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MICROWAVE REMOTE SENSING OF SOIL MOISTURE

by

J. C. Shiue and J. R. Wang (675)

Knowledge of soil moisture is important to many disciplines, such as agriculture, hydrology, and meteorology. Soil moisture distribution of vast regions can be measured efficiently only with remote sensing techniques from airborne or satellite platforms.

At low microwave frequencies, water has a much larger dielectric constant than dry soil. This difference manifests itself in surface emissivity (or reflectivity) change between dry and wet soils, and can be measured by a microwave radiometer or radar.

The Microwave Sensors and Data Communications Branch is developing microwave remote sensing techniques using both radar and radiometry, but primarily with microwave radiometry. Our efforts in these areas range from developing algorithms for data interpretation to conducting feasibility studies for space systems, with a primary goal of developing a microwave radiometer for soil moisture measurement from satellites, such as Eos or the Space Station. A proposal to develop a synthetic aperture radiometer for soil moisture observation from Eos polar platform is being prepared from our group. (See separate element under ESTAR by D. Levine)

We started in soil moisture research by making truck-based measurements of emissivities of bare and vegetation covered agricultural fields to establish the basic algorithms for data interpretation. We studied the synergistic aspects of soil moistures as measured by both an L-band microwave radiometer (LBMR) and an L-band synthetic aperture radar (SAR) from the Space Shuttle. We also conducted airborne experiments of soil moisture with an LBMR in the Eastern Shore of Maryland, western high plains of Texas, and southern France (HAPEX)*. We studied (in cooperation with Hughes Aircraft and G.E.) the feasibility of building an LBMR with a 10 meter real-aperture, electronically scanning array.

In 1987, we participated in the FIFE** remote sensing experiment over the Konza Prairie in Kansas, and made a time series measurement of the area's soil moisture changes with an LBMR from aboard the NASA C-130. We are processing and analyzing the data from the flight experiments. Figures 1 and 2 are some preliminary results from the FIFE flights. Figure 1 is a comparison between soil moistures retrieved from the airborne LBMR to soil moistures obtained from direct in-situ probes. This figure establishes that, except for a small bias, the retrieved soil moisture correlates very well with the ground truth, showing the maturity of this observation technique. The real power of this technique is in its ability to map areal distribution of soil moisture. Figure 2 shows soil moisture contours of a small water shed, about 1 km by 1.5 km in size. The data represent a saturated soil moisture condition, shortly after a storm.

We will be back to flying over the Konza Prairie again in 1988 to study the change in emissivity of the area, after some part of the Konza's grassland is burned as a part of the special research treatment. During May of 1988, J. R. Wang will be participating in an aircraft experiment to study the use of synthetic aperture radars to measure soil moisture and vegetation of agricultural fields in the San Juanquin Valley of California.

*	: HAPEX	=	Hydrologic and Atmospheric Pilot Experiment
**	: FIFE	=	First ISCLSCP*** Field Experiment
***	: ISCLSCP	=	International Satellite Land Surface Climatology Program

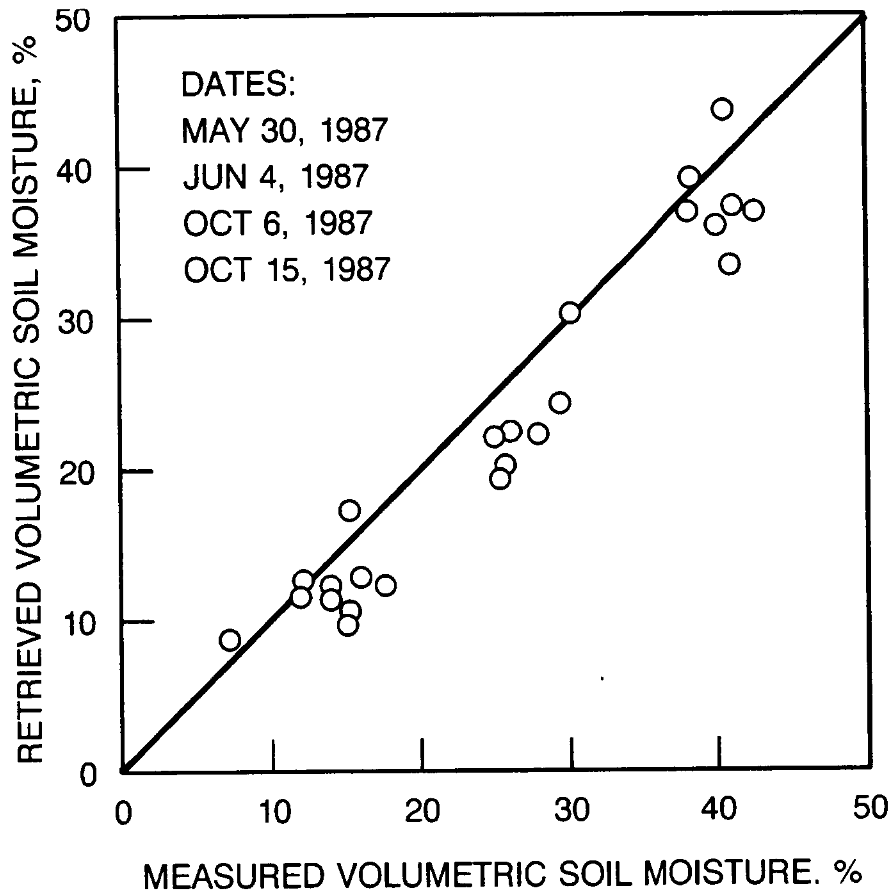
DATES:
MAY 30, 1987
JUN 4, 1987
OCT 6, 1987
OCT 15, 1987
RETRIEVED VOLUMETRIC SOIL MOISTURE, %
MEASURED VOLUMETRIC SOIL MOISTURE. %
0
10
20
30
40
50

Figure 1.

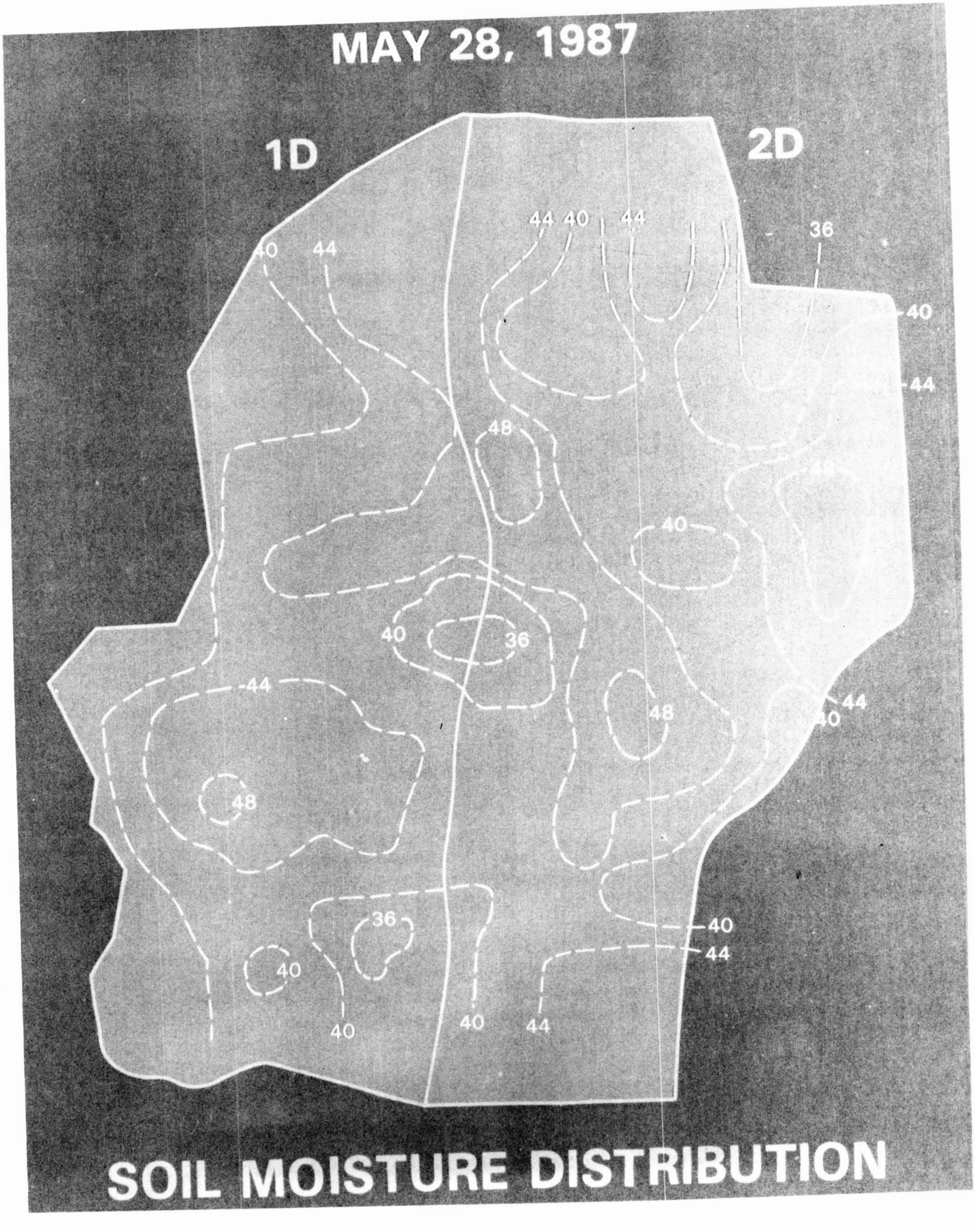

Figure 2.

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