Developing a GIS database of lake drainage potential for the western Arctic Coastal Plain of northern Alaska

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This work is being supported by a grant from the Arctic Landscape Conservation Cooperative

Introduction
Lakes of the Arctic Coastal Plain of northern Alaska provide essential habitat for water birds and fish, are important resources for subsistence users, and supply water for human consumption and industrial activities. These wetland habitats persist because of the complex interactions among temperature, precipitation, and permafrost. Therefore, projected climate change could impact lake distribution on the landscape and amplify a naturally occurring process on the landscape, lake drainage. This project is focused on the development of a GIS database that identifies lakes with a high potential for drainage due to the presence of a drainage gradient, providing managers with a spatially-explicit model of projected habitat change and allowing assessment of the impacts from lake drainage.

Study area
Our initial study area is defined by the availability and extent of an Interferometric Synthetic Aperture Radar (IFSAR) derived digital surface model for Arctic Coastal Plain in northern Alaska. This data was acquired between 2002 and 2006 in a joint effort by the BLM, USGS, and NSF. The study area includes high-resolution imagery, derivatives, and workflow.

Imagery, derivatives, and workflow
Extraction of lakes from the IFSAR dataset
Extraction of waterbodies and removal of rivers and features smaller than 1 ha
Series of buffers to determine drainage gradient
Identification of lakes with a drainage gradient
DGPS surveys at high and low potential sites for comparison to IFSAR derived measures

Example of lake drainage potential map for subset of study area

Drained lake basins
Drainage of lakes in the study region is a natural process that may be amplified by a changing climate. Thus, is it possible to develop a scheme that we can use to predict if and when an individual lake may drain?

Reframing the GDC database
We plan to incorporate numerous other datasets and attributes that can be used to further refine the lake drainage potential database:
- Incorporation of lake expansion rates due to permafrost degradation
- Information on near-surface permafrost characteristics and ground-ice content
- Relative position on the landscape towards other dynamic landscape features (i.e. near coastline, on inside or outside meander of a river, etc.)
- Calculation of flow accumulation in lakes as a proxy for implications of increases in runoff due to increased precipitation or increased permafrost degradation
- Removal of lakes with a stable outlet

Linking physical processes with biological trade-offs
LCC’s are management and science-based partnerships that inform integrated resource management actions addressing climate change and other stressors within and across landscapes. Thus, in addition to providing information on the potential amplification of natural processes in the Arctic given climate change, it is also critical to link those shifts to the potential trade-offs from a biological standpoint.

Within this subset of the western Arctic Coastal Plain study area there are 539 lakes (5.6% of population) representing an area of 100 km² (7.2% of total lake area) classified as having a high potential for drainage based on existing drainage gradients around the periphery of the waterbody.