International Journal of
Environmental Sciences & Natural Resources
ISSN: 2572-1119

Juniper Publishers
key to the Researchers

Research Article
Volume 16 Issue 5 - January 2019
DOI: 10.19080/IJESNR.2019.16.555946

Int J Environ Sci Nat Res

Inversion of As Content in Soil Based on Worldview-3 Satellite Remote Sensing Image -- A Case Study of Western Tianfu New District

Liang Yuanling[1], Ouyang Yuan[2], Yang Xin[1], Zeng Tao[1], Jian Ji[1]* and Yang Xiaoxia[1]

[1]*College of Earth Sciences, Chengdu University of Technology, China*

[2]*Chengdu Institute of Geology and Mineral Resources, China*

Submission: January 17, 2019; **Published:** January 29, 2019

***Corresponding author:** Jian Ji, College of Earth Sciences, Chengdu University of Technology, China

Abstract

Most studies on the inversion of heavy metals in soil in large areas are based on the measured hyperspectral data. However, the field spectral data acquisition requires large workload, high cost and long time. This paper attempted to obtain spectral information directly from worldview-3 satellite remote sensing image, combined with a small number of measured geochemistry samples, and established a model through regression analysis to invert heavy metal As in soil in the Western Tianfu New District. It is equivalent to a spectral acquisition on each pixel, which replaces the traditional field spectral acquisition and saves the workload. The results show that the content distribution of the inversion results is basically consistent with the measured results, and the distribution trend of heavy metal content can be well demonstrated. This method can greatly reduce the cost and realize the rapid, non-destructive and normalized monitoring of heavy metals.

Keywords: Soil; Inversion of heavy metals; WorldView-3 images; Tianfu New District

Introduction

As is a common heavy metal element in soil and one of the nutrient elements for the crop growth. Moderate concentrations of heavy metals are beneficial to crop, and both high and low content will inhibit crop growth [1]. The ability of microorganisms to decompose heavy metals is limited. Undecomposed As can be transferred to water through soil and converted into toxic compounds, damaging water quality and possibly threatening human health. Therefore, monitoring the content of heavy metals in soil is of great significance [2]. The traditional method to obtain the distribution of soil heavy metal content is field sampling, laboratory chemical determination, and spatial interpolation [3].

The accuracy of traditional methods is affected by the density of geochemical sampling. A large number of field samples are collected to obtain the high-precision interpolation. In addition, the later geochemical analysis process is tedious and requires a lot of manpower, material and financial resources, and is usually not real-time [4]. Spectral analysis technology gets the spectral information of samples with spectrometer or remote sensing images. Combines with a small number of geochemical samples, the inversion model is established through regression analysis to predict the heavy metal content of other samples with spectral information [5]. Spectral analysis technology has been applied in soil science for more than 20 years, and it has obvious advantages over the traditional interpolation method of heavy metal inversion, including non-destructive, highly reproducible, rapid, cheap. The content distribution of heavy metal can be controlled macroscopically with only a few geochemical samples [6]. A large number of studies have shown that the spectral analysis technique modeling with high precision and good stability can replace the traditional geochemical analysis.

Western Tianfu New District is the key area of Chengdu city. The local government listed it as a no-fly zone. The image available in the area is limited, and only worldview-3 remote sensing images were collected. Based on the worldview-3 image, this research established a model to invert As content in the study area and explored the feasibility of using the spectrum obtained from the image to invert the heavy metal content in soil, to provide the basis for the pollution control of heavy metals in soil and environmental improvement in Tianfu New District.

Model Construction

The worldview-3 image contains 8 multi-spectral bands and 8 short-wave infrared bands. Pearson coefficient was used to evaluate the correlation between each band and the content of heavy metals. As content in MUL1, MUL2, MUL3, MUL4, MUL5 and SWR1 all passed the significance at 0.01 level, and their Pearson correlation coefficients were 0.574, 0.592, 0.545, 0.529, 0.487

and -0.347, respectively. It indicates that there are characteristic responses of As in the vicinity of the corresponding bands at 425nm, 480nm, 545nm, 605nm, 660nm and 1210nm, and these 6 bands are selected as the characteristic bands of As. After determining the characteristic bands and comparing different regression algorithms, this paper adopts the multiple stepwise regression to establish the As content inversion model in this region. The inversion results and the measured interpolation results are shown in Figure 1.

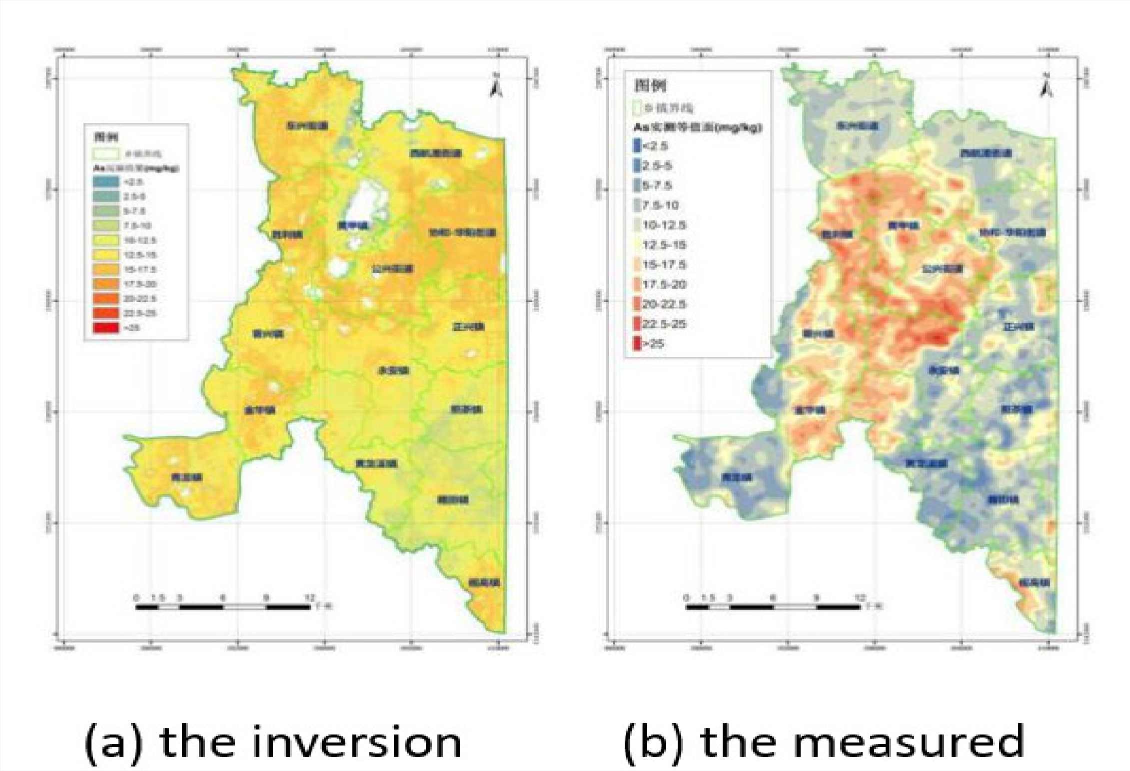

Figure 1: As content distribution.

Conclusion

a) The content of As is generally concentrated in 7.5-17.5mg/kg, and the maximum content is about 22mg/kg, which is in the clean standard level, indicating that the Western Tianfu New District is not polluted by heavy metal as.

b) The overall distribution trend is high content in the north and low content in the south. It is speculated that the reasons for the high content of As in these regions may be as follows: Interference from strong reflections in the northern cloud area; The northern is the urban area where buildings are concentrated, and the heavy metal content may be higher.

c) The result shows that the distribution trend of As in the study area is consistent with the interpolation of measured content. Therefore, it was feasible to predict the content of heavy metal As in the soil in Western Tianfu New District by worldview-3 images.

References

1. Liu J, Zhang Y, Wang H, Du Y (2018) Study on the prediction of soil heavy metal elements content based on visible near-infrared spectroscopy. Spectrochim Acta A Mol Biomol Spectrosc 199: 43-49.
2. Wu Mingzhu J (2014) Hyperspectral response and inversion model of chromium in subtropical soil. Spectroscopy and spectral analysis 34(06): 1660-1666.
3. Xu liangji J (2017) Hyperspectral inversion of heavy metal content in soil reconstructed by coal gangue filling and reclamation. Spectroscopy and spectral analysis 37(12): 3839-3844.
4. Song lian J (2014) Spectral measurement and analysis of heavy metal content in soil As, Cd and Zn in wansheng mining area. Spectroscopy and spectral analysis 34(3): 812-817.
5. Yang ai-xia J (2016) Estimation of total phosphorus content in desert soil based on the selection of observable near-infrared spectral variables. Spectroscopy and spectral analysis 36(3): 691-696.
6. Khosravi V, Ardejani FD, Yousefi S, Aryafar A (2018) Monitoring soil lead and zinc contents via combination of spectroscopy with extreme learning machine and other data mining methods. Geoderma 318: 29-41.

How to cite this article: Liang Y, Ouyang Y, Yang X, Zeng T, Jian J, et al. Inversion of As Content in Soil Based on Worldview-3 Satellite Remote Sensing Image -- A Case Study of Western Tianfu New District. Int J Environ Sci Nat Res. 2019; 16(5): 555946. DOI: 10.19080/IJESNR.2019.16.555946.

DOI: 10.19080/IJESNR.2019.16.555946

How to cite this article: Liang Y, Ouyang Y, Yang X, Zeng T, Jian J, et al. Inversion of As Content in Soil Based on Worldview-3 Satellite Remote Sensing Image -- A Case Study of Western Tianfu New District. Int J Environ Sci Nat Res. 2019; 16(5): 555946. DOI: 10.19080/IJESNR.2019.16.555946.