



Early Orbit Results from the NASA TROPICS CubeSat Constellation Mission

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The NASA Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) mission will provide nearly all-weather observations of 3-D temperature and humidity, as well as cloud ice and precipitation horizontal structure, at high temporal resolution to conduct high-value science investigations of tropical cyclones. TROPICS will provide rapid-refresh microwave measurements (median refresh rate of approximately 50 minutes for the baseline mission) over the tropics that can be used to observe the thermodynamics of the troposphere and precipitation structure for storm systems at the mesoscale and synoptic scale over the entire storm lifecycle. The TROPICS constellation mission comprises six 3U CubeSats (5.4 kg each) in three low-Earth orbital planes. Each CubeSat will host a high performance radiometer to provide temperature profiles using seven channels near the 118.75 GHz oxygen absorption line, water vapor profiles using three channels near the 183 GHz water vapor absorption line, imagery in a single channel near 90 GHz for precipitation measurements (when combined with higher resolution water vapor channels), and a single channel at 205 GHz that is more sensitive to precipitation-sized ice particles. TROPICS spatial resolution and measurement sensitivity is comparable with current state-of-the-art observing platforms. Launches for the TROPICS constellation mission are planned in the first half of 2022. NASA's Earth System Science Pathfinder (ESSP) Program Office approved the separate TROPICS Pathfinder mission, which launched on June 30, 2021, in advance of the TROPICS constellation mission as a technology demonstration and risk reduction effort. The TROPICS Pathfinder mission has provided an opportunity to checkout and optimize all mission elements prior to the primary constellation mission. This presentation will describe the on-orbit results for the successful TROPICS Pathfinder precursor mission and will highlight numerous technical innovations that have made the TROPICS mission possible and enabled new capabilities for future earth observing missions.

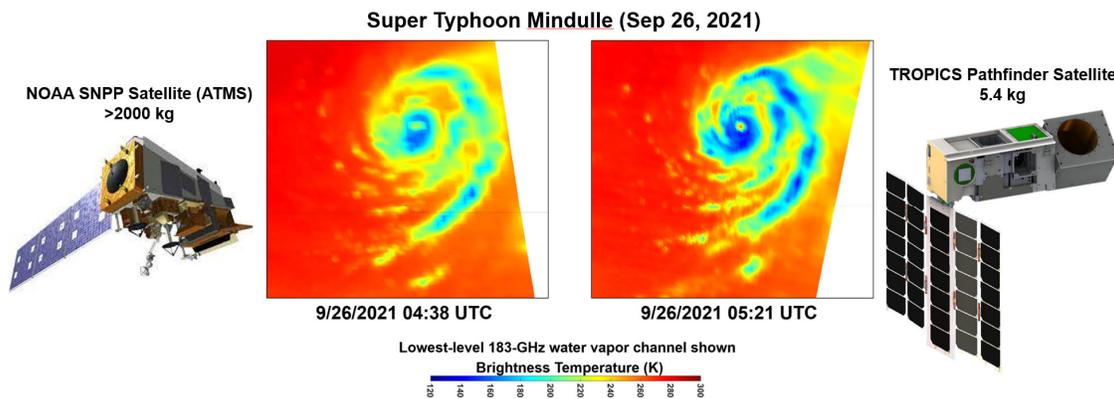


Figure 1. On September 26, 2021, Super Typhoon Mindulle intensified into a Category 5 storm and was imaged by the Advanced Technology Microwave Sounder on the NOAA-20 (JPSS-1) satellite. Forty minutes later, Mindulle was imaged by the TROPICS Pathfinder satellite. Immediately evident is the high data quality of TROPICS Pathfinder, revealing fine details in the inner rain band and eye structure.

1. W Blackwell, S Braun, R Bennartz, C Velden, M DeMaria, R Atlas, J Dunion, R. Rogers, et al. An overview of the TROPICS NASA Earth Venture mission. Quarterly Journal of the Royal Meteorological Society, 2018.

2. H. W. Christophersen, B. A. Dahl, J. P. Dunion, R. F. Rogers, F. D. Marks, R. Atlas, and W. J. Blackwell. Impact of TROPICS radiances on tropical cyclone prediction in an OSSE. Monthly Weather Review, 2021.