GERB TOA radiances and fluxes validation over the Valencia Anchor Station during the IV GERB Ground Validation Campaign


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ABSTRACT

The Geostationary Earth Radiation Budget (GERB) instrument on board Meteosat-8 and -9 provides accurate measurements of shortwave and longwave broadband radiances and fluxes at the Top Of the Atmosphere (TOA) with very high temporal resolution of 15 minutes. The aim of this study is to validate radiances and fluxes at the TOA measured by GERB during the IV GERB Ground Validation Campaign at the Valencia Anchor Station (VAS) area (31st July – 6th August 2006). In the study, GERB enhanced spatial resolution data (GERB High Resolution) is used, where the resolution of the computed fluxes is improved through the combination of well-calibrated GERB broadband data with SEVIRI narrow-band high-sampling-rate data. Clouds and the Earth’s Radiant Energy System (CERES) Terra FM2 data is also used from dedicated PAPS (Programmable Azimuth Plane Scanning) observations over the study area during February 2004 campaign. The validation capabilities of the Valencia Anchor Station have previously been assessed by successfully reproducing CERES TOA radiances and fluxes with the occasion of different ground validation campaigns. The methodology consists in performing radiative transfer simulations of CERES and GERB TOA radiances and fluxes from independent ground measurements of surface and atmospheric parameters (such as derived from precipitable water vapour content from CIMEI sunphotometer and GPS (Global Positioning System) radiosoundings from the Spanish stations of Madrid and Murcia, aerosol optical thickness also from CIMEI broadband all-sky radiometers and temperature over shells, bare soil and vineyards in the study area) in conjunction with other satellite products such as TOMS (Total Ozone Mapping Spectrometer) ozone, CERES/GERB emissivity and MODIS BRDF (Bidirectional Reflectance Distribution Function). The latter allows us to analyze the contribution of each land use to the anisotropy of the shortwave radiation field and constitutes a good improvement of the methodology that had been tested for the case of CERES in previous campaigns. The comparison between simulations and CERES calibrated and validated data provides a good indicator of the reliability of the methodology to be applied as a validation tool for GERB.

THE VAS SITE

GERB OBSERVATIONS

CERES PAPS observations over VAS

RESULTS

GERB simulations

CERES simulations

REFERENCES

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CONCLUSIONS

- The methodology here shown is able to reproduce CERES and GERB TOA unfiltered radiances and fluxes under clear sky conditions.
- Simulated radiances reproduce the anisotropy of the radiation field showing low RMSEs for clear sky conditions.
- The inclusion of a higher resolution BRDF in the methodology has significantly improved the comparison between simulated and measured fluxes and will allow further studies over wider areas.
- CERES dedicated PAPS observations over the VAS are of great value to develop the methodology to validate low spatial resolution remote sensing data and products. In this way, the methodology has been extended and applied to GERB products.

Methodology

To reproduce radiances and fluxes at the TOA, it is needed a good characterization of the surface and the atmosphere.

Atmospheric profiles:
- Water Vapour: Radiosounding ascent interpolated to ten resolution and compared with MLS (mid Latitude) profiles. Then, select B4-B5 levels and scale the profile to the integrated water vapor retrieved obtained with the GPS (Global Positioning System).
- Aerosols: STRAEBER MLS standard profile, assuming background tropospheric aerosols and background atmospheric aerosol and aerosol optical thickness from CIMEI, sunphotometer measurements.

Selection of surface parameters:
- Solar Zenith Angle from the instantaneous, volumetric and geometric elements of the MODIS product for the scene (Fast-9x4-Spanes). Radiative transfer model: gapeo = s x k, k = 0.4 x gapeo + 0.4 x gapeo

Calibration algorithm:
- CERES/PAPS (channell and interchannel) adjustment to CERES FM2 data is used to compute a gain and offset factor that will allow the comparison between simulated and measured radiances.
- Use the gain and offset factor to scale the simulated radiances to the measured radiances.

Validation:
- The simulated radiances are compared to the measured radiances and the following statistics are calculated:
  - RMSE_SW = 8.6 W m^-2
  - RMSE_LW = 2.1 W m^-2

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