INVERSION of SOIL Cu CONCENTRATION Based on BAND SELECTION of HYPERSPECTRAL DATA

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1. INTRODUCTION

An unfortunate consequence of the vast utilization of pesticide and fertilizer in the past century is the release of toxic products which alters trace elements in soils on a global scale. This phenomenon is especially significant for developing countries such as China. To understand this change both the China Geological Survey and China Ministry of Environmental Protection are launching new geochemical surveys spanning the whole country. These two huge projects are involving considerable time and are cost-consuming. As a result, there is an increasing need to develop rapid and inexpensive methods of soil analysis aimed at investigating soil composition.

Although contaminant elements in soils are spectrally featureless due to their low concentration as stated (Wu et al. 2007) from the simulation experiments, the potential use of reflectance spectra within the visible-shortwave infrared (V-SWIR) region (380 – 2500 nm) for predicting them as an economical, rapid, and non destructive method, has been demonstrated in the last decade.

2. DATA AND METHODS

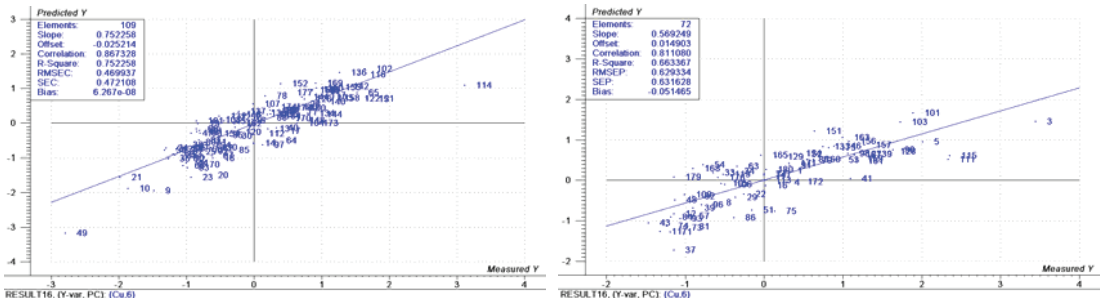
Hyperspectral data offers a powerful tool for predicting soil heavy metal contamination due to its high spectral resolution and many continuous bands. However, band selection is the prerequisite to invert and predict soil heavy metal concentration by hyperspectral data.

In this study, 181 soil samples were collected from the suburb of Nanjing City, and their reflectance spectra and Cu concentrations were measured in the laboratory. Based on these dataset, band selection was conducted to invert Cu concentration using

stepwise regression approach, and prediction accuracies of Cu by partial least-squares regression (PLSR) model with different selected bands were analyzed. In addition, the influences of spectral resolution on prediction results of Cu were discussed by using a Gaussian re-sampling function.

3. RESULTS AND DISCUSSION

It demonstrated that the optimal band number was 10 for Cu inversion and the corresponding model prediction accuracy was R^2 of 0.7523 and RMSE of 0.4699. The optimal spectral resolution was 32nm and the corresponding model had an accuracy of R^2 =0.7028 and RMSE =0.5147. Results of this paper may provide scientific verification for designing low-cost and practical hyperspectral spaceborne sensors and provide theoretical bases for simulating spaceborne sensors to predict soil heavy metals concentration in the future.



(a) Training result (b) Validation result

Fig.1 Correlation between Inverted and Measured Soil Cu Concentrations by PLSR Model

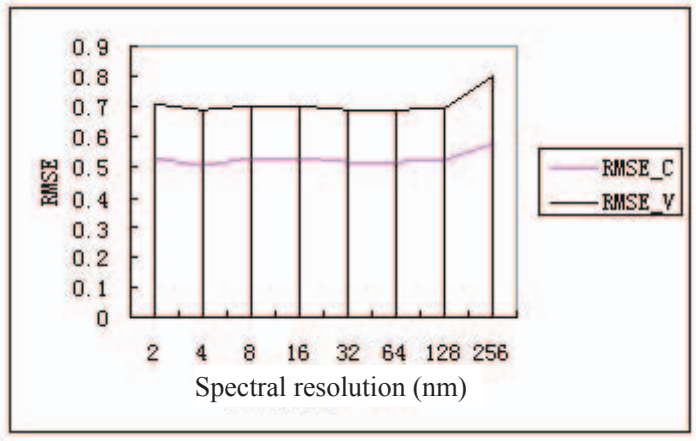


Fig.2 The performance of PLSR model using different spectral resolutions

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