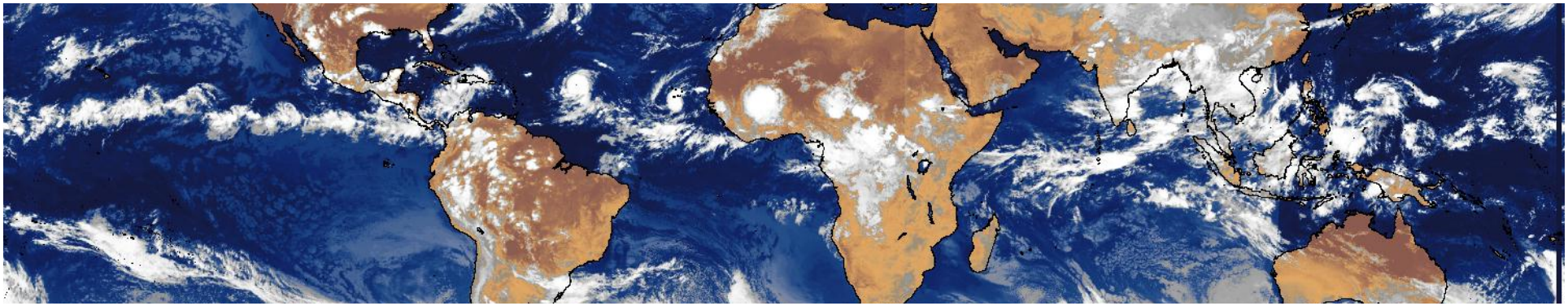
The Megha-Tropiques Mission



Sep 13th, 2010 0000Z courtesy www.satmos.meteo.fr

Rémy Roca (LMD)
and the French MT science team

The Megha-Tropiques mission
Outline of the talk

- Mission & Objectives
  - Payload
  - Orbit
- Activities on ERB in the MT team
  - Organisation
  - L2 and up
  - Side activities on GEO
- Cal/val plan
- International science team
- Follow on to MT !

The Megha-Tropiques mission
Overview

Indo-french mission realized by

The Indian Space Research Organisation and the

Centre National d'Etudes Spatiales

Dedicated to the

Water and energy cycle in the Tropics

Low inclination on the equator (20°);

865 km height

High repetetivity of the measurements

Launch foreseen in spring 2010 … 2011

Expected duration: instruments 3 yr Plateform 5 yr fuel/operation

The Megha-Tropiques mission
Scientific objectives

Atmospheric energy budget in the intertropical zone and at system scale (radiation, latent heat, …)

Life cycle of Mesoscale Convective Complexes in the Tropics (over Oceans and Continents)

Monitoring and assimilation for Cyclones, Monsoons, Mesoscale Convective Systems forecasting. NRT capability.

Contribution to climate monitoring :

- **Radiative budget (complementary to CERES)**
- **Precipitation (enhanced sampling in the tropics)**
- **Water vapour (enhanced sampling in the tropics),**

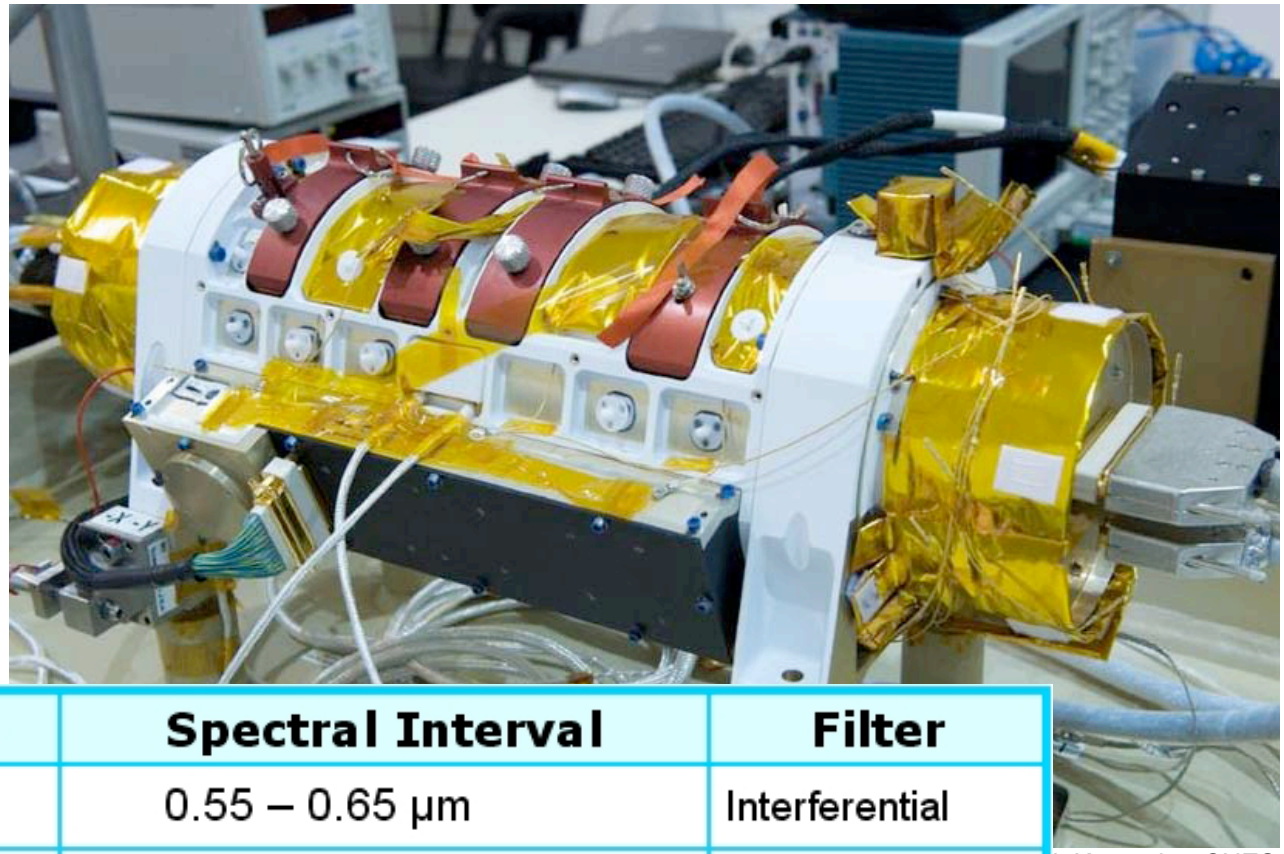
The Megha-Tropiques mission

Payloads (1/2)

•**ScaRaB** : broad band instrument for inferring longwave and shortwage outgoing fluxes at the top of the atmosphere

•ScaRaB-3 on MT

•cross track scanning
•40 km resolution at nadir



I. Karouche, CNES

Channel	Description	Spectral Interval	Filter
1	VIS (visible)	0.55 – 0.65 µm	Interferential
2	SW (or solar)	0.2 – 4 µm	Silice filter
3	T (total)	0.2 – 100 µm	No filter
4	IR (Infrared)	10.5 – 12.5 µm	Interferential

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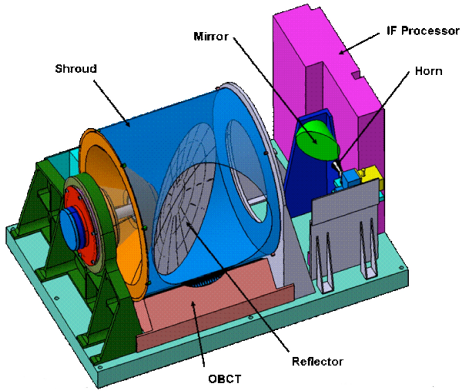
Payloads (2/2)



Source: N. Karouche, CNES

SAPHIR : microwave sounder for water vapour sounding : 6 channels in the WV absoption band at 183.31 GHz. (cross track, 10 km)

MADRAS : microwave imager for precipitation : channels at 18, 23, 37, 89 and 157 GHz, H and V polarisations. (conical swath, <10 km to 40 km)

MARFEQ RF Hardware

GPS RO: water vapor profile …

GEOSTATIONARY DATA

- Cloud mask for the MW algo
- Quicklook for interpreting MT data
- Basic inputs for MCS tracking algorithm
- Basic inputs for Level 4 rainfall (radiation) products

The Megha-Tropiques mission

Orbit (1/3)

Megha-Tropiques
Orbite par rapport à la Terre

Altitude = 865.5 km a = 7243.678 km

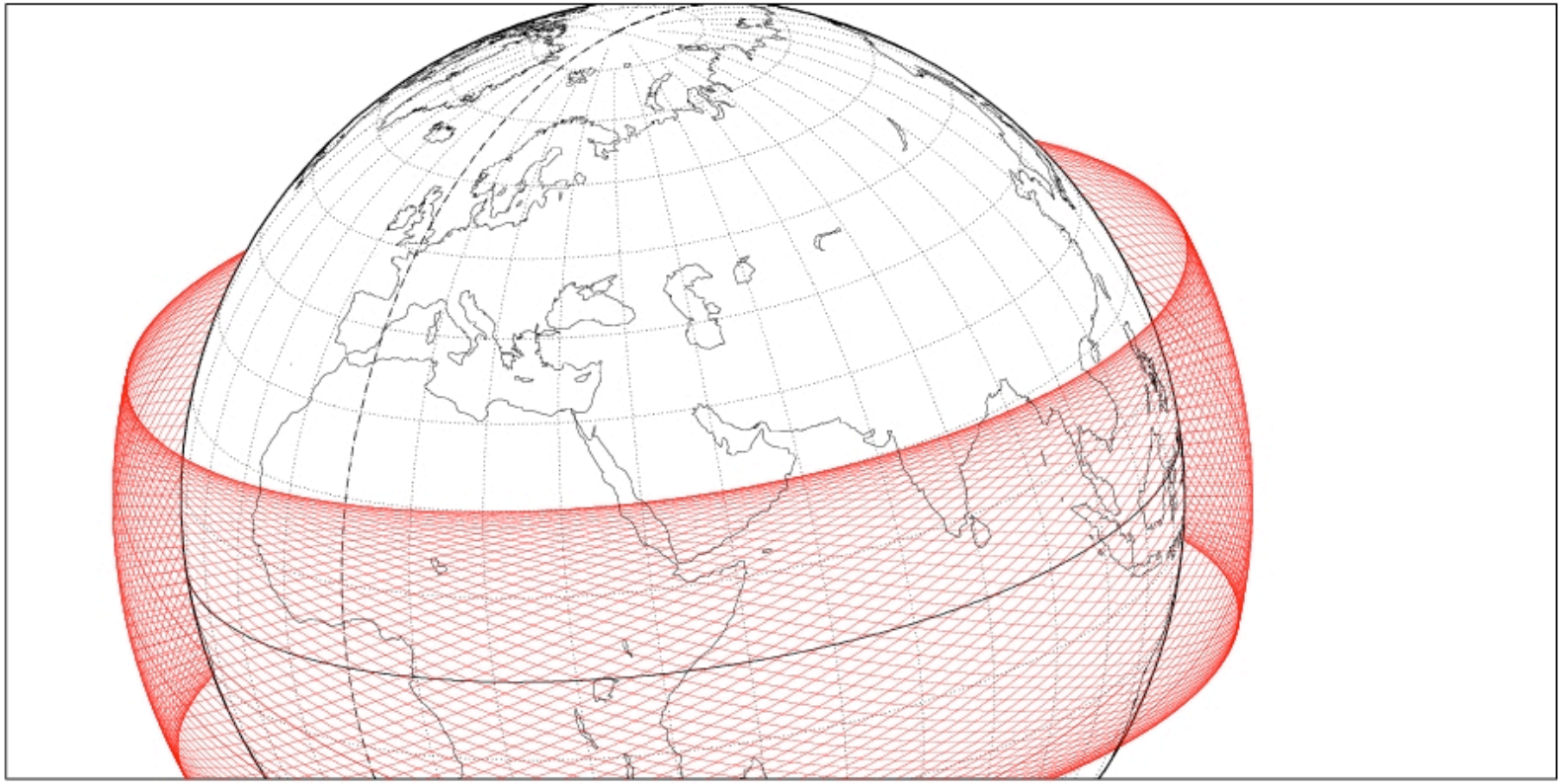
Inclinaison = 20.00 °

Phasage = [14; -1; 7] 97

Période = 101.93 min * Révol./j.=14.13

>>> Durée représentée : 7.00 jours

Décalage à l'équateur = 2892.0 km (26.0 °)



Projection : Orthographique CP: 20.0 ° N; 45.0 °E /CZ: 30.0 ° N; 60.0 ° E Noeud asc. : -180.00 ° [00:00 TSM]

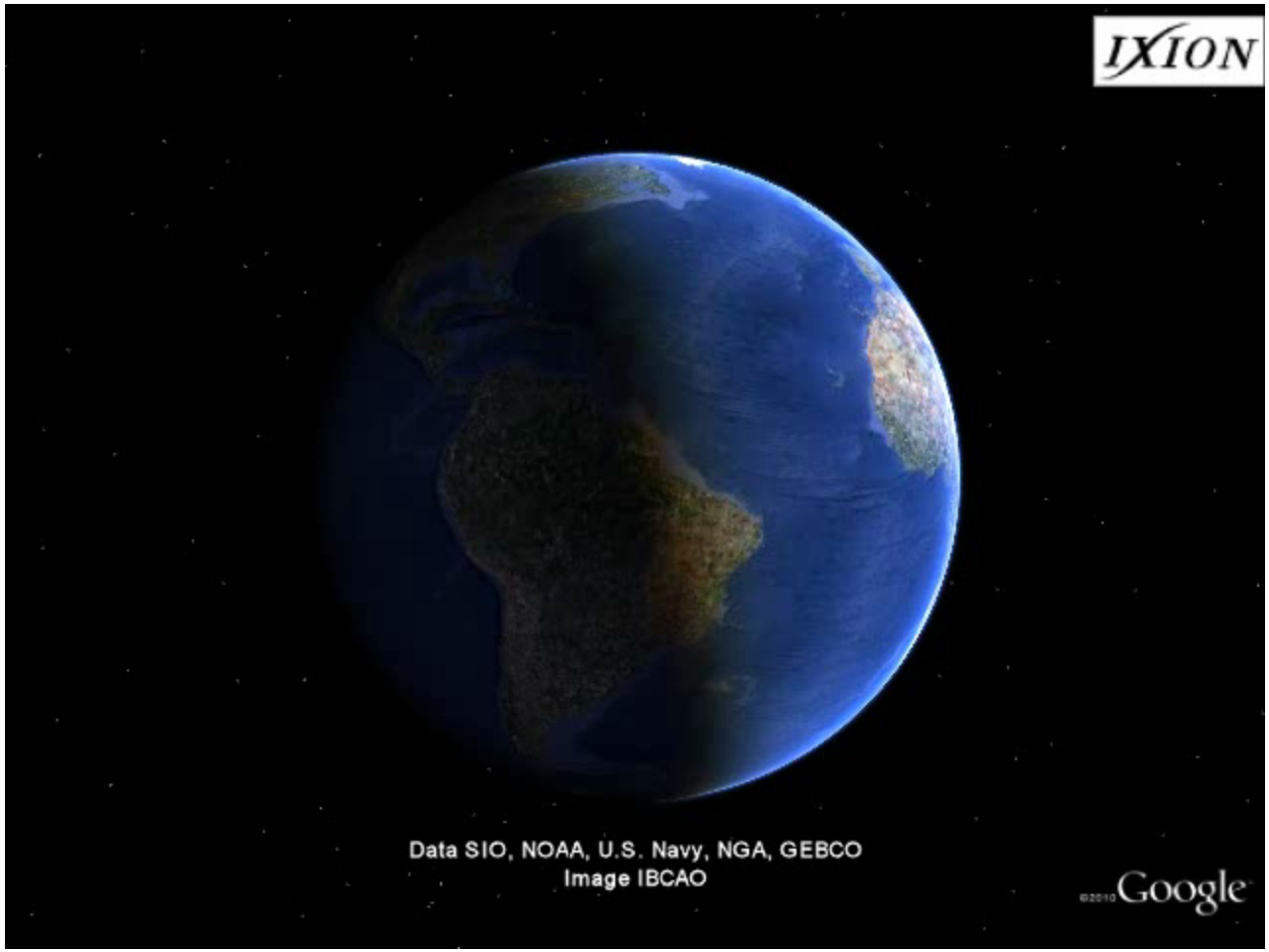
Propriété : (sans) Aspect : Oblique

⊕ T.:Azimutal - Grille : 10° {4.2} [-90.0/ +70.0/ +45.0] [+8] EGM96

Ιξιων
MC ★ LMD
Ατλας

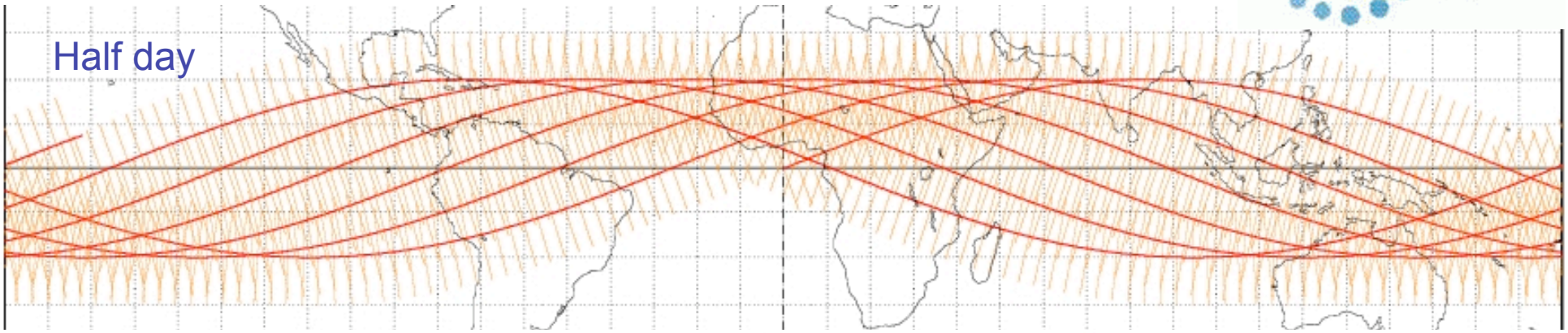
The Megha-Tropiques mission

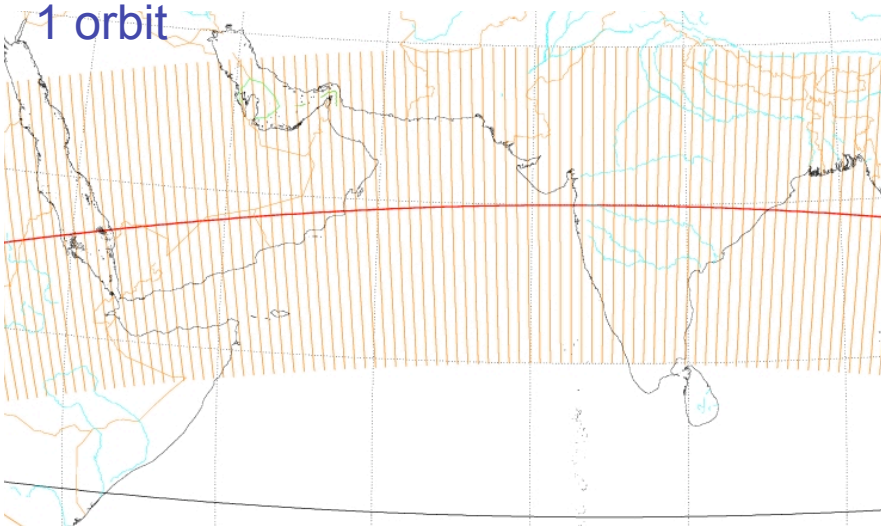
Orbit (2/3)

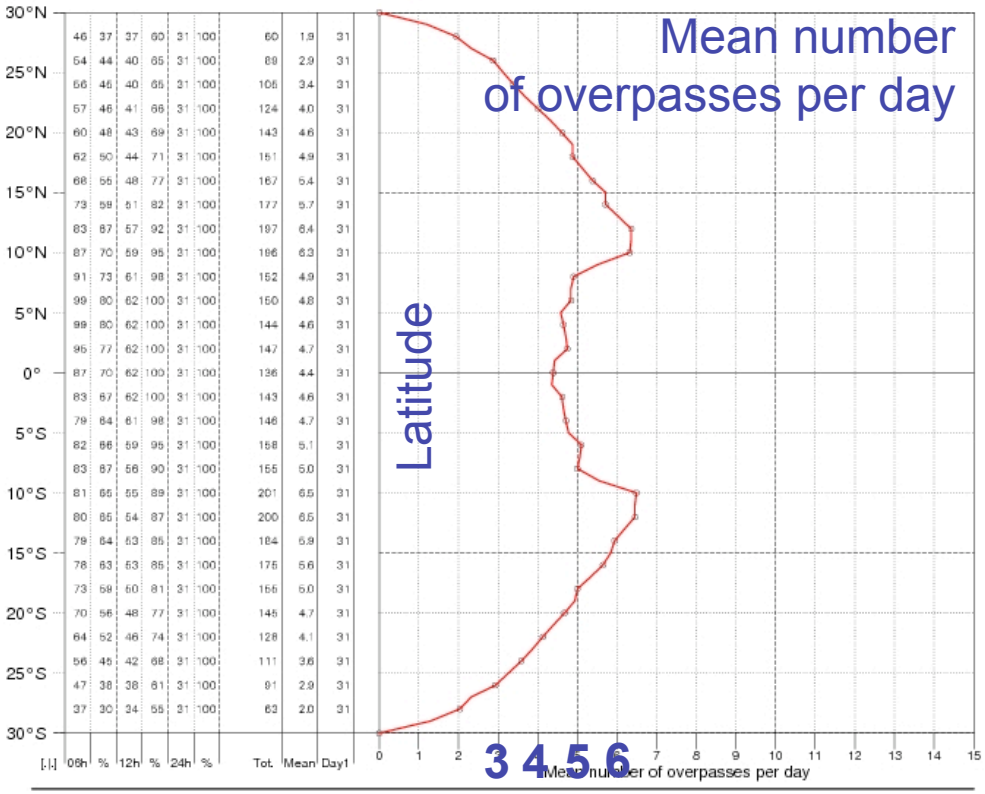


The Megha-Tropiques mission

Orbit (3/3)







SCARAB sampling over 20°S-20°n
Min 4 per day
Max 6 per day

Life cycle of Mesoscale Convective Systems
Compositing with MT

The Megha-Tropiques mission

Who's doing what in France

MT is a research space mission carried by both the CNES and the CNRS
Two teams are sharing the responsibilities:

A PROJECT TEAM led by
Dr Nadia Karouche,
Project Manager from CNES
In the team :
Engineers from CNES,
Engineers from Astrium (Madras),
and from the research labs (CNRS)

A MISSION TEAM led by
-Dr Rémy Roca, PI from CNRS
(formerly Dr Michel Desbois)
In the team :
Scientists from research Lab
(mainly CNRS), and programmatic
from CNES

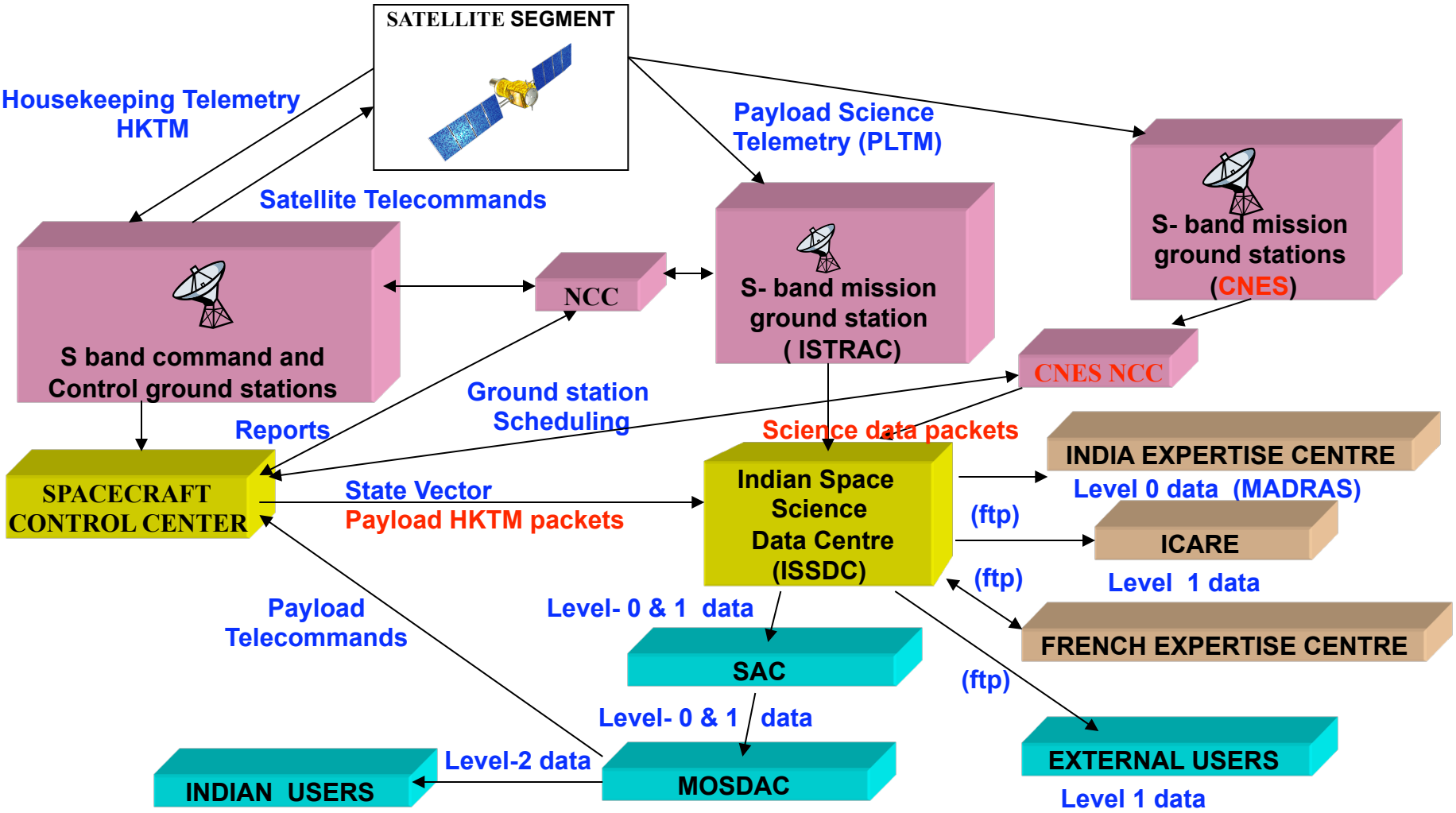
CNES/ISRO MoU

Start	Phase A,B,C,D,E….	Launch L1	Retrievals L2	Cal/Val	Science
Mission Team	Project Team	Project Team	Mission Team	Mission Team	Mission Team

Interactions between the teams in a"mission group" + dedicated meetings
Project team to change after calibration to Operation Team
Scientific Ground segment (~DTM+ASCD) called ICARE in Lille, France

The Megha-Tropiques mission

Who's doing what Data flow (as of June '08)



The Megha-Tropiques mission

Who's doing what Science Side in France

ScaRaB	Rémy Roca	LMD	Science
	Olivier Chomette	LMD	Level 2 & 3
	Patrick Raberanto	LMD	Instrument, calibration,Level 3
	Michel Capderou	LMD	Celestal mechanics
	Nicolas Gif	LMD	Programming
	Sophie Cloché	IPSL	Data management & QC

Radiation	**Rodrigo Guzman**	LMD	PhD Clear sky OLR
	Bijoy Thampi	LMD	Post doc (soon) Cloud radiative forcing

ERB activities in the MT Team

Products developpements

Chomette, Raberanto, et al

ERB products Day 1

L2 Instantaneous TOA fluxes (SW+LW)

Accuracy of 10 Wm^{-2} for instantaneous fluxes

CERES ADMs are considered as reference

Scarab Artificial Neural Network algorithm (SANN)

Table 2, Loeb, JAM, 2003	**Estimated regional (1°) instantaneous SW TOA flux error ($W.m^{-2}$) – All sky**
ANN	10.8
ERBE-like	24.4

L3 Clear sky fluxes (SW+LW)

In the process of defining the most suited space-time averaging

Finalizing the error model to help in assessing the above

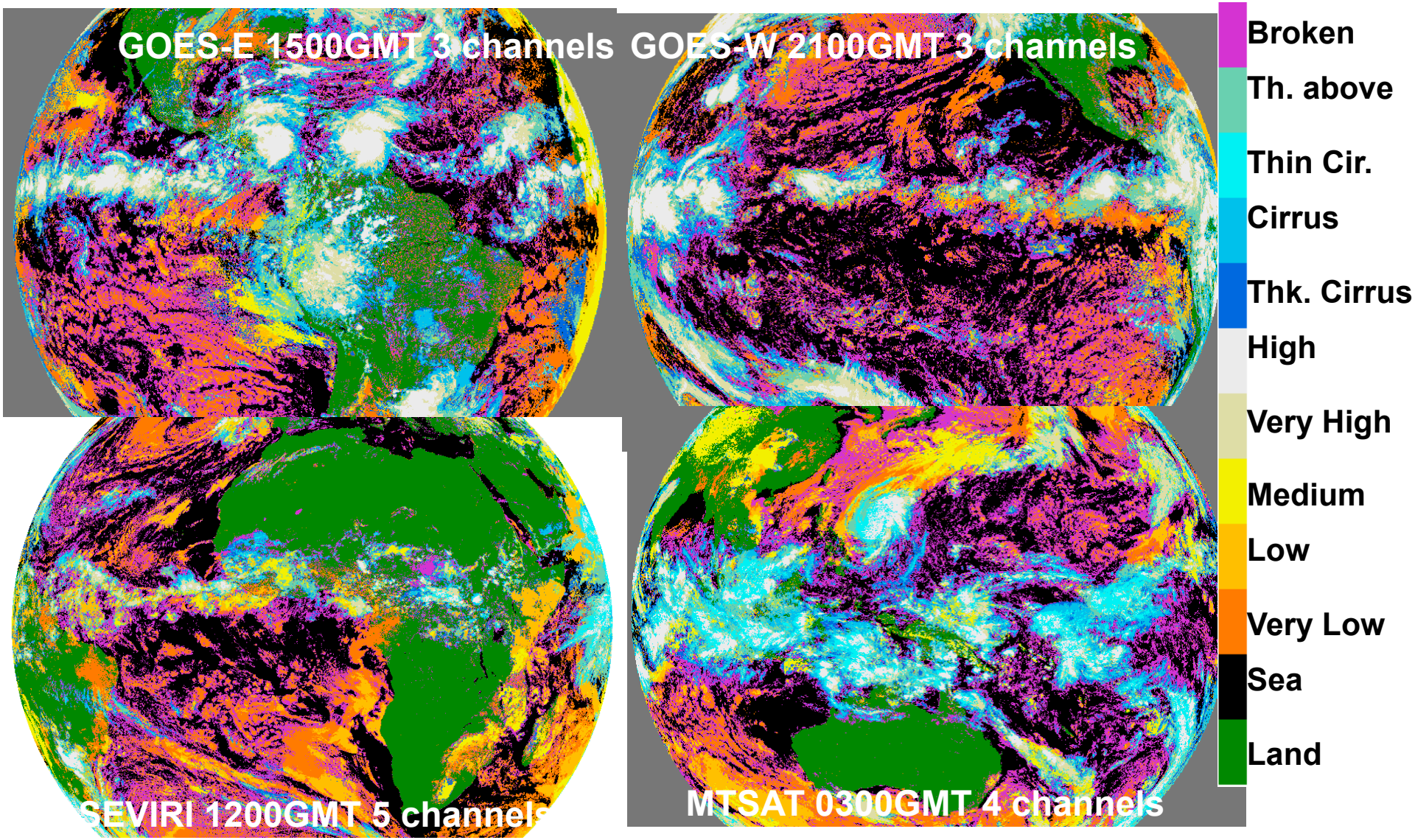
See Olivier Chomette presentation

ERB activities in the MT Team

GEO cloud activities

SAF NWC cloud classification is streaming

Geneviève Sèze et al.



The Megha-Tropiques mission

Earth radiation budget measurement summary

Across scales:

from the tropical belt down to the MCS scale (See Talk R Roca)

Combination of the payloads:

- WV sounding (SAPHIR) and OLR (Scarab) to study the greenhouse effect (See Talk from R. Guzman)
- Latent heat (MADRAS) and Cloud Radiative Forcing (Scarab) to study the relative role of these two components of the atmospheric heating
- Cloud information (GEO) and WV in the low levels (MADRAS) and TOA RB (ScaRaB) to constrain surface radiation budget estimates
- Use of high frequencies in the microwave (85, 157, 183 Ghz) for ice caracterisation (MADRAS, SAPHIR and SCARAB)
- …

The CAL/VAL Plan

- Radiometric quality check before & after launch
  - Spectral characterization
  - Gain determination

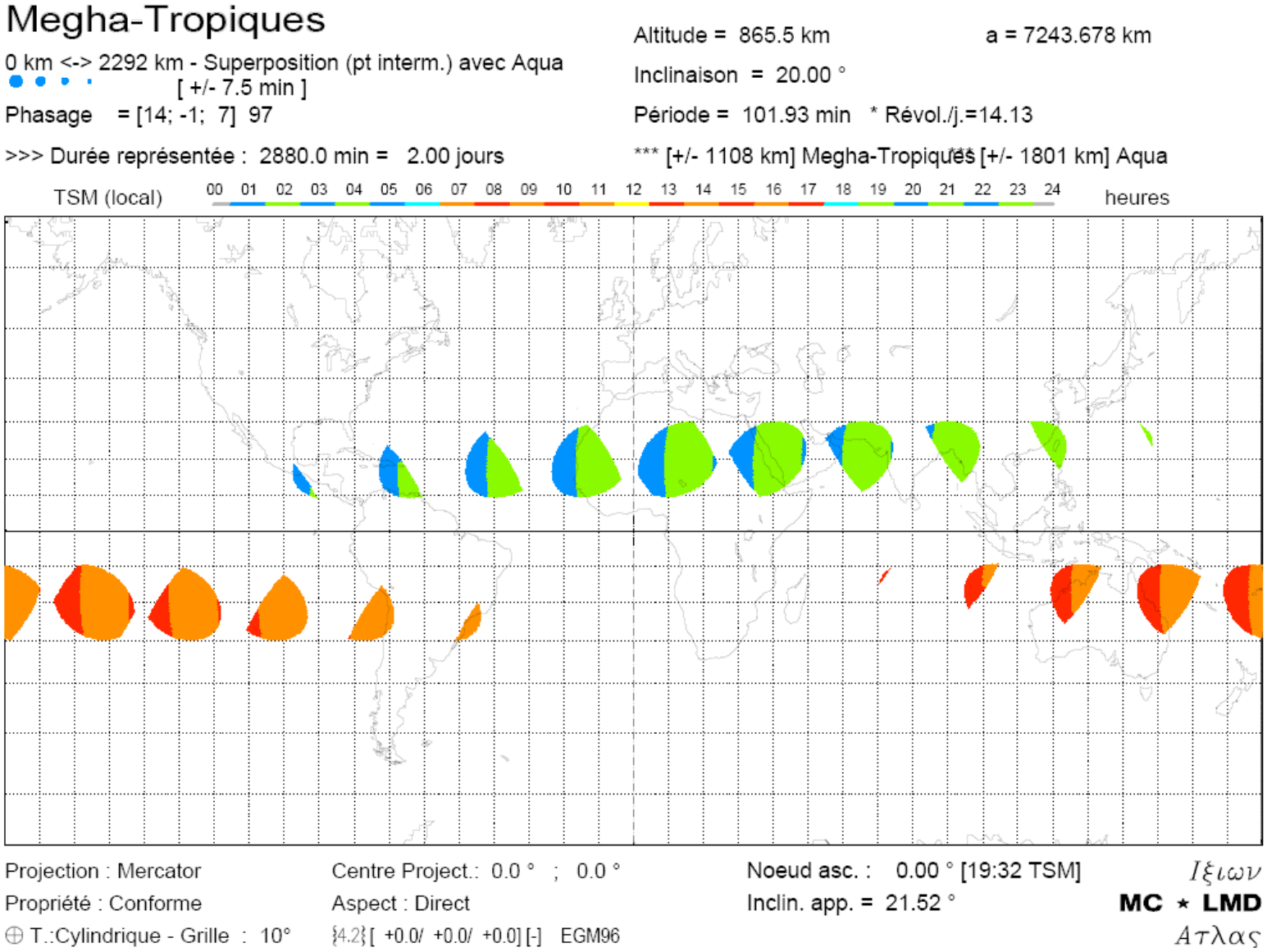
  } ~ 2% SW ; ~ 1% LW
  - Independence of TOA fluxes on the viewing geometry

- Vicarious calibration (indirect methods)
  - With terrestrial targets with known SW reflectance such as desert (precision ~ 2%)
  - or thick cloud with the DCC method to calibrate LW & SW radiances (precision ~ 1 %)

- Comparison with other ERB instruments
  - CERES & GERB real time (monitoring)
  - Comparison with historical data

Validation using CERES one example

Example with CERES (2 days), ±5 mn, no viewing angular conditions



Megha-Tropiques International Science Team

No cost call spring 2010
20 teams from 11 countries were selected

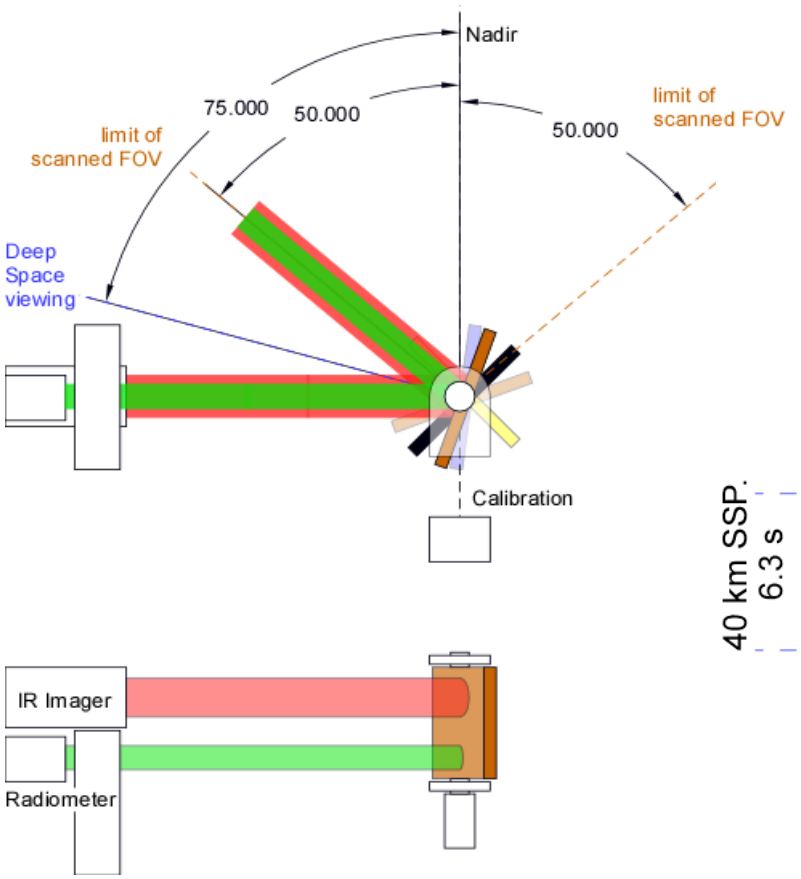
Brett Candy	Met Office	UK	Water vapor
Steven Sherwood	Univ of New South Wales	Australie	rain
Mathias Milz	Lulea Univ of Technology	Suède	Water vapor
Ziad Haddad	NASA-JPL	USA	Water vapor
Arthur Hou	NASA Goddard	USA	rain
Kenji Nakamura	Nagoya Univ	Japon	rain
Byung-Ju Sohn	Seoul National Univ	Corée du Sud	Water vapor and radiation
David Doelling	NASA Langley	USA	Radiation
Abdou Ali	Agrhymet	Niger	Rain
Edward Kim	NASA Goddard	USA	Microwave
Lakshmi Kumar	SRM University City Campus	Inde	Rain
Hareef Baba Shaeb	ISRO-DOS, Nagpur	Inde	Radiation
Flávio Ponzoni	NISR – INPE	Brésil	Radiation
Mark Ringer	Met Office, Hadley Center	UK	Rain, radiation, etc..
Sante Laviola	ISAC-CNR	Italie	Rain
V. Chandrasekar	Colorado State University	USA	Rain
Carlos Angelis	INPE	Brésil	Rain
Eric A. Smith	CRCES	USA	Rain
Arona Diedhiou	IRD-LTHE	France	Rain

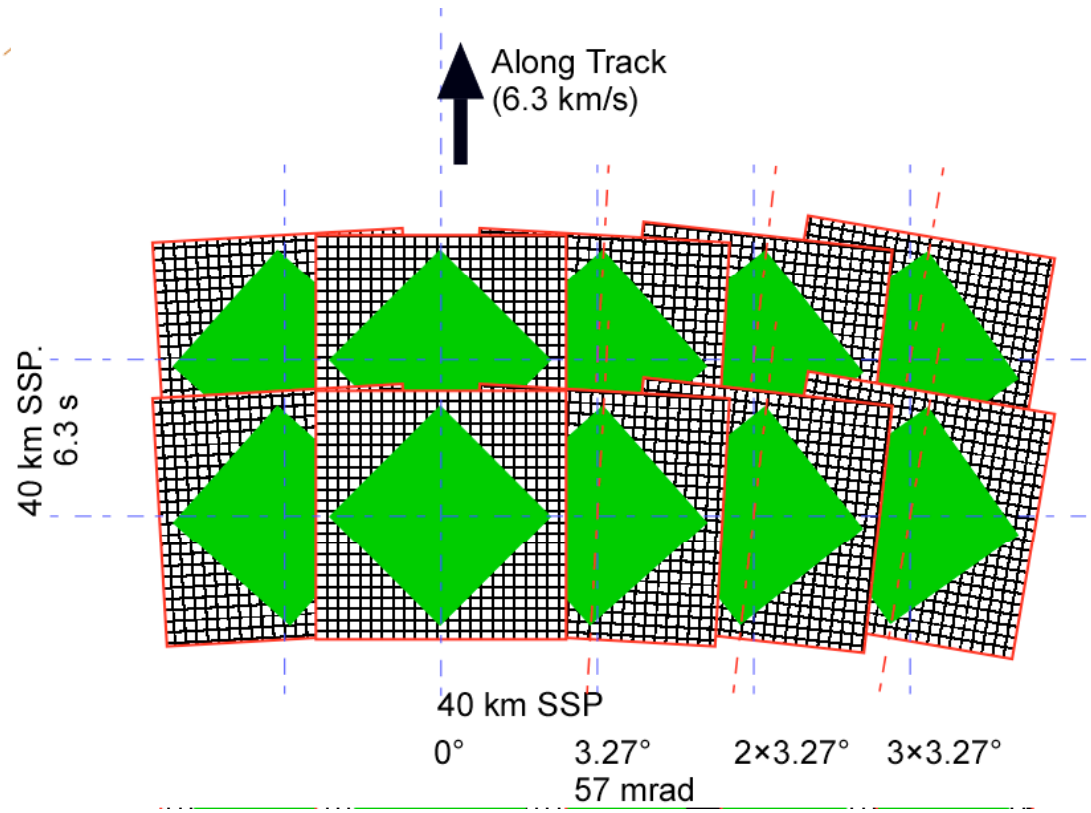
Soon start the animation (newsletter etc..) of the International Science Team
A second call is anticipated after the launch

The Megha-Tropiques mission Follow –on !

Elaboration of a new concept instrument

SCARAB+ IR Imager « inside the pixel »





Courtesy of EADS Astrium

The Megha-Tropiques mission
On going

Science and cal/val

- Special Issue with Day 1 algorithm QJRMS
  - Around 15 papers
  - October 2010
- New post doc student (B. Thampi) to start this fall on ScaRab and MCS with us
- Update the cal/val plan document for CNES accounting for possible delay
- Consolidate participation to DYNAMO (Oct 2011)
- ScaraB-4 RDM (end of phase 0 in 27 Sep)

Ground segment

- L3 daily multiplatform decision
- L1 still not finalized from the project
- Finalize implementation QC on geo and other

Thank you for your attention

http://megha-tropiques.ipsl.polytechnique.fr