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This TYPE I report is submitted for ERTS Contract No. S-70251-AG for the period November 10, 1972 to March 10, 1973.

Title of Investigation: Use of Space Data in Watershed Hydrology

GSFC ID: AG 003

Objective of the Contract:

The objective of this proposal is to determine how effectively ERTS MSS data can be used to characterize watershed runoff coefficients. Two common runoff equations having a coefficient related to soils, land use, and terrain roughness will be used as a means of relating MSS data to the study watersheds. If the coefficients for the runoff equations can be predicted with MSS data, the ERTS-derived parameters will then be injected into a hydrologic model and the performance of the model compared when satellite data is used versus coefficients estimated by experienced hydrologists. If improved performance of the model is noted when satellite data is used, the model will be modified to routinely accept satellite data.

Summary of Work Performed this Reporting Period:

A test set of data on CCT for a scene in central Texas was used to try the computer programs required to extract the data pertaining to watersheds under study. Some modification was necessary to most of the programs, however they appeared to be performing well where large watersheds were concerned. Two more sets of CCT for orbit number 1058 and orbit number 1094 from scenes over the Chickasha study area were received prior to January 1. During January the data pertaining to the Chickasha watershed study area was selected from the tapes using the IBM 1800 at Weslaco, and the selected study area was then displayed and study watersheds were selected from the display. Considerable difficulty has been experienced in selecting the small watersheds from the display with any confidence. The statistical distribution in each of the four bands for each watershed was determined with a short program and results of these analyses were plotted for each watershed. It was found that difference exhibited between orbit 1058 and 1094 represents change from extreme drought to an extreme wet condition while vegetation was dormant. The range of the mean spectral response in all bands was reduced under wet conditions. A good distribution in the means was evident under the dry condition. A computer printout was made of the response in Channel 5 and from the printout of an area surrounding the smaller watersheds, very definite boundaries for these small watersheds could be mapped. This technique will be used in the future to select all watersheds less than 10 square miles in area.

(E73-10513) USE OF SPACE DATA IN
WATERSHED HYDROLOGY Progress Report, 10
Nov. 1972 - 10 Mar. 1973 (Southern Great
Plains Watershed Research) 4 p HC \$3.00

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A discriminant analysis program has been used on the four smallest watersheds in the study. Two watersheds having very low runoff were combined and two having extremely high runoff were combined. An attempt was made to find the best linear combination of bands to discriminate between these two conditions. It was found, after trying all combinations of the bands, that bands 1, 2, and 4 offered the best discrimination when used in a simple linear combination. This was true for both the dry and wet conditions. The values of the coefficients in the discriminant equation changed indicating that in the wet condition, very little significance was added to the discriminator by using band 5, however, in dry conditions, the coefficients indicate that band 5 is the most significant contributor to discrimination between high runoff and low runoff watersheds.

Aircraft data from a November 4 flight with the C-130 aircraft using the MSS scanner; from a January 18, 1973 flight with the WB-57F aircraft using RC-8 cameras; and from a January 24, 1973 C-130 aircraft flight using the MSS scanner were received during this work period. The photographic data is excellent, however both flights using the MSS scanner on the C-130 provided very poor data. Two trips were made to JSC in Houston to try to determine what data from these flights could be salvaged. Considerable discussion took place at Houston over the quality of the data and the possibility of selecting small areas and identifying the elements of bad data. Data from Mission 226 on January 24 was screened on the Bendix DAS and it appeared that possibly four channels of data were suitable for use. Several other channels were selected that had some static and we considered that it was worth the effort to later try processing these on the IBM 1800 to determine how poor the data could be and still be useable. Data management personnel at JSC are making a determined effort to correct the problems in the 24-channel data system. During this work period, none of the aircraft data concerning this project has been analyzed or selected on the IBM 1800.

Work was completed during this period on selection of a second runoff equation using precipitation and antecedent precipitation index as predictors of runoff for the study watersheds. After considerable computer time had been spent on selection of an equation, we are satisfied that this final simple equation will do as good a job of predicting runoff as the Soil Conservation Service equation commonly used.

Conformance or Nonconformance to Work Schedule:

It appeared at the end of this work period that it will be difficult to arrive at a satisfactory completion of this work within the time period of the contract. Due to the late start on the computer tapes, it is felt that at least an additional 6 months time period will be necessary to complete the entire contract. We are satisfied that the work progress has been good considering the problems we have found in the selection of data and the development of coefficients for the two test equations for runoff.

Efforts to Achieve Reliability:

We feel that the selection of smaller watersheds (10 square miles or less) should be performed by printing out data over an area containing the watershed and defining the boundaries with a plotter routine as opposed to picking the boundaries of the watershed from a visual display. Boundaries of watersheds are not clearly defined since there is seldom any contrast on the response over high elevations in the rolling plains.

We have made some investigation of the statistical distribution of numbers representing the spectral response in the various bands. The distribution of numbers for the study watersheds from both orbit 1058 and 1094 were plotted and in both cases, the bands 1, 2, and 3, or those bands having seven bit numbers, have an excessive number of odd numbers; thus a plot of the distribution is ragged. We question whether this type distribution can be safely used for discrimination purposes if one is looking at discrimination from response within one band. This same characteristic appears in the data from the aircraft MSS and personnel at JSC have now recommended installation of a nine bit digitizer and they propose to drop the least significant bit from the data.

After looking at this data in some detail, we feel that we should investigate the possibility of the uneven distribution of numbers affecting our discriminant analysis between watersheds. This will be done in the next work period.

Adequacy of Funds to Complete the Task:

The funds stated as necessary in the original proposal appear to be adequate for completion of this proposal. We would like to request that the contract be amended, reducing computer expenditures to \$2,000 and allocating the remainder of that fund to part-time labor. We would also like to request that time of completion of this contract be extended to June 30, 1974. The determination of the best time of year to measure watershed coefficients can only be done after each set of data has been received. The bulk of analysis will be required when time has expired for the final report. Some of the data will not be available until near the end of the present time limit.

Changes in Contractor's Operating Personnel:

Early in March we received a resignation effective April 1 from our part-time programmer employed at Weslaco. This man will be replaced at or near May 15. It is planned at this time to make use of two students for additional help during the summer months if adequate data is on hand.

Planned Work for the Next Reporting Period:

The next reporting period will be devoted to rechecking from printouts all of the smaller watersheds and checking the boundaries to see if data previously selected is reliable. After we have assurance of its reliability as to location, we plan to run a discriminant analysis program on one-half of the study watersheds and see if we can get a linearity between the discriminant score and the coefficients we have derived for the runoff equations. An additional set of data has been ordered for a January pass. This data will be processed and appropriate data for each watershed selected and discriminant analysis will be run on the same set of 10 watersheds.

