The NASA TROPICS CubeSat Radiometers

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ABSTRACT

Polar-orbiting atmospheric sounders provide critical observations that drive numerical weather prediction models but are currently hampered by revisit rates that are almost an order of magnitude poorer than what is required to resolve dynamic weather events. Recent technology advances in miniature microwave radiometers that can be hosted on very small satellites has made possible a new class of affordable constellation missions that provide very high revisit rates of tropical cyclones and other severe weather. The Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) mission was selected by NASA as part of the Earth Venture–Instrument (EVI-3) program and is now in development with planned launch readiness in late 2019. The overarching goal for TROPICS is to 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 better than 60 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. TROPICS comprises a constellation of six CubeSats in three low-Earth low-inclination 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. This observing system offers an unprecedented combination of horizontal and temporal resolution to measure environmental and inner-core conditions for tropical cyclones on a nearly global scale and is a major leap forward in the temporal resolution of several key parameters needed for assimilation into advanced data assimilation systems capable of utilizing rapid-update radiance or retrieval data.