MEGHA – TROPIQUES is a scientific mission dedicated to the study of the atmospheric water cycles, energy exchanges and convective systems in the inter-tropical belt.

MEGHA - TROPIQUES is a joint ISRO/CNES program based on the development of one unique satellite launched by PSLV in India.

Key interest: inclined orbit 20° wrt to equator and altitude 865,5Km.
MEGHA-TROPIQUES PAYLOADS

Bus: IRS from ISRO
Payload: 4 payloads
- MADRAS (CNES/ISRO)
- SAPHIR (CNES)
- SCARAB (CNES)
- GPS-ROSA (ISRO)

- Mass: 1 ton
- Power: 694 Watts
- Life time spec: 3 years
- Fuel > 5 years
Launch in October 2011

MEGHA-TROPIQUES satellite was launched Octobre 12th 2011 at 11Hours local time (5H30 UT) by Indian PSLV launcher from SRIHARIKOTA in INDIA

Launch was successful and orbit nominal
MEGHA - TROPIQUES

CNES Contribution: SCARAB

Instrument devoted to the Measurement of outgoing radiative fluxes at the top of the atmosphere

SCARAB OPTICAL HEAD for MEGHA-TROPIQUES
MEGHA-TROPIQUES

SCARAB estimates:
the solar reflected fluxes & the long wave emitted flux of the Earth/Atmosphere.

Channels spectral responses

2 broadband channels
- short wave (up to 4 mm) to measure direct Solar reflection
- Total channel to measure both direct Solar reflection and earth/atmosphere emitted radiation

2 Visible and Infrared windows channels (auxiliary narrow channels)
- To permit scene identification and comparison with geostationary satellites
### SCARAB CHANNEL REQUIREMENTS

<table>
<thead>
<tr>
<th>Channel</th>
<th>Wave length</th>
<th>Signal dynamics</th>
<th>Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sc 1 - Visible</td>
<td>0.5 to 0.7 μm</td>
<td>120 W.m².sr⁻¹</td>
<td>&lt; 1 W.m².sr⁻¹</td>
</tr>
<tr>
<td>Sc 2 - Solar</td>
<td>0.2 to 4 μm</td>
<td>425 W.m².sr⁻¹</td>
<td>&lt; 0.5 W.m².sr⁻¹</td>
</tr>
<tr>
<td>Sc3 - Total</td>
<td>0.2 to 200 μm</td>
<td>500 W.m².sr⁻¹</td>
<td>&lt; 0.5 W.m².sr⁻¹</td>
</tr>
<tr>
<td>Sc 4 - IR Window</td>
<td>10.5 to 12.5 μm</td>
<td>30 W.m².sr⁻¹</td>
<td>&lt; 0.5 W.m².sr⁻¹</td>
</tr>
</tbody>
</table>

- Main channels: Solar channel Sc2 and Total Sc3
- Sc1 (visible) and Sc4 (IR) are used for scene identification and for compatibility with operational satellites: absolute accuracy
- Longwave irradiance is calculated from the difference between Sc3 and Sc2
  - Channel 5: \( LW = Channel\ 3 - \ A \times Channel\ 2 \Rightarrow \) Thermal energy
  - Channel 5 is a synthetic channel
SCARAB is a cross track scanning radiometer

Main Requirements

- Scan angle coverage: ±49°
- Footprint at Nadir is 41Km
- Swath is about 2240 Km
- Location requirement: 5km
- Co-registration for C2/C3: 98%
SCARAB Pixel pattern on ground

Centre of pixel 1 : -48.91°
Centre of pixel 51 : +48.91°

<table>
<thead>
<tr>
<th></th>
<th>At Nadir</th>
<th>Pixel 0 and N°50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pixel size diagonal</td>
<td>58,82 Km</td>
<td>192,53 Km</td>
</tr>
<tr>
<td>across track</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pixel size diagonal</td>
<td>58,82 Km</td>
<td>99, 46 Km</td>
</tr>
<tr>
<td>along track</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
● 4 Channels based on 4 identical telescopes focusing radiation on 4 pyroelectric detectors located at the prime focus of a spherical aluminum mirror

● The 4 channels are mounted on rotating scan support to realize cross track scanning

● Channel 1, 2 and 4 are equipped with filters
  » Channel 1 and 4: filters are mounted on the channel
  » Channel 2: filter is implemented on filter wheel

● A filter wheel is implemented to enable filters to be moved in front of channel 2 (nominal mode) or in front of channel 2 and 3 (calibration modes)
Detectors being sensitive to modulated energy, mechanical choppers are used to measure alternately the signal coming from earth and signal coming from internal blackbody reference.

A calibration Unit, composed of 3 blackbodies and a lamp is dedicated to in flight gain calibration.

During each scan period, a space view measurement is performed to provide a reference.

Acquisition pattern in nominal mode is composed of 4 phases: constant speed for earth acquisition, stop on deep space, acceleration and deceleration on the remaining period.

Total period or a scan = 6 seconds.
INSTRUMENT MODES

Nominal: Solar Filter is set on channel 2 and no filter on total channel: acquisition pattern with stop on space view channel 2, 3, 4 and internal reference for channel 1

Solar Mode - Mode MS: Filter wheel is oriented in order to set 2 identical solar filters on channel 2 and channel 3

Total mode – Mode MT: Filter wheel is oriented such as no filter are located in front of channel 2 and 3

Mode CAL C: measurements of blackbodies and lamp are acquired – These measurements are used for gain calibration
First switch ON:

Switch ON in stand by mode October 13th puis 3 semaines d’attente

Switch to nominal mode November 4th 2011,

Nominal performance since launch

C1: Visible
C2: Solar
C3: Total
C4: Infrared
Products generated from CNES algorithms Specifications, and disseminated from ISRO mission center

**Standard Product**: Day-wise Product: Latency – 6 hours typical

**Near Real Time Product**: Dump-wise Product: Latency - 3 hours 30

**Product L1A**:

- 51 pixels in scan line geometry
- with Radiometric corrections
- time tagged - Geolocated (including geometric corrections)

**Product L1A2**

- Same as L1A plus better registration of channels with reference to channel 2 by interpolation
Product L1A3: collocated SCARAB data with MADRAS

Projection of scarab information ON MADRAS 89GHz channel geometry (conical scan)

Product L1B: Projection on ISRO Grid static grid along the orbits
Data dissemination

• Products availability at L1 level in ISRO MOSDAC and ICARE centre Lille was delayed due to delay in data processing development

• July 26th 2012: L1 A dump product disseminated in routine mode

• September 18th 2012: L1A and L1A2 dump products disseminated in routine mode
  ➢ Including some improvement in location processing

• Reprocessing of One year data going on, in ISRO with the objective to be disseminated by October End 2012