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R.P.d'Entremont, D.P.Wylie, Szu-Cheng Ou and Kuo-Nan Liou

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Atmospheric and Environmental Research, Inc.
840 Memorial Dr.
Cambridge, MA 02139-3794

Department of Meteorology/CARSS
University of Utah
Salt Lake City, UT 84112

Space Science and Engineering Center
University of Wisconsin
Madison, WI 53706

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In addition to the wide variability in properties common for the other types of clouds, cirrus clouds have transmissivity values t_λ that span the entire possible domain $0 \le t_\lambda \le 1$. This variability adds complexity to the analysis of cirrus clouds. In comparison to opaque clouds, uncertainties exist in thin cirrus cloud amount, altitude, thickness, and optical properties as retrieved from satellite because the measured cirrus signal is affected additionally by an unknown radiation component from below.

Cirrus radiative and spatial properties are derived using HIRS CO_2 Slicing and multispectral AVHRR imager techniques. Each of these models is based on radiative transfer principles that intrinsically account for both the semi-transparent nature of thin cirrus clouds and the attenuation effect of atmospheric water vapor in the MWIR and LWIR thermal window regions.

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Directorate of Geophysics
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Retrieval of Cirrus Radiative and Spatial Properties Using Coincident Multispectral Imager and Sounder Satellite Data

Robert P. d'Entremont
Atmospheric and Environmental Research, Inc.
840 Memorial Drive, Cambridge, MA 02139-3794

Donald P. Wylie
Space Science and Engineering Center
University of Wisconsin, Madison, Wisconsin 53706

Szu-Cheng Ou and Kuo-Nan Liou
Department of Meteorology / CARSS
University of Utah, Salt Lake City UT 84112

In addition to the wide variability in properties common for other types of clouds, cirrus clouds have transmissivity values t_λ that span the entire possible domain $0 \leq t_\lambda \leq 1$. This variability adds complexity to the analysis of cirrus clouds. In comparison to opaque clouds, uncertainties exist in thin-cirrus cloud amount, altitude, thickness, and optical properties as retrieved from satellite because the measured cirrus signal is affected additionally by an unknown radiation component from below.

Cirrus radiative and spatial properties are derived using HIRS CO_2 Slicing and multispectral AVHRR imager techniques. Each of these models is based on radiative transfer principles that intrinsically account for both the semi-transparent nature of thin cirrus clouds and the attenuation effect of atmospheric water vapor in the MWIR and LWIR thermal window regions.

Comparison is made of cirrus cloud attributes, both spatial and radiative, obtained for the same cloud scene using measurements from the independent AVHRR and HIRS sensors onboard the NOAA polar orbiting satellites. While the fundamental requirement is the same for both the HIRS and AVHRR models, i.e. to detect the presence of thin cirrus and to determine its radiative and spatial attributes, the capabilities of the two techniques depart from each other in numerous respects. The most important distinctions are based on the differences in the spectral bandpass and spatial resolutions of the HIRS and AVHRR sensors.

Three cirrus retrieval algorithms, CO_2 Slicing, AVHRR, and SERCAA have been shown to complement one another for increasing the accuracy of the obtained cirrus parameters. New techniques will be presented that combine the strongest and most reliable attributes of the imager and sounder-based cirrus retrieval algorithms in combination with SERCAA-derived background analyses to generate an improved overall cirrus analysis. The "background" may be either the clear ground or an underlying water-droplet cloud. Improved SERCAA estimates of underlying cloud and surface temperature can significantly improve the AVHRR and HIRS CO_2 Slicing determination of cirrus bulk emissivity.

The SERCAA-derived cirrus fraction N is useful to CO_2 slicing in separating the effect of N from the effective emissivity $N\varepsilon$ for those cirrus clouds whose optical attributes are uniform within a particular HIRS FOV, thus allowing for direct comparisons of the true thermal infrared cirrus bulk emissivities retrieved by each algorithm. On the other hand, the CO_2 slicing technique provides an independent determination of cirrus effective altitude z which obviates the need for the AVHRR parameterization of the variation of ε with wavelength.

Better cirrus emissivity analyses in turn will significantly improve the accuracy of cirrus radiative models.