Navigating Disturbance Regimes in the New Arctic

(NSF Awards 1927772 and 1928048)

Key Project Contact(s):

Melissa L. Chipman, Assistant Professor, Syracuse University, mlchipma@syr.edu, Co-PI

Mark J. Lara, Assistant Professor, University of Illinois, mjlara@illinois.edu, Co-PI

Project Website Urls & Social Media Accounts:

https://mlchipma.expressions.syr.edu
http://go.illinois.edu/LaraLab
Twitter: @mchipman5 and @mjlara71

Project Objectives:

Objectives: The primary objective of our project is to evaluate the vulnerability and/or resilience of Arctic tundra in northern Alaska to multiple interacting disturbances. We will use a combination of ***remote sensing, chronosequence surveys, and lake-sediment archives*** to investigate the interactions between ***climate warming, wildfire, permafrost degradation, and shrub expansion*** in the Arctic on decadal to millennial time-scales.

Methods: (1) High-resolution time-series image analyses will detect permafrost degradation and tall shrub expansion over the past 70+ years, used to develop spatially explicit models of landscape evolution. (2) Above and belowground parameters measured from field to airborne (UAS hyperspectral/LiDAR) chronosequence surveys will unravel disturbance-climate interactions/feedbacks linked with landscape evolution. (3) Paleoecological reconstructions from lake sediments will be used to evaluate linkages between climate, wildfire, permafrost degradation, and shrub expansion, and to validate spatially-derived models.

Broader Impacts: We will develop tundra vulnerability maps for 18 Alaskan villages to optimize inter-village navigation, hunting routes, infrastructure development, and preservation of heritage sites. We will also develop STEM educational and outreach initiatives focused on training and collection of drone imagery to capture seasonal patterns of permafrost degradation processes using structure-from-motion photogrammetry techniques.

Keywords: wildfire, permafrost degradation, shrub expansion, time-series analysis, paleoecology

Progress to Date/Future Plans: We will focus on sample collection from two regions of the Alaskan Arctic. Our first field campaign will occur in late July 2020 and will include UAS acquisitions, soil/vegetation surveys, and lake-sediment coring from six sites near the Toolik Field Station. Our second field season is planned for summer 2021, and will repeat measurements in the Noatak River Watershed. Both PIs and 2-3 graduate students will conduct field activities. Additionally, we have launched a special issue in *Remote Sensing* entitled, "Dynamic Disturbance Processes in Permafrost Regions" and will be accepting submissions through 30 Sept. 2021.

Highlights or Expected Outcomes: Our research will result in several key deliverables, including new and extended spatial and temporal observations and interactions between permafrost degradation, wildfire, and shrub expansion in the Alaskan tundra. In addition, we will provide education, training, and technology to indigenous high school classrooms and provide new permafrost vulnerability products/maps to many Arctic communities.

NNA Community Collaboration and Research Coordination: Because one of the overall goals of this project is to advance knowledge of Arctic disturbances, we are very interested in leveraging the knowledge and experiences of other NNA scientists to learn of successful approaches for engaging with native Alaskan communities. We aim to develop synergistic educational and research activities with these communities to combine the perspectives of both scientists and residents in understanding these rapidly changing landscapes.

Advice for Overcoming NNA Project Challenges: N/A --this is a new project.