

Early Results of Hurricane and Severe Storm Observations from Temporal Experiment for Storms and Tropical Systems - Demonstration (TEMPEST-D) Mission

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The Temporal Experiment for Storms and Tropical Systems (TEMPEST) mission is a proposed constellation consisting of identical 6U-class satellites with three- to five-minute revisit time, to measure the temporal evolution of convective clouds as they form and begin to precipitate within about 20 minutes. The payload for each 6U-Class satellite is a five-frequency millimeter-wave radiometer (89-182 GHz) with the capability to observe microphysical changes in liquid water and ice content as the storm develops and precipitation begins. Such a 6U-class satellite constellation mission would enable the first global measurements of clouds and precipitation on the temporal scale of a few minutes to several tens of minutes. As such, TEMPEST fills a gap in our understanding of cloud systems by providing critical information on the temporal development of clouds and precipitation.

For TEMPEST, 6U CubeSat satellites are chosen to provide substantial margins on mass, power, ground communications and microwave radiometer calibration. To demonstrate the capabilities of such a 6U CubeSat constellation to accomplish NASA Earth science goals, the TEMPEST Technology Demonstration (TEMPEST-D) mission is underway, as well as to raise the TRL of the instrument and key satellite systems from 6 to 9. The success criteria for the TEMPEST-D mission are to: (1) demonstrate precision inter-satellite calibration between TEMPEST-D and NASA/JAXA's Global Precipitation Microwave Imager or the Microwave Humidity Sounder on NOAA and ESA/EUMETSAT satellites; and (2) demonstrate differential drag maneuvers sufficient to achieve the required temporal spacing in a constellation of 6U CubeSat satellites from a single launch.

TEMPEST-D is a partnership among Colorado State University (Lead Institution), NASA/Caltech Jet Propulsion Laboratory and Blue Canyon Technologies. The TEMPEST-D satellite was launched on May 21, 2018, on the Northrop Grumman/Orbital ATK OA-9 commercial resupply mission to the International Space Station. TEMPEST-D was successfully deployed into orbit by NanoRacks on July 13, 2018. After spacecraft and instrument commissioning, the TEMPEST-D mission consists of a minimum of 90 days of Earth observations and differential drag demonstrations from an initial orbit with 400-km altitude and 51.6° inclination.

We report early results of TEMPEST-D observations of cyclones and convective storms, including an overflight of Hurricane Florence on September 11, 2018.