SIMULATION OF AVHRR-K BAND RATIOS WITH AVIRIS

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1.0 INTRODUCTION

The AVHRR-K polar-orbiting imager scheduled for launch by the mid-1990's will include two new near-infrared narrowband detectors, Band 3A, 1.58-1.64 μm, and a modified (narrower) Band 2, 0.84-0.87 μm. The AVIRIS is an ideal testbed for these bands. This paper summarizes the results of a comparison between AVIRIS band ratio values and AVHRR-K radiances simulated from AVIRIS.

Prior analysis of AVIRIS multispectral data has shown that channel ratios can aid in the estimation of scene type and other physical parameters (Gao and Goetz,1990; Berendes et al., 1991). Figure 1 demonstrates the discrimination of surface and cloud types with the ratio of two window-channel radiances corresponding to AVHRR-K. Shown here is the ratio of pixel radiance in a sequence of AVIRIS channels, to the radiance at 0.85 μm (the center of the AVHRR-K Band 2). The largest values are observed for a growing cumulus cloud (A) which undoubtedly contains a large concentration of liquid water. An altostratus cloud area (D) which visually appears glaciated has the lowest ratio value. This is consistent with ice cloud due to the larger absorption coefficient for ice (four times larger than for water at 1.6 μm). The ratio values for two altocumulus scenes (B,C; more likely to contain a mixture of ice and water) fall between A and D. Snow-covered surfaces have the lowest values in Fig. 1, particularly a sun-illuminated sample (H). The ratios are largest in magnitude and show the best separation near the 1.62 μm center of AVHRR-K Band 3A. Thus, the ratio of AVHRR-K Band3A/Band 2 band center wavelengths appears to contain information on cloud properties. However, the AVHRR-K has both a wider bandpass and larger field of view than AVIRIS.

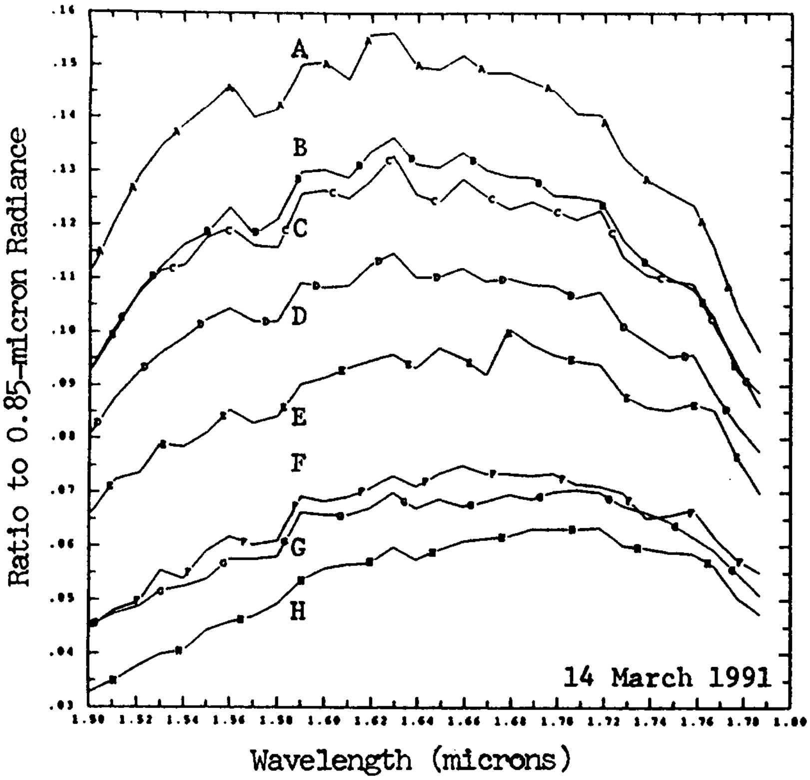

Fig.1. Ratio of AVIRIS radiance at the wavelength indicated on the abscissa, to that at 0.85 μm, for isolated growing cumulus (A), altocumulus (B,C), glaciated altostratus (D), exposed land (E), snow under shadow (F,G), and sunlit snow (H).

2.0 SIMULATION OF AVHRR-K RADIANCES

The AVHRR-K spectral bandpasses were simulated with four consecutive AVIRIS channels for Band 2, and eight consecutive channels for Band 3A. The channel radiances were numerically integrated, and a spectral transmittance function was applied which is similar to the existing AVHRR shortwave channels. The ratios of these band radiances are seen as the values in Figure 2, for a one-pixel field of view. The differences between these single-pixel values and the 1.62 μm/0.85 μm AVIRIS radiance ratios at the same points are 1.4% or less. The effect of the larger field of view for AVHRR is simulated by successively increasing the pixel averaging area from 1x1 to 55x55, where the largest area represents the 1.1 km field of view of AVHRR. As we note in Figure 2, the magnitudes and separation of the band ratio values for the various cloud types are preserved as the averaging area increases. While the land and snow surface scenes tend toward a ratio value of 0.08, the value is distinct from those of the cloud scenes. This analysis procedure will be carried out for a large set of image pixels to obtain statistical results for differing scene types.

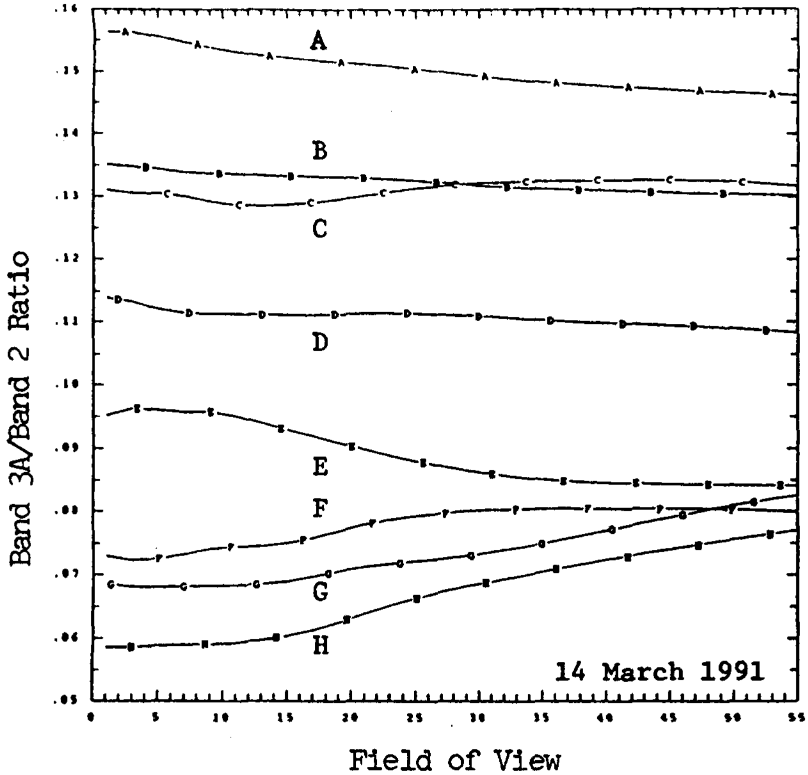

Fig. 2. Ratio of AVHRR-K Band 3A/Band 2 radiances simulated from AVIRIS at a varying field of view (AVIRIS pixels), for the scenes in Fig. 1.

3.0 DISCUSSION

This analysis indicates that predominant particle phase near cloud top may be observable in the AVHRR-K band ratios. Particle size and phase retrievals, using the Adding Model to calculate arrays of cloud spectral reflectance (Wetzel and Vonder Haar, 1991) and LOWTRAN7 to correct AVIRIS reflectance for path radiance and extinction, are being developed and tested against coincident ground-based radar and microwave radiometer observations, and aircraft measurements of in-cloud droplet and crystal size distributions.

4.0 REFERENCES

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