Enabling Time-Resolved Observations of Cloud and Precipitation Processes from 6U-Class Satellite Constellations: Temporal Experiment for Storms and Tropical Systems Technology Demonstration (TEMPEST-D)

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The Temporal Experiment for Storms and Tropical Systems (TEMPEST) mission concept consists of a constellation of 5 identical 6U-Class nanosatellites observing at 5 millimeter-wave frequencies with 5-minute temporal sampling to observe the time evolution of clouds and their transition to precipitation. TEMPEST is designed to improve the understanding of cloud processes by providing critical information on the time evolution of cloud and precipitation microphysics and helping to constrain one of the largest sources of uncertainty in climate models. TEMPEST millimeter-wave radiometers are able to make observations in the cloud to observe changes as the cloud begins to precipitate or ice accumulates inside the storm. Such a constellation deployed near 400 km altitude and 50°-65° inclination is expected to capture more than 3 million observations of precipitation during a one-year mission, including over 100,000 deep convective events.

The TEMPEST Technology Demonstration (TEMPEST-D) mission will be deployed to raise the TRL of the instrument and key satellite systems as well as to demonstrate measurement capabilities required for a constellation of 6U-Class nanosatellites to directly observe the temporal development of clouds and study the conditions that control their transition from non-precipitating to precipitating clouds. A partnership among Colorado State University (Lead Institution), NASA/Caltech Jet Propulsion Laboratory and Blue Canyon Technologies, TEMPEST-D will provide observations at five millimeter-wave frequencies from 89 to 183 GHz using a single compact instrument that is well suited for the 6U-Class architecture. The top-level requirements for the 90-day TEMPEST-D mission are to: (1) demonstrate precision inter-satellite calibration between TEMPEST-D and one other orbiting radiometer (e.g. GPM or MHS) measuring at similar frequencies; and (2) demonstrate orbital drag maneuvers to control altitude, as verified by GPS, sufficient to achieve relative positioning in a constellation of 6U-Class nanosatellites. The TEMPEST-D 6U-Class satellite is planned to be completed during the second half of 2017, be delivered for a commercial launch to the International Space Station during the first half of 2018 and soon thereafter be deployed via Nanoracks into a 400-km orbit with 51.6° inclination.