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COMPARISON OF AIS VS. TMS DATA COLLECTED OVER THE VIRGINIA PIEDMONT

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ABSTRACT

The Airborne Imaging Spectrometer (AIS), NS001 Thematic Mapper Simulator (TMS), and Zeiss camera collected remotely sensed data simultaneously on October 27, 1983, at an altitude of 6860 meters (22,500 feet). AIS data were collected in 32 channels covering 1200-1500 nm. A simple atmospheric correction was applied to the AIS data, after which spectra for four cover types were plotted. Spectra for these ground cover classes showed a telescoping effect for the wavelength endpoints. Principal components were extracted from the shortwave region of the AIS (1200-1280 nm), full spectrum AIS (1200-1500 nm) and TMS (450-12,500 nm) to create three separate three-component color image composites. A comparison of the TMS band 5 (1000-1300 nm) to the six principal components from the shortwave AIS region (1200-1280 nm) showed improved visual discrimination of ground cover types. Contrast of color image composites created from principal components showed the AIS composites to exhibit a clearer demarcation between certain ground cover types but subtle differences within other regions of the imagery were not as readily seen. Verification of these preliminary results is necessary since the AIS data were collected in a fixed grating position with 32 channels compared to a greater spectral coverage of the TMS. Also, no ground checking has been performed. In addition, the AIS data were matched with TMS data from the more distal (from nadir) pixels in the swath coverage where pixels exhibit the most distortion.

DISCUSSION

Remotely sensed data from the Zeiss camera, NS001 Thematic Mapper Simulator (TMS) and Airborne Imaging Spectrometer (AIS) were collected during a flight of the NASA Ames C-130 at an altitude of 6860 meters (22,500 feet) on October 27, 1983, over the Chopawamsic Formation in the Piedmont Province in Central Virginia. This region consists of metamorphosed graywackes, subgraywackes, and impure quartzites interlayered with altered greenstone volcanics. This region is heavily vegetated, and in undisturbed areas is covered with both deciduous and coniferous forest. Due to the relatively flat topography much of the region is under cultivation, including coniferous plantations.

Nadir pixel resolution for the TMS data was 19 meters and the swath width was approximately five kilometers. In contrast, the AIS data featured a nadir pixel resolution of 14 meters and the AIS data featured a nadir pixel resolution of 14 meters and a relatively narrow swath width of one-half kilometer.

The AIS was operating in the fixed grating mode at (old) position 0 (1200-1500 nm). This grating position includes spectral information associated with vegetation biomass and leaf water (Tucker, 1978). During the 1983 season the AIS utilized a 32x32 element HgCdTe area array detector (JPL, 1984). A video screen was available to the on-board investigator to track collection of the TMS data set but the actual AIS swath was not delineated. It was found post-flight that the AIS was offset from the test area approximately three kilometers to the west. Thus, the following analysis is restricted to a comparison of TMs vs. AIS data since we were unable to evaluate AIS data in a known region of stressed vegetation related to our present geobotanical anomaly project.

Our approach in evaluating the AIS data was three-fold. First we examined AIS spectral information in the 1200 to 1500 nanometer range to determine whether the narrow spectral band data were yielding new information or if redundancy would be evidenced. Second, we compared the TMS band 5 (1000-1300 nm) to the shortwave region of the AIS (1200-1280 nm) for a possible increase in the ability to visually discriminate ground cover classes in the two data sets. Finally, to further assess ability to discriminate ground cover classes, we enhanced three separate color image composites utilizing principal components for the TMS data, shortwave region of the AIS, and full spectrum of AIS, excluding the water absorption channels.

Prior to image processing, a simple atmospheric correction, based upon signal return over a waterbody, was applied to the AIS data. From infrared photography, four classes of ground cover were chosen containing information in a coniferous tree stand, agricultural field, waterbody, and over two separate deciduous tree stands.

To begin appraisal of spectral information in the 1200 to 1500 nm range, the spectra for the above mentioned classes were plotted. From these spectral plots it was usually noted that there appeared to be a telescoping of the actual positioning in the channels from both ends of the grating position. A nominal shift of 10 nm to the longer wavelengths at the 1200 nm position was observed together with a 10 nm shift to the shorter wavelengths at the 1500 nm position. Otherwise, the relative reflectance values for classes were found to be as expected based upon the color infrared photography for the fall season.

Next, to compare TMS and AIS in an image interpretation context, TMS band 5 (1000-1300 nm) and six AIS principal components (1200-1280 nm) were enhanced. Even though the AIS principal components exhibited vertical striping in several samples due to dead pixel elements (JPL, 1984) and horizontal noise in a periodic manner, certain ground cover classes were more readily defined. Fields not distinguishable from one another with TMS data were separable with the AIS data. Also texture was more apparent in forested areas in the AIS data, allowing demarcation of what are perhaps species assemblage changes within such areas based upon subtle changes in texture. Such forested areas could only be outlined with the TMS data. This result appears to be related to the fact that six orthogonal AIS components overlap spectral information contained in only one TMS channel.

Finally, three color composites were created from principal components using (1) TMS data (450-12500 nm), (2) shortwave region of AIS data (1200-1280 nm), and (3) the full AIS spectrum (1200-1500 nm) excluding the water absorption bands. While the AIS composite enabled a clearer demarcation between certain ground cover types as previously noted, subtle differences within other regions on the image were not as readily seen in the AIS composite.

Verification of these very preliminary results is necessary since no ground checking has been done. The AIS data were matched only by the more distal (from nadir) pixels of the TMS data. In addition, a fixed grating position (1200-1500 nm) was employed for the AIS data collection whereas the TMS recorded data in eight bands covering the 450-12,500 nm range.

REFERENCES

Jet Propulsion Laboratory, 1984, Airborne Imaging Spectrometer, Science Investigator's Guide to AIS Data, p. 15.

Tucker, C. J., 1978, A Comparison of Satellite Sensor Bands for Vegetation Monitoring, Photogrammetric Engineering and Remote Sensing 44 (11): 1369-1380.