PROJECT SUMMARY

NSFGEO-NERC: Collaborative Research: The Integrated Characterization of Clouds, Energy, Atmospheric state, and Precipitation at Summit, Aerosol-Cloud Experiment (ICECAPS-ACE)

Overview: A two-year extension is proposed to the Integrated Characterization of Energy, Clouds, Atmospheric state, and Precipitation at Summit (ICECAPS) project that will include an Aerosol-Cloud Experiment (ACE). This project is an international collaboration that funds the original ICECAPS researchers through the U.S. National Science Foundation's Arctic Observing Network and a new team of aerosol researchers through the U.K. Natural Environment Research Council. The ICECAPS project has continuously operated a sophisticated suite of ground-based instruments at Summit Station, Greenland since 2010 for observing clouds, precipitation, and atmospheric structure. The project has significantly advanced understanding of cloud properties, radiation and surface energy, and precipitation processes over the Greenland Ice Sheet (GrIS), while also supporting process-based model evaluation, development of new measurement techniques, ground comparisons for multiple satellite measurements and aircraft missions, and operational radiosonde data for weather forecast models. We propose to enhance the ICECAPS project by pursuing two major goals: 1) provide a better understanding of aerosol-cloud interactions over the GrIS and how they impact the surface energy budget, and 2) provide observations that can be used for numerical model assessment as part of the Year of Polar Prediction (YOPP).
Intellectual Merit: ICECAPS observations have revealed much about clouds and the atmosphere over the GrIS. In spite of this, little is known about the role that aerosols play in regional cloud and precipitation processes. Summit is a unique location to study such interactions because there are no significant local sources of cloud-active aerosols. Therefore, observations from Summit Station can provide insight into the role that advective aerosol sources play in cloud and precipitation processes. The addition of the proposed aerosol measurements by the University of Leeds are complementary to the ICECAPS instrument suite and will allow, for the first time, an investigation of how aerosols impact the surface energy and mass budgets of the central GrIS. In addition, the proposed time period of the ICECAPS-ACE project overlaps with the Year of Polar Prediction (YOPP) and field activities of the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) project. YOPP offers an unprecedented focus by the operational modeling community on the Arctic system. Because of the importance of the GrIS to the Arctic system, the ICECAPS project has been endorsed as a YOPP activity, assuming that observations continue through 2020. During the YOPP, participating operational centers will archive high-resolution model output at fixed stations, including Summit, to provide a unique opportunity for physical process-based model evaluation and verification. The ICECAPS team has developed unique approaches for such evaluation that target surface energy budget processes, precipitation, cloud processes, and will now include cloud-aerosol interactions.
Broader Impacts: As society begins to acknowledge the implications of climate change, it is necessary to understand how the physical climate system operates and evolves. Greenland is of critical importance to human society because it is currently a large contributor to sea-level rise, and the GrIS is melting at an accelerating rate. Providing a better understanding of the interactions between aerosols and clouds is of direct societal value because of their ultimate impact on the GrIS mass budget. This project will continue the successful record of international collaboration started by the ICECAPS project, which have made use of the unique ICECAPS data sets over the GrIS. This project will also continue to train the next generation of polar scientists by providing valuable opportunities for polar field work and experimental research. The ICECAPS research team will continue to provide innovative approaches to teaching polar science through the use of K-12 teaching modules that utilize hand-held instruments that emulate ICECAPS instruments, and by creating and disseminating Computational Guided Inquiries that use polar field data for undergraduate and graduate engineering and science courses.