DETECTION AND CORRECTION OF THIN CIRRUS EFFECTS USING THE 1.375-μm MODIS CHANNEL

Bo-Cai Gao¹, and Yoram J. Kaufman²

¹University Space Research Association, Greenbelt, MD
²Climate & Radiation Branch, NASA/GSFC, Greenbelt, MD
INTRODUCTION

- The 1.375-μm MODIS channel
  - Detection of thin cirrus clouds

- Empirical correction of thin cirrus effects using the 1.375-μm channel

- Applications of the 1.375-μm channel for the studies of aerosol, land surface, and ocean color

- Summary
TWO-WAY CLEAR-SKY TRANSMITTANCE

WAVELENGTH (μm)

- - - Z = 20 km
- - - Z = 10 km
-- - Z = 6 km
- - - Z = 0

(Tropical Model)
AVIRIS Data Over North Carolina, 7/22/93

(a) 0.557 \mu m  

(b) 1.372 \mu m
AVIRIS IMAGES OVER MONTEREY, CA
(09/04/92)

0.648 µm

1.373 µm

0.648 µm, Corrected
EQUATIONS

\[ \rho_{\lambda}^* = \rho_{c\lambda} + T_{c\lambda} \rho_{\lambda} / (1 + S_{c\lambda} \rho_{\lambda}) \]  \hspace{1cm} (1)

\[ \rho_{c\lambda} : \text{path radiance due to cirrus} \]
\[ S_{c\lambda} : \text{cloud scattering of upward radiation back to surface} \]
\[ \rho_{\lambda} : \text{Surface reflectance} \]

If \( S_{c\lambda} \ll 1 \), then Eq. (1) becomes

\[ \rho_{\lambda}^* = \rho_{c\lambda} + T_{c\lambda} \rho_{\lambda} \]  \hspace{1cm} (2)

We found an empirical relation:

\[ \rho_{c\lambda} = \rho_{c1.375} / t_{co} \]  \hspace{1cm} (3)

\( t_{co} \) is a function of water vapor above \& within cirrus clouds

We found another empirical relation:

\[ T_{c\lambda} \sim (1 - 0.84 \rho_{c1.375}) \]  \hspace{1cm} (4)

Substitute (4) and (3) into (2), we get

\[ \rho_{\lambda} \sim \{\rho_{\lambda}^* - \rho_{c1.375} / t_{co}\} / \{1 - 0.84 \rho_{c1.375}\} \]  \hspace{1cm} (5)
Thick Cirrus Spectrum

**APPARENT REFLECTANCE**

**WAVELENGTH (µm)**
SUMMARY

- Using spectral imaging data collected by the NASA/JPL Airborne Visible Infrared Imaging Spectrometer (AVIRIS), we have demonstrated that it is possible to remove thin cirrus effects from remote sensing data using the 1.375-μm channel.

- We expect that the 1.375-μm MODIS channel can have important applications for the quantitative studies of atmospheric aerosols, land surfaces, and ocean color.