Microwave Temperature and Humidity Sounder (MATHS) on Oceansat-3A: Intercalibration Plans

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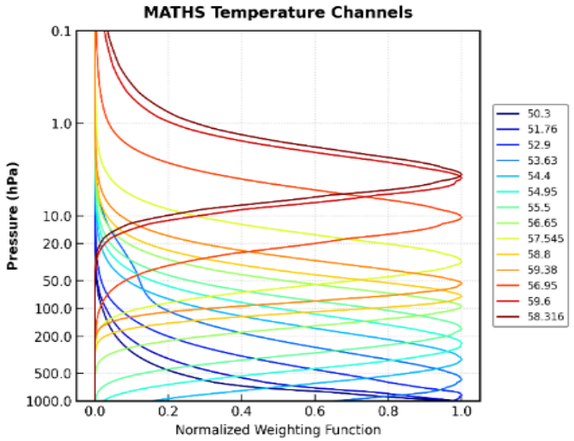
GSICS Presentation

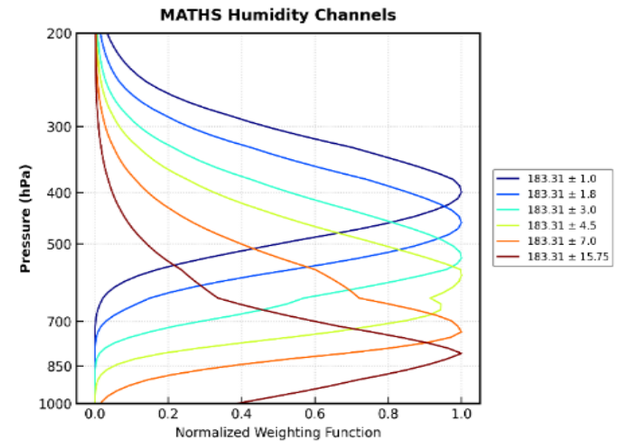
Mission & Instrument Overview

➢ MATHS

- Dedicated Indian microwave sounding capability
- Improved coverage over tropics and Indian Ocean region
- High-sensitivity channels for temperature (50–60 GHz) and humidity (183 GHz)
- Supports continuous and independent observations

S. No.	Parameters	Specifications	
1	Orbit	Sun Synchronous Polar Orbit	
2	Altitude	732km (nominal)	
3	Swath	1565 km	
		Temperature Sounder	Humidity Sounder
4	Frequency band	50-60 GHz (14 channels)	183.31 ± 17.25 GHz (6 channels)
5	Polarization	Quasi-Horizontal	
6	System Noise Temperature	650 K	1600 K
7	Input Dynamic Range	2.7 - 323 K	
8	Antenna Beamwidth	2°	1.2°
9	Spatial Resolution @ Nadir, Swath Edge	25*25 km (Nadir) & 38*62km (Scan Edge)	15*15 km (Nadir) & 23*37km (Scan Edge)
10	Integration Time	4.096 msec	
11	Spatial Sampling (across scan)	10 km	
12	Scan Rate	30 rpm	
13	Mass	~78 kg	
14	Power	~100 W	
15	Data Rate	135Kbps	75Kbps
16	Volume	1085 x 910 x 350 mm^3	





GSICS Inter-Calibration Approach

- Reference Instruments :

  -ATMS

  -AMSUA+MHS

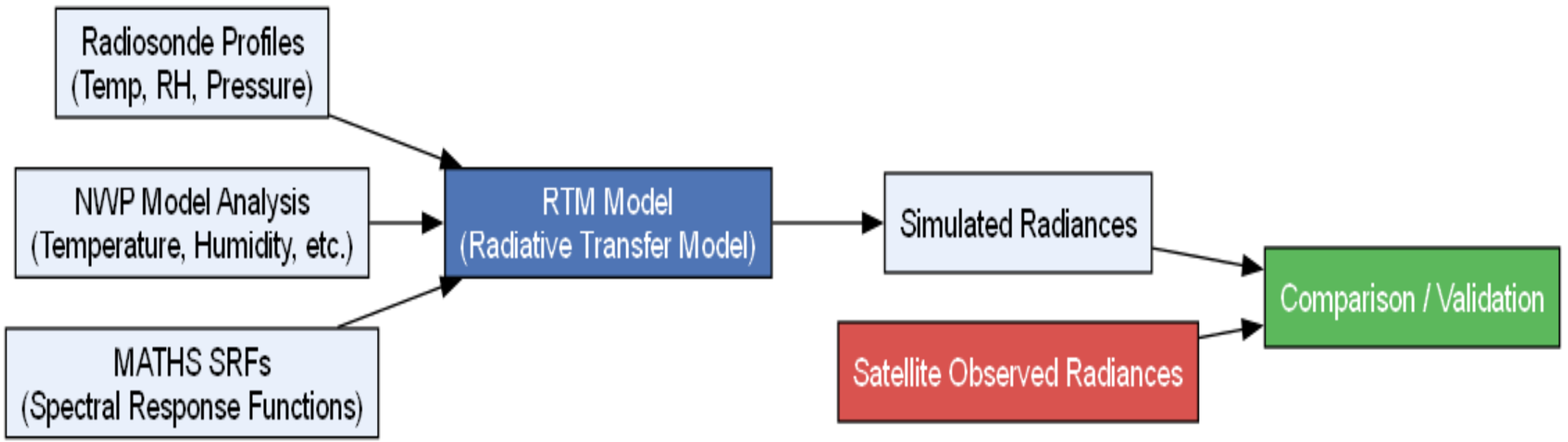
  -MWTS+MWHS

- Simultaneous Nadir Overpass (SNO)
- Double difference technique
- Generation of GSICS correction coefficients

➢MATHS + GSICS ensures consistent, reliable microwave observations for improved weather prediction.

Radiative Transfer-Based Calibration of MATHS in the GSICS Framework

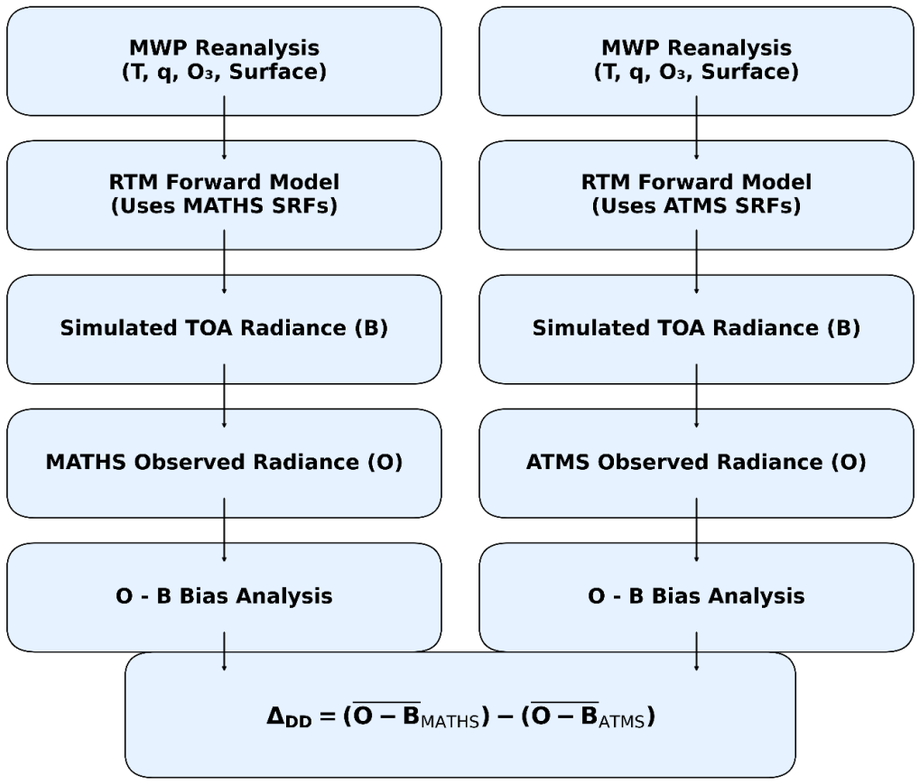
- Radiosonde matchup database
- NWP reanalysis for RTM simulations
- Radiative transfer model (RTM) simulations
- Assessment matrix: Bias, Std.Dev, Stability



Radiative Transfer-Based Assessment of MATHS Radiances

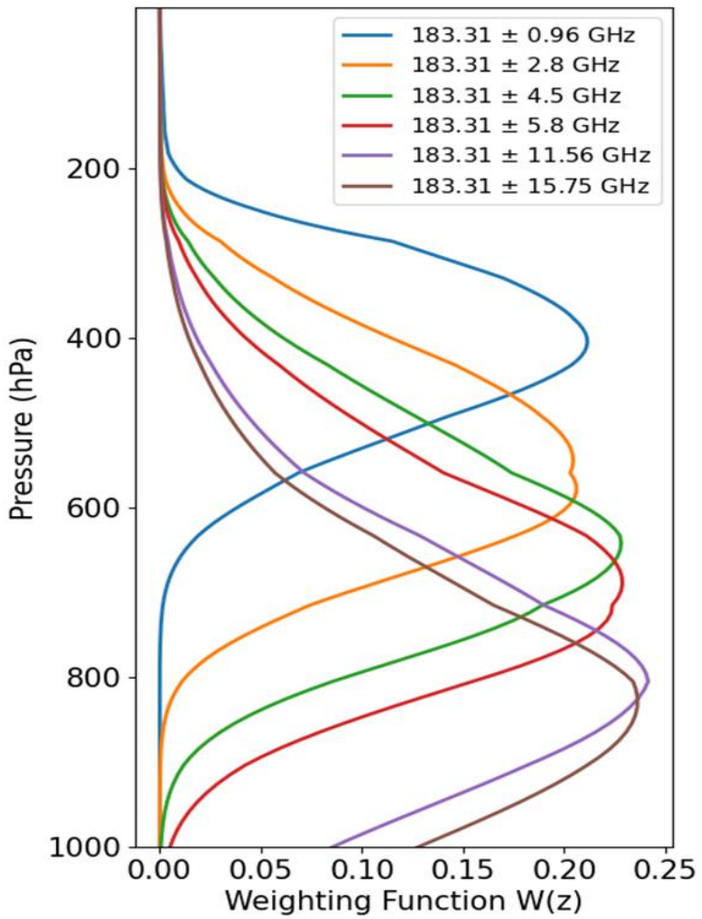
NWP Analysis/Reanalysis and RTM in a GSICS Validation Context

- **NWP Analysis (e.g. ERA5) is used as an independent reference atmospheric state to simulate TOA radiances for MATHS channels**
- **ERA5 reanalysis (ECMWF) provides:**
  - Globally consistent atmospheric temperature/humidity profiles
  - Surface skin temperature and pressure
  - Ozone and trace gas fields
  - Hourly temporal resolution (~0.25° grid)
  - Dynamically consistent fields suitable for RTM calculations
- **This allows:**
  - Model–Observation comparison
  - Monitoring of radiometric biases
  - Assessment of calibration drifts
  - Double-difference analysis
    (e.g., MATHS vs. ATMS through RTM reference)

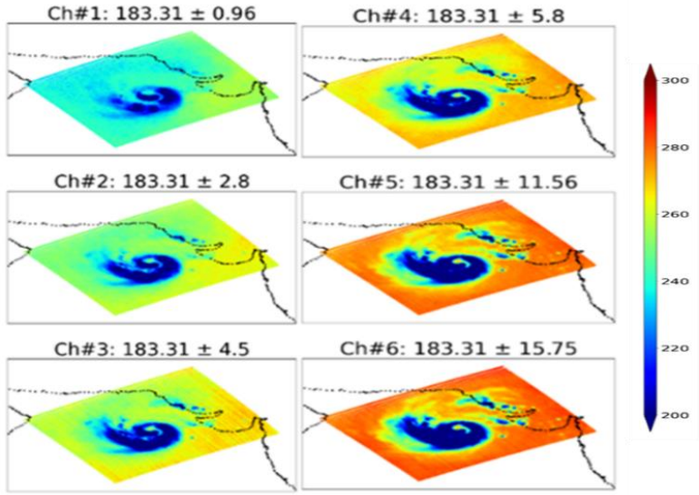


ISRO's Experience with Previous Microwave Sounding Instruments

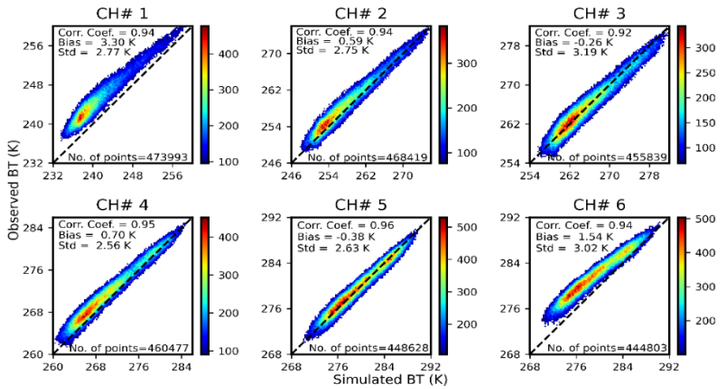
EOS-07 Millimeter Wave Humidity Sounder (MHS)



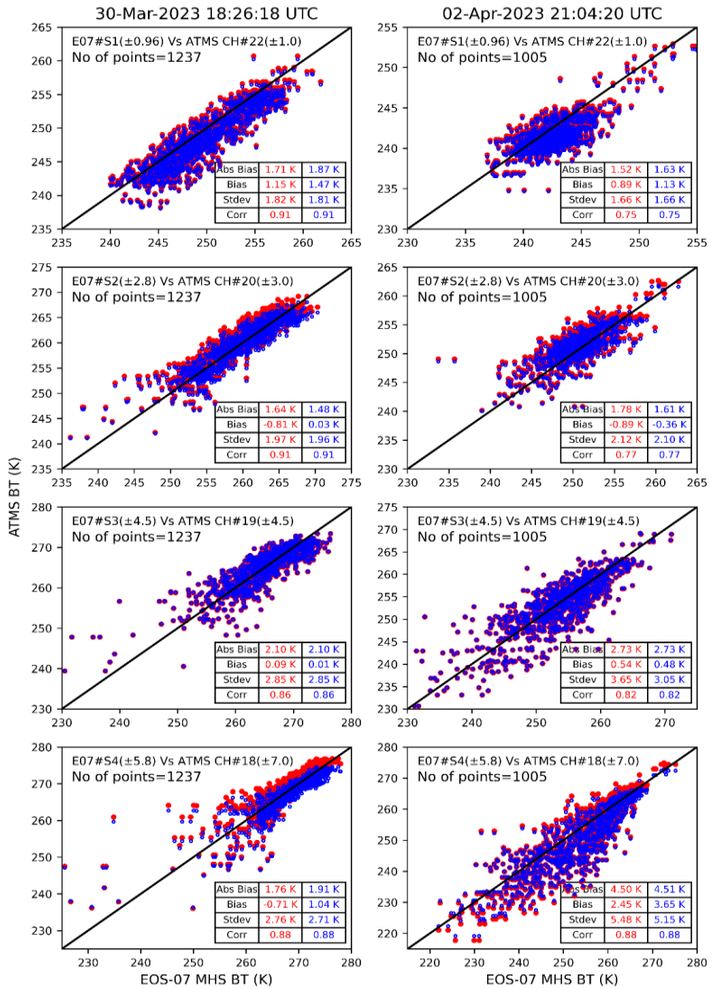
Biparjoy Cyclone



RTM simulated Vs. Satellite observed



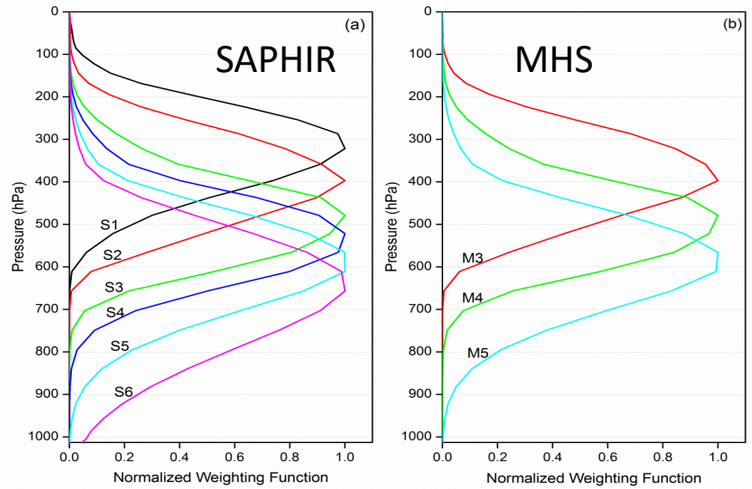
ATMS Vs. MHS



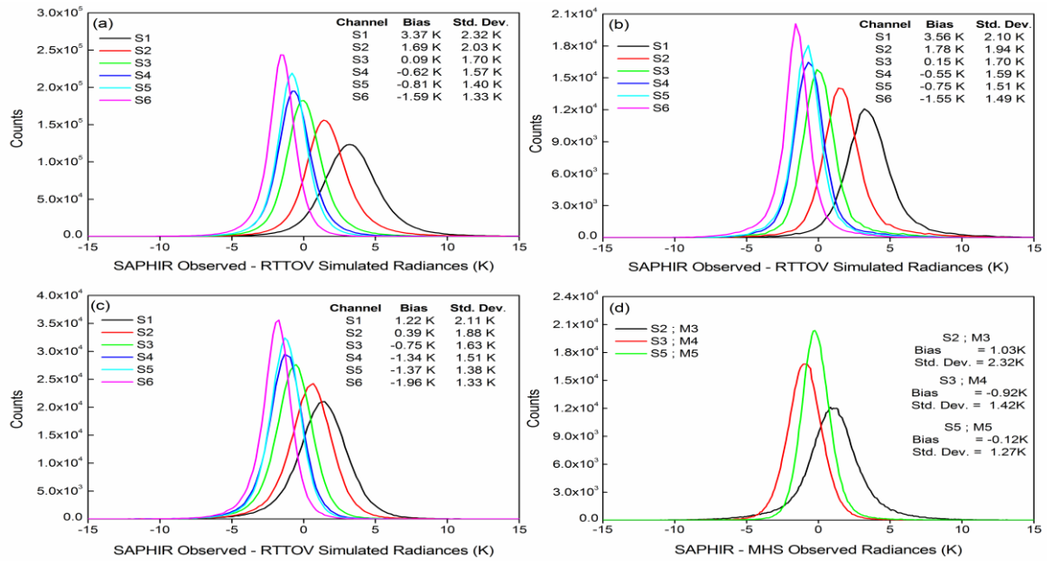
ISRO's Experience with Previous Microwave Sounding Instruments

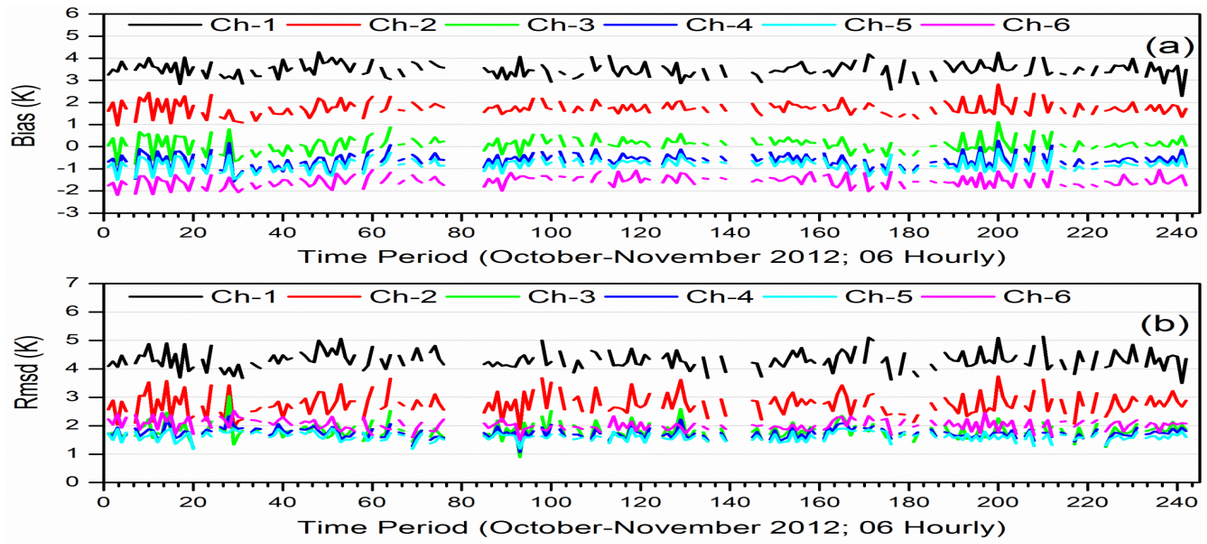
Megha Tropiques: A Joint Indo-French Mission

- Joint mission by ISRO (India) & CNES (France).
- Launched on 12 October 2011 into a low-inclination orbit.
- Provided measurements of water vapour, precipitation, clouds, and radiation budget.
- Four key scientific instruments on board: SAPHIR, MADRAS, SCARA, ROSA.



Radiance quality was monitored by comparing RTM-simulated and MHS.





Conclusion & Way Forward

- MATHS will provide high-quality microwave temperature and humidity sounding capability
- Calibration strategy is fully aligned with GSICS standards
  - SNO-based Intercalibration
  - RTM-based independent validation
- Heritage from EOS-07 and Megha-Tropiques ensures proven calibration methodology
- Expected outcome:
  - Stable radiometric performance
  - Improved data assimilation and NWP accuracy

➢ **MATHS is designed to be GSICS-ready from the start, ensuring reliable and traceable radiometric performance.**

Thank You