Project Summary

Development of the Autonomous Arctic Infrared Observer (AAIRO) Simulator

To fully understand the Arctic system, it is imperative that atmospheric measurements of the lower atmosphere be made across the Arctic, including over the Arctic Ocean. Currently, high-quality observations are being made at three Intensive Observing Sites (Barrow, Eureka, and Summit), which are all on land. Automated weather stations are frequently deployed on ocean and ice buoys, but they only sample surface conditions. In many cases, passive satellite instruments are only able to measure down to the tops of clouds, but are unable to profile the atmospheric conditions between the surface and the cloud base. Thus, new instruments platforms must be developed to fill this gap in the Arctic Observing Network so that pressing questions about rapid Arctic change can be addressed.

Intellectual Merit

The proposed work will be a "proof of concept" for a new instrument platform called the Autonomous Arctic Infrared Observer (AAIRO). The primary goal of the project is to assess the value of data products retrieved from simulated AAIRO measurements relative to instruments that are currently deployed as part of the ICECAPS experiment. [ICECAPS stands for Integrated Characterization of Energy, Clouds, Atmospheric state, and Precipitation at Summit.] A computer model will be developed that simulates the operation of the AAIRO by degrading the spectral resolution of spectra from the Polar Atmospheric Emitted Radiance Interferometer (P-AERI) deployed at Summit, Greenland. Algorithms will be used to retrieve atmospheric properties from the simulated AAIRO spectra. Retrieved properties will include near-surface temperature structure, trace gas amounts of water vapor, carbon monoxide, and methane, and macrophysical (fraction, base height) and microphysical properties (phase, effective particle radius, optical depth) of clouds. Retrieved properties from the AAIRO simulator will be compared to those retrieved from the suite of ICECAPS instruments. This project will prove the usefulness of the AAIRO as a complementary instrument within the broader context of NSF's Arctic Observing Network and will set the stage for future development of the actual AAIRO instrument.

Broader Impacts

The proposed work will support a graduate student and a postdoctoral fellow who will have the opportunity to be involved in both infrared instrument design and remote sensing retrievals. Proof of the AAIRO's measurement capabilities could potentially improve the polar research community's ability to address the basic science questions outlined in the SEARCH Implementation Plan. The potential development of an instrument like that AAIRO complements other existing and proposed sensors and could provide a more complete network of observations that are critical for understanding the Arctic system.