

## B. PROJECT SUMMARY

(1) *Intellectual Merit*: Global climate change will produce serious impacts on natural and human systems in permafrost regions. The Circumpolar Active Layer Monitoring (CALM) program is concerned with observing the response of the active layer and near-surface permafrost to climate change at multi-decade time scales. CALM and its companion borehole temperature program, *Thermal State of Permafrost*, are closely coordinated international observational networks devoted to permafrost (together, they comprise the Global Terrestrial Network-Permafrost, or GTN-P). The present active-layer network of 168 sites represents the only coordinated and standardized program of observations designed to observe and detect decadal changes in the dynamics of seasonal thawing and freezing in high-latitude soils. Long-term observations of active-layer thickness and dynamics, obtained using standard measurement protocols, are the essential rationale behind the CALM network. Local site conditions and seasonal variations in climate create complex interactions that determine the magnitude of seasonal soil thaw and information about related biogeochemical processes. Long-term time series of thaw measurements at the same locations and across diverse terrain types and regions are required to identify scales of spatial variation, establish trends, and validate models. Measurement of thaw subsidence is an integral part of the observation program. Although this proposal is concerned only with observing stations located in the Arctic region, it is important to note that CALM is a global network incorporating observatories outside the Arctic Circle, including a rapidly developing Antarctic component (“CALM-South”). About half of the sites in the CALM network are maintained and data reported on a voluntary basis.

(2) *Broader Impacts*: Widespread, systematic changes in the thickness of the active layer could have profound effects on the flux of greenhouse gases, on the human infrastructure in cold regions, and on landscape and hydrologic processes. It is therefore critical that observational and analytical procedures continue over decadal periods to assess trends and detect cumulative, long-term changes. Annual recovery of data and their dissemination is required from all participating sites. The objectives of the observational network stress the need for long-term active layer, ground temperature, and thaw settlement measurements, integration of data to provide the basis for comprehensive assessments of changes in active-layer and near-surface permafrost, and preparation and dissemination of data sets to assist detailed process studies, and in validating and developing of climate change, ecology, hydrology, and geocryology models. The geographical focus of the network of CALM grids and soil temperature sites is on Arctic tundra environments, where the program has made a substantial progress at building a consistent, long-term database that has been used effectively and extensively by the modeling community and has helped to shape recent ACIA and IPCC reports. Educational and outreach activities are an integral part of the proposed research. The project will provide opportunities for field experience and educational participation at levels ranging from elementary school through postdoctoral. The circum-Arctic nature of CALM will foster extensive international collaboration between students involved in project activities. An outreach component of the project includes extensive involvement of local, predominantly indigenous population in observational program at remote Arctic sites. This proposal requests logistical and operational support primarily to continue observational programs at sites in Eurasia, and at selected existing Arctic Alaskan sites. We will continue to incorporate data into our web-accessible CALM database from existing and new sites. We will continue to foster existing collaborative relationships and to develop new ones with both U.S. and international observational networks and research programs, and to contribute to educational programs ranging from elementary school through postdoctoral appointments.