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INVESTIGATION OF THE APPLICATION OF
HCMM THERMAL DATA TO SNOW HYDROLOGY

James C. Barnes, Principal Investigator

ERT Document No. P-2061-8
HCMM Investigation No. 036

October 10, 1979

Type II Report for Period
July through September 1979

Prepared for

National Aeronautics & Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

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October 10, 1979

National Aeronautics & Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Mr. Frederick Gordon, Jr.
Mail Code 902.6
HCMM Investigation Support

Subject: Contract NAS5-24316: Investigation of the Application of HCMM Thermal Data to Snow Hydrology

Dear Mr. Gordon:

We are pleased to enclose the eighth quarterly progress report (Type II Report) under the subject contract. This report covers the period from July 1 through September 30, 1979.

As specified in the contract, nine (9) copies of the report are enclosed. One additional copy has been mailed to the NASA Scientific and Technical Information Facility.

Very truly yours,

James C. Barnes
Principal Investigator

JCB/11s

Enclosures (9)

1. INTRODUCTION

1.1 Objectives of Investigation

The objectives of the investigation of the application of HCMM thermal data to snow hydrology (HCMM Investigation No. 036) are as follows:

- (1) determine practical utility of HCMM thermal IR data to establish distribution of snow cover and determine accuracy of temperature measurements;
 - a. determine accuracy of surface temperatures acquired through use of HCMM thermal IR measurements,
 - b. determine relative resolution utility between VHRR and HCMM for thermal IR measurements, and
 - c. specifically delineate and quantify the problems involved with measuring snow temperature from space and relate them to present and planned earth observing satellite systems. This objective will take into consideration and utilize the capability of HCMM for day and night thermal measurements over appropriate sites and the satellite's eight-day repeat cycle;
- (2) determine if and how HCMM measurements can be factored in with Landsat data into an overall snow hydrology program related directly to snowmelt runoff prediction; and
- (3) develop an approach to automated data processing of combined visible and thermal infrared satellite acquired data to provide information of interest and use to the snow hydrologist.

1.2 Anticipated Results

The primary anticipated result of the proposed investigation is the development of improved techniques for the mapping and analysis of snow cover using spacecraft-acquired data. The results will provide an evaluation of the usefulness of high resolution thermal infrared data for snow mapping and for input to snowmelt prediction programs; and will provide a better understanding of the relationships between the measured

temperature values and such factors as type of snow, snow depth, type of terrain, and vegetation. The mapping and analysis techniques can then be applied to the automatic processing of data from future spacecraft systems, and will eventually enable snow survey, which is a vital part of water resources management, to be accomplished on a more cost-effective basis.

2. ACCOMPLISHMENTS DURING REPORTING PERIOD

During this reporting period, a CCT containing HCMM digitized data for the Sierra Nevada test site (30 May 1978, nighttime) was received. The original tape, however, was inadvertently damaged during processing. A duplicate tape was requested and was received late in the reporting period. The initial processing of this tape has been completed, and the data appear to be good.

The only CCT received previously was for the 31 May/daytime pass over the same test site (the analysis of those data has been discussed in a previous progress report). With the nighttime data, we now have a day/night sequence for the Sierras test site. Data were also collected on day and night U-2 flights across the test site on the same dates; hence, this case appears to be an excellent one for analysis.

During the past two weeks, a considerable amount of HCMM imagery has been received. With this recent data, a total of approximately 150 HCMM images has been received to date. Of this number, several are duplicates and several do not cover any of our test sites. In fact, some images were annotated incorrectly, and actually cover ocean areas, such as the eastern Atlantic (about a dozen of these mis-registered images have been received). Some images over the specified test sites are during periods of little or no snow cover, and several images contain too much cloud to be useful. Nevertheless, several excellent images, especially for the Arizona and Sierra Nevada test sites during the winter/spring of 1979, are included in the overall sample of data received to date.

Following review of the total sample of HCMM images, a request for digitized data for the Arizona test site has been submitted. The CCT's are for daytime HCMM passes on 9 February, 15 February, 24 March, 4 April,

and 15 April (1979), and a nighttime pass on 7 February. These data provide an excellent sequence of cloud-free passes through the snowmelt season of the late winter and spring. The imagery for the Sierras test site is currently being reviewed, and CCT's for selected cases will also be requested. It is hoped that at least one or two additional day/night cases will be available for the Sierras.

3. PROBLEMS

A request for a six-month extension in time for our investigation has been submitted. As stated in the seventh quarterly progress report (July 6), completion of the study is dependent upon timely receipt of the digital data products. At this time, we still have not received a sufficient number of HCMM tapes to carry out a thorough data analysis. However, with the CCT's recently requested, we anticipate that the data sample will be sufficient to complete the investigation. The six-month extension in time will enable these data to be acquired and analyzed.

4. PLANS FOR THE NEXT REPORTING PERIOD

Further review of the imagery received to date will be carried out to select additional cases for ordering digitized data. It is anticipated, in particular, that CCT's will be requested for additional passes over the Sierras test site, for which several good quality images are now on file. Although cloud-free images have also been received for the Pacific Northwest test site, as well as for other snow covered areas, the analysis of digitized tape data will be concentrated on the Arizona and Sierras test sites because of the substantial number of good passes and greater amount of supporting data for those areas.

The analysis of the Sierras data for 30-31 May 1978 will be continued using the digitized data for the daytime pass received earlier in the study and the recently received CCT for the corresponding nighttime pass. The day/night registered data (temperature difference) will also be ordered for this case.

5. TRAVEL

No travel related to the project occurred during this reporting period.

6. PUBLICATIONS

No material related to this investigation was published during this reporting period.

7. SIGNIFICANT RESULTS

No significant results have been obtained through the eighth reporting period of the investigation.

8. FUNDS EXPENDED

Approximately 45 percent of the available funds have been expended to date. At this time, we anticipate that the remaining funds will be adequate to complete the project. However, the further delay in receiving data has made necessary a request for a six-month time extension; therefore, we will examine carefully the financial status of our contract to determine whether any additional funds will be needed to insure that the investigation can be completed meeting all originally proposed objectives.