

# **Payloads Onboard MicroSat-2B on SSLV-D2**

- (1) Spectrum Monitoring Payload (SMP)**
- (2) Millimeter-wave Humidity Sounder (MHS)**

**First Results: 12<sup>th</sup> February, 2023 (Sunday)**

**SPACE APPLICATIONS CENTRE (SAC), ISRO**

**AHMEDABAD**

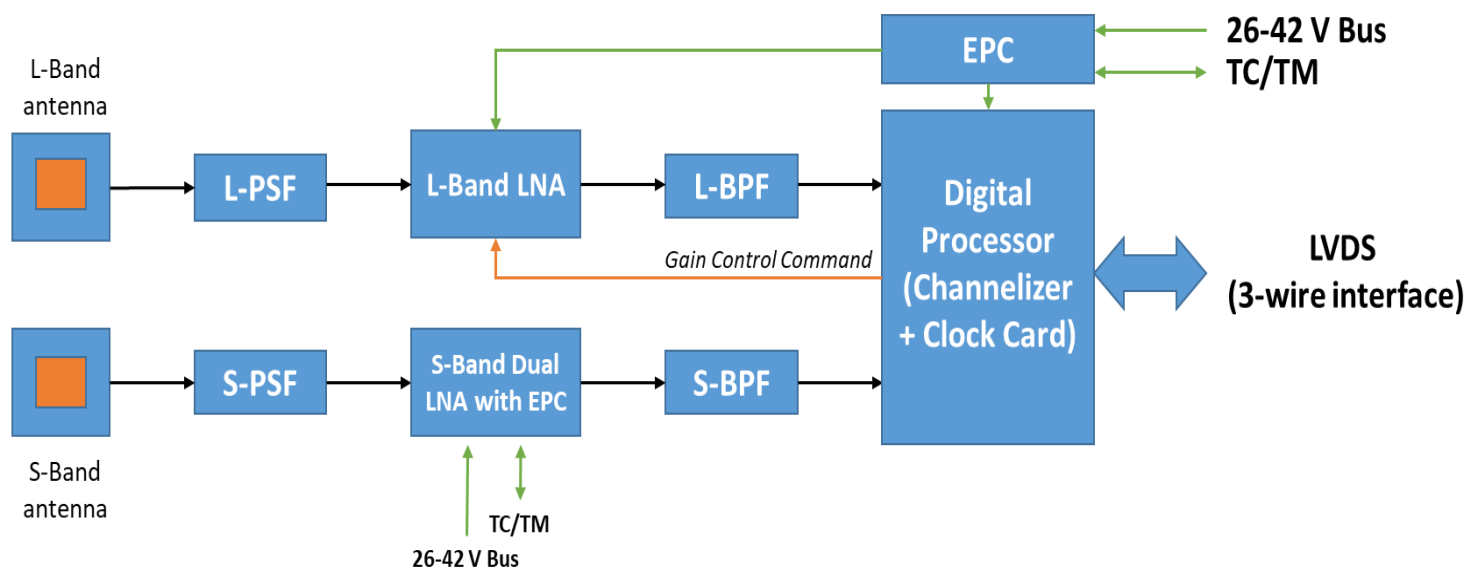
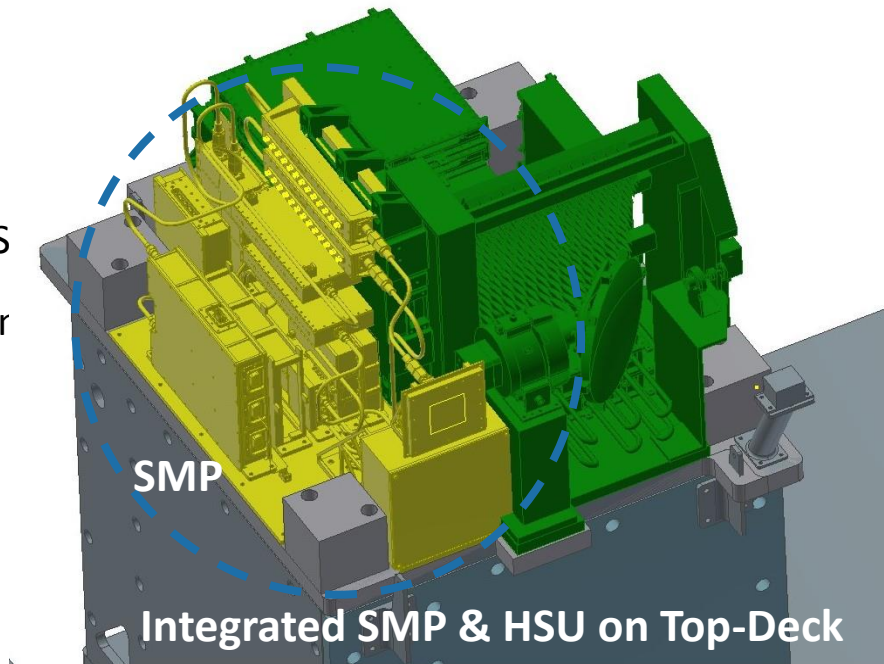
# Spectrum Monitoring Payload (SMP) Configuration for SSLV-D2

## Main Objectives (Three-3) :

- 1. ADS-B Detection and Message Decoding (1090 MHz) over AAI coverage  
Priority-1 : Indian FIR / mainland, neighboring countries, Arabian Sea, Bay of Bengal  
Priority-2 : Africa, Middle East, South & South East Asia. Parts of Indian ocean
- 2. Interference power monitoring in S-Band (2655-2690 MHz): localization of MS interference from neighboring countries
- 3. Radar Signal Monitoring (RSM) in L-Band (1200-1400 MHz): Channelization PW/PRI/CF detection

## Payload Configuration:

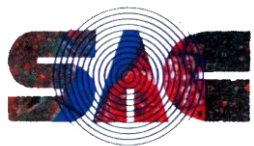
- 1. Cavity backed Cross Arrow/Patch antennas in L & S-Band
- 2. Digital processing for L & S-band signals and ADS-B message decoding



## Challenges:

- 1. Accommodation of SMP & HSU on top-deck
- 2. Antenna pattern optimization
- 3. Dual-band simultaneous digital processing
- 4. EMI/EMC Issues

SMP Mass	DC Power Consumption
12 kg	35 W



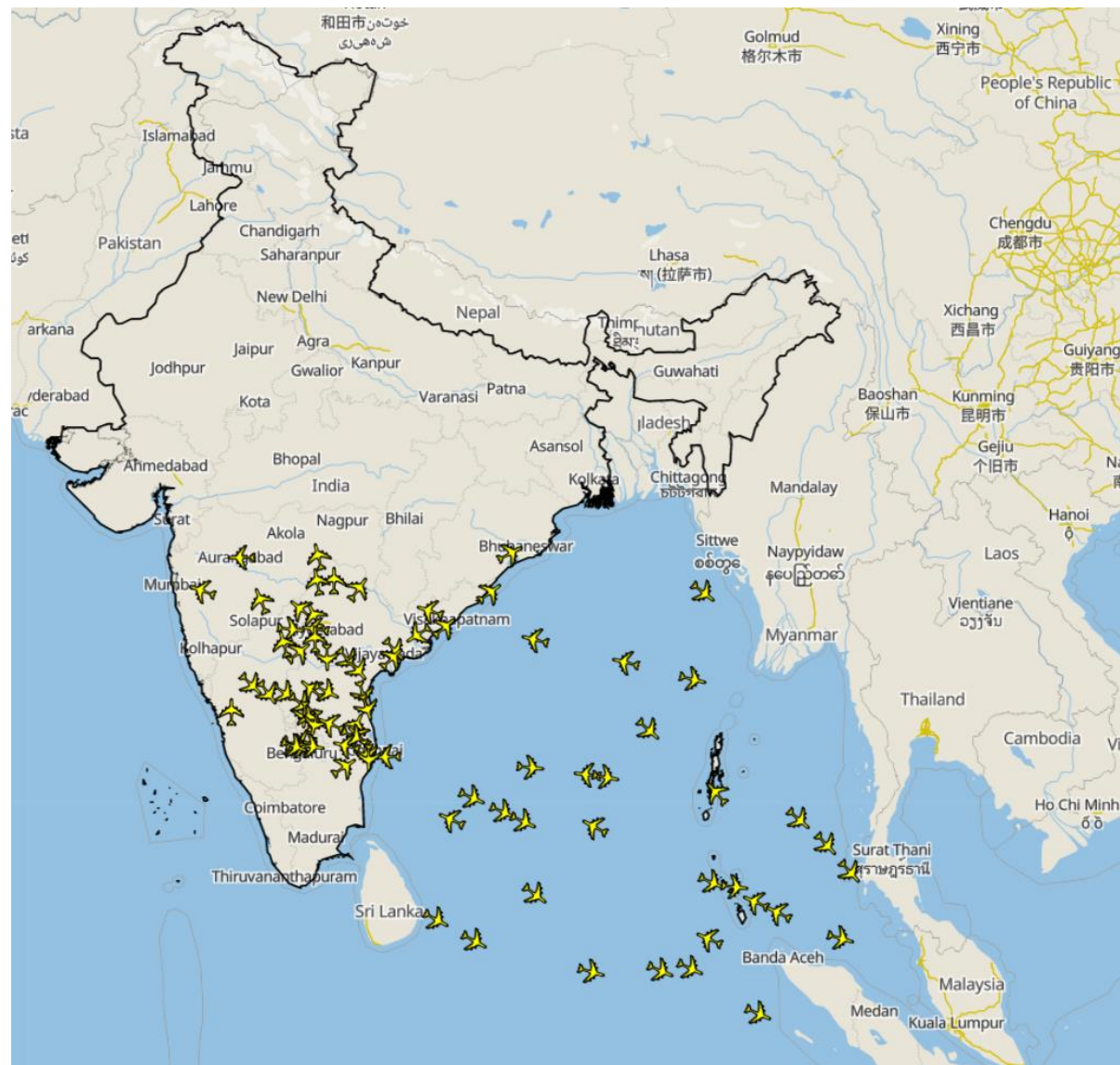
# SMP Objective-1: ADS-B Coverage

Result: 224 Aircrafts Detected (4742 Messages)

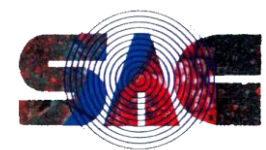


Data collected in Real Time

- Descending pass
- **Telangana to Port Blair**



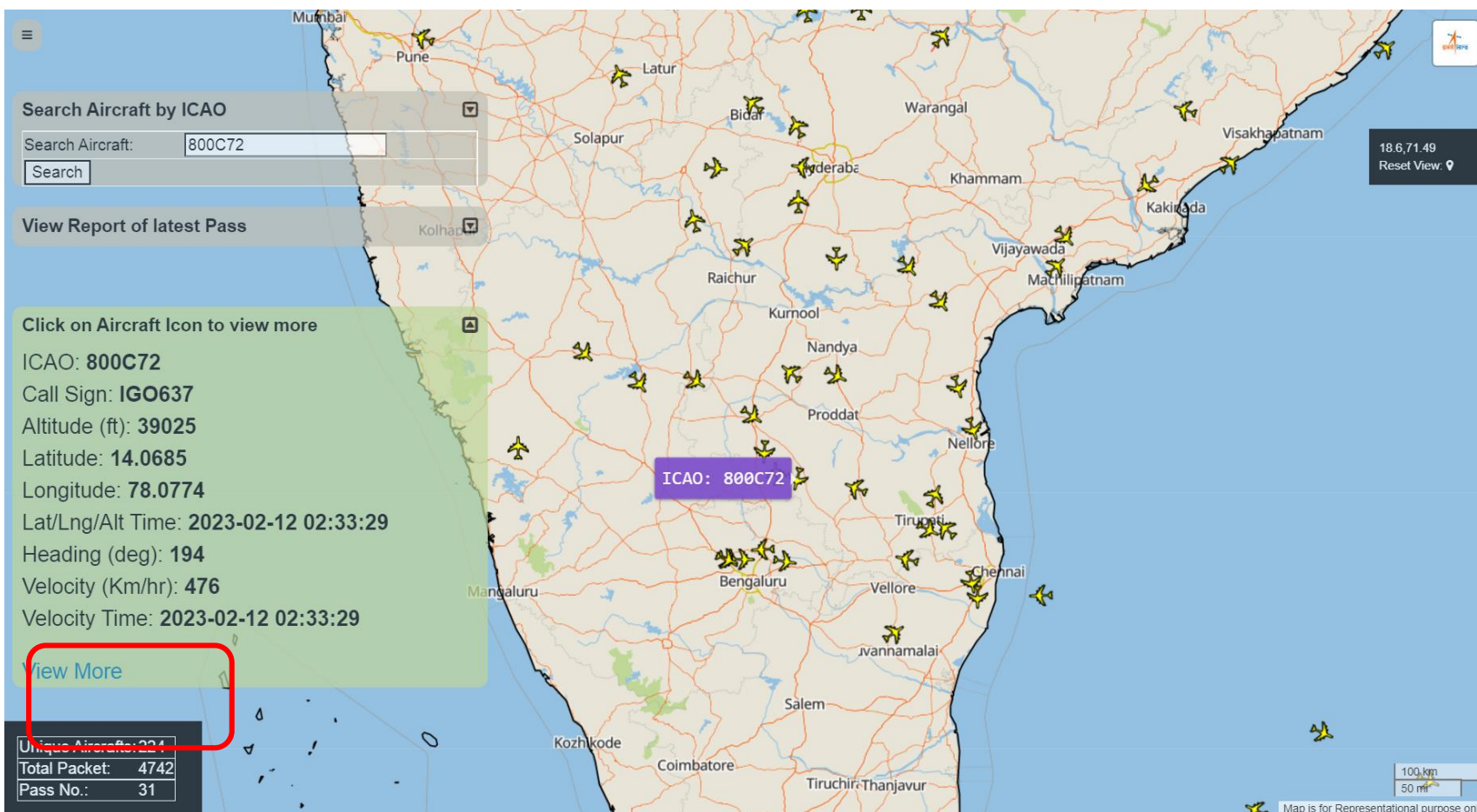




# ADS-B Typical Example: Validation of IGO-637 (INDIGO 6E 637: HYD-KOCHI)



## Screenshot of DP Software with Detected Packets

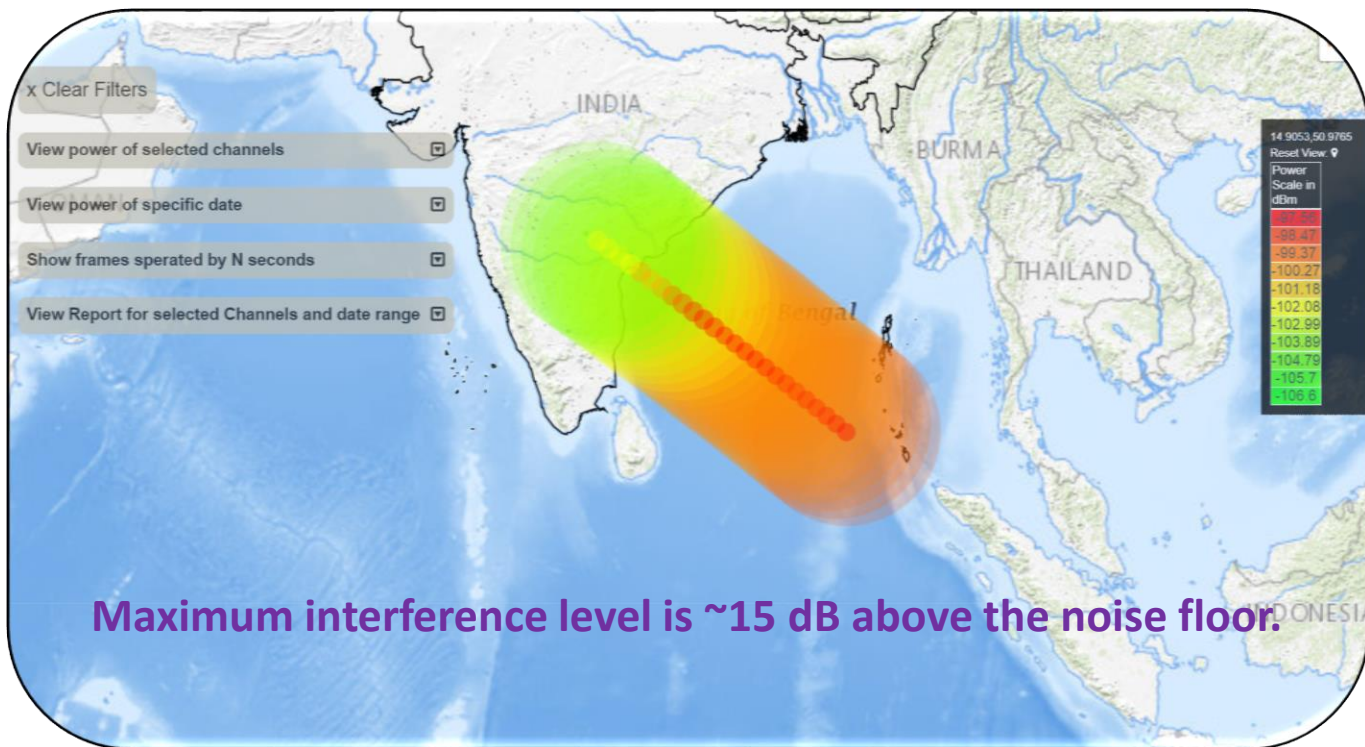


## Data Validation using FlightRadar24

Callsign	Position	Altitude	Speed	Direction
IGO637	14.948296,78.297058	39000	424	194
IGO637	14.828657,78.267044	39000	421	193
IGO637	14.710098,78.237381	38975	420	193
IGO637	14.596573,78.209015	38975	422	193
IGO637	14.475651,78.17881	39000	422	193
IGO637	14.355686,78.148933	39000	423	193
IGO637	14.236954,78.119331	39025	424	193
IGO637	14.118256,78.089874	39025	424	193
IGO637	14.000656,78.060562	39025	422	193

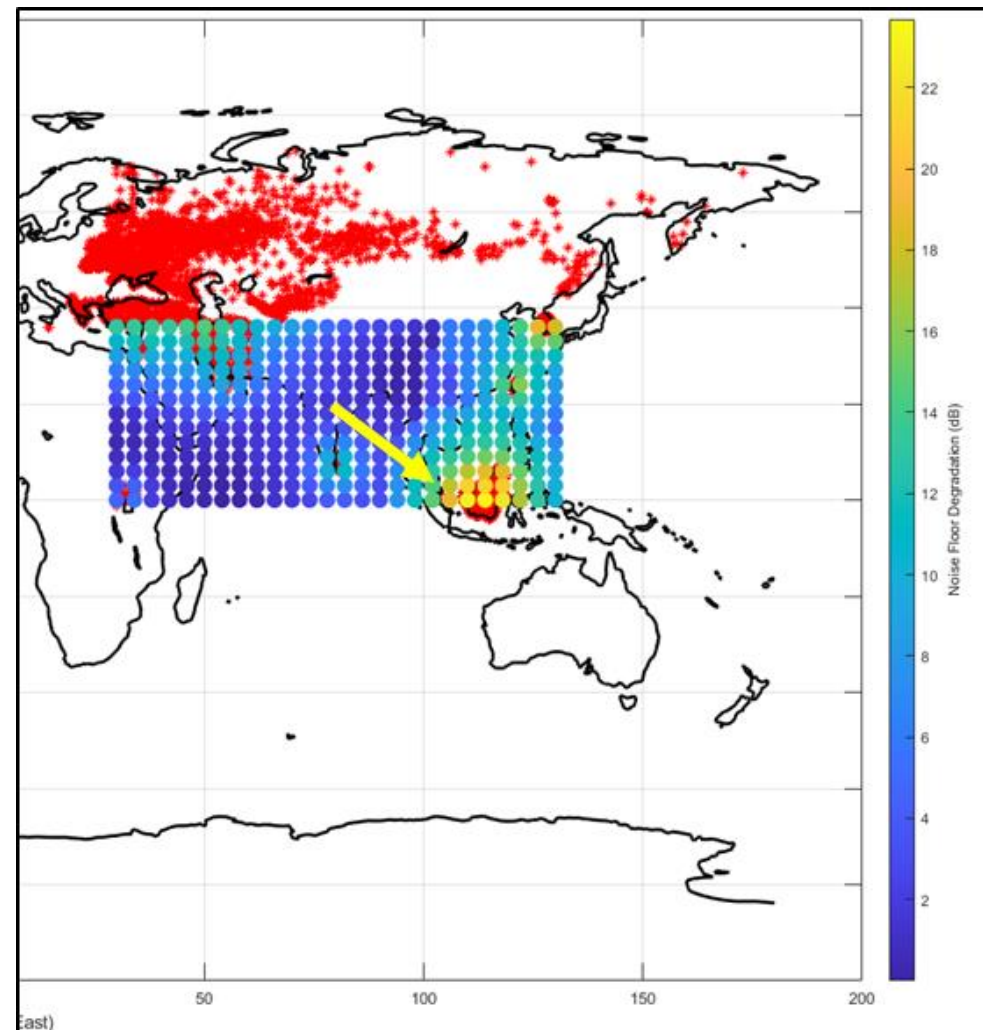
# SMP Objective-2: S-Band Interference Measurement

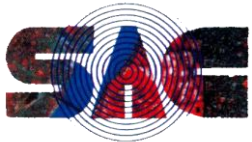
Screenshot of DP Software with Noise Floor



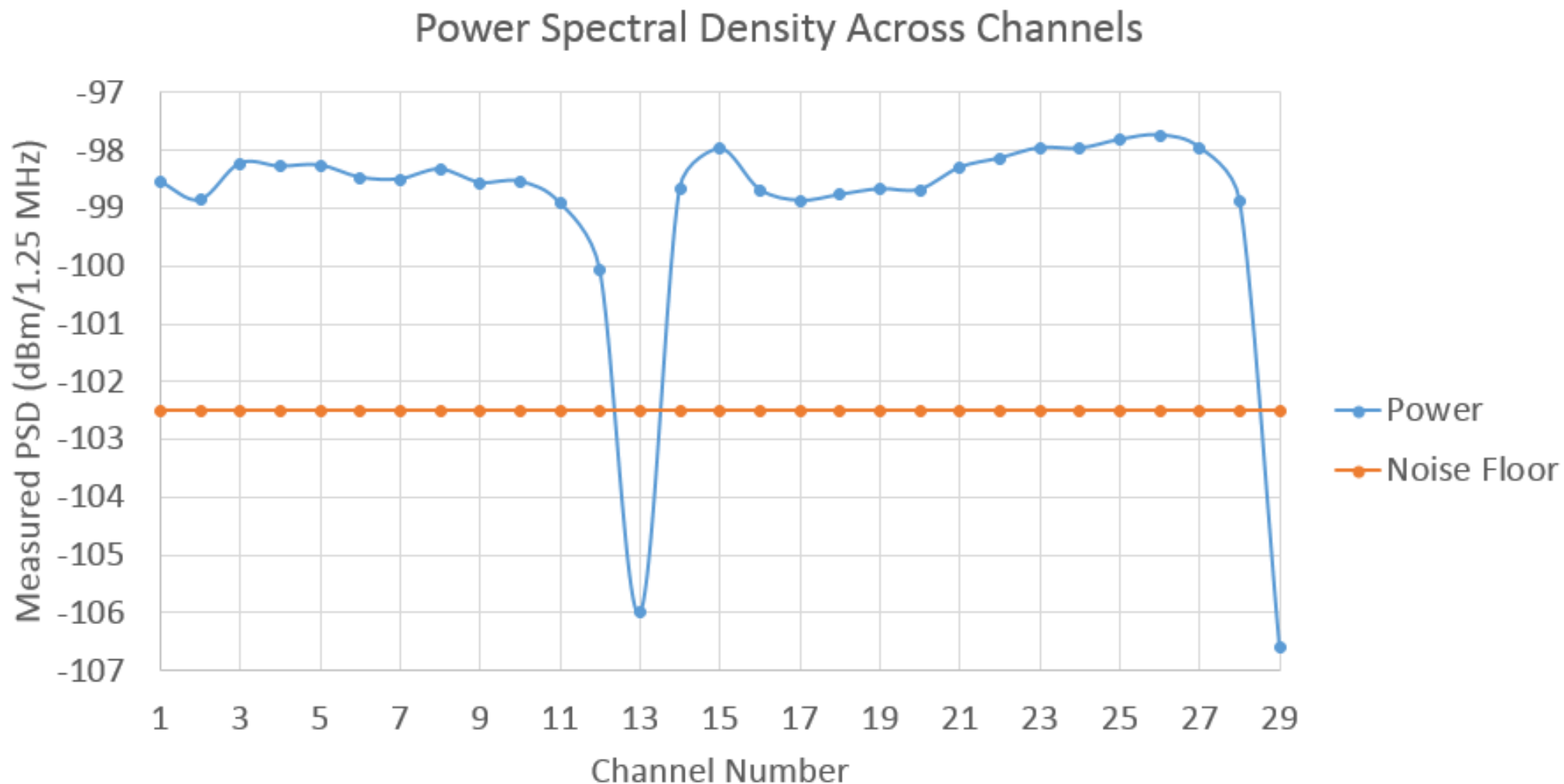
- Bigger Bubble represents average power across 29 channels
- Smaller Dot represents maximum power across 29 channels

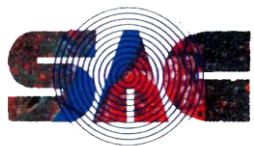
Simulated Noise Floor using Monte-Carlo Analysis





# SMP Objective-2: S-Band Interference Measurement



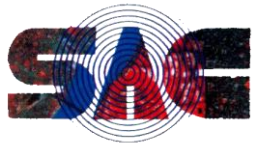


### RSM – FIRST SUMMARY REPORT

- Multiple Radar Signals Detected Successfully
- Frequency of arrival, pulse width, PRI & its classification and average power of **MOTR Radar** operating @ 1300 MHz and other Radar operating @ 1260 MHz are estimated.
- Detailed analysis of other detected Radar is under progress.
- Self interference analysis (in few channels) is under progress.

Parameters	Unit	MOTR	Radar-2
FoA	MHz	1296.9	1260
PW	μs	7.146	8.4
PRI	ms	4.7	2.27
PRI Classification	-	Constant PRI	Constant PRI
Average Pulse Power	dBm	-92.7	-85.3

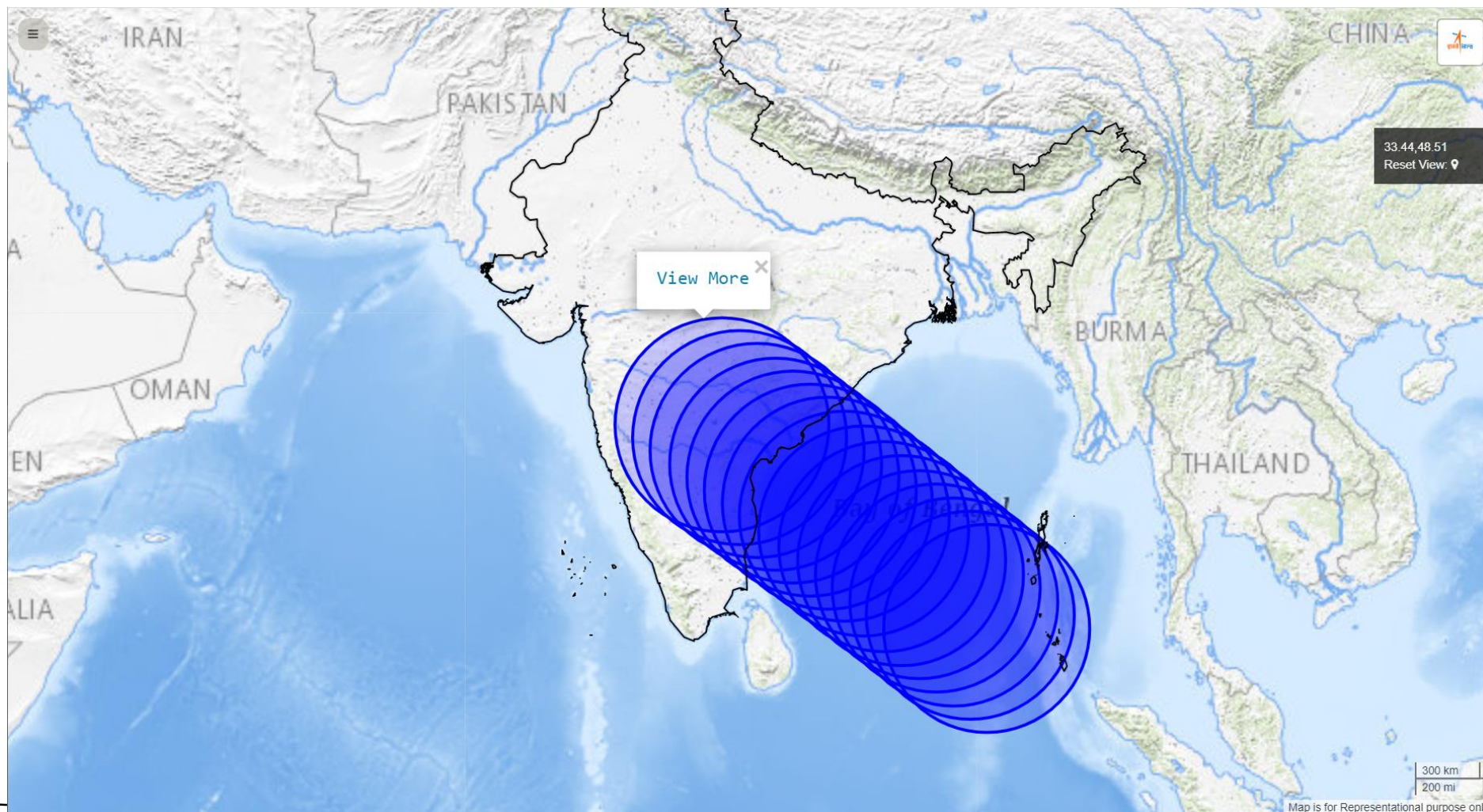




# SMP Objective-3: Radar Signal Monitoring (RSM)



## RSM – Detected RADARs





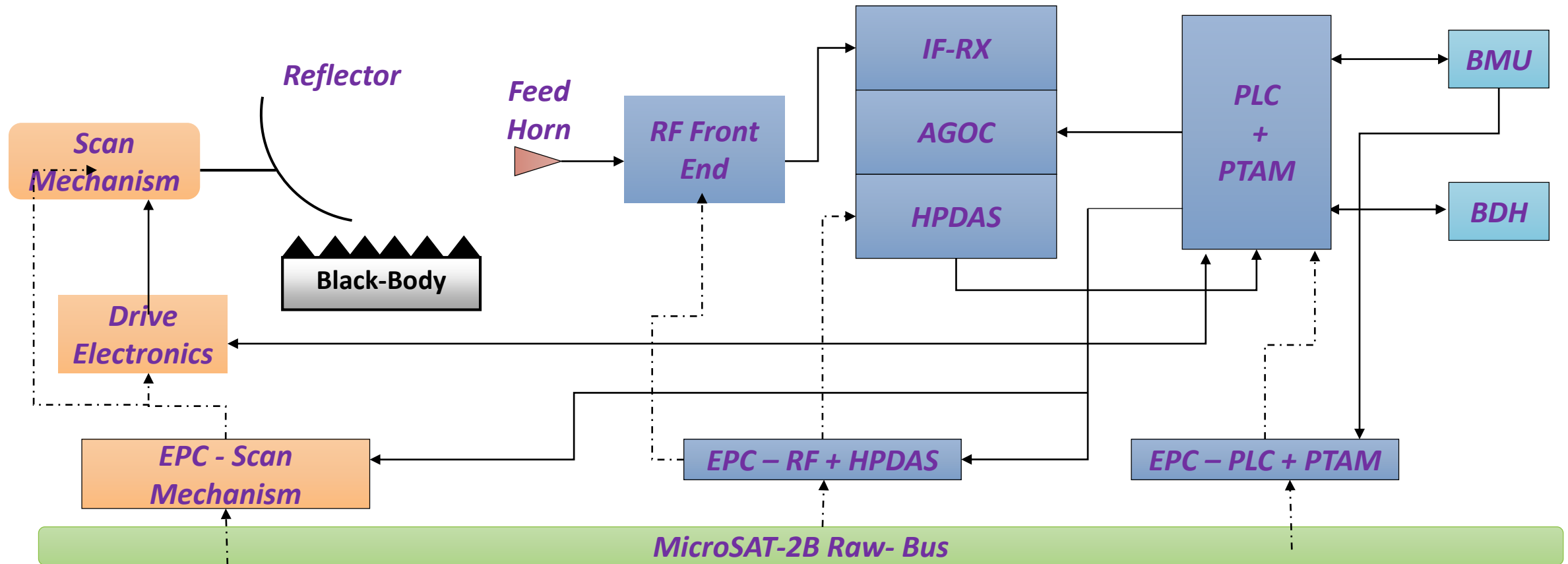
# Millimeter-wave Humidity Sounder (MHS)

- 5-channel cross-track scanning Radiometer @183.31± 15 GHz band.
- Atmospheric vertical humidity profiling from surface to 12km.
- Vertical resolution <2km and spatial resolution of 10km, 6 hr re-visit.
- Indigenous follow-on of the CNES, France' SAPHIR (Megha\_Tropiques)
- Complements the INSAT-3D series' IR Sounding, through all weather and through cloud sensing.

S..	Parameters	Specifications
1	Orbit	Circular (37° incl.)
2	Altitude	450km (nominal)
3	Swath	1050 km
5	Frequency band	183.31 ± 15 GHz
6	System Noise Temp.	1400 K
7	Input Dynamic Range	3 - 330 K
8	Antenna Beamwidth	1.2°
9	Spatial Res.	10 km (Nadir), 20km @ Nadir, Swath Edge
10	Dwell/Integ. Time	4 msec
11	Scan Rate	50 rpm
12	ADC ENOB	13bits

S. No.	Centre Frequency (GHz)	Noise Figure (dB)	Pol.	3-dB Bandwidth (MHz)	NEΔT (K) at 300K @ 4ms
1	183.31 ± 0.96	7	QH	300	1.5
2	183.31 ± 2.8	6	QH	600	0.85
3	183.31 ± 5.8	7	QH	700	1
4	183.31 ± 11.56	8	QH	900	1
5	183.31 ± 15	6.8	QH	1000	0.8

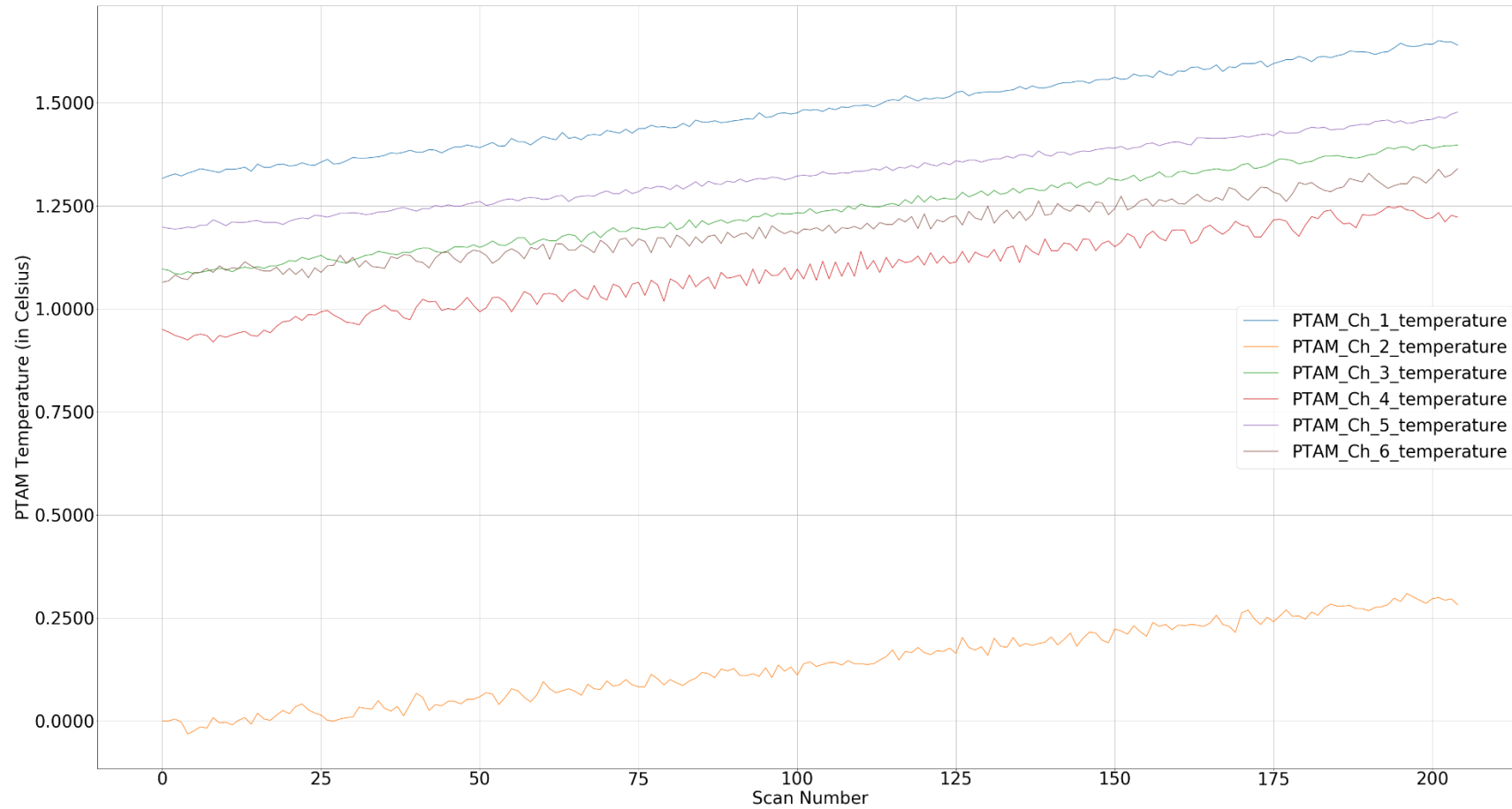
# MHS -Payload Schematic Block Diagram



# Black Body Temperature(deg C)

## Variation of BlackBody PTAM channels temperature w.r.t Scan Number

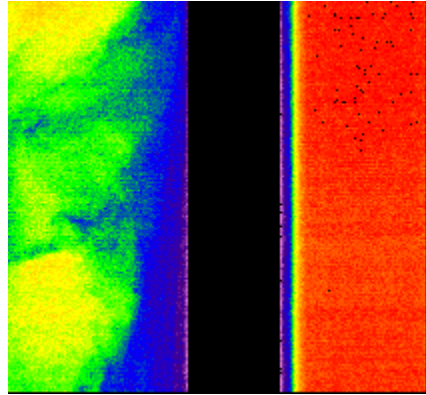
Variation of BlackBody PTAM Channels w.r.t Scan Number



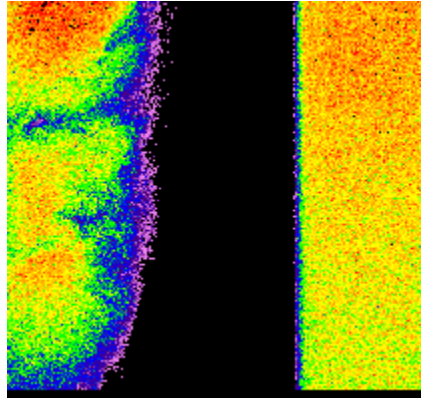
Black body temperature variation is consistent and as per specification



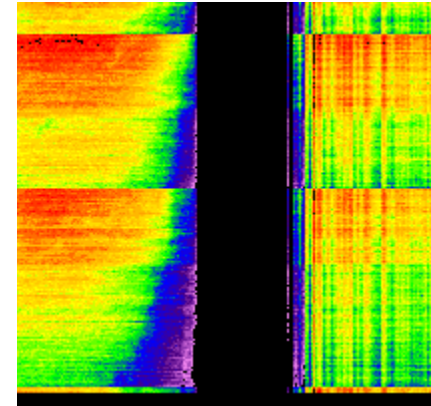
## RAW Voltages – all 6 Channel



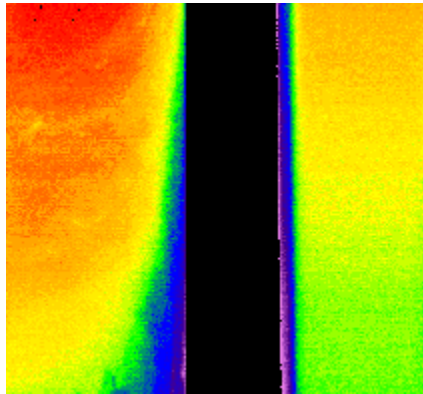
Channel(183.31  $\pm$ 0.96)



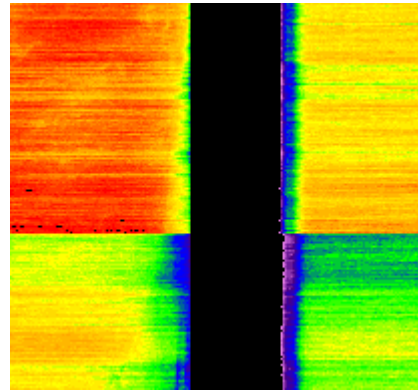
Channel (183.31  $\pm$ 2.8)



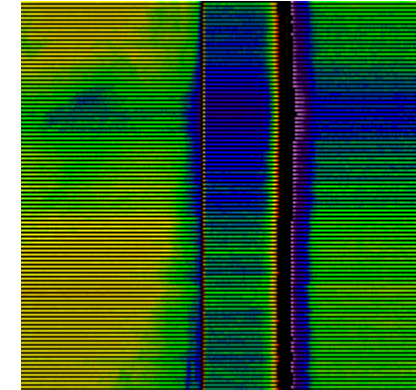
Channel (183.31  $\pm$ 4.5)



Channel(183.31  $\pm$ 5.8)



Channel(183.31  $\pm$ 11.56)



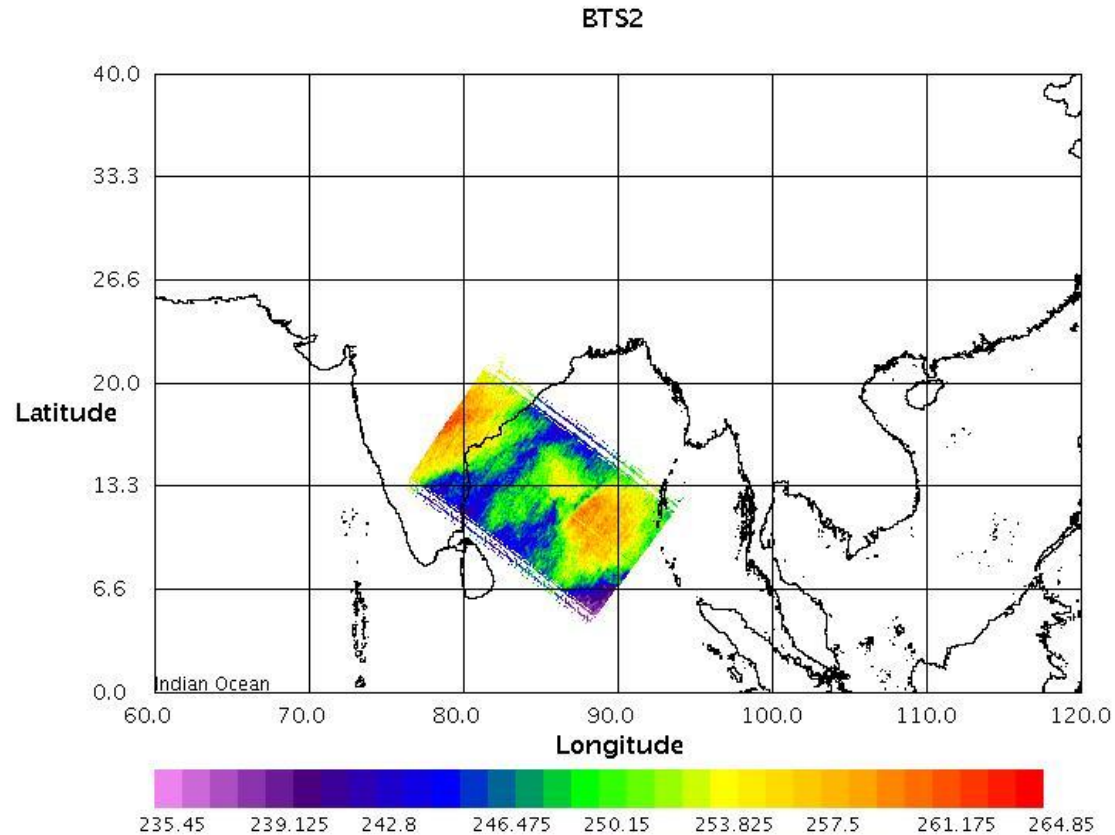
Channel(183.31  $\pm$ 15.75)

Acquired footprint voltage variation is consistent with respect to scan Angle over full scans  
However, channel voltage in Channel(183.31  $\pm$ 15.75) is getting saturated.. Feedback given for updation

## Level1 Product Brightness Temperature

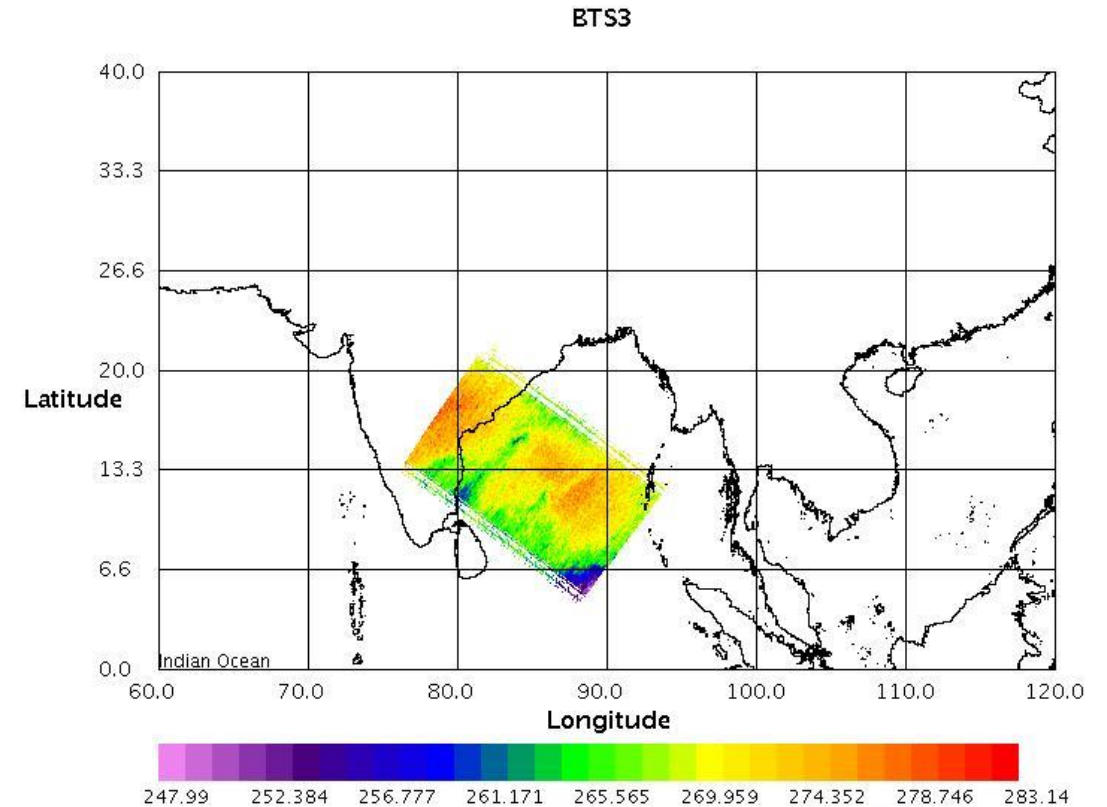
Channel( $183.31 \pm 0.96$ )

Observed dynamic range for BT = 235-265K



Channel ( $183.31 \pm 2.8$ )

Observed dynamic range for BT = 248-283K



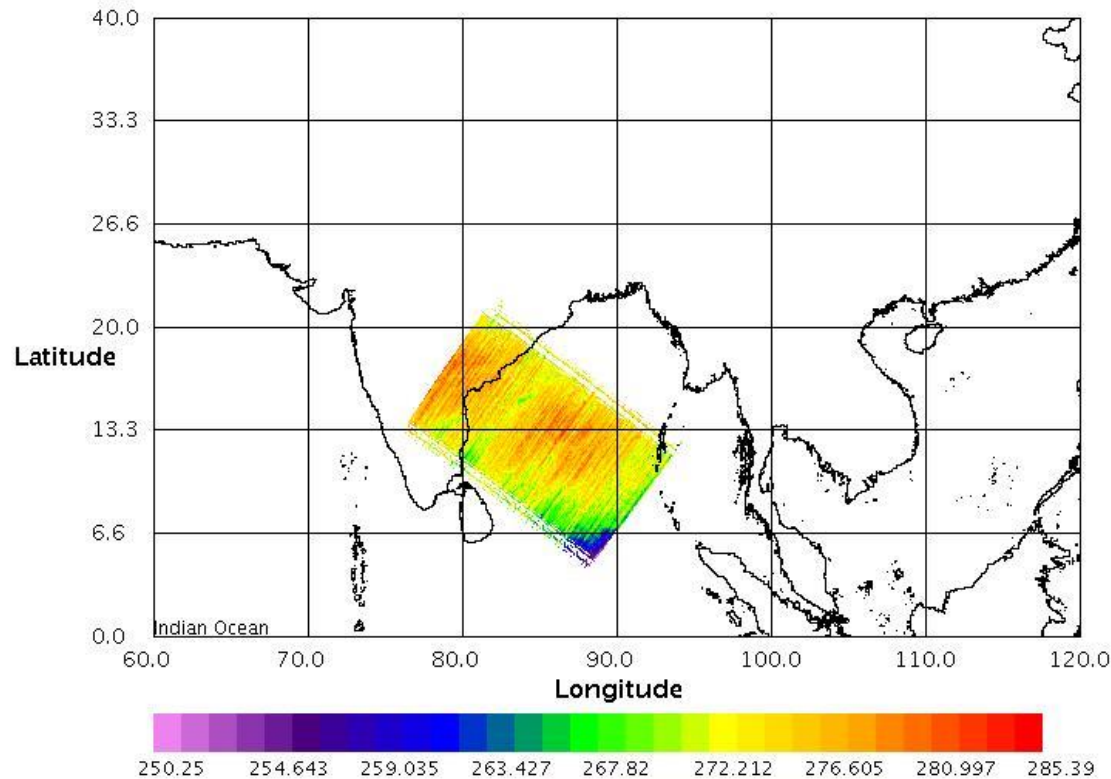
BT variation Range is within the specification Range

## Level1 Product Brightness Temperature

Channel ( $183.31 \pm 4.5$ )

Observed dynamic range for BT = 250-286K

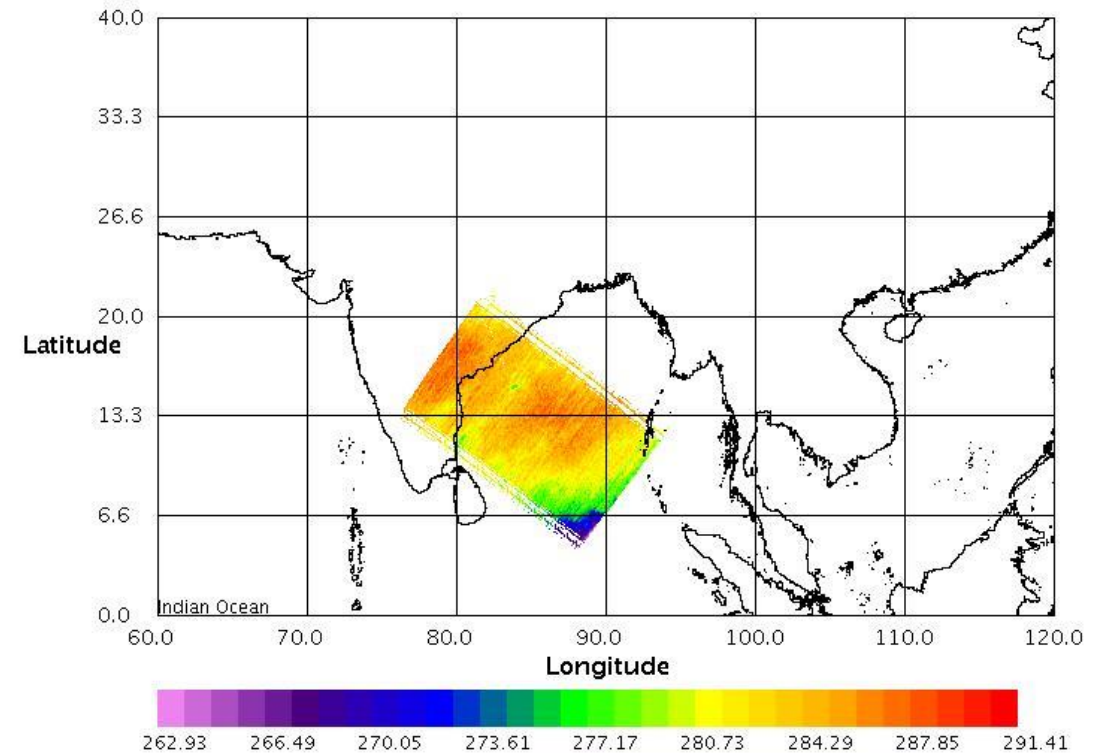
BTS1



Channel( $183.31 \pm 5.8$ )

Observed dynamic range for BT = 263-292K

BTS4



BT variation Range is within the specification Range

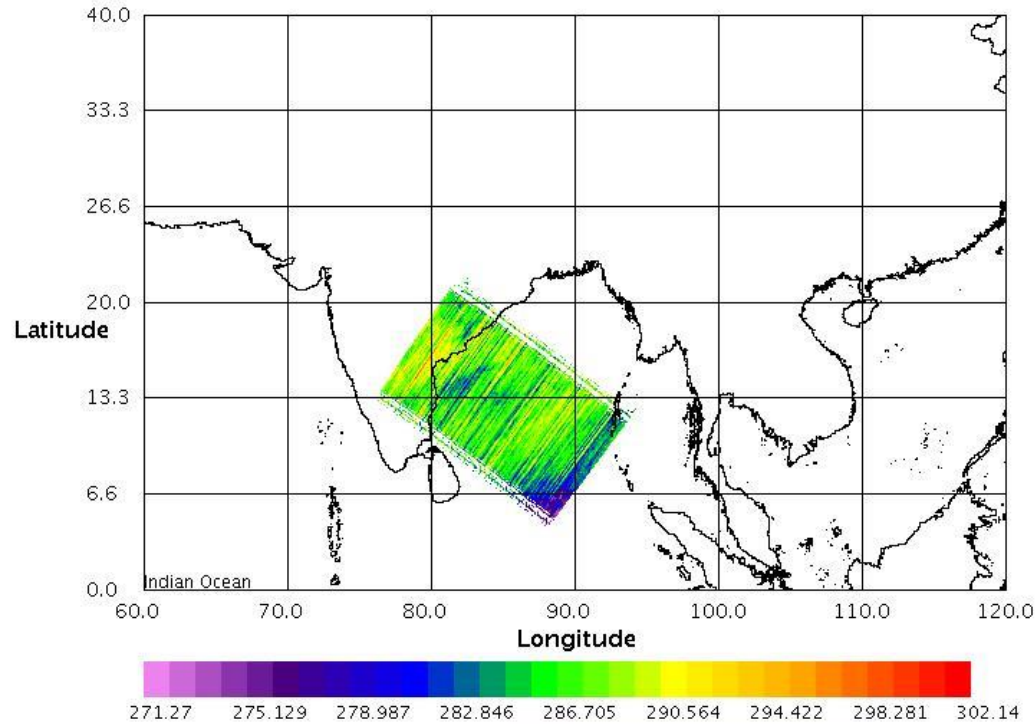


## Level1 Product Brightness Temperature

Channel( $183.31 \pm 11.56$ )

Observed dynamic range for BT = 271-302K

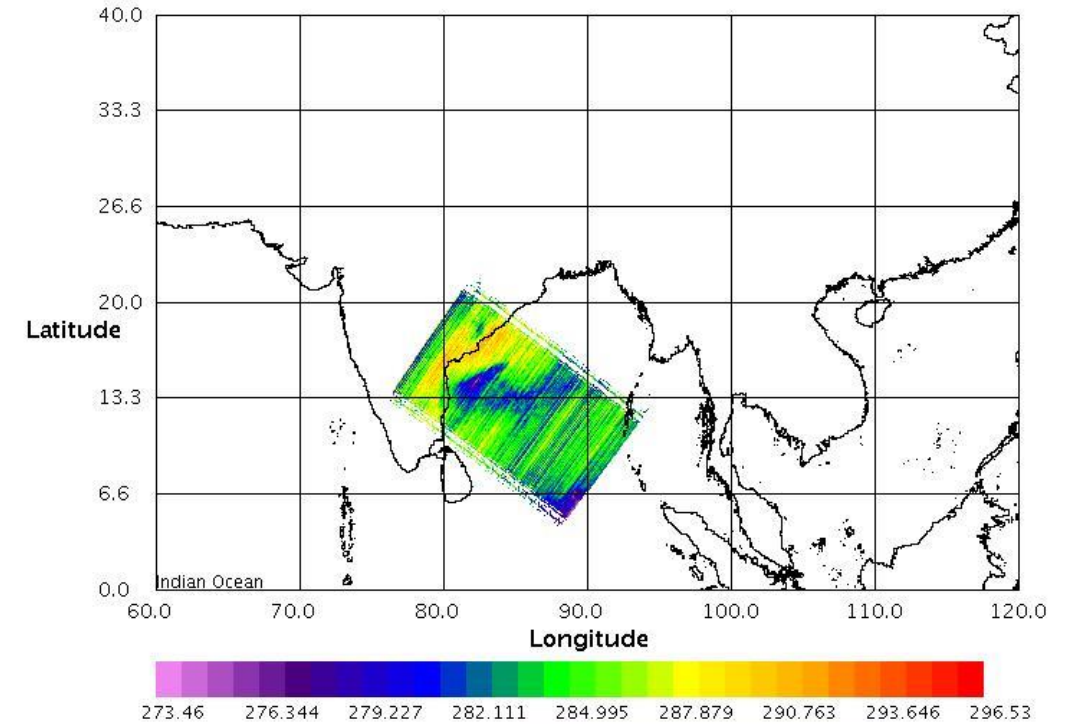
BTS5



Channel( $183.31 \pm 15.75$ )

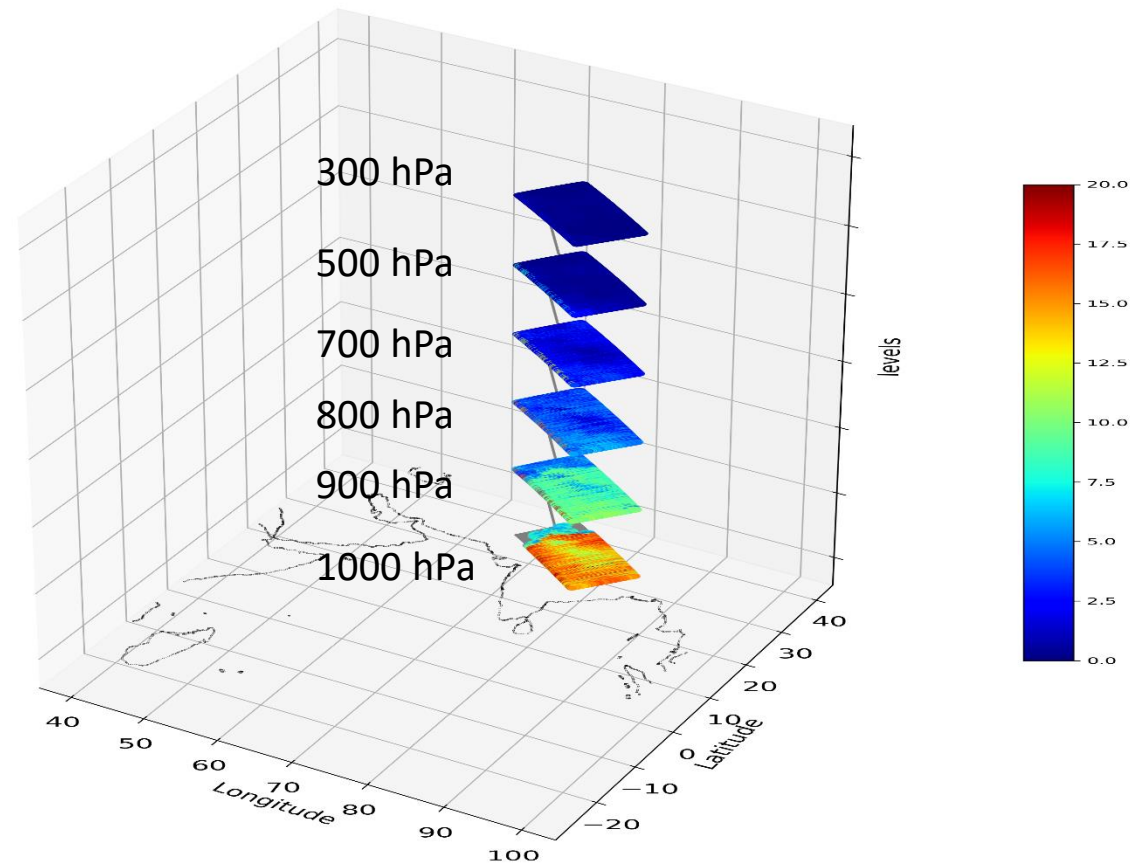
Observed dynamic range for BT = 273-296K

BTS6



BT variation Range is within the specification Range

## Level2 Specific Humidity(gm/Kg)



First cut results are encouraging .....

Thank you