Generation of TOA Radiative Fluxes from the GERB Instruments

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Broadband radiometer to be launched on the MSG-1,2,3 satellites.

GERB = Geostationary Earth Radiation Budget

Ground segment in UK (RAL) and Belgium (RMIB) to convert the instrument data into radiative fluxes at top of atmosphere:

- Emitted thermal flux
- Reflected solar flux

Main interest for GERB: accurate ERB measurement at high temporal sam-

- Plume rate

2 channels: TOT (0.32\,\mu m) > \lambda > 100\,\mu m and SW (0.32\,\mu m) > \lambda > 4\,\mu m

\text{4\,\mu m}
**RMIB-GERB Ground Segment Overview**

**Output:**
- Solar and thermal radiative fluxes at top of the atmosphere.

**Input:**
- Data from GERB and SEVIRI (both on MSG).

**Processing:** Data fusion from 2 (very) complementary instruments.

**Instrument**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Advantages</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>GERB</td>
<td>Fine spatial resolution</td>
<td>Limited radiometric accuracy, narrow-band filters, only 2 channels, coarse spatial resolution</td>
</tr>
<tr>
<td>SEVIRI</td>
<td>Multispectral (12 channels), narrow-band filters, limited radiometric accuracy, fine spatial resolution</td>
<td>Multispectral signature, ≥ extended λ range, broad-band filters</td>
</tr>
</tbody>
</table>

**Processing:** Data fusion from 2 (very) complementary instruments.

**Advantages**
- Fine spatial resolution
- Multispectral (12 channels)
- Narrow-band filters
- Limited radiometric accuracy
- Coarse spatial resolution

**Drawbacks**
- Limited radiometric accuracy
- Narrow-band filters
- Only 2 channels
- Coarse spatial resolution

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For the solar channels:
- Limited radiometric accuracy
- Narrow-band filters

For the thermal channels:
- Fine spatial resolution
- Multispectral signature
- Only 2 channels
- Coarse spatial resolution

**Note:**
- EGS meeting, April 25, 2002
### Instruments Main Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>GERB</th>
<th>SEVIRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial resolution (at nadir)</td>
<td>48 km</td>
<td>3 km</td>
</tr>
<tr>
<td>Temporal sampling</td>
<td>15'</td>
<td>15'</td>
</tr>
<tr>
<td>Radiometric accuracy (solar)</td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td>Radiometric accuracy (thermal)</td>
<td>0.5%</td>
<td>1%</td>
</tr>
<tr>
<td># channels</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Channel type</td>
<td>broadband</td>
<td>narrow band</td>
</tr>
</tbody>
</table>

Same field of view (Atlantic, Africa, Europe).
GERBSEVIRI

Angular modellings
Spectral modellings
(resolution enhancement)

Spatial modellings

unfiltered radiances \( L \)

Fluxes \( F \)

at GERB spatial resolution

filtered radiances

SEVIRI

Anguler modellings
(+scene identification)
Instrument data unfiltering

Method:

\[ \chi P(\chi) T \int \phi(\chi) = T \leftarrow \chi P(\chi) \phi(\chi) T \int = \int T \]

Explotation of spectral information (spectral signature) from the 12 SEVIRI channels.
Radiance-to-flux conversion

Method: Use of Angular Dependency Models (ADMs)

\[ \int_{\phi}^{\phi'} T(\theta, \phi) \frac{J}{\mu} \cos \theta \, d\theta = R \rightarrow (\phi', \theta) \]

Solar radiation: CERES-TRMM models \( R(\phi, \theta) \) for about 200 different scenes. Model selection need scene identification (see after).

Thermal radiation: models \( R(\phi, \theta) \) taking into account spectral information from SEVIRI and parameterized using RTM (SBDART, STREAMER, MODTRAN4).

\( \frac{H}{\nu} = (\phi', \theta) \)
Shortwave ADM selection - Scene Identification

Cloud identification:
- Cloud phase (water/ice).
- Cloud optical depth
- Cloud fraction in the radiometer footprint.

Computations:
- Clear sky values (see poster of Alessandro Ipe)
- 

Surface Identification: from IGBP Geotype from the Global 1km data

Cloud Identification: from SEVIRI L0.67, L1.67, L1.87; the associated

IGBP project.

Sufficient for the CERES-TRMM ADM selection.
Problem: the low-resolution GERB fluxes are sufficient for climatological studies but not for Meteorology, for example, for comparison with NWP (presentation of Cedric Bertrand).

Method:
- Renormalization of these estimates using the low-resolution GERB fluxes alone (NB-2-BB and angular conversion).
- Renormalization of these estimates using the low-resolution GERB fluxes alone (NB-2-BB and angular conversion).
- Estimate of high spatial resolution (10x10 km) fluxes from the SEVIRI instrument.

Spatial Resolution Enhancement

EGS meeting, April 25, 2002
Conclusions

The first GERB data will be available soon (MSG launch August 2002),

Web resources:

- Synergistic use of SEVIRI for the GERB data processing (untangling, radiance-to-flux and resolution enhancement).
- ftp://gerb.oma.be/gerb (data)
- http://gerb.oma.be/gerb/documentation
- http://www.ssd.rl.ac.uk/gerb

EGS meeting, April 25 2002