Temporal Experiment for Storms and Tropical Systems Technology Demonstration (TEMPEST-D): Risk Reduction for 6U-Class Constellation Measurements

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The Temporal Experiment for Storms and Tropical Systems Technology Demonstration (TEMPEST-D) is designed to demonstrate drag-adjusting altitude maneuvers required to provide time separation to a 6U-Class satellite constellation with common deployment as well as precision intercalibration of TEMPEST-D with the Global Precipitation Mission (GPM) Microwave Imager (GMI) or another available satellite radiometer. TEMPEST-D will reduce the risk of a future constellation of 6U-Class nanosatellites capable of directly observing the time evolution of clouds and studying the conditions that control the transition of clouds to precipitation using high-temporal resolution observations. TEMPEST millimeter-wave radiometers in the frequency range of 90 GHz to 183 GHz to penetrate into the cloud to observe key changes as precipitation begins or ice accumulates inside the storm. The evolution of ice formation in clouds is important for climate prediction since it is one of the key factors in Earth's radiation budget. TEMPEST improves understanding of cloud processes and helps to constrain one of the largest sources of uncertainty in climate models.

TEMPEST-D provides observations at five millimeter-wave frequencies between 90 GHz and 183 GHz using a single compact instrument that is well suited for the 6U-Class satellite architecture and fits well within the capabilities of NASA's CubeSat Launch Initiative (CSLI), for which TEMPEST-D was approved in February 2015. For a potential future one-year operational mission, for example, five identical 6U-Class satellites deployed in the same orbital plane with five-minute spacing at ~400 km altitude and 50°-65° inclination are expected to capture 3 million observations of precipitation, including 100,000 deep convective events. TEMPEST is designed to provide critical information on the time evolution of cloud and precipitation microphysics, yielding a first-order understanding of the behavior of assumptions in current cloud-model parameterizations in diverse climate regimes.