Coincidence campaign between CERES and ScaRaB
First Results

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- What is this campaign
- Why we made it
- What do we compare
- And how we do it
- Some preliminary results
ScaRaB products

How we came to do this campaign?

Level 1A

Output ➔ Calibrated & geolocated SW & LW filtered radiances

Level 2

SEL ➔ “ScaRaB Erbe Like“
SANN ➔ “ScaRaB ANN“

Output ➔ Unfiltered SW & LW Radiances
TOA SW & LW Fluxes + Albedo

Level 2B - SANN

LW = TOTAL - SW

Validation phase, to have an idea of the accuracy of the radiances

Unfiltering process
SEL & SANN algorithms

Focus on radiances in this presentation.

Same as Level 2 but on a 1°x1° grid (instantaneous product)
Radiances comparisons

Possible ScaRaB/others Comparisons

- No in-situ measurements
- Radiances comparisons with another ERB instruments: geographical, temporal and angular (because of the anisotropy of the observed scenes) colocations.

**SW radiances**
Co-angular ($\theta_{\text{zenith}} \pm 5^\circ$ & $\theta_{\text{azimuth}} \pm 10^\circ$ or conical aperture < 5°)
Simultaneous ($\Delta T \pm 5 \text{ mn}$)

**LW radiances**
Same as SW without the $\theta_{\text{azimuth}}$ constraint

Focus on comparisons between CERES & ScaRaB.
ScaRaB and CERES comparisons

ScaRaB on MT ➔ 20° inclination, half-swath: 48.9° - XT mode
CERES on TERRA ➔ 98.2° inclination, half-swath: 55.2° - XT mode

CERES & ScaRaB crossing
same angular conditions only near nadir.

Comparisons in XT mode all along MT mission to analyse the possible drifts between instruments
ScaRaB and CERES comparisons

CERES/Terra & ScaRaB/MT
Represented period : 16 days
Temporal colocation : 7’30”

No co-angular restriction here!
ScaRaB and CERES comparisons

CERES/AQUA & ScaRaB/MT
Represented period : 16 days
Temporal colocation : 7'30"
Conical aperture = 5°
ScaRaB and CERES comparisons

CERES/AQUA & ScaRaB/MT
Represented period : 16 days
Temporal colocation : 7’30”
Conical aperture = 10°
The CERES PAPS mode

In SW, it is required to have measured radiances under the same angular conditions to improve radiances matching for highly anisotropic scenes ➔ inconvenient poorer statistics in XT mode

How can we optimize the frequency of co-angular observations?

CERES others scanning modes (RAPS and PAPS):
CERES can change the angle of his axis scan.

How to choose the best angle for the PAPS mode?

Fixed rotating angle

CERES in RAPS mode
(Scan angle modified over time)
θ_s is the ScaraB scan angle.
θ_c is the CERES scan angle.

θ_{PAPS} is the PAPS angle i.e. the angle needed for the 2 scans to be aligned.

Prediction tracks generated using IXION software and NORAD TLE data. Crossing computation ➔ start time, end time, angles.
Schedule and Statistics of the campaign

Schedule of the campaign

1 – First test on **March 31th** (TERRA/FM2 in PAPS mode)
2 – PAPS mode over 51 days (**April 17 to June 8**) for each CERES & ScaRaB crossing.
   Every 7 days, we sent the prediction files to the NASA operational center with computed angles
   (computed with IXION software and the NORAD data).
3 – Checking angles after data reception.

Statistics over the campaign

Temporal colocation: ± 5’
Duration: 51 days (daytime only: SW radiances)

<table>
<thead>
<tr>
<th>Angular conditions</th>
<th>TERRA XT (FM1)</th>
<th>TERRA PAPS (FM2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cone ± 5°</strong></td>
<td>771</td>
<td>5817</td>
</tr>
<tr>
<td><strong>VZA ± 5°</strong></td>
<td>54974</td>
<td>15215</td>
</tr>
</tbody>
</table>

almost **7.5 times more** collocated pixels using PAPS mode.

51 days PAPS ~ 1 year XT for SW radiances + not only collocate the near nadir ScaRaB pixels
Why a 51 days campaign?

Daytime data: 08h – 16h LMT

51 days

4 to 6 overpasses per day (08-16h LMT)

51 days in order to avoid effects due to measurements during an incomplete cycle.
Crossing examples

Exemple of 3 crossings (17 april 2012)

CERES Scan
(PAPS mode & backward scan)

CERES Nadir
(go to South)

ScaRaB scan
(go to East)
130 crossings between CERES & ScaRaB

Approximately 5 crossings each couple of days (daytime only)

Crossings determined using $\Delta t = \pm 7'30''$

Day 1 : April 17  
Day 51 : June 6

Total : 130 crossings
The spatial colocation

- Spatial colocation

ScaRaB (green) = master pixel
Others (red) = slave pixel

Pixels with different sizes, shapes and weighting functions

The deformation of the pixels are taken into account

The PSF-weighted co-location estimates the contribution of each slave (red) pixel inside the master (green) one

Comparisons between an averaged value (from CERES pixels into a ScaRaB pixel) and the ScaRaB measurement.

Exemple of ScaRaB PSF
Angular & Temporal Colocation

- Angular colocation

  ADM bin angles: 10°
  Clerbaux et al.: ± 5°

  5°
  Aperture of the cone

- Temporal colocation

  Szewczyk et al.,
  Clerbaux et al.: ± 7.5 min.

  Possible to increase this value?

  Study ScaRaB pixels behavior with time using GOES SRS
Temporal Colocation

ScaRaB pixels evolution with time in the GOES image

4000 ScaRaB pixels in this image (with nadir resolution). GOES pixels are projected into ScaRaB pixels. Differences between original image (t=0) and images following

⇒ 4 or 5 minutes instead of 7.5 minutes
Preliminary Results

ScaRaB L1A, Megha-Tropiques, XT mode vs. CERES ES8, TERRA-FM2, PAPS Mode

(51 days – April 17, June 6) 5’ & 5° colocation criteria

**SW Radiances**
(5817 colocated pixels)
1.09 ± 13.76 W.m⁻².sr⁻¹
0.05 ± 17.79 % (RMS : 17.79%)

**LW Radiances**
(15215 colocated pixels)
-0.37 ± 3.17 W.m⁻².sr⁻¹
-0.75 ± 4.94 % (RMS : 5.0%)
Preliminary Results

ScaRaB L1A, Megha-Tropiques, XT mode vs. CERES Flash-Flux, TERRA-FM1, XT Mode (51 days – April 17, June 6) 5’ & 5° colocation criteria

**SW Radiances**
- (771 colocated pixels)
- \(1.01 \pm 5.6 \text{ W.m}^{-2}\text{.sr}^{-1}\)
- \(1.22 \pm 7.56 \% \text{ (RMS : 7.7\%)}\)

**LW Radiances**
- (54974 colocated pixels)
- \(-0.24 \pm 2.20 \text{ W.m}^{-2}\text{.sr}^{-1}\)
- \(-0.40 \pm 3.38 \% \text{ (RMS : 3.4\%)}\)
Preliminary Results

No time dependence
No SZA dependence
No surface dependence
PAPS campaign: preliminary data from CERES and ScaRaB
   Have to wait for final data to finalize this study?

Validation phase for ScaRaB radiances ➔
   PAPS campaign
   CERES FM1 & FM3 XT
   GERB

Validation phase for ScaRaB Fluxes & Albedo ➔
   CERES SSF FM1 & FM3
   GERB

Validation will be made all along the Megha-Tropiques mission

Thank-you