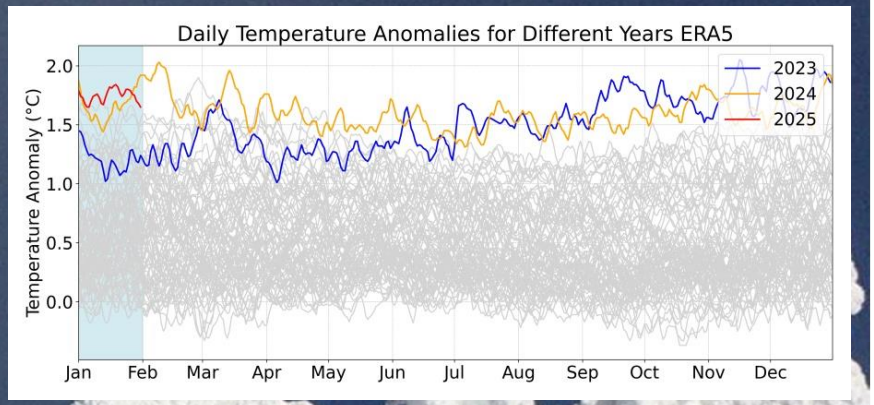
Climate Disruption



The Ripple Effect

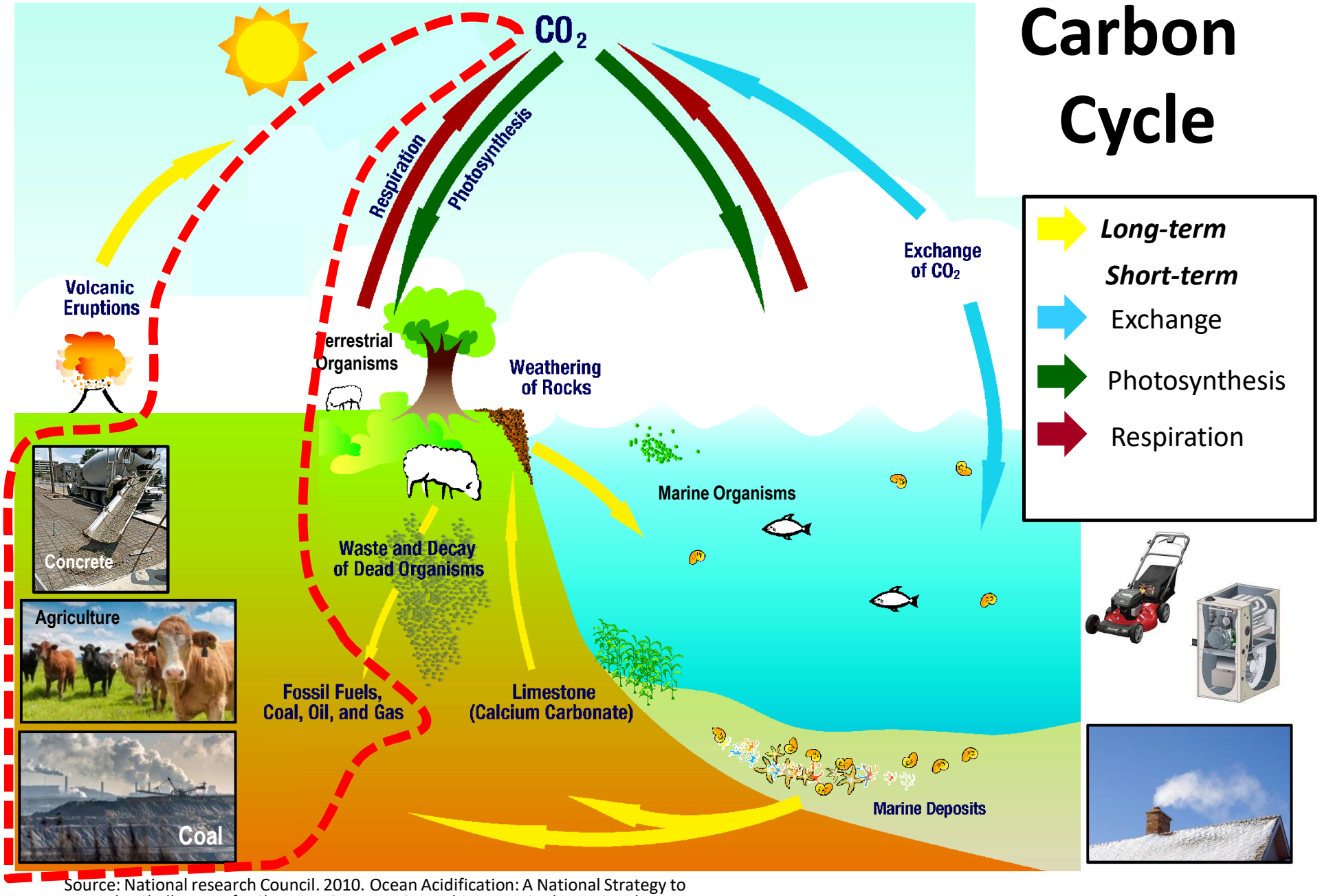
Connecting Land, Water and Communities

May 1-2, 2025

Grand Forks, BC

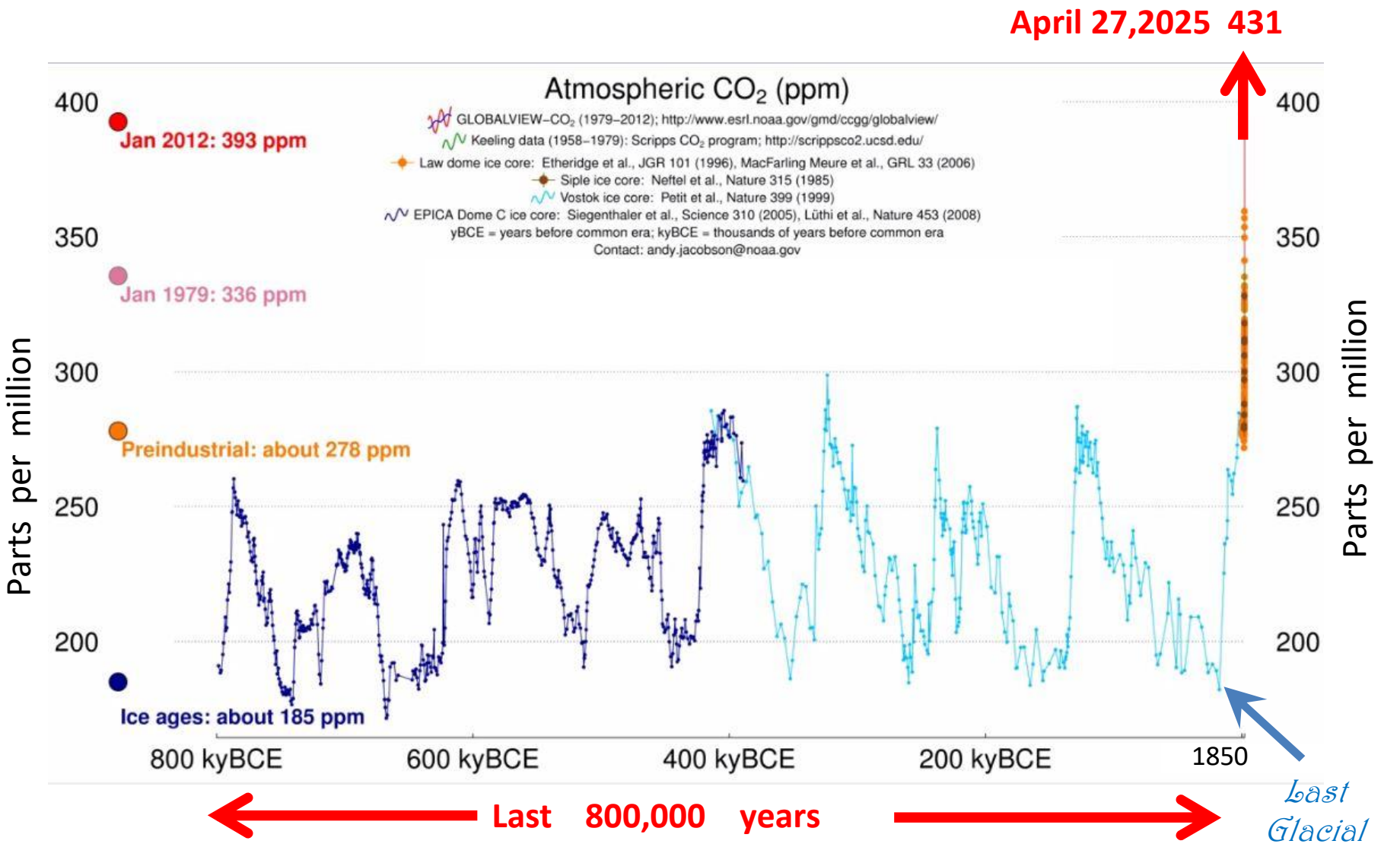
Greg Utzig
Kutenai Nature Investigations Ltd.
Nelson, BC CANADA
g13utzig@telus.net
www.kootenayresilience.org

Carbon Cycle



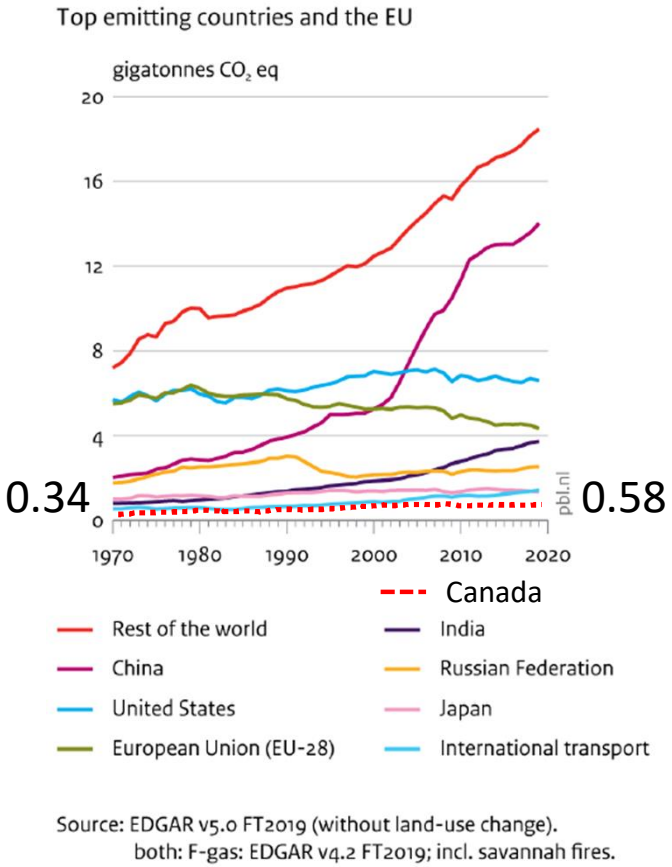
Source: National research Council. 2010. Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean. p. 3. Washington DC: The National Academies Press. Credit: Peter Olsen Photography Moment Getty Images

Long-term CO_2 Accumulation in the Atmosphere



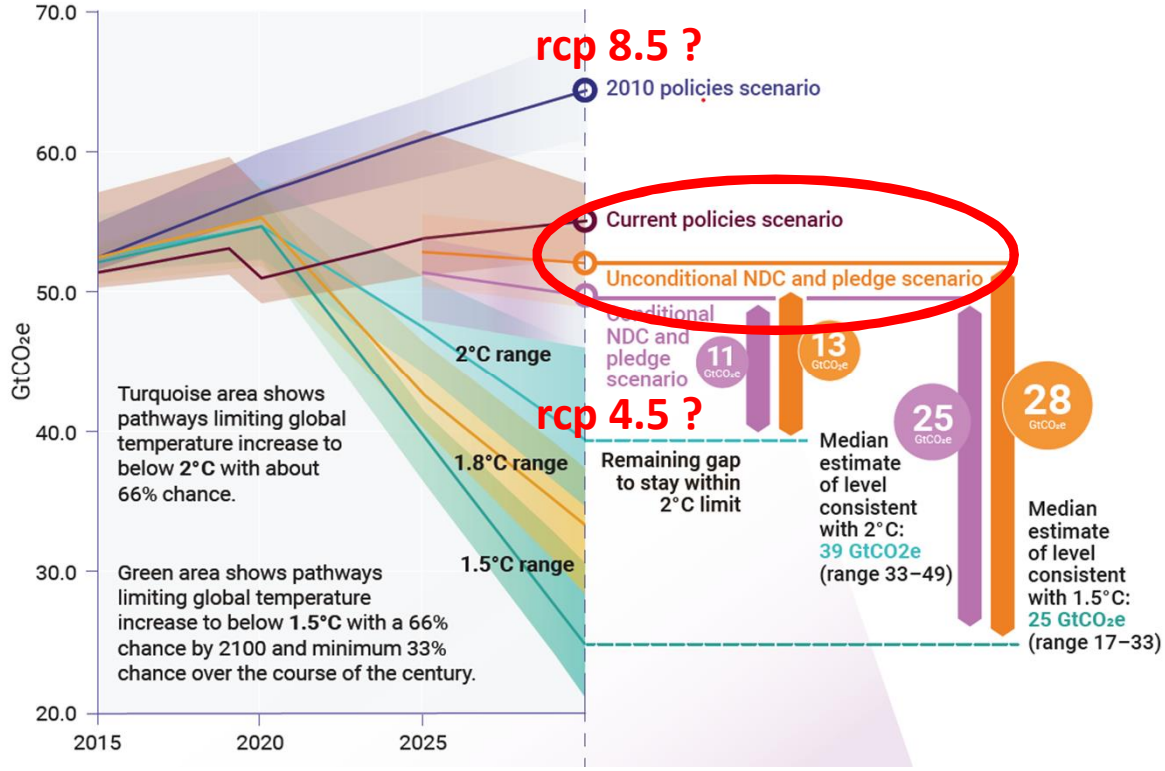
Video on-line at NOAA http://www.esrl.noaa.gov/gmd/ccgg/trends/history.html

Which emission scenario?



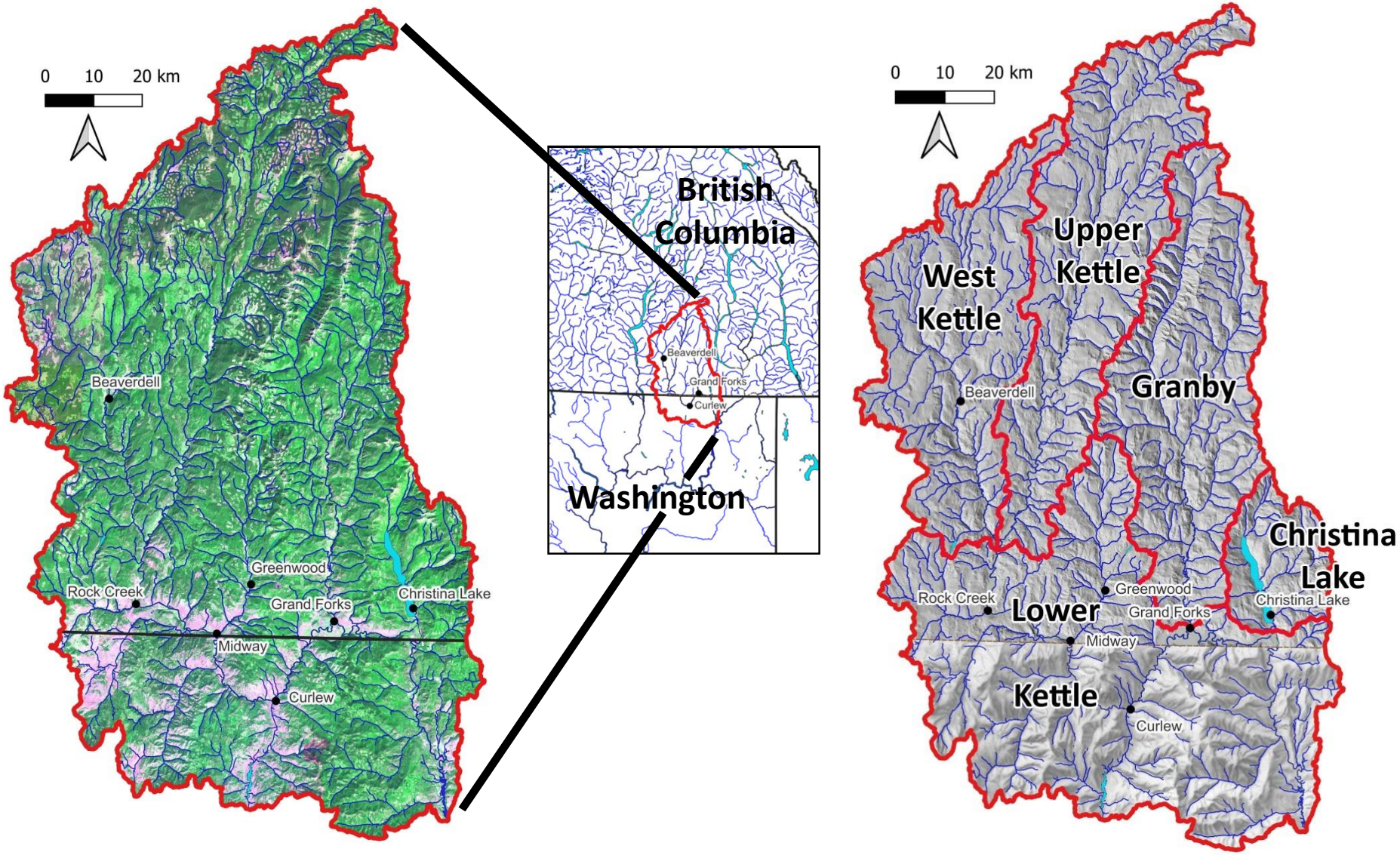
Source: EDGAR v5.0 FT2019 (without land-use change).
both: F-gas: EDGAR v4.2 FT2019; incl. savannah fires.

From: Olivier and Peters 2020
& Global Carbon Budget 2023
https://ourworldindata.org/

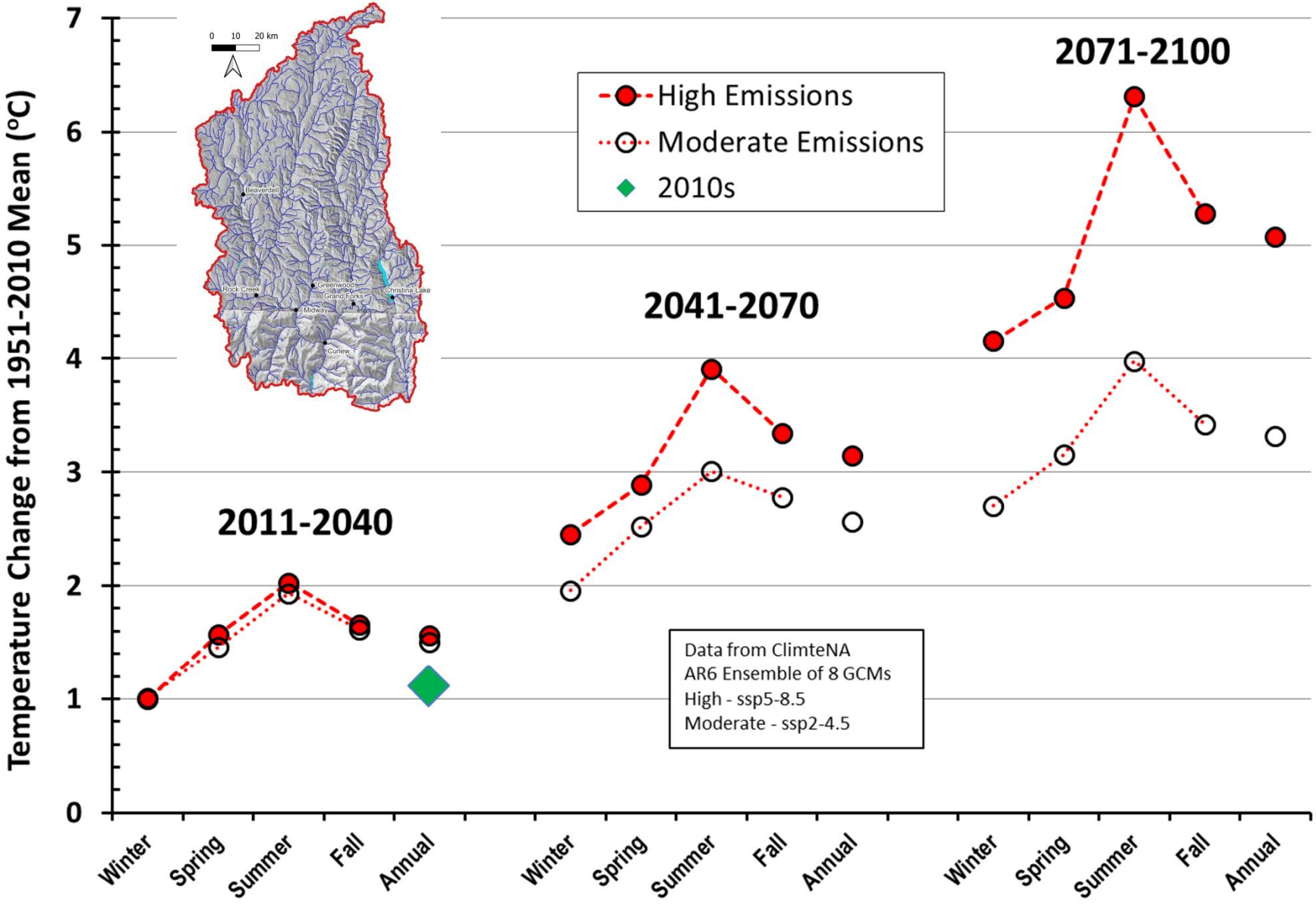


From: IPCC 2021 Gap Report

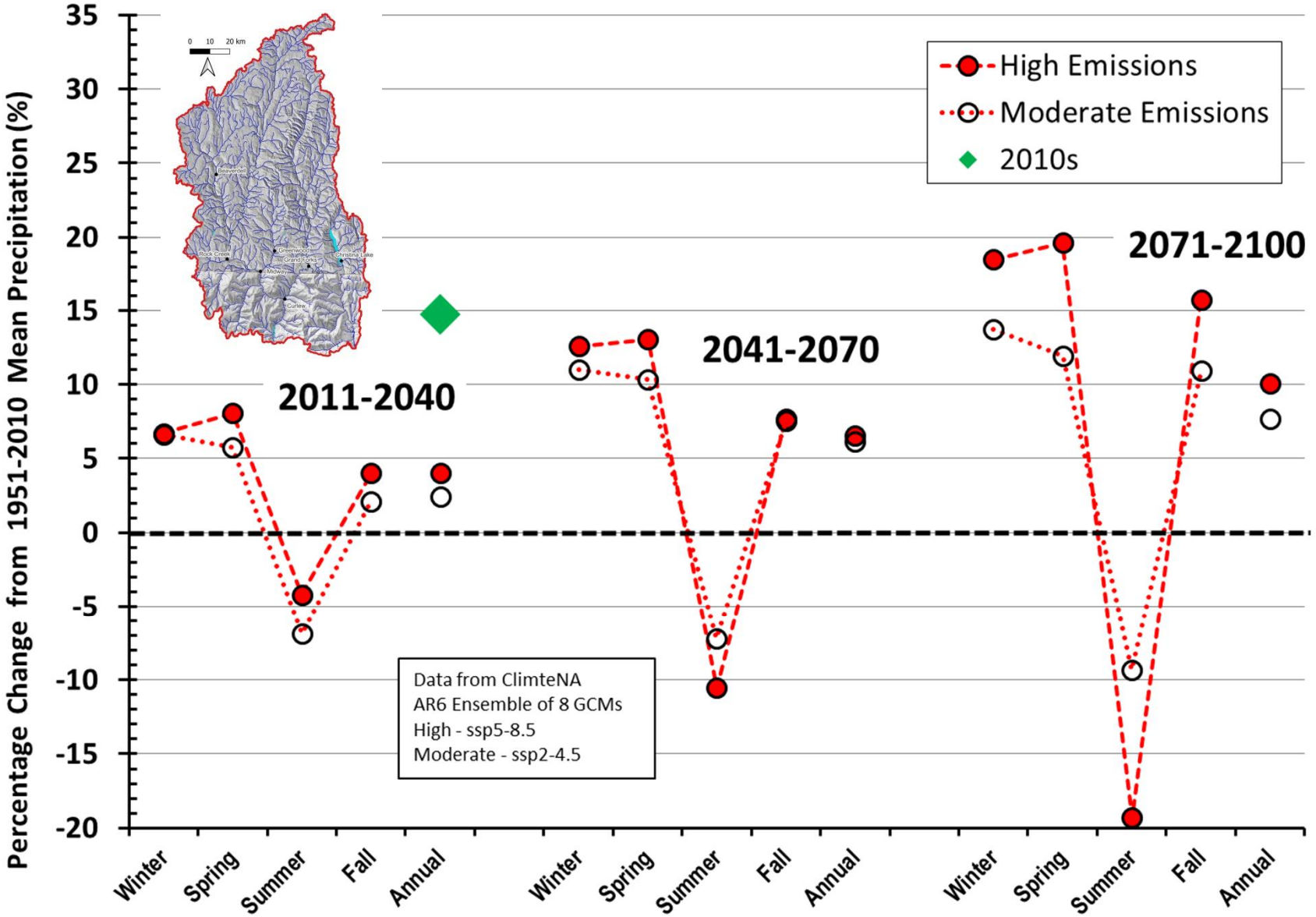
Kettle River Watershed



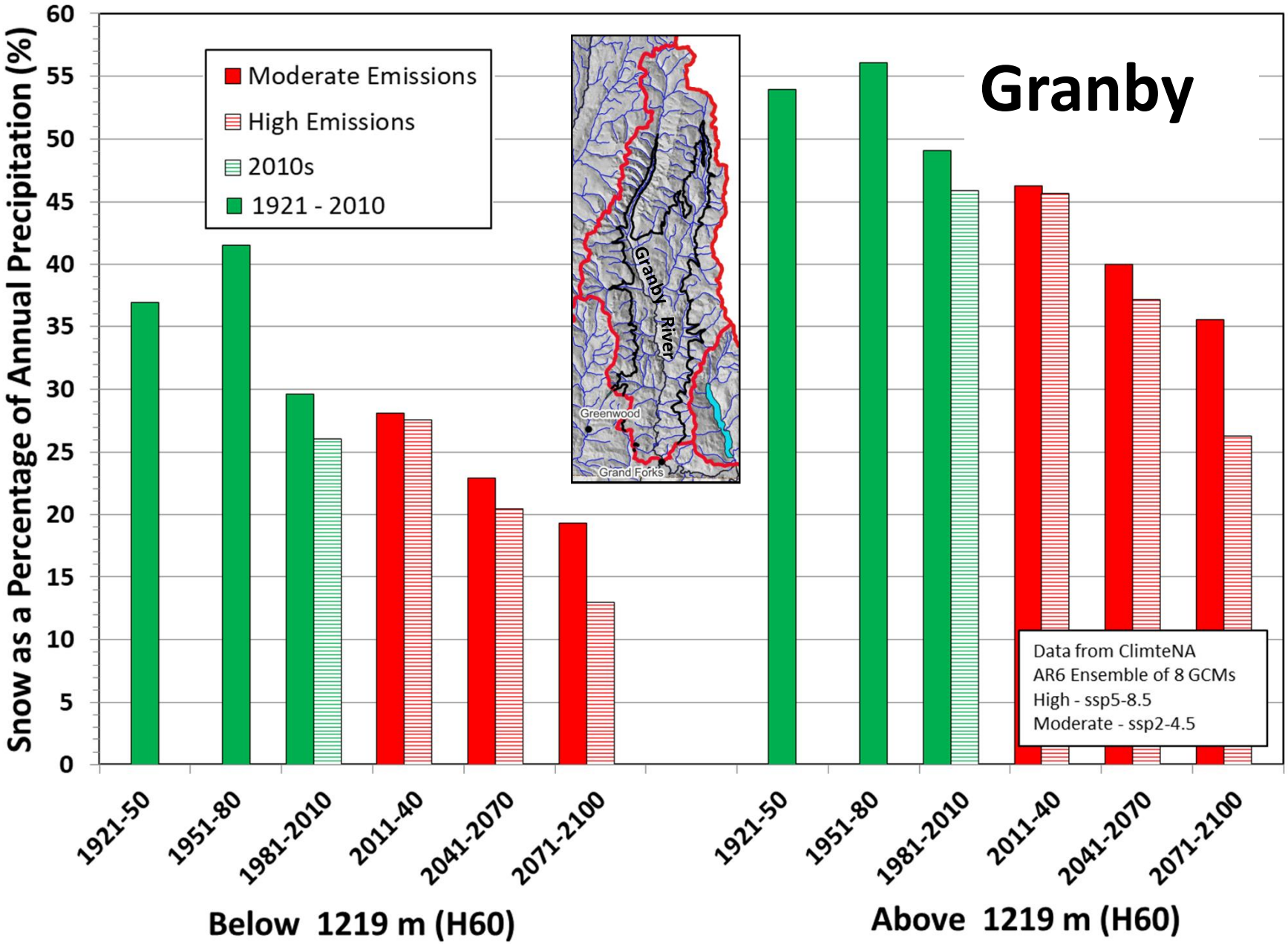
Projected Changes in Temperature – Kettle River Watershed



Projected Changes in Precipitation – Kettle River Watershed



Snow as a Proportion of Precipitation

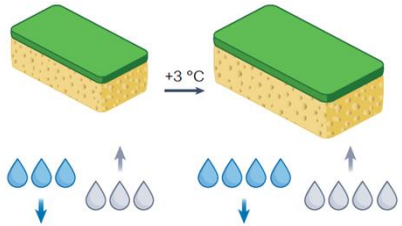


Some Increasingly Relevant Concepts

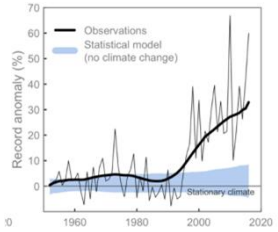
Vapour Pressure:

- **saturation vapour pressure:** how much moisture the atmosphere can hold
- **vapour pressure deficit:** strength of moisture demand from plants or fuels
- **both increase by 7% per degree Celsius**

Atmosphere Holds More Moisture



Increasing Extreme Precipitation



Robinson et al. 2021

Increasing Floods/ Landslides

Increasing Drought

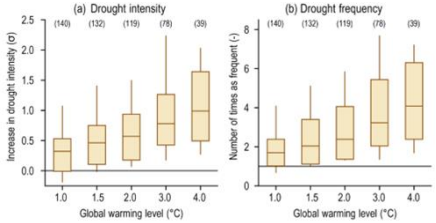
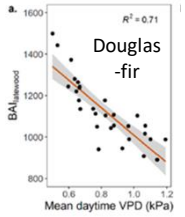


Figure 11.18 in IPCC, 2021

Decreased Transpiration

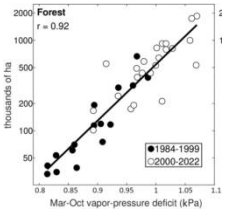
Decreased Tree Growth



Jarecke et al. 2024

Drier Fuels

Increased Area Burned



Novick et al. 2024

Some Increasingly Relevant Concepts

Vapour Pressure:

- **saturation vapour pressure:** how much moisture the atmosphere can hold
- **vapour pressure deficit:** strength of moisture demand from plants or fuels
- **both increase by 7% per degree Celsius**

Atmospheric Volatility (climate whiplash):

- sudden, large and/or frequent transitions between very dry and very wet conditions

Increasing Drought

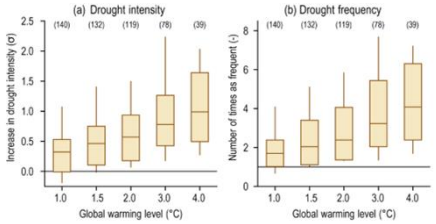
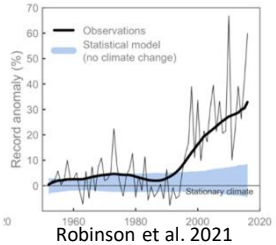


Figure 11.18 in IPCC, 2021

Increasing Extreme Precipitation

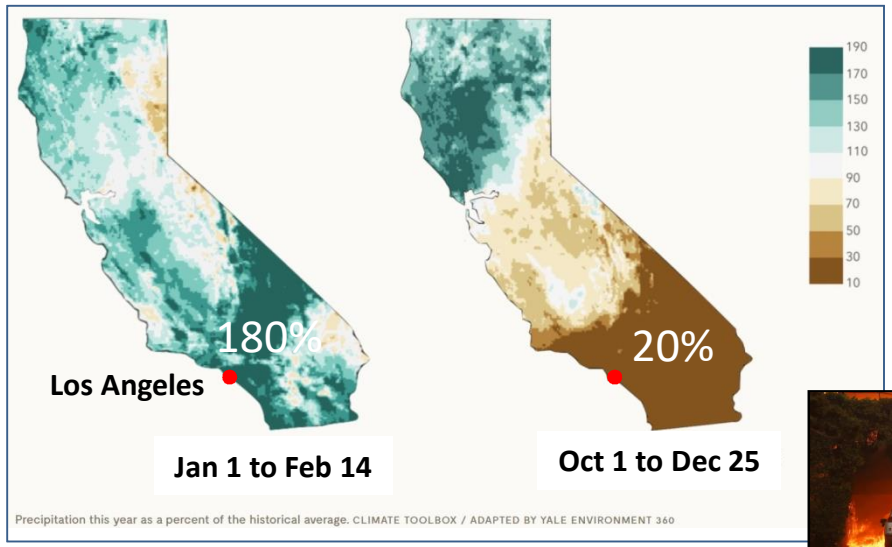


Robinson et al. 2021

Atmospheric Volatility/ Climatic Disasters

California Precipitation 2024

(% of normal)



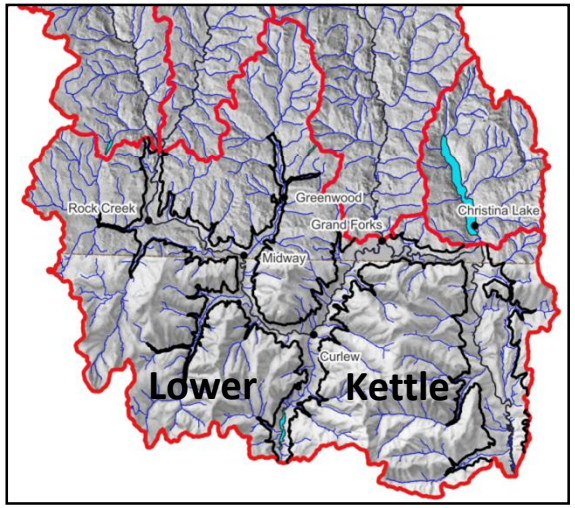
Los Angeles Wildfire

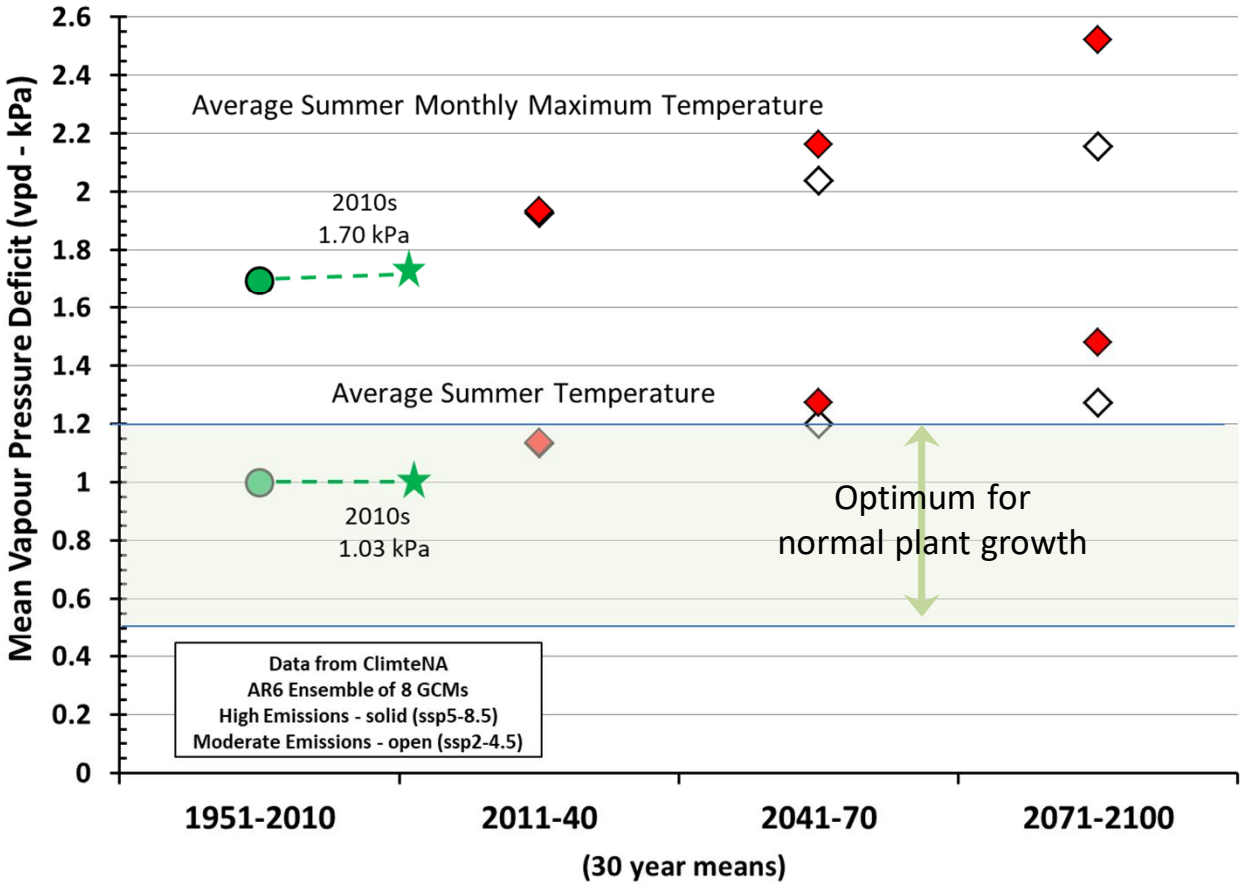
AP 2025

Vapour Pressure-Deficit, or VPD

"the difference between the amount of moisture in the air and how much moisture the air can hold when it is saturated"

Historic and Projected VPD Valley Bottom for Lower Kettle (<865 m)

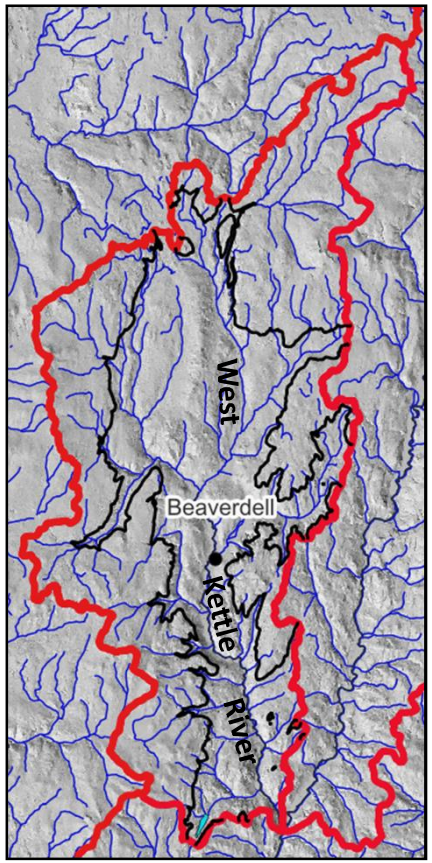


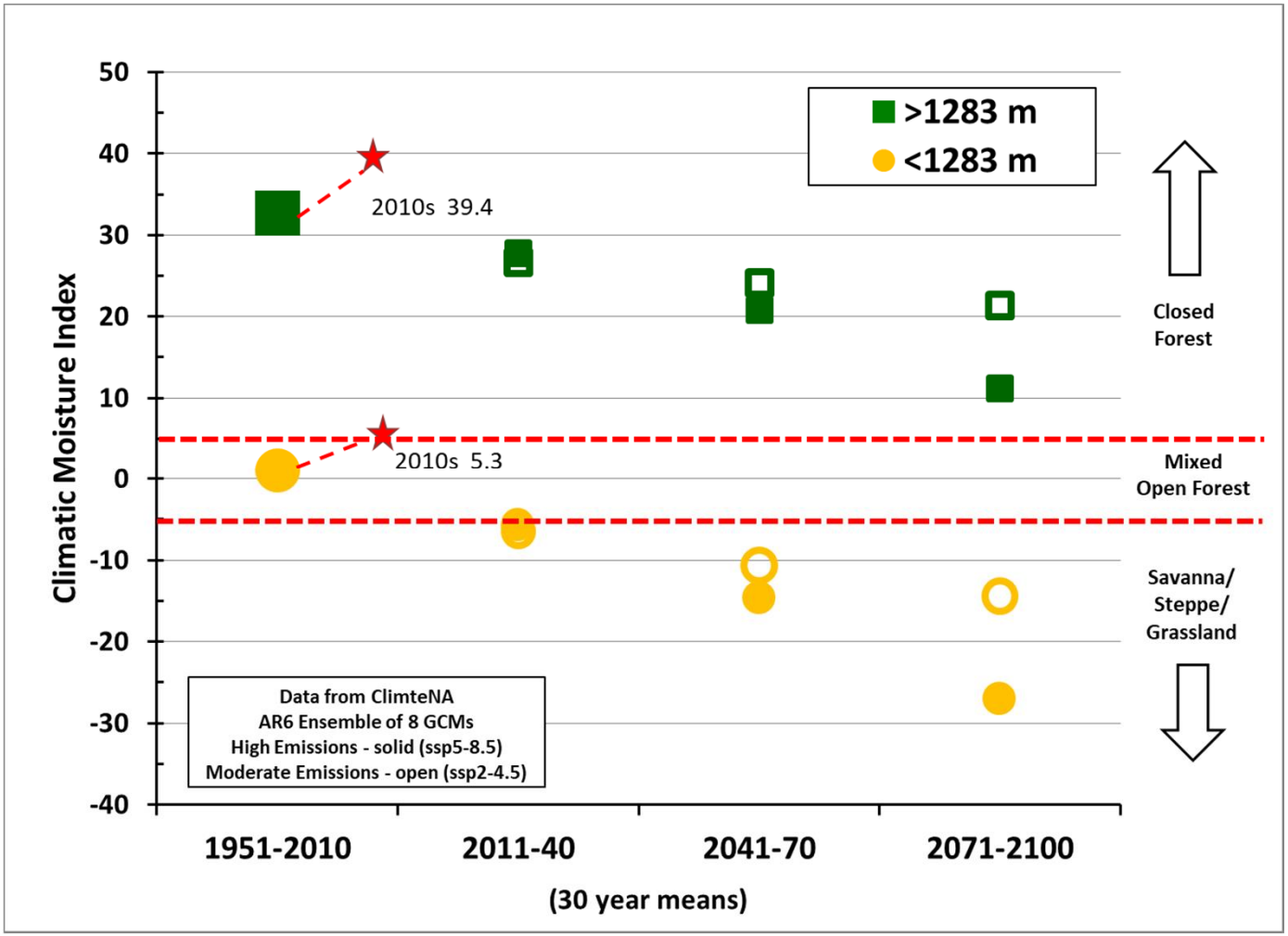


Projected Changes in Climatic Moisture Index (CMI)

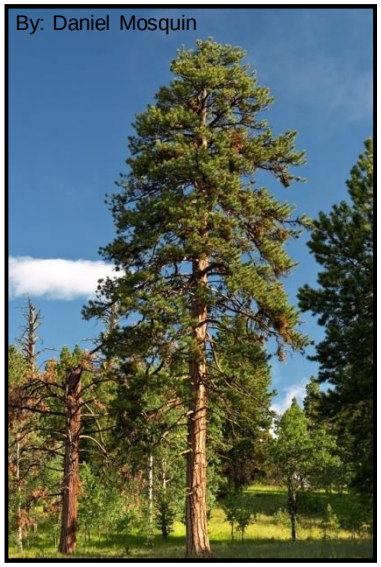
CMI = (annual precipitation) – (annual potential evapotranspiration)

Two elevation bands in the West Kettle

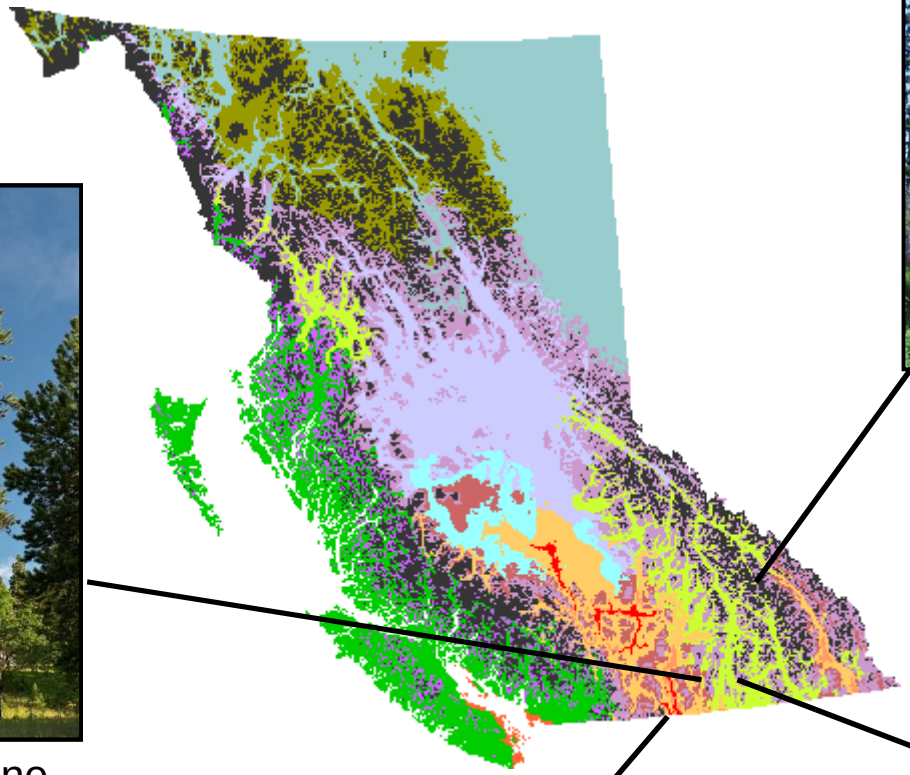




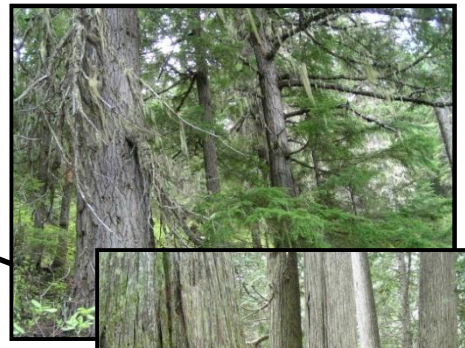
Biogeoclimatic (BEC) Zones



Ponderosa Pine



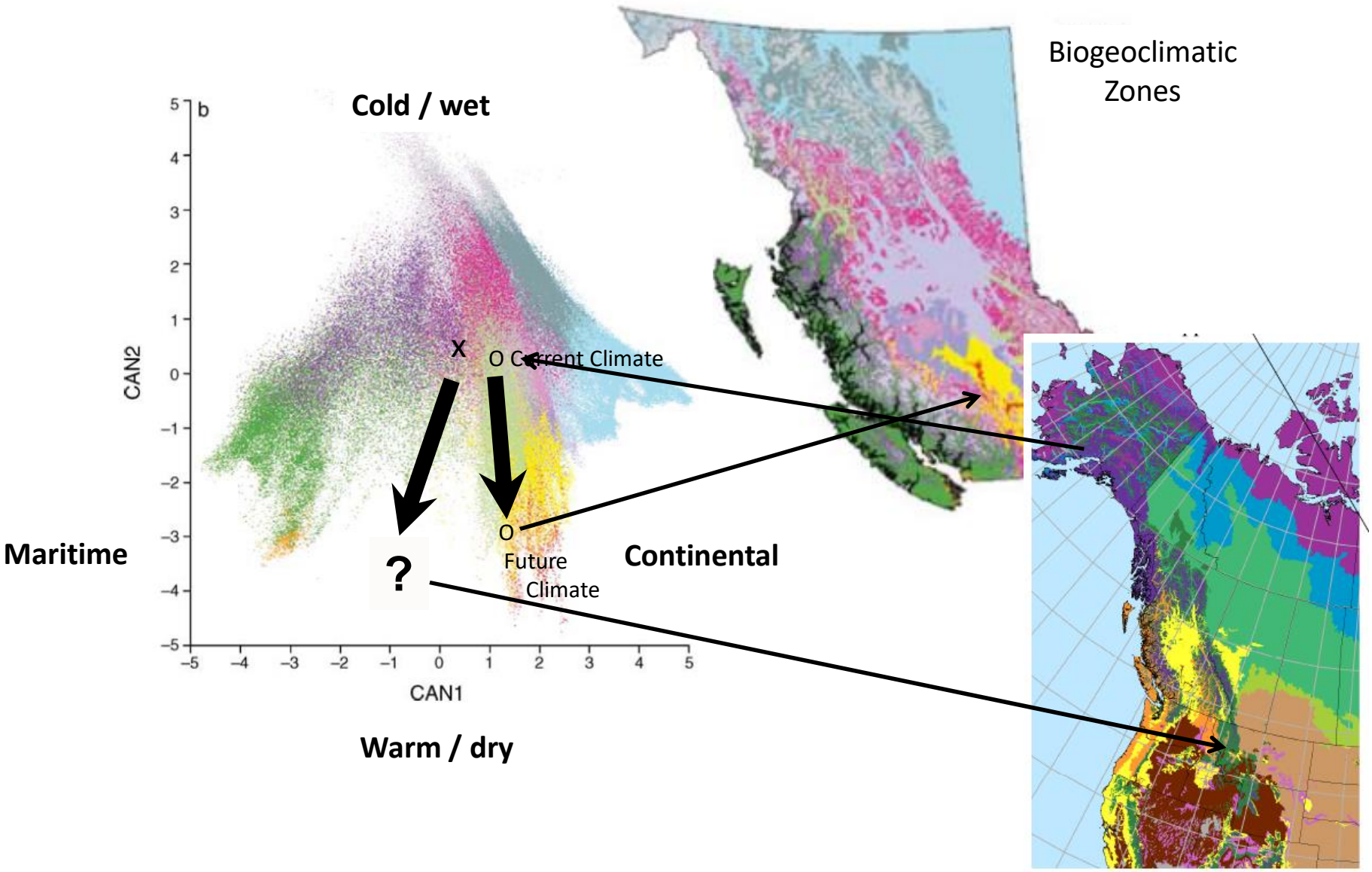
Engelmann Spruce ï
Subalpine Fir



Interior Cedar ï
Hemlock

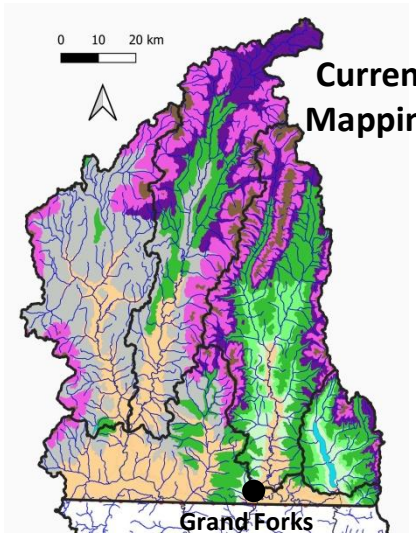
Grasslands/
Sage Brush

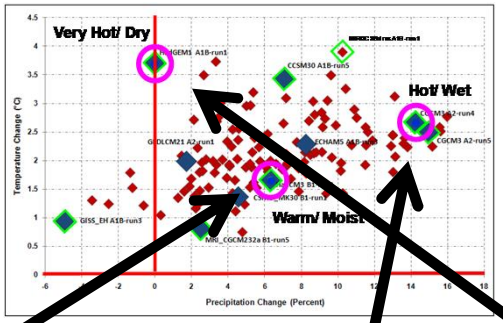
Ecosystem Units as "Bioclimate Envelopes"



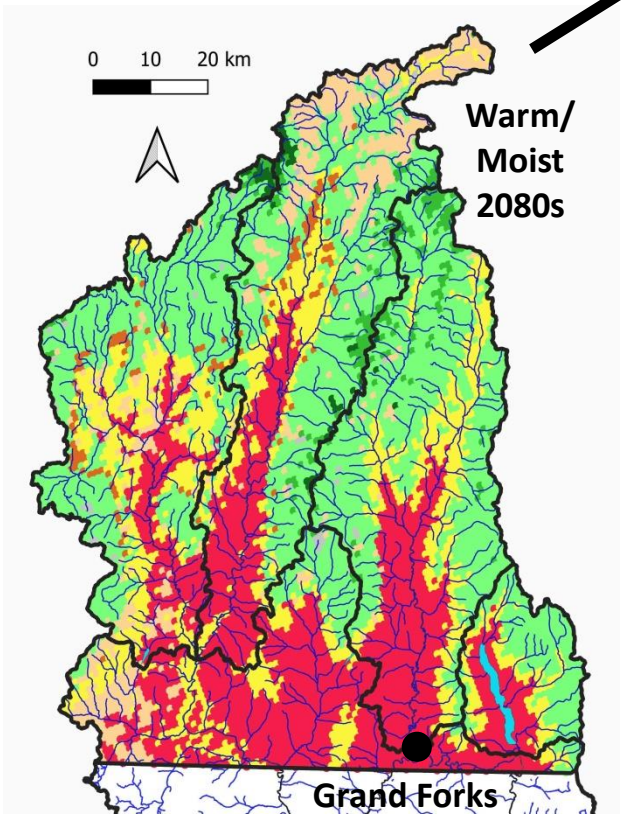
Adapted from: Hamann and Wang 2006 & Roberts and Hamann 2011
Canonical discriminant analysis of PRISM data by BEC Unit

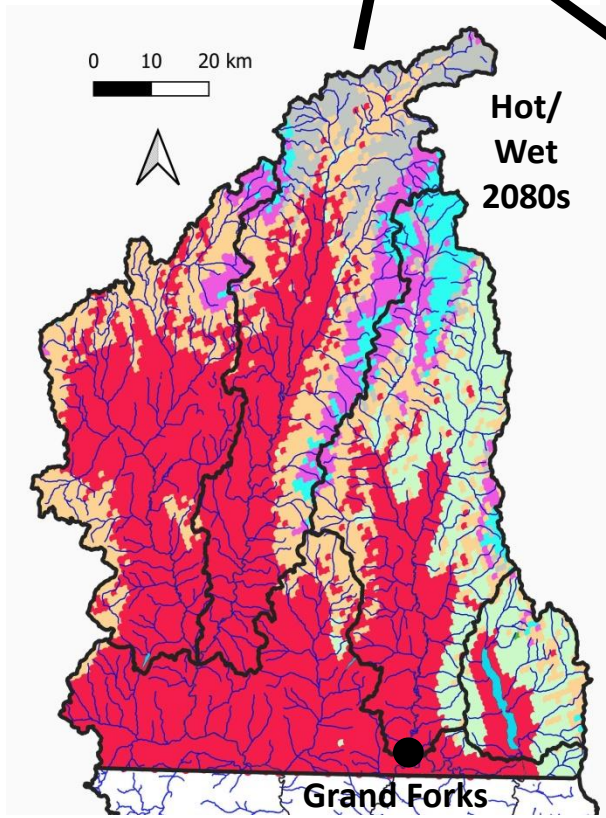
Range of Projected Bioclimate Envelopes

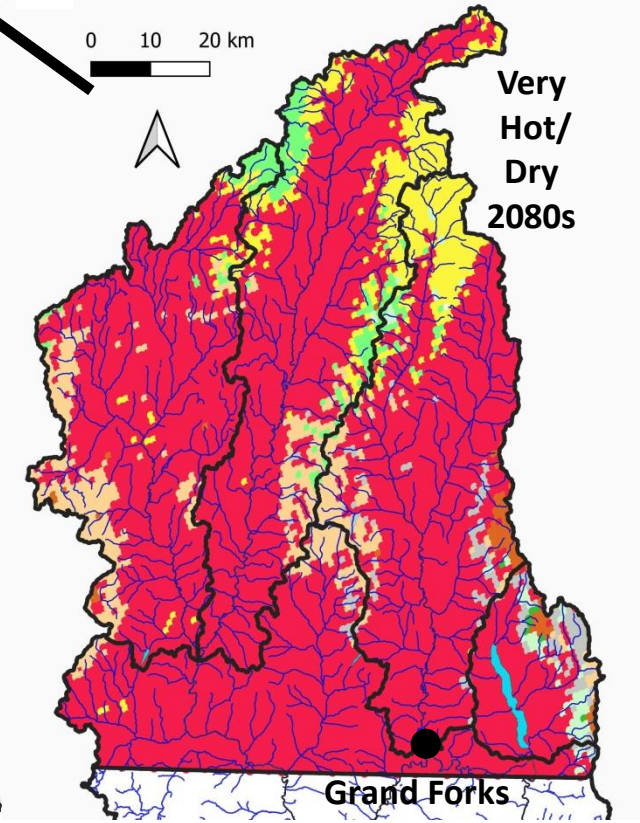




- Alpine
- Alpine parkland
- Wet subalpine forest
- Dry subalpine forest
- Coastal hemlock
- Transitional coast/ interior hemlock
- Montane/sub-boreal spruce forest
- Wet interior cedar/ hemlock
- Moist interior cedar/ hemlock
- Dry interior cedar hemlock
- Grand fir/ Douglas-fir
- Wet Douglas-fir
- Dry Douglas-fir
- Ponderosa pine savanna
- Grassland/ steppe

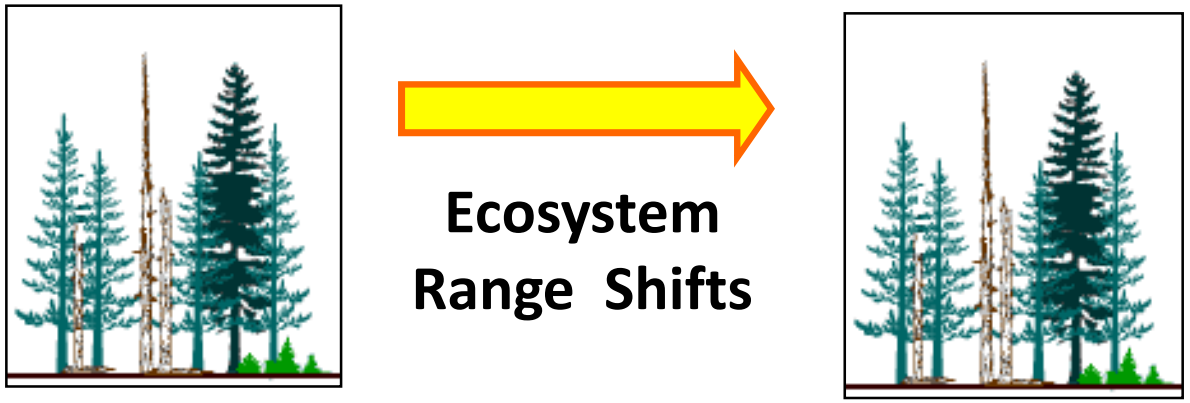






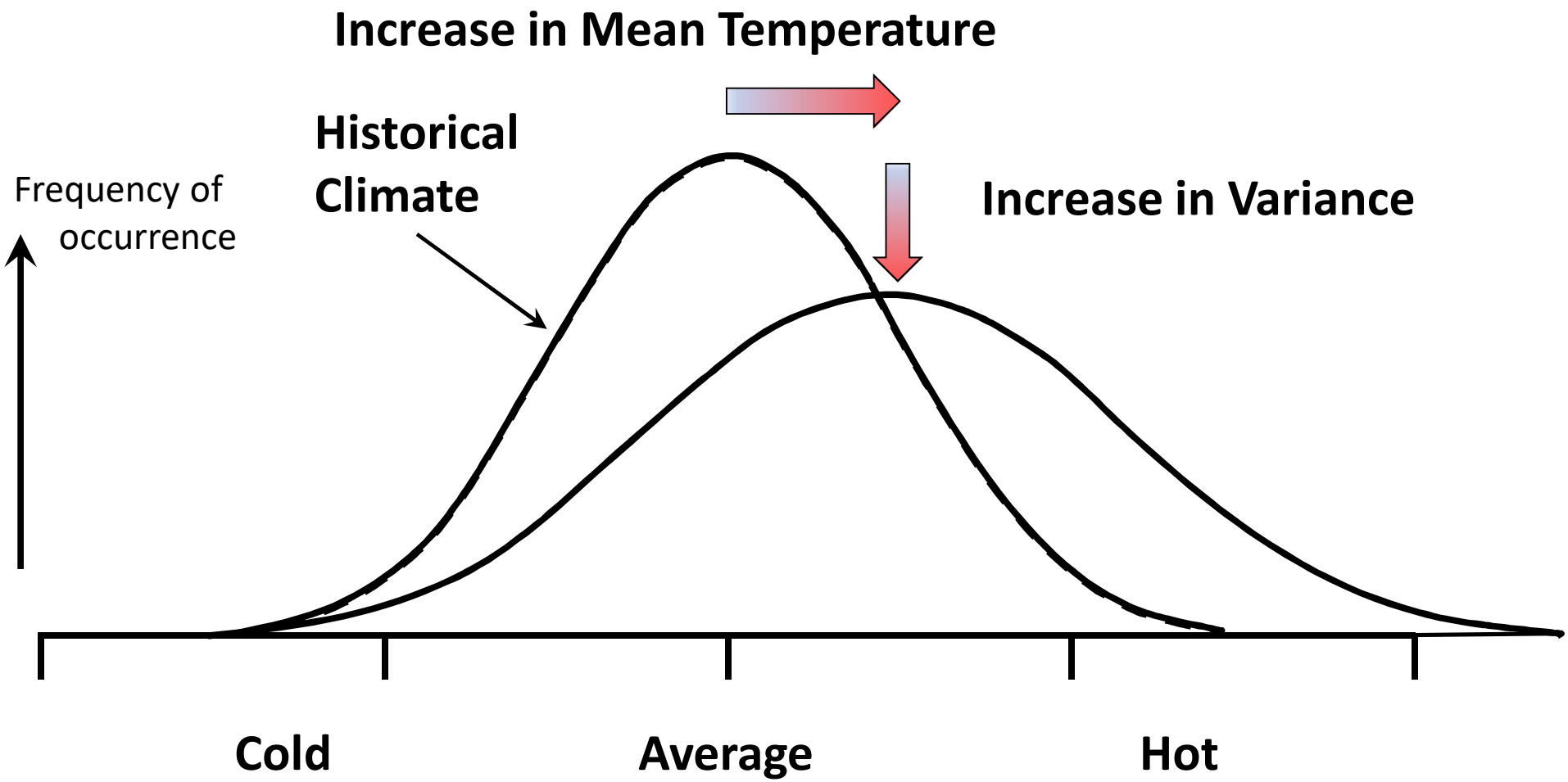
G. Utzig; original data from: Roberts and Hamann, U of A; AR4 GCMs and emission scenarios: HadCM3_B1, CGCM3_A3, HadGEM_A1B and Mackillop

Ecosystem Response



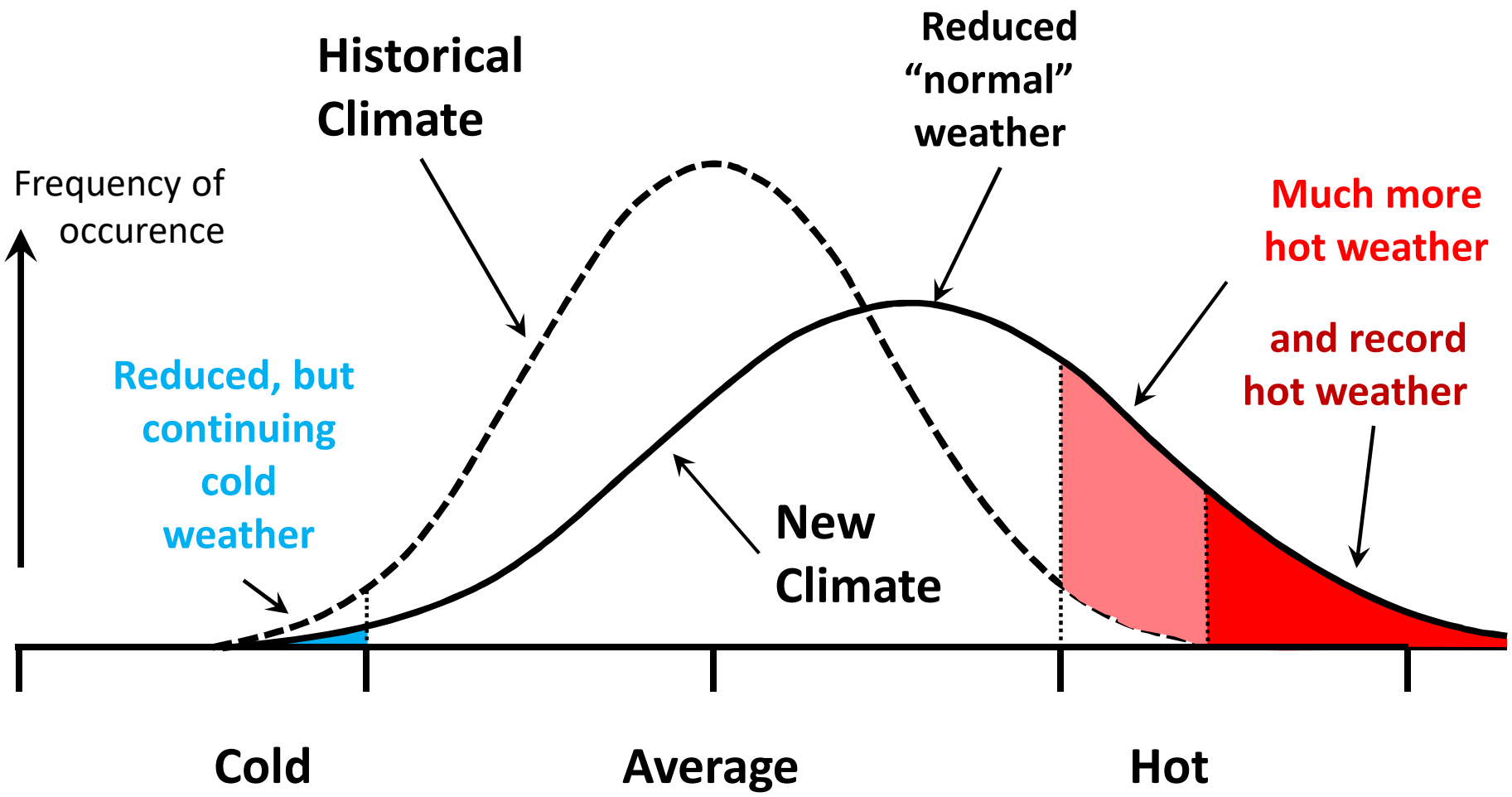
Ecosystem Re-organization

Global Warming or Climate Change ?



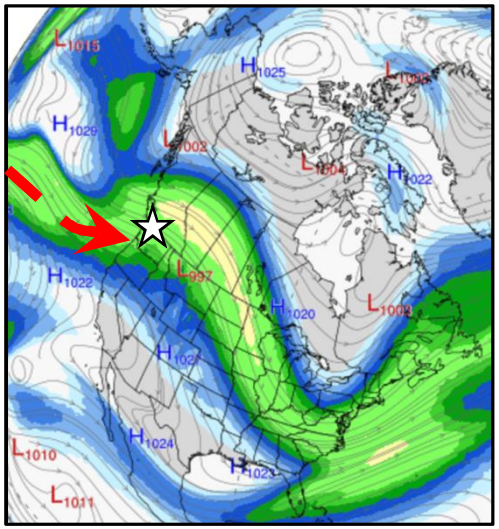
Adapted from: IPCC & Reasoner 2012

Increase in Mean Temperature & Variance



Adapted from: IPCC & Reasoner 2012

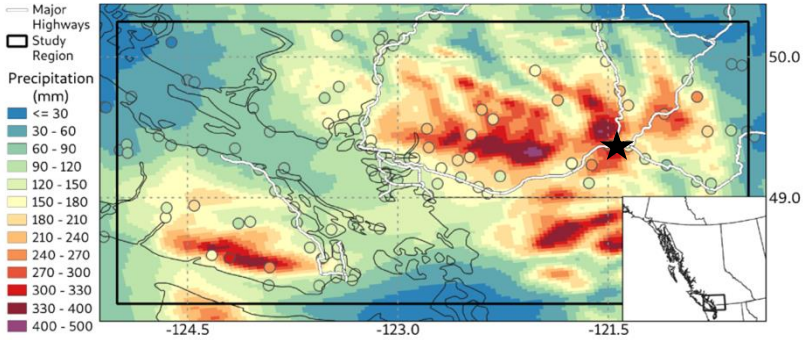
BC Extreme Precipitation 2021



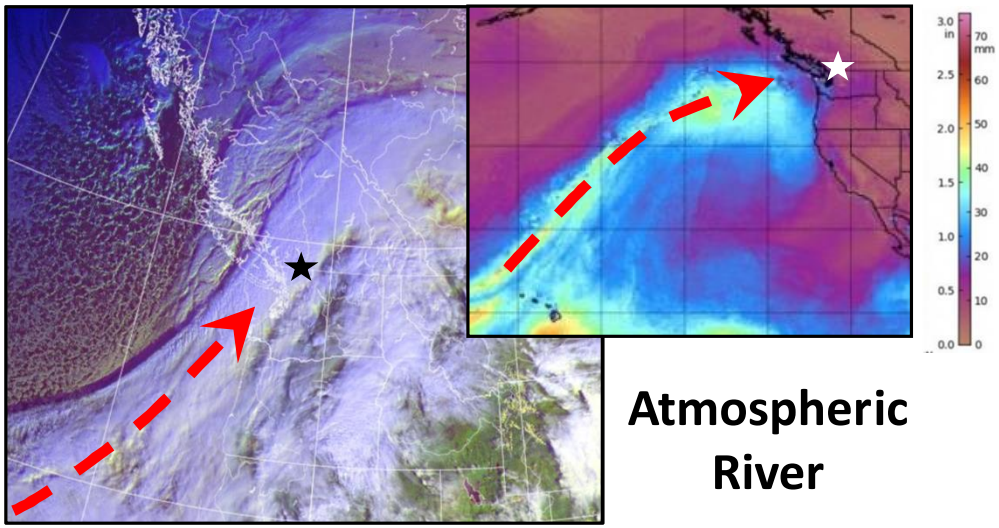
Jet Stream Configuration

Mid November

Precipitation Nov. 14-15



November 15, 2021 **November 13, 2021**



Atmospheric River

Attribution analysis – with climate change:

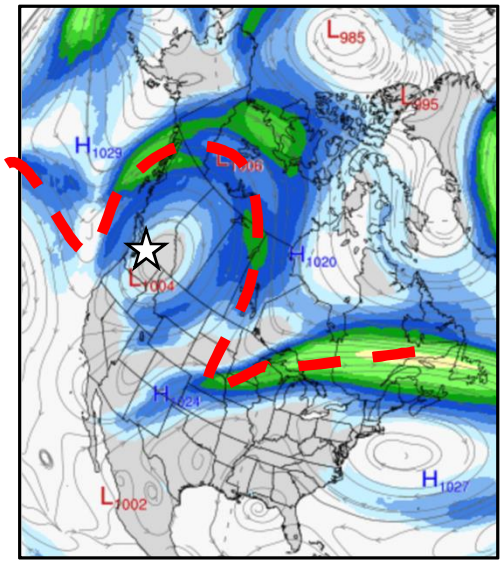
- atmospheric river of this magnitude 1 in 10 year event but 60% more likely
- 2-day precipitation 1 in 50-100 year event but 50% more likely
- extreme streamflow 2 to 4 times more likely
- wet soils and rain-on-snow also contributed

Image from Climate Reanalyzer, Climate Change Institute, U of Maine, USA http://cci-reanalyzer.org". Natural Resources CAN

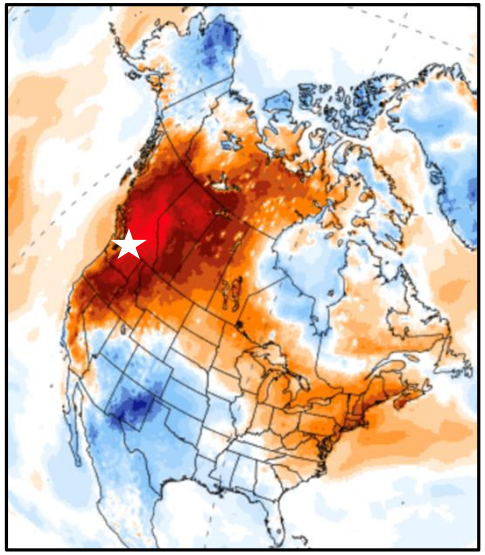
Other Sources: BC MoTI; Divergent Weather; Gillett et al. 2022;

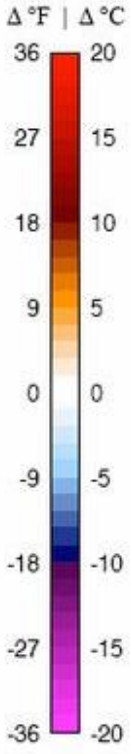
G. Utzig, P. Ag. 2/10/22
Kutenai Nature Investigations Ltd.

BC Extreme Heat/ Fire 2021

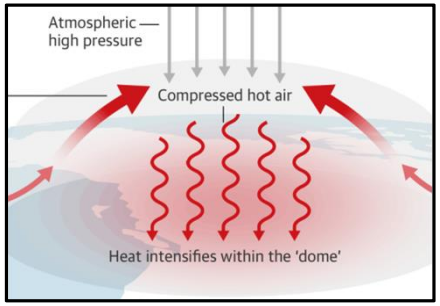


Late June 2021

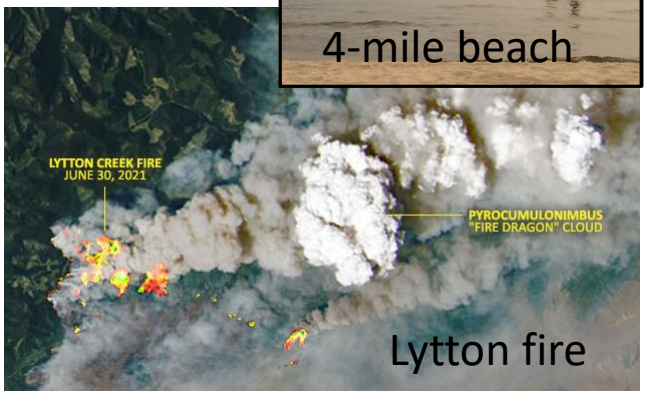




Jet Stream Configuration



Heat Dome



BC heat-related deaths: 619

Temperature Anomaly Compared to 1979-2000 Average

Attribution analysis:

- 1 in 1000 year event but 150 times more likely with climate change
- with 2°C warming – every 5-10 years by 2050

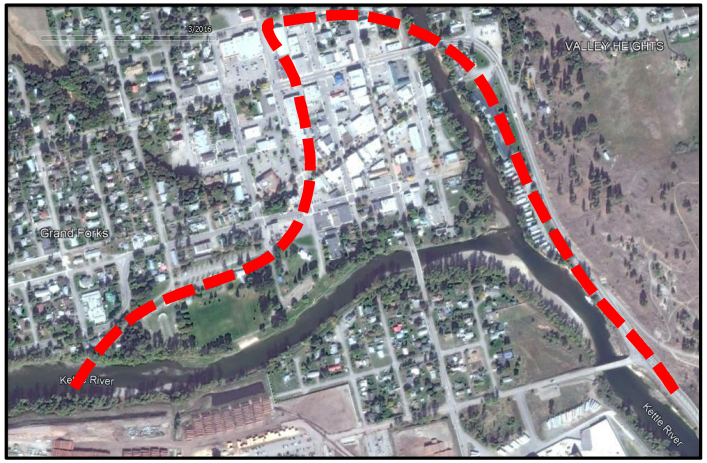
Images from Climate Reanalyzer, Climate Change Institute, U of Maine, USA http://cci-reanalyzer.org

Other Sources: Sjoukje et al. 2021; NASA Earth Observatory; The Guardian.

G. Utzig, P. Ag. 2/10/22
Kutenai Nature Investigations Ltd.

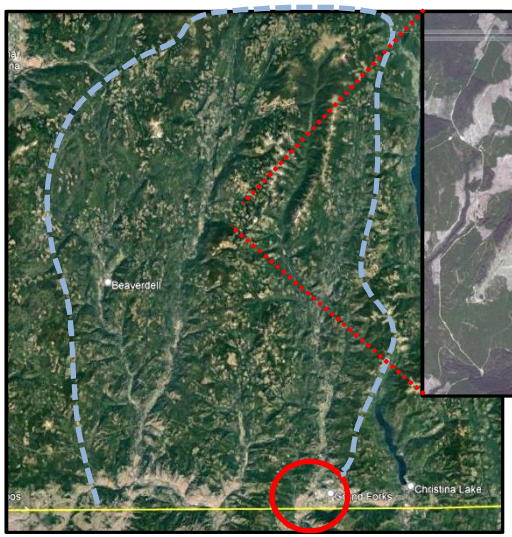
A Climate Disaster ?

Grand Forks Flooding 2018



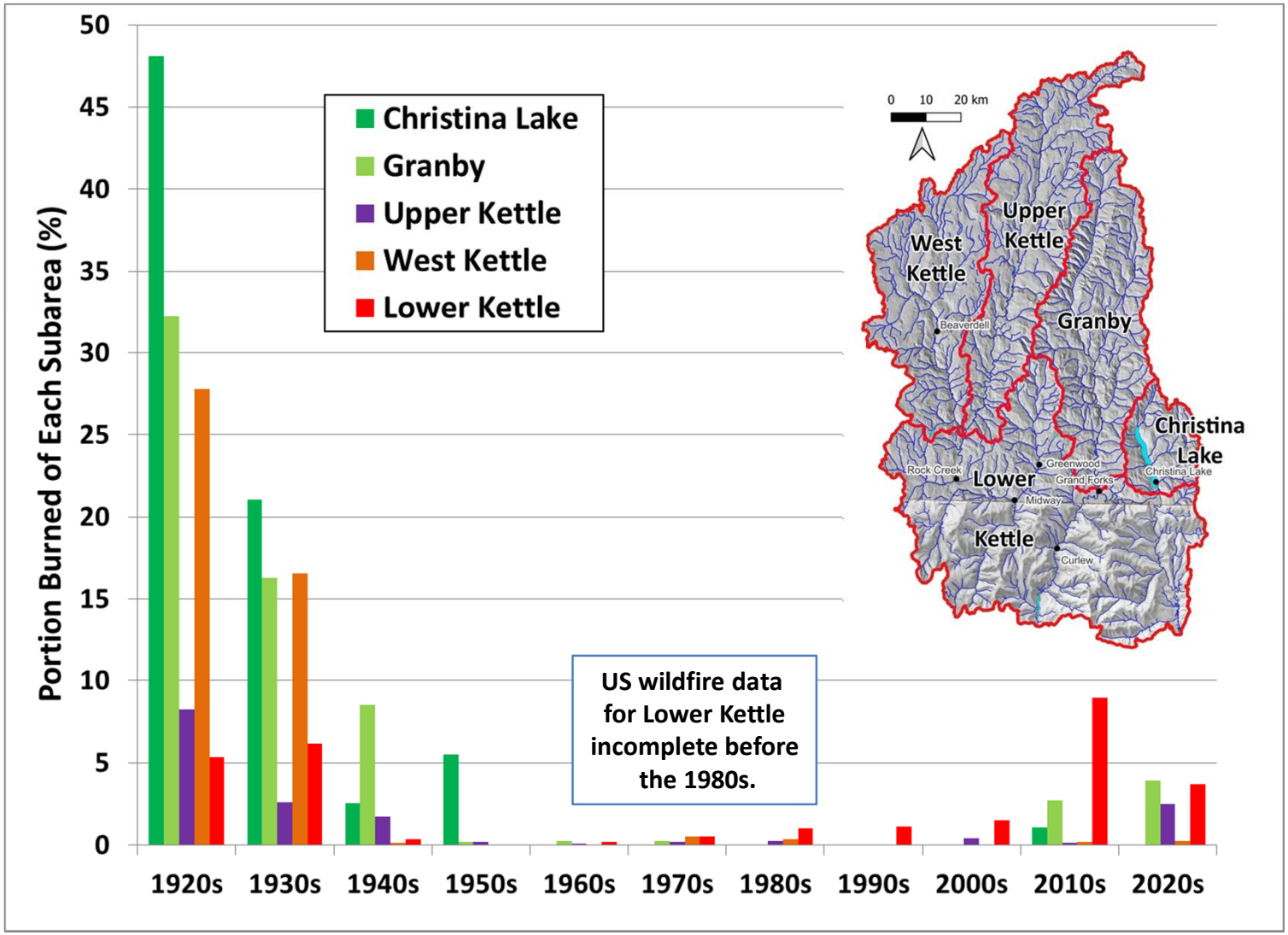
Rafferty Baker CBC 5/11/18

Sgt. Mike Wicentowich

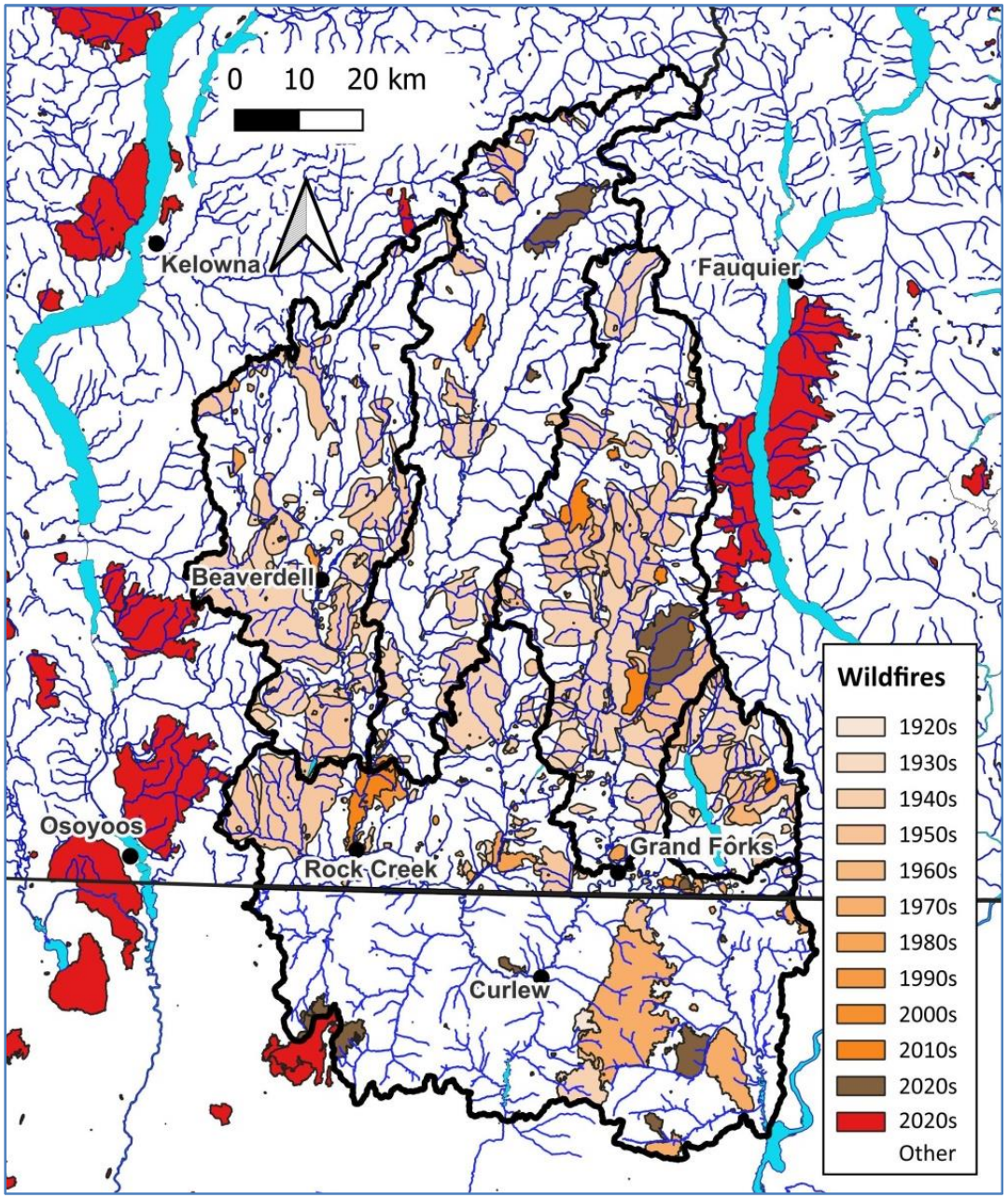


Or Deficient Forest Management?

Wildfire History

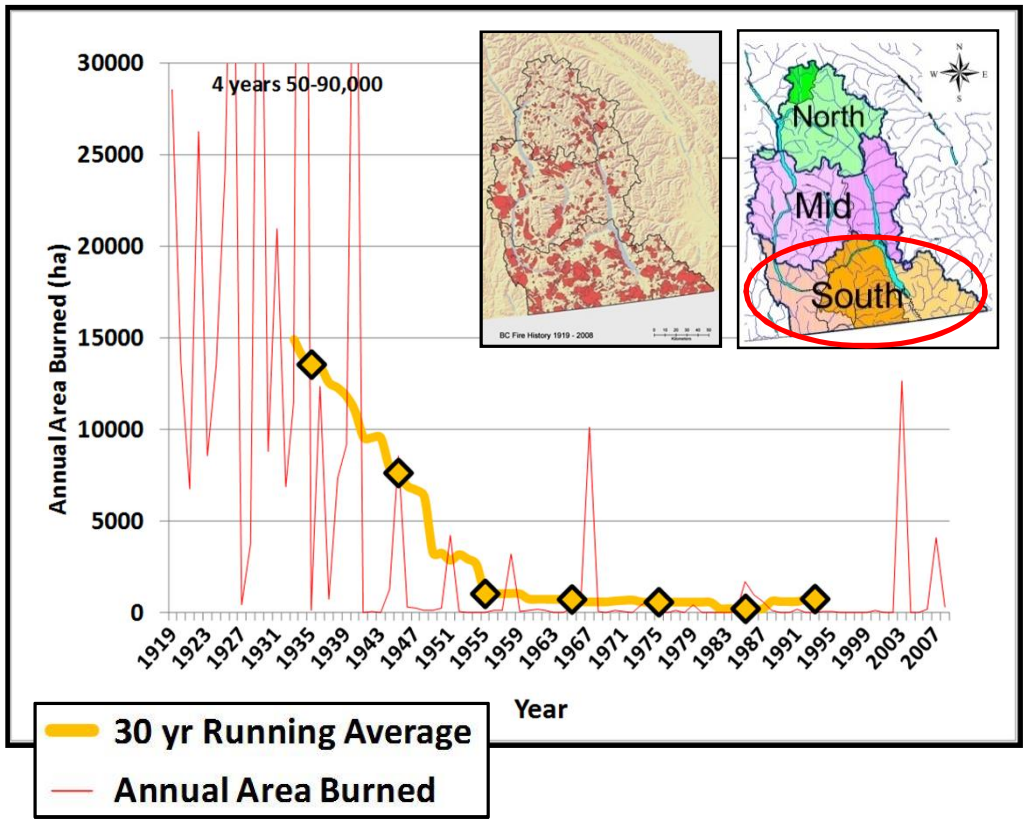


Wildfire History



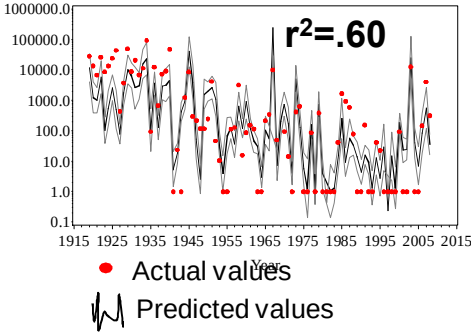
US wildfire data for Lower Kettle incomplete before the 1980s.

Southern West Kootenay Area Burned




Kutetl 2003

Jordan 2007



Multiple Regression Analysis

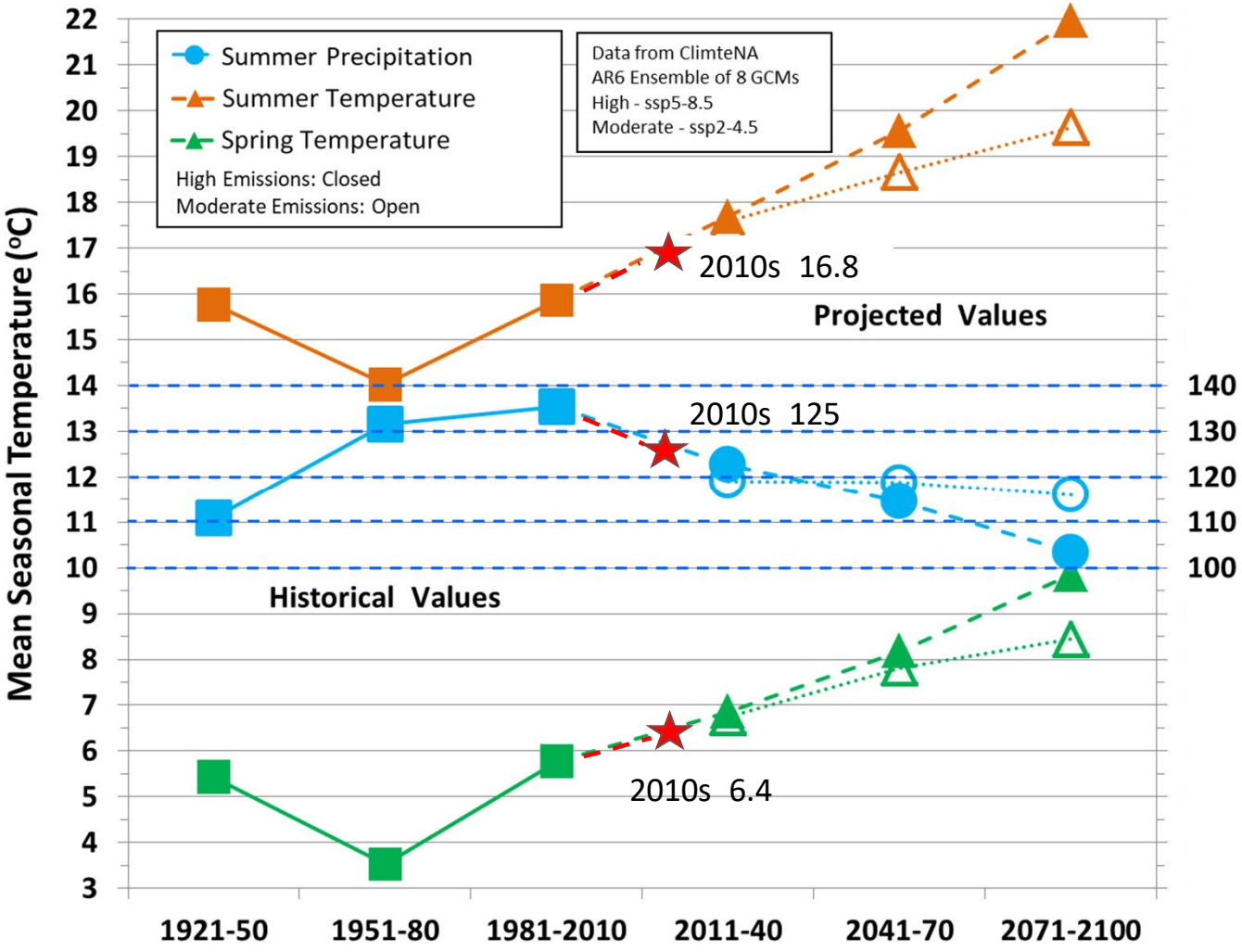

Touchstones Archives, Nelson

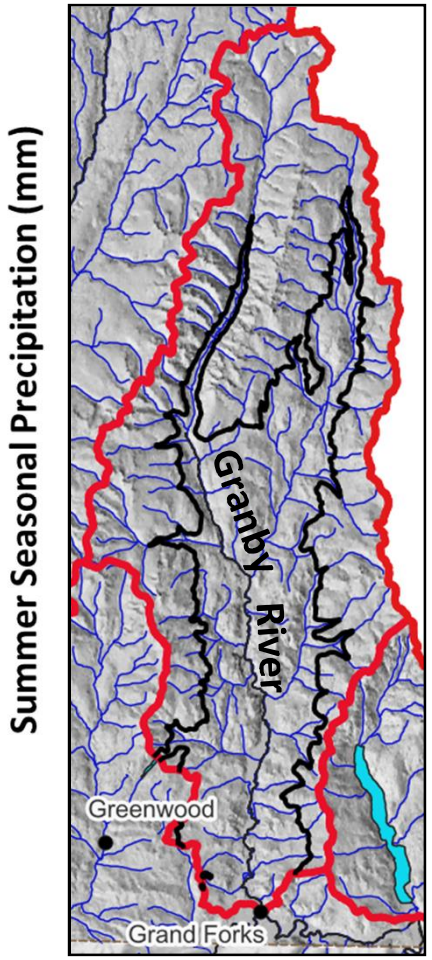
Predictor Variables

- Mean maximum temperature of hottest month (+)
- Climatic moisture deficit (+)
- June precipitation(-)
- Precipitation of month before/after hottest month (-)

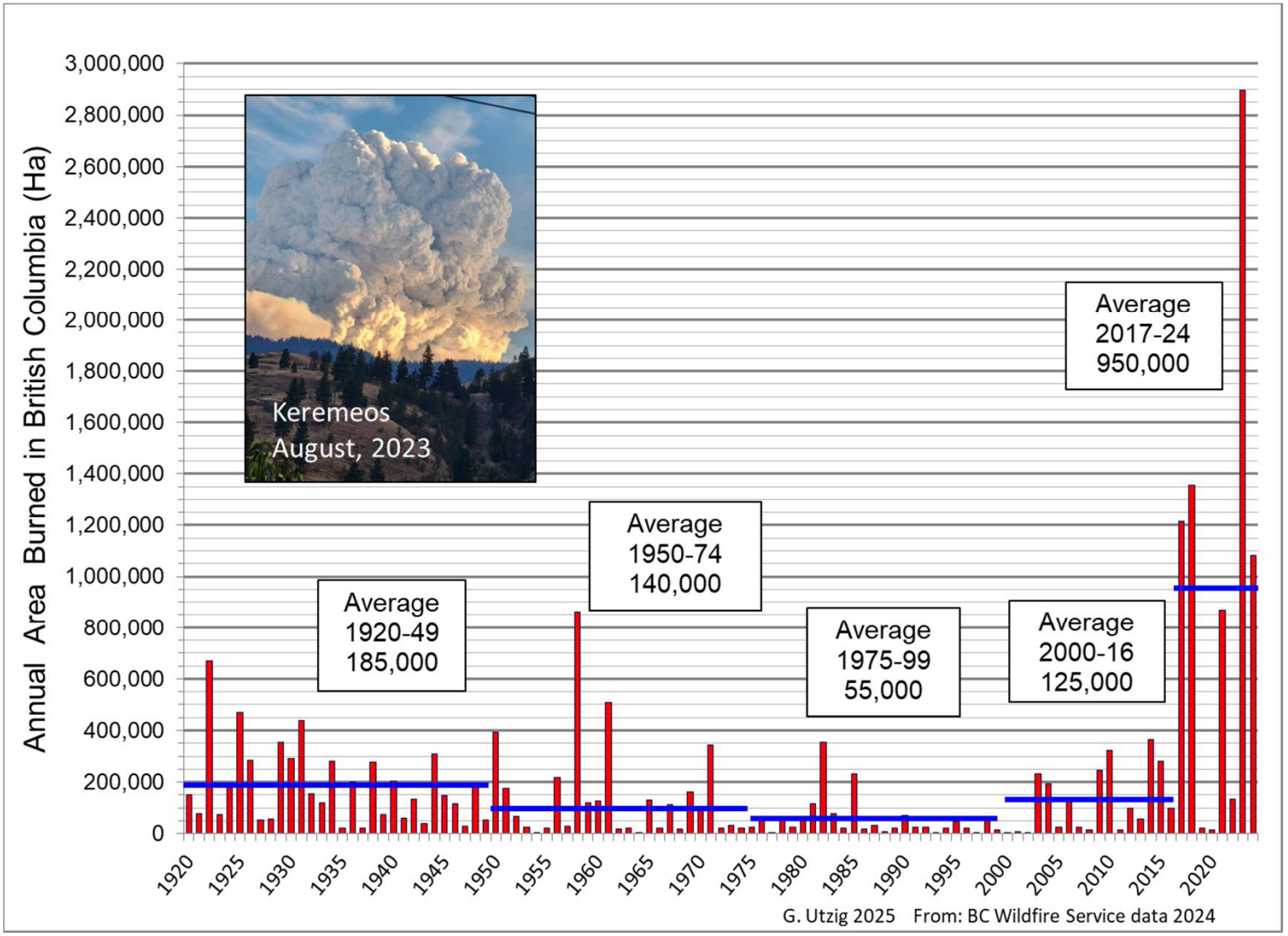
Climate Projections and Wildfire

Lower Elevations of Granby Watershed (< 1219 m)





Historical Wildfire in BC



Climatic Interactions – 2003/2004

Heat Wave / Drought / Fire / Rainstorm - Kuskanook

Upslope Wildfire (2003)

Water–repellent Soils

Summer Rain Storm

Debris Flow (2004)

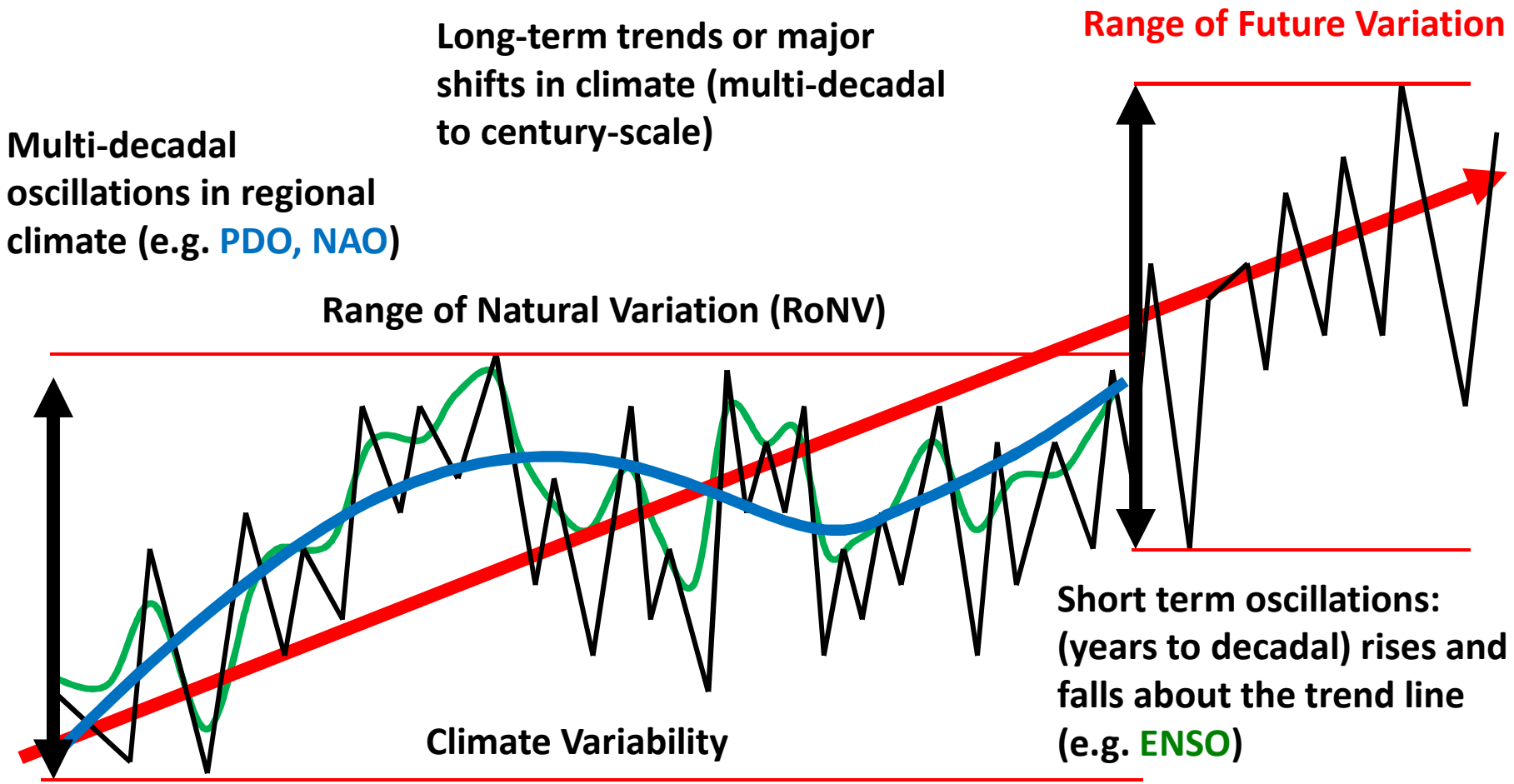
Impacts

- 2 houses destroyed
- Other buildings damaged
- Highway blocked
- Ongoing future risks

Photos: Peter Jordan

Weather and Climate Variability

Climate Change



Options and Actions

- Investigate projected changes – bioclimates, disturbance regimes, species range shifts – equip yourself with scientific facts and projections!
- Use the past to understand relationships – **not** as a template for future conditions
- Devise strategies for resilience based on **projected changes and risks** – ecosystems are going to change – the past is not really an option
- Use creativity and innovation – try **new** things
- Investigate and prepare for **extreme events**
- **Be open to new learning** – e.g. “if tree water stress stems primarily from atmospheric aridity, then thinning could prove ineffective for mitigating drought and may **even worsen** physiological water stress by intensifying atmospheric aridity below the canopy.” Jarecke et al. 2024
- Advocate for the end of **GHG emissions** – ALL fossil fuels stay in the ground!
- **Embrace uncertainty**

It is all about that thin little layer of air

Eliminating GHG emissions is the only real answer

ñWe have options, but the past is not one of themò

Sauchyn and Kulshreshtha 2008, p.295

ñTimes have changed ï no longer is our goal sustainable development é . our goal must now be sustainable survivalò

Blackstock 2008, p.15

www.kootenayresilience.org