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Cameron County Saline Soil Study

INTRODUCTION

The multispectral scanner (MSS) digital data summarization from the eight saline study areas in Cameron County, for the Bendix 24-band MSS, the SKYLAB S192 MSS, and the LANDSAT-1 MSS has been finished and correlation analysis of these data with electrical conductivity (ECe) measurements have been completed. The saline soil study and ECe measurements taken are described in the Weslaco SKYLAB MPR #9, dated September, 1974. Coverage of Bendix 24-band MSS data and SKYLAB S192 MSS data for the saline soil study area are described in the Weslaco SKYLAB MPR #11, dated November, 1974, and the Weslaco SKYLAB MPR #13, dated January, 1975, respectively. The coverage from LANDSAT-1 has only recently been determined and has not been reported to date.

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MATERIALS AND METHODS

Computer compatible digital tapes (CCT) were obtained from four data sources: the December 11, 1973, Mission 258 aircraft overflights (Bendix 24-band MSS) at 5,700 ft and 16,000 ft; the December 11, 1973, LANDSAT-1 overpass (4-band MSS); and the December 5, 1973, SKYLAB overpass (13-band MSS). Threshold values for distinguishing among water, vegetation, and bare soil were determined using band 10 (0.981 to 1.045 μm) for the Bendix 24-band MSS, band 7 (0.78 to 0.88 μm) for the SKYLAB S192 13-band MSS, and MSS 7 (0.8 to 1.1 μm) for the LANDSAT-1 4-band MSS. These threshold values permitted studies of salinity effects on bare soil and vegetation separately and also permitted editing out MSS digital values caused by water. Additional threshold values were determined for the SKYLAB S192 MSS data to permit editing out digital values caused by clouds and cloud shadows.

Line printer gray maps were generated, using CCT, for each of the four MSS data sources to locate the MSS digital data values corresponding to the eight saline study areas. The mean MSS digital data values within each saline area was determined for bare soil and vegetation categories separately. Simple linear correlation analysis was used to relate the ECe measurements to the mean MSS digital data values from bare soil and vegetation separately for each of the four data sources. Correlation analysis of ECe measurements was also determined for the digital value difference and ratio between bare soil and vegetation. The rationale was that the reflectance contrast between bare soil and vegetation (i.e., MSS digital value difference or ratio between bare soil and vegetation) should be better indicators of salinity effects than bare soil or vegetation individually.

RESULTS AND DISCUSSION

Simple linear correlation analysis showed that Bendix 24-band MSS digital data collected at 5,700 ft was better correlated to ECe measurements than MSS data collected at 16,000 ft. Correlation coefficients (Table 1) ranging from 0.045 to -0.853** for MSS data collected at 5,700 ft and ranging from 0.0 to -0.828** for MSS data collected at 16,000 ft, considering bare soil (BS), vegetation (VEG), VEG-BS, and VEG/BS, support this conclusion.

Multispectral scanner data collected at 5,700 ft was correlated highest with ECe measurements for the difference between vegetation and bare soil ($r = -0.853^{**}$; band 23) as compared with bare soil ($r = 0.827^{**}$; band 9), vegetation ($r = -0.826^{**}$; band 23), and the ratio of vegetation and bare soil ($r = -0.841^{**}$; band 23). At 16,000 ft the ratio of vegetation and bare soil was correlated highest ($r = -0.862^{**}$; band 7) with ECe measurements. These results show that a measure of the vegetation and bare soil contrast is the best indicator of saline soil effects, as compared to vegetation and bare soil individually, at aircraft altitudes.

Initially, correlation analysis showed that SKYLAB S192 and LANDSAT-1 MSS mean digital values were not very well correlated to ECe measurements as compared to the Bendix 24-band MSS data. Correlation coefficients (Table 2) ranging from 0.029 to -0.656**, for S192 MSS data (N = 7), and 0.075 to -0.568* for LANDSAT-1 MSS data (N = 8), show that even though some of these correlations were significant, they were too small to be conclusive. Using graphical methods it was found that saline area H, using SKYLAB S192 MSS data, and saline area G, using LANDSAT-1 MSS data, deviated significantly from a linear relationship with ECe measurements, and were deleted from the analysis and new correlation coefficients determined.

The new correlation coefficients (Table 2) show that the SKYLAB S192 MSS data and LANDSAT-1 MSS data are highly correlated to the ECe measurements. Correlation coefficients ranging from 0.051 to -0.963**, for SKYLAB S192 MSS data (N = 6), and ranging from 0.170 to -0.859**, for LANDSAT-1 MSS data (N = 7), considering bare soil (BS), vegetation (VEG), VEG-BS, and VEG/BS, support this conclusion.

Highest correlations were found using the difference between vegetation and bare soil, for both SKYLAB S192 MSS data ($r = -0.963^{**}$; band 10) and LANDSAT-1 MSS data ($r = -0.859^{**}$; band 7), as compared with bare soil, vegetation, or the vegetation and bare soil ratio. These results show that a measure of the vegetation and bare soil contrast is the best indicator of saline soil effects, as compared to vegetation and bare soil individually, at satellite altitudes as well as aircraft altitudes.

CONCLUSION

Saline areas selected in Cameron County with low, medium, and high salinity levels may be distinguishable using MSS digital data from either aircraft or satellite altitudes. A measure of the contrast between vegetation and bare soil was found to be the best indicator of saline soil effects, as compared to vegetation and bare soil individually.

Starr County Saline Soil Study

A manuscript is being prepared entitled "Distinguishing Saline from Nonsaline Rangelands with SKYLAB Imagery," by J. H. Everitt, A. H. Gerbermann, and J. A. Cuellar. We tentatively plan to include a preliminary draft of the paper in the next report.

TABLE 1 SIMPLE LINEAR CORRELATION ANALYSIS RELATING SOIL SALINITY LEVELS (ELECTRICAL CONDUCTIVITY READINGS) TO EACH OF BARE SOIL (BS), VEGETATION (VEG), VEG-BS, AND VEG/BS BENDIX 24 BAND MSS DIGITAL DATA. DATA WAS COLLECTED FROM PAREDES LINE ROAD AND FARM ROAD 510 ON DECEMBER 11, 1973 FROM EIGHT SALINE SOIL AREAS AT 5,700 FEET AND 16,000 FEET.

BENDIX MSS BANDS	SALINITY AREAS A THROUGH H CORRELATED WITH (N=8; 5,700 FT):				SALINITY AREAS A THROUGH F CORRELATED WITH (N=6; 16,000 FT):			
	BARE SOIL (BS)	VEGETATION (VEG)	VEG-BS	VEG/BS	BARE SOIL (BS)	VEGETATION (VEG)	VEG-BS	VEG/BS
1	0.671**	-0.241	-0.747**	-0.721**	-0.067	-0.303	-0.401	-0.406
2	0.686**	-0.106	-0.805**	-0.781**	0.357	-0.210	-0.258	-0.250
3	0.656**	-0.296	-0.779**	-0.759**	0.156	-0.290	-0.415	-0.421
4	-0.769**	-0.815**	-0.331	-0.219	0.155	-0.077	-0.183	-0.178
5	0.778**	0.132	-0.679**	-0.635	0.255	-0.042	-0.123	-0.107
6	-0.437	-0.437	-0.260	-0.243	-0.267	-0.140	-0.067	-0.029
7	0.664**	-0.233	-0.555*	-0.528*	0.627*	-0.247	-0.828**	-0.862**
8	0.225	-0.635**	-0.503*	-0.455	0.526	-0.296	-0.790**	-0.851**
9	0.827**	0.728**	-0.684**	-0.621*	0.645*	-0.314	-0.706*	-0.812**
10	0.258	-0.617*	-0.487	-0.444	0.787**	-0.291	-0.549	-0.616*
11	0.763**	0.015	-0.620*	-0.603*	0.487	-0.308	-0.394	-0.411
12	-0.750**	-0.748**	-0.269	-0.077	0.180	-0.334	-0.382	-0.371
13	0.790**	0.740**	-0.850**	-0.697**	-0.088	-0.443	-0.160	-0.253
14	0.528*	-0.300	-0.706**	-0.680**	-0.418	0.316	0.413	0.411
15	-0.464	-0.531*	-0.158	-0.221	0.210	0.252	-0.166	-0.167
16	-0.747**	-0.753**	-0.257	-0.337	0.000	-0.413	-0.413	-0.000
17	-0.241	-0.465	-0.414	-0.404	0.254	0.403	-0.167	-0.159
18	0.462	-0.013	-0.711**	-0.654**	0.268	0.572	-0.094	-0.086
19	-0.740**	-0.758**	-0.174	-0.360	0.210	0.396	-0.120	-0.118
20	0.510*	0.077	-0.657**	-0.580*	0.013	-0.379	-0.142	-0.167
21	-0.565*	-0.719**	-0.354	-0.397	0.058	-0.220	-0.163	-0.168
22	0.045	-0.508*	-0.615*	-0.591*	0.072	-0.072	-0.162	-0.168
23	-0.139	-0.826**	-0.853**	-0.841**	0.301	0.096	-0.331	-0.325
24	0.471	-0.411	-0.541*	-0.519*	0.391	-0.124	-0.707*	-0.644*

* SIGNIFICANT AT THE 5% PROBABILITY LEVEL.
** SIGNIFICANT AT THE 1% PROBABILITY LEVEL.

TABLE 2 SIMPLE LINEAR CORRELATION ANALYSIS RELATING SOIL SALINITY LEVELS (ELECTRICAL CONDUCTIVITY READINGS) TO EACH OF BARE SOIL (BS), VEGETATION (VEG), VEG-BS, AND VEG/BS MSS DIGITAL DATA. DATA WAS COLLECTED FROM PAREDES ROAD AND FARM ROAD 510 ON THE DECEMBER 5, 1973 SKYLAB OVERPASS FROM SEVEN SALINE SOIL AREAS AND DECEMBER 11, 1973 LANDSAT-1 OVERPASS FROM EIGHT SALINE SOIL AREAS.

S192 MSS BAND NUMBER	SALINITY AREAS A,B,C,D,F,G,AND H CORRELATED WITH (N=7):				SALINITY AREAS A,B,C,D,F,AND G CORRELATED WITH (N=6):			
	BARE SOIL (BS)	VEGETATION (VEG)	VEG-BS	VEG/BS	BARE SOIL (BS)	VEGETATION (VEG)	VEG-BS	VEG/BS
1	-0.437	-0.448	-0.307	-0.294	-0.438	-0.481	-0.389	-0.376
2	0.327	-0.355	-0.428	-0.434	0.588*	-0.375	-0.527	-0.530
3	0.153	-0.357	-0.362	-0.370	0.430	-0.358	-0.456	-0.462
4	0.055	-0.250	-0.367	-0.396	0.078	-0.272	-0.505	-0.543
5	-0.357	-0.435	-0.463	-0.475	-0.354	-0.445	-0.492	-0.507
6	-0.110	-0.597*	-0.340	-0.312	-0.136	-0.623*	-0.739**	-0.727**
7	0.000	-0.656**	-0.293	-0.275	0.162	-0.929**	-0.946**	-0.865**
8	0.062	-0.259	-0.198	-0.213	0.159	-0.393	-0.862**	-0.688*
9	0.670**	-0.116	-0.455	-0.525	0.936**	-0.258	-0.876**	-0.905**
10	0.029	-0.548*	-0.277	-0.278	0.184	-0.760**	-0.963**	-0.869**
11	0.064	-0.504	-0.499	-0.479	0.083	-0.626*	-0.722**	-0.680*
12	0.050	-0.567*	-0.513	-0.503	0.051	-0.649*	-0.569	-0.566
13	0.420	-0.157	-0.374	-0.368	0.424	-0.180	-0.423	-0.416

LAND- SAT-1 BAND NUMBER	SALINITY AREAS A THROUGH H CORRELATED WITH (N=8):				SALINITY AREAS A,B,C,D,E,F, AND H CORRELATED WITH (N=7):			
	BARE SOIL (BS)	VEGETATION (VEG)	VEG-BS	VEG/BS	BARE SOIL (BS)	VEGETATION (VEG)	VEG-BS	VEG/BS
4	0.345	0.414	-0.075	-0.096	0.397	0.441	-0.280	-0.292
5	0.437	0.501	0.126	0.078	0.268	0.368	-0.170	-0.183
6	-0.192	-0.355	-0.365	-0.324	-0.445	0.585*	-0.780**	-0.749**
7	-0.245	-0.568*	-0.496	-0.431	-0.730**	0.674**	-0.859**	-0.835*

* SIGNIFICANT AT THE 5% PROBABILITY LEVEL.
 ** SIGNIFICANT AT THE 1% PROBABILITY LEVEL.

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