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Quarterly Progress Report

Evaluation of SLAR and Thematic Mapper MSS Data for Forest Cover Mapping Using Computer-Aided Analysis Techniques

by

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I. Activities of the Past Quarter

A. Analysis of the 1979 TMS Data

1. Selection of Training Data

During the past quarter a new set of training statistics for the 30 meter resolution simulated Thematic Mapper MSS data has been generated, designed primarily to use in the wavelength band evaluation phase of this project. These training data are based upon land use/land cover classes that correspond to the USGS Land Use Cover Classification System (Anderson, et al. 1976). A list of the cover types used is shown in Table 1. These 9 cover types were found to be represented by 27 spectrally separable cover classes (see Table 2.) which were subsequently used in a per-point Gaussian maximum likelihood classification analysis. Separability of the spectral classes representing the different informational classes was determined by histogram plots of the training data, and tested using transformed divergence values. The transformed divergence values indicated that in most cases a very high separability could be achieved for most channel combinations when utilizing three or more of the seven available channels. Some discrepancies did occur, however, such as a relatively low separability between a spectral class of pasture and one of clearcut, but for most channel combinations of four or more channels this confusion did not appear to be significant.

In addition to this supervised data set a non-supervised, multicluster block set of training statistics is being defined in order to compare the classification results and evaluate the effect of the different training selection methods on classifier performance.

Table 1. Description of the Cover Classes and Number of Spectral Classes within each Cover Class Defined for the CAMIS Study Area.

Cover Class	Number of Spectral Classes	Description of Cover Class
Tupe	2	Water tupelo; generally restricted to narrow ox-bow lakes and other areas of inundated soils.
Crop	2	Row crops and small grain crops in varying stages of maturity.
Past	4	Pasture and old fields; plant cover varies from healthy,improved pasture grasses to senescent forbs and invader species
Soil	4	Bare soil areas associated with agricultural activities; varies in sand, clay, and organic material content as well as moisture content.
Hdwd	2	Old age bottom-land hardwood; found in pure dense stands to stands with large inter-crown gaps.
Ccut	6	Areas subjected to clearcut forestry practices; ground cover comprised of dry to inundated soils with varying amounts of residual or regeneratin vegetation.
Pine	3	Pine forest areas; primarily slash with long-leaf and loblolly common; occurs at various stages of maturity in even-aged stands.
Watr	4	Water; includes the Wateree River,dark marsh water, and water associated with surface mining.

Table 2. Spectral Class Means and Standard Deviations for all 7 Channels of the Included 27 Spectral Classes*

	1	2	3	4	5	6	7
CCUT1	63.09 2.06	59.15 2.63	44.32 3.80	60.83 15.36	54.32 16.12	39.04 12.02	61.17 16.35
CCUT2	66.04 3.93	72.63 4.73	61.02 6.30	118.59 15.83	116.99 19.06	84.05 14.99	125.24 20.92
CCUT3	63.00 1.93	61.03 2.14	43.89 3.38	104.19 14.79	94.39 14.32	59.00 8.45	78.17 10.49
CCUT4	77.76 3.30	81.45 5.61	81.48 10.01	106.62 7.40	111.36 13.01	111.36 19.00	163.88 27.19
CCUT5	75.76 3.51	85.48 4.01	84.29 5.68	116.48 1.91	133.33 2.20	122.38 5.90	210.24 12.49
CCUT6	95.39 7.40	110.61 10.04	113.06 13.04	126.94 7.59	145.28 8.02	143.11 11.36	179.72 60.46
PINE1	54.88 1.87	54.39 1.60	41.09 3.11	99.17 9.07	95.42 6.58	50.95 4.71	85.11 11.47
PINE2	56.08 1.97	52.80 2.18	35.79 2.93	105.82 8.96	98.38 7.88	45.08 4.18	68.44 7.98
PINE3	55.47 1.53	57.45 1.60	49.06 2.60	95.78 4.06	102.29 3.46	72.65 5.47	135.48 12.67
HDWD1	56.53 1.87	53.62 2.15	33.73 1.97	145.01 9.46	119.79 7.86	50.71 4.59	62.18 5.16
HDWD2	57.11 2.15	54.54 2.96	33.80 2.45	164.69 9.85	136.34 7.96	56.91 4.86	64.42 5.20
TUPE1	59.83 2.01	63.64 6.62	39.15 4.08	142.54 6.35	117.49 4.77	54.80 2.75	59.52 4.03
TUPE2	58.66 1.77	64.22 3.05	38.28 2.07	164.03 9.50	133.22 7.57	55.92 2.76	56.48 3.92
SOIL1	80.01 4.98	89.40 7.07	91.80 8.48	92.42 6.19	100.91 8.43	107.50 10.44	175.09 30.92
SOIL2	94.15 5.36	11.96 6.56	104.83 9.60	119.60 7.50	125.13 7.48	120.27 9.35	105.52 7.30
SOIL3	88.42 3.51	101.55 6.87	100.30 8.16	98.02 2.45	103.30 12.75	93.07 15.18	106.32 3.37

Table 2. Spectral Class Means and Standard Deviations (cont.)

	1	2	3	4	5	6	7
SOIL6	120.91	156.90	165.08	165.14	166.45	167.68	111.38
	8.93	11.69	16.92	13.62	11.42	11.92	16.02
CROP1	66.76	67.28	45.00	206.99	146.92	55.63	67.38
	4.07	7.36	9.50	10.68	6.83	10.18	8.13
CROP2	60.65	68.29	50.38	155.07	125.45	53.80	85.85
	1.49	2.75	3.94	10.69	6.13	3.32	7.20
PAST1	66.03	70.67	48.88	177.40	150.98	71.20	101.25
	1.63	1.87	1.96	15.61	8.69	3.53	7.72
PAST2	70.70	73.17	61.71	123.26	133.81	102.30	145.08
	4.53	4.56	7.20	11.95	8.88	13.71	23.38
PAST3	72.10	83.71	73.55	145.83	156.12	123.71	192.21
	1.68	2.33	5.70	4.38	3.14	5.76	16.07
PAST4	71.75	76.82	57.55	173.27	164.23	99.13	135.80
	1.55	2.46	2.46	7.46	4.45	3.67	7.97
WATR1	64.25	65.75	51.29	34.46	23.04	11.56	28.38
	3.87	4.39	3.50	15.82	15.54	6.93	5.31
WATR2	66.52	56.29	40.88	31.58	22.00	13.20	59.31
	2.47	3.35	3.82	9.36	8.07	4.90	5.77
WATR3	137.55	184.70	127.04	46.83	30.15	21.81	65.40
	11.12	17.34	8.34	13.23	16.[illegible]0	15.62	7.55
WATR4	74.71	73.33	42.73	36.59	29.82	18.94	70.37
	2.40	2.38	1.60	11.80	11.86	7.78	4.48

*Within each spectral class, the upper element is the mean and the lower is the variance.

Channel Number	Band
1	0.45 - 0.52 μm
2	0.52 - 0.60 μm
3	0.63 - 0.69 μm
4	0.76 - 0.90 μm
5	1.00 - 1.30 μm
6	1.55 - 1.75 μm
7	10.4 - 12.50 μm

2. Selection of Test Data

Three separate test data sets will be used in the evaluation of the classification of the TMS data; two sets defined using a stratified sampling procedure incorporating a grid system with dimensions of 50 lines by 50 columns and the other based upon an analyst-supervised set of test fields.

(a) Supervised Test Data Set

The supervised test data set was selected by two analysts in such a fashion as to represent all major cover types present in the study site, and to obtain test data from throughout the study site in case there were any along or across-track variation which might still be present in the data, i.e., even subsequent to all radiometric corrections applied. Table 3 depicts the number of pixels for each cover class selected by this procedure.

(b) Grid Test Data Set

A procedure was developed to define a set of test fields in the 1979 data in a manner which was essentially free of possible bias introduced by the analyst doing the selection. In order to achieve this, a grid system was introduced in the imagery at intervals of 50 lines and 50 columns, starting at line 200 and ending at line 800 in the along track direction and occuring from column 0 to column 250 across the imagery.

This procedure yielded 78 intersection points in the data. At each of the intersection points a test field was defined, based upon the following criteria:

Table 3. Number of Supervised Test Pixels Contained within each Cover Class

Cover Class	Tupe	Crop	Past	Soil	Hdwd	Ccut	Pine	Watr
Number of test pixels	210	197	124	606	3032	537	577	164

Total 5447 = 2.4% of the total area.

Table 4. Number of Test Pixels selected by the Grid Test Procedure within each Cover Class.

Cover Class	Tupe	Crop	Past	Soil	Hdwd	Ccut	Pine	Watr
Number of test pixels	126	133	4	261	8181	163	1299	28

Total 10195 = 4.5% of the total area

(1) Test fields could only be defined at the designated grid intersections.

(2) The grid intersection formed the upper left corner of the test field; thus the analyst was responsible only for defining the lower right corner.

(3) The size of the test field at each grid intersection was not to exceed 25 lines by 25 columns.

(4) Subject to the limitation described in 3 above, the test field at each grid intersection was to be as large a sample as possible of the cover type occurring at the intersection.

(5) In those cases where a grid intersection occurred at the boundary of two cover types, the analyst was allowed to move the upper left corner of the test field to the right by a distance not to exceed five columns in order to define a test field within a single cover type.

The method chosen for overlaying the 50 by 50 grid on the 1979 color infrared (CIR) photography of the flight line was to use a Bausch and Lomb Zoom Transfer Scope (ZTS) with the CIR print on the upper stage, and a Varian print of the multispectral scanner (MSS) imagery containing the 50 by 50 grid positioned on the table below the ZTS. This procedure allowed the grid from the MSS data to be transferred to acetate overlays on the minimum number of CIR photos required to cover the flight line.

Upon beginning the transfer process with the ZTS, several methods were tried before the final technique was adapted. As a result of the experience gained with each trial, the transfer of points was accomplished with the following general guidelines:

(1) The higher powered, narrower field of view objective was utilized on the ZTS. Experimentation with the wide field of view objective indicated too wide a variation of image geometry to be accomodated by the range of adjustments available on the ZTS. The narrower field of view was sufficient to cover a full 50 by 50 grid cell when properly positioned in the ZTS.

(2) The geometry of the imagery should be correlated to the photo as well as possible in the immediate area of the grid intersection being transferred to the photo. It was found that even with only a 50 by 50 area of the scanner imagery being viewed at one time, the geometry was often varying enough to make it extremely difficult to achieve a totally accuarate overlay of the scanner data and the CIR image over the entire 50 by 50 area.

(3) It was more expedient to work down the flightline in the along track direction than to work in the cross track direction. This was true because the variation of the imagery scale in the cross track direction required more adjustment at each area where the ZTS was trying to transfer a point, while less adjustments were generally required between points in the along track direction.

Once the grid was overlaid on the acetate for the CIR prints, two analysts independently selected the maximum size test field at each grid intersection and indicated the cover type present. Their results were compared and any conflicts of size of test areas were reconciled. A third analyst, more experienced in determination of cover types, also independently identified the cover types present at each grid intersection, and then the final cover type designations were made based on the three independent determinations. These cover type designations were checked against those developed in the training process to assure compatibility.

The results of implementation of this grid technique at the 78 points in the flightline could have resulted in a maximum of 78 test fields each 25 rows by 25 columns in size, or a total of 48750 pixels. This maximum or best case situation would have resulted in 27.2% of the pixels in the flightline being used as test fields. Completion of the selection of test field via the grid required that any test fields in conflict with previously designated training fields or cluster blocks be reduced in size until the conflict was removed. A summary of the number of pixels of test areas per class is presented in Table 4. As indicated, the actual number of test pixels obtained using this technique was 10195, or 4.5 percent of the total data. A potentially significant problem with this procedure is indicated in Table 3 by the fact that the cover types are poorly represented in the test data set. This problem indicated a need for a different method of selecting test data in a statistically unbiased manner.

(c) Sample Block Test Data

The method determined to offer the best solution to the problems previously encountered in defining test data sets involves the following steps:

(1) A set of primary sample blocks or units is designated in the data set, each of which is 25 x 25 pixels in size.

(2) The sample blocks should be located at intervals of every 50 lines and columns, starting at the northwest corner of the data set, thereby allowing approximately 25 percent of the area to be included within these sample blocks.

(3) Within each sample block the analyst will define a single test field for each cover type or information class present.

(4) These test fields shall be defined so as to include the largest possible rectangle of each cover type or information class within the sample block.

B. Classification of 1979 TMS Data

The supervised training data set was used to generate training statistics. A per-point Gaussian Maximum-likelihood classification of the data was then obtained.

The classification was evaluated using the supervised test data set. Separability of all interclass spectral class pairs and the relatively high training class performance (Table 5) gave no indication of the resulting poor test class performances for some of the cover classes, as shown in Tables 6 and 7. This may have resulted from inadequate representation of the true variability of some of the cover classes, such as the class tupelo in which the training areas consisted of relatively small but homogeneous stands. In many cases, as with the confusion between tupelo and hardwood, we were surprised at the apparent lack of separability since these two classes are distinctly different on the color IR photography and in the visible and middle infrared wavelength bands of the TMS data. There is some possibility that these classification results may serve to indicate some of the possible

Table 5. Classification Performance Evaluation from Classification of Training Data with 27 Class Training Statistics.

Wavelength Bands Used: 0.45-0.52, 0.52-0.60, 0.63-0.69, 0.76-0.90, 1.00-1.30, 1.55-1.75, 10.40-12.50 μm.

	No. of Pts.	% Correct	Ccut	Pine	Hdwd	Tupe	Soil	Crop	Past	Watr
Ccut	335	100.0	335	0	0	0	0	0	0	0
Pine	962	99.5	3	957	1	0	0	0	1	0
Hdwd	2732	95.8	3	3	2618	108	0	0	0	0
Tupe	240	93.8	0	0	15	225	0	0	0	0
Soil	344	99.7	1	0	0	0	343	0	0	0
Crop	451	99.8	0	0	0	0	1	450	0	0
Past	325	98.2	5	0	1	0	0	0	319	0
Watr	460	99.8	1	0	0	0	0	0	0	459

Overall Classification Accuracy (5706/5849) = 97.6%

Table 6. Classification Performance Evaluation from Classification of Test Data with 27 Class Training Statistics.

Wavelength Bands Used: 0.45-0.52, 0.52-0.60, 0.63-0.69, 0.76-0.90, 1.00-1.30, 1.55-1.75, 10.40-12.50 µm.

	No. of Pts.	% Correct	Ccut	Pine	Hdwd	Tupe	Soil	Crop	Past	Watr
Ccut	427	76.1	325	24	3	1	21	0	51	2
Pine	564	92.9	17	524	6	0	2	0	15	0
Hdwd	3032	95.5	7	17	2895	112	0	0	1	0
Tupe	175	49.7	0	0	85	87	0	0	3	0
Soil	863	92.1	17	0	0	2	795	20	17	12
Crop	152	46.1	5	5	4	0	7	70	61	0
Past	124	50.8	43	3	15	0	0	0	63	0
Watr	162	84.0	8	0	0	0	13	0	5	136

Overall Classification Accuracy (4895/5499) = 89.0%

Table 7. Classification Performance Evaluation from Classification of Test Data with 27 Class Training Statistics with the Classes Hardwood and Tupelo, and Crop, and Pasture Grouped into the Informational Classes Hardwood and Agriculture Respectively.

Wavelength Bands Used: 0.45-0.52, 0.52-0.60, 0.63-0.69, 0.76-0.90, 1.00-1.30, 1.55-1.75, 10.40-12.50 μm.

	No. of Pts.	% Correct	Ccut	Pine	Hdwd	Soil	Agri	Watr
Ccut	427	76.1	325	24	4	21	51	2
Pine	564	92.9	17	524	6	2	15	0
Hdwd	3207	99.1	7	17	3179	0	4	0
Soil	863	92.1	17	0	2	795	37	12
Agri	276	70.3	48	8	19	7	194	0
Watr	162	84.0	8	0	0	13	5	136

Overall Classification Accuracy (5153/5499) = 93.7%

Table 8. Locational Information for Preprocessed NS 001 MSS Data Obtained on August 29, 1980.

Flight Line	1S
Original Data As It Arrived From NASA/JSC January 20, 1981	R(80000300)T(5246)F(1)[1]
Columns Reversed and Geometrically Adjusted	R(80000300)T(2665)F(1)
Response Level Adjusted by Column (15.3 x 15.3 m)	R(80000300)T(5246)F(2)
Degraded Spatial Resolution (30.6 x 30.6 m)	R(80000300)T(2665)F(2)

[1] R = Run No.; T = Tape No.; F = File No.

limitations of using a supervised training procedure. Such limitations may further be defined with the comparison of the classification results from the supervised training statistics and the unsupervised, multicluster block statistics particularly when both are evaluated with the same test data set.

C. Radiometric Adjustment of the August, 1980 MSS Data

The need for and objective in radiometrically adjusting the MSS data have been given in a previous quarterly progress report (reporting period: September 1, 1979 - November 30, 1979). However, the method used to radiometrically adjust the 1980 MSS data set was somewhat different than the method used to adjust the 1979 MSS data set.

The method used to adjust the 1979 data set required homogeneous areas to be identified which appear to have no across-track stratification of covertype. In assessing the characteristics of Flightline 1-S in preparation for the radiometric adjustment of the 1980 data set, it was determined that there were no areas in the data set that fully met this criteria. Therefore, a new approach was devised for the 1980 data set to determine the effect of changes in reflectance associated with changes in viewing angle. Figure 1 provides an overview of the process utilized, followed by a more detailed description of the various phases of this process.

The approach used for the 1980 data set consisted of looking at homogeneous blocks of a single cover type located at regular intervals across the flight line. A set of columns, each of which was 20 pixels wide were marked across the flight line. Homogeneous fields of old growth hardwood cover types were located within each column group. Old

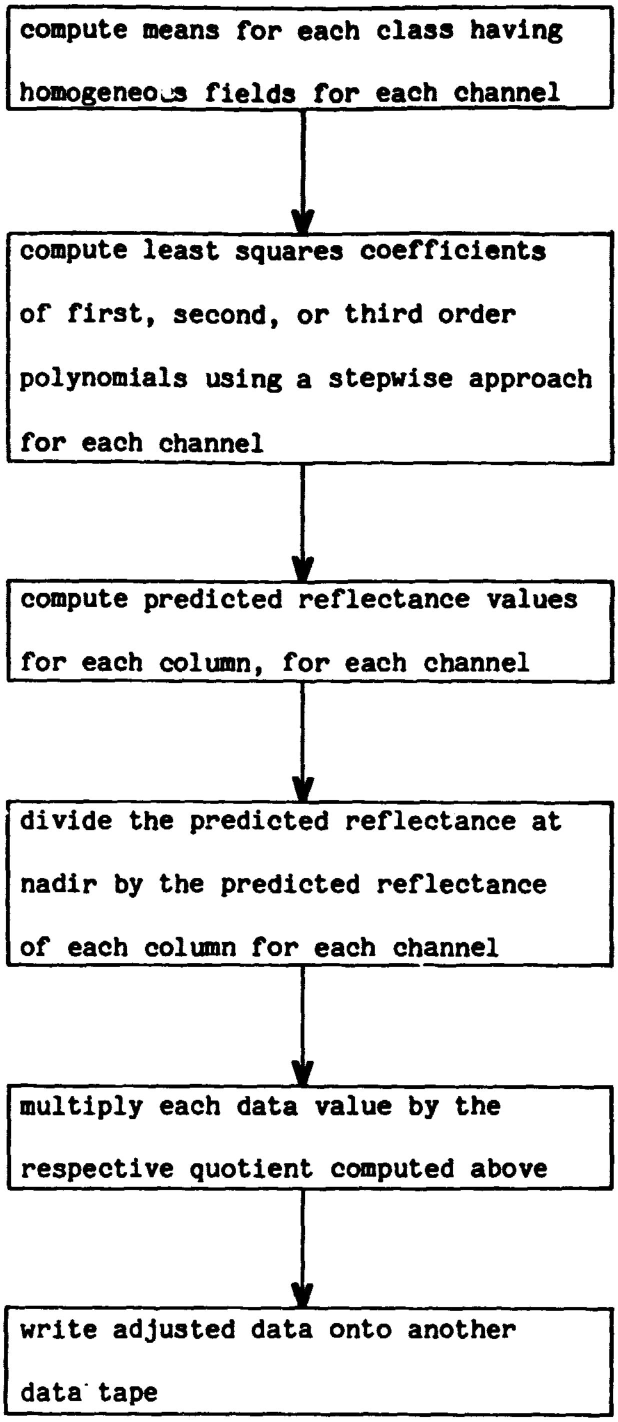

Figure 1. Flowchart of steps taken to radiometrically adjust 1980 MSS data set in an attempt to remove radiometric variance associated with viewing angle.

growth hardwood stands were successfully located in 16 of the column groups (see Figure 2). Mean and standard deviations were calculated for each column group or class, and coincidental spectral plots illustrating the change of reflectance across the flight line were obtained (see Figure 3).

Using the means of the 16 classes a regression analysis was then run using first, second, and third degree polynomials for each channel. The regression equations used were:

$$\hat{Y}_{ij} + \beta_{oj} + \beta_{1j}X + \varepsilon_{(ij)}$$
$$\hat{Y}_{ij} = \beta_{oj} + \beta_{1j}X + \beta_{2j}X^2 + \varepsilon_{(ij)}$$
$$\hat{Y}_{ij} = \beta_{oj} + \beta_{1j}X + \beta_{2j}X^2 + \beta_{3j}X^3 + \varepsilon_{(ij)}$$

where:

$\hat{Y}_{ij}$= predicted reflectance level of the ith column of the jth channel;

X = fractional location within class across the flight line; .55, ..., 28.95

X^2 = fractional location squared (.55) , ..., (28.95)

X^3 = fractional location cubed (.55) , ..., (28.95)

β_{oj} , β_{1j}, β_{2j} , β_{3j} are the least squares fitted coefficients of the regression model variables for the jth channel (each beta for each channel is different). The graphs in Figure 4 illustrate the attempt to remove radiometric variance associated with viewing angle.

The difference between the class means before the adjustment ranges between 6 and 43 digital counts or radiance values. After the

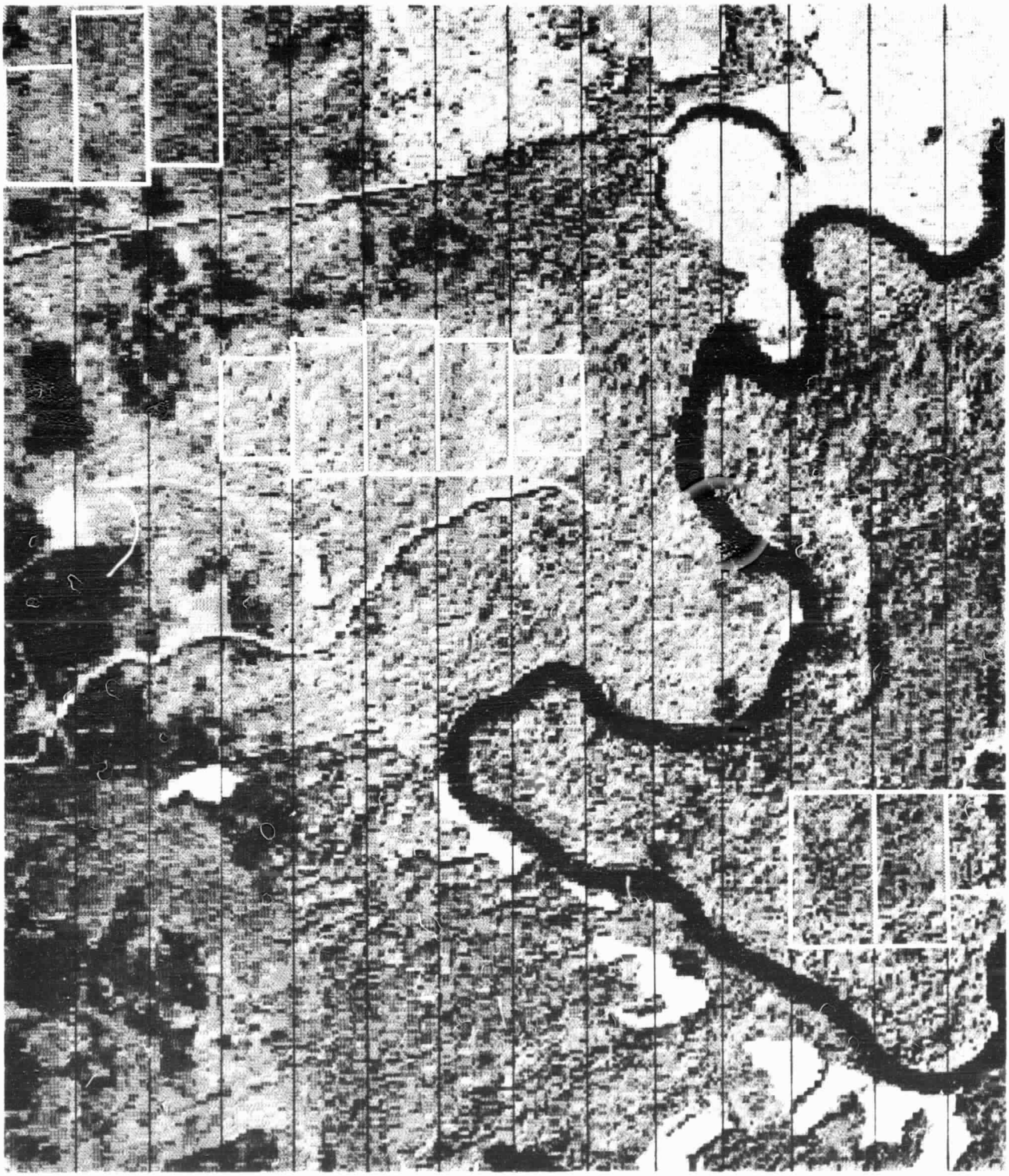

Figure 2. Location of fields within the column groups for a portion of the flight line.

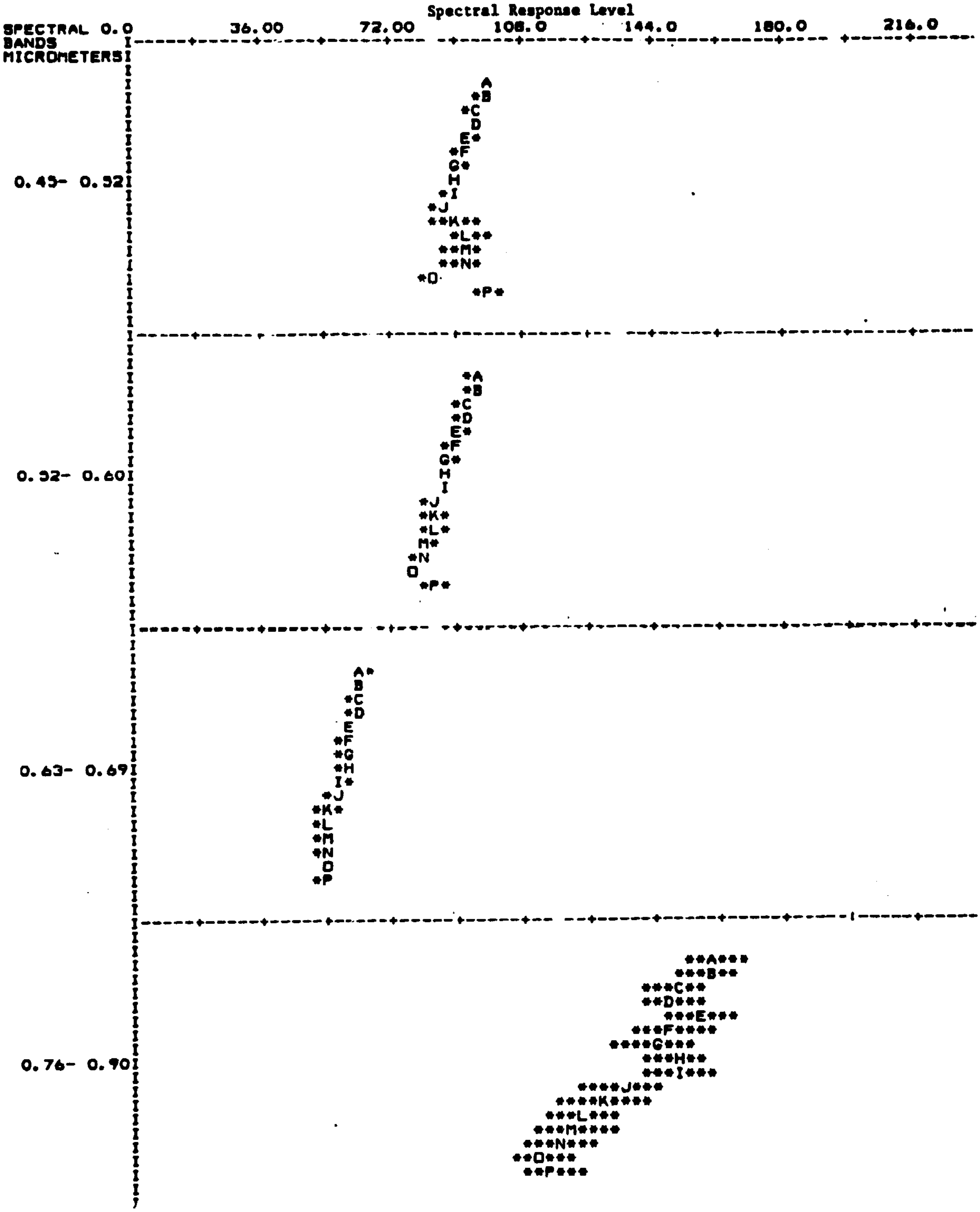

Figure 3. Coincidental spectral plots of the 16 classes which had homogeneous fields.

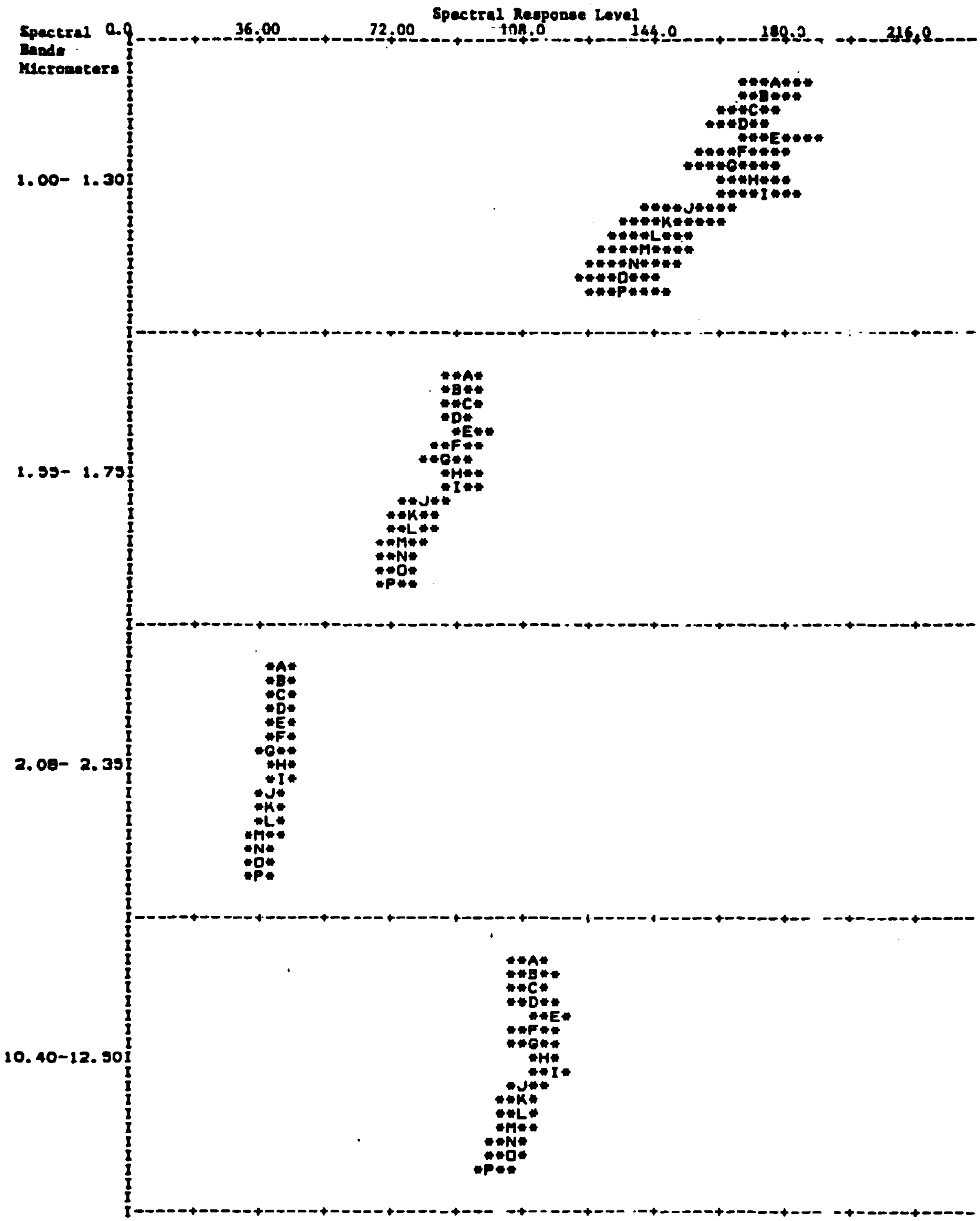

Figure 3. (Continued)

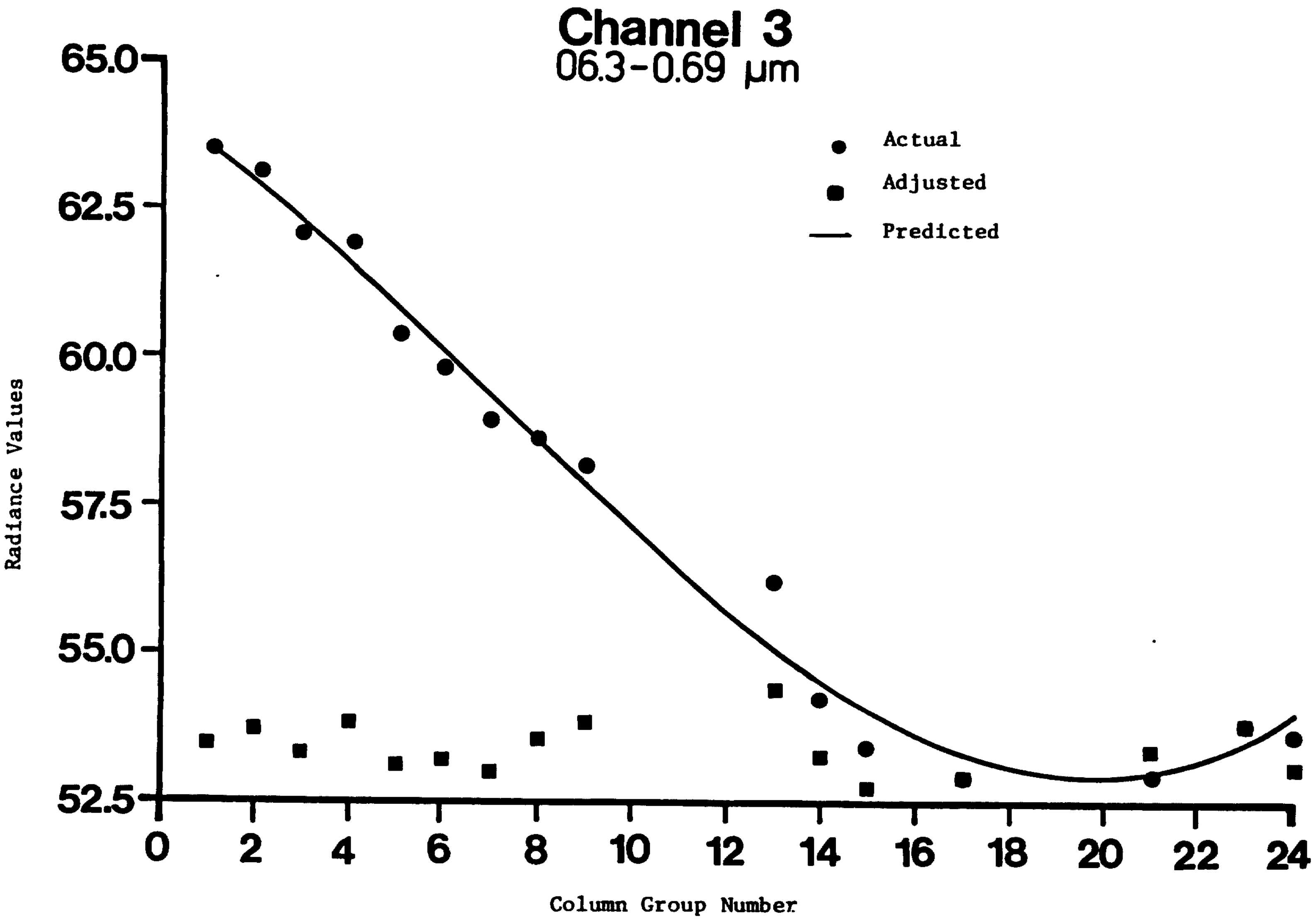

Figure 4. Mean column group response before and after applying the radiometric adjustment.

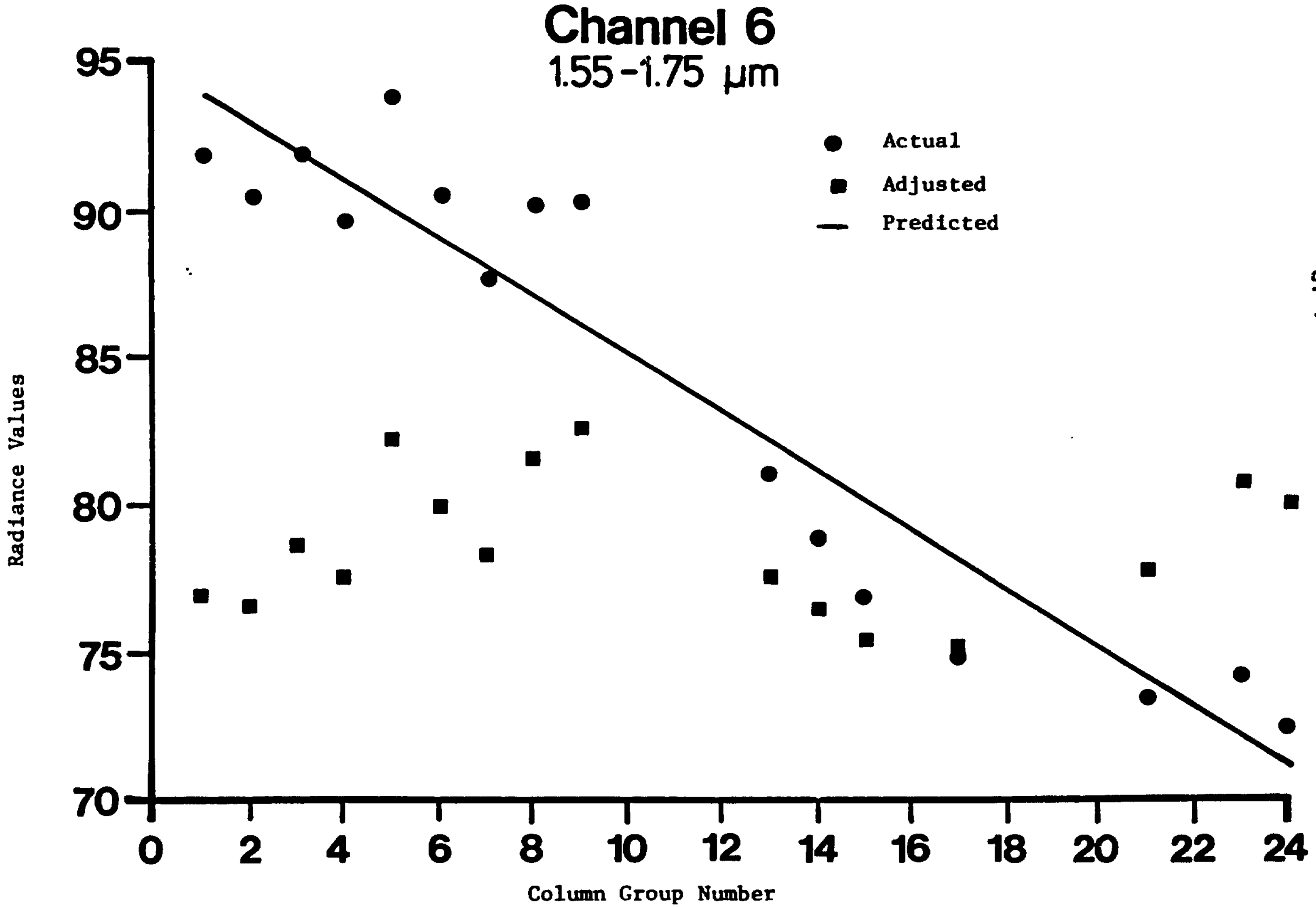

Figure 4. (Continued)

adjustment the difference between class means ranges between 1 and 17 digital counts. An easy method to determine if there were any effects remaining due to changes in reflectance across the flight line was to conduct a regression analysis of the adjusted class means. The regression analysis found that as one moved across the flight line the x-variable, location across flight line, was not significant at an alpha level of 0.05. These results indicate that the radiometric adjustment has been successful in removing the effect of changes in viewing angle (see Figures 5 and 6).

D. Redigitization of SAR Data

The redigitization of the HH and HV polarization images were completed by the Lockheed Corporation at the Johnson Space Center. The 7-track tapes containing the digitized data arrived at LARS on March 13, 1981.

After producing 9-track tapes from the 7-track tapes, it was determined that there were several problems with the HH polarized data (the problems are discussed in detail in the section entitled Problems Encountered). Mr. Norman Hatcher and personnel at Lockheed were notified of the problem, and redigitization of the HH polarization image was done. The 7-track tape of the HH polarized data arrived at LARS on May 26, 1981 and has been copied onto a 9-track tape. Histograms of this most recently digitized data set and varian plotter gray-scale printouts indicate that an appropriate gain setting was used and that the data should be satisfactory for analysis.

Figure 5. Varian imagery of the radiometrically unadjusted 1980 MSS data (channel 5).

Figure 6. Varian imagery of the radiometrically adjusted 1980 MSS data (channel 5).

E. Qualitative Analysis of SAR Imagery

Preliminary results have been obtained from the qualitative analysis of the SAR imagery. These results do not include a comparison between the SAR imagery and the color infrared photography or a detailed analysis of the forest cover types on the imagery.

Beside the distinctive band effect on the HH image, there is also a tonal variation related to range angle on the HV image which impacted the ability of the interpretor to determine various cover types. The procedures used to interpret the radar images consisted of three general steps:

1. Identify various forest cover types on color infrared photography using standard photo-interpretation techniques, supplimented by field observation data.
2. Locate forest cover types on both polarizations of the radar imagery, and determine if tonal and/or textural differences exist.
3. Compare and evaluate tonal and textural differences between the HH and HV polarized images for each cover type.

In general, the results have shown that the overall tonal contrast between features is greater on the HH image. Dense stands of deciduous forest cover in the alluvial plain near the river are easily identified on the HH image due to a distinctive light tone, whereas on the HV polarization these areas have a somewhat darker tone. The tonal contrast and shadow effects between old growth deciduous forest cover and second growth forest cover are more distinct on the HH image. Conifer stands tend to have a fairly uniform, relatively dark tone on the HH image, whereas on the HV image they have a slightly higher contrast, speckled appearance. This distinctive difference in appearance between the two polarizations allow conifer stands to be separated fairly easily. Recent clearcuts are very dark in tone in both polarizations as compared to the surrounding forest cover. Older clearcuts have a light gray tone on the HV image that tend to be very similar to the surrounding forest cover, whereas on the HH image the clearcuts are darker in tone, thereby providing more contrast. The shadow and edge effect due to large differences in vegetation height is much more prevalent on the HV image, which helps to delineate the boundary of clearcuts. Other features such as water and fields with bare soil are black in tone in both polarizations; however, the shapes and some speckling of the agricultural fields can be used to separate them from the water.

The analysis of the dual-polarized SAR imagery has shown that certain forest cover features are more easily identified in one polarization than the other, while other features look very similar in both polarizations. Neither polarization is consistantly better for identifying the various forest cover types examined. These results suggest the usefulness of a dual-polarized SAR system for mapping forest cover. The results of this evaluation will be used in the second phase of the data analysis to define appropriate cover type classes for computer-aided classification of digitized SAR imagery.

The information presented in this section has been further summarized to be given as a poster paper during the Seventh International Symposium on Machine Processing of Remotely Sensed Data.

The Symposium will be held during June 23-26, 1981 at Purdue University.

II. Problems Encountered

The HH polarized data set, redigitized during March, 1981, had a distribution with two independent peaks. Figure 7a. shows a computer histogram of the data. Over 15 percent of the total data is represented in the largest peak, with the response level of the peak being 255. The problem with this data is that a large portion of the detail in the higher reflectance values is saturated into a single bin. Mr. Dennis Taylor, Lockheed Electronics Corp., who had been helping in the digitization process of the SAR data, was notified of the problem.

The saturation in the highest bin was apparently caused by using the same gain setting for the digitization of both the HV and HH polarized images. The contrast of the HV image is much lower than the HH image, i.e., the range of response values is less on the HV image than on the HH image. Using a higher gain setting to stretch the response values on the HV image and then to use the same gain setting on the HH image would cause the range of values to be widened even further on the HH image, thereby saturating the last bin. Figure 7b. shows the computer histogram of the latest attempt to redigitize the HH image using a different gain setting (the HH image was redigitized during May, 1981). It appears that the quality of this data set is good, and the digitized SAR data now at LARS can be utilized in the quantitative analysis of the SAR data.

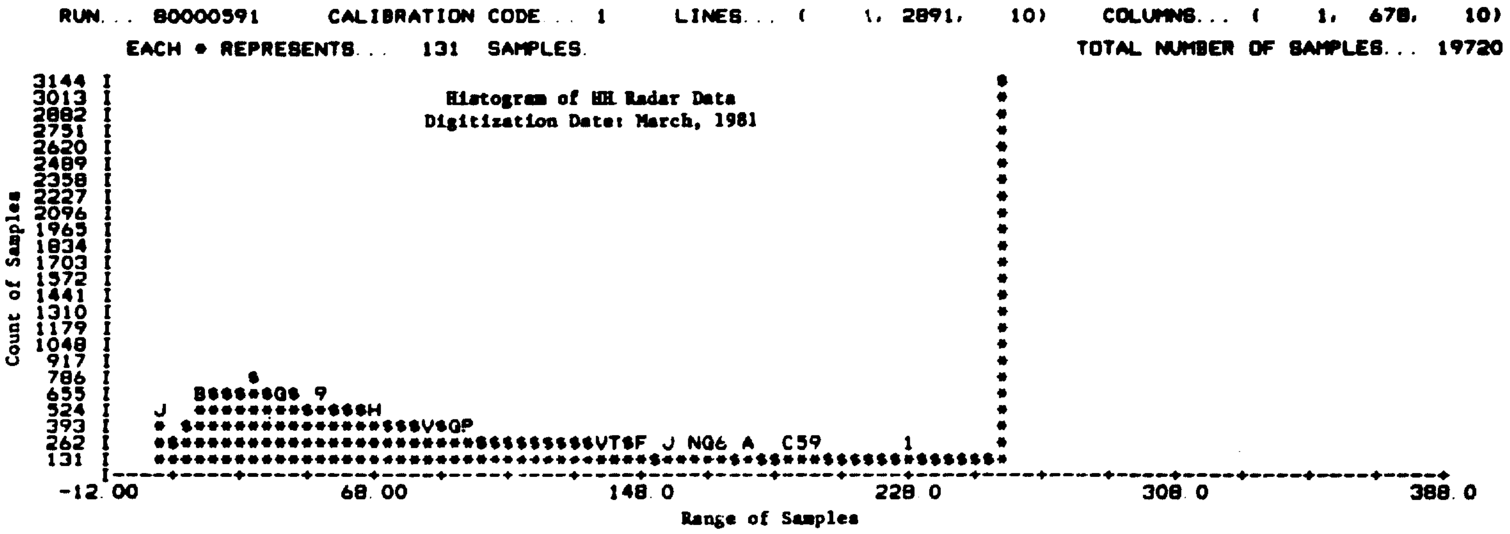

Figure 7a.

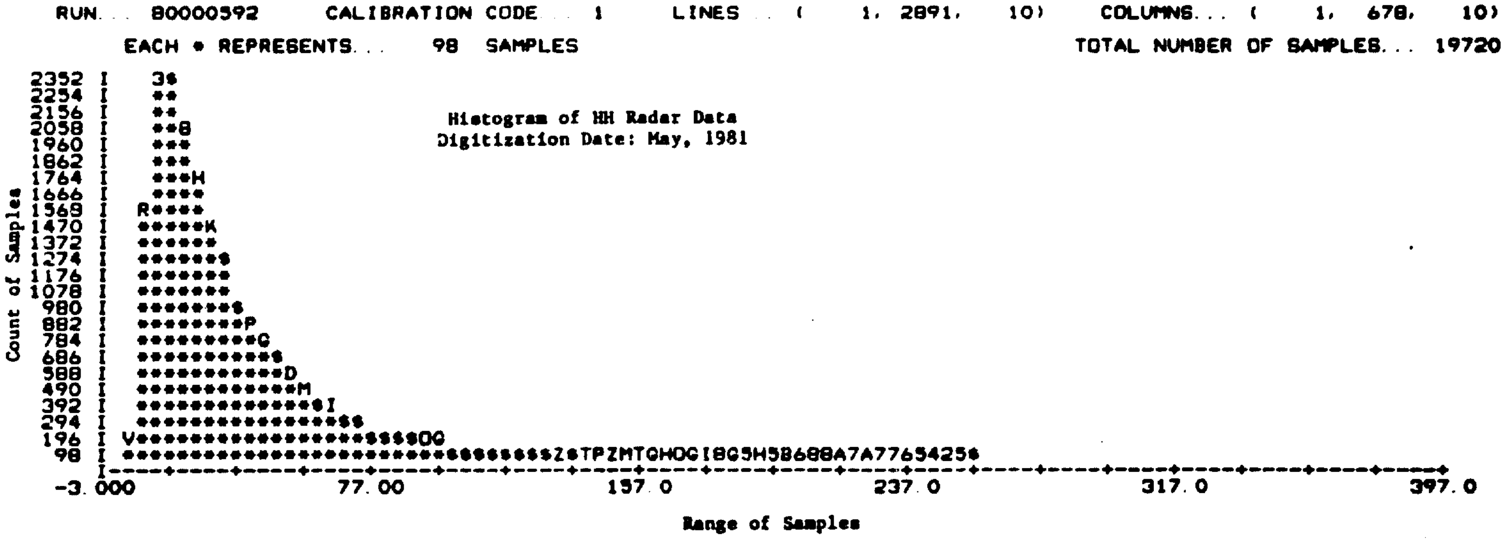

Figure 7b.

Figure 7. Computer histogram of the digitized 1980 SAR imagery.

III. PERSONNEL STATUS

The following personnel committed the respective percentages of time to the project during the past quarter:

Name	Position	Ave. Monthly Effort (%)
Dean, Ellen	Research Associate	58
Hoffer, Roger	Principal Investigator	35
Knowlton, Doug	Research Associate	58
Prather, Brenda	Secretary	47

IV. ANTICIPATED ACCOMPLISHMENTS

The following are the anticipated accomplishments for the forthcoming quarter (June 1 - August 31, 1981):

1) Digital overlay of HH and HV polarized SAR data

2) Computer classification of cross-polarized SAR data

3) Complete work on and presentation of a poster paper entitled "Radar Imagery for Mapping Forest Cover Types" by Douglas J. Knowlton and Roger M. Hoffer, at the 7th International Symposium on Machine Processing of Remotely Sensed Data.

4) Complete the writing of, and present a paper entitled "Classification Accuracy Due to Spatial Resolution with Two Classifiers" by R. S. Latty and R. M. Hoffer, at the 7th International Symposium on Machine Processing of Remotely Sensed Data.

5) Development of training and test data sets for the August 1980 TMS data; analyze the spectral characteristics and conduct a wave band evaluation of this data set.

6) Process the 1980 TMS data using the Principal Components Transformation, and classify the transformed data.

7) Conduct a field trip to the South Carolina Test Site area to evaluate classification rsults and verify training and test sets.