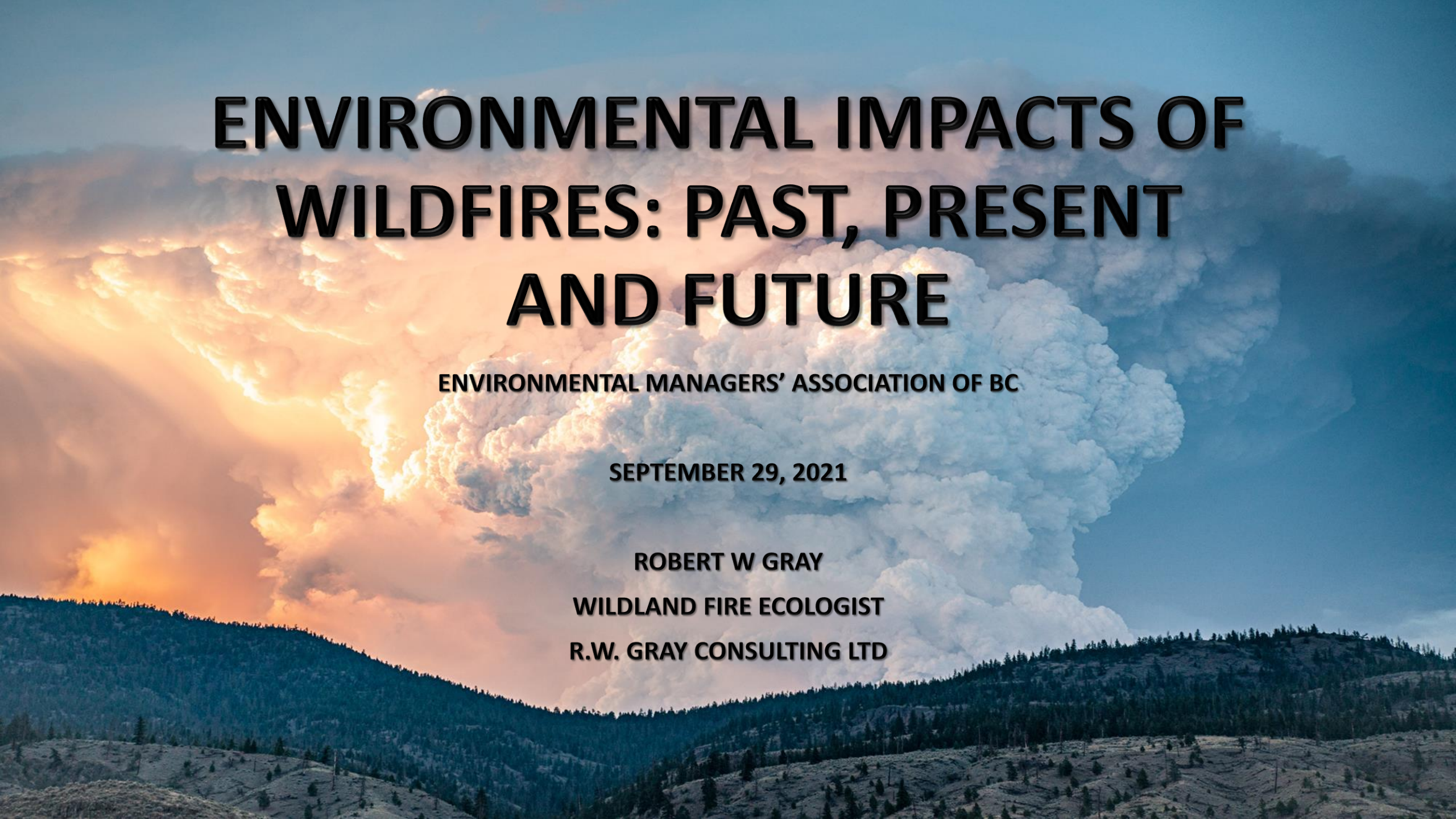


ENVIRONMENTAL IMPACTS OF WILDFIRES: PAST, PRESENT AND FUTURE

ENVIRONMENTAL MANAGERS' ASSOCIATION OF BC

SEPTEMBER 29, 2021

ROBERT W GRAY

WILDLAND FIRE ECOLOGIST

R.W. GRAY CONSULTING LTD

HISTORICL FIRE REGIMES

High Severity

Moderate Severity

Low Severity

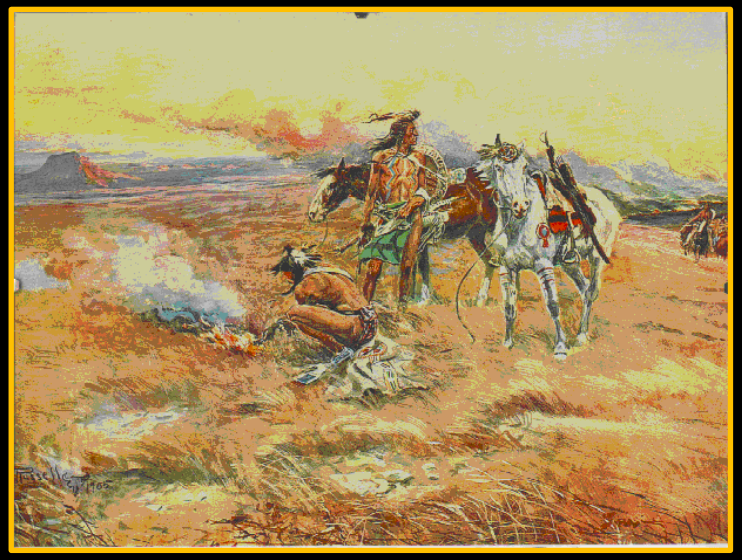
Warm / Dry

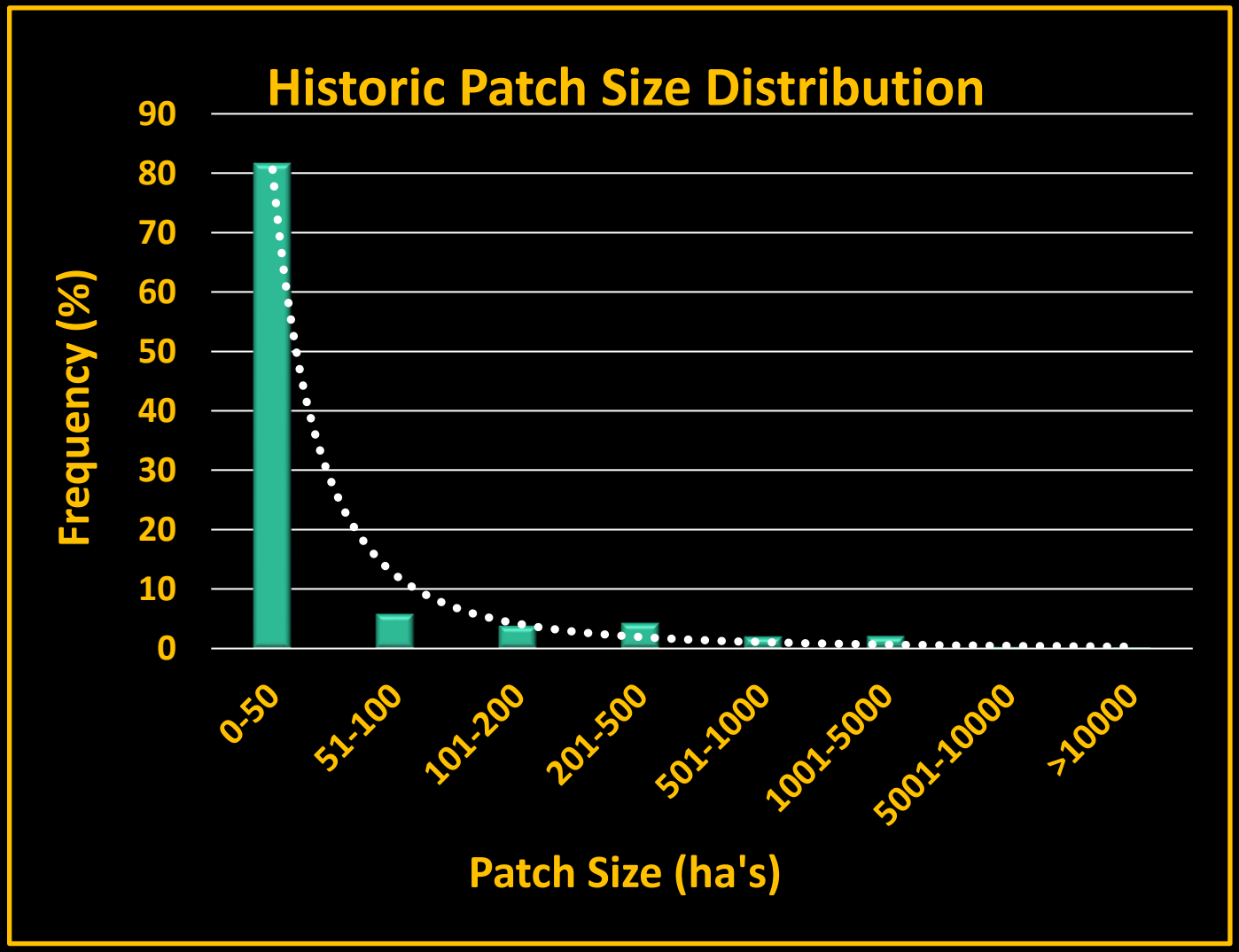
Warm / Moist

Cool / Moist

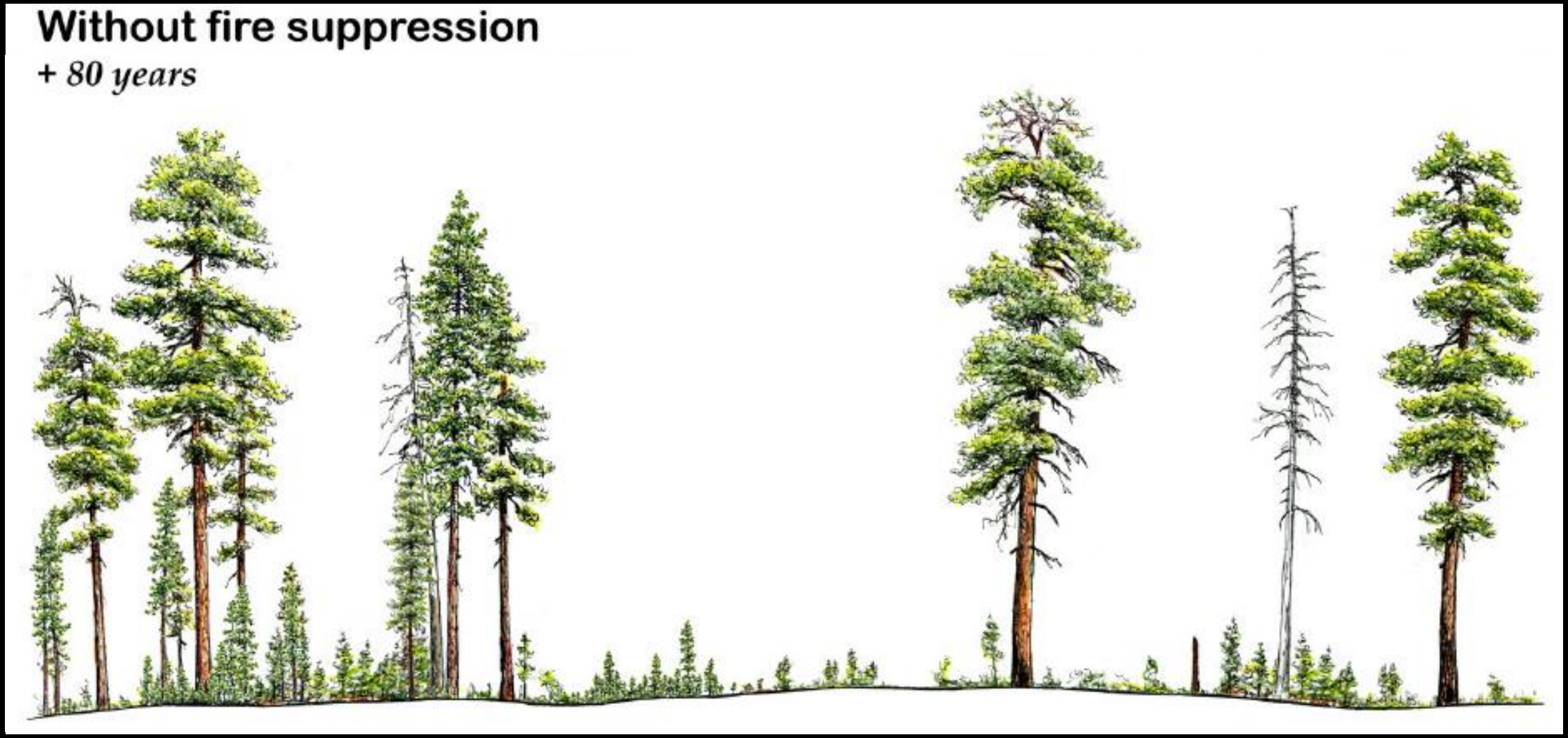
HISTORICAL FIRE EFFECTS: LANDSCAPE-SCALE

LANDSCAPEs EXPERIENCED A LOT OF FIRE, BUT BECAUSE OF THAT, MOST FIRES WERE SMALL





HISTORICAL FIRE EFFECTS: STAND-SCALE

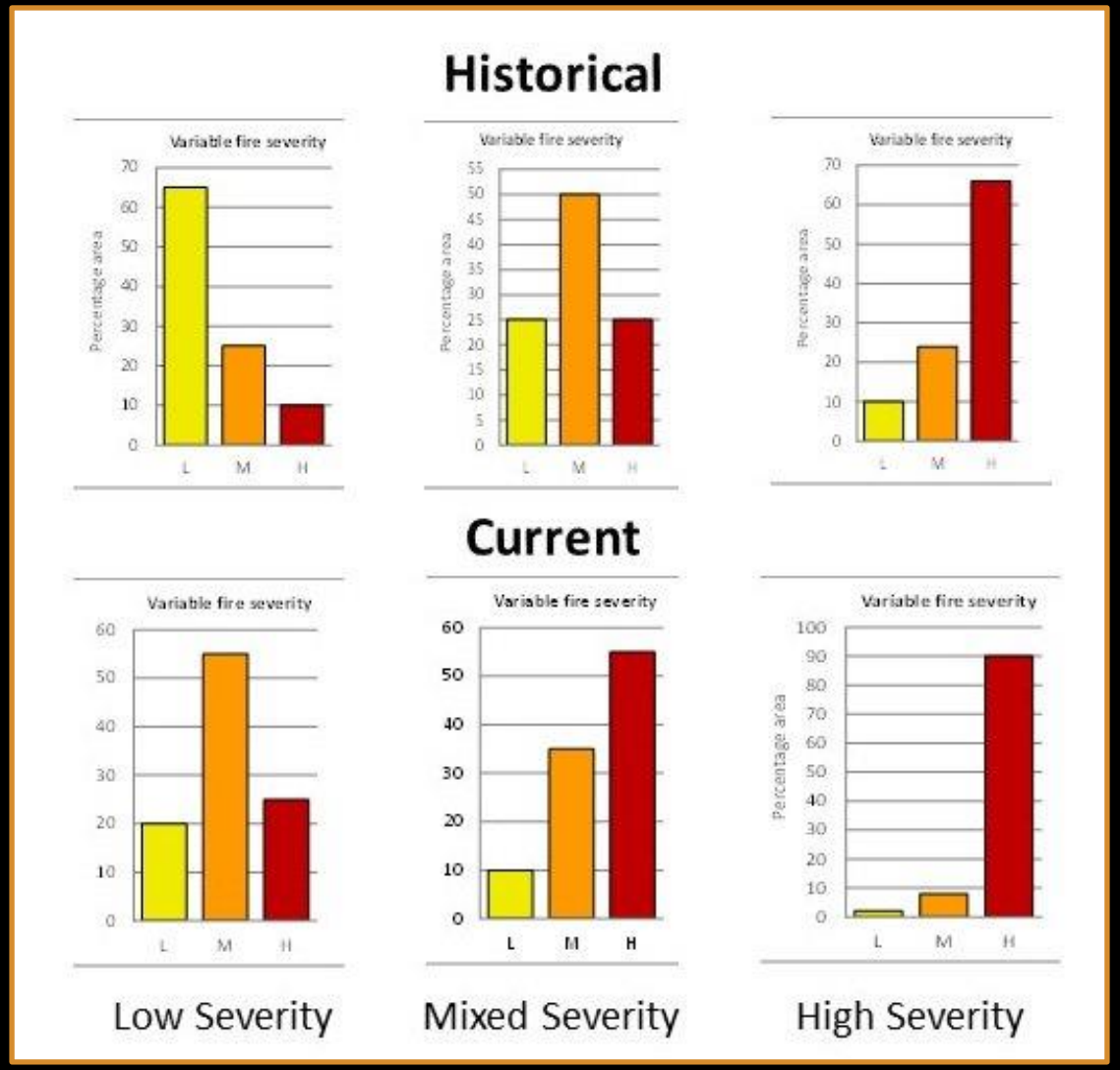


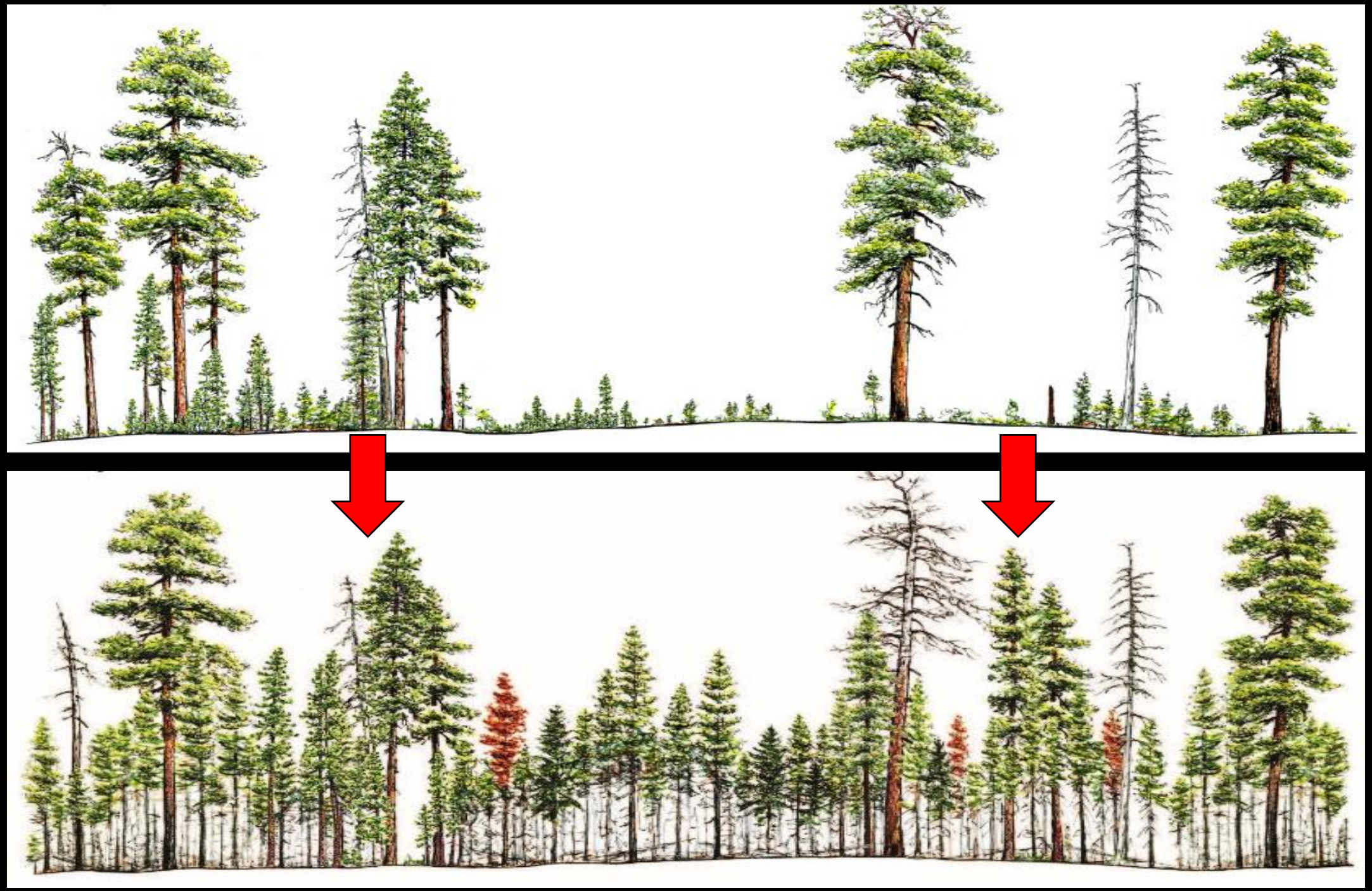

CURRENT CONDITION

CONTEMPORARY CHANGES TO FIRE REGIMES

- Land management influences:
  - forest management
  - fire exclusion
  - livestock grazing
  - human settlement
- Climate change

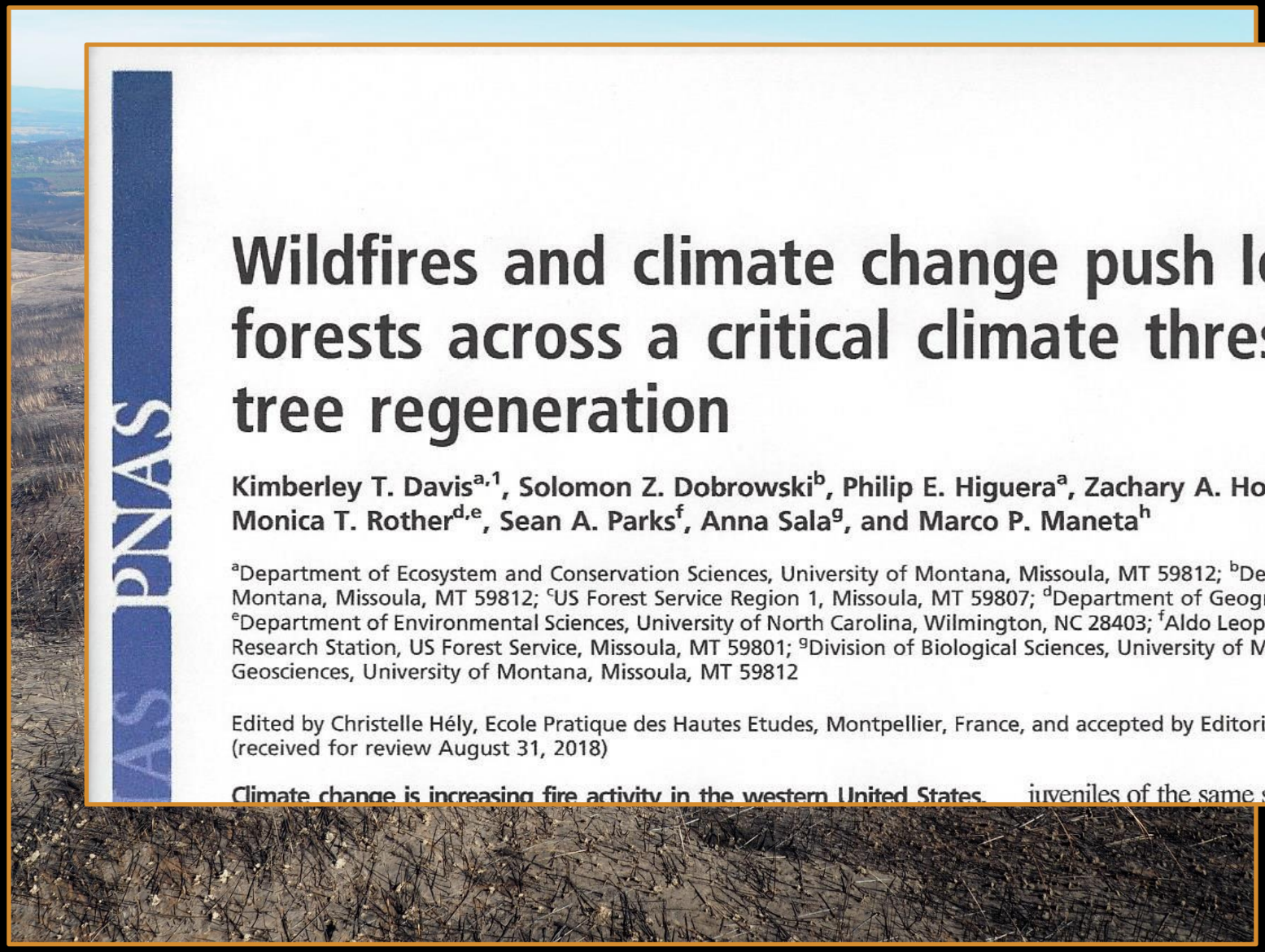
- Result is a change in how ecosystems burn and how they react to fire.
- Much more high severity fire across all fire regimes now.





CONTEMPORARY CHANGES TO FIRE REGIMES: LANDSCAPE-SCALE FIRE BEHAVIOUR – INCREASE IN INCIDENCE OF MEGAFIRES

SOME LARGE, SEVERELY BURNED AREAS WILL FAIL TO REFOREST



PNAS

Check for updates

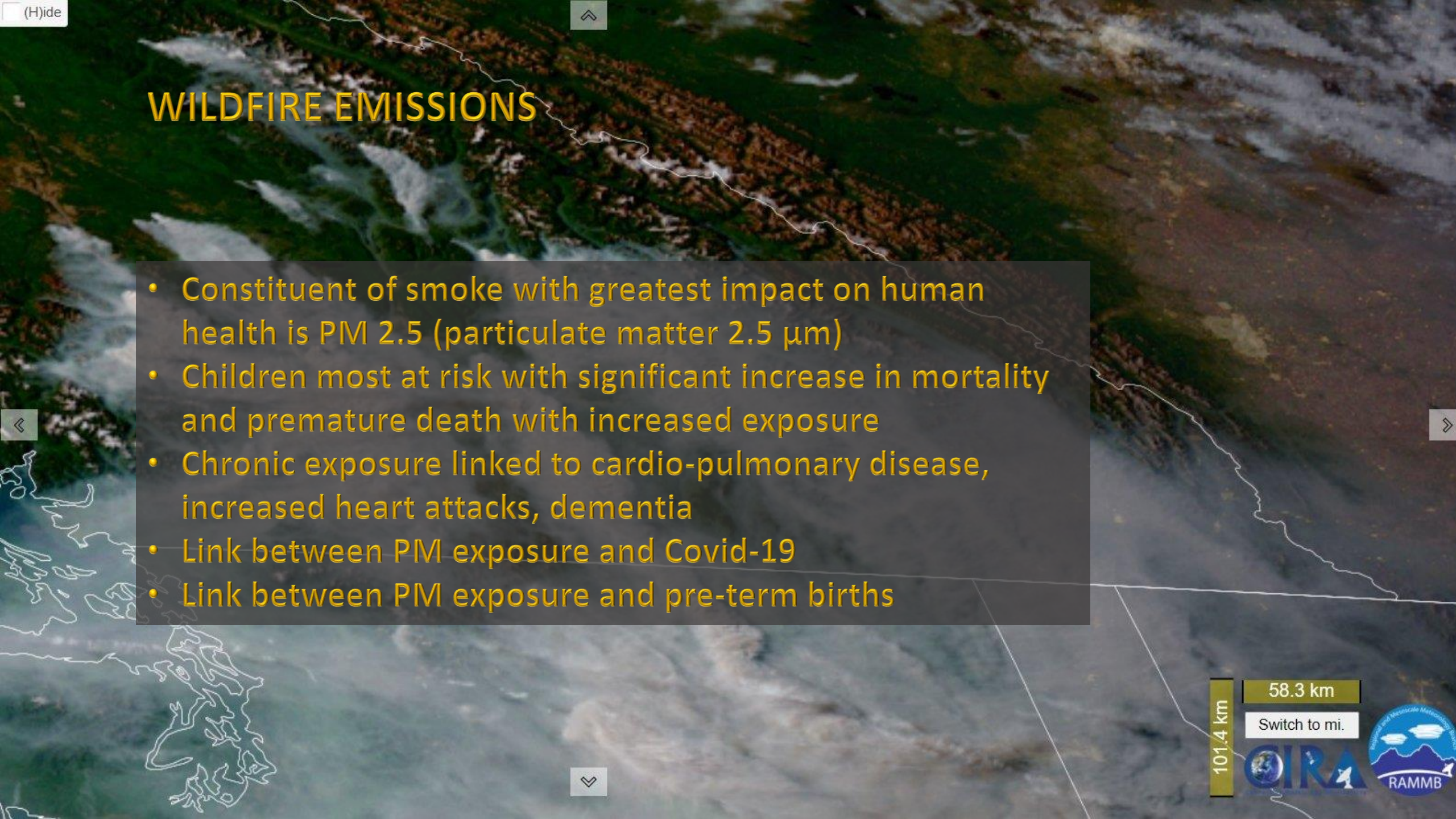
Wildfires and climate change push low-elevation forests across a critical climate threshold for tree regeneration

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


(H)ide
WILDFIRE EMISSIONS
• Constituent of smoke with greatest impact on human health is PM 2.5 (particulate matter 2.5 µm)
• Children most at risk with significant increase in mortality and premature death with increased exposure
• Chronic exposure linked to cardio-pulmonary disease, increased heart attacks, dementia
• Link between PM exposure and Covid-19
• Link between PM exposure and pre-term births
101.4 km
58.3 km
Switch to mi.
CIRA
RAMMB

WA

- Loss o
  waters
  - Inc
  - De
  - Inc
- Other
  - So
  - So
  - Wa

e burned; 12
t >75% area.

Fish and Wildlife Populations and Habitat Effects

- Increased sedimentation,
- Increased water temperature,
- Increased nutrient load (leads to reduced dissolved oxygen),
- Increased toxins.

Fire can affect wildlife populations directly or indirectly

- Large mammals and birds are rarely killed in wildfires,
- Small mammals and reptiles/amphibians that can burrow under the ground typically survive,
- Small mammals, birds and reptiles/amphibians that cannot burrow are often killed in large numbers in large wildfires.

Indirectly, wildfire affects wildlife populations through the loss of habitat

- Large, high-severity fires affect connectivity, seral stage distribution, habitat patch sizes, habitat structures (snags, downed logs), ecosystem composition (loss of plant propagules), recovery time, etc.

Positive Feedback Loop

Climate Change

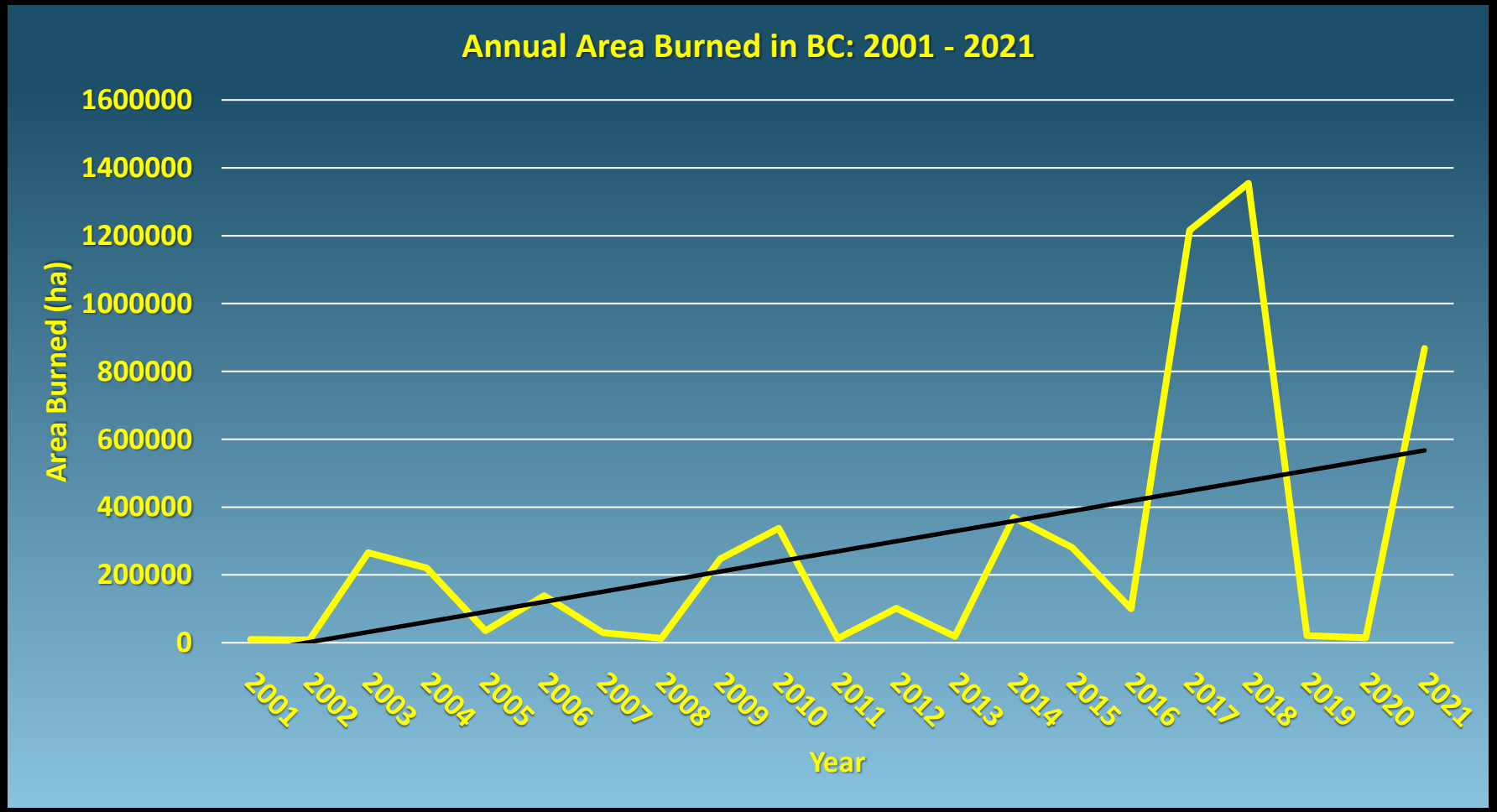
Longer fire seasons
More burned area
More fire activity

CO_2 and other Greenhouse Gas emissions[1]

Wildfire

[1]BC's 2017 wildfire emissions estimated at 180 million tonnes of CO2 eq and 2018 emissions estimated to be 200 million tonnes.

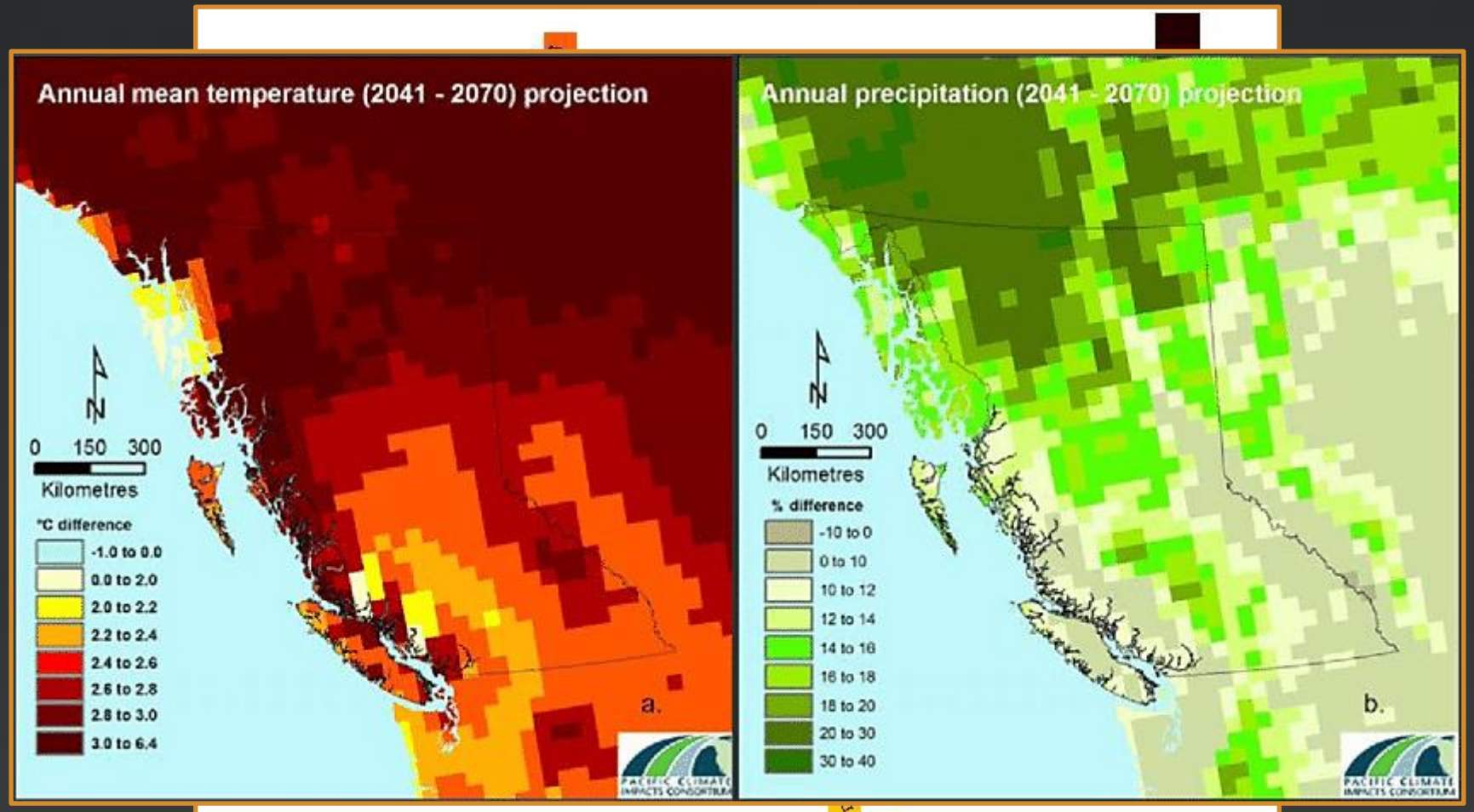
FUTURE CHANGES TO FIRE REGIMES: INFLUENCE OF CLIMATE CHANGE ON FIRE BEHAVIOUR



Moving average in 2001 was less than 30,000 ha; in 2021 the average is almost 600,000 ha's. That's an increase of over 500,000 ha's in just 13 years.

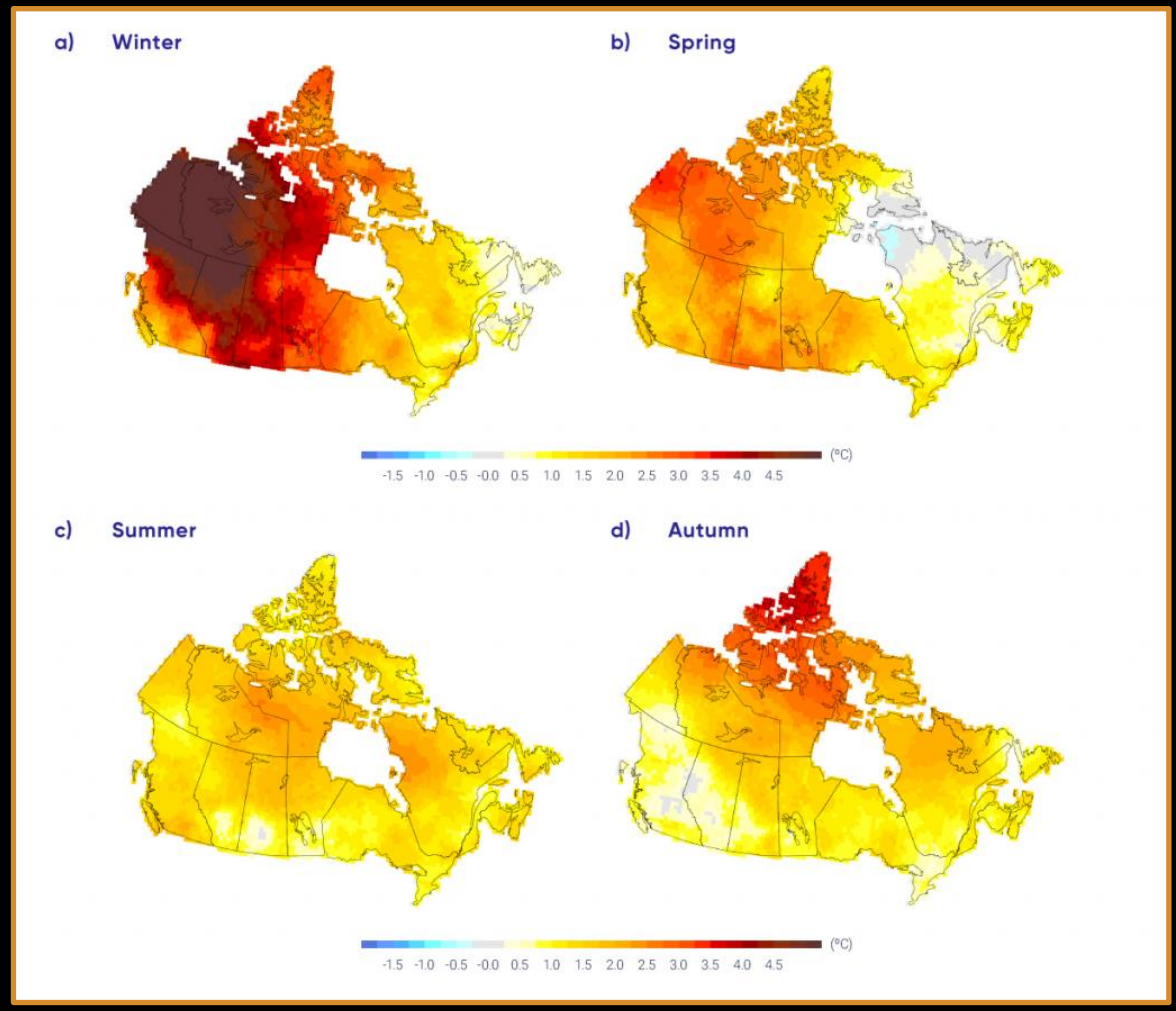
Climate models: What does the future hold?

Global mean temperature has risen approximately 1.11 °C since 1850

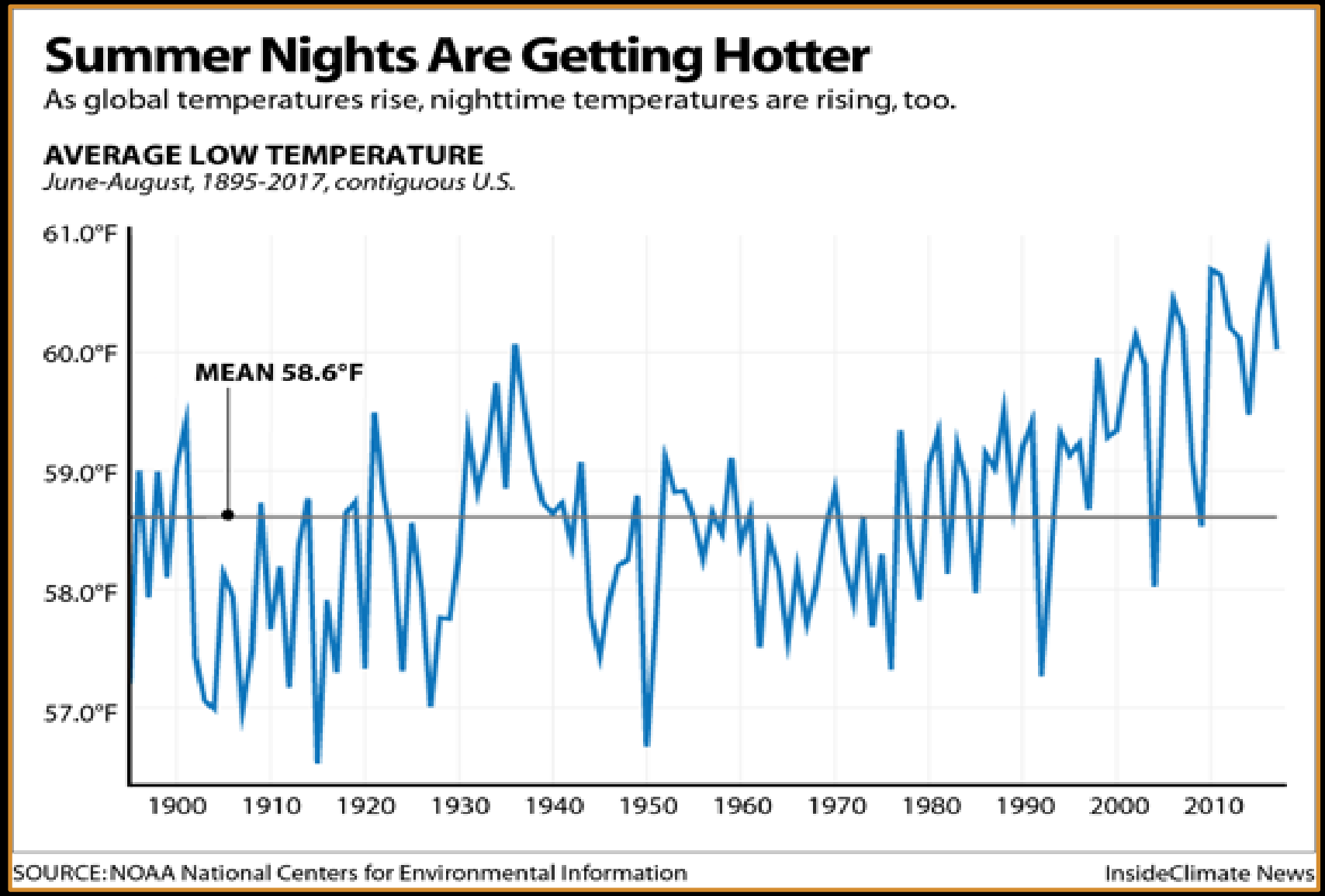


Later start to winter snows, and earlier snow melt

- 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

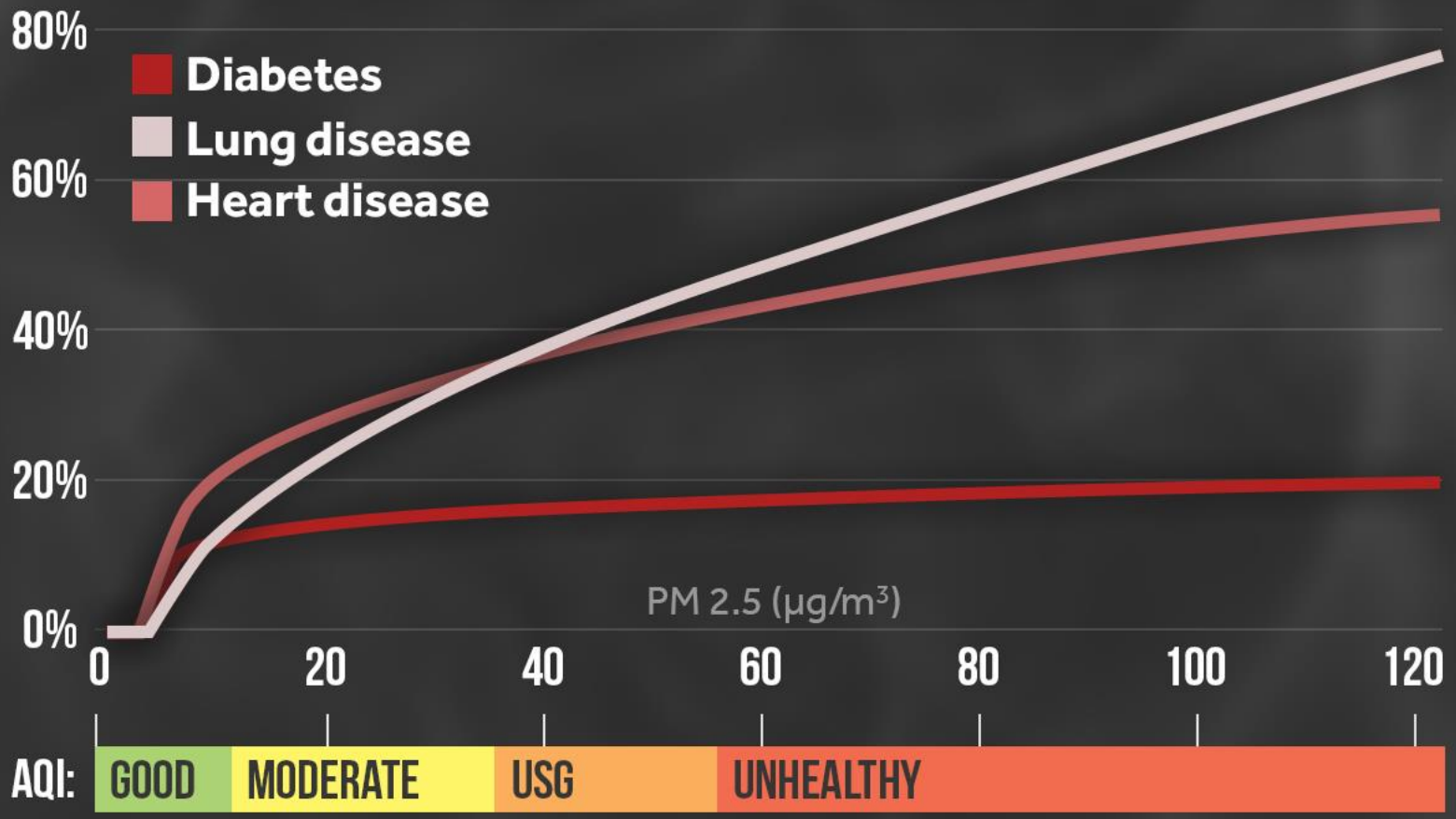


Changes in temperature and relative humidity



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

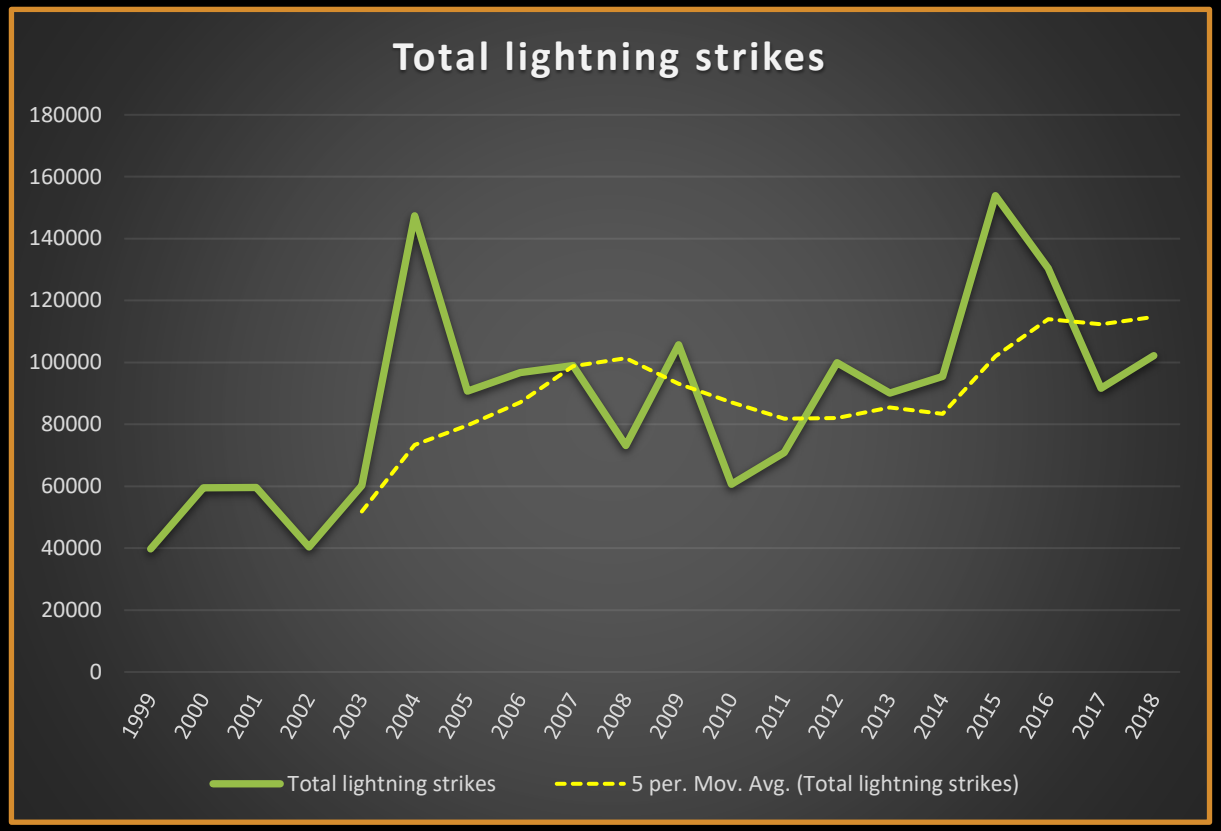
WILDFIRE SMOKE RISKS



USG = Unhealthy for sensitive groups
Source: Bowe et al (2018), Cohen et al (2017)

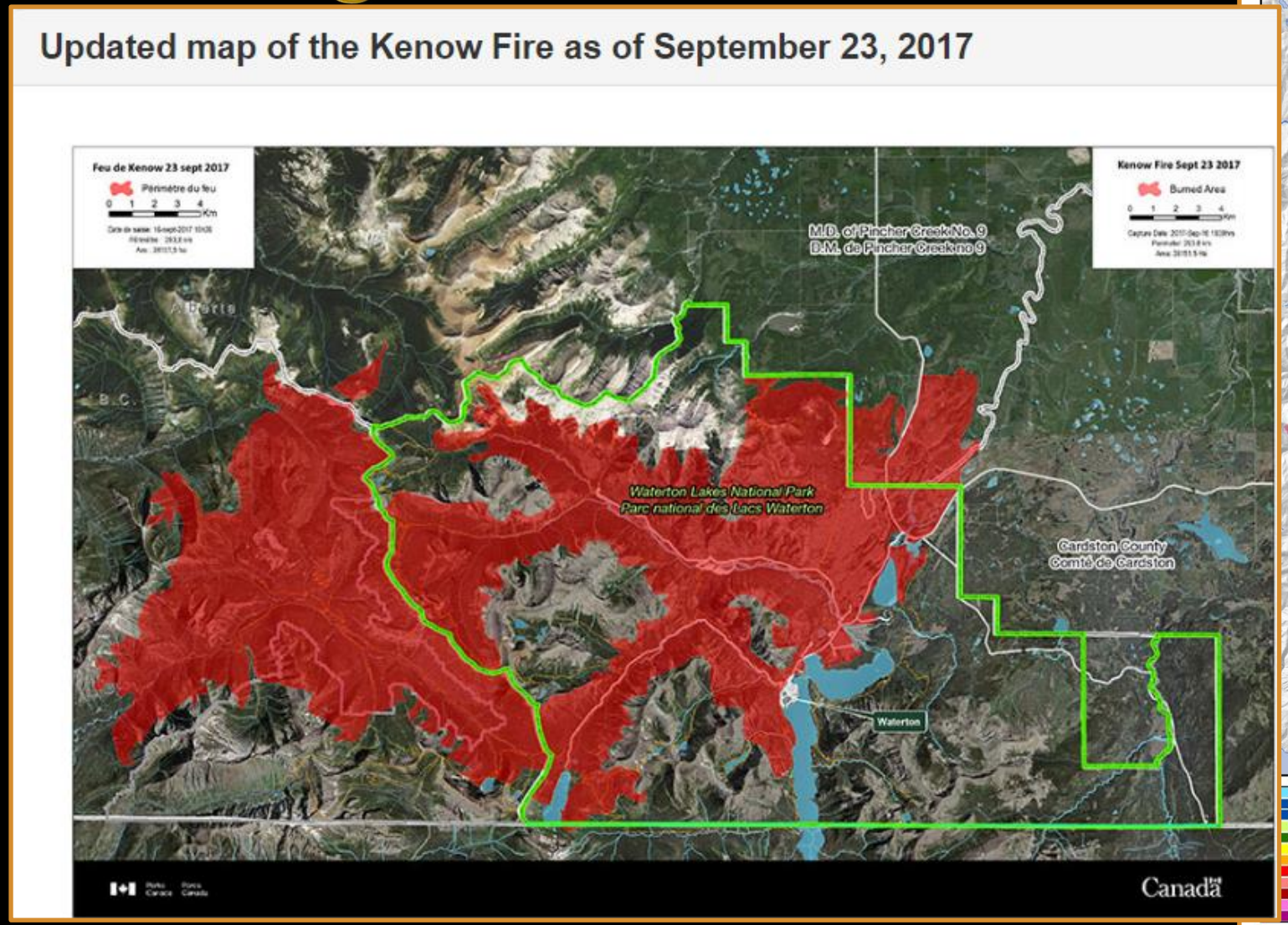
CLIMATE CENTRAL

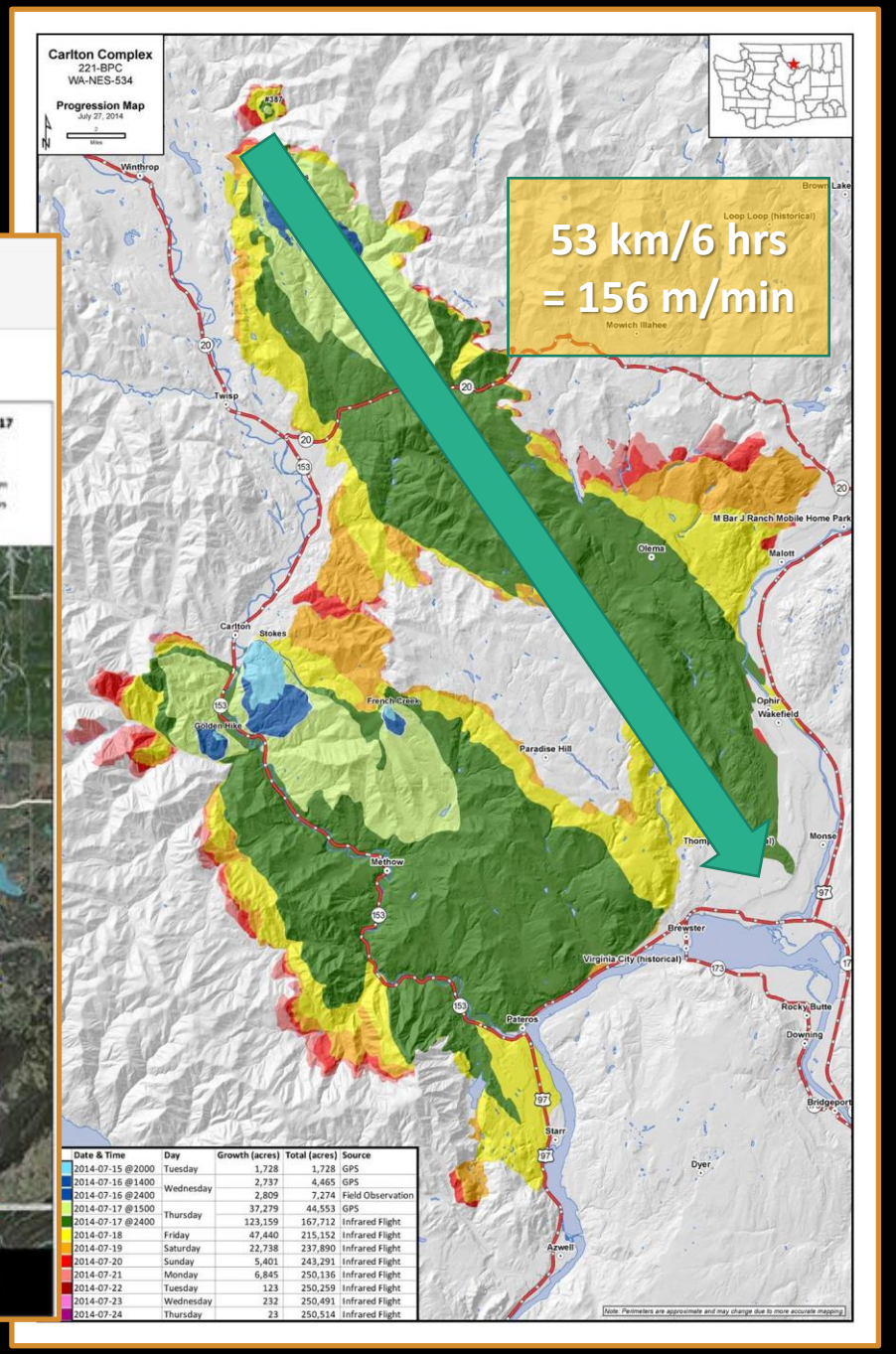
Higher incidence of lightning



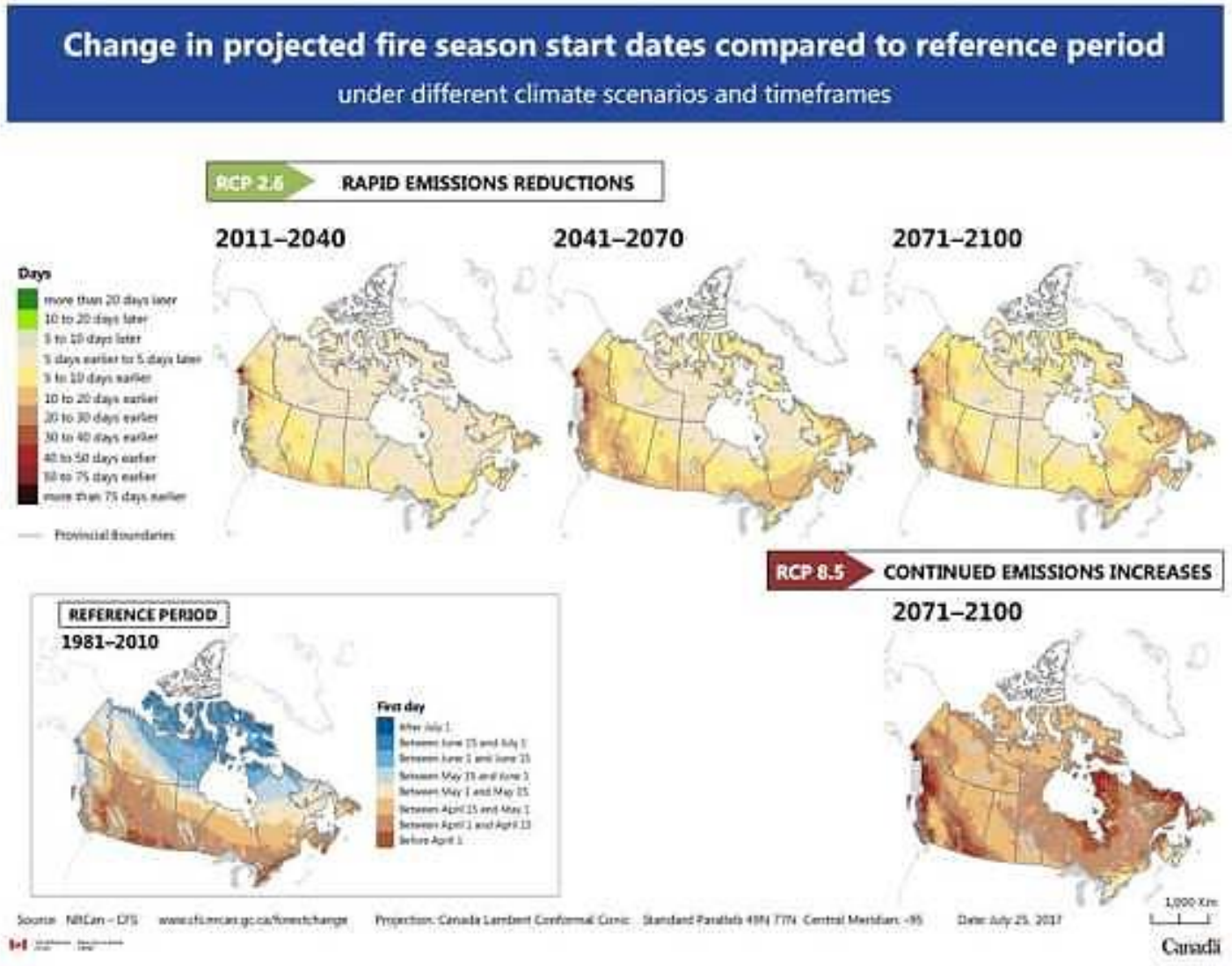
Less precipitation during the fire season and higher incidence of strong convective storms

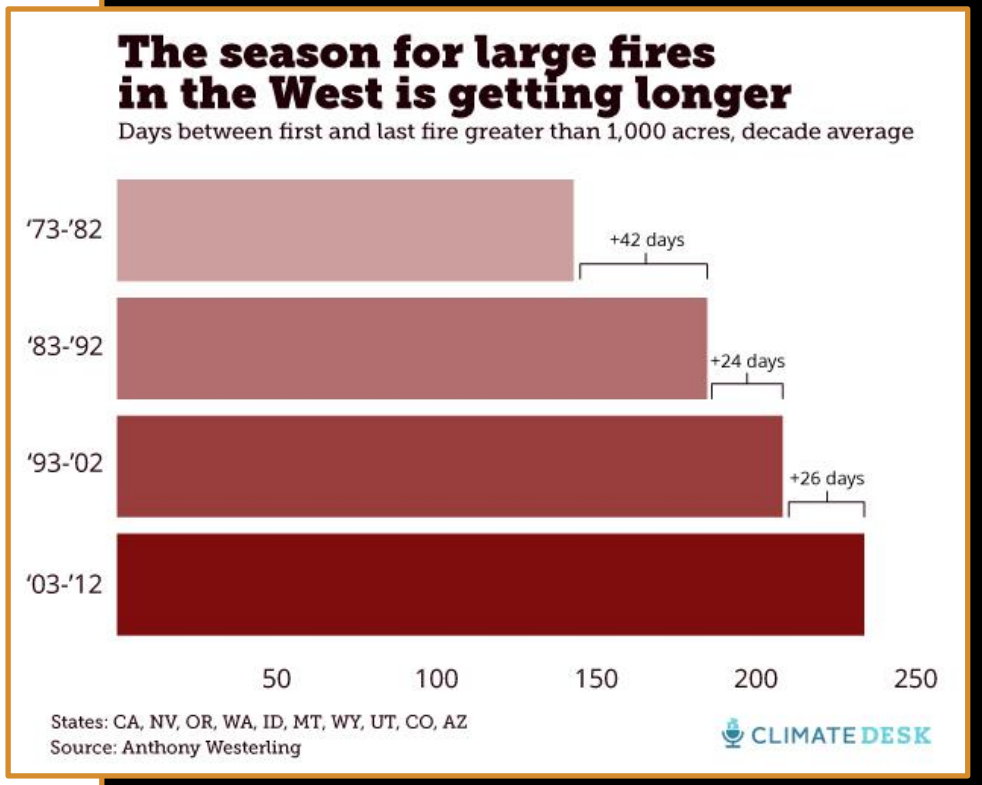
Higher incidence of strong wind events



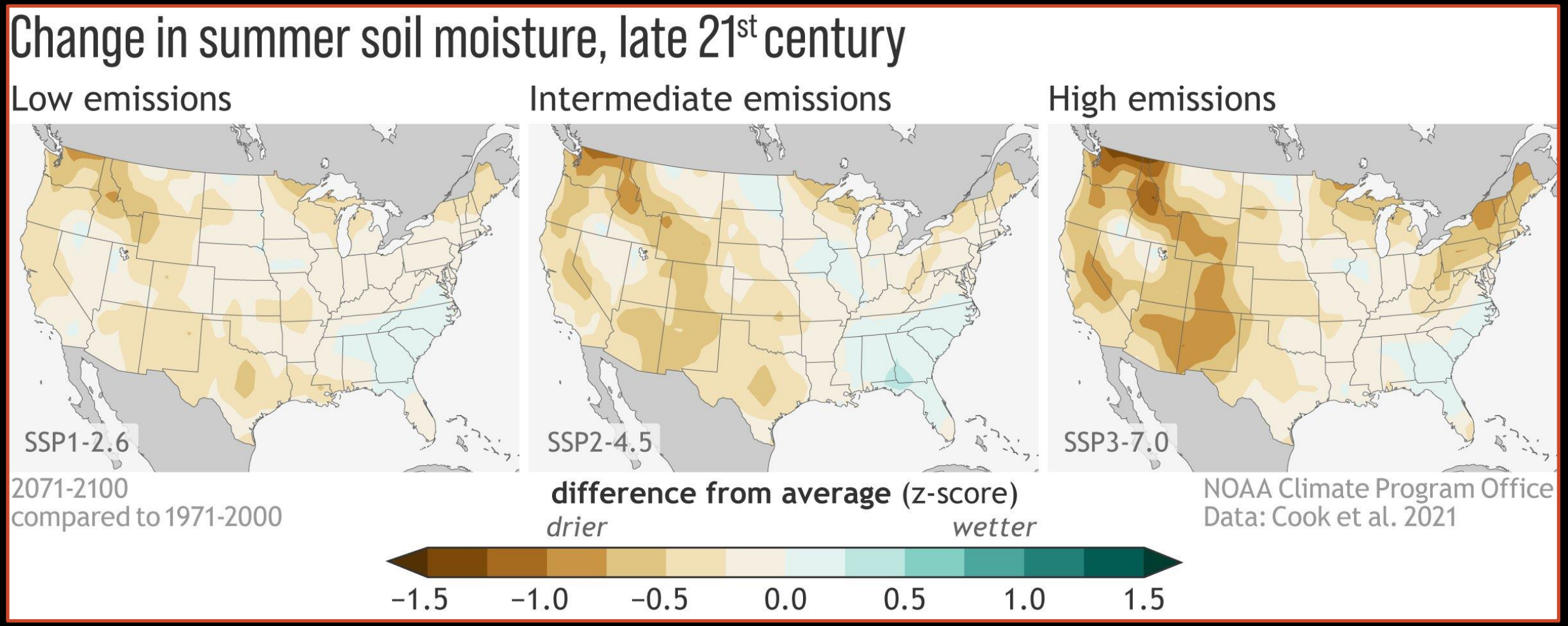


Longer fire seasons

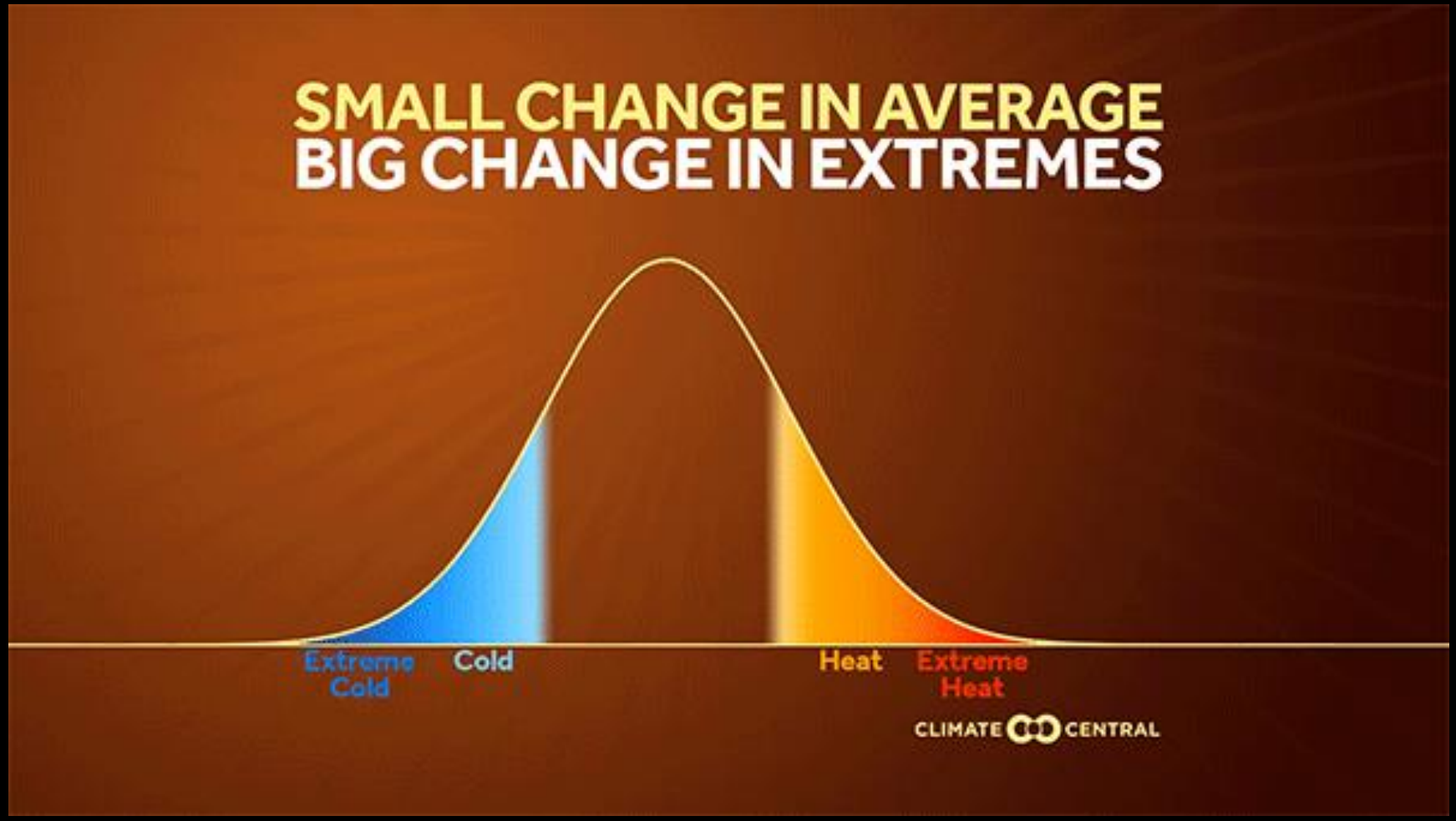




Drought


Change in summer soil moisture, late 21st century
Low emissions
Intermediate emissions
High emissions
SSP1-2.6
SSP2-4.5
SSP3-7.0
2071-2100
compared to 1971-2000
difference from average (z-score)
drier
wetter
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
NOAA Climate Program Office
Data: Cook et al. 2021

Future Trends



CLIMATE CHANGE, WILDFIRES, AND THE COSTS OF LIMITED ACTION

Published by University of BC Okanagan, July 2021

Co-authors: Mathieu Bourbonnais, UBCO; Robert Gray, R.W. Gray Consulting Ltd.; Scott Green, UNBC; Robin Gregory, UBC; Crystal Kolden, University of California – Merced; Susan Prichard, University of Washington; Francisco Seijo, Instituto de Empresa, Madrid, Spain

STRATEGIC-SCALE (GOVERNMENT TASK BUT WE CAN ADVOCATE)

- Only thing we can control is what burns – biomass/fuel,
- Scale of the problem is in the millions of hectares and billions of tonnes,
- No short-term, easy fixes,
- Needs a western North American solution (Alaska/Yukon to California),
- Needs a non-partisan solution,
- Short-term, post-disaster funding programs are inefficient and ineffective,
- Need sustainable solutions – long-term markets for biomass (direct to dimension lumber and bioeconomy),
- Subsidies will be required – current economic approach (market capitalism) not working,

- Need to act quickly; latest IPCC report suggests we have less than 2 decades to turn the situation around,
- Therefore, governments need to:
  - act urgently,
  - to scale,
  - grounded in social justice,
  - informed by holistic and inclusive policies,
  - supported by long-term sustainability.

WHAT CAN WE DO TO MITIGATE THE EFFECTS OF CATASTROPHIC FIRE: PLANNING AND OPERATIONS

- LIMIT EXPANSION INTO THE WUI / FIRE HARDEN INFRASTRUCTURE
- USE MODIFIED SUPPRESSION WHERE AND WHEN APPROPRIATE
- REQUIRE CLEANER HARVEST BLOCKS
- DON'T REPLANT CERTAIN AREAS
- RESTORE RIPARIAN AREAS
- CONDUCT MORE PRESCRIBED BURNING – INCLUDING INDIGENOUS BURNING
- THIN OVERLY DENSE FORESTS

Questions?