APPLICATION OF THE SATELLITE REMOTE SENSING TECHNOLOGY IN SALT INDUSTRY*

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Abstract: This paper introduces applications of the satellite remote sensing technology in salt industry. Firstly, the production actuality of our country's salt industry was be introduced, and also the importance of monitor for salt production; then introduces satellite remote sensing technology and its merit; finally takes estimating for area of salt pond as a example, this paper introduces the principle of satellite remote sensing technology and its realization method.

Key words: Satellite remote sensing, Salt industry, Estimate, Application

INTRODUCTION

The salt is one of the basic raw materials of the chemistry industry, and at the same time it is a necessity for life. The total yield of salt in our country is the second in the whole world, in which the sea salt yield possesses 70% in our country that has already been the first in the world. The producing area of sea salt in our country focuses on the coastal zone from Yalu river estuary in Liaoning to Beicang river estuary in Guangxi, which is more than 15,000 kilometers and distributed hundreds of the sea salts corporation. At present, the technique of the production of the sea salt is comparatively backward, which includes a few steps, such as offering tidewater , evaporating to make bittern, crystal and separating out the salt etc, on the other side, the sea salt production area is bigger, which is from ten square kilometers to hundreds of square kilometers, it is necessary to strengthen macroscopic monitor research and management for sea salt production by using the satellite remote sensing technology.

At present the research of sea salt already widely caused the coastal country's attention, a lot of research work has carried out in the government and the international organization, such as the salt field soil infiltration research, the salt field biology to enhance sea salt output research, meteorology condition to salt field output research, these research works mainly concentrate on how to enhance salt output, was microscopic, but there were less in the sea salt field monitor and the salt field production monitor, applications of satellite remote sensing technology developed from the 1960's is much less in salt industry.

SATELLITE REMOTE SENSING TECHNOLOGY

The remote sensing technology is a novel synthetically survey technology which rapidly develops in the 1960's, western countries, such as the USA, Russia, which are at the leading position in the remote sensing technology, they start early, invest many, the scale are big, represented the remote sensing technology development level in the certain degree. In our country, experiment and application of remote sensing technology started later, but develops quickly, obtained many results. After more than 20 years, Our country has developed the remote sensing platform of space flight and aviation, launched a series of monitors satellite such as the resources satellite, the weather satellite, the ocean satellite, constructed some ground implements, such as the satellite earth station, data processing center, formed the formidable remote sensing data gain handling ability. The No.1 ocean satellite(HY-1), launched on May 15th 2002, which is our country first experimental professional satellite using in the sea water color survey, two remote sensor are loaded on this satellite , one is sea water color scanning apparatus of ten wave bands, the other is four wave bands CCD imaging apparatus. The CCD imaging apparatus have 4 wave bands, first wave band (0.42-0.5um), mainly uses in to monitor pollute plants, the vegetation water color, the ice and landform under water, the second wave band (0.52-0.6um), mainly uses in the aerosol silt, the pollution, the vegetation, the ice and the shoal, The third wave band (0.61-0.69um), mainly uses in the aerosol silt, the soil, the water vapor quantity and so on, the fourth wave band (0.76-0.89um), mainly uses in the soil, the water vapor quantity and the atmosphere proofread and correct and so on. High image in interactive area of sea and land may obtain using the HY-1 satellite CCD imaging apparatus, this remote sensor wave band establishment gave dual attention to the sea and the land demand, its product mainly applies to dynamic monitor in resources of key area in our country coastal zone and the vegetation investigation, the coastal zone, as well as coastal zone vicissitude for a long time studied.

Comparing with traditional monitor methods, the merit of satellite remote sensing technology is:

1) Macroscopical, fast and economical

One satellite picture, like Landsat, its area coverage is 185km×185km, its area is equal to more than 51,000,000 Chinese acres land. If investigation for resources of these such greatly larger land will be carried with the traditional conventional method, it will need more than ten thousand person to investigate and estimate, but if we put the computer tape of holding the above area into computer to carry on the image processing, the resources and area of different environment may be extracted in several hours, its macroscopically, fast and economical are obvious.

2) The amount of information is larger and the content is rich

One image of satellite picture (viz. satellite photo), such as the HY-1 satellite, probably has more than 8,000,000 images units (viz. Pixel, a minimal and distinguishable pixel in MSS picture).If the area coverage of satellite image is beach, it not only may reflect the environment resources status of this area, but also moreover even can show ecology factor including soil, landform, moisture status, this will provide necessary gist and important parameter for analyzing and researching salt yield. This objectivity and abundance of remote sensing information is too far behind to catch up with traditional method.

3) Do not contact and do not destroy studies object

If we want to estimate yield of salt industry production with traditional method, we will not only need to measure salt pond density frequently, but also even need to survey area of salt pond. But for estimating yield with remote sensing, it mainly use some

* The present work is supported by Nature Science Fund of Tianjin (043600411)

related parameter to achieved goal by detecting spect-
rum echoing characteristic of salt pond water bodies, echo from training area (area of experimental study),therefore the object of studying will not be contacted. So if it be used in estimating yield for crop, the crops may not be experiment directly, so there is not any problem, such as destroy or damage crop.

4) Precision is objective and credible

Although the precision of remote sensing estimates still can not be perfect, but according to some correlative document in both home and abroad, it is be proved that the precision of remote sensing estimate is comparatively objective, thus it is credible. For example, the 90/90 standard (viz. the probability when the difference of total estimated yield and real yield exceed 10% must under 90%) which was be stipulated in the experiment carried in the US was regarded as advisable, this experiment was be carried to estimate yield of larger area agriculture.

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Analysis of remote sensing principle

The information reflected from ground object to electromagnetic and heat radiation information of ground object itself is being recorded in satellite remote sensing image. Because of the difference of structure, composition and physics and chemistry character among all of ground object, it caused that there have some difference of reflection from ground object to electromagnetic and heat radiation itself among them. To the 0.4-2.5um electromagnetic wave, absorbability of natural water bodies is obvious higher than the majority other ground objects, so the total radiation level of water bodies is lower than the other ground objects, it show dark color tone in colored remote sensing image. The energy absorbed by water bodies in visible light wave band is more than in infrared wave band, even if the water is very shallow, all incident energy in near infrared wave band and mid-infrared wave band will be absorbed completely by the water bodies also, so the reflection energy from water in near-infrared and mid-infrared wave band is very few, but in these two wave bands energy absorbed by vegetation or soil is smaller, and reflection is higher, this caused there has a obvious difference between water bodies and vegetation or soil in these two wave bands. In the image, water shows dark color tone, but soil or vegetation is bright. Therefore, select one appropriate near-infrared wave band and decide a threshold value of water bodies, regard pixel which value is lower than this threshold value as water, higher as non- water bodies, in this way, it is very easily to distinguish water bodies from the other ground objects.

Figure 1 is a remote sensing image of Tianjin sea area which scanned by CCD imaging apparatus of HY-1 satellite in June of 2003, we may clearly find a dark region inside shoreline, in fact this region is composed of evaporation pond, crystallizing pond Tanggu saltern.

Figure 2 is spectral analysis picture of the left picture; it showed the outline of spectrum profile chart, indicated the value of the spectrum passed through the image. In the left picture, when we click on the different position with mouse, the place in the left picture is darker; the value of spectrum in right picture is lower. The place near the middle red line in the right picture is the region of saltern of the left picture, we can find that the spectrum value of this region is lower, it was conformed to the front discuss.

Fig.1 HY-1 Satellite Tianjin sea area remote sensing image

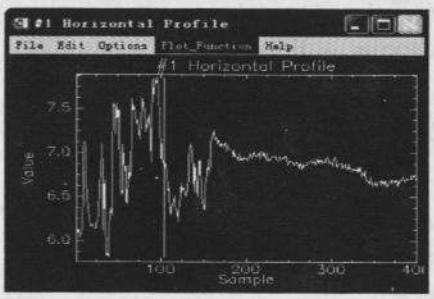

Fig.2 HY-1 Satellite remote sensing image spectral analysis picture

Realization method

According to principle of remote sensing and analysis of spectrum characteristic, the process of salt field area (viz. salt field water bodies) extraction may follow this several steps showed by figure 3 .

1) Draw the histogram of image density

According to the deferent of reflection energy between water bodies and ground object, we can computer their value of brightness, so it is easy to draw the histogram of image density, such as figure 4.

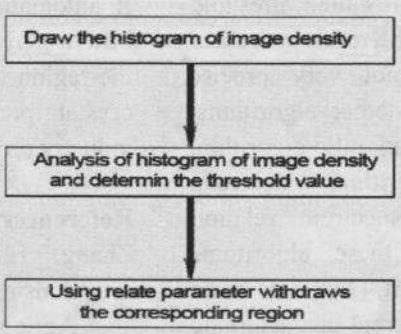

Fig.3 The picture withdraws the process

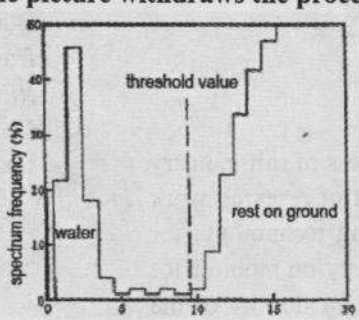

Fig.4 The water bodies differently distributes with other thing brightness value

2) Determine threshold value

According to figure 4, we can find that there respectively has a peak value in the water bodies which will be extracted and the other ground objects, there is a transition region in the middle place, in order to avoid every shallow water bodies not being extracted, the threshold value should be decided in the non-water bodies beginning, for instance 9 was be choose as threshold value in this example.

3) Extract connected region from the master map by using some related parameter

According to the above analysis result, we may very easily to extract connected region with program which compiled with C language. Its method is: for each pixel of image which was be input, if its value of brightness is more than the threshold value, its brightness value will be set 1 when it will be output, otherwise be set 0, its formula is as follows.

$$g(x,y)=\begin{cases}1 & f(x,y)\geq t\\ 0 & f(x,y)<t\end{cases}$$

There f(x,y) is the value of brightness at position(x, y) place before processed, g(x,y) is the value of brightness at position(x, y) place after processed, and "t" is the threshold value.

Then the area of these connected regions may be calculated from the processed image, this is the area of salt field.

The above algorithm is called threshold value algorithm, certainly the result processed with this algorithm is not very precise possibly. There are many other algorithms, such as differential algorithm, ratio algorithm, density slicing algorithm, chroma distinguishes algorithm, spectrum relation algorithms and so on, these algorithms respectively has its merit, but its basic principle all is use the different characteristic of reflection among different ground objects to do.

CONCLUSION

In the production process of salt industry, we also can do many kinds of research work with satellite remote sensing technology, for instance we can use it to carry on monitor for sea water density, monitor for density of the region which used to making bittern and the crystal pool, estimate of salt field output, monitor for present situation, such as biology growing trend in crystal pool, and so on. Because in remote sensing image, the brightness reflected by different density bittern is different, so according to these principles, the density of bittern among deferent area can be automatic distinguished, if automation equipment will be combined, bittern may be automatic adjustment between the region which be used to make bittern and crystal pool, so the automation of salt industry production can be realized.

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