HIGH-PRECISE WATER EXTRACTION BASED ON SPECTRAL-SPATIAL COUPLED REMOTE SENSING INFORMATION

Jiancheng Luo [1], *Yongwei Sheng* [2], *Zhanfeng Shen* [1], *Junli Li* [3]

1. Institute of Remote Sensing Applications, Chinese Academy of Sciences, Beijing, 100101
2. Department of Geography, University of California, Los Angeles, USA, CA90095-1524
3. Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi, Xinjiang, 830011

1. INTRODUCTION

Remote sensing information extraction is the key step of remote sensing application. However, the former algorithms mainly used the spectral information of remotely sensed image, without much spatial information. It is worth mentioning that remotely sensed image contains both spectral and spatial information, the later also plays an import role in remote sensing applications; and thus, formed the spectral-spatial coupled information, which is more comprehensive and reasonable, and will become the research hotspot in the near future.

Water body is one of the main targets, and also an easy and typical land type on the earth surface. Thus, automatic and high-precise extraction of water information from remotely sensed images is of great significance and urgently required in research fields of water resources investigation, natural disaster evaluation, even global ecological environment evolution, etc. However, due to the various influencing factors of water, such as suspension, chemistry component, imaging condition and so on, water information extraction methods only using fixed models on whole image are always with low accuracy and aren't suitable for complex conditions.

This paper presents a method to extract water information using spectral-spatial coupled information, which using spectral information through water index computation from spectrum library; and using spatial information by a step-by-step iterative transformation mechanism.

2. METHODOLOGY

2.1 Work flow

According to the characteristics of remotely sensed image and the need of water information extraction, we give the method implementation and work flow according to Figure 1, and by this procedure we can extract water body in different forms and conditions.

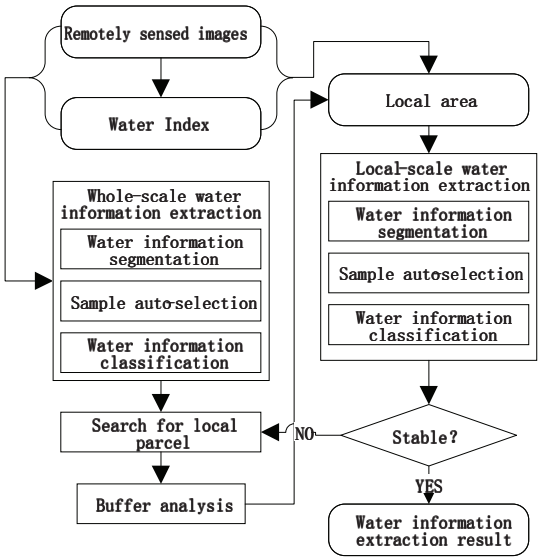


Fig.1 Flow chart of water body information extraction

2.2 Water Index Computation

Nonlinear water index which stands for spectral information, can be gained through the simulation in the spectrum library, which is more accurate than the linear water index, such as NDWI. It can enhance the difference of water and land in spectrum, which makes the extraction more precise. The following processes are mainly based on this index.

2.3 Whole-scale water information extraction

Through segmentation of index image and the following classification with additional multispectral images on the whole image, we can get the preliminary separation of water and land. Then search for and select local areas, and create buffer zone of them, in order to execute local process on this basement.

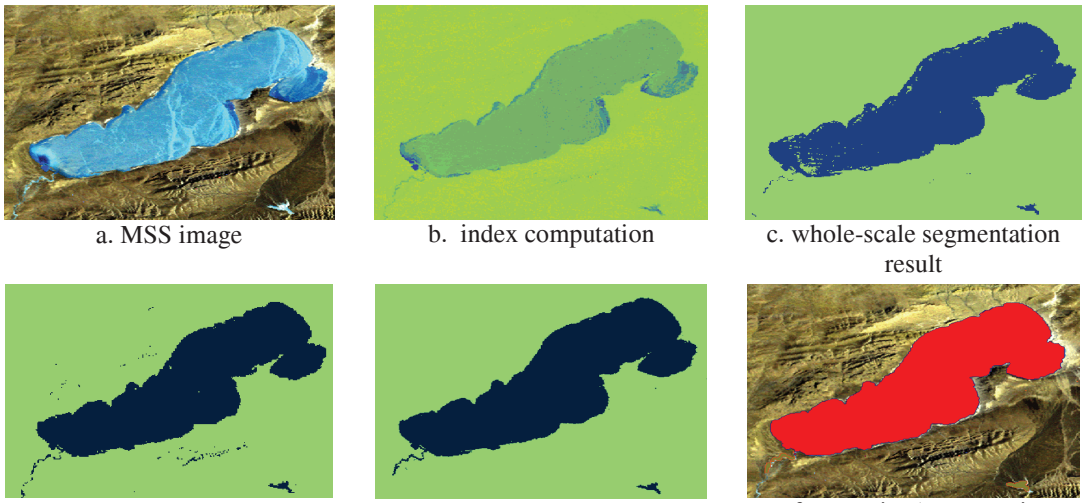
2.4 Local-scale water information extraction

Within each local area, the spatial extent and spectrum are more purified, and the influence of the surroundings is relatively less. Thus, doing local segmentation and classification is more specified. Besides, the iterative algorithm also makes water extraction result more and more precise gradually.

Through the former two steps, we could use the spatial information adequately, which locate the water distribution gradually and accurately.

3. EXPERIMENTS

Here we select a MSS image of a lake on Tibetan plateau as the experiment image (Figure 2(a)), and implement the method according to that showed in Figure 1. The results are listed below (Figure 2(b) - (f)).



a. MSS image b. index computation c. whole-scale segmentation result

d. whole-scale classification result e. local-scale classification result f. vectorized water unit

Fig.2 Result of water body information extraction

According to Figure 2, water body can be basically extracted from background information through the procedure of index computation, whole-scale segmentation and classification, but there still exist some misclassifications and noises. The following process of local-scale segmentation and classification can solve this problem effectively, and obtain water body's optimal margin finally.

4. CONCLUSIONS

This paper presents a new idea of water information extraction, which not only considers the spectral information, but also uses the spatial distribution and variation pattern. Thus, results using both of the two fundamental elements of geosciences are more reliable and precise than using anyone of them alone in complex environment. What's more, it is nearly automatic that manual operation is hardly needed. This idea can also be used to the automatic and high-precise extraction of other different objects, such as vegetation, desert, wetland and so on.

REFERENCES

[1] Zhou C H, Luo J C, etc., Flood Monitoring Using Multi-temporal AVHRR and RADARSAT Imagery, Photogrammetric Engineering & Remote Sensing, vol. 66, no. 5, pp. 633-638, 2000.

[2] McFeeters S K, The Use of Normalized Difference Water Index (NDWI) in the Delineation of Open Water Features, International Journal of Remote Sensing, vol. 17, no. 7, pp. 1425-1432, 1996.

[3] Ouma Y O and TATEISHI R, A Water Index for Rapid Mapping of Shoreline Changes of Five East African Rift Valley Lakes: An Empirical Analysis Using Landsat TM and ETM+ data, International Journal of Remote Sensing, vol. 27, no. 15, pp. 3153-3181, 2006.