Wageningen University dissertation no. 2878

Abstract

Title: Estimation of areal soil water content through microwave remote sensing
Author: ir. P.J. van Oevelen
Date: 1 november 2000

In this thesis the use of microwave remote sensing to estimate soil water content is investigated. A general framework is described which is applicable to both passive and active microwave remote sensing of soil water content. The various steps necessary to estimate areal soil water content are discussed through literature review, laboratory experimental results and results of extensive field experimental work. Even with the large amount of field data being available, no experiment provided all the necessary data to illustrate the framework completely for both passive and active techniques.

The framework developed is intended to be independent of the models used. In this way insight is gained in the dominating factors and problems associated with the use of remote sensing and not with specific models. Throughout the thesis both passive and active techniques are used and compared.

The passive techniques, mainly L-band and C-band, show better results that are more easily obtained at the cost of a relatively low spatial resolution. The standard error in the remotely sensed soil moisture estimates (< 5%) even in the presence of low to moderate vegetation cover is often lower than that of the ground truth measurements. The launch of a space-borne L-band radiometer will make this technique useful for mesoscale and global scale hydrological and meteorological modeling.

The active techniques are severely tampered by vegetation and surface roughness effects making soil water content estimation more cumbersome. Despite these drawbacks this technique is complimentary to the passive technique because of the higher attainable spatial resolutions and the possible use of longer wave lengths (P-band). The latter enables estimation of soil water content under vegetation cover and over larger depths, about 30 cm for P-band, compared to for example about 5-10 cm depth for L-band. The standard error of soil moisture estimates in absence of vegetation is in general around 5%.

In this thesis the effects of vegetation have been excluded in the analysis. To operationalise remotely sensed soil moisture estimation it will be necessary to develop methods that can estimate soil water content when vegetation is present. Especially for active and space-borne passive techniques.

Direct comparison between a passive L-band radiometer and an active C-band radar showed consistent results over stationary heterogeneous areas, i.e. low vegetation cover and relatively homogeneous surface roughness characteristics.

The estimation of soil water content needs to be done from the perspective of the objective. This means that in the case of hydrological and meteorological modeling *assimilation of direct remotely sensed measurements such as brightness temperatures or backscattering coefficients can yield better results, e.g. better forecast, than incorporation of the remotely sensed soil water content*. This depends strongly on the land surface parameterization and in particular the definition of soil water content in the models used.