The RAVAN CubeSat Mission: Progress Toward a New Measurement of Earth Outgoing Radiation

William H. Swartz*[1], Lars P. Dyrud[2], Steven R. Lorentz[3], Dong L. Wu[4], Philip M. Huang[1], Stergios J. Papadakis[1], Allan W. Smith[3], David M. Deglau[1], and Warren J. Wiscombe[4]

[1] Johns Hopkins University Applied Physics Laboratory, Laurel, MD
[2] OmniEarth, Arlington, VA
[3] L-1 Standards and Technology, Inc., New Windsor, MD
[4] NASA/Goddard Space Flight Center, Greenbelt, MD

The Earth radiation imbalance (ERI) is the single most important quantity for predicting the course of climate change over the next century. The Radiometer Assessment using Vertically Aligned Nanotubes (RAVAN) CubeSat mission will demonstrate a small, accurate radiometer that measures top-of-the-atmosphere Earth-leaving fluxes of total and solar-reflected radiation. Coupled with knowledge of the incoming radiation from the Sun, a constellation of such measurements would aim to determine ERI directly. The maturation of small satellites and constellation technologies provides a unique and timely opportunity for making the next great leap in Earth radiation budget measurement.

The objective of RAVAN is to establish that a compact radiometer that is absolutely calibrated to climate accuracy can be built and operated in space for low cost. RAVAN demonstrates two key technologies that enable accurate, absolute Earth radiation measurements in a remarkably small instrument. The first is the use of vertically aligned carbon nanotubes (VACNTs) as the radiometer absorber. VACNT forests are some of the blackest materials known and have an extremely flat spectral response over a wide wavelength range. The second key technology is a gallium fixed-point blackbody calibration source, embedded in RAVAN's sensor head contamination cover, that serves as a stable and repeatable reference to track the long-term degradation of the sensor. Absolute calibration is also maintained by regular solar and deep space views.

We present an overview of the mission, progress toward fabrication and calibration of the RAVAN radiometer, integration into a 3U CubeSat, and plans for launch (anticipated in 2016). RAVAN will help enable the development of a constellation Earth radiation budget mission that can provide the measurements needed for superior predictions of future climate change.