QUARTERLY STATUS AND TECHNICAL

PROGRESS REPORT

Title: Evaluation of Spatial, Radiometric and Spectral Thematic Mapper Performance for Coastal Studies

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1. Problems

Only one TM image of our Delaware Bay test site was available (P014, R033, 12/13/82) and due to snow cover, it was unsuitable for marsh vegetation (biomass) studies. To solve the problem, one of our Chesapeake Bay test sites was activated and an available high-quality TM image ordered (P015, R033, 11/02/82). Due to the delay in transmitting additional TM data from Landsat 4, four more scenes of similar test sites were ordered (P014, R032, 11/27/82 and P012, R031, 9/10/82). Pictures and tapes for all scenes have been received and analysis of the Chesapeake Bay scene has been initiated.

2. Accomplishments

The majority of our most recent efforts have been to modify our computer software (a version of the Pennsylvania State ORSER package) to read and analyze CCT-AT and CCT-PT formatted data. This task has been completed and we now have an operational version of the software.

A series of experiments have been initiated to determine the feasibility of using Thematic Mapper spectral data to estimate wetlands biomass. To date, actual Thematic Mapper data have not been available for our Delaware test site. However, a number of experiments have been conducted using hand-held radiometers simulating Thematic Mapper wavebands 3, 4 and 5. Spectral radiance data have been collected from the ground and from a low altitude aircraft in an attempt to gain some insight into the potential utility of actual Thematic Mapper data for biomass estimation in wetland plant communities.

The study described herein does not attempt to distinguish individual plant species within brackish marsh plant associations. Rather, we have chosen to lump plant species with similar canopy morphologies and then estimate from spectral radiance data the biomass of the group. The rationale for such an approach is that plants with a similar morphology will produce a similar reflecting or absorbing surface (i.e., canopy) for incoming electromagnetic radiation. Variations in observed reflectance from different plant communities with a similar canopy morphology are more likely to be a result of biomass differences than a result of differences in canopy architecture. If the hypothesis that plants with a similar morphology exhibit similar reflectance characteristics is true, then biomass can be estimated based on a model for the dominant plant morphology within a plant association and the need for species discrimination has been effectively eliminated.

As noted in previous progress reports, we have also classified two subscenes of TM imagery believed to include significant amounts of Submerged Aquatic Vegetation (SAV). The first image classified was of Broad Creek, Maryland,

just north of the Choptank River. The second image classified was of Vaucluse Shores/Hungars Creek located in the southern portion of Chesapeake, north of the Bay Bridge Tunnel. In both cases, the classification resulted in moderate success. However, in the Vaucluse Shores image, the classifier frequently misclassified SAV as deep water and vice versa. We are presently attacking this problem by including spatial clues within the classification procedure such as location relative to land and anticipated water depth.

We continue to refine our radiative transfer models describing volume reflectance of eight water columns containing SAV. Although the modeling efforts are progressing nicely, we hesitate to report any results until we can get out into the field and verify the model. We anticipate concluding that phase of the research by the end of this coming summer.

3. Significant Results

Based on the three morphologic wetland canopy types, simple regression models were developed equating the vegetation index and the infrared index with biomass. Spectral data were collected with the hand-held radiometer from the ground and from a low altitude aircraft. Sampling points were arranged on a 30 m grid with actual harvesting of vegetation conducted after the radiance data were collected. With the vast majority of spectral radiance index and model combinations, the spectral radiance index estimates of total live biomass were not significantly different from the harvest biomass estimates. The species combination models for the vegetation and infrared indices were particularly good, with the all species models being the best models for use with all three spectral radiance indices. The MSS vegetation index estimates were very similar to the vegetation index estimates. This is not surprising considering both indices contain essentially the same spectral information.

We have also found that all major wetland vegetation species can be clearly discerned in TM imagery. The spatial resolution of TM data appears to be better than 30 meters, i.e., it seems to be closer to 25 meters than 30 meters.

4. Publications

1) Ackleson, S.G. and V. Klemas. "Assessing Landsat TM and MSS Data for Detecting Submerged Plant Communities", Landsat-4 Early Results Symposium, NASA Goddard Space Flight Center, February 23-24, 1983.

2) Hardisky, M.A. and V. Klemas. "Remote Sensing of Coastal Wetlands Biomass Using Thematic Mapper Wavebands", Landsat-4 Early Results Symposium, NASA Goddard Space Flight Center, February 23-24, 1983.

5. Recommendations

All of our quantitative analyses are performed on digital tapes. Paper print and transparencies are of great importance for selecting tapes and planning the digital tape analysis. Therefore it is more important for us to get the paper prints and transparencies as early as possible (timely release) than to worry about small density deviations or scale errors in the film products. The paper prints and transparencies are usually sufficient for planning the processing of the digital tapes (e.g., test site location identification, cloud-free area selection, etc.).

6. Funds Expended

Approximately $23,000 have been expended during the first nine months of the contract.

7. Data Utility

The State Highway Department is interested in using Landsat data for planning new highway corridors. This is an outgrowth of our work using Landsat data for developing and testing archeological predictive models, which are able to predict the potential location of historic Indian sites with a factor 2 better than any other available technique.

A project is being developed with State agencies to use Landsat 4 TM to study the environmental degradation of Delaware's inland bays (Rehoboth Bay, Indian River Bay, etc.). These bays are shallow, their shorelines are overdeveloped (e.g., summer homes, marinas, etc.) and as a result, the pollution concentrations are reaching dangerous levels. The State is proposing to analyze TM data on our ERDAS system to study turbidity plumes and circulation patterns in the bays and map changes in vegetation around the bays.