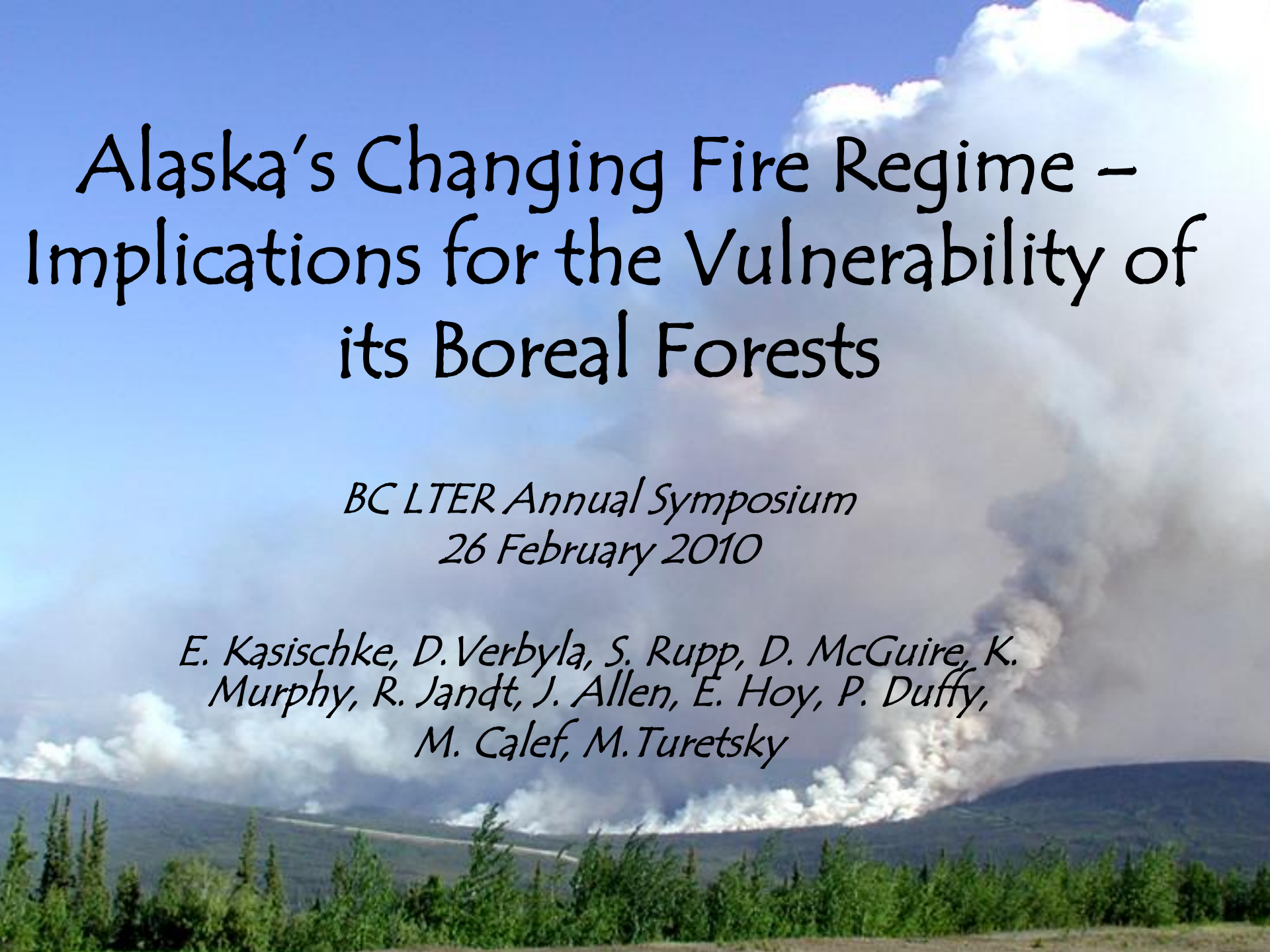

Alaska's Changing Fire Regime – Implications for the Vulnerability of its Boreal Forests

BC LTER Annual Symposium
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Outline

1. Sources of fire regime information
2. Variations in the fire regime over time
3. Satellite observations of fire
4. Fire and vulnerability of black spruce forests

Measurement of fire regime characteristics

1. **Fire ignitions** – lightning strikes, fire management records
2. **Burned area** – Annual fire reports, fire event databases, fire perimeters, satellite observations, theoretical backcast models
3. **Fire frequency** – burned area, tree rings, sediment charcoal (not addressed in paper)
4. **Seasonal patterns of burning** – daily fire management reports, satellite observations, fire event reconstructions
5. **Fire severity** – field observations, satellite observations

Quality of burned area data is highly variable over time

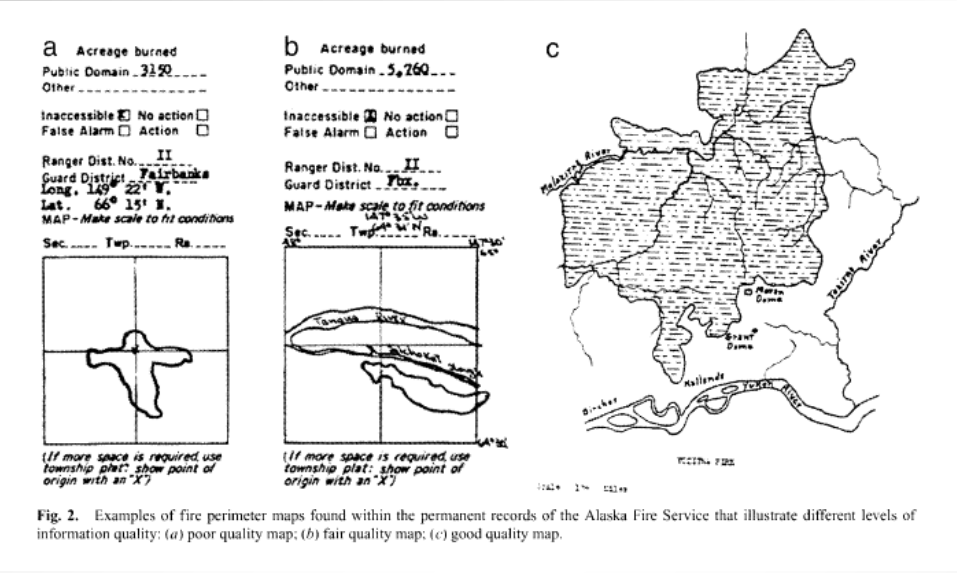


Fig. 2. Examples of fire perimeter maps found within the permanent records of the Alaska Fire Service that illustrate different levels of information quality: (*a*) poor quality map; (*b*) fair quality map; (*c*) good quality map.

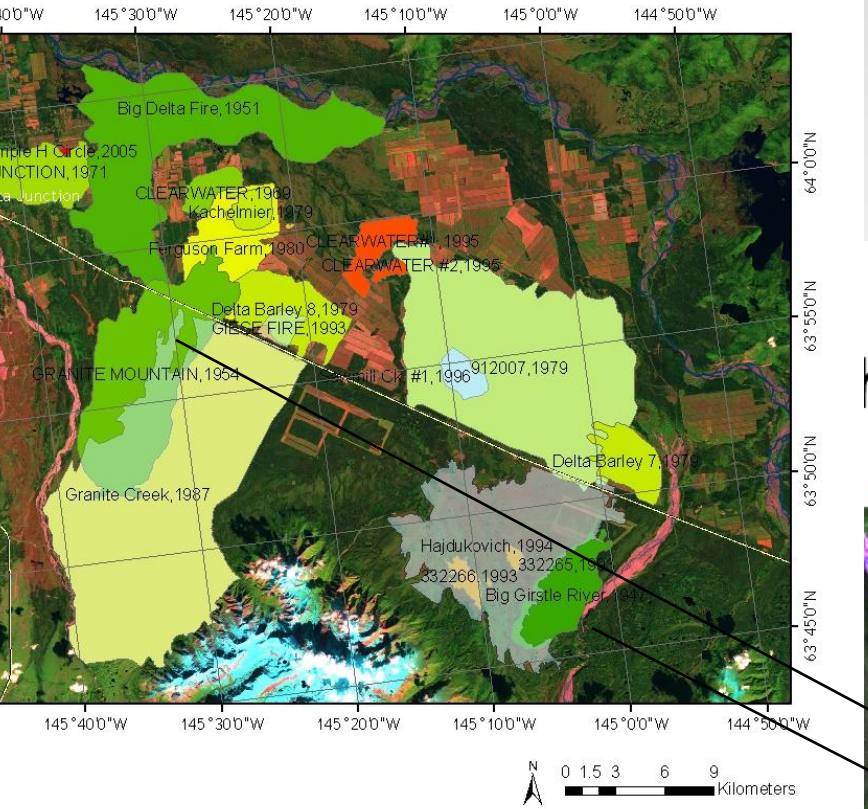
Kasischke et al.
IJWF, 2002

1. Beginning in the late 1940s, the availability of surplus aircraft plus trained pilots increased access to remote fire events

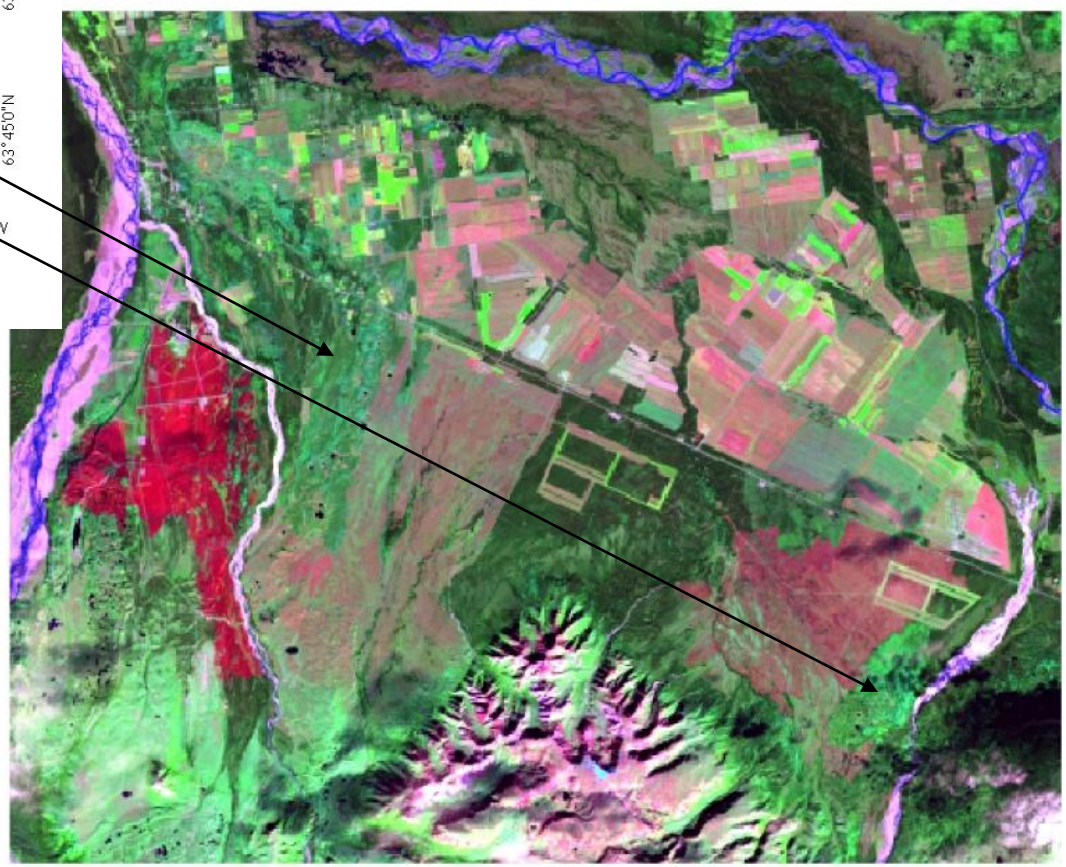
2. High-quality base maps (USGS) were not available until the 1970s

3. Since the early 1990s, the availability of GPS has improved mapping of fire perimeters considerably

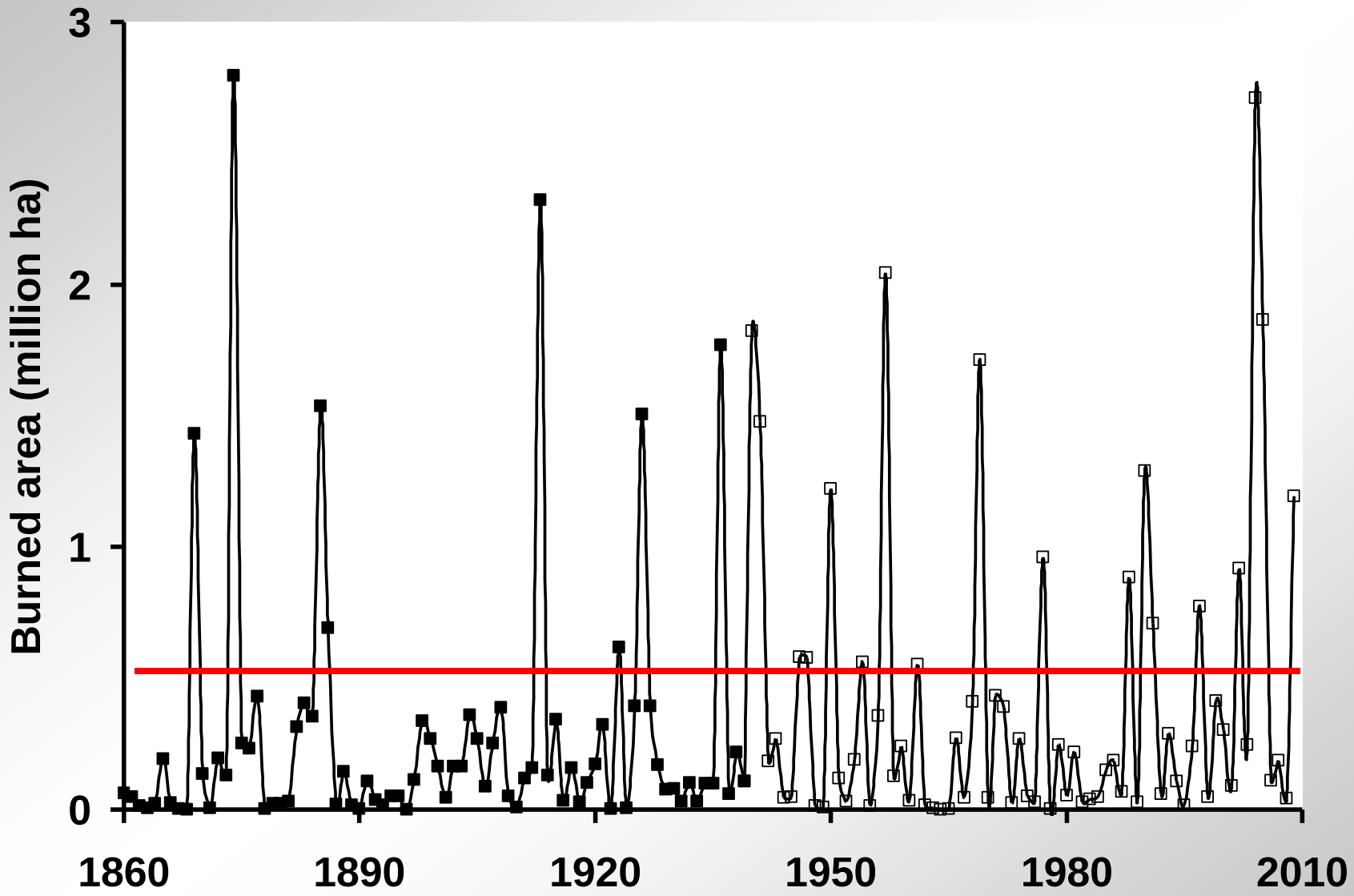
4. In some instances, Landsat data are being used to map fire perimeters

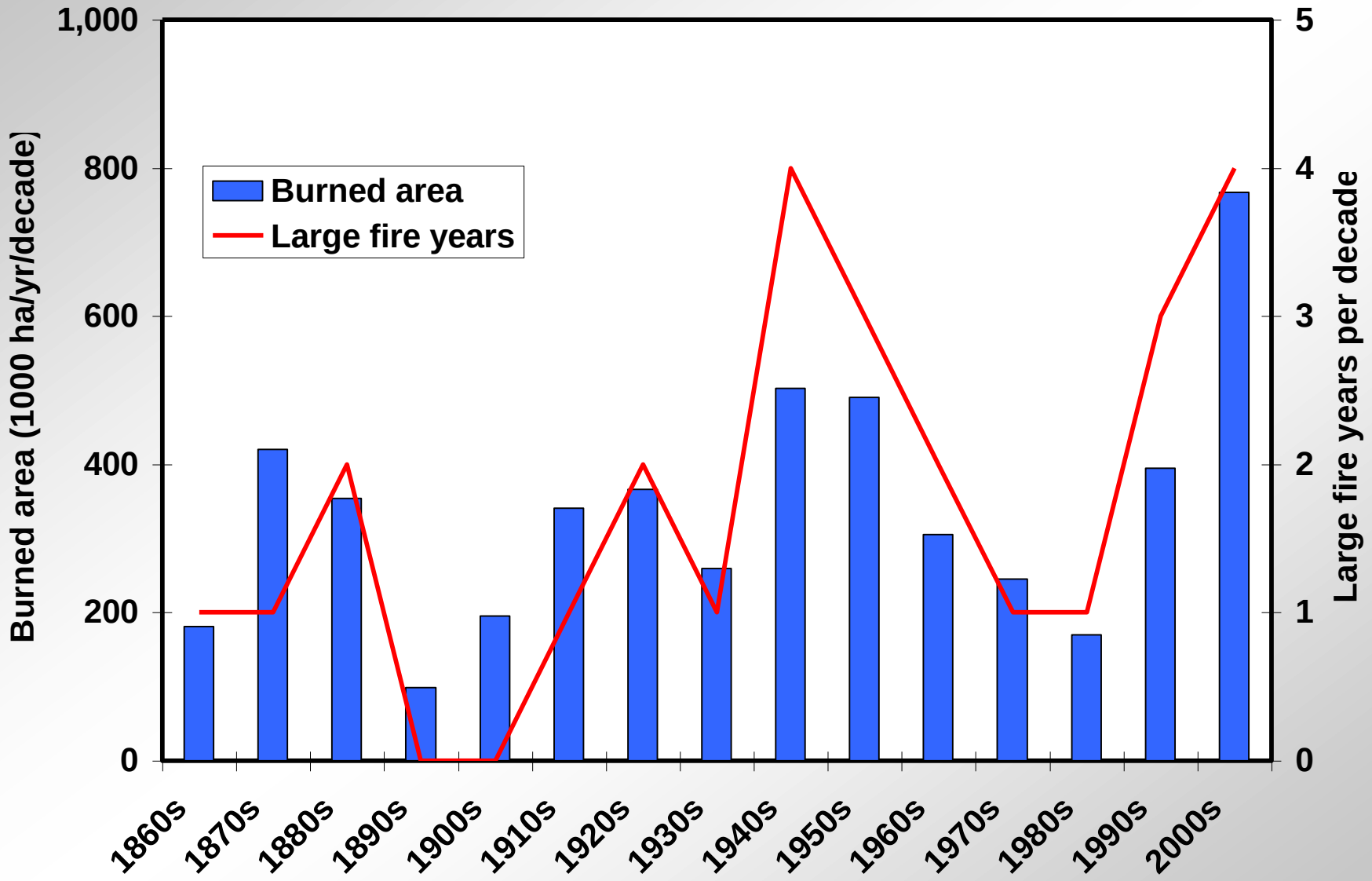


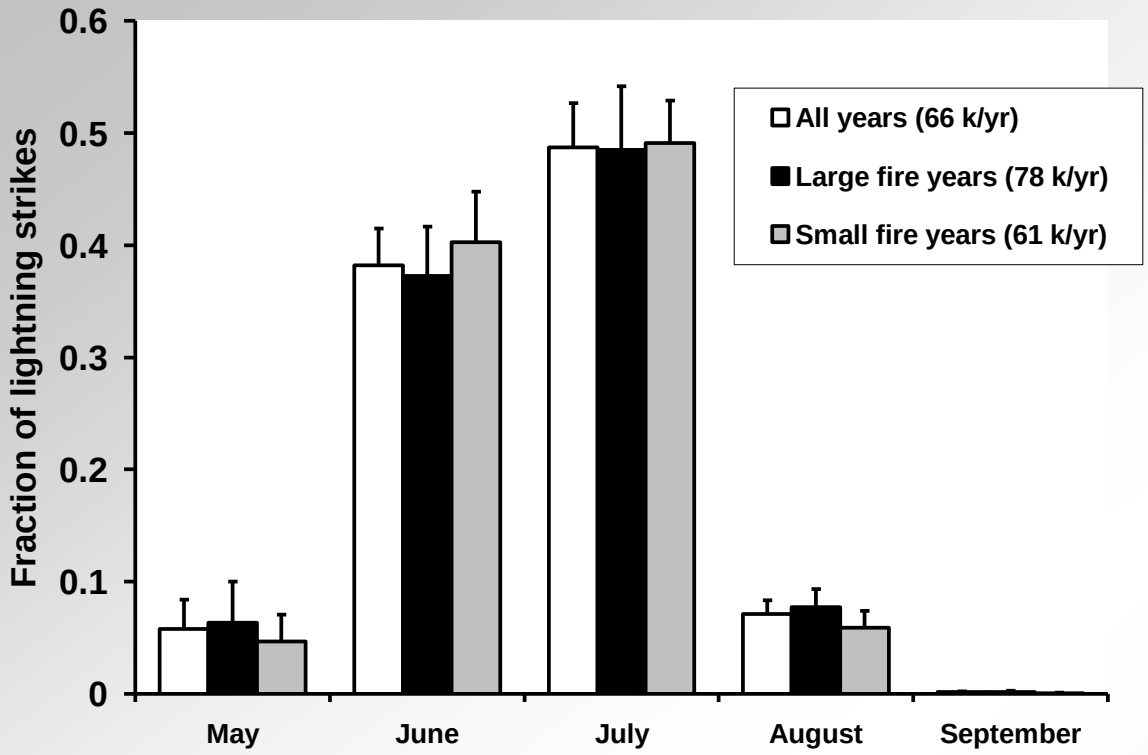
hanced Thematic Mapper Image
Bands 7,4, and 3



Old data is not necessarily bad data


Large-fire year threshold
Burned area (million ha)
3
2
1
0
1860
1890
1920
1950
1980
2010

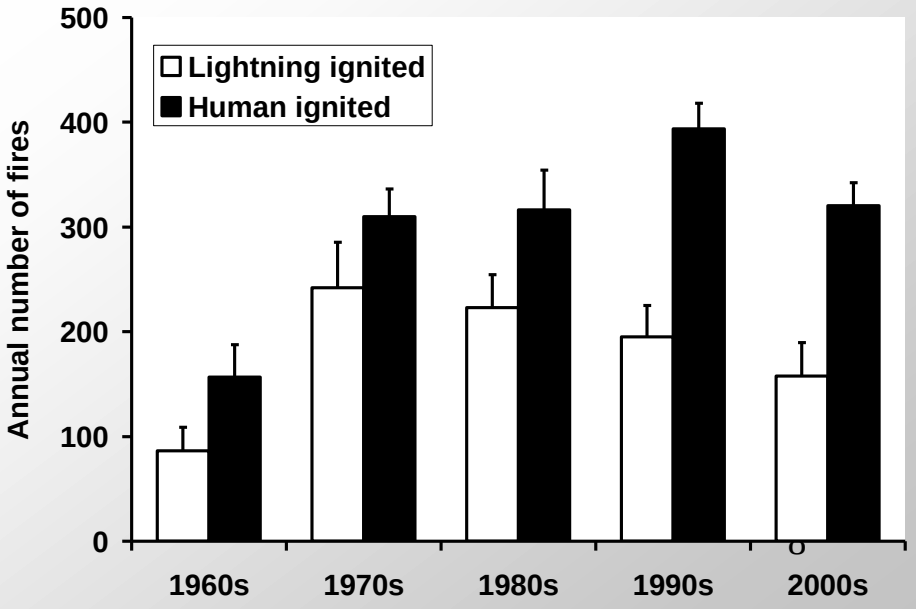

Burned area (1000 ha/yr/decade)
Large fire years per decade
Burned area
Large fire years
1,000
800
600
400
200
0
5
4
3
2
1
0
1860s
1870s
1880s
1890s
1900s
1910s
1920s
1930s
1940s
1950s
1960s
1970s
1980s
1990s
2000s

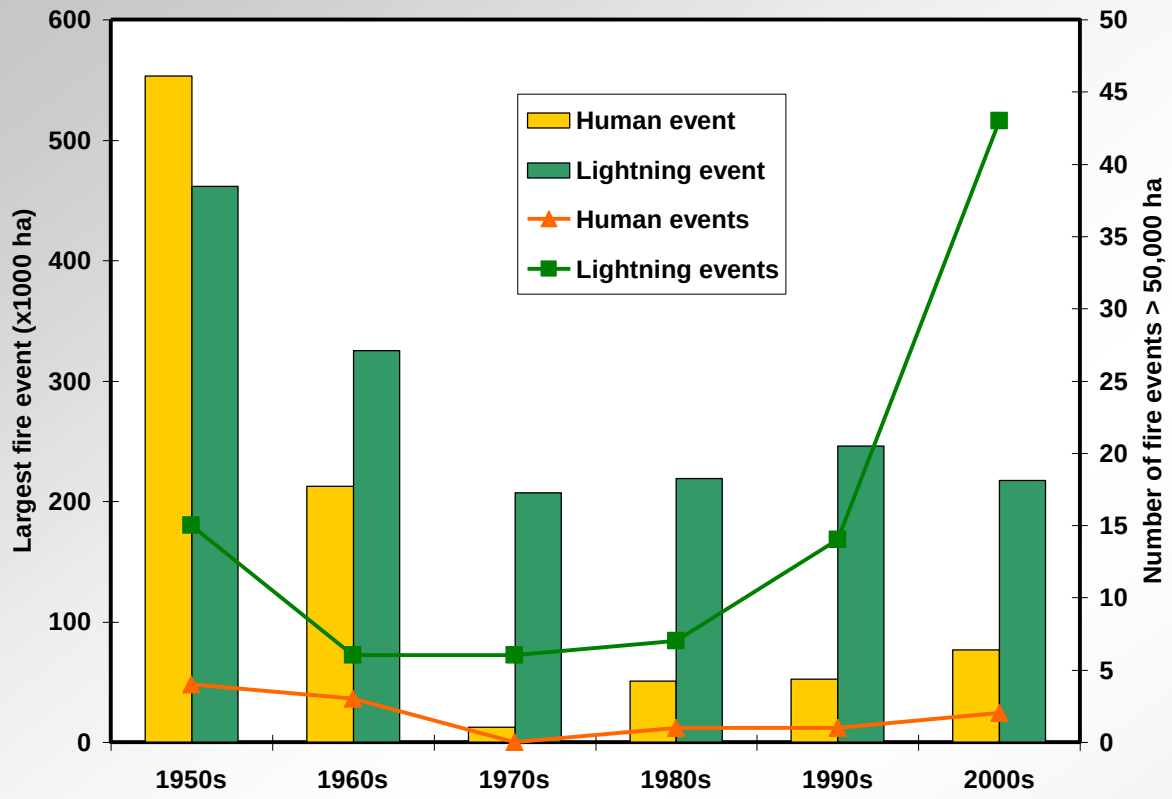


Lightning strike data available for 1990s, 2000s

Sensor technology changed in late 1990s

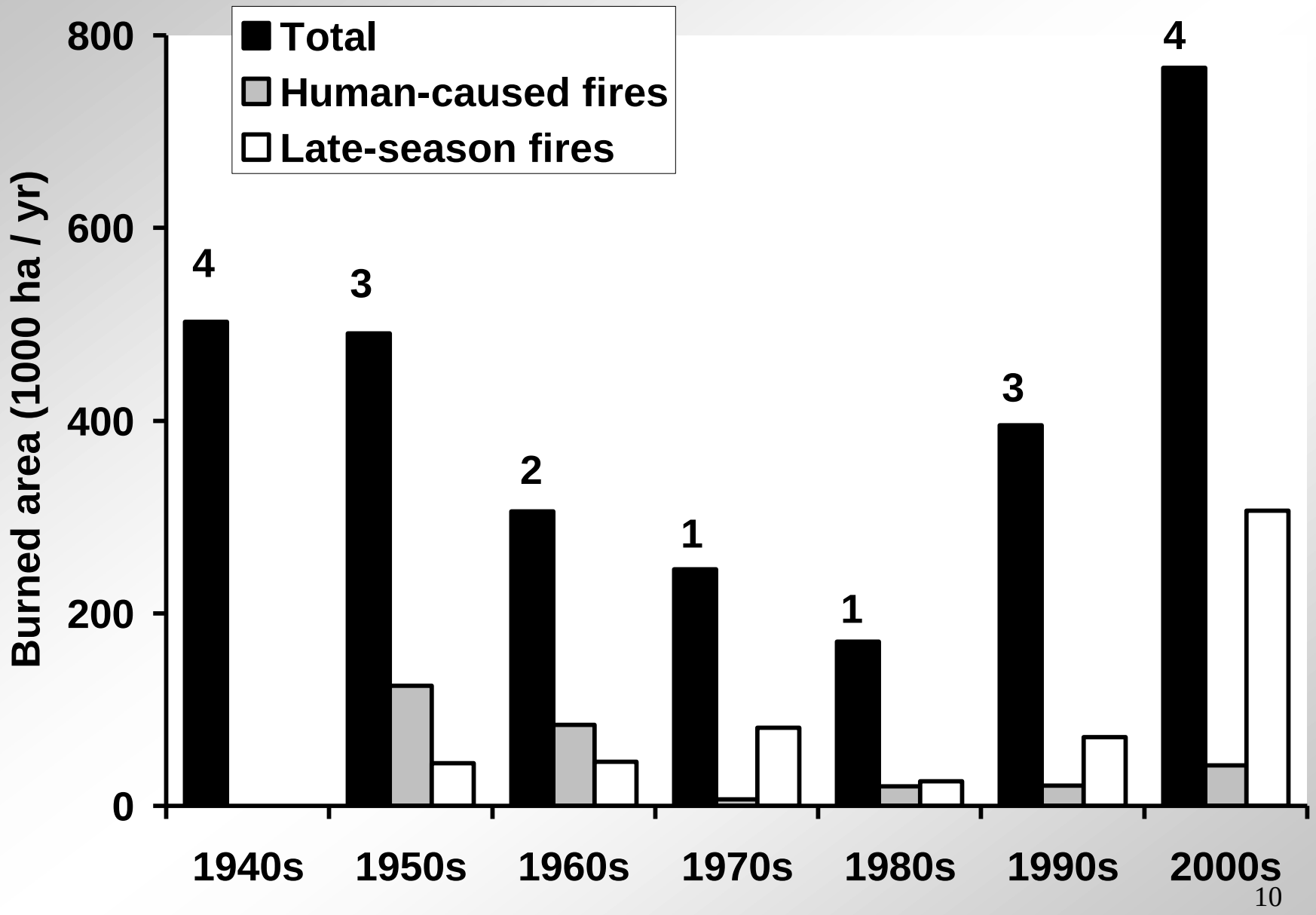
Human vs. lightning ignitions





Studies by DeWilde and Chapin 2006 and Calef et al. 2008 show

As proximity to human infrastructure/access (settlements, roads, rivers) decreases
The number of human ignitions increase
Burned area decreases


Total
Human-caused fires
Late-season fires
Burned area (1000 ha / yr)
800
600
400
200
0
4
3
2
1
1
3
4
1940s
1950s
1960s
1970s
1980s
1990s
2000s

Our research is based on data collected in plots in 36 fire events and unburned stands

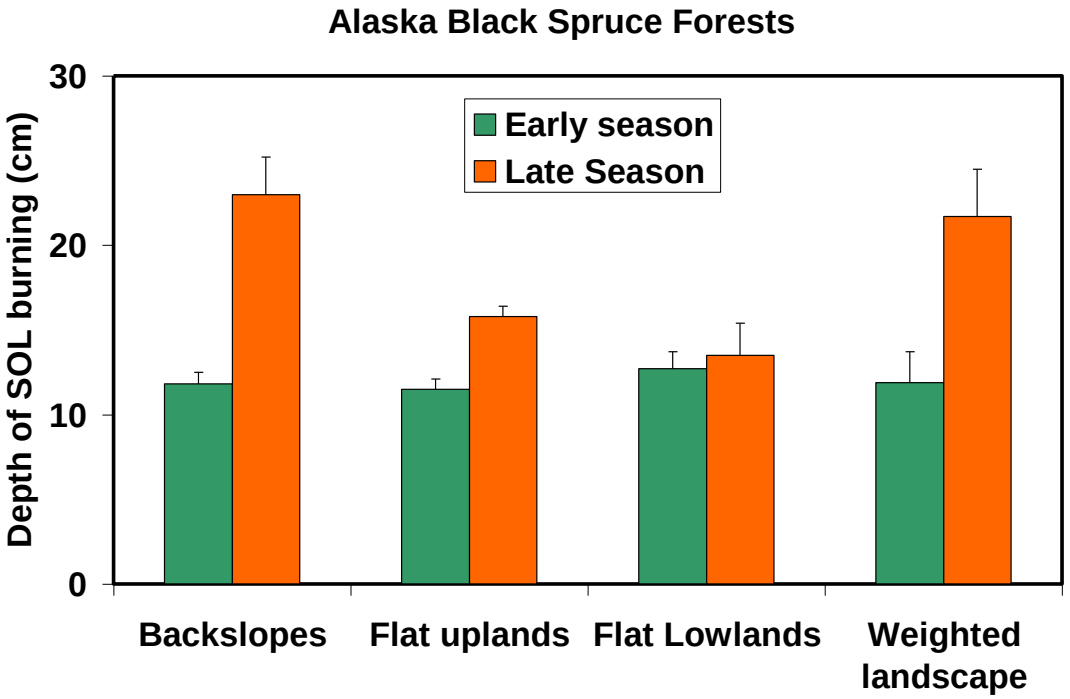
- **Used to measure fire severity and surface fuel consumption in black spruce forests**

Studies by researchers at ERIM, UMD, MSU, UAF, USFS, USGS, USFWS

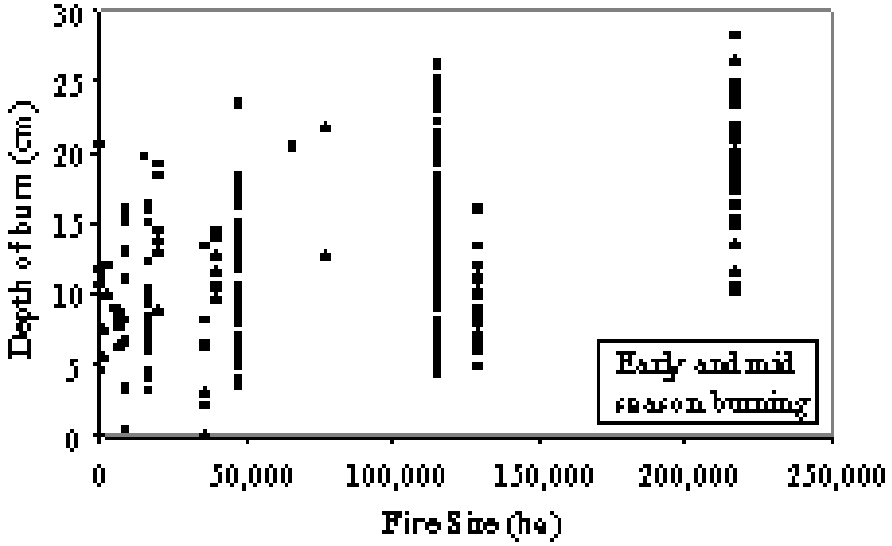
284 plots in unburned stands, 465 plots in burned stands

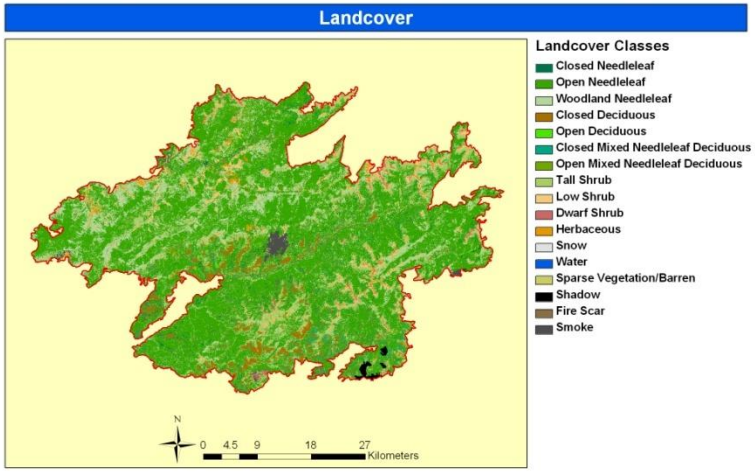
8,447 organic layer depth measurements in unburned stands, 10,140 in burned stands

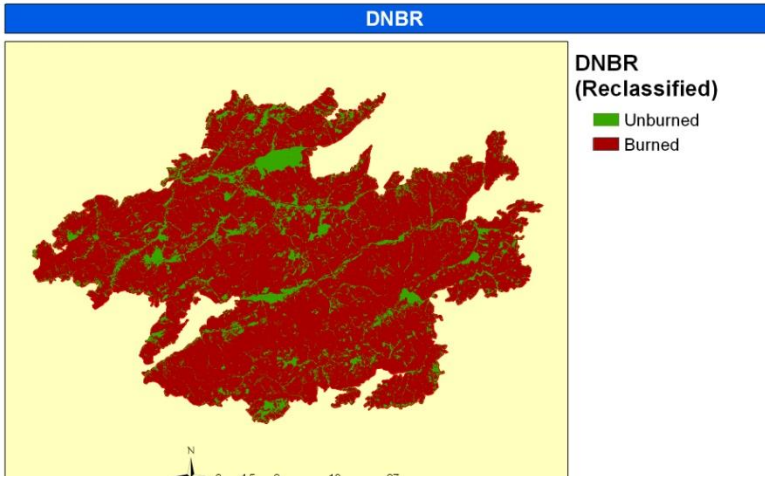
>2,000 organic layer samples collected for lab analysis to determine bulk density and % C

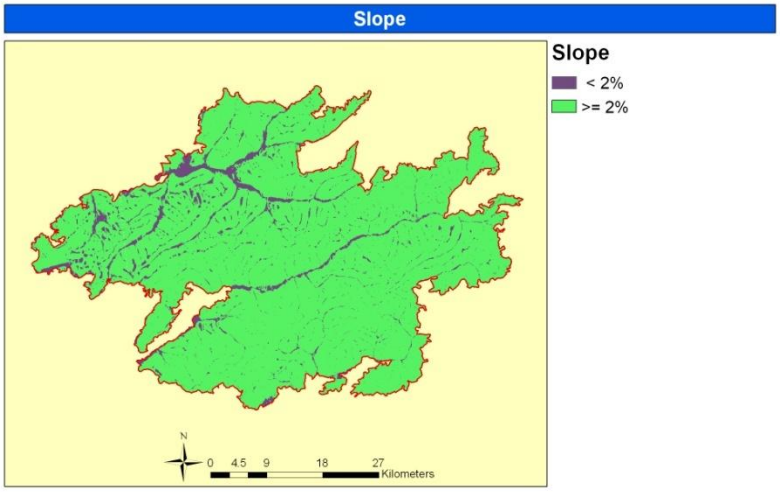


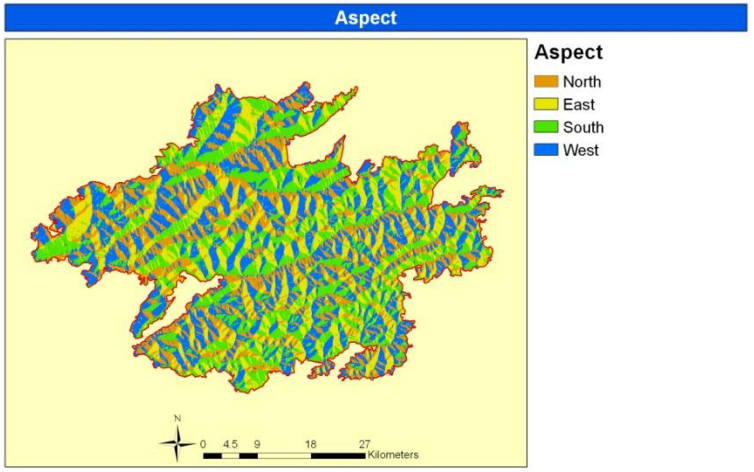
Turetsky et al. in review



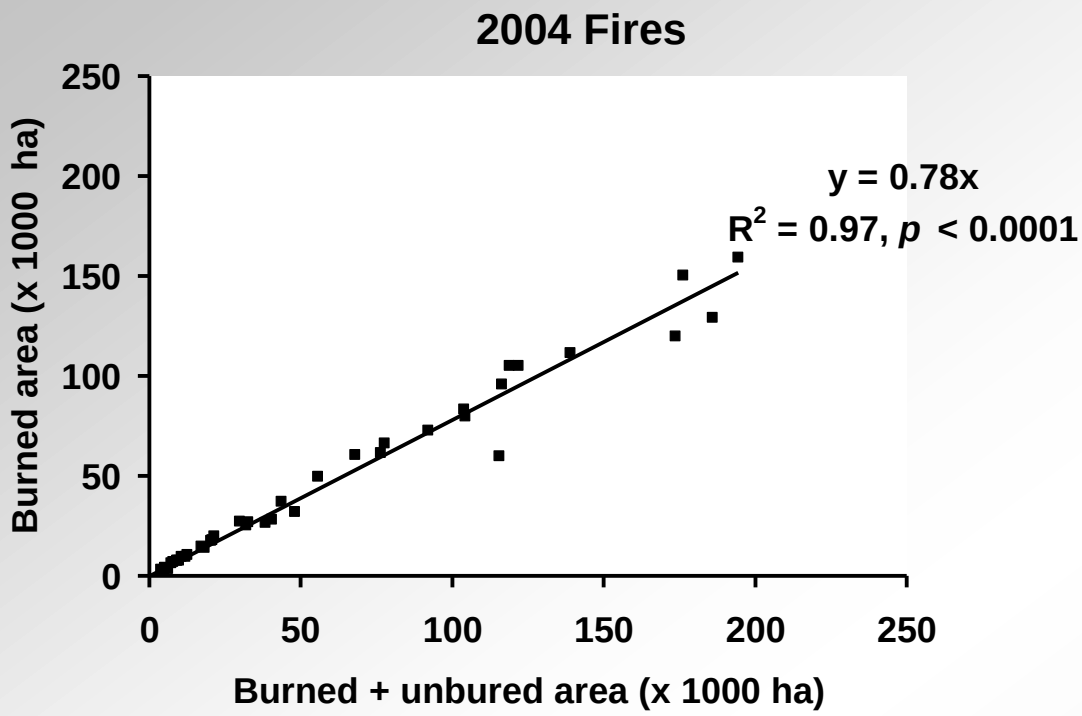


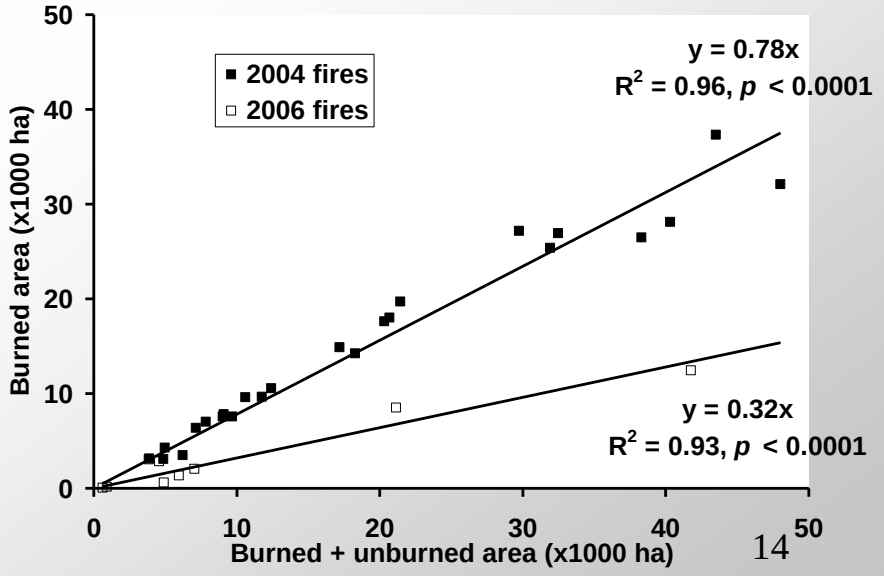




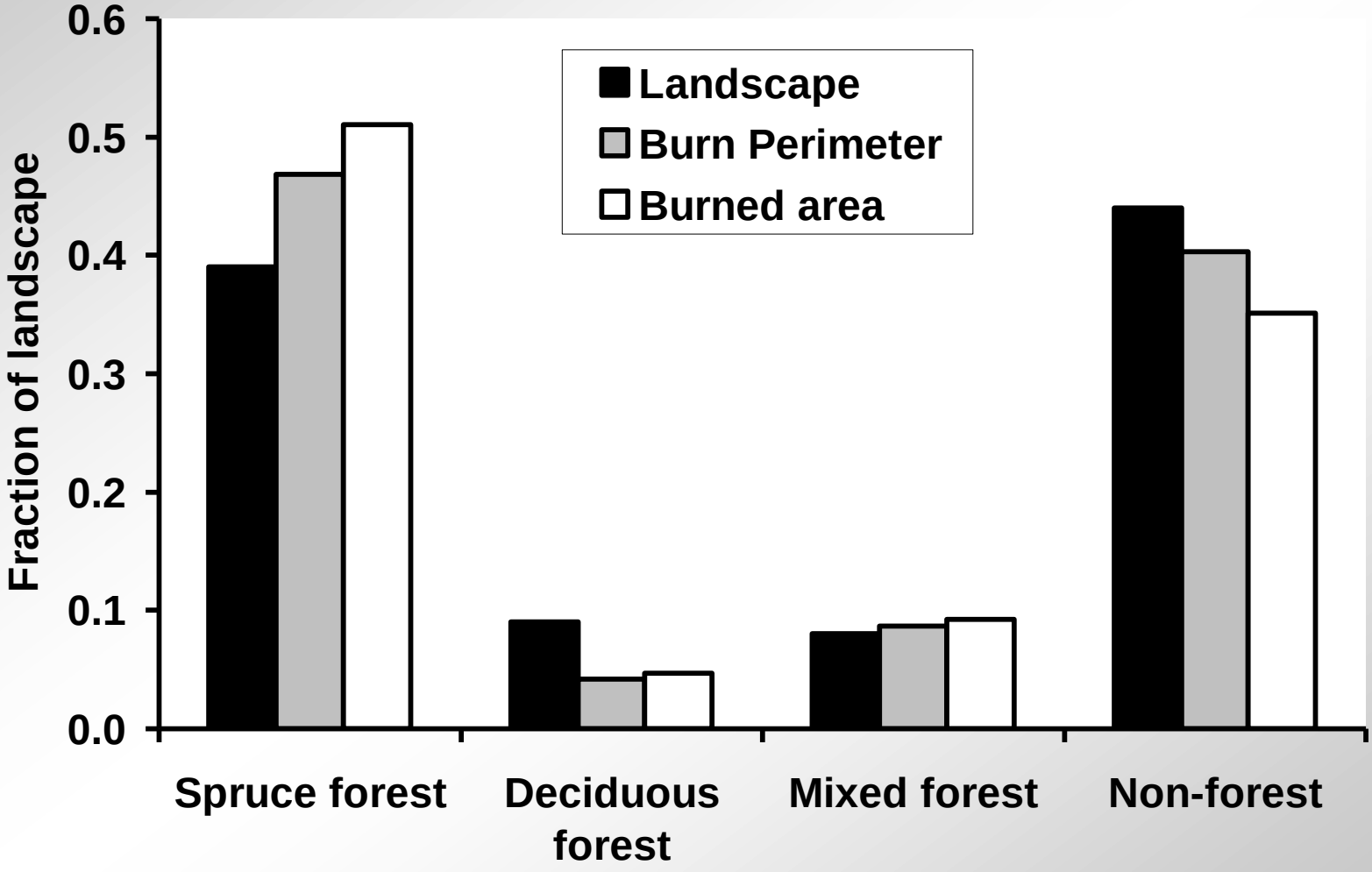


Geospatial data sets for analysis of patterns of burning

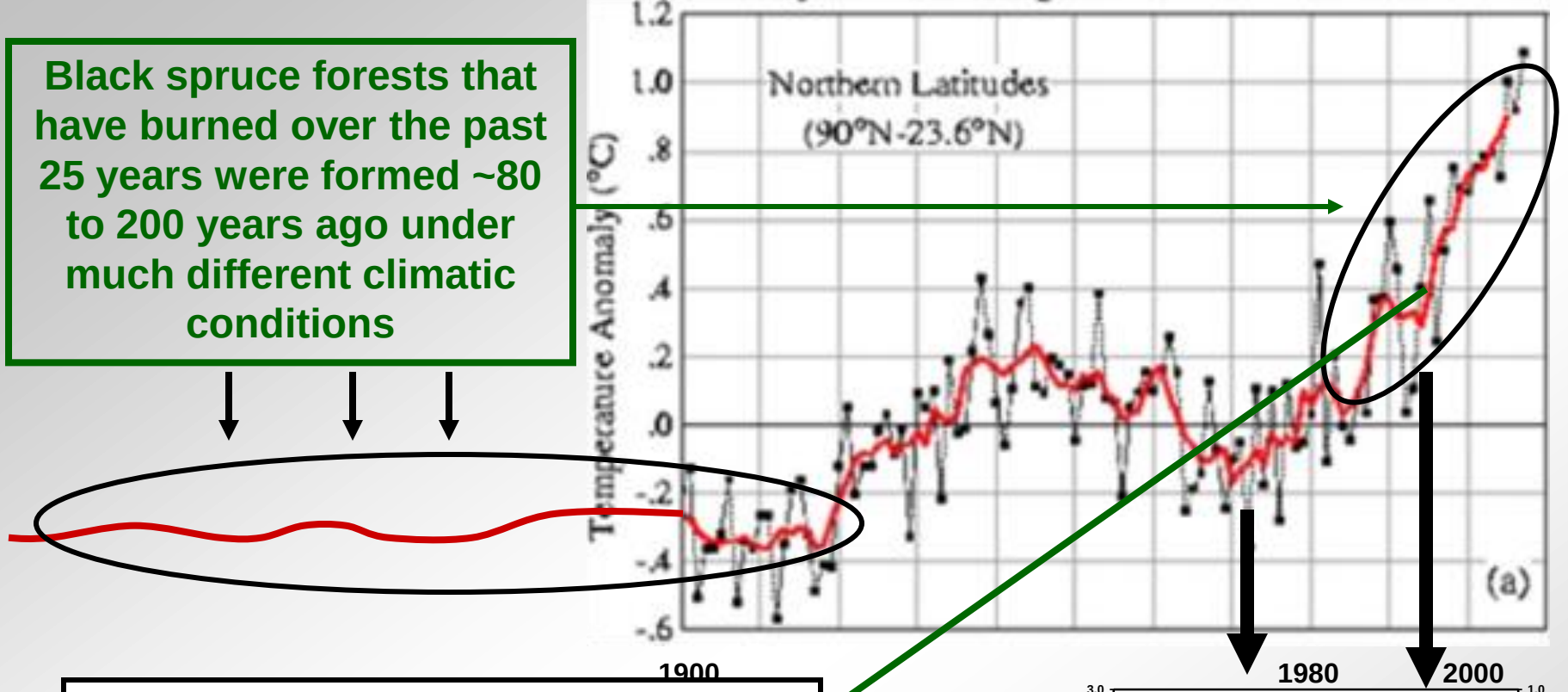

2004 Fires
y = 0.78x
R2 = 0.97, p < 0.0001
Burned area (x 1000 ha)
Burned + unbured area (x 1000 ha)
0
50
100
150
200
250


2004 fires
2006 fires
y = 0.78x
R2 = 0.96, p < 0.0001
y = 0.32x
R2 = 0.93, p < 0.0001
Burned area (x1000 ha)
Burned + unburned area (x1000 ha)
0
10
20
30
40
50

Landscape = Interior forest ecoregions
Burn = 2004 fires

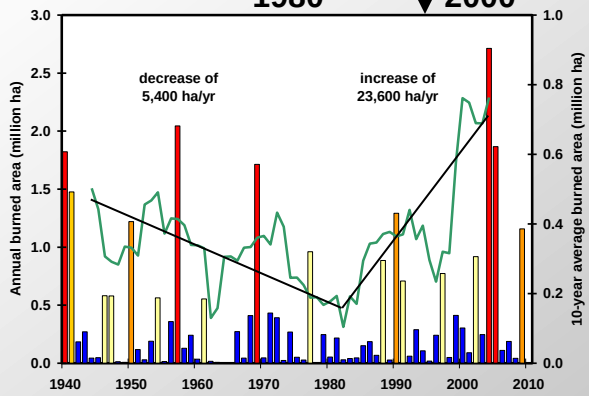


Black spruce forests that have burned over the past 25 years were formed ~80 to 200 years ago under much different climatic conditions



1. To what extent will black spruce forests reorganize themselves in response to the changes in the fire regime and climate?

2. What processes will control this re-organization?



Significant changes in the fire regime have occurred over the past 25 years

Controls on Vulnerability of BS Forests

1. Topography – lowland sites are resilient to deep burning fires
2. Frequency of large fire years
   a. A higher fraction of the landscape burns
   b. More large fire events → increased depth of burning in flat uplands and backslopes in early and mid-season fires
   c. More late season burning → increased depth of burning in flat uplands and backslopes