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STUDY OF MESOCALE EXCHANGE PROCESSES UTILIZING LANDSAT AIR MASS CLOUD IMAGERY

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PREFACE

Small scale cumulus associated with both tropical and polar air masses over the central United States as observed in ERTS-1 and LANDSAT images are being analyzed. The objective of the analyses is to define relationships between the spacing and density of the cumuliform cloudiness and major terms of the surface energy and water budgets. The program is currently entering the data analysis phase. A series of bulk images covering selected cooperative ground truth sites have been collected and some initial site analysis has been accomplished. CCT's have been ordered for selected scenes. No conclusions have yet been reached in the study.

I. INTRODUCTION

Small scale air mass cloudiness, cumuliform, associated with tropical and polar air masses reveal non-uniformities in both density and size. LANDSAT images are being used to detect and map such cloud elements and to relate non-uniformities in the distribution to variations in the land surface character, for example soil moisture, vegetation cover, rock type, etc. The small scale changes in heat and moisture budgets induced by variations in surface character are being related to existing ground truth sites where measurements of net radiation, evaporation, soil moisture, and other micrometeorological data are acquired.

This progress report presents the results of our Phase I activities including Tasks 3, 4, 5 covering initial analysis and data reduction activities. Phase I Tasks were reported on under our May Quarterly Report.

II. PHASE I DATA COLLECTION AND INITIAL DATA REVIEW

1. Collect maps and other literature over appropriate test sites.
2. Survey LANDSAT data over test sites and prepare bulk image order.
3. Establish contacts with cooperative test sites and initiate data collection.
4. Review literature relating to energy exchange processes.
5. Review LANDSAT images prior to preparation of 1:250,000 enlargements and submission of CCT orders.

2.1 Collect Maps and Other Literature

This task has been completed. Some additional local data, i.e. thematic maps, etc. may be assembled during our site visits.

2.2 Survey LANDSAT Data and Prepare a Bulk Image Order

An initial order of LANDSAT-1 bulk images has been received from NOAA EDS. These images cover potential test sites. The initial order was recently supplemented to provide additional images over selected test regions.

A review of the initial bulk images for the indicated period shown on Table 1 (from our first Quarterly Report) indicated that the Texas, Illinois and Ohio images were potentially most significant for further study.

2.3 Contacts with Cooperative Test Sites and Data Collection

Follow-up contacts have been made with two of the selected study area test sites. A contact will soon be made with the Ohio Agricultural Research Center at Coshocton. A visit to each of the three sites will be planned within the next two months if the appropriate site personnel are available.

2.4 Literature Review

We have continued a level of effort directed toward review of pertinent information on energy exchange processes. We anticipate that this review will continue throughout the program.

2.5 Review of LANDSAT Images Prior to Preparation of 1:250,000 Enlargments and Ordering CCT's

We have completed our initial review of the 9 X 9 inches (1:1,000,000 scale) images received from NOAA EDS. The scenes covering our Texas, Illinois and Ohio sites appear to be most interesting for further analysis. On the basis of this review an order for CCT's has been placed with the EROS Data Center at Sioux Falls. (A two month delivery schedule has been promised!)

An initial evaluation of the Texas images included a test analysis of the cumliform density and size distribution on a 2nm grid mesh and a qualitative estimate of spectral reflectance in the Band 5 MSS image taken 22 May 1974. A second clear image taken on 4 May 1974 has subsequently been ordered and received from NOAA. This image is very clear and provides a much better overview of spectral reflectance variations. We will prepare an evaluation of the qualitative spectral reflectances on the 2nm grid mesh for comparison with the clouded image analysis.

Our first analytical evaluation, while very approximate, suggests clearly that cumuliform cloudiness density and size are correlated with spectral reflectance, i.e. areas with low Band 5 reflectances such as green crop cover or forested areas appear to have lower cloud densities and smaller element sizes while higher spectral, Band 5, reflectance areas seem to be related to larger cloud elements and greater densities.

When we can obtain the site data on evapotranspiration from the Lysimeters or other instrumentation we will examine, in detail, the other processes that may be operating on the cloud field through various exchange processes. We anticipate that albedo will continue to predominate but we obviously cannot ignore the interrelations among albedo, surface temperature, surface moisture, evapotranspiration, etc.

Based on our initial image review and analysis we have initiated an order for the preparation of selected 1:250,000 enlargements. These enlargements will be used to prepare careful evaluations of the cloud density and element size. We intend to use the CCT's, when they arrive, to prepare maps of albedo. These "maps" will be displayed in a form to permit comparisons at spatial albedo with the cloud analysis.

III. PROGRAM FOR NEXT REPORTING PERIOD

During the next reporting period we will plan to proceed on the following task items.

(a) Complete analyses of the cloud density and size on the 1:250,000 images for at least two of the three selected test sites.

(b) Complete development of an algorithm to compute albedo from the calibrated MSS CCT's. (Our work on this problem is awaiting calibration data from EROS)

(c) Visit the cooperative test sites and obtain available data.

(d) Obtain appropriate standard surface climatological data from NOAA EDS for the selected test sites and times.

(e) Initiate a request to NOAA for any available VHRR data tapes covering our test periods and areas.

IV. RECOMMENDATIONS

The long delivery period for the CCT's from EROS, while not greatly impacting this study, seems excessive. More data users might make use of CCT's if they were at least as accessible as the images.

V. DATA USE

In the investigation to date we have the following data use summary.

1. Value of Data Allowed

Bulk	768
CCT	9600

2. Value of Data Ordered

Bulk	200
CCT	2400

3. Value of Data Received

Bulk	200
CCT	0