The effects of fire occurrence on vegetation composition and nutrient cycling in the Yukon-Kuskokwim Delta, AK

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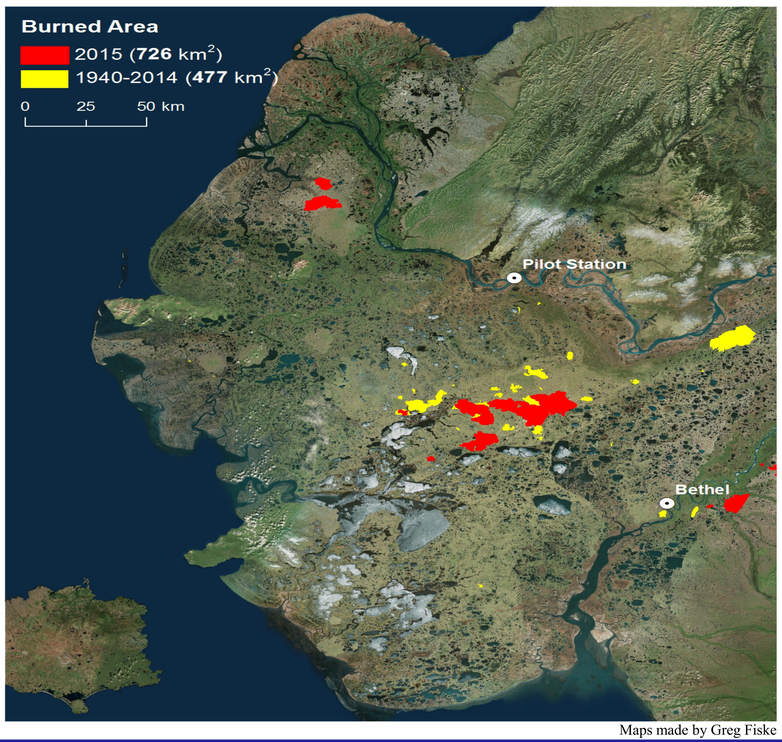
Introduction

Increasing frequency of wildfires in the Arctic alters ground thaw and plant community structure. Due to its ability to sequester carbon, plant biomass plays a key role in the net ecosystem exchange of carbon to the atmosphere. In the summers of 2018 and 2019, we tested the hypothesis that fire causes significant changes in vegetation composition that manifest in altered carbon exchange between the ecosystem and the atmosphere.

Study Area

This study was conducted in a wetland tundra in the Yukon-Kuskokwim Delta, Alaska. We located 7 study sites within a 4-kilometer radius. All study sites included an area that burned in 2015 and a corresponding unburned area. Additionally, three of the sites included an area that burned in 1972.

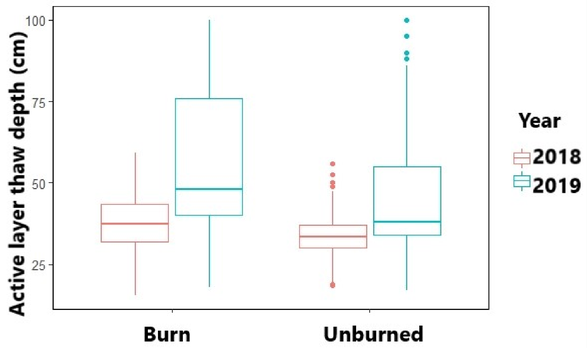


Maps made by Greg Fiske

Methods

We collected data on species and functional type of vegetation and thaw depth at 1 meter intervals for 30m transects in triplicate. Species and functional type data were collected by the using the point intercept method. In 2019, Fluxes of ecosystem and soil respiration were taken using an IRGA attached to a clear plexiglass chamber that was shaded for soil respiration measurements in an unburned and recently burned area.

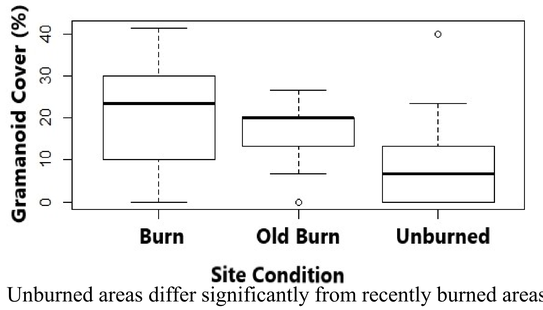
Thaw Depth



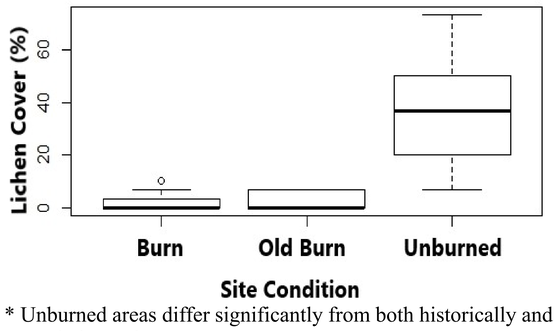
*Unburned areas differ significantly from recently burned areas and 2019 thaw depth averages differ significantly from those of 2018

Vegetation

* Unburned and recently burned areas both differ significantly from historically burned areas, though not from each other

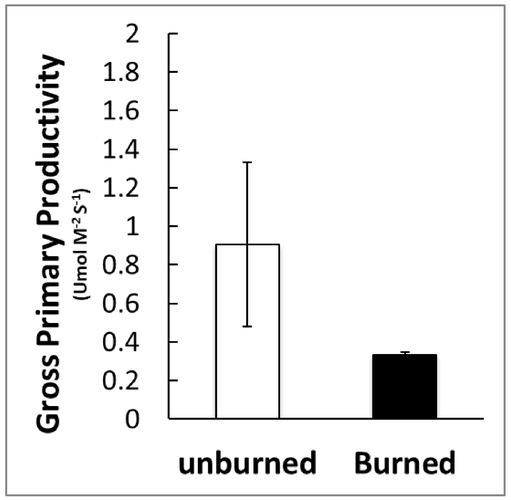


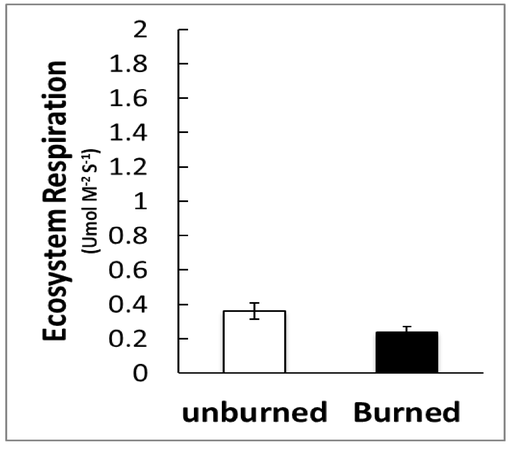
* Unburned areas differ significantly from recently burned areas

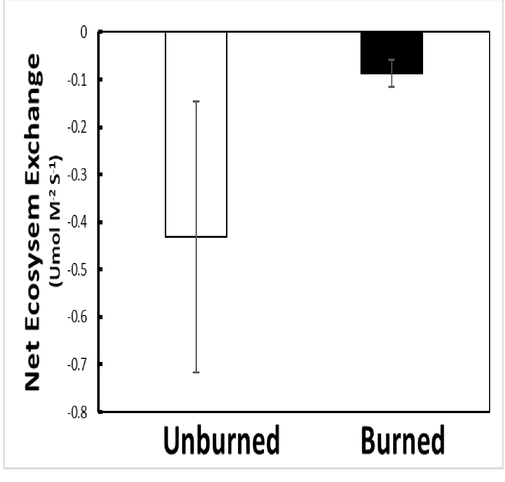


* Unburned areas differ significantly from both historically and recently burned areas

CO_2 Exchange







Discussion

Fire increased ground thaw and altered plant composition. Although literature highlights increased shrub dominance after tundra fire, we found that initially following fire, graminoid dominance increased, while lichen and (to a lesser extent) shrub dominance was significantly reduced.

In contrast to recently burned areas, nearly 50 years following fire, shrub dominance increased in the system while lichen dominance remained reduced, suggesting fire may cause fundamental shifts in tundra plant community structure.

Gross primary productivity was lower in recently burned areas, causing a reduction of growing season net ecosystem exchange (NEE). This reduction in summer CO_2 sink strength was likely caused by decreased plant biomass following burn.

Future research will focus on comparing summertime NEE dynamics in old burn areas to assess how increasing shrub dominance affects tundra ecosystem C balance over time.

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