the public. The government can also regularly hold some more entertaining competitions, use local natural resources to adapt to local conditions, and carry out folk activities.
Enriching tourism consumption formats, creating high-quality tourism projects, and improving comprehensive tourism benefits

There are no high-quality projects in tourism projects in this area, and most of them are shoddy. Streaming products are just some ordinary products and cannot represent the regional characteristics of the region. Most of the products are of low grade and poor quality. Many tourist areas have concentrated shopping and accommodation places, but most tourist areas are very far away from commodity areas and accommodation areas. Most of the accommodation areas are low grade, which will greatly reduce the experience of the tourists and also reduce the income of scenic spots. In order to solve these problems, on the one hand, we must increase the promotion of the leisure and tourism characteristics of the scenic spot, and on the other hand, we must further develop transportation and strengthen the exchanges with shopping malls in surrounding cities. The tourist area should contact the surrounding shops and hotels as much as possible, and provide one-stop service as much as possible to ensure the convenience and speed of tourists. Tourist areas should also build some high-quality tourism projects, add some comprehensive facilities such as camping grounds, and further enhance the comprehensive benefits of tourism products and enrich the tourism environment.

Speeding up tourism informatization and advancing publicity and marketing plans

We should also use existing scientific and technological means to develop tourism in combination with modern technology. We can promote the local tourism characteristics by advertising on the Internet and publicity on TV. Only by increasing the local reputation can we further attract tourists. By marketing the area, we can let more people have a deeper understanding of the local area, and also stimulate their interest in the area and attract them to travel here. The local management department should also design unique entertainment activities based on the characteristics of the resources of the region. Only entertainment projects with regional characteristics can be more competitive and worthy of promotion.

Improve community participation and establish a multi-level talent training mechanism

If we want to vigorously develop tourism and develop tourism products, we need the participation of local residents. Local residents play a very important role in product development and management. If a city wants to develop leisure sports culture, it needs the support and participation of most residents. Only by truly allowing residents to live a healthy life can they successfully develop good sports tourism products and attract others to travel more. The surrounding residents should also actively participate in the construction of the tourist area, provide their own suggestions for the construction, and can also provide corresponding designs. At the same time, the surrounding residents can also actively participate in the management and environmental protection of the tourist area, so as to realize the rapid, sustained, and stable development of the local tourism industry. However, organizing sports and leisure activities is more dangerous than simply traveling and sightseeing, and it also requires some specialized

Fig. 18 The effect of separating clouds from a three-dimensional cloud image
management talents to manage them. The cultivation and recruitment of talents are very important for the development of the tourism industry and the research and development of tourism products in the region. Some professionals in the tourism industry have an understanding of some leisure sports activities and professional qualities that others cannot match. This is of great significance to the development of the local tourism industry and products, and can also affect the feelings of tourists. At present, the talent management training program in this area has been developed relatively comprehensively, and the government will also organize corresponding training activities to conduct regular training for managers. However, most of the training is aimed at the surrounding hotels and restaurants, and the corresponding training for leisure sports activities is rare. The government should devote some energy to safety inspections and professional training in the leisure tourism industry. The region can also unite some universities and specialized colleges to provide relevant training for leisure sports activities to further promote the long-term development of the region.

**Conclusion**

We use satellite cloud images obtained by remote sensing technology to predict rainfall in coastal areas, and we can arrange and plan leisure and sports activities in coastal areas in time. To develop tourism in coastal areas, we must not only provide some good tourism products but also tourism services that can meet the needs of customers. The government should also invest corresponding funds to improve local infrastructure and create cultural activities and landscapes with regional characteristics. Responsible personnel in the tourism industry also need to have good communication with the surrounding dining and accommodation conditions to further enhance tourists’ travel satisfaction. At the same time, we must combine local residents to build more high-quality and inexpensive leisure facilities to better improve the satisfaction of tourists and promote the long-term and stable development of the local tourism industry.

**Declarations**

**Conflict of interest** The authors declare that they have no competing interests.

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