

Satellite Microwave instruments in the low earth inclined orbits for NWP: Contribution from India

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Megha-Tropiques (MT) was a joint Indo-French Satellite mission launched by the Indian Space Research Organization (ISRO) on 12 October 2011. MT was positioned in a highly inclined equatorial plane of 20° at a height of 867 km above the Earth so as to orbit the tropical region between 30°N and 30°S nearly 14-15 times a day. There were four payloads onboard MT, consisting of a Microwave radiometer (MADRAS), a microwave humidity sounder (SAPHIR), a radiation budget instrument (SCARAB) and a radio occultation sounder (ROSA). SAPHIR was one of the highly used microwave humidity sounder observations by the leading global operational NWP centres (Chambon et al., 2015, Chambon and Geer, 2017, Singh and Prasad, 2017, Jones et al., 2017, Doherty et al., 2018, Kumar et al. 2018).

A collaborative study between NCMRWF and the UK Met Office reported the NWP requirement of microwave imager and sounder together in the same satellite platform and demonstrated that the humidity sounders ATMS, MHS, and SAPHIR perform similarly; however SAPHIR notably outperforms the other instruments between 650 and 1000 hPa (Doherty et al., 2018). This is due to the lowest peaking channel of SAPHIR (183.31 ± 11 GHz) which is absent in both ATMS and MHS. Since the MADRAS onboard MT was not functional, the performance of AMSR-2 and SAPHIR and their combined impact showed that the imager (AMSR-2) assimilation produces lowest errors in specific humidity below 600 hPa, while SAPHIR performs best at higher altitudes (Rani et al., 2016).

MT was decommissioned in January 2022. On 10 February 2023, ISRO launched a follow-on experimental mission (Microsat-2B) to SAPHIR in a low earth circular orbit of 37° inclination at an altitude of 450 km above the Earth, with an expected life period of 12 months. This mission is also known as Earth Observation Satellite seven in the series (EOS-07). Table-1 shows the specifications of EOS-07 and MT-SAPHIR. There are slight differences in the channels frequencies of SAPHIR and Microsat-2B. The channel frequencies are slightly shifted down in Microsat-2B compared to SAPPHIR. Figure 1 shows the weighting functions of SAPHIR and Microsat-2B humidity sounder channels over a tropical location. It is expected that the NWP centres will benefit from the EOS-07 mission also.

Table 1: Satellite parameters of EOS-07 and Megha-Tropiques

Parameter	Specifications	
	EOS-07	Megha-Tropiques (SAPHIR)
Launch date	10 February 2023	12 October 2011
Orbit	Circular, 37° inclination	Drifting, 20° inclination
Altitude	450 km	867 km
Swath	1050 km	1700 km
Frequency Band	183.31 GHz	183.31 GHz
Spatial resolution Nadir	10 km	10 km
Mission Life	12 months	10 years (2011-2022)

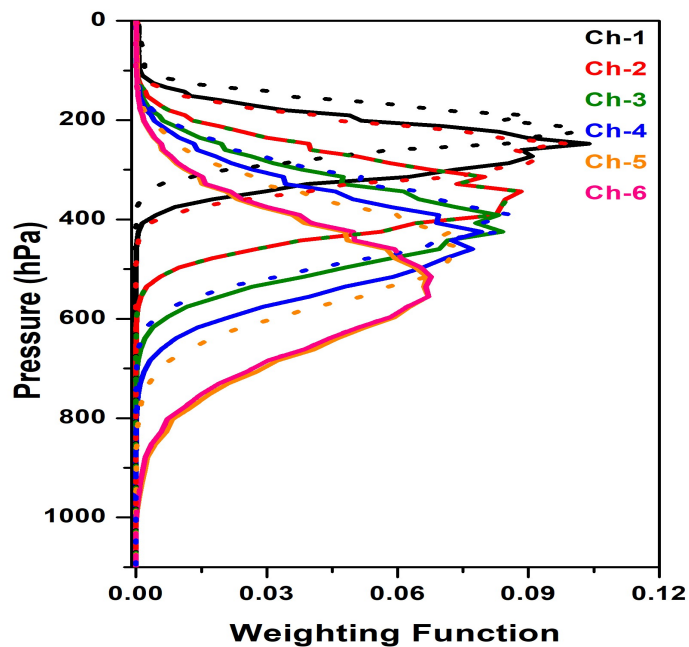


Figure 1: Weighting functions of SAPHIR (dotted) and Microsat-2B (continuous) humidity channels over a tropical location.

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