(E79-10270) MEASUREMENT OF SOIL MOISTURE TRENDS WITH AIRBORNE SCATTEROMETERS Progress Report, 1 Jun. 1978 - 1 Jun. 1979 (Texas A&M Univ.) 15 p HC A02/MF A01 CSCL 08M G3/43

N79-31728

Unclas
00270

MEASUREMENT OF SOIL MOISTURE TRENDS WITH AIRBORNE SCATTEROMETERS

Principal Investigator
Bruce J. Blanchard

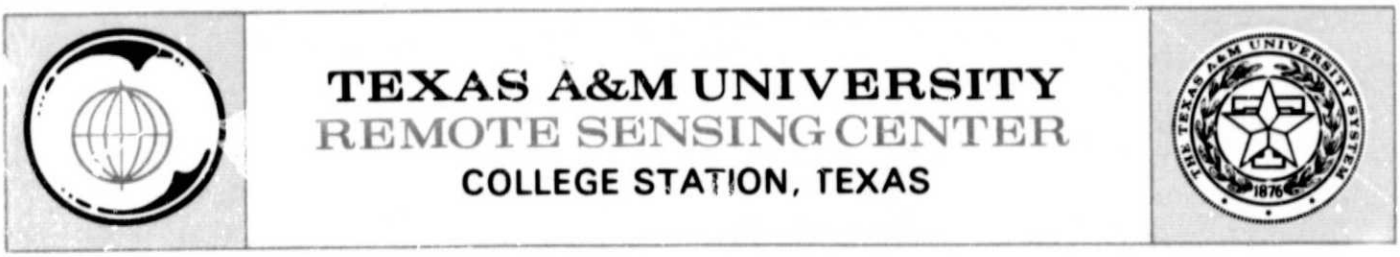
Remote Sensing Center
Texas A&M University
College Station, Texas 77843

Progress Report for Period
June 1, 1978 to June 1, 1979

Prepared for

Goddard Space Flight Center
Greenbelt, Maryland 20771

Grant No. NSG 5134



Progress Report RSC 3458-3

MEASUREMENT OF SOIL MOISTURE TRENDS WITH AIRBORNE SCATTEROMETERS

Principal Investigator
Bruce J. Blanchard

Remote Sensing Center
Texas A&M University
College Station, Texas 77843

Progress Report for Period
June 1, 1978 to June 1, 1979

Prepared for

Goddard Space Flight Center
Greenbelt, Maryland 20771

Grant No. NSG 5134

MEASUREMENT OF SOIL MOISTURE TRENDS WITH AIRBORNE SCATTEROMETERS

INTRODUCTION

This study was initiated to define the capability of active microwave systems for measurement of soil moisture trends in bare ground fields. In the current year of the study the objective was expanded to include use of multi-spectral systems for estimation of soil moisture in well controlled sample fields. In addition the data collected will be used in support of validation of the Seasat SAR system by defining the ability of that system to detect soil moisture differences.

Initially a set of six fields were selected in the Brazos River Valley where field roughness and vegetation could be controlled while repeated aircraft flights were made over the fields. The previous progress report on this study defines the details of this effort. The scatterometer data as reported in previous progress report has since been questioned and will be further discussed in this report.

The expansion of effort to a site that would be appropriate for validation of the Seasat SAR required selection of an experiment location near Guymon, Oklahoma. An extensive set of ground data was collected at that site and has been summarized and reported in the Final Report on Contract No. NAS 5-25144. Aircraft data over the fields in the Guymon site

were collected during six flights made at three day intervals and staged at mid-morning hours to coincide with orbital times of the Seasat SAR. Due to lack of orbital control of the Seasat vehicle only one Seasat SAR pass was available over the Guymon site during this experiment. Additional passes of the Seasat SAR are however available from another experiment site in Kansas conducted at a later date when aircraft coverage was not available.

DATA SOURCES AND PROCESSING

Site Selection and Preparation

A thorough discussion of the site selection, layout of sample fields and collection of ground samples for the Brazos Valley site can be found in a prior report (RSC 3458-2) presented June 1, 1978. For clarification a brief description is given here. The site consisted of six square fields that were approximately 3.50 meters across in either direction. Three fields were located on each of two flight lines. Each field was disked with the same implement in order that roughness would be constant throughout the six sample fields. Arrangements were made with the owner to leave the fields in the same condition for a two month period. Some minor smoothing of the micro roughness occurred as a result of rainfall on the bare soil during the experiment period.

Site selection and data collection on the ground at the Guymon site has been described in Final Report RSC 3829

(April 1, 1979) for Contract No. NAS 5-25144. At the Guymon site eight bare ground fields were selected on four flight lines. Two fields from this group were irrigated during the experiment period. Additional fields with alfalfa and Milo crops growing were also sampled at this site. Six sets of soil moisture samples were collected at three day intervals in each field. Aircraft flights were made on August 2, 1978, and every third day thereafter until August 17. Four bare ground primary fields including the two that were irrigated were intensively sampled at the time of the aircraft flights.

In general terms the ground sampling at the Guymon site provided more accurate estimates of soil moisture than sampling for any previous experiment. Sampling at three day intervals or more frequently with a time series of three or more sets of samples allows the investigator to locate sampling errors. Unusual care was taken at this site to train the personnel and insure that the same people collected samples at specific locations throughout the experiment. Only one sample field was sampled on alternate days by two teams. Differences in sampling technique were readily detected between the two teams in that field. Numerous errors in marking samples were detected in other fields by plotting time series of the soil moisture for each depth at each sample point.

Scatterometer Data Processing

Scatterometer data consisting of analog tapes containing data from the 13.3 GHz and 1.6 GHz systems were processed for

the Brazos river site. Seven sets of data were collected with six sets flown over bare soil and the final set flown in June of the following summer when the fields were vegetated. These data were initially digitized and processed in January of 1977 with the final June flight being processed in late summer. A major revision of the computer processing program began shortly after these data were first processed then these data were again processed in 1978. Results of the 1978 processing were reported in Progress Report RSC 3458-2. Immediately after the report was submitted it became evident that the computer programs being developed at the Remote Sensing Center and at the NASA-JSC failed to produce comparable results. Further revisions and study of the processing technique continued to May 15, 1979. Comparison of the processor performance between the TAMU-RSC system and the NASA-JSC system were based on flight lines over the Death Valley site. After agreement was reached on the Death Valley data an additional data line from Kansas was processed on both systems with comparable results. Upon agreement that the programs produced like results on that date, all scatterometer data for the two sites used in this study were again reprocessed.

The revised data are summarized in Tables 1, 2 and 3 in this report for the record. Plots of the data for the 13.3 GHz system and the like polarized (HH) 1.6 GHz system are not reproduced in this report as the results are similar to those

Table A1. 13.3 GHz-VV Scattering Coefficient (Tσ) at Each Angle on Each Date For Fields 1-6.

Date	Field No.	Volumetric H_2O Content	5°	10°	15°	20°	25°	35°	40°	45°
10-18-76	1	0.210	13.1	7.6	0.7	- 2.2	- 2.7	- 8.3	- 9.5	-10.3
10-20-76	1	0.310	15.6	9.1	2.0	- 1.7	- 3.9	- 6.6	- 9.8	- 9.2
10-22-76	1	0.250	13.3	6.8	- 0.1	- 1.9	- 3.6	-10.8	-10.1	-12.1
10-26-79	1	0.340	14.9	7.4	0.0	- 3.4	- 3.6	- 9.5	-10.9	-10.4
11-10-76	1	0.130	6.6	2.4	- 4.3	- 6.6	- 6.1	-13.3	-13.1	-14.0
11-12-76	1	0.090	10.4	3.3	- 3.2	- 7.0	- 8.8	-11.0	-14.9	-13.9
06-21-77	1	0.070	3.0	- 0.1	- 2.3	- 4.3	- 4.2	- 6.5	- 9.7	- 9.6
10-18-76	2	0.250	15.7	8.3	0.9	- 2.2	- 2.0	- 8.0	-10.3	- 9.8
10-20-76	2	0.310	17.8	8.0	2.6	- 2.9	- 4.4	- 6.9	-10.2	-10.8
10-22-76	2	0.300	14.5	8.2	1.3	- 2.0	- 2.5	-10.3	- 9.9	-10.8
10-26-76	2	0.330	13.7	7.9	0.7	- 3.0	- 3.2	- 8.8	-10.2	-10.0
11-10-76	2	0.090	11.7	5.9	- 2.0	- 4.7	- 5.0	- 9.9	-13.6	-12.7
11-12-76	2	0.100	9.1	2.3	- 4.2	- 7.1	- 9.1	-12.1	-15.7	-15.3
06-21-77	2	0.060	1.9	- 0.7	- 1.4	- 4.3	- 4.5	- 5.6	- 9.3	- 8.7
10-18-76	3	0.190	16.3	8.6	1.7	- 3.2	- 3.9	- 8.4	-10.0	-10.2
10-20-76	3	0.290	17.5	7.3	2.1	- 2.1	- 4.0	- 7.8	-10.6	-10.7
10-22-76	3	0.260	15.5	9.3	0.7	- 2.4	- 3.8	-10.4	-10.3	-11.3
10-26-76	3	0.300	13.1	6.8	- 0.6	- 3.2	- 3.7	- 8.7	- 9.6	- 9.7
11-10-76	3	0.090	12.3	5.6	- 3.0	- 6.0	- 8.2	-13.1	-13.1	-13.8
11-12-76	3	0.090	10.5	3.0	- 3.7	- 7.1	- 8.5	-12.7	-16.0	-14.5
06-21-77	3	0.060	2.2	2.7	- 1.6	- 3.9	- 4.5	- 4.6	- 9.2	- 8.4

Table A1. (Continued)

Date	Field No.	Volumetric H_2O Content	5°	10°	15°	20°	25°	35°	40°	45°
10-18-76	4	0.070	8.9	4.5	- 1.9	- 5.4	- 5.4	-11.9	-11.7	-12.0
10-20-76	4	0.180	10.6	5.2	0.7	- 2.8	- 4.0	- 7.7	-11.4	-10.9
10-22-76	4	0.110	9.5	2.6	- 0.8	- 4.3	- 6.2	- 9.7	-12.4	-11.8
10-26-76	4	0.220	10.5	6.9	- 0.8	- 3.2	- 2.3	- 9.6	- 8.8	- 9.9
11-10-76	4	0.070	6.9	1.9	- 4.7	- 6.3	- 6.1	-11.2	-12.0	-12.3
11-12-76	4	0.080	6.6	1.3	- 2.8	- 5.0	- 7.1	- 9.6	-13.9	-13.5
06-21-77	4	0.240	0.8	- 0.2	- 2.2	- 3.9	- 3.7	- 5.1	- 7.3	- 5.7
10-18-76	5	0.070	7.6	2.5	- 2.0	- 5.8	- 7.1	-11.3	-11.5	-12.1
10-20-76	5	0.150	11.4	4.7	0.5	- 2.1	- 4.3	- 8.0	-12.2	-10.0
10-22-76	5	0.110	8.2	2.7	- 1.4	- 4.5	- 6.1	-10.0	-13.6	-11.9
10-26-76	5	0.200	9.6	5.8	- 0.2	- 3.1	- 2.6	- 9.1	- 9.6	-12.2
11-10-76	5	0.060	11.8	3.5	- 3.3	- 5.4	- 5.3	-11.0	-12.0	-13.4
11-12-76	5	0.080	9.3	2.5	- 1.4	- 5.9	- 8.0	- 9.8	-13.0	-13.6
06-21-77	5	0.170	0.9	- 0.3	- 1.5	- 3.5	- 3.4	- 5.5	- 7.1	- 6.7
10-18-76	6	0.100	8.6	3.3	- 2.5	- 5.7	- 5.6	-11.6	-11.8	-11.5
10-20-76	6	0.140	13.7	7.1	1.4	- 1.0	- 2.8	- 5.2	- 9.3	- 9.6
10-22-76	6	0.130	7.6	2.2	- 1.4	- 4.7	- 5.8	- 9.3	-11.7	-11.1
10-26-76	6	0.210	9.5	6.0	- 1.1	- 2.7	- 1.8	- 8.4	- 9.2	-10.3
11-10-76	6	0.080	8.2	3.6	- 3.0	- 5.4	- 5.4	-11.8	-12.5	-13.4
11-12-76	6	0.090	9.6	3.2	- 0.4	- 6.4	- 7.7	-10.2	-13.3	-12.8
06-21-77	6	0.180	- 0.8	0.3	- 2.2	- 2.8	- 4.0	- 4.4	- 8.4	- 7.0

Table A2. 1.6 GHz-HH Scattering Coefficient (Tσ) at Each Look Angle on Each Date For Fields 1-6.

Date	Field No.	Volumetric H_2O Content	5°	10°	15°	20°	25°	35°	40°	45°
10-18-76	1	0.245	3.8	0.9	- 3.1	- 6.1	- 8.1	-14.1	-16.9	-20.4
10-20-76	1	0.315	8.2	2.9	- 0.8	- 5.1	- 8.4	-14.3	-15.7	-16.5
10-22-76	1	0.265	5.2	1.1	- 3.1	- 5.4	- 9.5	-16.8	-20.3	-22.3
10-26-76	1	0.335	6.3	1.4	- 3.8	- 6.8	-11.4	-16.0	-18.3	-20.3
11-10-76	1	0.180	- 4.3	- 5.6	- 8.7	-10.7	-12.2	-18.9	-20.0	-21.6
11-12-76	1	0.145	2.2	- 1.0	- 3.9	-10.0	-12.4	-19.0	-19.9	-21.3
06-21-77	1	0.120	- 8.4	- 8.8	-15.4	-14.7	-15.6	-19.1	-19.2	-18.2
10-18-76	2	0.260	7.6	3.6	- 1.0	- 4.3	- 9.0	-15.3	-17.9	-20.2
10-20-76	2	0.315	7.2	3.2	- 0.6	- 5.7	- 9.1	-14.4	-15.9	-17.6
10-22-76	2	0.295	8.0	4.2	- 1.2	- 5.8	- 9.2	-16.1	-17.8	-20.0
10-26-76	2	0.325	6.8	2.0	- 1.9	- 5.5	- 9.4	-15.1	-17.3	-20.8
11-10-76	2	0.155	- 2.2	- 4.5	- 6.6	- 8.9	-11.9	-17.4	-18.5	-20.2
11-12-76	2	0.160	1.3	- 1.7	- 3.4	- 8.2	-11.9	-16.5	-20.3	-20.0
06-21-77	2	0.130	- 9.5	-13.5	-14.1	-13.9	-15.4	-16.5	-18.8	-20.9
10-18-76	3	0.225	7.5	3.4	- 1.1	- 4.3	- 9.3	-16.4	-19.6	-19.9
10-20-76	3	0.290	7.6	3.5	- 0.3	- 6.2	- 8.5	-15.2	-17.1	-18.3
10-22-76	3	0.260	8.5	3.4	- 1.4	- 5.7	-10.3	-17.4	-19.5	-21.8
10-26-76	3	0.295	5.8	1.1	- 3.3	- 7.3	- 9.9	-15.2	-17.1	-18.3
11-10-76	3	0.150	- 2.9	- 6.0	- 8.4	-10.8	-13.5	-17.0	-21.2	-22.4
11-12-76	3	0.135	3.8	- 0.9	- 3.0	- 9.5	-11.9	-16.3	-18.5	-20.8
06-21-77	3	0.105	- 8.1	-12.8	-15.2	-14.2	-14.9	-18.5	-17.0	-19.7

Table A2. (Continued

Date	Field No.	Volumetric H_2O Content	5°	10°	15°	20°	25°	35°	40°	45°
10-18-76	4	0.175	- 0.4	- 4.3	- 9.4	-10.3	-15.5	-20.1	-21.8	-24.2
10-20-76	4	0.255	6.6	- 0.4	- 2.0	- 7.0	- 5.8	-13.3	-16.0	-17.3
10-22-76	4	0.190	- 1.6	- 5.8	- 9.8	-10.8	-15.3	-21.6	-23.8	-24.1
10-26-76	4	0.270	3.2	0.4	- 2.7	- 5.1	- 7.8	-14.3	-17.7	-21.0
11-10-76	4	0.085	- 7.5	- 8.0	-11.2	-12.5	-16.5	-19.9	-22.4	-23.2
11-12-76	4	0.100	- 4.1	- 7.6	- 5.3	-13.6	-17.6	-20.7	-21.6	-23.6
06-21-77	4	0.255	-10.8	-11.6	-12.8	-11.3	-13.5	-14.3	-15.5	-16.4
10-18-76	5	0.165	- 0.9	- 5.2	- 9.0	-10.8	-13.8	-19.4	-20.9	-22.3
10-20-76	5	0.240	4.5	- 0.5	- 3.1	- 7.4	-12.6	-16.9	-20.1	-21.1
10-22-76	5	0.190	- 0.4	- 5.8	-11.0	-12.4	-15.3	-22.6	-23.6	-26.0
10-26-76	5	0.250	2.7	- 2.3	- 5.7	- 8.1	-11.1	-17.8	-20.6	-23.2
11-10-76	5	0.085	- 7.6	- 8.6	-11.2	-11.9	-14.4	-21.2	-20.9	-21.0
11-12-76	5	0.110	- 2.5	- 6.4	- 4.7	-12.5	-15.0	-19.6	-20.3	-24.1
06-21-77	5	0.200	- 9.8	-11.2	-11.4	-12.2	-13.4	-14.4	-15.0	-15.3
10-18-76	6	0.205	- 0.5	- 3.9	- 8.4	- 9.2	-13.7	-18.6	-20.5	-20.8
10-20-76	6	0.235	4.7	0.4	- 2.8	- 6.9	- 9.4	-14.9	-16.8	-16.8
10-22-76	6	0.210	- 1.4	- 6.2	-10.9	-12.0	-15.6	-20.5	-23.2	-26.1
10-26-76	6	0.270	1.8	- 3.1	- 5.9	- 7.5	-10.8	-15.4	-18.8	-21.9
11-10-76	6	0.095	- 6.7	- 8.5	-12.1	-12.0	-16.1	-20.3	-21.3	-16.7
11-12-76	6	0.130	- 3.1	- 5.6	- 5.8	-12.8	-15.8	-19.9	-21.8	-21.6
06-21-77	6	0.215	-12.8	-10.1	-12.5	-12.8	-12.4	-13.3	-14.9	-13.3

Table A3. 1.6 GHz-HV Scattering Coefficient ($T\sigma$) at Each Look Angle on Each Date For Fields 1-6.

Date	Field No.	Volumetric H_2O Content	5°	10°	15°	20°	25°	35°	40°	45°
10-18-76	1	0.245	-17.8	-18.2	-19.5	-21.6	-24.3	-27.5	-28.7	-28.2
10-2?-76	1	0.315	-14.9	-18.0	-19.0	-20.1	-19.6	-23.8	-23.9	-26.3
10-22-76	1	0.265	-18.2	-21.0	-21.9	-24.0	-26.9	-29.3	-31.0	-30.9
10-26-76	1	0.335	-16.8	-18.9	-21.5	-22.3	-22.4	-25.4	-26.2	-26.9
11-10-76	1	0.180	-20.5	-22.2	-24.5	-26.0	-26.7	-31.5	-31.2	-33.5
11-12-76	1	0.145	-19.5	-20.8	-22.8	-24.6	-26.3	-30.2	-30.3	-31.0
06-21-77	1	0.120	-21.7	-22.6	-24.2	-22.3	-22.8	-22.0	-24.5	-24.5
10-18-76	2	0.260	-15.7	-18.0	-19.5	-22.2	-24.0	-27.8	-27.4	-27.9
10-20-76	2	0.315	-14.5	-17.6	-18.3	-20.0	-20.8	-22.4	-24.8	-26.0
10-22-76	2	0.295	-17.4	-18.1	-20.3	-23.6	-25.1	-27.5	-28.4	-29.1
10-26-76	2	0.325	-16.2	-18.1	-20.2	-20.2	-22.2	-25.9	-26.6	-27.3
11-10-76	2	0.155	-18.9	-21.2	-23.1	-23.7	-26.1	-29.0	-29.5	-30.7
11-12-76	2	0.160	-17.9	-19.8	-24.1	-23.4	-25.8	-28.3	-29.0	-28.5
06-21-77	2	0.130	-22.0	-21.9	-22.8	-22.8	-22.0	-22.6	-24.5	-24.5
10-18-76	3	0.225	-17.2	-18.8	-20.4	-22.6	-24.7	-27.4	-28.5	-29.1
10-20-76	3	0.290	-13.7	-17.4	-18.3	-19.9	-21.4	-23.8	-24.0	-26.5
10-22-76	3	0.260	-16.9	-18.8	-21.1	-24.7	-26.0	-27.6	-29.0	-30.5
10-26-76	3	0.295	-16.8	-19.7	-21.3	-22.1	-22.5	-25.2	-26.6	-26.6
11-10-76	3	0.150	-18.4	-22.9	-24.3	-26.4	-28.0	-30.8	-31.7	-30.8
11-12-76	3	0.135	-18.1	-20.0	-23.7	-24.5	-27.0	-29.6	-29.8	-28.8
06-21-77	3	0.105	-20.8	-22.8	-21.9	-20.2	-22.5	-21.4	-22.8	-22.5

Table A3. (Continued)

Date	Field No.	Volumetric H_2O Content	5°	10°	15°	20°	25°	35°	40°	45°
10-18-76	4	0.175	-21.4	-22.4	-25.5	-28.1	-28.5	-30.6	-31.3	-31.9
10-20-76	4	0.255	-17.8	-20.6	-21.4	-21.7	-23.7	-25.0	-27.6	-28.0
10-22-76	4	0.190	-21.1	-23.5	-26.0	-27.3	-30.0	-31.8	-34.3	-33.1
10-26-76	4	0.270	-19.6	-18.5	-20.4	-23.3	-23.4	-27.5	-28.1	-29.2
11-10-76	4	0.085	-23.9	-25.2	-27.0	-27.2	-31.4	-32.9	-32.8	-32.5
11-12-76	4	0.100	-21.2	-20.3	-25.0	-25.6	-30.1	-31.0	-33.0	-32.6
06-21-76	4	0.255	-20.5	-20.7	-19.6	-18.7	-19.7	-19.6	-20.1	-22.3
10-18-76	5	0.165	-20.9	-22.8	-25.2	-26.5	-28.3	-30.6	-32.7	-32.8
10-20-76	5	0.240	-17.8	-20.4	-20.6	-21.0	-23.0	-25.7	-27.4	-27.6
10-22-76	5	0.190	-20.1	-24.5	-25.2	-27.7	-27.6	-31.8	-31.2	-33.5
10-26-76	5	0.250	-20.0	-20.4	-21.5	-24.9	-26.5	-27.7	-29.7	-32.9
11-10-76	5	0.085	-23.0	-25.4	-27.4	-28.2	-29.4	-33.0	-32.4	-32.4
11-12-76	5	0.110	-21.0	-19.7	-23.4	-25.2	-27.7	-30.5	-31.7	-32.4
06-21-77	5	0.200	-20.4	-21.9	-21.2	-20.2	-21.2	-21.8	-22.5	-23.7
10-18-76	6	0.205	-20.5	-23.2	-25.1	-28.7	-28.5	-29.2	-32.4	-28.9
10-20-76	6	0.235	-16.1	-18.4	-20.3	-20.8	-22.7	-24.0	-25.3	-23.4
10-22-76	6	0.210	-19.8	-21.8	-24.3	-24.7	-28.2	-31.5	-32.9	-33.2
10-26-76	6	0.270	-18.7	-20.2	-22.3	-22.5	-25.7	-27.6	-27.9	-28.1
11-10-76	6	0.095	-24.1	-25.2	-27.6	-28.2	-29.3	-33.5	-32.8	-27.7
11-12-76	6	0.130	-19.3	-19.9	-24.8	-24.9	-27.3	-30.5	-31.4	-30.8
06-21-76	6	0.215	-20.6	-20.2	-18.6	-18.9	-19.6	-18.4	-21.2	-20.0

previously reported in the RSC 3458-2 progress report. The plots of revised data for the 1.6 GHz cross polarized (HV) data indicate the data does not substantiate the favorable conclusions reached in the previous report.

Scatterometer data for the Guymon experiment site have also been processed with the revised system. These data have some unexplained variance over fields that were dry throughout the experiment. Cooperative efforts between JSC and TAMU are now being made to reexamine the data on two days to locate the problem in these data.

Guymon MMS Data Processing

The Modular Multispectral Scanner (MMS) was operating on all flights at the Guymon site. In view of the excessive cost required to produce the digital tapes (CCT's) requests for the data were limited to five channels and to time frames that represented a minimum of flight line coverage. Single coverage over each sample field on each flight day was requested. Even after placing these limits on the data, 83 nine track CCT's were required to deliver the data. Each tape was first reviewed by greymapping the thermal channel to locate field boundaries and location of the appropriate data for each field.

Boundaries were read into a computer program to excerpt, average and store the five channels of data from each field. The tape storage for each field can then be assessed for

further study if added detail is needed at a later date. Field averages were examined and some problems were noted. Cloud cover on two days interfered with incoming radiation. An attempt will be made to normalize these data by reference to some uniform targets along the flight lines. One of the selected channels also has noisy data and will not be useful for analysis.

Guymon Landsat Data Processing

One good quality Landsat pass over the Guymon site was available for August 13, 1978. The data was used at GSFC to search the experiment area and averages for the four bands were extracted over each sample field. Additional fields that appear to exhibit extremes on the Seasat data were also extracted from the Landsat data. The Landsat data for all fields is good quality.

Guymon Seasat Data Processing

One pass of the Seasat SAR was made over the Guymon site on August 9, 1978. These data have been processed on the digital system developed by NASA-JPL and have been delivered to the project. Each sample field has been examined on a grey scale mapping of the test area. Average digital values have been extracted from the data for each field of interest. These data are at the present time comparable on a field to field basis within the pass. The average values

cannot be compared to other areas where Seasat SAR data are available since the digital processing does not produce calibrated data. The same pass has been processed with the optical processor adapted to a systems control tape drive that may produce comparable data from pass to pass. These film products therefore will be digitized in an attempt to normalize the data and make comparisons with results from another site located near Sublette, Kansas.

Analysis and Discussion of Guymon Data

Only cursory examination of data products for the sample fields has been made at this time. Primary efforts are being directed toward validation of the data and clarification of sensor performance and data quality.

Revised data will be tabulated and delivered to the other team members on this experiment at the University of California at Santa Barbara after the data quality has been verified.

SIGNIFICANT RESULTS

A paper that will summarize the results of the Brazos River Valley study is being prepared and presented at the American Society of Photogrammetry in September 1979.