The Polar Radiant Energy in the Far Infrared Experiment (PREFIRE): Filling a Startling Gap in Polar Climate Observation

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Abstract

While polar climate feedbacks have been understood for a long time, current models still struggle to accurately simulate important societal consequences of Arctic climate including the rates of ice sheet melt and sea ice decline. This may be explained, at least in part, by a lack of observational constraints on thermal energy flows in polar regions and the roles water vapor and clouds play in modulating them. Far-infrared radiation (that occurring at wavelengths longer than 15 microns) makes up nearly 60% of the thermal emission at the poles and nearly half of Earth's emission, globally. Remarkably, however, while far-infrared spectra have been collected from every planet in the solar system, Earth's far-infrared emission spectrum has never been systematically documented. Accurate measurements of far infrared spectra and their evolution on daily to seasonal scales could offer powerful new insights into the key processes at work in cold, dry regions of the climate system including the rapidly changing Arctic. This presentation will describe a new satellite mission aimed at addressing this critical observational gap. The Polar Radiant Energy in the Far-InfaRed Experiment (PREFIRE) utilizes two CubeSats in asynchronous high-inclination orbits to systematically document the spectral variation of thermal emission across the mid- and far-infrared (5 – 45 microns) throughout the Arctic and Antarctica. We anticipate that PREFIRE measurements will reveal the response of the full spectrum of polar radiant energy to processes that operate on sub-daily through seasonal timescales. By distinguishing the unique spectral fingerprints of changes in surface characteristics, temperature, water vapor, and clouds, PREFIRE will help untangle the complex time-varying errors in model physics responsible for the large spread in simulations of the polar energy budgets.