Meteosat Count versus CERES-TRMM Unfiltered Radiance

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Abstract

A database of colocated and coangular pairs of Meteosat-[5,7] and CERES-TRMM shortwave radiances has been built. From this data base, it is possible to derive simple parameterizations to estimate the broadband unfiltered shortwave radiance at TOA directly from the Meteosat count images. This technical note describes the data base and shows the scatter plots of the pairs Meteosat/CERES data.

1 Data

- 22 days of CERES-TRMM data when the instrument is operated in RAPS (rotating azimuth plan scan mode, about 1 day out of 3) mode during the months of June, July and August 1998. The ES8 Edition 2 data has been used (CER_ES8_TRMM-PFM_Edition2_021018.YYYYMMDD) .
- Meteosat-7 VIS data provided by the EUMETSAT MARF as OpenMTP images for all the 30' slot from the slot 16 (0800UTC) to 32 (1600UTC) and from the 4th of June to 31st of August.
- Meteosat-5 VIS data provided by the EUMETSAT MARF as OpenMTP images for the slots: 16, 20, 24, 25 and 26. From 1st of July to 31st of August.

2 Selection criteria

- Each CERES footprint is colocated in the Meteosat field of view.
- The Meteosat count value is extracted for the nearest pixel. There is no convolution with the CERES PSF.
- The maximum difference in time between the CERES and Meteosat observations is set to 600 seconds.
- The maximum angle between the CERES and Meteosat direction of observations is 15 degrees.
- The spatial variability is estimated within the Meteosat count image. For this, the minimum and maximum count values are computed over a 11*11 pixels window centered on the colocation pixel. If the difference (max-min) over this window is higher than 20% of the central value, the data is rejected.

After these different rejection criteria, the number of couples of corresponding CERES and Meteosat data is:

- 6.503 for Meteosat-5
- 94.800 for Meteosat-7

3 Scatter Plots

The figures (1) and (2) give the scatter plots of the CERES unfiltered shortwave radiance versus the Meteosat-[5,7] count.

4 Best Fits and RMS error

Using least mean square technique, one can derive the following "best fits". The third order fit give relatively good results (see the RMS error hereafter) over the whole range of Meteosat count.

Meteosat-7

Equation :	*RMS*
$L = 1.52688\,C$	5.84
$L = -4.8286 + 1.60962\,C$	4.73
$L = -8.0137 + 1.82106\,C - 0.001745\,C^2$	3.79
$L = -9.17821 + 1.93996\,C - 0.00389505\,C^2 + 8.89172\,10^{-6}\,C^3$	3.74

Meteosat-5

Equation :	*RMS*
$L = 1.48196\,C$	5.77
$L = -1.33323 + 1.49647\,C$	5.70
$L = -6.08072 + 1.68847\,C - 0.00113845\,C^2$	4.86
$L = -9.56841 + 1.94927\,C - 0.00508902\,C^2 + 1.46755\,10^{-6}\,C^3$	4.51

5 Comments

- It is possible to estimate BB unfiltered shortwave radiance from the Meteosat-[5,7] count image.
- The first and second order regressions give good results **except for cloudy scenes**. The third order regressions give better result for all-sky scenes. The regression coefficients are given on the scatter plots (1) and (2).
- According to the kind of regression, the residual RMS error lies between $3.8\,Wm^{-2}sr^{-1}$ and $6\,Wm^{-2}sr^{-1}$. The main source of residual error are: spectral signature of the scene, sensor noise, colocation (PSF), coangular (up to 15° difference in observation direction) and difference of time of observation... It is not obvious to separate the error according to these sources.

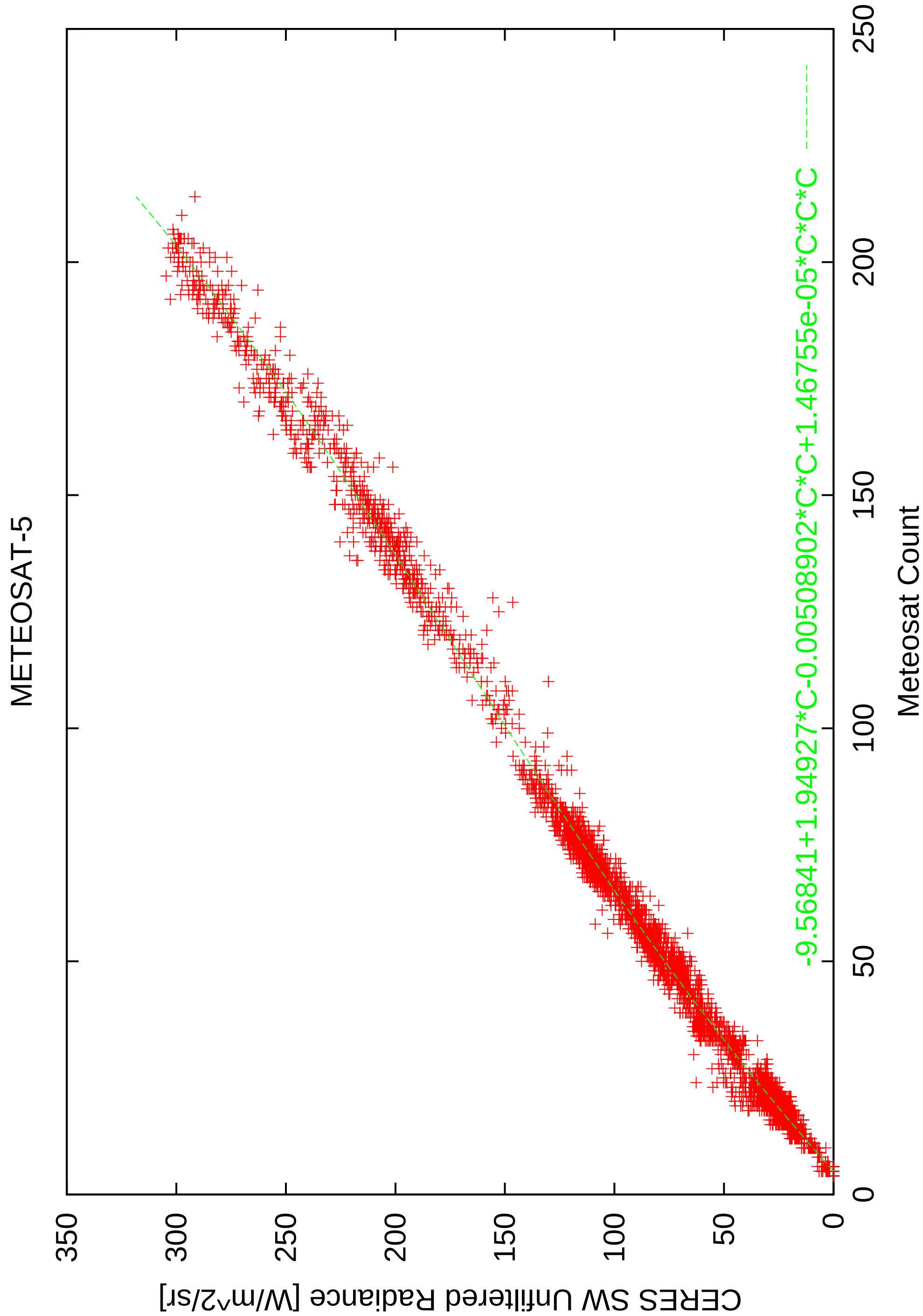

Figure 1: CERES Unfiltered SW radiance versus Meteosat-5 count.

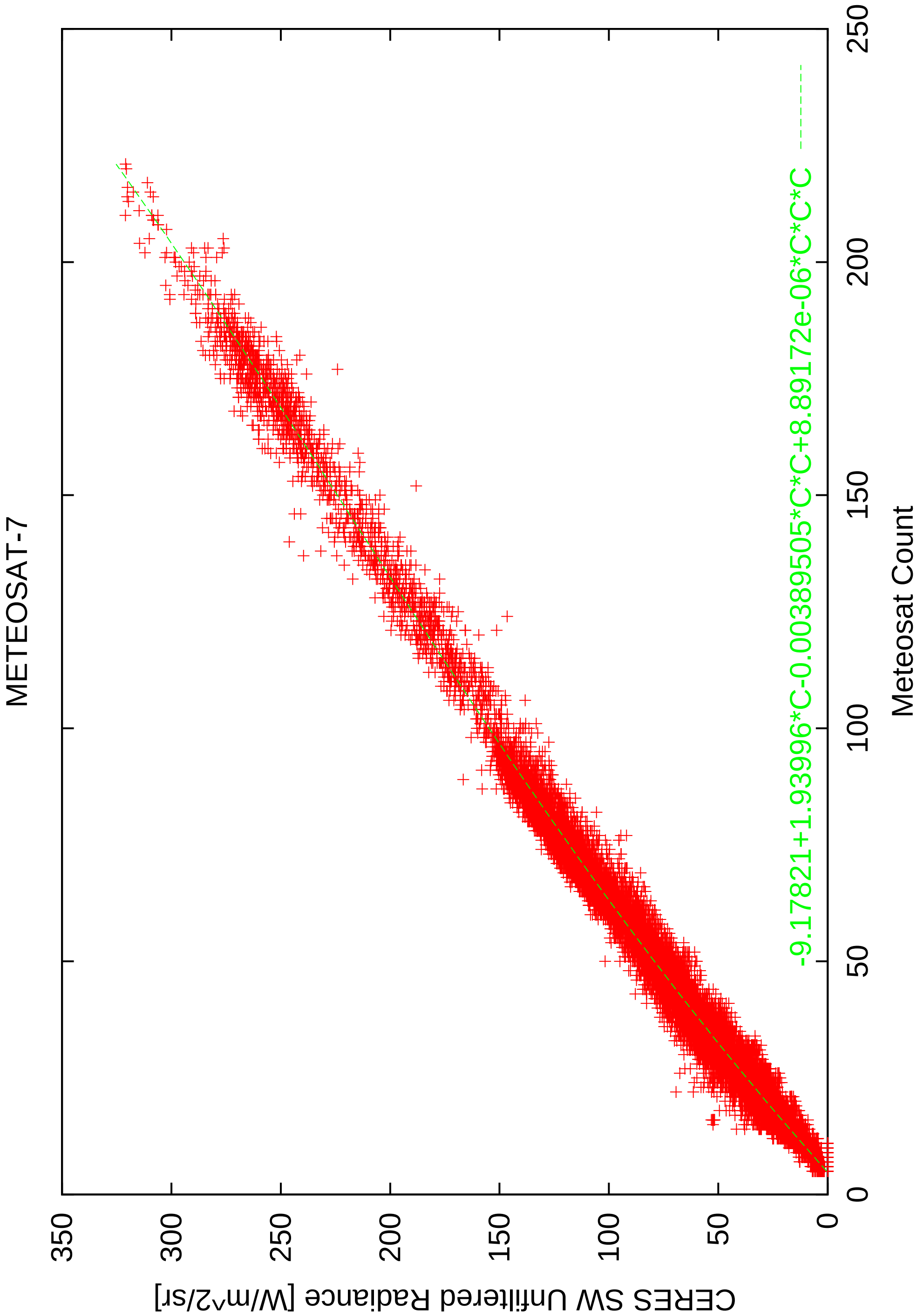

Figure 2: CERES Unfiltered SW radiance versus Meteosat-7 count.