ARCTIC LTER: CLIMATE CHANGE AND CHANGING DISTURBANCE REGIMES IN AN ARCTIC LANDSCAPE

LOCATION
Toolik Field Station is at 68°N, in northern foothills of the Brooks Range, Alaska. The site lies in formerly glaciated rolling hills and includes an array of tundra ecosystems, streams, and oligotrophic lakes up to 20 m depth.

CLIMATE
| Air Temp | May | 0.6°C |
| June | 8.1 |
| July | 11.9 |
| August | 7.4 |
| Precipitation | 300-200 mm |

LAND-WATER INTERACTIONS RESEARCH
Rapid disturbances (e.g., fires and thermokarst failures) are increasingly affecting the chemical and physical components of tundra streams. Thermokarst failures export primarily dissolved forms of DIC and DOC; unburned catchments export equal amounts of DIC and DOC. Downstream processing will be dependent on the forms of carbon moved from land to water. Carbon and nitrogen export is much higher from thermokarst-affected systems than from either control or burned catchments.

STREAMS RESEARCH
Warming of the arctic is increasing the duration of the “flowing water” season, but the duration and periodicity of sunlight is not changing. This asynchronous change in key physical drivers is having unexpected influences on the chemistry and biology of stream ecosystems.

1.) The warming climate has caused unusual, late-season droughts that may significantly reduce the health of migrating Arctic graviing. The condition (upper) and mass (lower) of Arctic graviing in the upper Kuparuk River during a drought in 2011 that caused an important reach of the river to go dry (hypoxic). This dry reach isolated fish in the river and limited their ability to feed effectively. An increase in frequency or duration of late-season droughts could threaten the viability of this important fish population.

2.) Previously frozen soil C released from thermokarst failures is labile to bacteria, and exposure to light amplifies this lability by more than 40%.

STUDIES OF NEC ESSENTIAL FOR UNDERSTANDING OF WEB, LAKES, AND TUNDRA

LAKES RESEARCH
The Arctic landscape is littered with thousands of lakes that arose after a series of Pleistocene glaciations and that show surprising variation in productivity. The lakes range from nutrient and light limited to nutrient and light enriched, and are increasingly important indicators of climate change and biogeochemical cycling. In the arctic, lakes and streams provide an array of ecosystem services, from climate regulation and nutrient cycling to aquatic and fisheries biodiversity.

During the experiment, we observed significant increases in primary, secondary, and tertiary productivity in the unburned deep lake relative, to the control deep lake (Fig 4). Enrichment first stimulated primary production but did not appear to have a measurable effect on higher trophic levels until the 8-9 day period of the study, after which secondary productivity increased dramatically. Increases in primary productivity resulted in concurrent decreases in hypolimnetic oxygen and reduced water transparency.

Continued stimulation of epidemic phytoplankton now appears to be shading the benthos; however, based on stable isotope analyses of the food web, there is considerable inter-annual cycling of "N" in the deep pelagial.

COLLABORATING INVESTIGATORS

Marine Biological Laboratory
Linda Desgain Anne Giblin John Hobbie Barrett Ed Rassweiler G. Shaver (lead PI) Jianwu Tang Colorado State University
Georgia Institute of Technology
Marc Sigg.
Lamont-Doherty Earth Observatory
Natalie Boitman Kevin Griffin
University of Alabama
Alex Huryn
University of Alaska Fairbanks
M. Sykes
Bret Hartle Gary Kofinas
University of Florida
Bret Shappley
University of Maryland
Byron Crump
University of Michigan
George Kling
University of California, Santa Barbara Sallie MacIntyre Josh Shimel
University of Texas-Arlington
Lake Sough
University of Vermont
John Moore
Utah State University
Phaedra Budy Chris Luecke

http://ecosystems.mbl.edu/arc