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SIMULATION OF ASTER DATA USING AVIRIS IMAGES

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The Advanced Thermal Emission and Reflectance Radiometer (ASTER) is a joint Japanese/US imaging instrument scheduled to fly on the first EOS platform in 1998. The complement of scanners includes a visible, three channel module with forward-looking stereo capability, a six channel short wavelength infrared module, and a five channel thermal module. As part of the definition phase for the instrument design, we used AVIRIS data to simulate the SWIR bands to investigate the effects of widening two of the bands to increase the signal-to-noise ratio (SNR) versus loss of spectral separability due to uncertainty in the post-launch band positions.

The six SWIR bands (channels 4 to 9) are located in the region between 1.60 and 2.43 μm. The nominal band positions and widths (FWHM) are shown in Table 1. These bands were selected to maximize separability of certain important minerals or mineral groups. Band 8, for example, is centered over a major absorption feature for carbonates. Bands 5, 6 and 7 are located to allow separation of absorption features of hydrous minerals: alunite in band 5, sericite/montmorillonite in band 6, kaolinite in bands 5 and 6, and chlorite in band 7, for example. At the time of this study, there was still freedom to modify the widths of bands 5 and 6. Increasing the widths from 40 to 50 nm would increase the SNR by about 25%, but would cause increased overlap between the bands, and hence a decrease of spectral separability for minerals whose major absorption features were in these two bands. In addition, there is a potential post-launch uncertainty of ±7 nm in the band positions, so they could possibly overlap even more than from just widening.

AVIRIS data over Cuprite, Nevada were chosen to create simulated ASTER bands to study the trade-off between SNR and spectral separability. These data were flown on July 19, 1990.

Four simulations of the ASTER bands were created: nominal bands, wider bands, and each of these shifted 7 nm closer together (the worst cases). ASTER bands were produced by fitting gaussian band shapes to the AVIRIS channels, then amalgamating the appropriate number of AVIRIS bands. SNR was calculated by a similar procedure using the dark current file for the noise, and locating areas on the images for signal computation.

Simulated images were processed using ratioing, principal components, etc. for visual examination and evaluation. Additionally, known mineralogically homogeneous area were extracted from the images, and the point spectra plotted for evaluation of spectral separability. These examples will be shown during the presentation.

The results of this study confirm that widening bands 5 and 6 from 40 to 50 nm would increase the SNR by about 25%. On the other hand, spectral separability of kaolinite and sericite suffers as a result of the combined effects of widening the bands and the (worst case scenario) further overlap caused by a 7 nm shift in band positions. The recommendation was made to maintain the bands at 40 nm width to maximize spectral separability, at the expense of increased SNR.

Table 1. ASTER nominal SWIR bands

Band	Range (μm)	Width (nm)
4	1.600-1.700	100
5	2.145-2.185	40
6	2.185-2.225	40
7	2.235-2.285	50
8	2.295-2.365	70
9	2.360-2.430	70

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