The Juneau Icefield Research Program: A new Earth & Planetary Sciences Polar Proving Ground & Training Program

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2. Statement of Need: To address global environmental challenges while advancing science and technology at a rapid pace, the U.S. must approach collaborations which leverage local, national, and global resources for environmental and economic benefit. University of Maine's (UM) vision of pursuing research and education with global impact and local relevance is particularly applicable to the Arctic because northern latitude change is intricately linked to Maine's environment and economy. The Arctic is a focal point for international research, exploration, policy, and national security due to its rapid change, potential resources, new transportation opportunities, and complex diplomatic relationships. Recent estimates suggest $8– $69 trillion in global costs associated with Arctic environmental change between 2050 and 2100. Existing U.S. Polar research programs in Antarctica and Greenland are already backlogged multiple years and COVID-19 has exposed the vulnerability of R&D and educational programs requiring international travel. To maintain forward progress and international leadership, there is a need for a long-term and easily accessible Polar study site on U.S. soil. Additionally, increasing interest in extraterrestrial life and icy planet exploration (e.g. Moon, Mars, Europa) is driving the need for an easy-access planetary R&D Polar testing site. Planetary expertise would also be valuable to Earth science research and vice versa, suggesting that significant opportunities exist for cross-collaboration. Lastly, burnout and loss of skilled professionals from Polar field research and logistics roles in U.S. Polar programs has been a decades-long unsolved dilemma (~3-5 year retention) which challenges forward progress in Polar research. Yet, there is a resource of early career professionals keen to back fill these roles if the U.S. can increase technical field training.

3. Description of Proposed Solution: We propose a new U.S. Polar Earth & Planetary Sciences Proving Ground and Training Program on and proximal to the Juneau Icefield (JIF; Alaska) through an existing UM collaboration with the Juneau Icefield Research Program (JIRP). This proposal will critically support Polar and planetary R&D as well as U.S. national security in the Arctic. Specifically, this proposal will provide: 1) a Polar proving site for academic institutions, federal agencies, and other organizations; 2) unprecedented opportunities for Earth and planetary scientists to collaborate and pool resources for mutually valuable R&D; 3) large scale community science experiments; and 4) extensive training opportunities for high school through Early Career STEM professionals. The JIF and JIRP resources offer an "icefield-to-oceans" natural laboratory and dedicated site for Polar and Planetary science R&D in collaboration with academic and federal partners. The one-of-a-kind field infrastructure of JIRP (8 stations on US soil across the JIF) offers easy access to multiple environments with reduced logistical challenges and a ~10:1 cost savings relative to Antarctica or Greenland. As the fifth largest icefield in North America, JIF also extends to the edge of a critical marine ecosystem, expanding the breadth of potential research while avoiding international challenges to operate (i.e., such as those in Antarctica and Greenland). Given the continued backlog in Antarctic and Greenland science, this site would provide a viable alternative for consistent Polar technology development and R&D over the long-term. Ultimately, this proposal will: 1) revolutionize how the U.S. Polar community engages with each other by developing broad collaborative opportunities; 2) bring Maine and UM significant opportunities to

expand Arctic, Polar, and Planetary R&D that is valuable for our environment, economy, and national security; and 3) bolster critical Polar STEM training and educational opportunities.

4. State and Federal Agency Support: Below, we outline established JIF partnerships with support at the Director (D), Program Management (PM), and/or Senior Scientist (SS) level, and their R&D interests. ***UAlaska-Southeast*** is submitting a joint proposal and the ***DoD US Army CRREL*** is our prime sponsor for this proposal (PM/SS; Cryosphere change detection, terramechanics, coastal processes, multi-sensor/AI/machine learning integration in unmanned systems). Co-sponsors include: ***U.S. Forest Service/Tongass National Forest*** (PM/SS; Icefield-to-Ocean and critical zone R&D); ***U.S. Geological Survey*** (SS; Glacier Monitoring Program); ***U.S. Dept. of Education - Upward Bound*** (D/PM; Underrepresented student education & training); ***JIRP*** (D/PM; Earth systems science R&D); ***Mendenhall Glacier Visitors Center*** (D; Education); ***Academic Institutions*** in ME, AK, MT, WA, NY, CO, FL, CA, NH and Europe. All affiliated organizations to this proposal also have interests in education/training on the JIF.

5. Sustainability: We will establish an Advisory Committee Consortium from academia, federal agencies, and private organizations that are interested in Polar R&D, innovation, and training, to provide sustainability guidance. Part of the federal funds will focus on advancing Advisory Committee and proposal leadership team recommendations. With minimal marketing effort, JIRP received ~$2.37M support requests on 14 proposals (~$29M in total funding) and 198 student application requests in 2020, suggesting a strong market for the JIF as a federal research station and education program. This proposal aligns with a recent MOU between NASA and NSF in 2021 to continue partnerships in mutually beneficial research activities. Multiple NSF and NASA-funded projects have recently been supported on the icefield including the ***Ice Drilling Program (NSF), Planetary Sciences (NASA)*** and ***Habitable Planet (NASA)*** research. ***UNAVCO/IRIS Consortium (NSF)*** have also shown interest in community experiments on the JIF.

6. Cost: $4 million/year to UM, UAS, and subawards to support operational activities on the JIF and in Juneau and support infrastructure improvements on the JIF.

7. UM Likelihood of Success in Future Federal Competition Support: UM has a long history of funding success in Polar R&D. This proposal significantly bolsters UM Polar collaborative funding opportunities primarily through NSF, NASA, and DoD avenues. There is also significant opportunity for academic and agency partnerships leveraging the vast network of current collaborations and potential for even broader U.S. participation.

Figure 1. Two of 8 existing JIRP field stations on U.S. soil. Each of these two stations have a current capacity of ~60 to 70 personnel per camp.

8. Additional Information: This proposal does not duplicate or circumvent existing Federal programs. The Proving Ground & Training program is the first-of-its-kind with emphasis on offering benefits to the Department of Defense, Polar Earth and Planetary research, and education community. The U.S. does not currently have a Polar Earth & Planetary sciences testbed on U.S. soil.