

CHAPTER VII. GROUND MEASUREMENTS OF SURFACE SOIL MOISTURE

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A. OBJECTIVES

The primary purpose for collecting ground observations of surface soil moisture was to provide calibration and verification data for the microwave remote sensing instruments. Sites were selected in an attempt to include a representative sampling of the various soil textures and land cover conditions. In addition, it was desirable to have these sites spatially distributed over the study area (in case of spatially distributed rainfall events) and also to have some clustered for radar analysis.

B. SAMPLING SCHEMES

For most of the sites, the primary goal was to determine the field average soil moisture. Data were not geolocated to an accuracy suitable for point by point comparisons. It was intended that the average of all samples from a site be compared to the average of the microwave data. Within each field, data were collected on a grid basis with a sample every 100 m (typically 14 samples per site). Some of the sites had unusual geometry that required some modifications. In all cases, the original data notebooks contain diagrams for each site and date.

Other sites were sampled for transect analyses. In these fields, the samples were collected along a line or transect perpendicular to the main drainage. These values should be averaged with caution because there were definite biases in their locations.

C. SAMPLING PROCEDURE

A gravimetric soil moisture sample was collected using a specially designed scoop that extracts a 5 cm cube. This sample is then placed in a metal can and sealed. The can number is then recorded on a schematic map of the site showing its approximate location. In addition, several fields were also sampled for the 1 cm soil moisture.

These gravimetric samples were then weighed at the ARS lab to obtain a wet weight. All samples were then dried for 24 hours and weighed again to obtain a dry weight. The gravimetric soil moisture was then computed by dividing the difference between the wet and dry weight by the dry weight less the can tare.

D. RESULTS

Table VII-1 through VII-3 summarize the site average soil moisture for each of the three experimental periods. These values are volumetric soil moisture computed by multiplying the gravimetric soil moisture by the soil bulk density (see Table III-1).

E. SOIL TEMPERATURE SAMPLING

Soil temperatures were collected at depths of 5 cm and 15 cm using a metal dial type thermometers as well as digital probes. This was done only when there was a C-130 flight (April only) and only in selected fields. Soil moisture was collected at each gravimetric sampling location. All of the observations were recorded in field notebooks, averages are listed in Table VII-7.

Table VII-1. April, 1994 Volumetric Surface Soil Moisture Averages

April Day	6	7	7	9	10	11	12	12	13	13	14	14	15	15	16	17	18	
Hour	11	10	15	16	12	13	10	15	10	15	10	15	11	15	14	12	10	
Site	Depth																	
11		0.073	0.083	0.076	0.084	0.095	0.246	0.242	0.202	0.193	0.201	0.164	0.134	0.132		0.109	0.088	0.104
12	1	0.035	0.062	0.045	0.033		0.281	0.213	0.116	0.101	0.021	0.058		0.035				
12	5	0.115	0.12	0.111	0.125	0.109	0.251	0.184	0.159	0.145	0.122	0.126	0.1	0.099		0.101	0.091	0.112
13		0.084	0.087	0.078	0.092		0.268	0.247	0.247	0.22	0.185	0.177	0.155	0.143		0.114	0.118	0.061
14		0.169	0.193	0.175	0.182	0.171	0.253	0.232	0.239	0.241		0.24		0.21		0.193	0.199	
15						0.111	0.27	0.248	0.2	0.2	0.16	0.152	0.124	0.125		0.107	0.09	
21		0.074	0.055	0.061	0.06		0.148											
22		0.105	0.078	0.063	0.069		0.197											
23		0.087	0.108	0.096	0.104	0.121	0.228	0.186		0.127		0.136		0.108		0.129	0.08	
31		0.093	0.098	0.076	0.064		0.292											
32		0.098	0.079	0.111	0.118		0.328											
33		0.067	0.066	0.067	0.045		0.284	0.264		0.215		0.199		0.154		0.117	0.106	
34		0.173	0.139	0.14	0.116	0.139	0.23	0.224		0.227		0.2		0.191		0.181	0.162	
51																		
52																		
53		0.053	0.05	0.054	0.048	0.065	0.151	0.127		0.109		0.095		0.079		0.062	0.066	
54		0.283	0.331	0.243	0.276	0.244	0.289	0.29		0.311		0.329		0.245		0.266	0.25	
55								0.314		0.285		0.292		0.199		0.231		
62				0.061	0.061		0.248	0.226			0.141		0.132		0.111	0.099		
71	1								0.104	0.064	0.044	0.047	0.024	0.036	0.019	0.028		
71	5						0.192		0.142	0.113	0.108	0.097	0.071	0.075	0.053	0.053	0.041	0.03

Table VII-2. April, 1994 Volumetric Surface Soil Moisture Standard Deviations

April Day	6	7	7	9	10	11	12	12	13	13	14	14	15	15	16	17	18	
Hour	11	10	15	16	12	13	10	15	10	15	10	15	11	15	14	12	10	
Site	Depth																	
11		0.032	0.033	0.029	0.030	0.015	0.082	0.063	0.058	0.057	0.069	0.046	0.054	0.053		0.058	0.041	0.035
12	1	0.026	0.035	0.024	0.032		0.039	0.056	0.060	0.045	0.017	0.033		0.026				
12	5	0.064	0.048	0.046	0.060	0.035	0.048	0.060	0.045	0.051	0.045	0.054	0.044	0.046		0.049	0.046	0.022
13		0.044	0.062	0.056	0.066		0.029	0.023	0.032	0.031	0.072	0.032	0.041	0.036		0.048	0.033	0.018
14		0.051	0.062	0.056	0.054	0.050	0.033	0.026	0.048	0.047		0.057		0.061		0.046	0.047	
15						0.038	0.044	0.045	0.040	0.034	0.027	0.025	0.023	0.028		0.029	0.030	
21		0.062	0.039	0.054	0.056		0.066											
22		0.651	0.068	0.045	0.061		0.068											
23		0.065	0.084	0.080	0.088	0.091	0.055	0.067		0.048		0.071		0.055		0.100	0.061	
31		0.058	0.044	0.017	0.014		0.044											
32		0.043	0.030	0.057	0.070		0.040											
33		0.036	0.024	0.023	0.044		0.067	0.052		0.058		0.033		0.046		0.036	0.045	
34		0.048	0.048	0.043	0.046	0.036	0.048	0.021		0.055		0.027		0.029		0.041	0.029	
51		0.000	0.000	0.000		0.000	0.000					0.000						
52		0.000	0.000	0.000		0.000	0.000					0.000						
53		0.058	0.057	0.059	0.053	0.061	0.044	0.042		0.042		0.051		0.036		0.043	0.043	
54		0.327	0.373	0.276	0.303	0.252	0.234	0.286		0.296		0.310		0.203		0.321	0.271	
55												0.200		0.192		0.253		
62				0.021	0.037		0.070	0.034			0.024		0.033		0.037	0.045		
71	1										0.028	0.015	0.015	0.019	0.011	0.017		
71	5										0.018	0.016	0.021	0.026	0.015	0.027	0.017	0.015

Table VII-3. August, 1994 Volumetric Surface Soil Moisture Averages.

Site	Depth (cm)	August Day				
		18	19	29	21	22
11	5		0.201	0.183		
12	5		0.218	0.189		
13	1		0.181	0.173		
13	5		0.169	0.155		
14	5	0.158	0.191	0.155	0.145	0.101
15	1		0.243	0.209		
15	5		0.237	0.210		
23	5		0.117	0.142		
33	5	0.074	0.084	0.087	0.057	0.053
34	5	0.174			0.107	0.077
72	5	0.102	0.071	0.054	0.027	0.025

Table VII-4. August, 1994 Volumetric Surface Soil Moisture Standard Deviations.

Site	Depth (cm)	August Day				
		18	19	20	21	22
11	5		0.054	0.054		
12	5		0.054	0.060		
13	1		0.067	0.047		
13	5		0.040	0.034		
14	5	0.023	0.033	0.038	0.039	0.013
15	1		0.103	0.086		
15	5		0.070	0.057		
23	5		0.046	0.035		
33	5	0.023	0.018	0.026	0.006	0.013
34	5	0.020			0.021	0.021
72	5	.009	.011	.013	.006	.003

Table VII-5. October, 1994 Volumetric Surface Soil Moisture Averages.

October Day		1	2	3	4	4	5	5	6	6
Hour					am	pm	am	pm	am	pm
Site	Depth									
11		0.110	0.093	0.073	0.069		0.168	0.143	0.094	0.082
12	1						0.114	0.085	0.048	0.037
12	5	0.144	0.075	0.062	0.062	0.074	0.149	0.104	0.083	0.080
13	1							0.039		
13	5	0.055	0.049	0.030	0.050	0.052	0.078	0.055	0.050	
14			0.119	0.123	0.110		0.116		0.097	
15		0.089	0.087	0.083	0.069		0.223	0.181	0.179	0.135
22			0.052	0.031	0.033		0.041		0.030	
23		0.059	0.064	0.042	0.040		0.120		0.086	
33		0.056	0.044	0.061	0.160	0.132	0.123		0.098	0.071
34		0.063	0.066	0.067	0.108	0.106	0.085		0.086	
51										
52										
53		0.043	0.047	0.060	0.056		0.039		0.033	
54										
56										
62		0.087	0.102	0.093	0.078		0.230	0.195	0.185	

Table VII-6. October, 1994 Volumetric Surface Soil Moisture Standard Deviations.

October Day		1	2	3	4	4	5	5	6	6
Hour					am	pm	am	pm	am	pm
Site	Depth									
11		0.035	0.035	0.025	0.034		0.039	0.055	0.035	0.034
12	1						0.049	0.045	0.039	0.034
12	5	0.078	0.041	0.040	0.024	0.022	0.042	0.047	0.048	0.041
13	1							0.012		
13	5	0.024	0.021	0.009	0.025	0.019	0.020	0.021	0.018	
14			0.033	0.045	0.035		0.052		0.036	
15		0.036	0.037	0.028	0.023		0.029	0.063	0.044	0.020
22			0.036	0.018	0.019		0.034		0.016	
23		0.034	0.026	0.023	0.020		0.047		0.038	
33		0.039	0.025	0.019	0.016	0.016	0.017		0.021	0.018
34		0.017	0.017	0.022	0.017	0.016	0.016		0.018	
51										
52										
53		0.016	0.013	0.022	0.026		0.015		0.014	
54										
56										
62		0.039	0.034	0.027	0.025		0.049	0.037	0.034	

Table VII-7. April, 1994 Soil Temperature (Deg. C) Averages

Day	April 6		April 7 am		April 7 pm		April 9		April 11	
Depth	5 cm	15 cm	5 cm	15 cm	5 cm	15 cm	5 cm	15 cm	5 cm	15 cm
Site										
11			15	11	15	13			15	16
12			16	10	16	14			16	16
13				9		17			16	16
14	9	7	6	7	13	11	16	14	12	11
21	13	9	13	10	15	12	20	15	14	12
22	17	10	16	12	19	14	24	17	14	13
23	14	10	13	11	19	14	22	17	13	12
31	21	14	11	9	23	17	27	22	15	15
32	17	11	10	9	19	14	25	20	14	14
33	14	9	10	9	20	15	27	22	15	14
53	16	11	13	10	23	17	30	23		
54	12	10	8	10	20	15	25	19		