Fact Sheet

REMOTE SENSING OF SOIL MOISTURE

PROBLEM

- The determination of soil moisture content, on a real-time basis, is essential for input into flood forecasting models. These data are used for water control, flood warnings, emergency management, etc.
- How well does the American Society for Testing Materials (ASTM) soil moisture method compare to the soil moisture probe method for field acquisition of soil moisture content?

SOLUTION

In support of the Remote Sensing/Geographic Information System Center's (RS/GISC) Image Processing Laboratory effort to assess the SIR-C/X sensor's ability to remotely monitor changes in soil moisture, a commercially available soil moisture probe and standard ASTM soil moisture/density sample acquisition and analysis techniques were used to provide soil moisture ground truth. The SIR-C/X system was flown over the test site in early October 1994 to compare soil moisture data acquired with the commercially available soil moisture probe and the ASTM soil moisture collection procedure. The commercial probe provides a volumetric soil moisture content and performs high-frequency electrical measurements of the capacitive and conductive properties of soil. These properties are directly related to the soil's moisture and salinity content.

A landfill near Concord, New Hampshire, which was in the process of being capped to an average depth of three feet with sieved, compacted, medium-sized sand, was selected as a test site. The sand fill did not contain vegetation or organic material. Over four consecutive days, a total of 824 soil moisture measurements were made on a 30- × 30-meter grid (total area = 240 m × 210 m) using the commercial probe. Numerous 10- × 10-meter-grid soil moisture subsamples were also acquired to define the spatial variability of soil moisture within the 30-meter grid cells. More than 1200 insertions into the soil were made without damage to the probe. Soil moisture content data were taken at depths of 0 inches (surface), 6–12 inches, and 18–24 inches. A hand-operated core sampler was used to extract these soil samples.

The correlation between the physical samples and the soil moisture probe was 0.75, with root mean square error of 2.5%. Used without a site-specific calibration, the probe accuracy is ±2.0% by volume. Comparing the data point outliers with on-site conditions, it is fairly certain that in areas where seepage was observed, chemical contamination of the probe data occurred, and so the correlation was artificially low and the error factor artificially high.

RESULTS

This type of commercially available soil moisture probe is ideally suited for on-site, repetitive soil moisture determinations and remote, long-term installations. Data collection can be recorded on a data logger, transmitted in real time, or set up to be queried. Greater accuracy could be achieved if the probe were installed in less permeable soils, because the spatial variability of moisture content should be lower than that found in the sieved sands at the Concord landfill.

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