A 6U CubeSat Constellation Concept for Atmospheric Temperature and Humidity Sounding

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To accurately predict how the distribution of extreme events may change in the future we need to understand the mechanisms that influence such events in our current climate. This includes understanding how modes of natural climate variability, such as the El Nino Southern Oscillation (ENSO), the North Atlantic Oscillation (NAO) and the Pacific Decadal Oscillation (PDO) impact the weather extremes. Our current observing system is not well-suited for observing extreme events globally due to the sparse sampling and in-homogeneity of ground-based in-situ observations and the infrequent revisit time of satellite observations. Observations of weather extremes, such as extreme precipitation events, temperature extremes, tropical and extra-tropical cyclones among others, with temporal resolution on the order of minutes and spatial resolution on the order of few kms (<10 kms), are required for improved forecasting of extreme weather events.

We are currently developing a 118/183 GHz sensor that will enable observations of temperature and precipitation extremes over land and ocean as well as tropical and extra-tropical cyclones. This project would enable low cost, compact radiometer instrumentation at 118 and 183 GHz that will fit in a 6U Cubesat with the objective of mass-producing this design to enable a suite of small satellites to image the key geophysical parameters that are needed to improve prediction of extreme weather events. We will take advantage of past and current technology developments at JPL viz. HAMSR (High Altitude Microwave Scanning Radiometer), Advanced Component Technology (ACT'08) to enable low-mass, low-power high frequency airborne radiometers. The 35 nm InP enabling technology provides significant reduction in power consumption (Low Noise Amplifier + Mixer Block consumes 24 mW). In this paper, we will describe the design and implementation of the 118 GHz temperature sounder and 183 GHz humidity sounder on the 6U CubeSat. In addition, a summary of radiometer calibration and retrieval techniques of temperature and humidity will be discussed. The successful demonstration of this instrument on the 6U CubeSat would pave the way for the development of a constellation sampling tropospheric temperature and humidity with fine temporal and spatial resolution.