The Tomorrow.io Microwave Sounder Constellation: Status and Data Products

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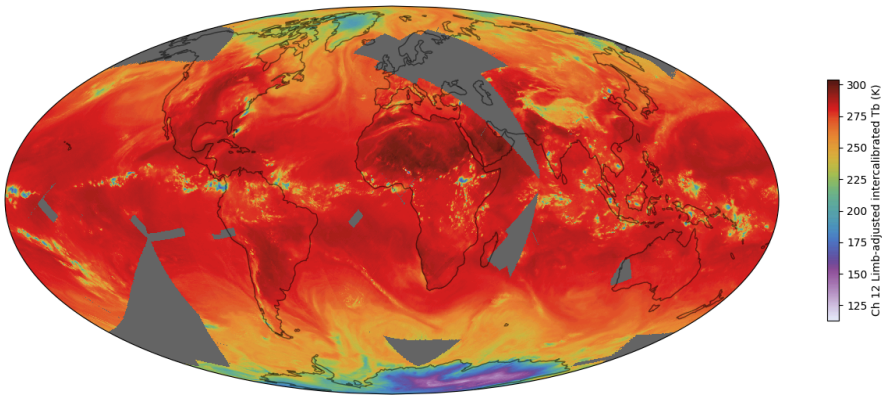

Composite coverage of TMS channel 12 (204 GHz) for 6-hour period on 13 May 2025.

The Tomorrow.io microwave sounder (TMS) constellation is a low earth orbit constellation of 6U Cubesats, derived from the NASA TROPICS mission, each carrying a 12-channel passive microwave radiometer measuring in the W-band (91 GHz), F-band (7 channels between 114 and 122 GHz), and G-band (4 channels between 184 and 204 GHz). As of early 2026, 11 TMS satellites were on orbit in a mixture of sun-synchronous and 45-degree inclination orbits, achieving hourly average revisit rates, and over 95% global coverage in any given 3-hour window. These coverage rates provide a rapid-refresh supplement to fill gaps in coverage from the multi-agency constellation of passive microwave sensors (e.g., GMI, SSMIS, ATMS, MHS, and AMSR2/3), which form the backbone of global satellite precipitation estimates. Additional TMS launches are planned to maintain or exceed the current coverage capability through 2028, after which the next iteration of the constellation will begin to launch. This next generation will feature the next major version of TMS alongside other instruments.

Several TMS data products are produced in near-real-time (over 75% of TMS data are downlinked and processed within an hour of observation). These include parsed L0 data packets, level 1 radiances at three levels of calibration (antenna temperature, brightness temperature, and constellation-intercalibrated/harmonized brightness

temperature), and level 2 geophysical retrieval products. All TMS level 1 products are distributed to NOAA and partner agencies under the Commercial Weather Data Pilot program, and NOAA NESDIS/STAR have run the Microwave integrated Retrieval System (MiRS) with TMS data, demonstrating similar precipitation retrieval accuracy to ATMS in terms of Heidke Skill Score (0.43 for NOAA 21 ATMS vs 0.42-0.44 range for TMS02, TMS05, and TMS06).

TMS data products have been designed with machine learning applications in mind. These include the level 1C-TCR product, which resamples and harmonizes observations across the constellation for image-based machine learning techniques that benefit from a larger data record than would be possible from a single TMS satellite. The open-source GPROF-NN 3D algorithm, originally developed for GPM constellation sensors, is currently being adapted to use the 1C-TCR product as input for both atmospheric profile and precipitation retrievals. In this presentation, TMS precipitation retrieval statistics will be compared to GPM constellation sensors under this common framework to better understand the strengths and weaknesses of TMS as a precipitation sensor.