Michael O'Neal - University of Delaware

Integrating Field and Remotely Sensed Data for Improved Characterization of Permafrost Landscapes in the Russian Arctic

This proposal is in response to the NASA LCLUC call for small proposals to contribute to ongoing non-NASA NEESPI projects. We seek supplementary funds to incorporate recent developments in remote sensing within the framework of the large international active layer observational program under the NEESPI domain.

Observational evidence indicates that climate warming is well underway in the Polar regions of Northern Eurasia in the past few decades. In permafrost regions the worming is manifested through thickening of the active layer, and warming and thawing of permafrost. Consequently, the scientific questions be answered is: What are the impacts of changes in climate and permafrost conditions on regional North-Eurasian landscapes, and consequently, on the environmental and climate system? Observations from Circumpolar Active Layer Monitoring (CALM) program suggest that permafrost degradation intensifies melting of ground ice, causes differential ground subsidence and potentially the development of thermokarst. These surface geomorphological processes have a significant impact on hydrology, vegetation, and ecosystem dynamics as a whole. They are also detrimental for human infrastructure. The overall objective of the proposed research is to investigate the response of permafrost and the active layer to climate change and increased human activities, using a combination of ground-based and satellite observations at Arctic ecosystems of the Northern Eurasia. The proposed research will be accomplished through aggregating and integrating diverse geocryologic observations from clusters of CALM sites within the context of remote sensing. It will be focused on developing an effective scaling strategy to produce estimates of the magnitude and spatial and temporal variability of near-surface permafrost parameter for several representative Russian regions.

Changes in climate, permafrost conditions, and landscape have important ramifications on regional socio-economics. Detailed regional assessment of permafrost conditions will therefore serve as a blueprint for mitigating future permafrost degradation and related landscape responses. The work will also complement efforts aimed at developing and evaluating permafrost parameterizations for comprehensive land-surface schemes used in coupled air-land-ocean models. The results of our study will provide initial conditions and validation data sets for simulations. The proposed research will include a strong international component through its association with CALM observational program. We will collaborate closely with colleagues from 12 Russian institutes. The proposed research will assist educational advances in several arenas. Educational benefits will accrue to graduate students participating in the project. We will develop general educational materials, in the form of laboratory exercises and instructional modules, that will be used at the undergraduate collegiate level.