

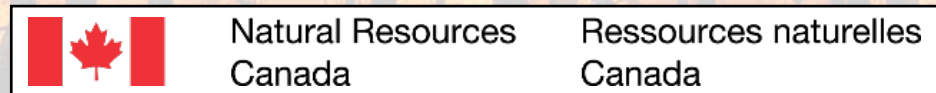
State of Wildfires in the North American Boreal Region

Frank H. Koch

US Department of Agriculture, Forest Service, Southern Research
Station, Research Triangle Park, North Carolina

Denys Yemshanov

Natural Resources Canada, Canadian Forest Service, Great Lakes
Forestry Centre, Sault Ste. Marie, Ontario



North American Boreal Biome

Source: Margolis HA et al. 2015. Can. J. For. Res. 45: 838-855.
<http://dx.doi.org/10.1139/cjfr-2015-0006>

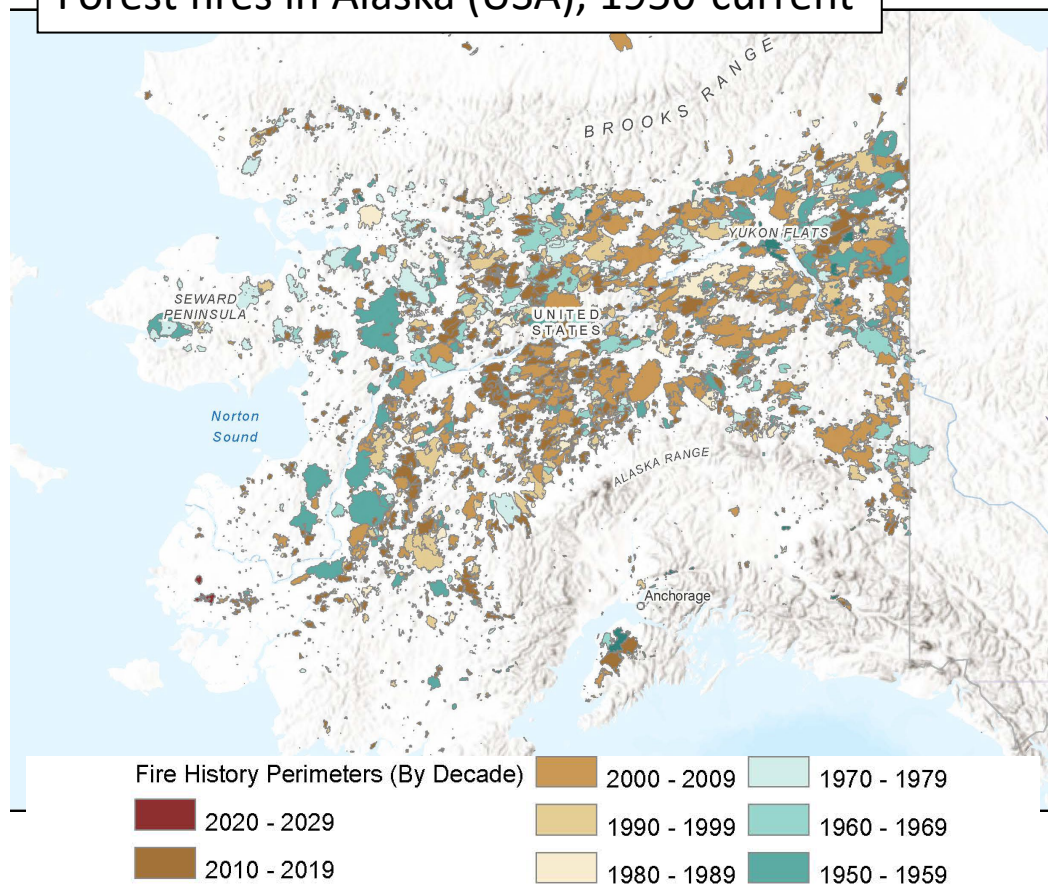


- Worldwide boreal zone covers 1.9 billion ha
 - Canada has **28%** of the zone (**552 million ha**)
 - Alaska (USA) has **4%** (**74 million ha**)
- Canada: **307 million ha** boreal forest (75% of all Canadian forests)
- Alaska: **55 million ha** boreal forest (18% of all USA forests)

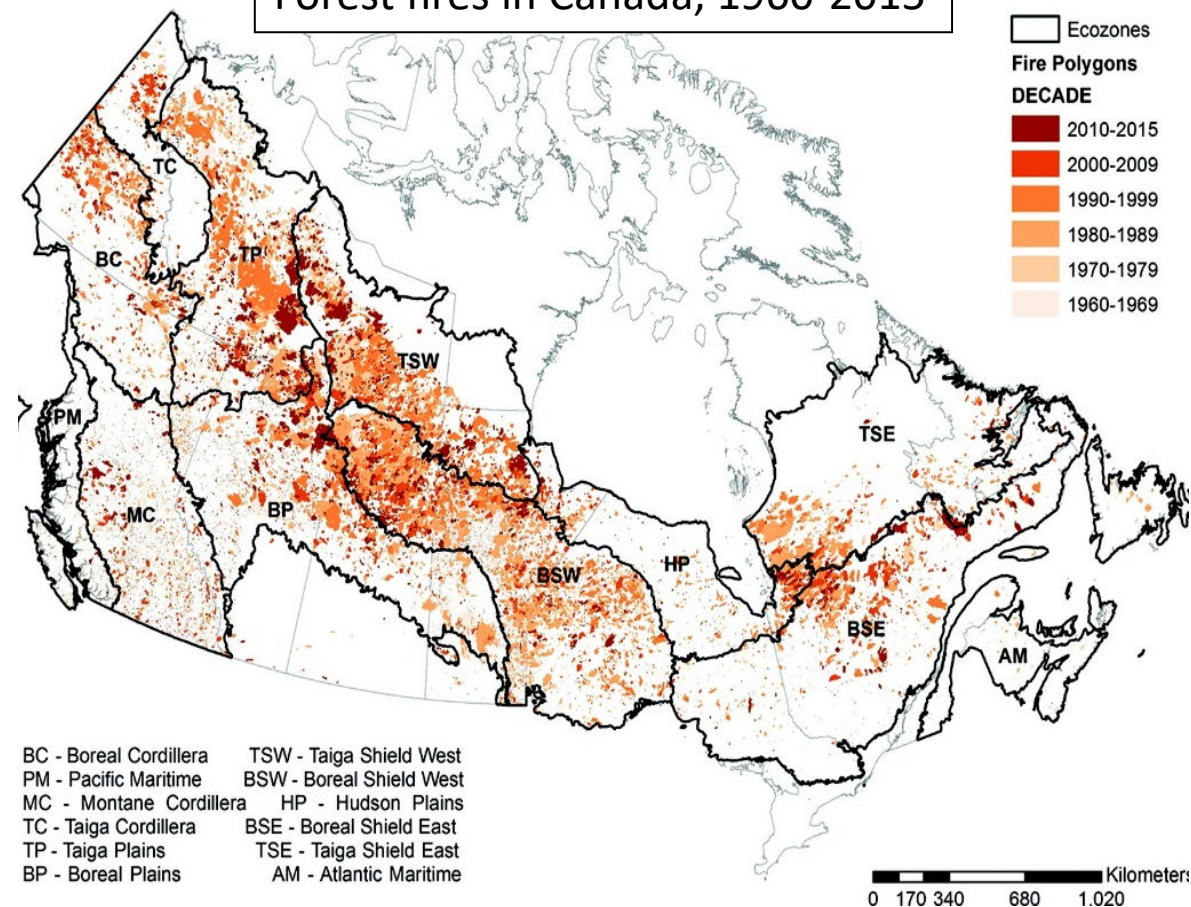
- North American boreal forest comprised of 22 ecoregions (WWF)
- Conifers predominate, especially spruce (*Picea mariana*, *P. glauca*)
- Deciduous species (aspen, poplar, birch) as well
 - These are typically shade-intolerant species

Wildfires in the North American Boreal Forest

Forest fires in Alaska (USA), 1950-current



Forest fires in Canada, 1960-2015



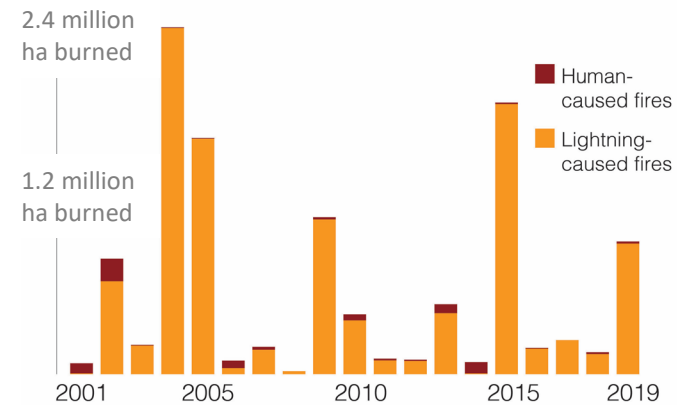
- Wildfires are integral to North American boreal forest ecosystems
- As much as **several million hectares** burned annually
- Fire regimes vary, but many forests subject to long-interval, stand-replacing fires

Wildfire Drivers

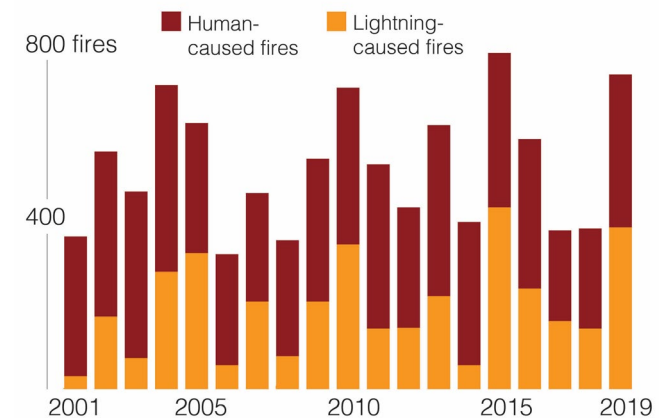
- At regional to continental scales, wildfires governed foremost by climate
 - Annual to decadal climate oscillations
 - Pacific Decadal Oscillation
 - El Niño – Southern Oscillation
 - Positive phases = warmer, drier conditions
- Annual seasons shaped by fire weather
 - Notably, amount of winter snowpack
 - Temperature, rainfall, wind speed, relative humidity, soil moisture
- Flammable fuel availability
- Ignition sources
 - Lightning and human-caused

Sources: Cronan et al. 2011. *Fire Regimes of the Alaskan Boreal Forest*. <https://www.frames.gov/afsc/projects/boreal-fire-history>
Parisien M-A et al. 2020. *Nat. Commun.* 11: 2121.
<https://doi.org/10.1038/s41467-020-15961-y>

Lightning burns more area in Alaska...



...but humans cause more fires, on average

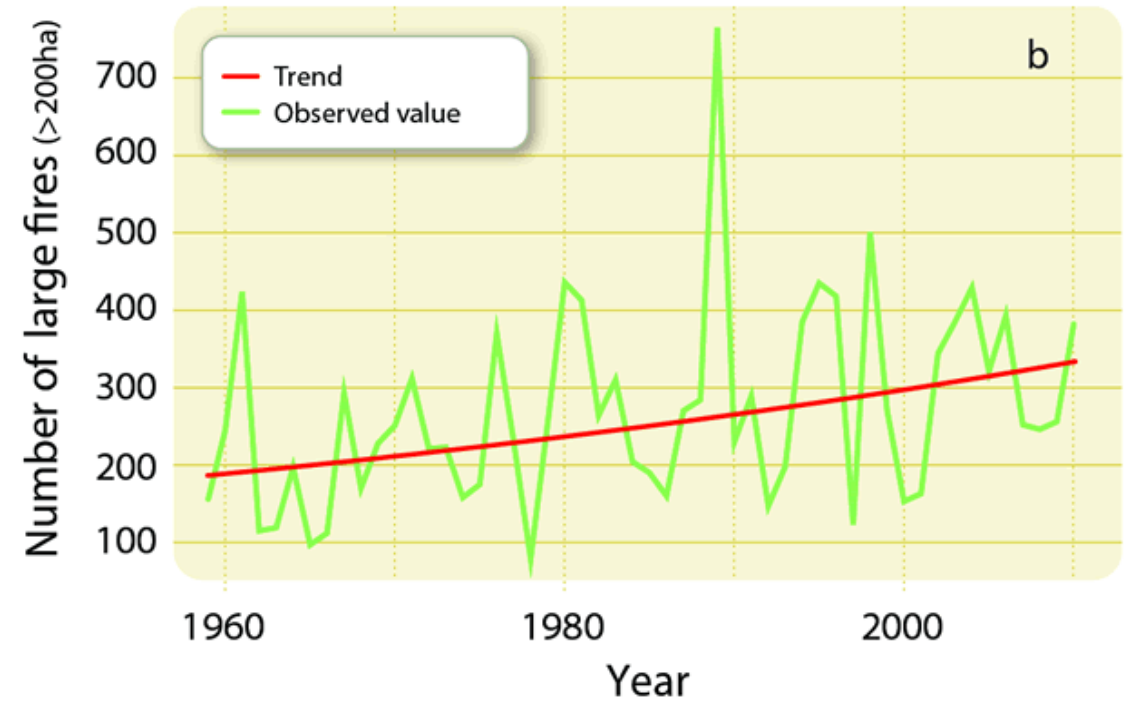
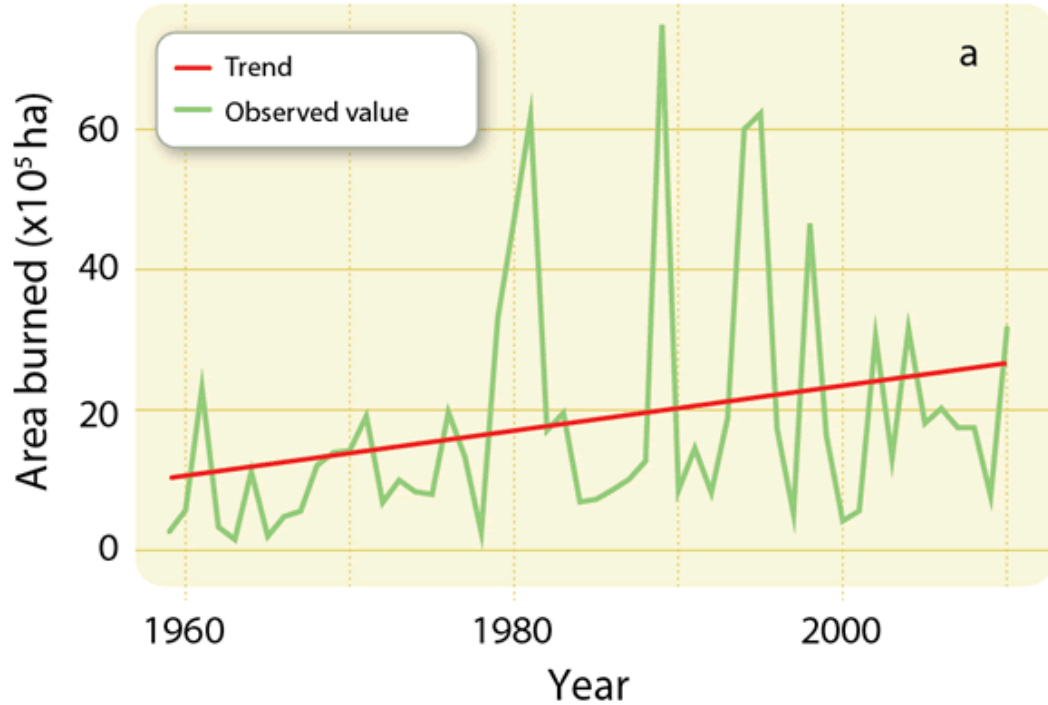


Source: Grabinski Z & McFarland HR. 2020. *Alaska's Changing Wildfire Environment*. <https://uaf-iarc.org/alaskas-changing-wildfire-environment/>

Also true for Canada: large human-caused fires account for **~50%** of wildfires, but **~10%** of total area burned

Source: Hanes CC et al. 2019. *Can. J. For. Res.* 49: 256-269. <https://doi.org/10.1139/cjfr-2018-0293>

Current Trends: Canada

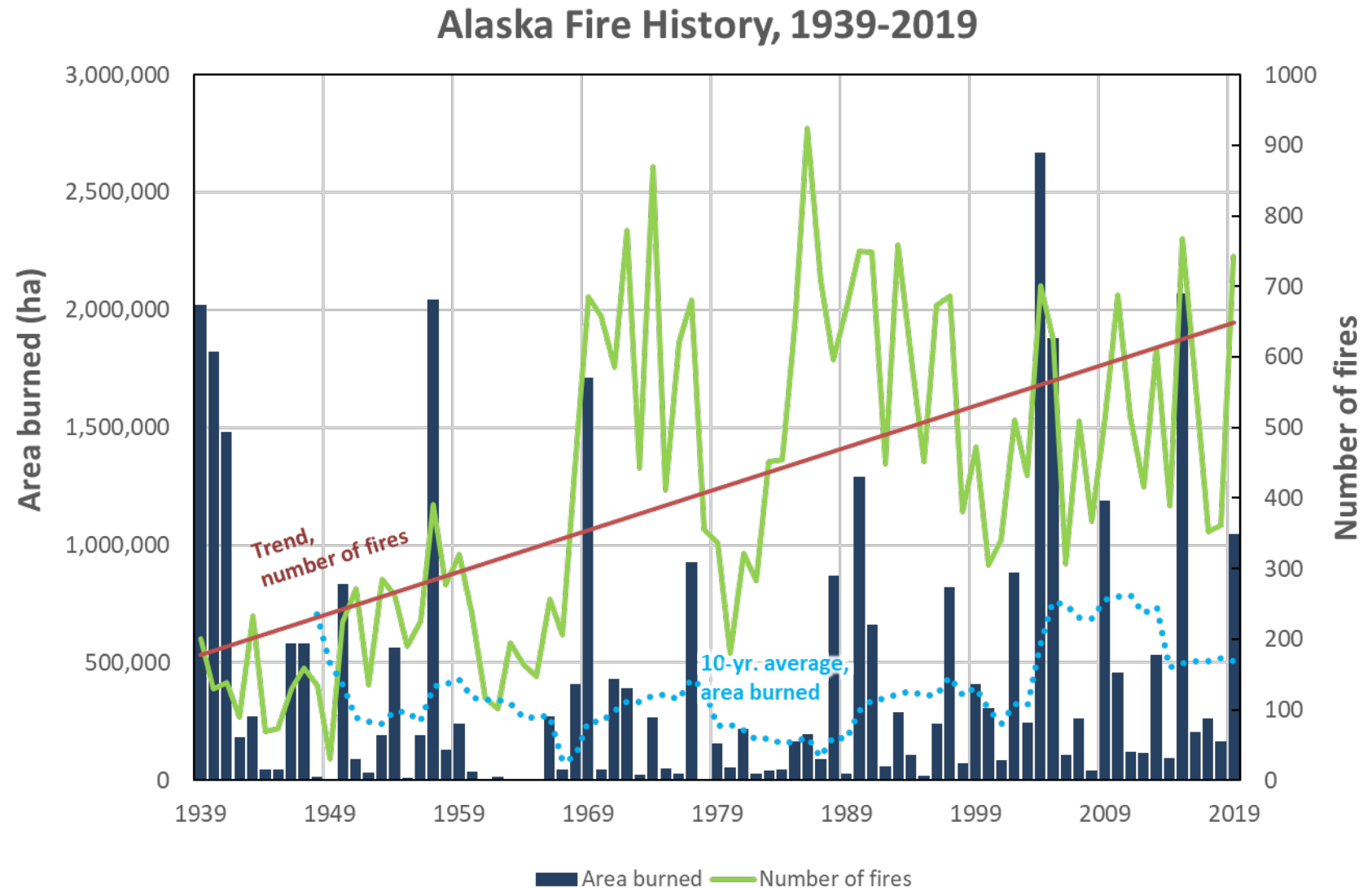


Source: Natural Resources Canada <https://www.nrcan.gc.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/forest-change-indicators/fire-regime/17780>

- Trends in area burned and number of large fires (≥ 200 ha) have increased significantly since 1959
- Evidence that large fires have been getting larger...and that the fire season has gotten longer

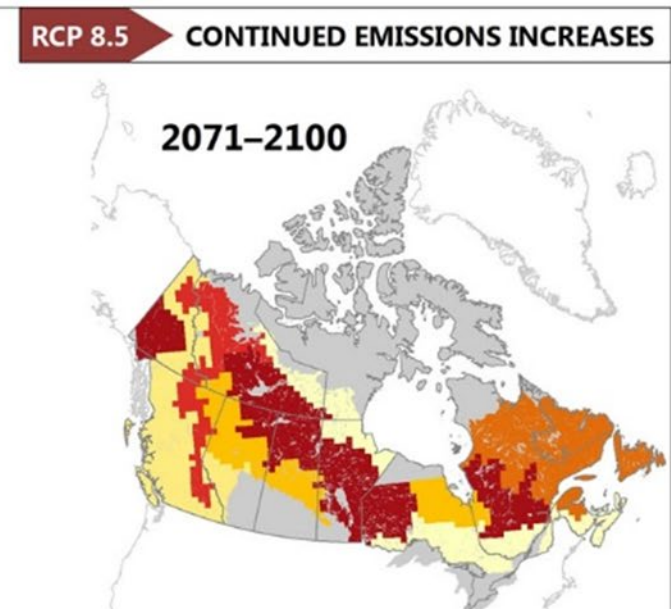
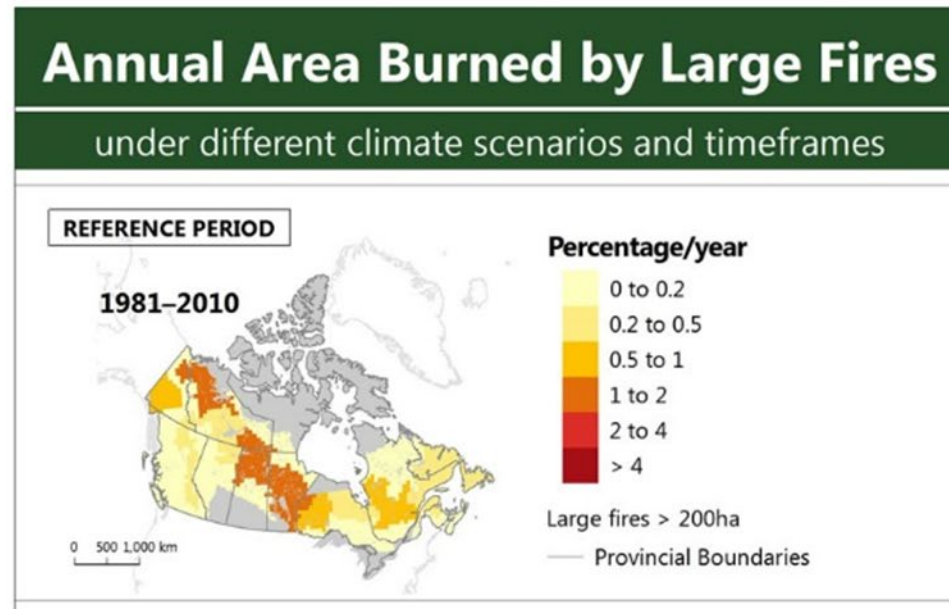
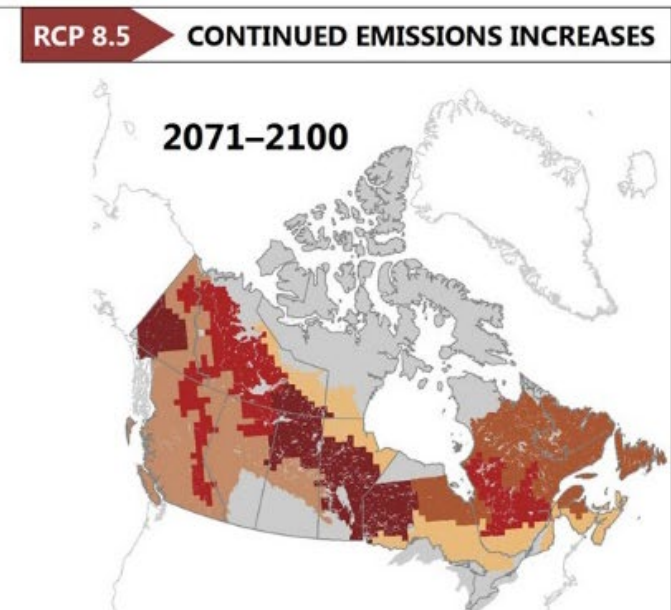
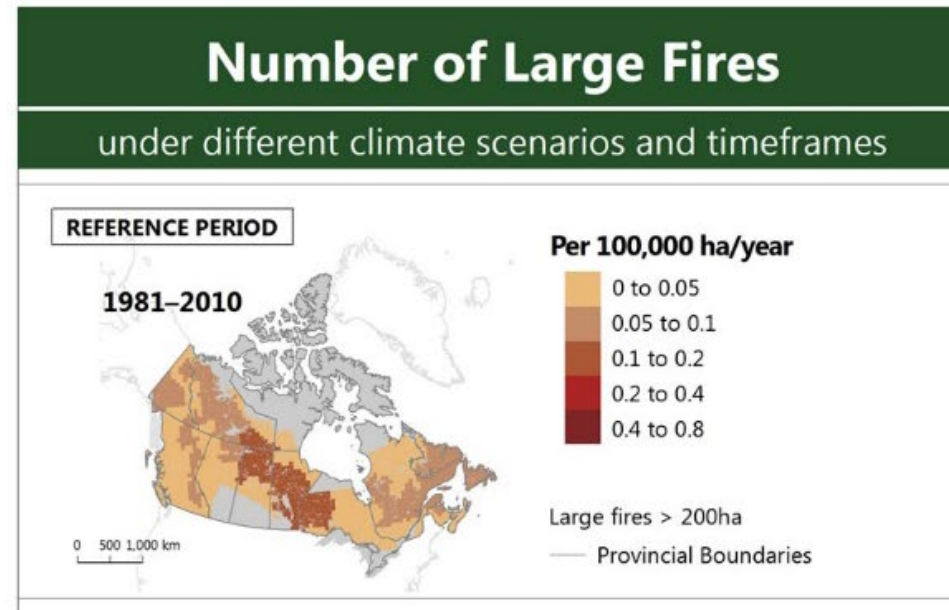
Current Trends: Alaska

- Similar story to Canada
 - Annual number of fires shows a steadily increasing trend
 - Area burned has varied considerably year to year, but 10-year moving average has jumped in last two decades



Future Trends

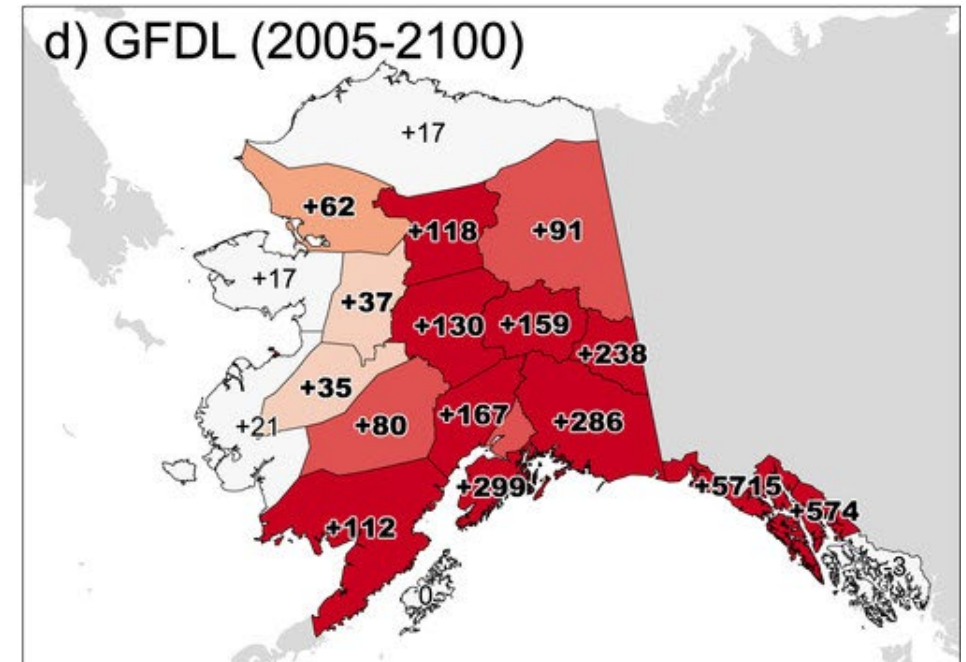
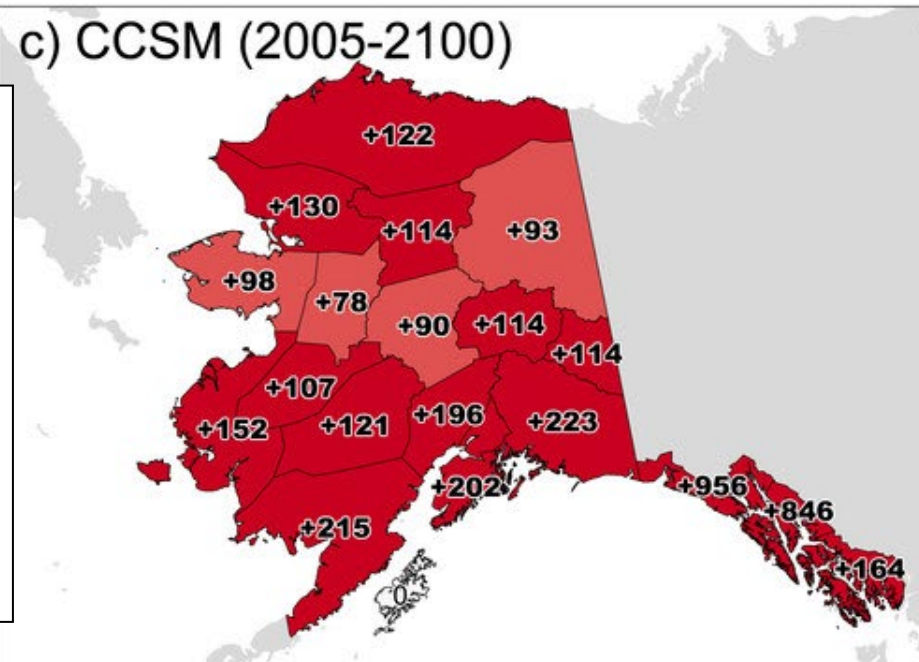
- Generally, climate scenarios predict
 - Increasing temperatures
 - Decreasing soil moisture
 - Higher forest fuel accumulation
 - Decreasing water availability
- Leading to significant increases in
 - Number of large fires
 - Annual area burned



Future Trends

- Other predictions
 - Longer fire seasons
 - More frequent occurrence of extreme fire weather, which triggers large catastrophic fires
 - Increases in both lightning and human-caused ignitions

Percent change of June-July lightning strike counts under CCSM and GFDL GCMs for Alaska, 2005-2100. Darker red = higher positive % change



Final Points

- Changing climate will cause significant transformations in North American boreal forest ecosystems
 - Longer fire seasons, more large fires and larger area burned
 - More frequent extreme weather events, leading to ignitions
- Rising temperatures and moisture deficit are also expected to exacerbate forest pest impacts, further increasing wildfire risk
- Suppression will become more problematic, placing significant strain on fire management agencies in Canada and USA
- Larger, more intense wildfires will increase response costs and magnify threats to human infrastructure and public health