GEMS2-Amethyst: Current Status, Data Products, and Future Directions at Weather Stream

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The Global Environment Monitoring System (GEMS) is a planned constellation of passive microwave radiometers deployed on CubeSat platforms to enhance global atmospheric observing capabilities. GEMS is designed to augment the existing microwave observing network, with particular emphasis on improving temporal sampling and monitoring of high-impact weather systems in data-sparse regions. GEMS2-Amethyst (GEMS2A), the first satellite in the second-generation GEMS series, features 24 channels spanning the 118 GHz and the 183 GHz bands. The compact 2U radiometer is scheduled for launch in March 2026. Its channel configuration provides precipitation-sensitive observations that complement existing operational microwave platforms. The follow-on sensor, GEMS2-Beryl (GEMS2B), currently in production and scheduled for launch in 2027, includes improvements in radiometric performance and long-term stability.

We present an overview of the GEMS2A mission and its on-orbit status, including calibration activities using observation-minus-background (O–B) characterization and double-difference statistics relative to operational microwave sounders. We then describe the GEMS2A product suite, with emphasis on precipitation-related retrievals. GEMS2A brightness temperatures are processed to Level-2 geophysical products using both the Microwave Integrated Retrieval System (MiRS) physical retrieval framework and a machine learning–based retrieval algorithm (GEMS-MLR). GEMS2A data products through Level-2 will be openly available for non-commercial research and operational evaluation.