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STUDY TO DEVELOP IMPROVED SPACECRAFT SNOW SURVEY METHODS USING SKYLAB/EREP DATA

(EREP Investigation No. 420)

James C. Barnes, Principal Investigator
Environmental Research & Technology, Inc.
Concord, Massachusetts 01742

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PURPOSE OF INVESTIGATION

The purpose of this investigation is to compare and evaluate Skylab data for mapping of snow cover. Visual interpretation of the S190 photographs will be performed to map areas that are snow-covered. The S192 imagery and digital printouts, S193 data, and S194 data will then be compared to the S190 photographs to determine how much additional information on areal extent of snow can be obtained from various spectral bands, thermal data, and microwave data. Snow-depth and area measurements taken routinely by various Government agencies in the Sierra Nevada, Arizona, Utah, and Great Plains shall provide ground truth. The relatively high-resolution EREP data will be compared with television and radiometric measurements from other satellites, and available aircraft imagery, to determine the optimum feature system for mapping the areal extent of snow. The results of this investigation will enable a more accurate assessment of the extent of snow cover in the United States and aid in prediction of runoff and better management of the country's water resources.

ACCOMPLISHMENTS DURING REPORTING PERIOD

During this reporting period it was necessary to devote some time to the sorting and cataloging of the numerous data books, magnetic tapes, technical notes and film products that were already on hand or had been received recently. At this date, all data that were requested have been received with the exception of the S193 data from the SL-4 mission. In conversations with the Technical Monitor, we have been informed that these latter data are essentially unuseable and therefore were not processed. With the vast amount of other data on hand, the lack of the SL-4 S193 data will not significantly affect the investigation.

Following the cataloging of the data, four test site areas have been selected for the final data analysis. For these four test sites, the data on hand include S190A and S190B photography, S192 imagery, and S192 digital tapes; for three of the sites, S194 data books and digital tapes are also on hand. The four test site areas are:

(1) Wasatch Area - Utah
(Wasatch Range - San Pitch Mountains)
SL-2, Pass 5, 5 June 1973

(2) Central Mountains - Arizona
(Salt-Verde Watershed)
SL-4, Pass 83, 14 January 1974

(3) Sierra Nevada - California, Nevada
(Walker Lake Area)
SL-4, Pass 98, 1 February 1974

(4) Mid-West - South Dakota, Minnesota,
Iowa, Illinois
SL-4, Pass 89, 24 January 1974

In addition to the above four test site areas of primary interest, S190A and S190B photography and S194 data are on hand for two other passes across the Mid-west (Pass 83 and Pass 90). S191 data have been received for Pass 3 over a portion of the Sierras and S193A data have been received for the same Pass 3 and for Pass 8 over the Cascades. S194 data are also on hand for Pass 8. Although the major effort in the final data analysis will be concentrated on the four primary areas, it is expected that some analysis can also be performed with these additional, more limited data sets.

Analysis of Photographic Products

Analysis of the various spectral bands of the S190A and S190B sensors have been performed for the Arizona and Mid-west test sites to examine further multispectral data characteristics in relation to snow-mapping. A comparison has been made between high-altitude aircraft, S190B, and ERTS imagery to show snow mapping capabilities and limitations of

each of these sensors when enlarged to an approximate scale of 1:120,000.

The feasibility of a Houston-Fearless Variscan rear projection viewer as an aid to accurate snow mapping was also tested. It was found that by modification of the existing optics in the Variscan, it is possible to enlarge S190A color photography to a scale of 1:250,000. The snowline can be traced onto an overlay and the resulting snow boundary information can be directly transferred to a 1:250,000 scale topographic map where a determination of the snowline elevation can easily be made. The results of the analysis of the photographic products from the SL-4 mission are similar to the results from the SL-2 data, reported in the Interim Report (ERT Document 0412-7, June 1974).

Analysis of S192 Data

A considerable effort has been devoted to the development of techniques to process the S192 digital tapes most economically and yet in a manner that will enable the extraction of the most useful information. In order to facilitate the process of locating a relatively small area and extracting the digitized values only for that area, a scheme has been developed whereby a tape is first processed to obtain a "picture" of the saturated areas. In this scheme, Band 1 (SDO 22) was used, and each saturated pixel (value of 255 on the tape output) was printed out as a dot; all Band 1 values that were not saturated were not printed out. The output from this scheme is essentially a "picture", with all snow covered areas (saturated in Band 1) appearing black and the remaining, snow-free areas white. A comparison between the resulting "picture" and S190 photography for the Wasatch and Salt-Verde test sites showed good correlation in the depiction of snow cover.

Using the above scheme, it has been possible to select specific scan

lines that cross the areas of prime interest. This greatly reduces the amount of data to be processed, since the exact scan lines can be selected rather than having to process a rather wide time segment of the pass to insure that the area of interest is included. The processing of the data for the Wasatch and Salt-Verde test sites is now in progress.

TRAVEL SUMMARY

No travel occurred during this period.

PLANS FOR THE NEXT REPORTING PERIOD

During the next reporting period the final analysis will be completed. The effort will be devoted primarily to the analysis of the S192 and S194 data for the Arizona, Sierra Nevada, Utah, and Mid-west test sites. Comparison of Skylab data for both the summer and winter missions will be made to investigate seasonal influences on the spectral response of snow vs. clouds, forested vs. non-forested, and other conditions that can affect the interpretation and delineation of snow cover in both mountainous and flat terrain.

Analysis of the limited amount of S191 and S193A data will also be performed; these analyses will be given lower priority, however, because of the problems with the sensors, and because the data from these sensors are not as crucial to the investigation as are the S192 data.

During this final reporting period, the results of the analysis of the Skylab EREP data will be documented in a final report to be submitted at the end of the period.

REPORTS AND PAPERS

During this reporting period a summary of a paper was submitted for presentation in the Water Resources Management Session of the Earth Resources Survey Symposium to be held in Houston, June 8-13. The paper is entitled "Snow Survey from Space, with Emphasis on the Results of the

Skylab EREP and Visual Observation Experiments".

SUMMARY OUTLOOK

We believe that the data that have been received and are currently being analyzed comprise a total sample sufficient to enable the objectives of the study to be met successfully.

FINANCIAL REPORT

In accordance with Appendix A of the Work Statement of the subject contract, the Financial Management Report is being submitted as a separate document.

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DISCUSSION OF SIGNIFICANT RESULTS

No significant results were obtained during this reporting period.