

A. Project Summary

Global warming and rapid social change are transforming the North at unprecedented rates, threatening social-ecological sustainability. To mitigate the effects of these changes, we must deepen our understanding of the interactions among physical, biological and social processes. This focus on the complex mechanisms of social-ecological change, accomplished through integrating disciplinary perspectives, provides a more comprehensive understanding than disciplinary science alone. While this approach is gaining momentum in science, it is still new, facilitated by advances in cyberinfrastructure and theoretical understanding of complexity.

Our proposed project contributes toward building the capacity needed for the University of Alaska (UA) to join this growing trend toward integrative science. Through strategic investments that build on existing strengths, we create a program that pulls together physical, biological and social science to address social-ecological sustainability in Alaska. We center our program around our Integration Core, a set of cross-cutting activities that enable synergy and synthesis of our science components. Within the physical, biological and social science disciplines, we address topics critical to understanding change in the North: permafrost variability, warming and degradation; changing biodiversity and ecosystem vulnerability; and resilience and well-being of rural communities in conditions of rapid change.

In building this program, we will take advantage of Alaska's strategic position in the North and the resulting international connections. This phase of Alaska EPSCoR coincides with the fourth International Polar Year 2007-2009, a once-in-a-career initiative that will provide unprecedented opportunities for research and education on the polar regions. In addition, we will strengthen ties between the Arctic Council and Alaskan researchers and research institutions.

The intellectual merit of the proposal rests both in the individual science components and our Integration Core. Each science component addresses new issues. The permafrost research uses a new paradigm to explore climate impacts on permafrost, testing the hypothesis that climate directly affects permafrost in the continuous permafrost zone but affects permafrost indirectly through interactions with vegetation and fire disturbance in the discontinuous permafrost zones. The biological research will document, for the first time, broad patterns of past, present and potential future biogeographic shifts in plants and animals in Alaska, with an emphasis on subsistence species. This research addresses both gradual change and abrupt changes mediated by plant-microbial interactions. The social science research integrates research on food systems, institutions, and social networks to describe how rural indigenous communities respond to climatic and social change. We integrate these three areas of disciplinary research through an integration core that allows us to examine the interactions among these components. This integration uses new cyberinfrastructure tools such as agent-based modeling and scenario development to explore hypotheses about how physical, biological, and social systems interact under conditions of rapid change.

The broader impacts will result from the proposal's education and outreach agenda. K-12, undergraduate and graduate students, post-doctoral associates and junior faculty will receive high-level training and mentoring, thereby enabling a new generation of integrated science research. Supported by established UA research clusters of national renown, new research capacity will be built in urban and rural campuses across the state. Particular emphasis will be devoted to Alaska Natives, women and other minorities underrepresented in science. Outreach will encompass communication with a variety of stakeholders, from local community members to professionals in private business and state and federal agencies. These partnerships will encourage the application of theoretical principles derived from resilience and vulnerability research to the realms of resource management, politics and economic development. Ultimately, the proposed research will enhance the sustainability of Alaska's human and natural resources by making innovative research relevant to its residents.