https://ntrs.nasa.gov/search.jsp?R=19790007187 2020-03-22T01:36:55+00:00Z

General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.

- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.

- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.

- This document is paginated as submitted by the original source.

- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

Produced by the NASA Center for Aerospace Information (CASI)

01 STIF II

Progress Report RSC 3712-3

7.9-10079
CR-157972

DRYLAND PASTURE AND CROP CONDITIONS AS SEEN BY HCMM

"Made available under NASA sponsorship in the interest of early and wide dissemination of Earth Resources Survey Program information and without liability for any use made thereof."

Progress Report for Period
July 1978 - October 1978

Prepared for

NASA - Goddard Space Flight Center
Greenbelt, Maryland 20771

(E79-10079) DRYLAND PASTURE AND CROP CONDITIONS AS SEEN BY HCMM Progress Report, Jul. - Oct. 1978 (Texas A&M Univ.) 20 p HC A02/MF A01 CSCL 02C
N79-15358
Unclas
G3/43 00079

Contract NAS5-24383

HCM-049

TEXAS A&M UNIVERSITY
REMOTE SENSING CENTER
COLLEGE STATION, TEXAS

RECEIVED
JAN 02 1979
SIS/902.6

TABLE OF CONTENTS

1.0 BACKGROUND AND SUMMARY

1.1 Background

This 16-month project is an extension of several other projects which involve estimates of wheat yield (Harlan et al., 1978), green biomass (Deering et al., 1977), and watershed runoff coefficient (Blanchard, 1978) using visible, near infrared and passive microwave data. In each estimate, soil moisture content is a major determining factor. The hypothesis of this study is that high resolution thermal infrared data, such as those received from HCMM, will enhance estimates of soil moisture content. Therefore, the three objectives of this project, as given in the statement of contract NAS 5-24383, are

1) to assess the capability for determining winter wheat and pasture canopy temperatures in a dryland farming region from HCMM data.

2) to assess the capability for determining soil moisture in dryland crops (winter wheat) from HCMM data of dryland crops and adjacent range lands.

3) to determine the relationship of HCMM-derived soil moisture and canopy temperature values with the condition of winter wheat and dryland farming areas during the principal growth stages.

To accomplish these objectives, measurements will be obtained at three levels: ground truth, aircraft, and satellite. The sites selected for these measurements are on the Washita River watershed, near Chickasha, Oklahoma. The area has a dense USDA/SEA-AR network of rain gauges, and rangeland and dryland winter wheat are often adjacent to each other. Ground truth data include canopy and lake surface temperatures, neutron probe and gravimetric soil moisture samples, and daily precipitation data. The aircraft will collect day/night thermal scanner data and aerial photos of commercial wheat and pasture fields; HCMM will collect day/night surface temperatures over the same sites. Data collected from each level will be correlated in three ways:

1) thermal (HCMM and aircraft) parameters of soil moisture and crop canopy temperatures will be derived,

2) a technique will be developed to calculate the antecedent precipitation indices from the thermal parameters of soil moisture and canopy temperatures, and

3) an input parameter for yield prediction models will be developed.

1.2 Summary

Accomplishments during the third period of the contract (July-October, 1978) included:

(1) receiving the aircraft M^2S and soil moisture data,

(2) relating surface temperatures, as measured by the PRT-5 on board the aircraft, to surface temperatures at the measurement sites,

(3) planning for ground measurements at Chickasha during late October or November in conjunction with HCMM and Landsat-2 overpasses, and

(4) publishing a technical memorandum describing the technique used in determing surface emissivity.

The M^2S CCT's were received from NASA/JSC on October 2. Data analysis is just beginning, so no results have been determined from the digital data.

Visicorder data (a reduced grey map image of the thermal M^2S data), however, was used to relate surface temperatures, as measured by the Barnes PRT-5 on board the C-130, to temperatures and soil moisture content at the measurement sites. The surface temperatures were correlated using a densitometer.

The ground sampling mission scheduled for August 19 was rained out. Consequently, we plan to collect extensive data on October 22 (or November 7) from one large rangeland area and one large wheat field. These dates were selected on the basis of HCMM and Landsat-2 pass dates over Chickasha.

Also, technical memo RSC-153, "Determination of Surface Thermal Emissivity," was published. Copies were sent to GSFC and other HCMM investigators.

2.0 ACCOMPLISHMENTS AND PROBLEMS

2.1 Accomplishments

During the third period, data received included:

(1) the afternoon and pre-dawn M^2S digital data,

(2) the soil moisture data, and

(3) 70mm visicorder film of the greymap of the M^2S thermal data obtained over Chickasha on May 8 and 9.

The M^2S digital data are now being processed. No siginificant conclusions can be made yet.

Soil moisture content at each site was calculated and the results are discussed in the Significant Results section. We are still awaiting information on the soil bulk density at the measurement sites, to calculate the volumetric moisture content.

To relate temperatures as measured by the Barnes PRT-5 to surface temperatures at the measurement sites, the M^2S visicorder film was analyzed using a Macbeth transmission densitometer (TD-504). This temperature comparison is based on several assumptions:

(1) differences in the tone on the film corresponds to a given temperature difference,

(2) the PRT-5 was oriented nadirward, and

(3) the measurement sites and areas having the same density also have similar emissivity.

In reality, surface emissivity differences may cause temperature differences of as much as 2°C. In spite of this difference, we are still able to get a rough idea as to the relative surface temperature differences, assuming a constant emissivity difference between pasture and wheat. The procedure used to determine site surface temperatures was:

(1) determine the density of the measurement site using the all-color filter and 1mm aperture of the densitometer;

(2) locate on area having the same density in the FOV path of the PRT-5 (160 ft. wide in the center of the visicorder film); and

(3) determine the surface temperature of both areas, using the time marks on the visicorder film and the PRT-5 line printout. The results are given in the Significant Results section.

2.2 Future Accomplishments

The next ground measurement mission to correlate HCMM data with ground data will be on October 22 or November 7--dates which Landsat-2 and HCMM pass over Chickasha. Samples will be collected from one (or two) large dryland winter wheat fields and one large rangeland area (both over 300 acres). Wheat at this time is just emerging, but due to a lack of rain, is suffering from moisture stress. Any water stress at this growth stage will have a direct effect on growth and final yield. The sampling technique and grid will be the same as described in the previous progress report.

Also, during the next period, ground and aircraft data will be processed at the Remote Sensing Data Analysis Facility (RSDAF). The results comparing thermal conditions in pasture and wheat to corresponding water stress conditions will be presented at the annual ASA (American Society of Agronomy) meetings in December. We also hope to receive and begin processing the first HCMM CCT of the Chickasha area. Given this data, we should be able to answer the questions:

(1) Can surface temperatures be detected and compared at different levels, and

(2) Are crop (wheat) growing conditions indicated by thermal differences between pasture and wheat?

2.3 Problems

The only major anticipated problem is the potential lack of allotted travel funds to sample in Chickasha. If the mission in October gets clouded over, an alternative may need to be evaluated to meet the specified objectives. This may entail SEA-AR personnel collecting additional data during future HCMM overpasses to correlate HCMM data with ground truth.

3.0 SIGNIFICANT RESULTS, PRESENTATIONS AND PUBLICATIONS

During the third period, soil moisture and aircraft (visicorder and CCT) data collected on 5/9/78 at Chickasha were received. Results of the soil moisture data are given in Table 1. A better comparison of moisture content between sites would be to use soil moisture percentage by volume rather than percentage by weight. This requires knowledge of the soil bulk density, which is presently being measured at each site. One notices that:

(1) fields tend to be drier along the west than east flight line, and

(2) several pasture fields are wetter than dryland winter wheat fields.

The soil moisture difference between the flight lines is partly due to water-holding capacity differences of the two soil types along each flight line. Fields along the east flight line are in clay; along the west flight line, in a sandy loam, which holds less moisture.

Due to differences in the amount of green material, the pastures are wetter than the wheat fields. Most of the pastures average from 40-80% green material, while wheat averages from 90-100% green material. A large amount of green material transpires more water and would deplete the soil water content faster than dead vegetation.

Visicorder data was analyzed using a transmission densitometer. The density readings and corresponding temperatures, as measured by a Barnes PRT-5, are given in Table 2. The results reasonably describe temperature differences between the rangeland and winter wheat fields. Such differences are higher for fields on the west flight line than the east flight line. This difference may be due to the soil moisture differences discussed earlier, but the actual M^2S data needs to be analyzed to confirm this.

Comparing results from the two tables, one can see that several pasture sites have high moisture contents, but warmer surface temperatures than winter wheat fields. The physical explanation for this difference is the differing amounts of green material between pasture and wheat fields. Pasture, as previously mentioned, has a larger percentage of dead material with different thermal properties than live vegetation, and surface temperature is primarily dependent on insolation. Dead vegetation heats more quickly than live. The dead material is transpiring less, but is warming up faster than wheat fields, resulting in higher daytime surface temperatures and moisture contents as well. Consequently, the timing of the green-up period for pasture is related to growing conditions of wheat. Theoretically, a wet, warm spring would hasten green-up and decrease the thermal and soil moisture difference between pasture and wheat. The opposite would be true for a dry, cold spring. Further analysis will be delayed until the aircraft M^2S data has been fully processed.

In addition to receiving the data, technical memo RSC-153, "Determination of Surface Thermal Emissivity" was published. Copies were sent to GSFC and other HCMM investigators.

4.0 FUNDS EXPENDED

During the third period, $17,562 was spent primarily on salaries and wages, other direct costs, and travel. Table 3 outlines the total expenditures for the first three quarters (through October 31). Approximately 64% of the money allotted to the Remote Sensing Center ($33,444) has been spent. A large percentage was allotted to salaries and wages ($5,538), other direct budgeted costs ($7,178)[$4,000 for assistance from SEA-AR], and travel to Chickasha ($1,990). During the next quarter, most of the funds will be allotted to data analysis and salaries and wages.

5.0 AIRCRAFT-SATELLITE DATA USAGE

No satellite data CCT has been received yet for the Chickasha area. Therefore, no qualitative judgments can be made on this data set. However, the transparencies indicate excellent quality.

The aircraft data were received during the first week of October. Data processing and analysis is just beginning, so the quality and usefulness of the tapes cannot be judged yet. The timeliness of the tapes was adequate. Receiving the tapes in October should allow adequate time to process and analyze the data before the presentation in December.

Table 1: Soil Moisture Data Collected at Chickasha

on 5/9/78

East Flight Line Site	Depth	Moisture (% by weight)
E-1	0-6"	19.1
(wheat)	6-12"	17.5
E-2	0-6"	17.5
(wheat)	6-12"	14.1
E-3	0-6"	17.0
(pasture)	6-12"	15.5
	12-18"	13.6
	18-24"	13.4
E-4	0-6"	13.1
(wheat)	6-12"	11.6
	12-18"	8.6
E-5	0-6"	25.0
(Wheat)	6-12"	23.8
	12-18:	22.7

West Flight Line Site	Depth	Moisture (% by weight)
W-1	0-6"	19.1
(pasture)	6-12"	19.3
	12-18"	19.3
W-2	0-6"	18.0
(pasture)	6-12"	14.0
	12-18"	15.0
W-3	0-6"	10.2
(wheat)	6-12"	9.3
W-4	0-6"	11.8
(pasture)	6-12"	11.9
	12-18"	10.5
W-5	0-6"	8.8
(wheat)	6-12"	8.4

ORIGINAL PAGE IS
OF POOR QUALITY

Table 1: Soil Moisture Data Collected at Chickasha

on 5/9/78 (Cont.)

East Flight Line Site	Depth	Moisture (% by weight)	West Flight Line Site	Depth	Moisture (% by weight)
E-6	0-6"	15.3			
(pasture)	6-12"	14.4			
	12-18"	16.5			
E-7	0-5"	17.5			
(wheat)	6-12"	15.4			
	12-18"	17.1			
E-8	0-6"	15.0			
(wheat)	6-12"	14.7			
E-9	0-6"	18.7			
(bare soil)	6-12"	19.5			
	12-18"	23.3			
E-10	0-6"	19.2			
(pasture)	6-12"	21.5			
	12-18"	22.8			
E-11	0-6"	19.3			
(wheat)	6-12"	18.7			

Table 2(a): Transmission Density of Visicorder Data and Corresponding Measurement Site Surface Temperature (East Flight Line)

Line	Site	Density	Temperature (°C)
1	E-1	.86	23.3
	E-2	1.08	26.0
	E-3	1.09	29.2
	E-4	.90	22.5
	E-5	.91	23.2
	E-6 (cloudy)	.81	21.8
	E-7 (cloudy)	.76	21.25
	E-8	1.12	30.75
	E-9	.90	26.5
	E-10	1.12	28.5
	E-11	.94	27.5
2	E-1	.80	24.0
	E-2	1.13	28.5
	E-3	1.12	29.5
	E-4	.83	24.2
	E-5	.78	24.2
	E-6	1.17	29.0
	E-7	.78	26.5
	E-8	.86	23.9
	E-9	1.30	31.0
	E-10	1.24	30.0
	E-11	.97	24.5
	Lake Burtchie	.48	18.5

Table 2(b): Transmission Density of Visicorder Data and Corresponding Measurement Site Surface Temperatures (West Flight Line)

Line	Site	Density	Temperature (°C)
3	W-1	1.15	31.5
	W-2	1.18	31.6
	W-3	.69	21.5
	W-4	1.22	32.0
	W-5	.72	23.0
4	W-1	1.21	34.0
	W-2	1.16	29.5
	W-3	.85	27.0
	W-4	1.22	32.1
	W-5	.87	26.3

Table 3: Funds Expended for the First Three Quarters

	First Quarter	Second Quarter	Third Quarter
Supplies	$ 1	$ 145	$ 391
Travel	69	1,612	1,990
Other Direct Costs	33	1,379	7,178
Total Other Direct Costs	103	3,135	9,559
Salaries and Wages	3,439	5,240	5,538
Total Indirect	1,553	2,412	2,465
TOTAL FUNDS EXPENDED	5,095	10,787	17,562

The REMOTE SENSING CENTER was established by authority of the Board of Directors of the Texas A&M University System on February 27, 1968. The CENTER is a consortium of four colleges of the University; Agriculture, Engineering, Geosciences, and Science. This unique organization concentrates on the development and utilization of remote sensing techniques and technology for a broad range of applications to the betterment of mankind.

ORIGINAL PAGE IS
OF POOR QUALITY