Impact of the Tomorrow.io Microwave Sounder Constellation on Global Precipitation Retrievals

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Tomorrow.io operates a growing constellation of low-Earth-orbit microwave sounders designed to enhance global numerical weather prediction, precipitation monitoring, and nowcasting. The Tomorrow.io Microwave Sounder (TMS) constellation now includes 11 satellites on orbit, with data available since September 2024. Each satellite carries a 12-channel (91–204 GHz) sounder with heritage from NASA's TROPICS design, providing sensitivity to temperature, humidity, and cloud and precipitation properties (ice and liquid water) across atmospheric layers. The constellation delivers approximately hourly global revisit, enabling low-latency, rapidly updating use cases.

Here, we present a convolutional neural network that integrates Level 1 observations from all 12 TMS channels with other microwave sensors (via GPM XCAL products) and geostationary data to produce a globally seamless precipitation product at 10-minute temporal and approximately 4 km spatial resolution. The retrieval was trained on multiple radar networks to promote robust performance across weather regimes. Verification against station observations showed significant improvements in both categorical and continuous precipitation metrics relative to publicly available satellite precipitation products, including more than 10 percent gains in Heidke Skill Score for light, moderate, and heavy precipitation. These low-latency microwave-informed retrievals have improved operational rapid-refresh precipitation prediction and short-lead nowcasting performance.

Building on this operational baseline, we describe a next-generation retrieval architecture that is designed around TMS. The motivation is to anchor the network on the relatively information-rich microwave radiances, and optimize how the model handles latency and revisit gaps. Then geostationary visible and IR imagery channels are added for spatiotemporal context and continuity. This approach departs from many legacy satellite precipitation retrieval paradigms, including our current system, and targets a higher performance ceiling for global precipitation estimation as denser constellations enable faster refresh of quality precipitation observations. We will present validation results, including comparisons with the previous operational version and ablation studies quantifying the impact of withholding TMS and other microwave sensor inputs from the precipitation retrieval network.