IMPROVEMENT OF SOIL PARAMETER INVERSION RESULTS OF LS AND S BAND POLARIMETRIC IMAGES FROM EMSL DATA

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ABSTRACT

In this paper we employ the fully polarimetric scatterometer data of rough dielectric surface, which was obtained at the European Microwave Signature Laboratory, for soil parameter inversion. The inversion results of three bands (L, Ls, S) images are analysed, and those of Ls and S band are obviously improved through revising the screening condition of the inversion models according to polarimetric scattering properties. The usually used screening condition is that the cross-polarized ratio smaller than -11dB , however, this value was proposed based on L band data. Experiments in this study show that the estimation of the soil parameters using Ls and S band images is consistant with the ground truth measurement by modifying the screening value of cross-polarized ratio.

The experiments NVT03-06-10 at EMSL were proposed with the aim to validate scattering models by generating a set of experimental data on different types of rough surfaces with known geometrical and dielectric properties.[1] The measurements were realized in a controllable environment and well calibrated. In the experiments, the scattering matrix of the surface was measured in monostatic mode vs. frequency (1-19GHz) and incident angles (10° -50°). So it is possible to make use of this data set to analyze soil parameter inversion models.

The most used inversion models for bare soil are the empirical model proposed by Oh and Dubois *et al*.[2-3]. Before using these models, one condition are usually considered to find out those areas where the models can be applied. The research of Dubois *et al*. shows that the L band cross-polarized ratio of -11dB (0.0793282) is a good descriptor to discriminate non vegetated terrains from vegetated ones. Then the cross-polarized ratio is often used as the screening condition of soil inversion models, even in the case of other bands.

During the experimental analysis, we firstly apply Circular SAR wave number algorithm to NVT03 data to obtain fully polarimetric images of L, Ls, and S band, with bandwidth of about 500MHz.[4] Secondly the inversion technique is performed according to the theory of Oh model using the obtained images. Then, we compare the ground truth measurement with the experimental results at the incidence angle of 40 degree in Table Ⅰ. The mean values of the estimated root mean square height and moisture are written down. It is obvious that only L band results are very close to the truth values.

The approach we proposed is to adjust the screening value for different frequencies. From the polarimetry perspective, HV channel corresponds to the vegetation scattering. For higher frequency, less vegetation can be observed. Thus, the division value between vegetation and non vegetation areas should probably be increased as the observing frequency is increasing. We obtain the value of 0.0943282 and 0.1053282 for Ls and S band respectively through amount of experiments. Again the inversion results based on model are written in Table Ⅰ for comparison with those results we got before. It is clear that the retrieved parameter values after adjustment are much closer than the original ones.

We presented an experimental method to improve the soil parameter inversion results of Ls and S band images obtained from EMSL data. The accuracy is increased a lot through adjusting the screening condition. More experimental analysis and investigation is necessary to find out the theoretical basis as well as the accurate value of cross-polarized ratio under the condition of other bands. In addition, this approach should also be applied to other data sets to see if it is generally effective, especially for those soil areas covered by sparse vegetation.

Index Terms—EMSL data, polarimetric image, bare soil, inversion model, Ls band, S band

Table Ⅰ Soil parameter inversion results of different bands at the incidence angle of 40 degree

	L band		Ls band		S band	
ground truth	rms height (cm)	moisture (%)	rms height (cm)	moisture (%)	rms height (cm)	moisture (%)
	2.5	16.6346	2.5	16.2242	2.5	14.9720
before adjustment	2.495	15.3763	2.2598	13.6895	1.7721	11.4525
after adjustment	--	--	2.5448	15.7149	2.2557	16.1959

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