GERB thermal flux regional bias: detection and correction by comparison with CERES

S. Dewitte
Royal Meteorological Institute of Belgium
Overview

- Methodology
- Used data
- Comparison results
- Bias correction
- Conclusions
Methodology

- Radiative flux at the top of the atmosphere: \( F \) (W/m\(^2\))
- Satellite observations: radiances \( L \) (W/m\(^2\)sr)
- Satellite viewing zenith angle \( \theta_{\text{vz}} \)

\[
F = \pi \frac{L(\theta_{\text{vz}})}{R(\theta_{\text{vz}})}
\]

- GERB: fixed \( \theta_{\text{vz}} \)
- Validation GERB fluxes: comparison with CERES fluxes with variable \( \theta_{\text{vz}} \)
Used data

- GERB: ARG fluxes, SEVIRI as imager, Version 2
- CERES FM3: RAPS or GERB mode or special scan, ES8, use of inflight calibration
- 1-6/2004
- use of night data for thermal fluxes
- CERES data is colocated to nearest GERB ARG pixel
95% confidence intervals

\[ \nu \text{ Radiance} \]
\[ \text{GERB}/(\text{CERES ES8 FM3}) = 0.988 +/- 0.002 \]

\[ \nu \text{ Flux} \]
\[ \text{GERB}/(\text{CERES ES8 FM3}) = 0.983 +/- 0.002 \]

\[ \nu (\text{CERES SSF})/(\text{CERES ES8}) = 0.992 \]
\[ \text{GERB}/(\text{CERES SSF FM3}) = 0.991 +/- 0.002 \]
Regional distribution

GERB data meeting, 10/2004
GERB – CERES difference fit

v Impose linear variation with $\theta_{vz}$:
$$f(\theta_{vz}) = (52.5^\circ - \theta_{vz}) / 52.5^\circ$$

v Fit difference as function of GERB flux:
$$F_{\text{gerb}} - F_{\text{ceres}} = a(F_{\text{gerb}}) \cdot f(\theta_{vz}) + b(F_{\text{gerb}})$$

$$a(F_{\text{gerb}}) = \text{GERB nadir error}$$

v Corrected GERB flux = $F_{\text{gerb}} - a(F_{\text{gerb}}) \cdot f(\theta_{vz})$
GERB - CERES FM3 thermal flux

Nadir diff. (W/m²)

GERB thermal flux (W/m²)
Expected theoretical error
All scenes

Before correction

GERB data meeting, 10/2004
Conclusions

- On the average, the GERB and CERES FM3 thermal fluxes agree within the required 1%.
- The anisotropy of the GERB fluxes is underestimated by the radiative transfer implicit ADM’s, resulting in regional biases up to 20 W/m².
- The bias seems to be due to semitransparent clouds, but it has a higher amplitude (0.14) than expected.
- An empirical GERB flux correction has been defined, which removes the bias within +/- 5 W/m².
- For further improvement of the instantaneous fluxes, a more detailed IR scene identification is needed.
Coldest scenes

Flux < 125 W/m²

125 W/m² < Flux < 175 W/m²

GERB data meeting, 10/2004
Warmest scenes

175 W/m² < Flux < 225 W/m²

Flux > 225 W/m²

GERB data meeting, 10/2004
125 W/m² < flux < 175 W/m²

Before correction

After correction

GERB data meeting, 10/2004
175 W/m² < flux < 225 W/m²

Before correction

GERB-CERES

After correction

GERB-CERES

Jan-Jun/2004

GERB data meeting, 10/2004