PROJECT SUMMARY

Overview:
Communities throughout the United States struggle to manage significant landslide risk. Our proposed project uses a new generation of smart and connected technologies, coupled with new geoscience and social science understanding, to help Sitka, Alaska, address its landslide challenge. We aim to improve landslide prediction by deploying a network of low-cost, low-power, wireless sensors and by image analysis with machine learning. We will enhance warning for Sitka's diverse population using mediated communications channels, social networking, culturally informed risk messaging, and network influence maximization. We will help the community make informed choices through participatory risk management using robust optimization, interactive data visualization, improved understanding of risk perception within diverse social networks and cultural frames, and the engagement of citizen scientists. While focused on Sitka, we expect the results of this research to be widely applicable.

Sitka represents an ideal first adopter of these smart and connected technologies. This small coastal town of 9,000, pressed against the steep slopes of the Tongass National Forest, has limited financial resources and confronts a particularly complex geologic setting. The town has, however, a strong history of engagement with the scientific community and a population newly focused on landslide risk. A 2017 SCC planning grant enabled our team to build strong ties with the Sitka community and a research plan reflective of their needs. The project's partners from Alaska state agencies, including the Alaska Division of Geological & Geophysical Surveys (DGSG), and the US Geological Survey (USGS) will help disseminate the research innovations to communities nationwide.

Intellectual Merit:
This project will advance geoscience, social science, and risk management through innovative use of information science that incorporates multiple data streams from sources such as historical records and imagery, hydrologic sensors, and social networks. The project will advance information science by showing how diverse sources of data (of disparate time scales, dimensionalities, and levels of noise) can be integrated to improve decision-making and policy-making in highly uncertain environments. These diverse streams of data will be applied to both existing machine learning methodologies, as well as novel influence maximization models for natural hazard risk. The project will advance geoscience by improving predictive models through direct measurement of landslide triggering conditions and region-specific threshold calibration, and by testing how a vast increase in the number of in-situ sensors affects the design, implementation, and performance of landslide early warning systems. The project will advance social science through an improved understanding of risk perception and communication in social and cultural contexts. It will be among the first to study how network influence maximization can improve community education and natural hazard response. By linking algorithms for multi-objective robust optimization with an understanding of social networks and cultural frames of risk perception, this project will improve understanding of how data can be used to facilitate a fair, accountable, and transparent risk management process.

Broader Impacts:
This project will benefit society by demonstrating a system of easy-to-use, low-cost, smart and connected technologies that enable small, resource-constrained communities to significantly reduce landslide risk. The project will help the remote community of Sitka deploy such a system and evaluate its impacts. DGGS and USGS partners will disseminate these methods nationwide. The project will broaden the participation of under-represented groups by engaging the Sitka Tribe in citizen science and the wider community in participatory risk management, as well as advancing participatory, multi-scenario, multi-objective decision support that makes data and tradeoffs transparent and accessible, thereby reducing any monopoly on expert information and empowering all stakeholders in the risk management process. This project will provide educational opportunities in multi-disciplinary, collaborative research for at least five PhD students; research and leadership opportunities for post-docs and early career scientists; and applied science education opportunities in two Sitka high schools, including a residential school for promising Alaskan Native students across the state.