A weighable Lysimeter for studying evaporation from paved urban soils

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Abstract:

Heavy metals had been brought from over-exploited mines into environment. These pollutants require special attention in the ecosystem due to their toxicity and persistence in environment. This concept is particularly important for the soil-crop system in the agricultural region beside mines because vegetation is subject to heavy metal stress in the soils and these pollutants transported into rice or other grain would pose a serious health risk to human beings through food chains. In this way, it will be necessary to identify and quantify heavy metal contamination in the soils, vegetations and grains by means of environmental monitoring methods. As a comfortable, convenient and efficient technology for environmental monitoring, remote sensing has been widely used to monitor environment contamination. Objectives of this study is 1) to explore the feasibility of laboratory and field spectroscopy in measuring heavy metal concentration (HMC) in soil, paddy plant, and paddy rice by using of laboratory spectroscopy and field spectroscopy, 2) to predict HMC in paddy plants via field spectral data with some wavebands simulated to Charge Coupled Device (CCD) of Chinese Brazil Earth Resource Satellite (CBERS).

Before paddy plants being transplanted, soil samples were taken from croplands in a little valley nearby a historic heavy metal mine. Paddy plants were also gathered here after canopy spectra were measured by multispectral radiometer (Cropscan, Cropscan Co. USA) at the tillering stage and then paddy rice were collected while they are ripe. Hyperspectral radiometer (ASD Fieldspec, ASD. Ltd., USA) was used to acquire spectra of both soil and rice screened by 0.25 mm mesh. In virtue of partial least square regression (PLSR) coupled with preprocessing methods like baseline correction (B), first derivative (FD), and standard normalized variate (SNV), some PLSR models were built for predicting Copper (Cu), Arsenic (As) and Iron (Fe) concentrations in soils with a root mean square error (RMSE) of 14.72 mg/kg, 28.74 mg/kg and 3.06 mg/kg as well as principal components of 1, 1 and 9 respectively. However, PLSR models for predicting Plumbum (Pb) as well as Zinc (Zn) cannot be well built because their concentrations vary hugely together with limited samples. Due to root system and stalk holding the majority of heavy metal, only Cu and Pb in rice are well respectively predicted by MSC-PLSR models with RMSE of 0.10 mg/kg, 0.15 mg/kg as well as R2 of 0.29 and 0.49. Furthermore, PLSR models based on raw canopy spectra gathered by Cropscan were built for predicting Cu, As, Pb and Zn in the canopy leaves with RMSE of 1.87 mg/kg, 0.06mg/kg, 5.94 mg/kg and 3.59 mg/kg respectively. According to the CCD waveband configuration of CBERS, meanwhile, some multispectral wavebands were simulated and used in PLSR models for HMC in the leaves like Cu, As, Pb and Zn with RMSE of 1.92 mg/kg, 0.09 mg/kg, 7.36 mg/kg and 4.39 mg/kg. It is a profitable approach to apply multispectral sensors widely carried on present satellites to monitor heavy metal contamination in vegetation, though the prediction is not as good as raw field canopy spectra.

Keywords: heavy metal contamination, soil-paddy plant-rice, mining, remote sensing
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