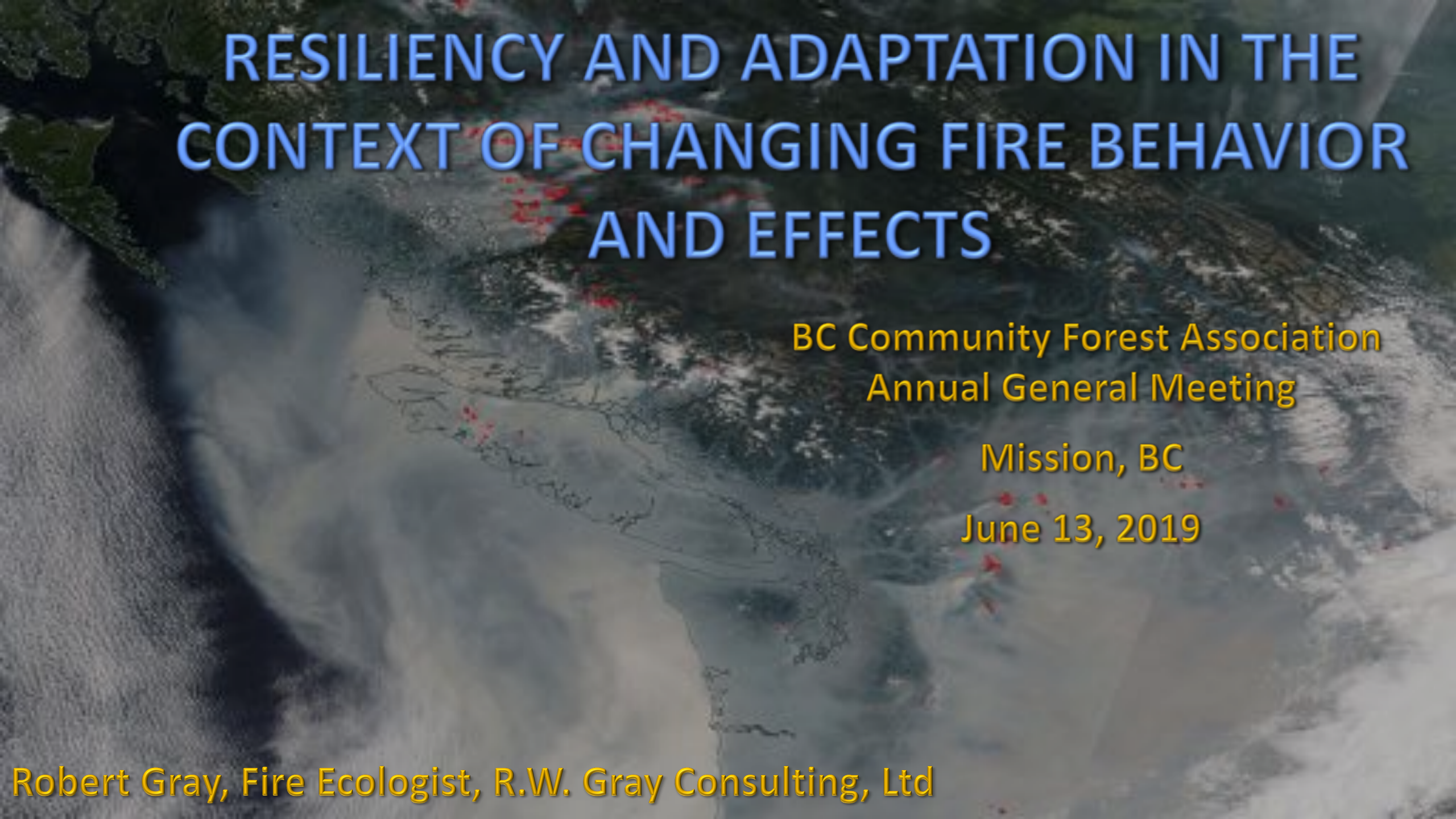


RESILIENCY AND ADAPTATION IN THE CONTEXT OF CHANGING FIRE BEHAVIOR AND EFFECTS

BC Community Forest Association
Annual General Meeting

Mission, BC

June 13, 2019

Robert Gray, Fire Ecologist, R.W. Gray Consulting, Ltd

Climate, Environment, and Disturbance History Govern Resilience of Western North American Forests. 2019. *Frontiers in Ecology and Evolution*.

"Resilience, which encompasses resistance, reflects the amount of disruption an ecosystem can withstand before its structure or organization qualitatively shift to a different basin of attraction."

"Combined with stresses imposed by human development and non-native species invasions, wildfires are testing the resilience and resistance of ecosystems worldwide."

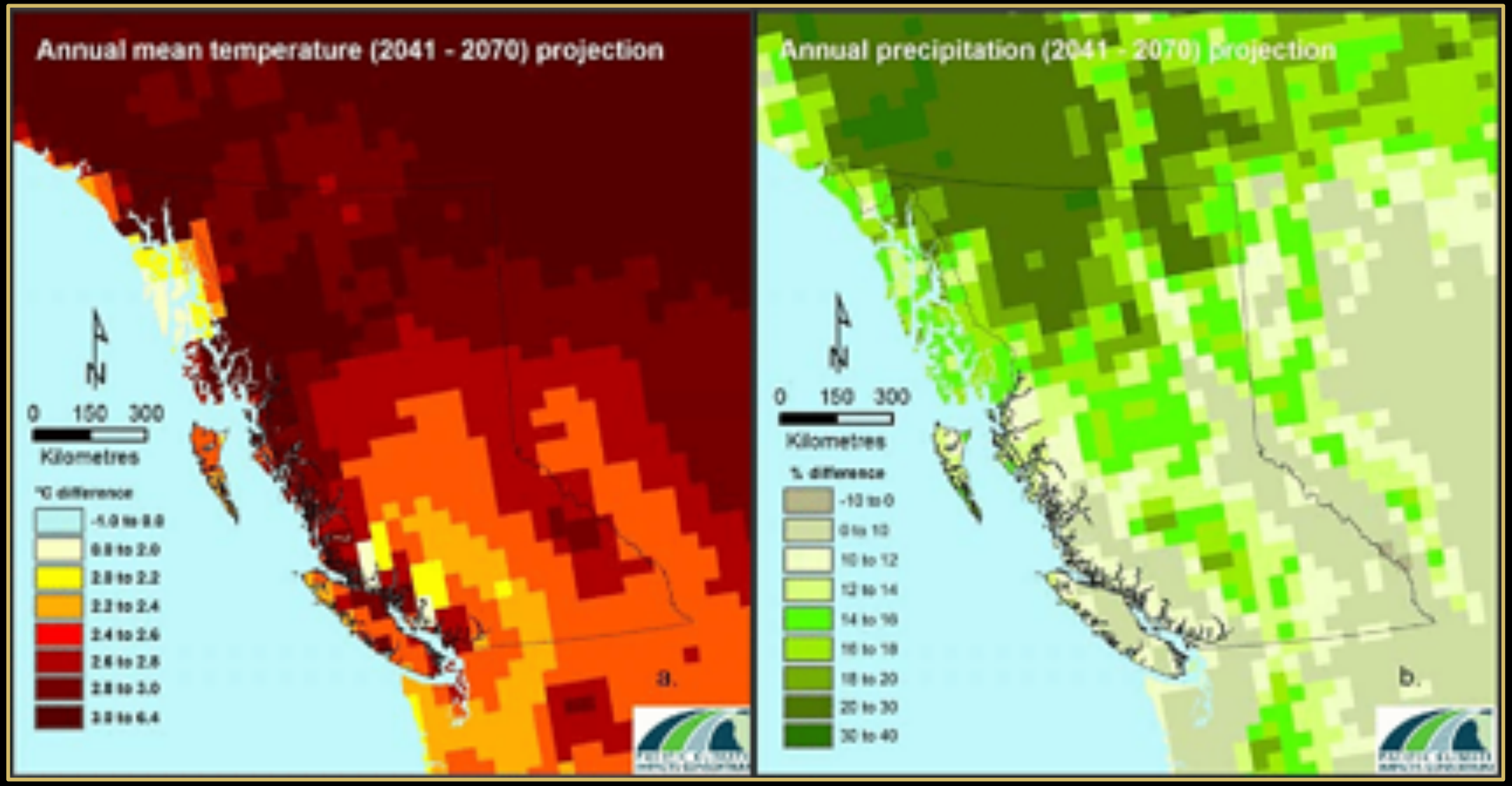
Authors:

Hessburg, P., Miller, C., Povak, N., Taylor, A., Higuera, P., Prichard, S., North, M., Collins, B., Hurteau, M., Larson, A., Allen, C., Stephens, S., Huerta, H., Rumann, C., Daniels, L., Gedalof, Z., Gray, R., Kane, V., Churchill, D., Hagmann, K., Spies, T., Parks, S., Cansler, A., Belote, R., Veblen, T., Battaglia, M., Hoffman, C., Skinner, C., and H. Safford. 2019.

WHAT DOES THE FUTURE HOLD FOR CLIMATE-FIRE INTERACTIONS?

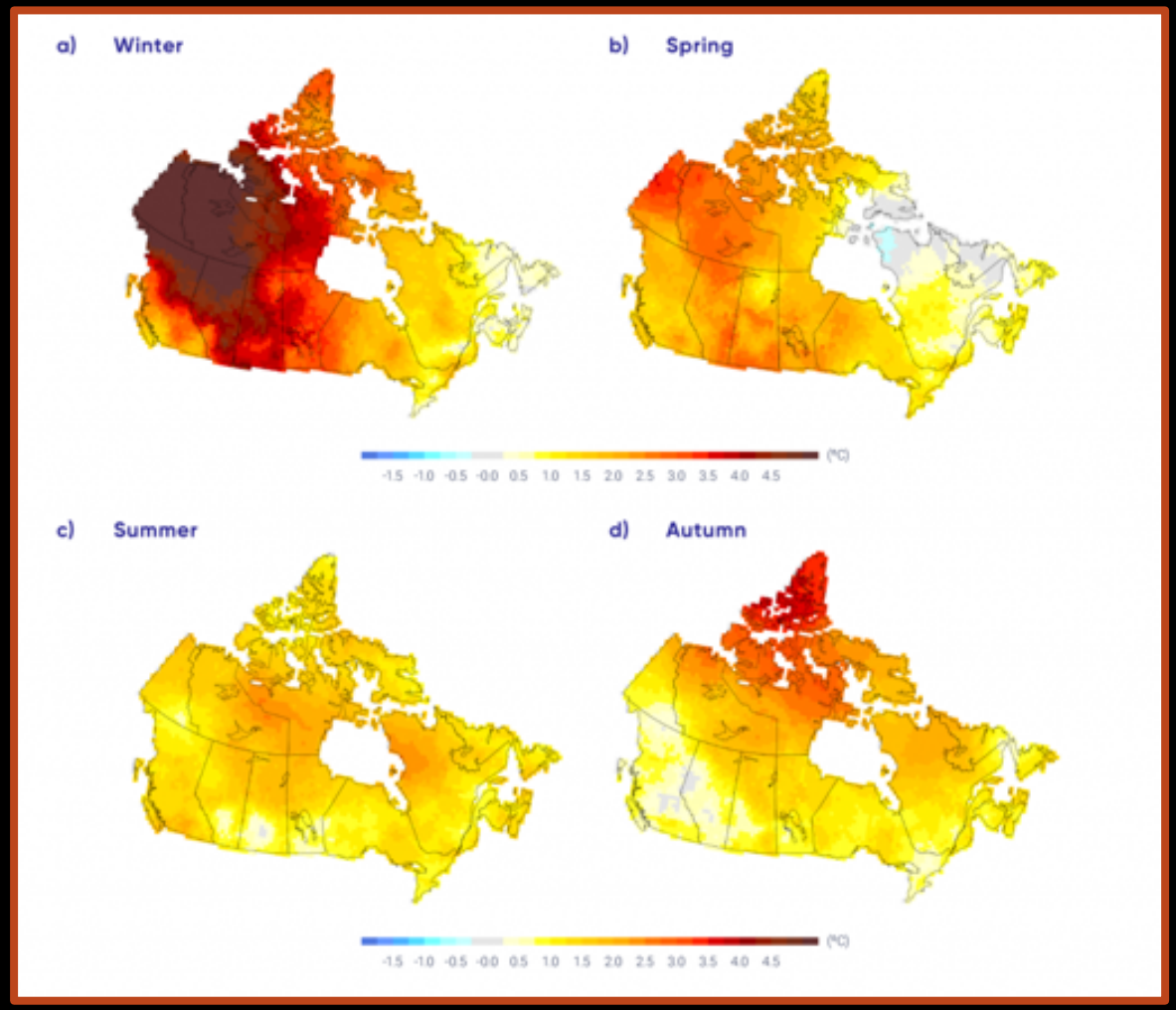
Climate models: What does the future hold?

Global mean temperature has risen approximately 1.11 °C since 1850

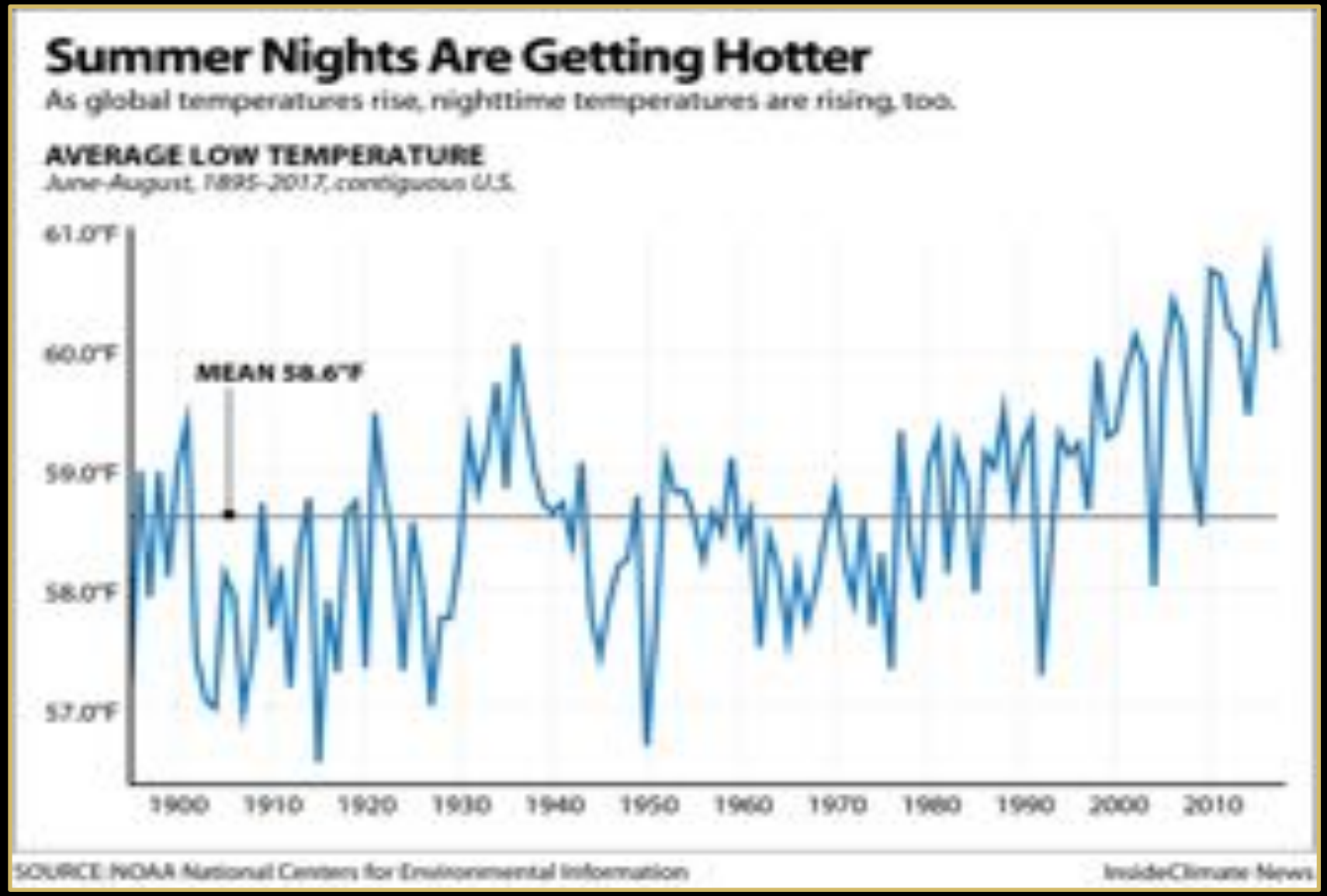


Later start to winter snows, and earlier snow melt

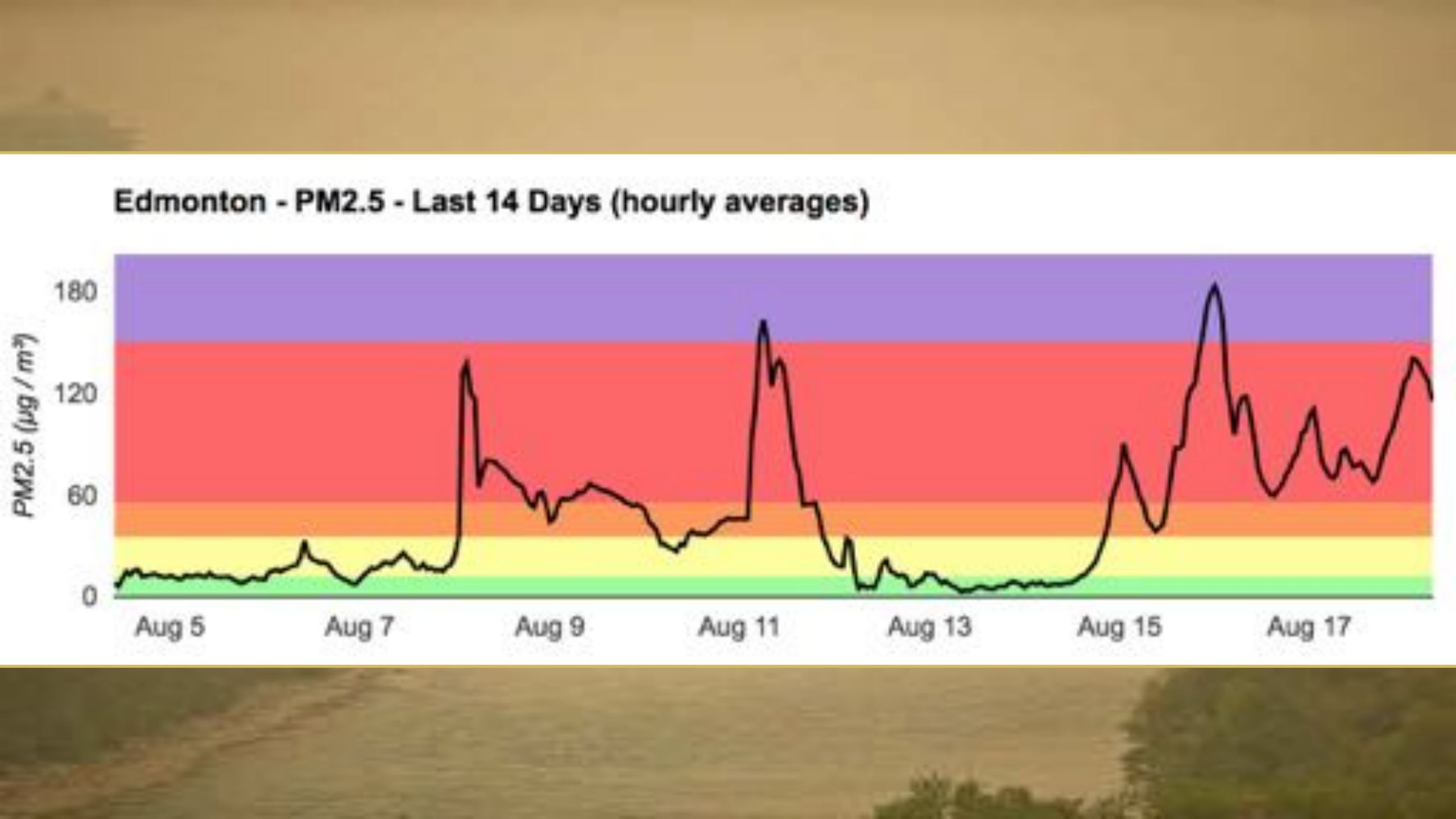
- Warmer winters and reduced snowpack,
- Very low late season water flows,
- Drought impacts,
- Access to water for fire suppression will become more of an issue



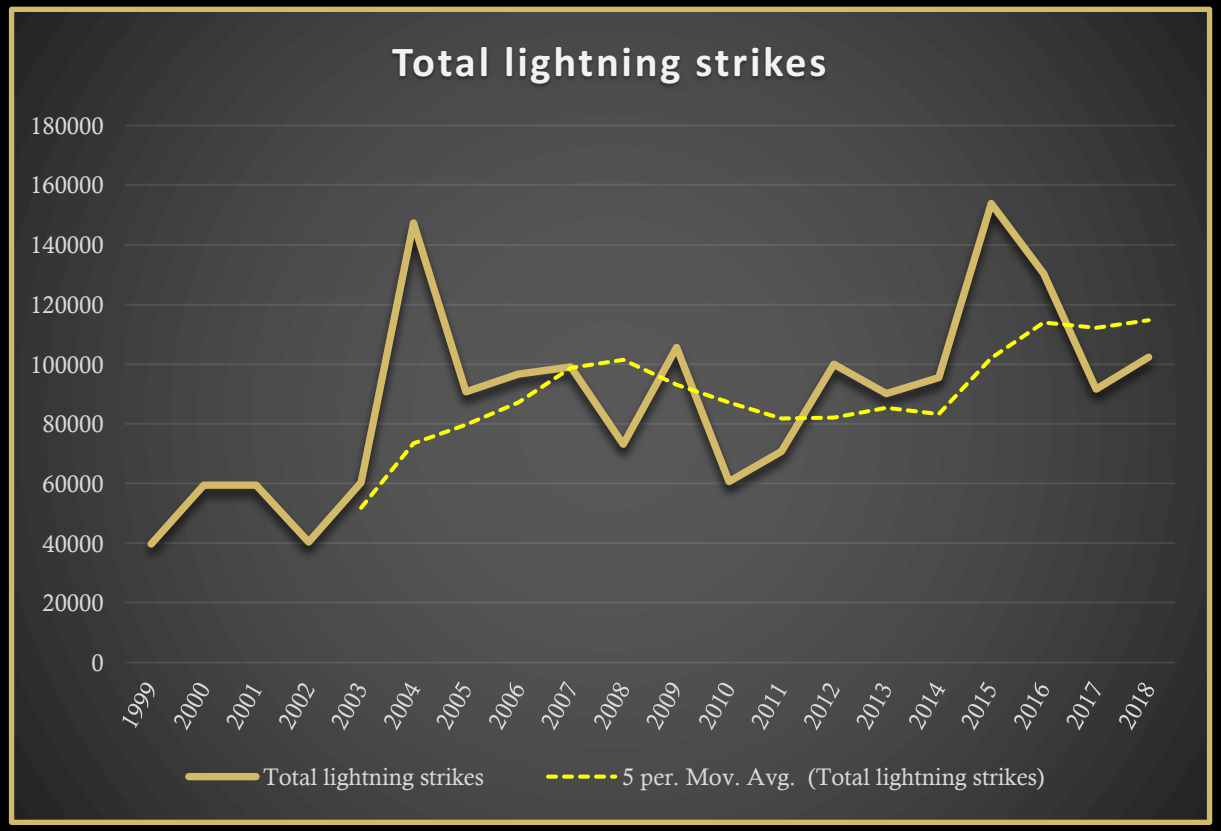
Changes in temperature and relative humidity



- Warmer daytime temperatures
- Lower daytime relative humidity
- Higher min nighttime temperatures (poor overnight recovery)
- Lower maximum nighttime relative humidity (poor overnight recovery)

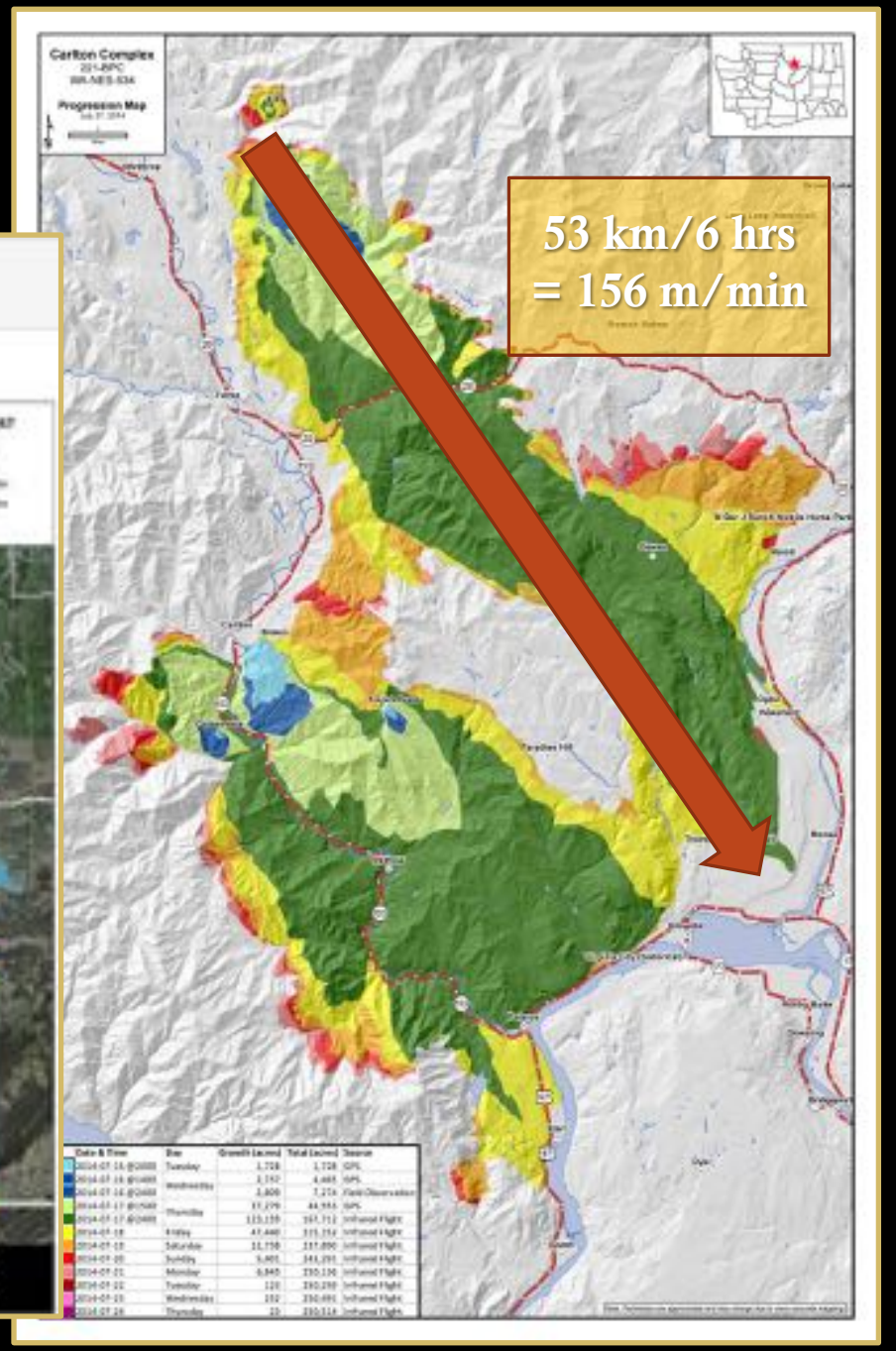

Edmonton - PM2.5 - Last 14 Days (hourly averages)
PM2.5 (µg / m³)
180
120
60
0
Aug 5
Aug 7
Aug 9
Aug 11
Aug 13
Aug 15
Aug 17

Higher incidence of lightning

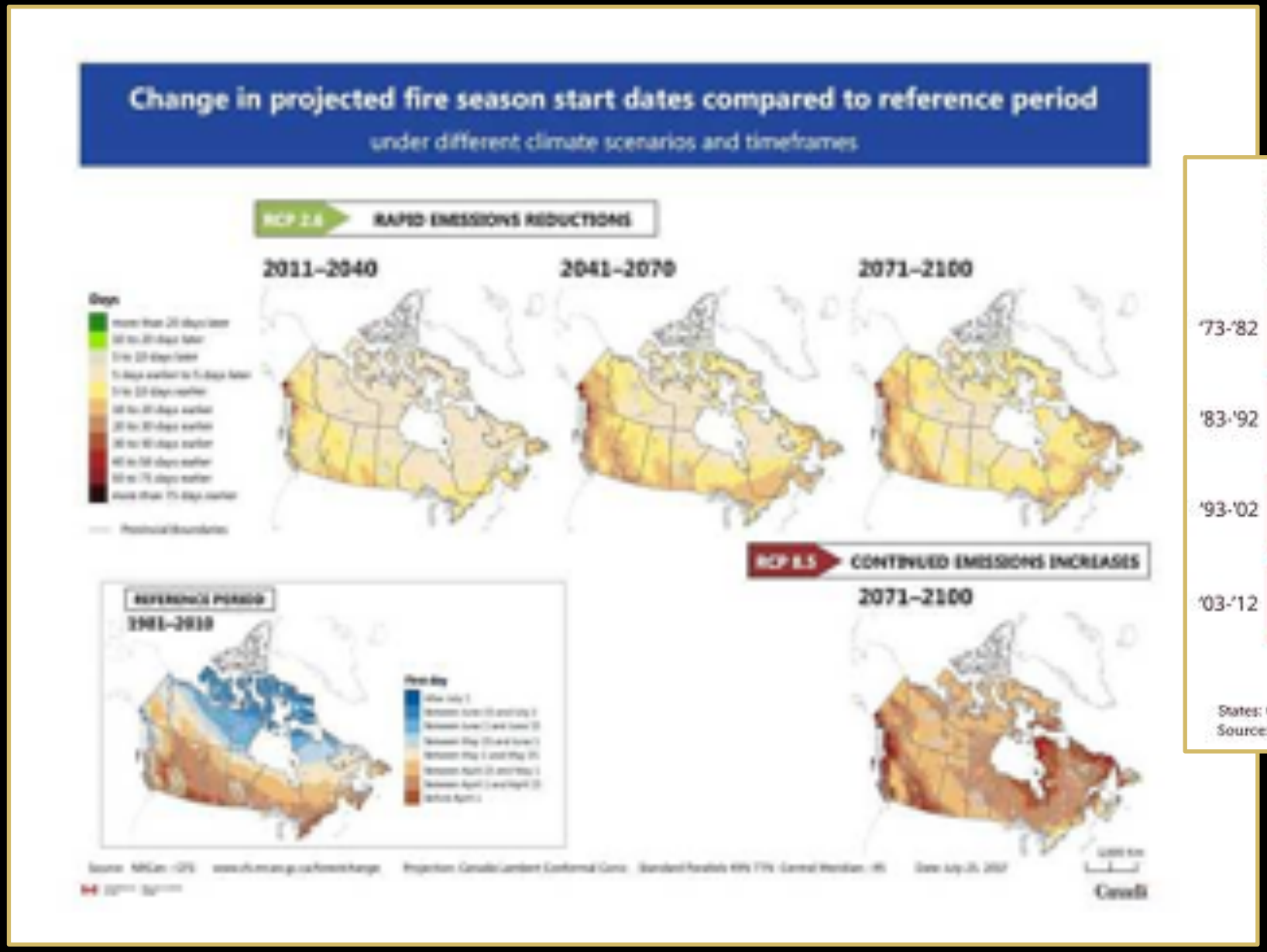


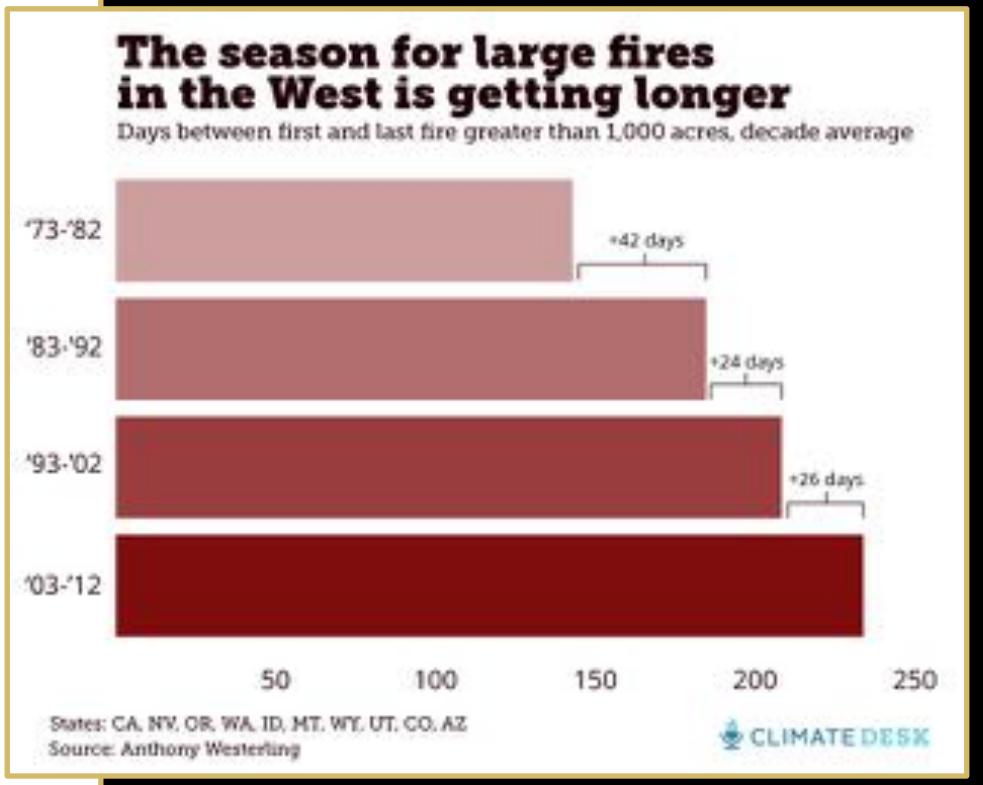
Less precipitation during the fire season and higher incidence of strong convective storms

Higher incidence of strong wind events

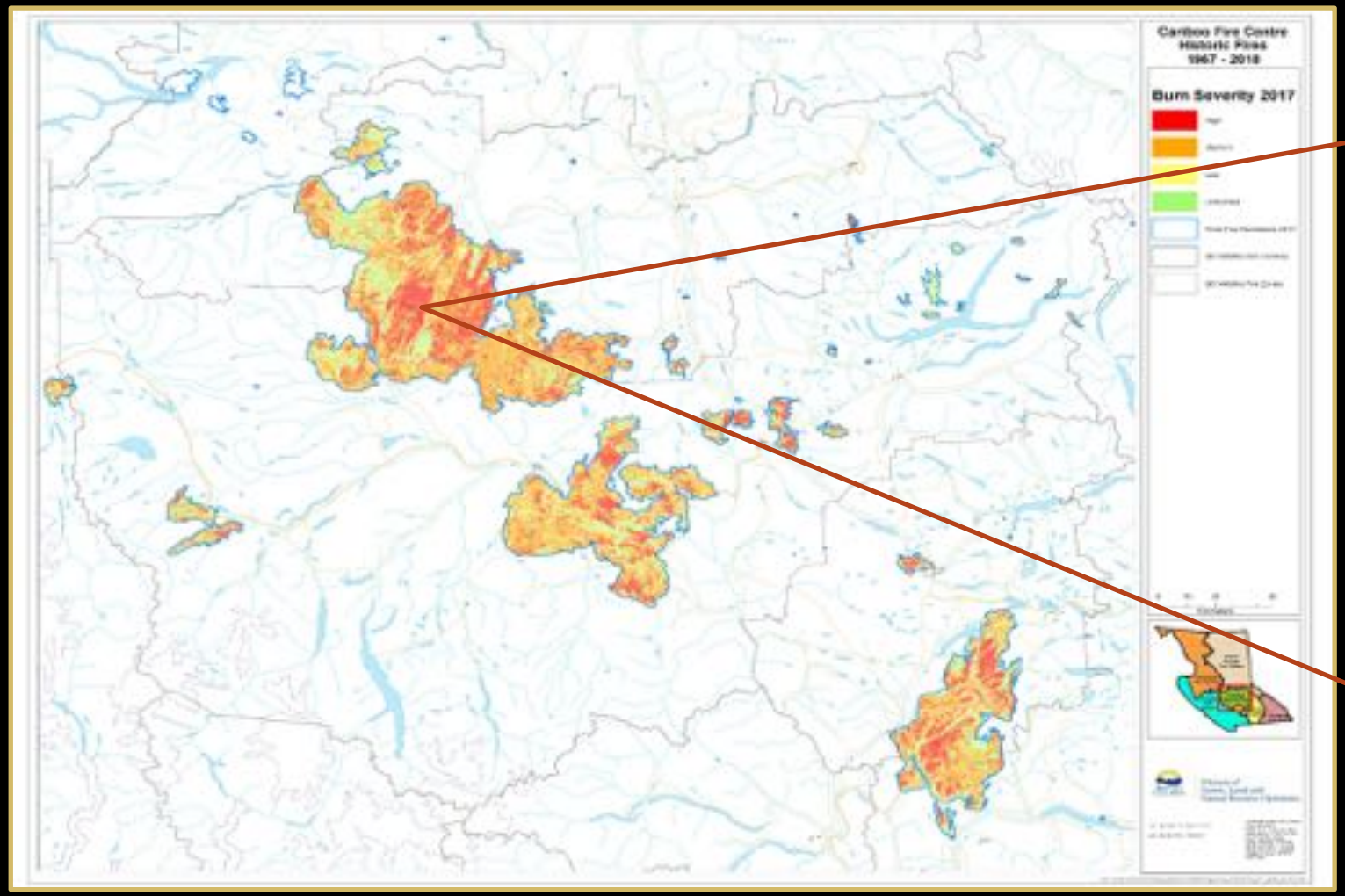


Longer fire seasons





Increased burned area and larger patches of high severity fire



Some large, severely burned areas will fail to reforest

PNAS

Wildfires and climate change push low-elevation forests across a critical climate threshold for tree regeneration

Kimberley T. Davis[a,1], Solomon Z. Dobrowski[b], Philip E. Higuera[a], Zachary A. Holden[c], Thomas T. Veblen[d], Monica T. Rother[d,e], Sean A. Parks[f], Anna Sala[g], and Marco P. Maneta[h]

[a]Department of Ecosystem and Conservation Sciences, University of Montana, Missoula, MT 59812; [b]Department of Forest Management, University of Montana, Missoula, MT 59812; [c]US Forest Service Region 1, Missoula, MT 59807; [d]Department of Geography, University of Colorado, Boulder, CO 80309; [e]Department of Environmental Sciences, University of North Carolina, Wilmington, NC 28403; [f]Aldo Leopold Wilderness Research Institute, Rocky Mountain Research Station, US Forest Service, Missoula, MT 59801; [g]Division of Biological Sciences, University of Montana, Missoula, MT 59812; and [h]Department of Geosciences, University of Montana, Missoula, MT 59812

Edited by Christelle Hély, Ecole Pratique des Hautes Etudes, Montpellier, France, and accepted by Editorial Board Member Robert J. Scholes January 31, 2019 (received for review August 31, 2018)

Climate change is increasing fire activity in the western United States, ... juveniles of the same species (6, 14, 15). Disturbance-catalyzed change

Positive Feedback Loop

Climate Change

Longer fire seasons
More burned area
More fire activity

CO_2 and other Greenhouse Gas emissions[1]

Wildfire

[1]BC's 2017 wildfire emissions estimated at 180 million tonnes of CO2

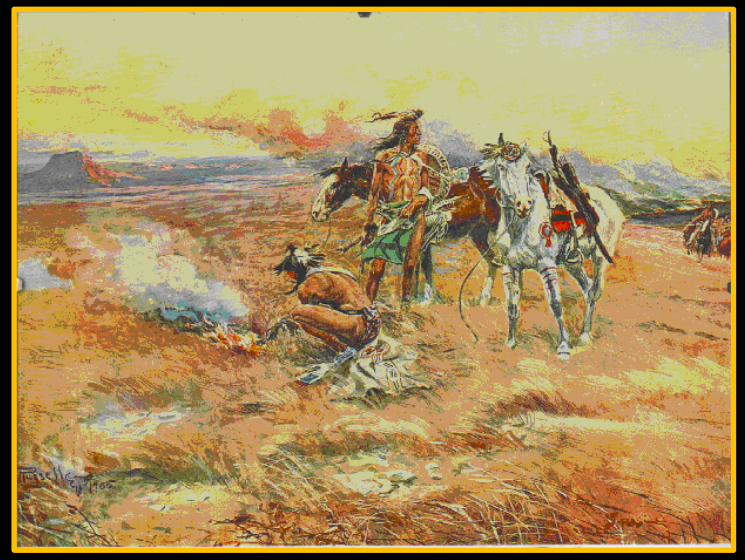
Resilience and adaptation

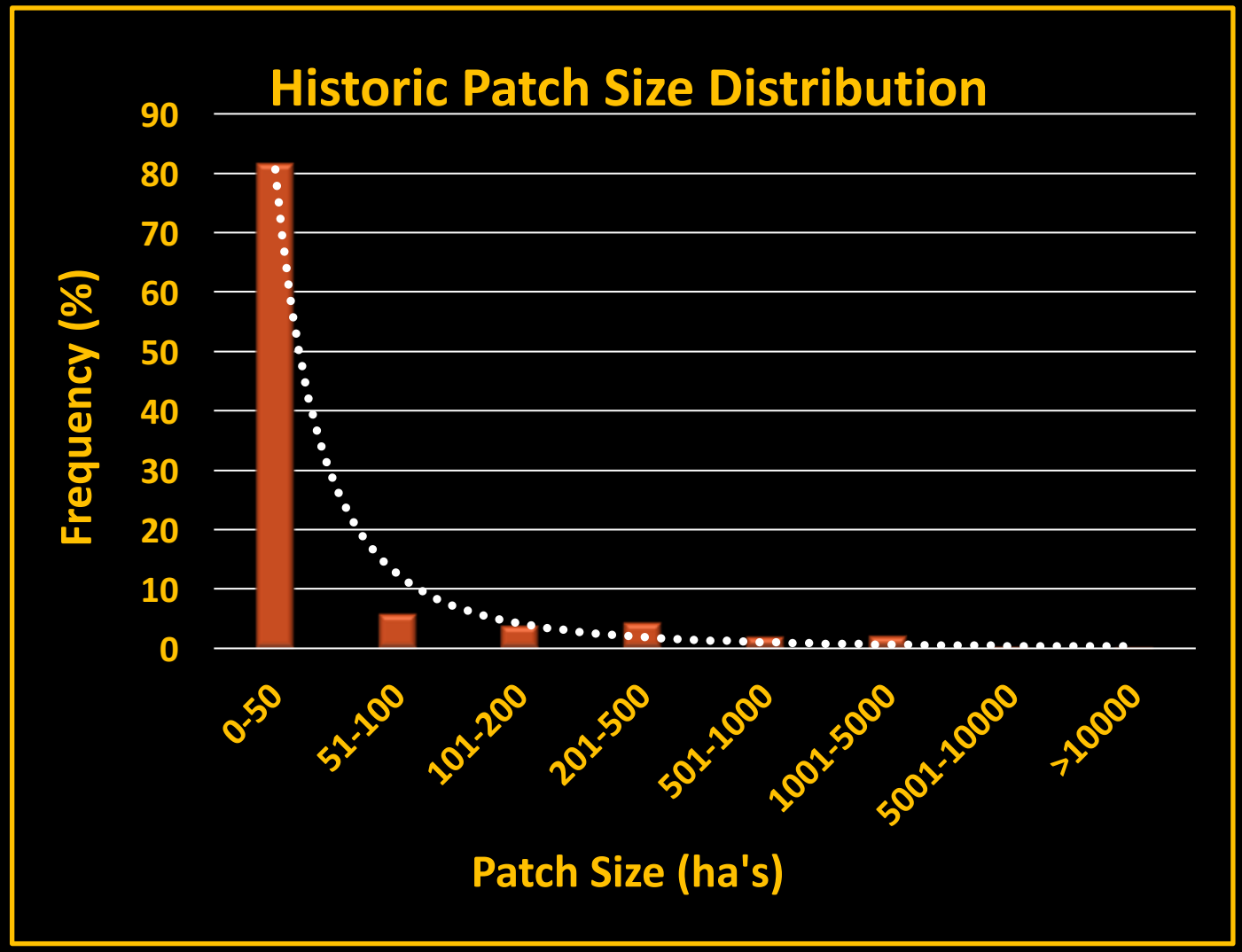
- “Wildfire” resilience:
  - Stand-level – low elevation dry forests
  - Landscape-level – mid and high elevation dry and moist forests
- Building back and maintaining structure, composition and patterns that enable ecosystems to withstand the negative effects of wildfire

Resilience and adaptation: stand-level

- Critical factors are:
  - Species, structures and patch dynamics that enable the stand to survive frequent disturbances including drought and wildfire
  - Conditions have to be maintained
  - Need to adapt practices as climate changes
  - Needs to be implemented at large scale

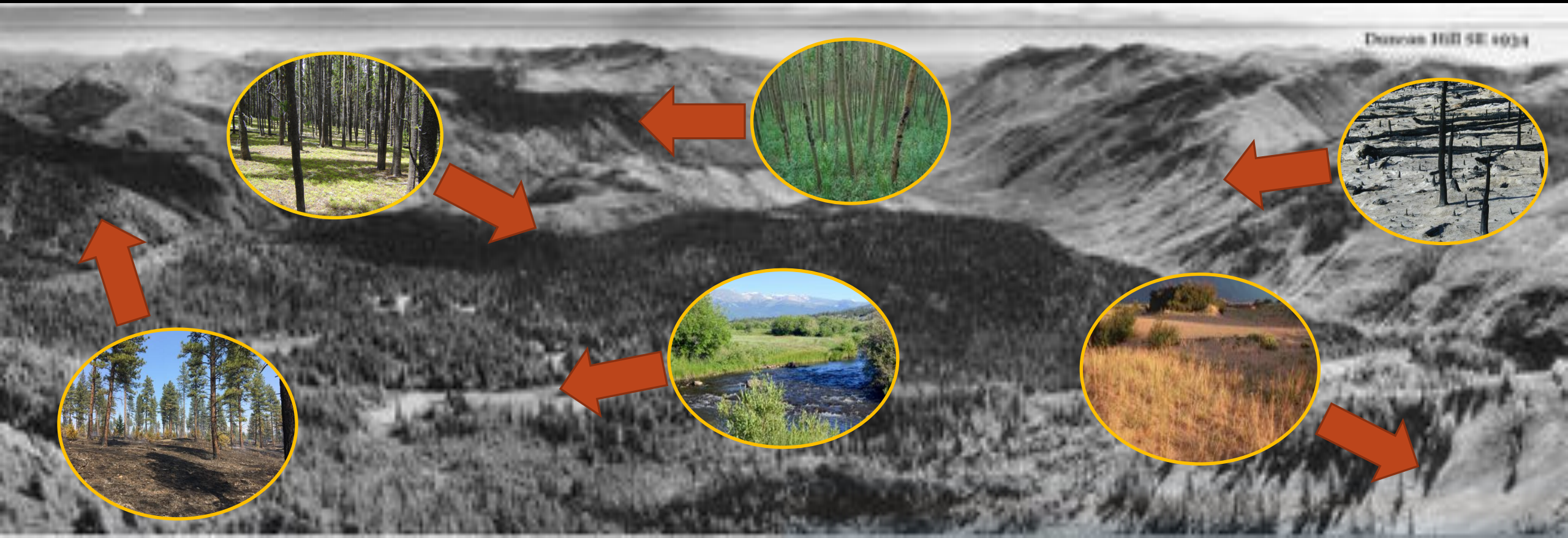
Landscape experienced a lot of fire, but because of that, most fires were small





Landscape flammability

- Certain seral stages and forest types were not very flammable – functioned as hedges against fire flow, and provided seed dispersal opportunities for plants to reseed burned patches



Fire as a contagion on the historical landscape

- How did fire move through this historical arrangement of seral stages and forest types?
- Fire maintained heterogeneity and diversity and allowed forest to be forest
- Estimates of up to 40% of the historical landscape was in these less flammable conditions

Fire as a contagion on the modern landscape

- Landscape highly vulnerable to large, severe disturbance events – highly contagious
- Fire exclusion and resulting wildfires have created homogeneous forest structure, and low resilience to future disturbances.

Resilience and adaptation: landscape-level

- Critical factors are:
  - Species, structures and patch dynamics that reduce fire severity and interrupt fire flow on the landscape
  - Scale of treatment needs to match the scale of disturbance – otherwise treatments will continue to be overwhelmed by fires
  - Need to adapt practices as climate changes
  - Limited window to act – next 20 years are critical