

COMPARISON OF NOAA-9 ERBE MEASUREMENTS WITH  
CIRRUS IFO SATELLITE AND AIRCRAFT MEASUREMENTS

Steven A. Ackerman<sup>1</sup>, Hyosang Chung<sup>1</sup>, Stephen K. Cox<sup>3</sup>

Leroy Herman<sup>1</sup>, William L. Smith<sup>1</sup>, Donald P. Wylie<sup>2</sup>

*Cooperative Institute for Meteorological Satellite Studies<sup>1</sup>*

*Space Science and Engineering Center<sup>2</sup>*

*University of Wisconsin-Madison, Madison, WI 53706.*

and

*Department of Atmospheric Science<sup>3</sup>*

*Colorado State University*

*Fort Collins, CO 80521*

ABSTRACT

Earth Radiation Budget Experiment measurements onboard the NOAA-9 are compared for consistency with satellite and aircraft measurements made during the Cirrus IFO of October 1986. ERBE scene identification is compared with NOAA-9 TIROS Operational Vertical Sounder (TOVS) cloud retrievals; results from the ERBE spectral inversion algorithms are compared with HIS measurements; and ERBE radiant exitance measurements are compared with aircraft radiative flux measurements.

INTRODUCTION

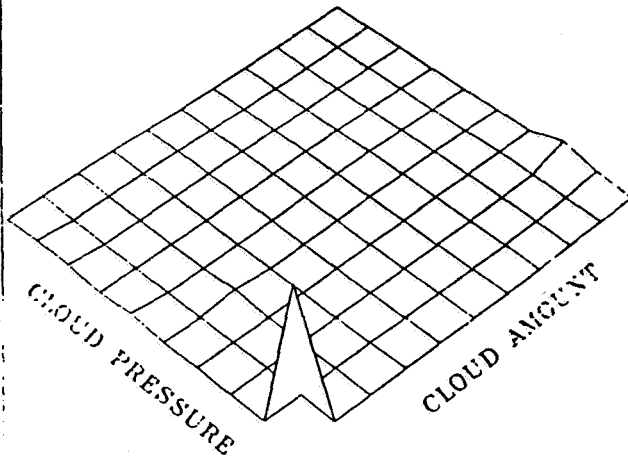
The Cirrus IFO included measurements made onboard satellites, research aircraft, weather balloons as well as on the ground. An integration of these measurements will be required to fully

accomplish the research objectives of the program (Cox *et al.*, 1987). In this paper consistency checks are made between measurements of the Earth Radiation Budget Experiment (ERBE) and measurements made on other Cirrus IFO platforms.

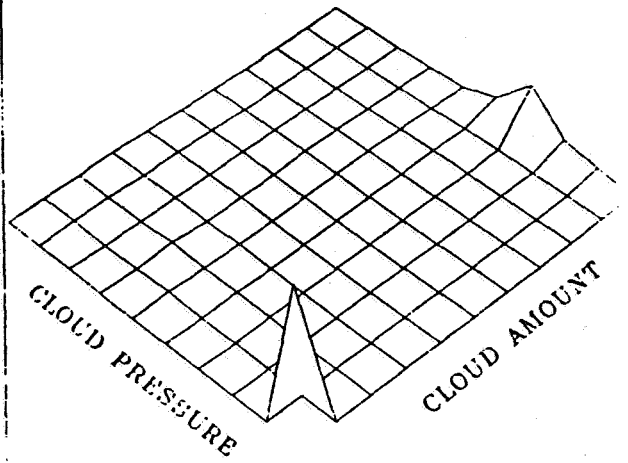
## ERBE SCENE ID AND NOAA-9 CLOUD RETRIEVALS

The ERBE includes shortwave (SW) and longwave (LW) radiance measurements by a scanning radiometer. To convert these measurements to radiant exitance at the top of the atmosphere requires knowledge of the scene type (e.g. cloud, ocean, desert, partly cloudy). The ERBE data management system includes 12 scene types. In the first part of this study, scene types from the NOAA-9 ERBE measurements are compared with cloud amount and cloud top pressure retrievals using the NOAA-9 TOVS (Whitlock *et. al.*, 1988). The spatial resolution of the ERBE is approximately  $44 \times 65$  km and nadir. Comparisons are made for four ERBE scene identifications (ID); clear (cloud cover  $< 5\%$ ), partly cloud ( $5\% \leq$  cloud cover  $< 50\%$ ), mostly cloudy ( $50\% \leq$  cloud cover  $\leq 95\%$ ), and overcast ( $95\% <$  cloud cover). The NOAA-9 TOVS derived cloud top pressure are categorized into 100 mb intervals (100-200 mb, 200-300 mb ...) and the effective cloud cover is categorized into 10% intervals (0-10%, 10-20%...). Having earth located the TOVS cloud retrieval, the nearest ERBE measurement is found and the scene ID noted. The ERBE and TOVS geographic locations are generally within  $0.3^\circ$  of each other. The TOVS cloud retrieval is then compiled in a cloud top pressure versus effective cloud area histogram. Preliminary analysis of 15 time periods in October 1986 are depicted in figure 1, where the number of counts in the histogram has been normalized with respect to the category with the maximum count. The total count for the clear, partly cloudy, mostly cloudy and overcast scene ID's are 51, 556, 524 and 160 respectively. The ERBE determined clear scenes are most often in agreement with the clear scenes identified with the TOVS. Good agreement is also exhibited in the overcast category, with thin high clouds determined by the ERBE to be overcast. Although the middle level cloud cover seen in the mostly cloudy scene ID, doesn't correspond to an ERBE overcast condition. The partly

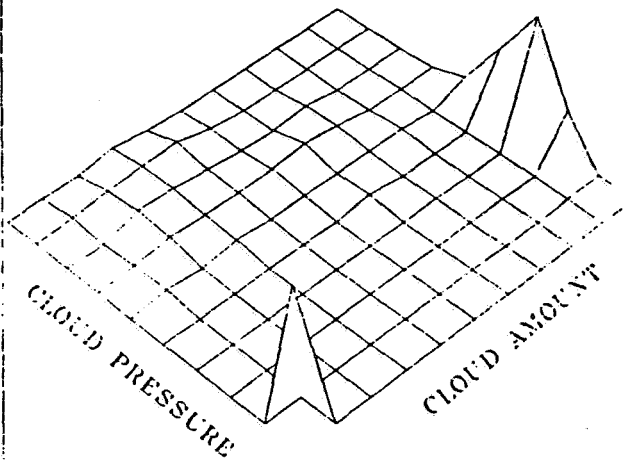
CLEAR



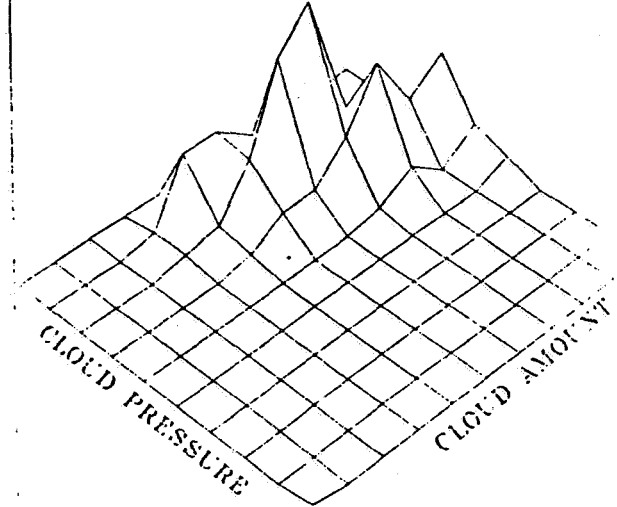
PARTLY CLOUDY



MOSTLY CLOUDY



OVERCAST



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and mostly cloudy ERBE cases do not exhibit the distribution one might expect. A more detailed analysis will be presented at the conference.

## ERBE SPECTRAL CORRECTIONS AND HIS MEASUREMENTS

The spectral response of the ERBE SW, LW and total channels are inverted to broadband radiances in a manner described by Avis *et al.*, 1984. In this section results from the LW inversion algorithms are compared with measurements of the High resolution Interferometer Sounder (HIS) (Smith *et al.*, 1988). To compare the data, a ratio of the NOAA-9 ERBE scanner filtered radiance measurements ( $M_{fil}$ ) to the unfiltered measurements ( $M_{unfil}$ ) is taken and plotted against the unfiltered measurements. The HIS measurements are then used to simulate an ERBE filtered ( $H_{fil}$ ) and unfiltered ( $H_{unfil}$ ) measurements, where

$$H_{fil} = \int_{2000}^{600} I_{\nu} \phi_{\nu} d\nu + \int_{600}^{50} B_{\nu}(T) \phi_{\nu} d\nu$$

$$H_{unfil} = \int_{2000}^{600} I_{\nu} d\nu + \int_{600}^{50} B_{\nu}(T) d\nu$$

where  $I_{\nu}$  is the HIS measured radiance and  $\phi_{\nu}$  is the ERBE spectral response function. The ratio  $H_{fil}$  to  $H_{unfil}$  is then plotted as a function of  $H_{unfil}$ . The HIS measures do not include contributions beyond approximately  $600 \text{ cm}^{-1}$  ( $16.7 \text{ }\mu\text{m}$ ). To represent this spectral energy we have assumed the Planck function,  $B_{\nu}(T)$ , assuming the average equivalent black body temperature determined from measured over the spectral region  $1300\text{-}1400 \text{ cm}^{-1}$ .

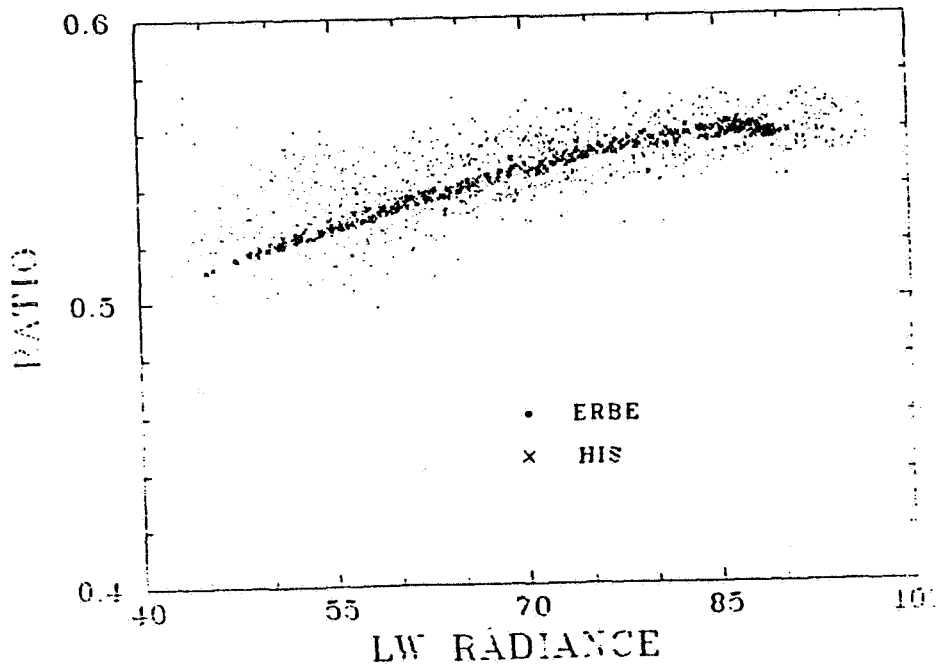
Figure 2 depicts these ratios for the ERBE NOAA-9 (dots) and the HIS (x) measurements. The HIS measurements were made on November 2, 1986 over the FIRE region, while the ERBE region measurements were made over an eight day period for the region  $25^{\circ}\text{-}50^{\circ} \text{ N}$  and  $75^{\circ}\text{-}95^{\circ} \text{ E}$ . Both the ERBE and HIS measurements display an increase in the ratio of the filtered to unfiltered radiance with increasing radiant exitance, consistent with the filter response function. The ERBE data display more scatter than the HIS data, particularly at the low radiances, otherwise the agreement is excellent.

## ERBE AND SABERLINER BROADBAND FLUX MEASUREMENTS

This comparison study is in progress and will be reported on at the meeting.

### REFERENCES

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- Smith, W. L., H. M. Woolf, H. B. Howell, H. L. Huang, and H. E. Revercomb, 1988: High resolution interferometer sounder- the retrieval of atmospheric temperature and water vapor profiles. *Proceedings of the Third Conference on Satellite Meteorology and Oceanography*, American Meteorological Society, Boston, Mass.
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