Geostationary Earth Radiation Budget (GERB): status update and user-friendly access to GERB data using Python

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1Royal Meteorological Institute of Belgium
2Imperial College London

EUMETSAT 2023 Conference
The GERB instrument

- Geostationary Earth Radiation Budget 2,1,3,4 aboard Meteosat Second Generation 1,2,3,4
- Broadband radiometer (0.32\(\mu\)m to 4\(\mu\)m and 0.32\(\mu\)m to 30\(\mu\)m)
- Field-of-view as SEVIRI
- 50km x 50km resolution at nadir
- 15 minutes refresh rate for “HR” product
# The GERB project

## Consortium organization

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Country</th>
<th>Role</th>
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</thead>
<tbody>
<tr>
<td>Imperial College (IC)</td>
<td>UK</td>
<td>Science lead, calibration, aerosol</td>
</tr>
<tr>
<td>Rutherford Appleton Laboratory (RAL)</td>
<td>UK</td>
<td>Instrument operation, “GGSPS”(^1), data up to L1</td>
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<td>Royal Meteorological Institute of Belgium (RMIB)</td>
<td>BE</td>
<td>Geolocation and L2 products</td>
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</tbody>
</table>

\(^1\) GERB Ground Segment Processing System
### GERB instruments since 2004

#### Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>GERB 2</th>
<th>GERB 2 IODC</th>
<th>GERB 1</th>
<th>GERB 1 IODC</th>
<th>GERB 3</th>
<th>GERB 4</th>
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- GERB 1 operating over Indian Ocean
- GERB 3 operating at 0 degree
- GERB 4 off since February 2023
GERB instruments since 2004

Timeline

Current status

- GERB 1 operating over Indian Ocean
- GERB 3 operating at 0 degree
- GERB 4 off since February 2023
Data availability

- GERB 2 - GERB 1: CEDA https://data.ceda.ac.uk/badc/gerb/

- Also in CM SAF: TOA Radiation from GERB/SEVIRI ed. 2.0
  https://wui.cmsaf.eu/safira/action/viewDoiDetails?acronym=TOA_GERB_V002

- Obs4MIPS
  https://data.ceda.ac.uk/neodc/obs4MIPS/ImperialCollege/GERB-HR-ED01-1-0

- 40 days of NRT data for GERB 3: https://gerb.oma.be/
Data products

GERB data products

- **NANRG** Non Averaged Non Rectified Geolocated (50km)
- **ARG** Average, Rectified, Geolocated
- **HR** High Resolution (9km)
- **BARG** Binned Averaged Rectified Geolocated

- Radiances from GERB / Cloud information from SEVIRI
### GERB data products

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- Radiances from GERB / Cloud information from SEVIRI

### GERB-like data product

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- Radiances from SEVIRI
GERB CERES colocation

Method

- CERES Single Scanner Footprint (SSF) fluxes (Aqua - MODIS - FM3)
- Colocation with GERB HR product

GERB 2,1,3

<table>
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<tr>
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<th>LW</th>
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<tr>
<td>G2</td>
<td>1.05</td>
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SW fluxes $<\text{G/C}> = 1.141$

LW fluxes $<\text{G/C}> = 0.973$
GERB L2 HDF5 files

- Flat structure
- Content
  - Radiometry: [Solar, Thermal] $\times$ [Radiance, Flux]
  - Scene Identification: Cloud, Scene Type, Angular model
  - Angles: Viewing Zenith Angle, Solar Zenith Angle, Relative Azimuth Angle
- Points of attention:
  - Floating point data is discretized: Need for multiplication by “quantization factor”.
  - “NaN” does not exist in HDF5 $\rightarrow$ check the “error value” in the documentation.

Check the RMIB GERB Products User Guide
GERB L2 HDF5 files

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Check the RMIB GERB Products User Guide
Using Python

- Convenient solution: add a “reader” to the Satpy library
  https://satpy.readthedocs.io/
- Satpy supports, among others: MSG SEVIRI, MFG MVIRI, Himawari AHI, GOES ABI, AVHRR, MODIS, VIIRS
- Satpy facilitates geolocation, resampling, image generation, etc.
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Check the “Satpy reader” link https://gerb.oma.be/
import satpy

scene = satpy.Scene(reader="gerb_l2_hr_h5", 
filenames=['G1_SEV2_L20_HR_SOL_TH_20120621_101500_ED01.hdf'])

scene.load(['Thermal Flux', 'Solar Flux'])
**Python code**

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```

**Data**

The data in this example is from the GERB 1 record available at
https://data.ceda.ac.uk/badc/gerb/
Python code for plotting

crs = scene['Thermal Flux'].attrs['area'].to_cartopy_crs()
ax = plt.axes(projection=crs); ax.coastlines();
ax.gridlines(); ax.set_global()
plt.imshow(local_scene['Thermal Flux'], transform=crs,
extent=crs.bounds, origin='upper', cmap=plt.cm.hot)

Python code to access the data array

print(scene['Solar Flux'].data.mean().compute(),
scene['Thermal Flux'].data.mean().compute())
Python code for plotting

crs = scene[‘Thermal Flux’].attrs[‘area’].to_cartopy_crs()
ax = plt.axes(projection=crs); ax.coastlines();
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plt.imshow(local_scene[‘Thermal Flux’], transform=crs,
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Python code to access the data array

print(scene[‘Solar Flux’].data.mean().compute(),
scene[‘Thermal Flux’].data.mean().compute())
Example scene: 2012-06-21 10:15

GERB Thermal Flux [W/m²]

GERB Solar Flux [W/m²]
Example scene: region “maspalomas” 2012-06-21 10:15

GERB Thermal Flux [W/m²]

GERB Solar Flux [W/m²]
Example scene: region “maspalomas” 2023-08-01 – 2023-08-09

GERB-like HR product
Solar (SW) & Thermal (LW) Radiance

**Comments**
- **Preliminary** based on simulated MTG data
- Same field of view as GERB → direct radiance comparison
GERB until 2030?

Outlook

- Postprocessing and QC of G4 dataset
- G3 mirror side calibration ongoing
- Hope for continuation beyond 2024 → concurrent operation with MTG-I1

Data - contact
- Test the data for yourself
- Contact: pierre.debuyl@meteo.be or team email gerb-me@meteo.be

Thanks for your attention
GERB until 2030?

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