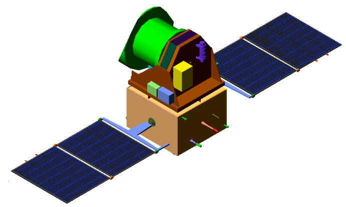


Megha-Tropiques

Pradip K Pal

Associate Project Director,
MT-Utilization
Space Applications Centre, ISRO
Ahmedabad

MEGHA - TROPIQUES MISSION

- INDO - FRENCH COLLABORATION (ISRO - CNES)
- CLIMATE / ATMOSPHERE RESEARCH AND APPLICATIONS SATELLTE FOR STUDIES OVER THE TROPICS
- INCLINED ORBIT OF 20 DEGREES FOR HIGH REPETITIVITY
- ORBIT AT 866.4 KM
- IRS BUS –1500 KG CLASS
- SHARED RESPONSIBILITY OF PAYLOADS
- ISRO's PSLV LAUNCHER
- SPACECRAFT CONTROL AND DATA RECEPTION FROM ISTRAC, BANGALORE
- 2008/09 LAUNCH FROM SHAR

MEGHA - TROPIQUES MISSION

UNIQUENESS OF THE MISSION

- **INCLINATION: Low orbital inclination 20^{o} SWATH: Large swath 1700 to 2200 km**
- **REPETIVITY: 6 times a day over 10 – 20 deg latitude band, 4 times at many other latitudes**
- **PAYLOADS: 3 payloads: A large number of climate/ atmospheric parameters from a common platform:**

  - Oceanic winds, humidity profile, liquid water, clouds, ice-clouds, radiation budget

MISSION OBJECTIVES

1. To collect a long-term set of measurements with a good sampling and coverage over Tropical latitudes to understand better the processes related to tropical convective systems and their life cycle.

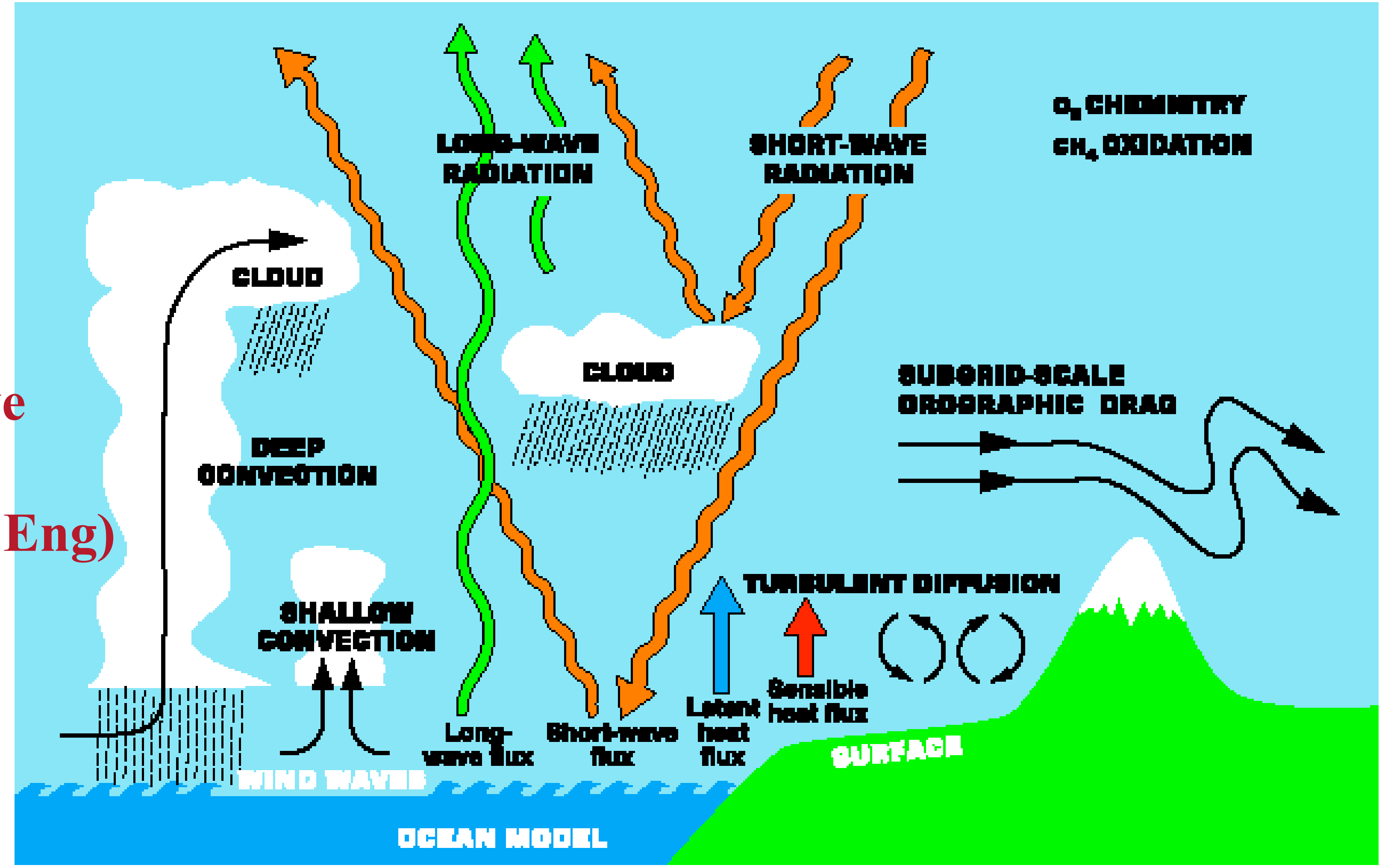
2. To improve the determination of atmospheric energy and water budget in the tropical area at various time and space scales.

3. To study tropical climatic events and their predictability: droughts, monsoon variability, floods, tropical cyclones ...

Science studies using MT data

Radiation Budget (Climate variability & change)
Cloud radiation interaction and feedback

Tropical Convective System (Thermal Eng)



Rainfall in tropics

PAYLOAD CONFIGURATION

- MADRAS (MICROWAVE ANALYSIS AND DETECTION OF RAIN AND ATMOSPHERIC STRUCTURES)
  - Imaging microwave radiometer from 18.7 to 157 GHz

    (5 Frequencies and 9 channels)

- SAPHIR (Sounder for Atmospheric Profiling of Humidity in the Intertropics by Radiometry)

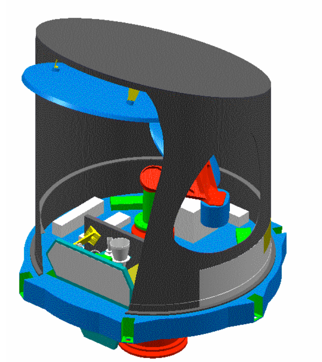
    (6 Channels Around 183 GHz)

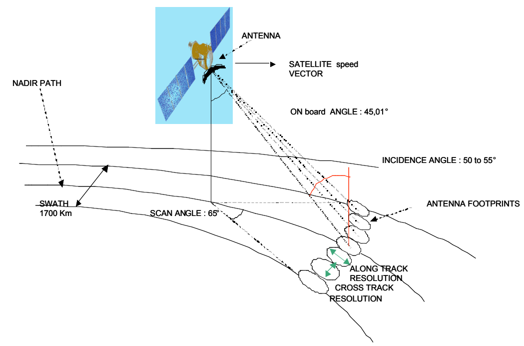
- SCARAB (Scanner for Radiation Budget)
  - Broadband radiation measurement instrument in shortwave (<4μm) and longwave (>4 μm)

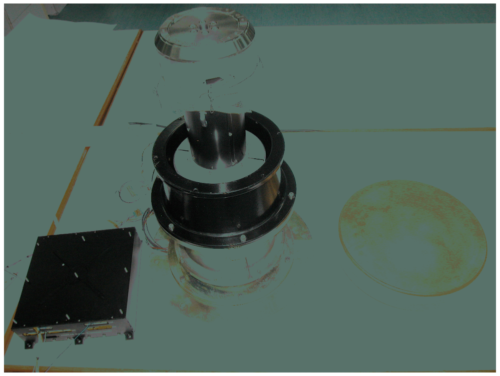
MADRAS CHANNELCHARACTERISTICS

Channel No.	Frequencies	Polarisation	Spatial resolution	Mission
M1	18.7 GHz	H+V	< 40 km	Rain above oceans, Wind speed
M2	23.8 GHz	V	< 40 km	Integrated water vapour
M3	36.5 GHz	H + V	< 40 km	Liquid water in clouds, rain above sea
M4	89 GHz	H + V	< 10 km	Convective rain areas over land and sea
M5	157 GHz	H+V	< 6 km	Ice in clouds

MADRAS SCAN PATTERN







MADRAS RF EQUIPMENT (MARFEQ) ***by CNES***

It is the 18 GHz – 157 GHz front end of MADRAS.
It rotates at 25 RPM on a conical surface. In each scan the receivers are calibrated with an ambient blackbody reference and a sky-looking reflector.
Status: FM under construction at ASTRIUM

MADRAS SCAN MECHANISM (MSM) by ISRO

Rotates the Front End antenna and receiver of mass 90 kg with a speed stability of < 0.1 % @ 25 rpm
Provides scan position with an accuracy of 10 arc-sec using 17 bit absolute optical encoder. Transfers power and signal via a 90-line PSTD with a life of 80 million revolutions. Status: EM tested successfully at IISU

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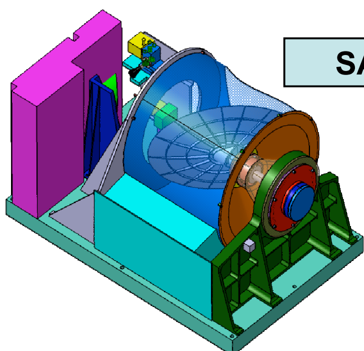
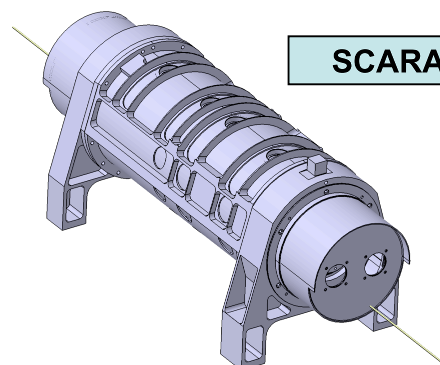
SCARAB CHANNEL CHARACTERISTIC S

Channel	Wave length	Signal dynamics	Noise
Sc 1 -Visible	0,5 to 0,7 ?m	120 W.m≤.sr^{-1}	< 1 W.m≤.sr^{-1}
Sc 2 - Solar	0,2 to 4 ?m	425 W.m≤.sr^{-1}	< 0,5 W.m≤.sr^{-1}
Sc3 - Total	0,2 to 100 ?m	500 W.m≤.sr^{-1}	< 0,5 W.m≤.sr^{-1}
Sc 4 - IR Window	10,5 to 12,5 ?m	30 W.m≤.sr^{-1}	< 0,5 W.m≤.sr^{-1}

- **Main channels : Sc2 and Sc3**
- **Sc1 and Sc4 are for scene identification and for compatibility with operational satellites**
- **Longwave irradiance is calculated from the difference between Sc3 and Sc2**



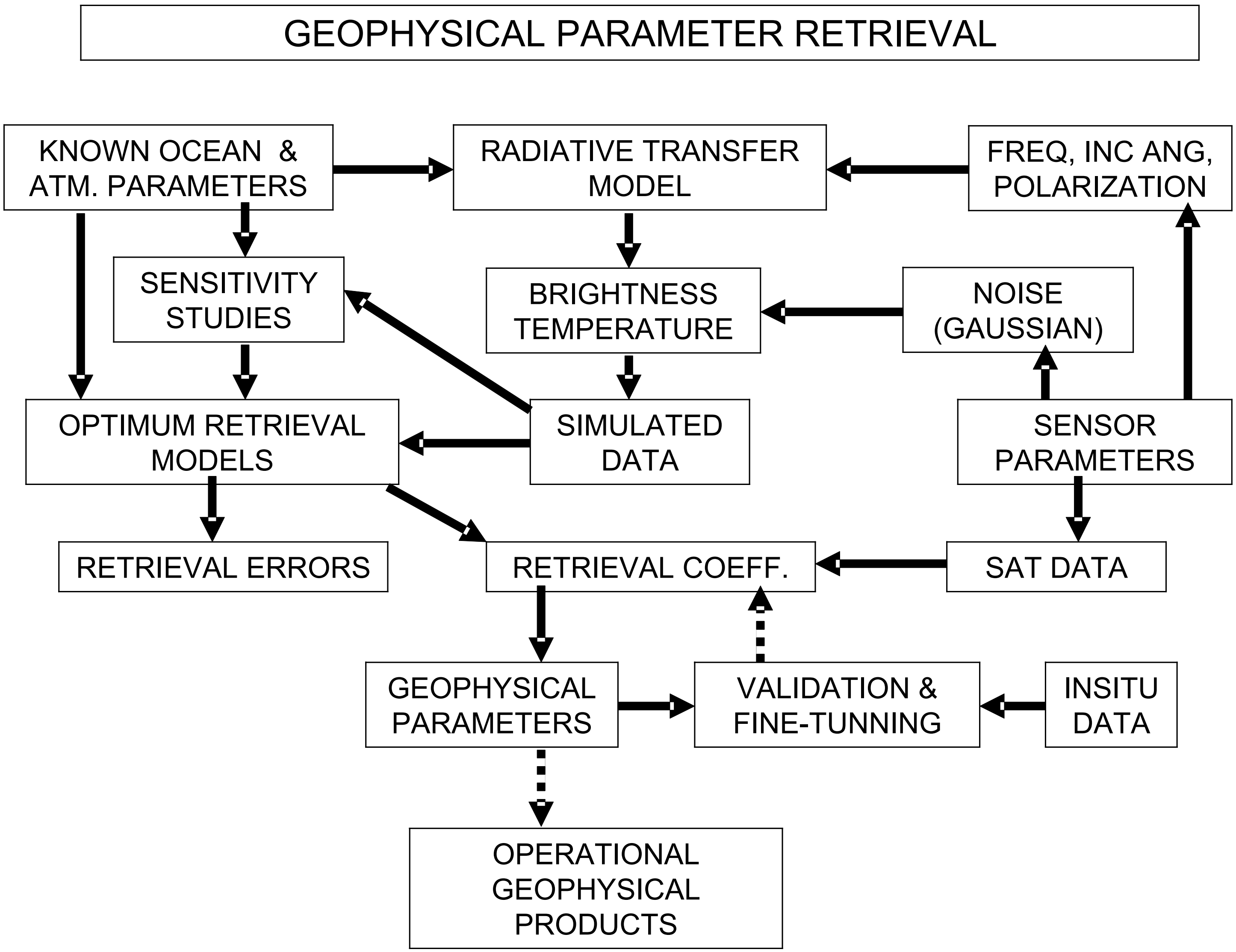
SAPHIR



SCARAB

Channel N°	Central Frequency (GHz)	Bandwidth (MHz)	Lower bandwidth (GHz)	Upper bandwidth (GHz)
1	183.31 ± 0.2	200	183.010 - 183.210	183.410 - 183.610
2	183.31 ± 1.1	350	182.035 - 182.385	184.235 - 184.585
3	183.31 ± 2.8	500	180.260 - 180.760	185.860 - 186.360
4	183.31 ± 4.2	700	178.760 - 179.460	187.160 - 187.860
5	183.31 ± 6.8	1200	175.910 - 177.110	189.510 - 190.710
6	183.31 ± 11.0	2000	171.310 - 173.310	193.310 - 195.310

Retrieval – MADRAS & SAPHIR



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MADRAS Retrievals

- Forward RT simulations using a data base from TRMM and PR for more than three years on optimum spatial and temporal scales.

- First version of rainfall using integrated Scattering Index (SI) and Polarization Corrected Temperature (PCT) methods in final stages of testing using DWR observations.

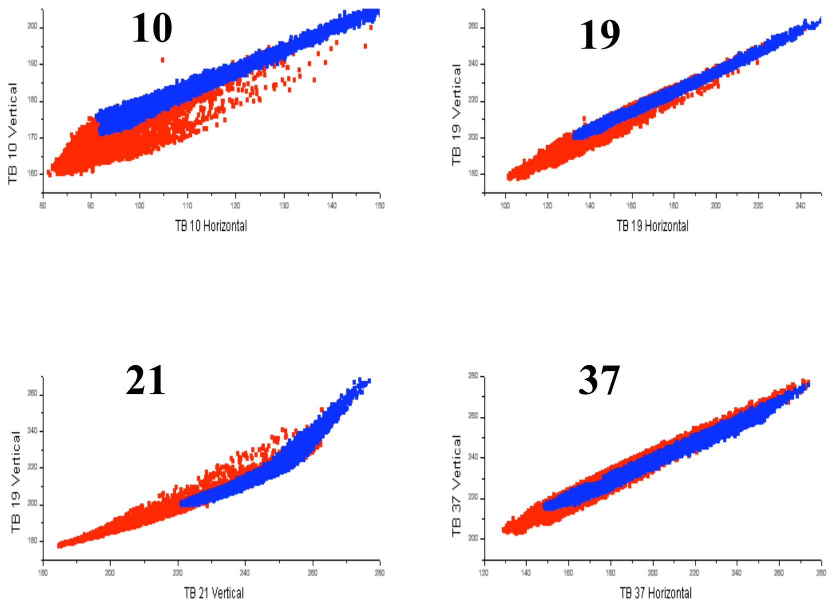
- Work has been initiated for blending Geo-St. IR and lower orbiting MW observations from INSAT & MT

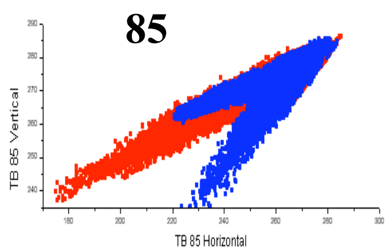
- Algorithm for inversion of MT measurements for WV and other geo-physical parameters based on 1-D variational approach

MADRAS Retrieval

Radiative Transfer Forward simulation

Non-raining atmosphere

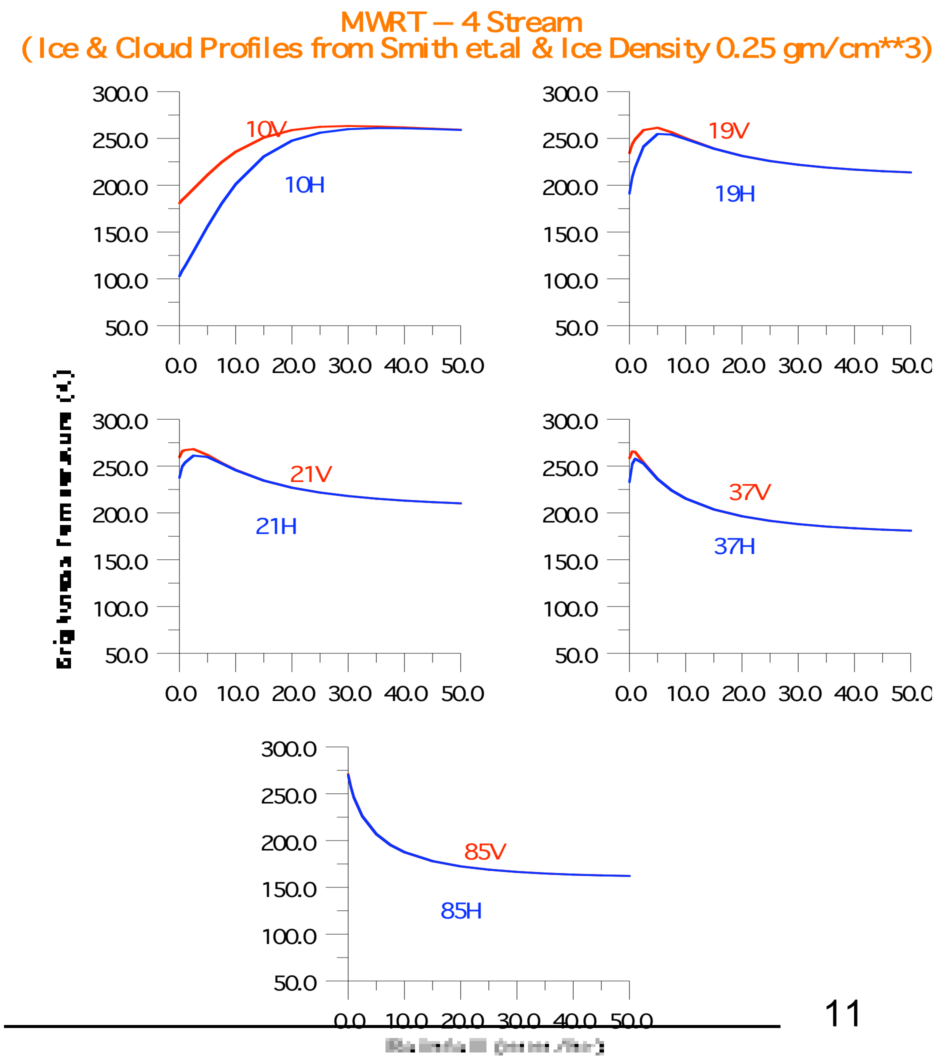




* Simulated Brightness temperatures

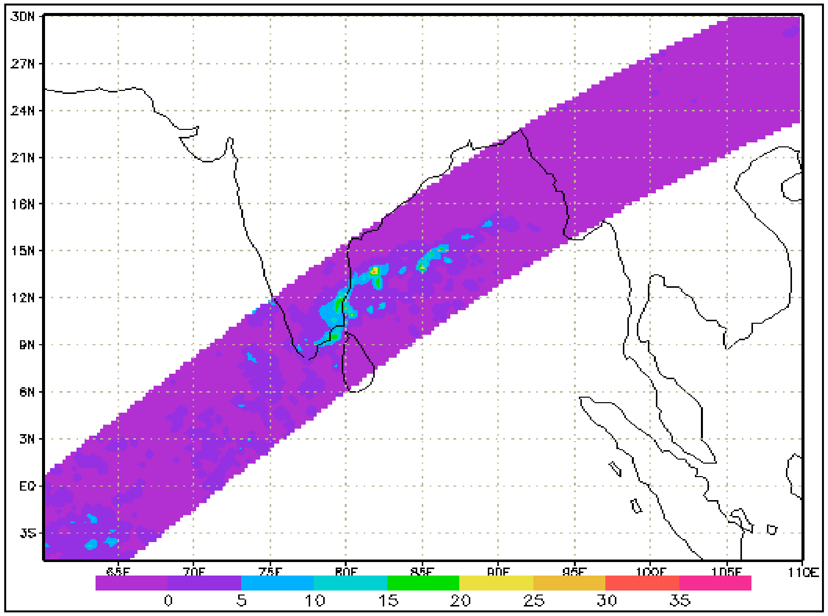
* TRMM-TMI Real Observations

Scattering atmosphere

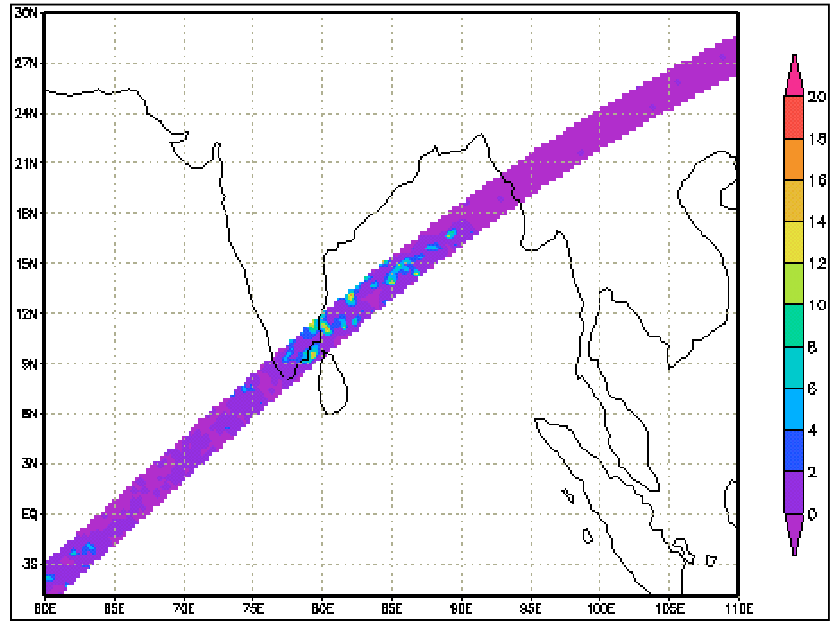


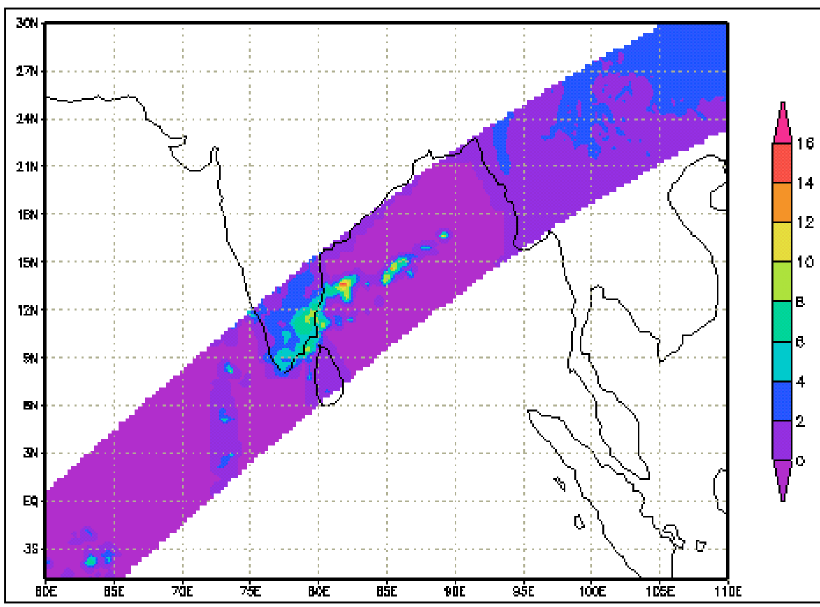
COMPARISON OF RAINFALL FROM NASA, PR & PRESENT ALGORITHMS

NASA TMI RAINRATE



NASA PR RAINRATE



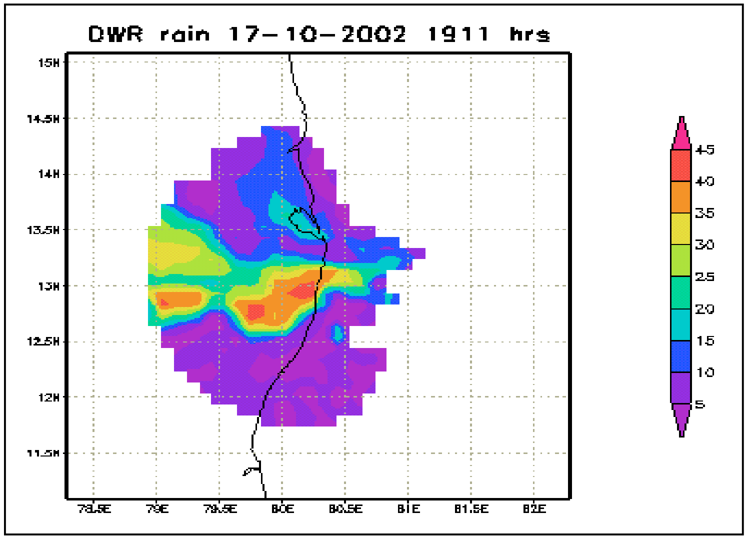


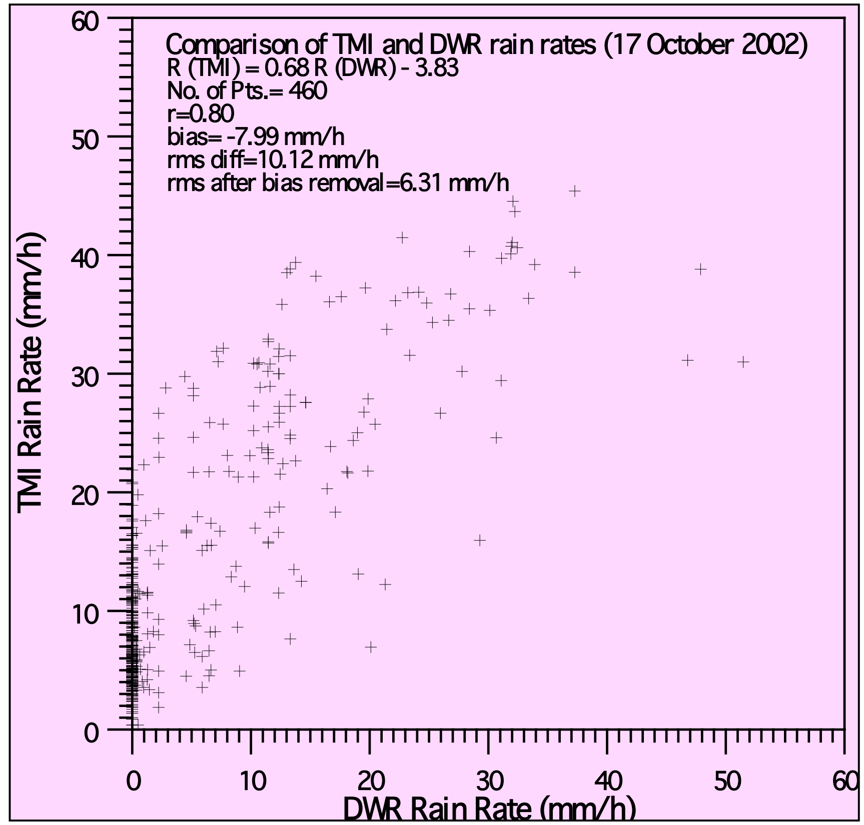
OCTOBER 10, 2002

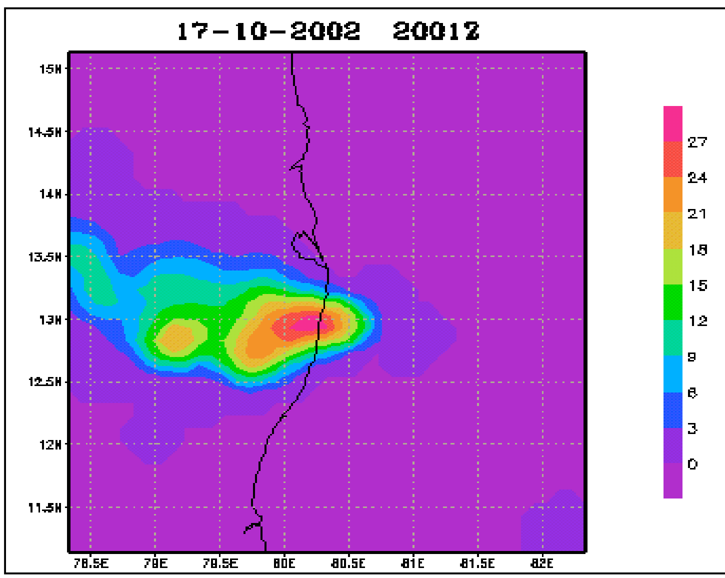
TMI RAINRATE
(PRESENT ALGORITHM)

VALIDATIONS: TRMM VS. DWR RAINFALL

OCTOBER 17, 2002





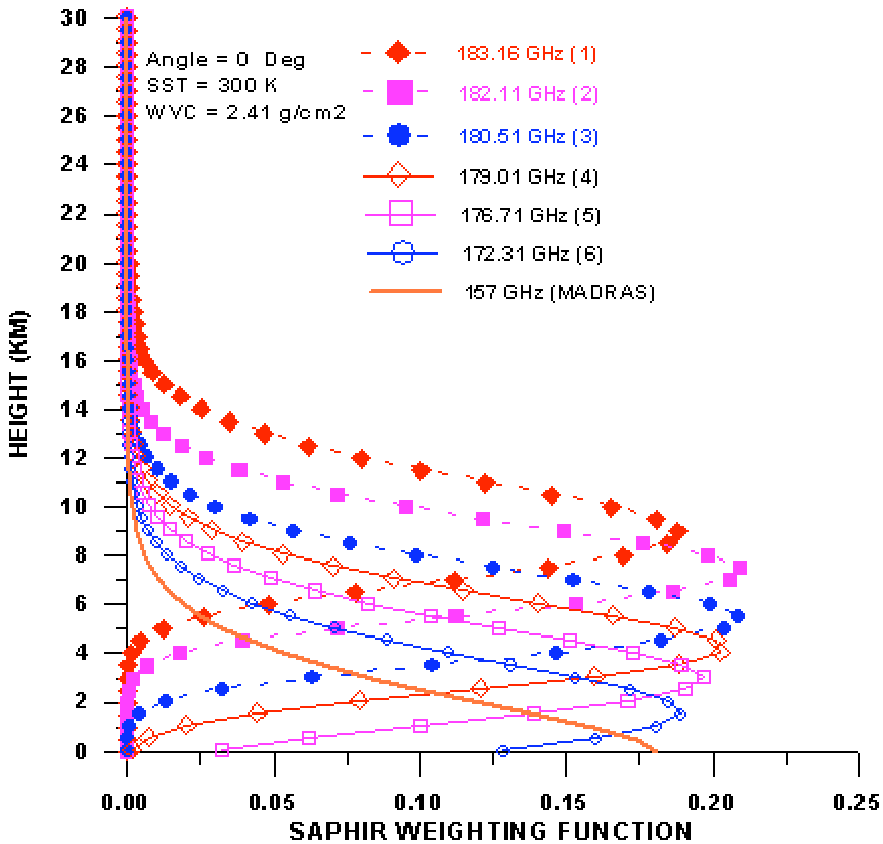


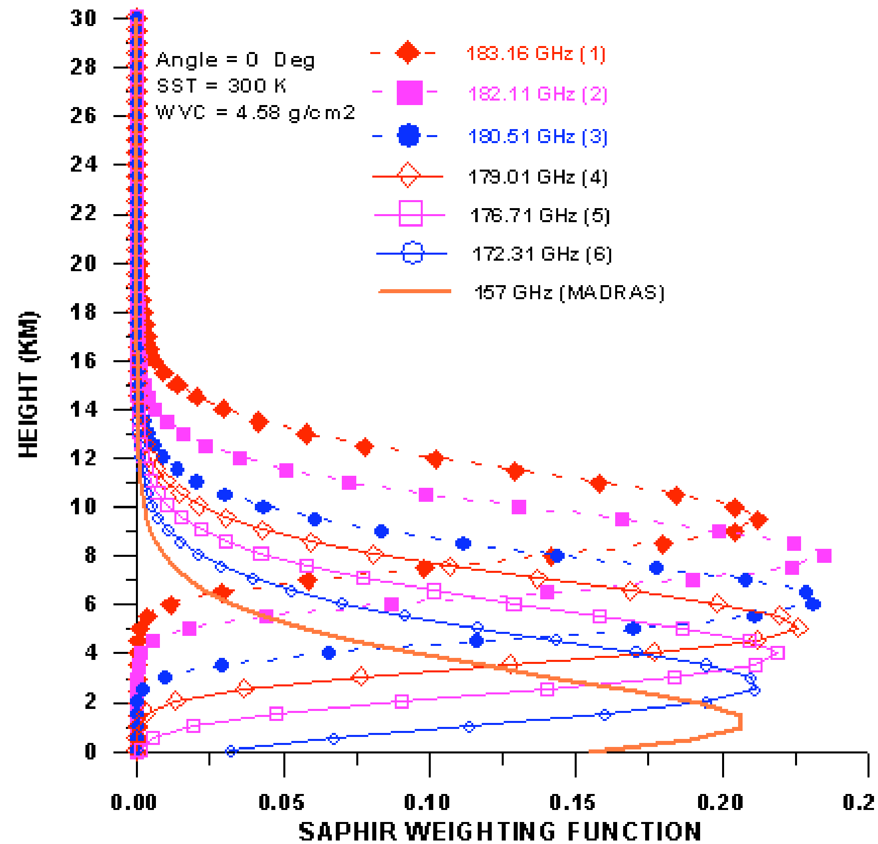
NASA-GPR OF RAINFALL PRODUCT

SAPHIR: Humidity profile

- Emission based RT simulations using simulated atmospheres
- Retrievals using Statistical & EOF techniques
- Improvement in lower level humidity profile through total water vapour content
- Impact of viewing geometry & surface contamination on retrievals
  - At nadir view with dry atmosphere, the low freq channels are contaminated by surface contributions
  - At oblique view with moist atmosphere, the low freq channels are less sensitive to boundary layer humidity which contributes the most to many meteorological & oceanographic processes

SAPHIR CHANNELS' RESPONSE (NADIR VIEW)





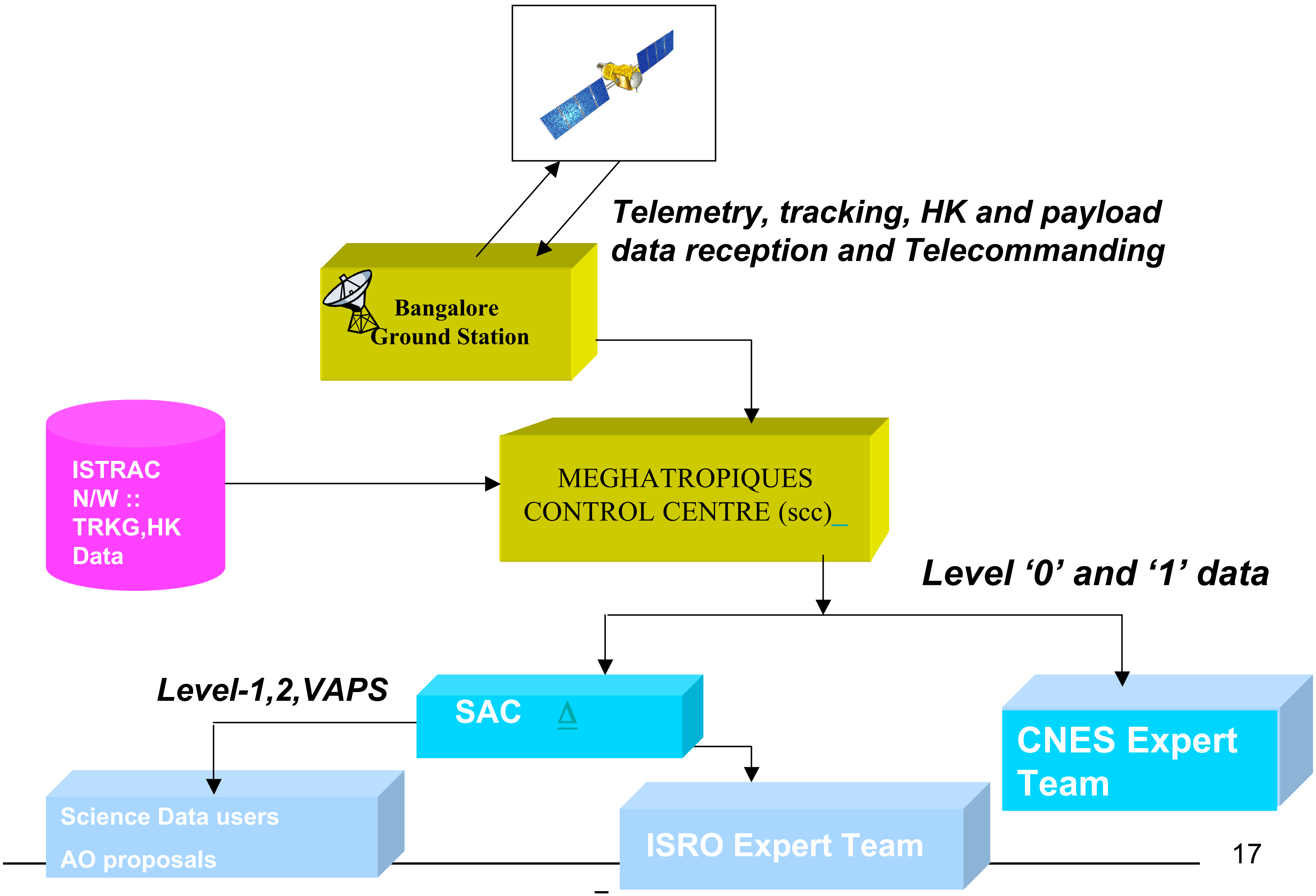
Dry Atmosphere | **Moist Atmosphere**

At nadir view with dry atmosphere, the low freq channels are contaminated by surface contributions

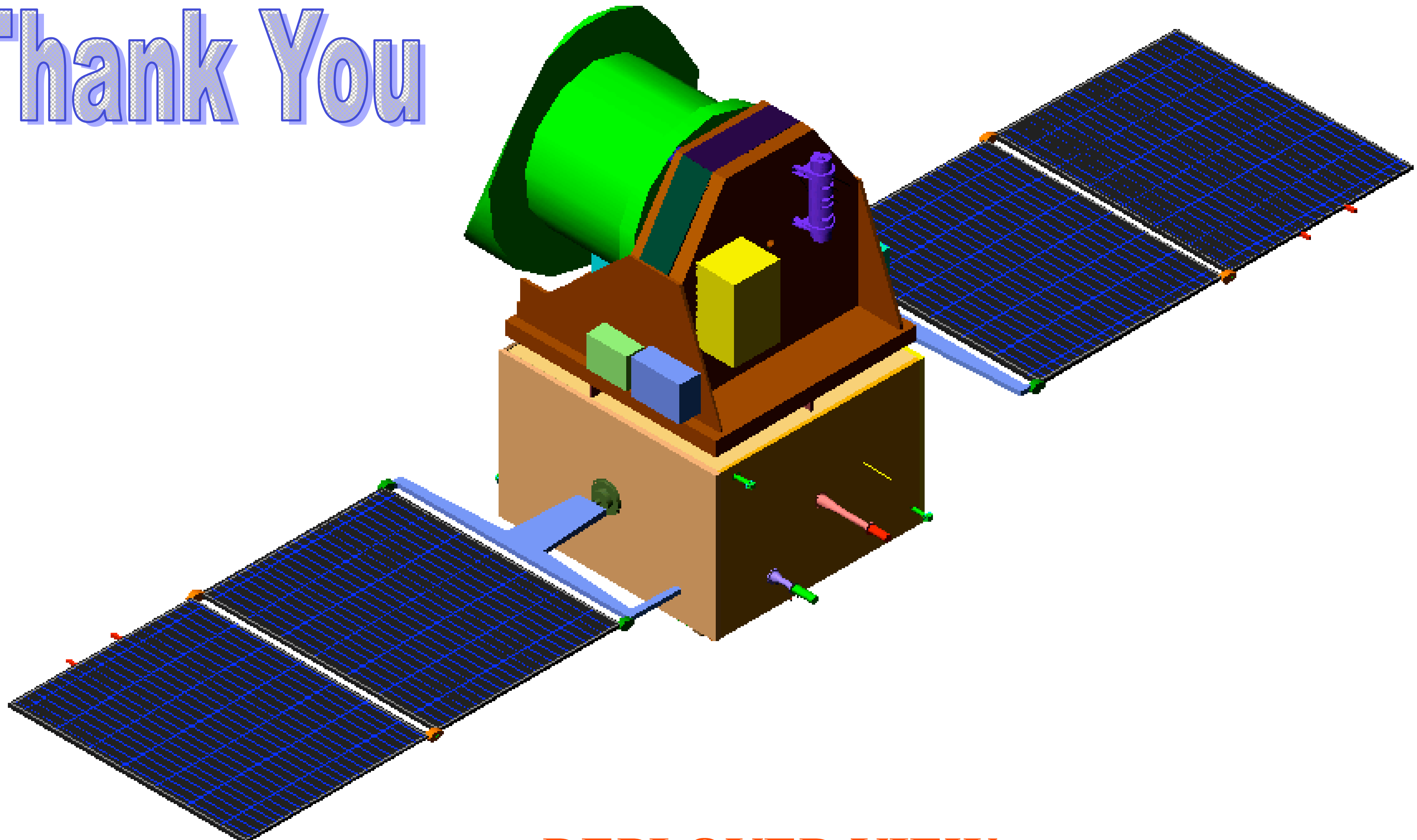
Validation Aspects

- **Participation in community field campaigns (similar to ARMEX, BOBMEX, AMMA, Ship cruises/ radiosondes)**
- **Comparison with high resolution model analysis**
- **Collaboration with a worldwide effort to derive column precipitable water from a network of surface GPS receivers**
- **Collaboration with regular observation agencies like IMD, NARL, NIOT, NIO, INCOIS etc.**

GROUND SEGMENT, OPERATIONS SCENARIO AND RESPONSIBILITIES



Thank You



DEPLOYED VIEW
MEGHA-TROPIQUES SPACECRAFT

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