ScaRaB on-board Megha-Tropiques
An end of mission review

Rémy Roca and the french ScaRaB group
Outline of the presentation

1. Quick recap on ScaRab and Megha-Tropiques
2. Highlights of the mission
   1. Cooperation with the CERES group
   2. GEO ring activities
   3. Life cycle resolved mesoscale convective systems radiative properties
3. Conclusions
ScaRaB/3

22 kg, 52 cm width, 40 watts
4 telescopes (in red)

- 2 main channels (# 2 & 3, broad band)
- 2 auxiliary channels (# 1 & 4 narrow band)
- Cross track scanning (2300 km swath)
- 40 km resolution at nadir

**ScaRaB goal**: To determine the longwave and shortwave outgoing fluxes observations at the TOA

Building on ScaRab-1 Kandel et al
ScaRab-2 Duvel et al

No VIS/IR imager

<table>
<thead>
<tr>
<th>Channel</th>
<th>Description</th>
<th>Spectral Interval</th>
<th>Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VIS (visible)</td>
<td>0.55 – 0.65 μm</td>
<td>Interferential</td>
</tr>
<tr>
<td>2</td>
<td>SW (or solar)</td>
<td>0.2 – 4 μm</td>
<td>Silice filter</td>
</tr>
<tr>
<td>3</td>
<td>T (total)</td>
<td>0.2 – 100 μm</td>
<td>No filter</td>
</tr>
<tr>
<td>4</td>
<td>IR (Infrared)</td>
<td>10.5 – 12.5 μm</td>
<td>Interferential</td>
</tr>
</tbody>
</table>

\[ L_{\text{LW}} \text{ (daytime)} = L_{\text{TOTAL}} - A' \times L_{\text{SW}} \]

\( A' \) depends on the spectral response of T and SW channels
Thanks to the inclined orbit and altitude, ScaRaB gives:
- a large swath with relatively large pixels
- precessing measurements all through the diurnal cycle

A small scientific team:
Michel Viollier, Michel Desbois, Michel Capderou, Olivier Chomette, Patrick Raberanto, Sophie Cloché, Thomas Fiolleau and me

A small instrument CNES team:
Alain Rosak, Nadia Karouche, Michel Dejus, JL Raynaud,…
The Megha-Tropiques mission timeline

A joint mission between ISRO and CNES

Phase A
1993

Phase BCD
1998

Phase E
10/2011

Phase E
2007

Phase E
2011

Phase E
10/2018

Phase E
04/2019

Phase E
12/2022

Phase F

Loss of MADRAS
03/2012

End of Nominal life
10/2014

Major Platform issue
10/2018

Degraded Mode
04/2019

End of exploitation
12/2022

12th Science Team Meeting
November 3-5, 2009
Fort Collins, CO

PI : Michel Desbois

Pi : Rémy Roca
The ScaRaB record (1/2)

Data completeness and quality
SCARAB L1A2 Dumpwise V10 000

completeness : % data available (mean : 64.82%)
quality : % invalid RAD (mean : 3.34%)
quality : % invalid LOC (mean : 2.74%)

Courtesy JL Raynaud CNES
The ScaRaB record (2/2)

SCARAB: Channel 1 to 4 noise
Tendency since the launch

 Courtesy JL Raynaud CNES
Comparisons with CERES

ScaRaB/MT ➔ inclinaison 20°, demi-fauchée: 48.9° - XT mode
CERES/TERRA ➔ inclinaison 98.2°, demi-fauchée: 55.2° - XT mode

Courtesy Chomette, Raberanto, Capderou

NASA activates the programmable mode of CERES for each crossings during the campaign
Comparisons with CERES

**L1:** CERES & ScaRaB are in good agreement. ➔ bias ≈2.5% in SW, with error budget ScaRaB≈1.6%, CERES≈1% (at 1σ) + errors brought by the colocation method > 1.5%

**Comparisons in XT mode**
in **black**
102 days each
550 px on average

**PAPS campaigns**
in **red**
≈ 60 days each
1000 px on average

Unfiltered SW radiances: 5’ 5° 80% ➔ 0-10%

**L2:** D. Doelling warned us about a mismatch of the definition of the Relative Azimuth Angle (RAA) between SCARAB and CERES (180° shift) but due to the flip manoeuvre it is true only part of the time!

This has been fixed
ScaRaB and the georing

Spectral normalization and calibration corrections of the $Tb_{GEOS}$ by using the SCARAB observations onboard Megha-Tropiques

- SCARAB-IR Channel 4: $[10.5 \mu m - 12.5 \mu m]$
- Temporal stability over the period

Updated from Fiolleau et al. 2020
Radiative properties of MCS along their life cycle

Life Cycle–Resolved Observation of Radiative Properties of Mesoscale Convective Systems

DOMINIQUE BOUINIOL, a REMY ROCA, a THOMAS FIOLEAU, b AND PATRICK RABERANTO c

OLR: life cycle
Albedo: LT and then life cycle
Conclusions

**ScaRaB-3 on Megha-Tropiques has come to an end:**
10 years + of high quality TOA broad band radiances measurements and flux estimates on a precessing orbit

**Highlights of science results**
Cross-Validation of CERES and SCARAB dataset within their respective instrumental uncertainty budget
Use for the GEORING calibration
Permit the characterization of the life cycle resolved radiative properties of the MCS: actually a science objectif from 2003!
More to it: science results from India

A long running (and much appreciated) companionship with the CERES team
A long running (and much appreciated) companionship!