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REMOTE SENSING OF SOIL MOISTURE OVER BARE AND VEGETATED FIELDS BY MICROWAVE RADIOMETERS

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Remote measurements of soil moisture contents over bare fields and fields covered with grass and soybeans were made during October 1979 with 1.4 GHz and 5 GHz microwave radiometers mounted on a mobile truck. The radiometric measurements of microwave brightness temperature T_B, covered the range of incidence angles from 10° to 70° in 10° steps. The system operation was controlled by a Hewlett Packard 9835 minicomputer which also provided real-time and post-measurement data processing. Ground truth on soil moisture content, ambient air and soil temperatures was acquired concurrently with the radiometric measurements. The biomass of the vegetation was sampled about once a week. All the fields in the test site were smooth. There were two types of grasslands, one covered with 8-cm high grass and the other with 30-cm grass. The soybeans were fully grown with a height of ~60-cm during the time of measurements.

The values of T_B for the bare field measurements were compared with those of radiative transfer model calculations using as inputs the acquired soil moisture and temperature data with appropriate values of dielectric constants for soil-water mixtures. A good agreement was found between the calculated and the measured results. Similar calculations were performed for the vegetated fields treating the canopy as a pure absorbing and emitting medium. The results showed: 1) the presence of vegetation reduces the sensitivity of soil moisture sensing by ~30% at 1.4 GHz and by ~90% at 5 GHz even for the 8-cm grassland; 2) the imaginary part of the dielectric constant for vegetation containing water at 1.4 GHz and 5 GHz is comparable. More elaborate calculations taking into account the microwave scattering by vegetation are now being performed and the progress will be discussed.

MULTITEMPORAL AND MULTISPECTRAL REMOTE SENSING OF SOILS IN CULTURED LANDSCAPES OF NORTH GERMANY

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Different techniques have been tested since 1974 to meet the difficult task of soil remote sensing in intensively cultured and small-parcelled landscapes of North Germany.

Conventional stereo - interpretation of physiographic elements and patterns of landscapes by pan, color and infrared air photographs lowers the necessary number of soil borings and the cost of survey appreciably as well as increasing the information content and accuracy of soil maps. Especially, man-induced soil erosion and accumulation of hilly young moraines, position of sand dunes and old river beds on outwash terraces and appearance of periglacial polygon soils on flattened old moraines, only partly or not detectable in the field, were made visible with remote sensing.

To increase the information content of remote sensing data and make interpretation more reproducible the multispectral remission was measured by an 11-channel-scanner. These data were calibrated by spectral photometry of soil samples within the wavelength range of 250 - 1400 nm to estimate by multiple regression analysis soil components, especially organic matter, free iron and clay.

Additional information was achieved by measuring three times a day the multitemporal thermal emission with the scanner in autumn and spring of test areas. The data were interpreted by experiments in the field and laboratory, which measured the heat balance of soils in relation to external factors and the soil moisture regime.

SOIL TAXOMETRICS: RESULTS FROM A WEST-GERMAN DATA BANK

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The terms of general soil classification systems serve within soil information systems not only as main criteria for storing and cross referencing data. The classes or taxons of soil classification may also be checked and improved by taxometric evaluations on data of the information system itself.

By means of a soil data bank of about 2000 profiles and 10,000 horizons, which were collected from West-German institutions of soil survey, results were evaluated by various taxometric methods. Examples are presented for the following topics:

-- quantitative description of the total varability of single soil attributes, including transformation problems,

-- detection and estimation of error variation caused by data transfer, sampling and measurement within and between survey institutions,

-- geno- and morphometrics on the depth function problems of soils,

-- correction of taxon differentia by uni- and multivariate analyses of discrimination and relocation.

USING SOIL COLOR/REFLECTANCE IN PREDICTING SOIL PROPERTIES

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Correlations of soil components, value and chroma with selected soil physical and chemical properties from 563 surface soil samples from the Great Plains area, USA revealed that clay, organic carbon, cation exchange capacity and water held at 1/3 and 15 bars were most highly correlated. Regression correlations based on these soil color components were developed to estimate many soil properties.

Surface soil samples from two study sites located in Boone County, Missouri, USA were measured by a laboratory spectral meter. These measurements showed that soil physical and chemical properties could be predicted from reflectance measurements especially in the near infrared region. A Landsat image taken over the same study sites during Spring, 1977 showed that soil reflectance could be used to assist the soil scientist in locating soil boundaries especially when there were contrasts in texture, organic matter or moisture capacity.