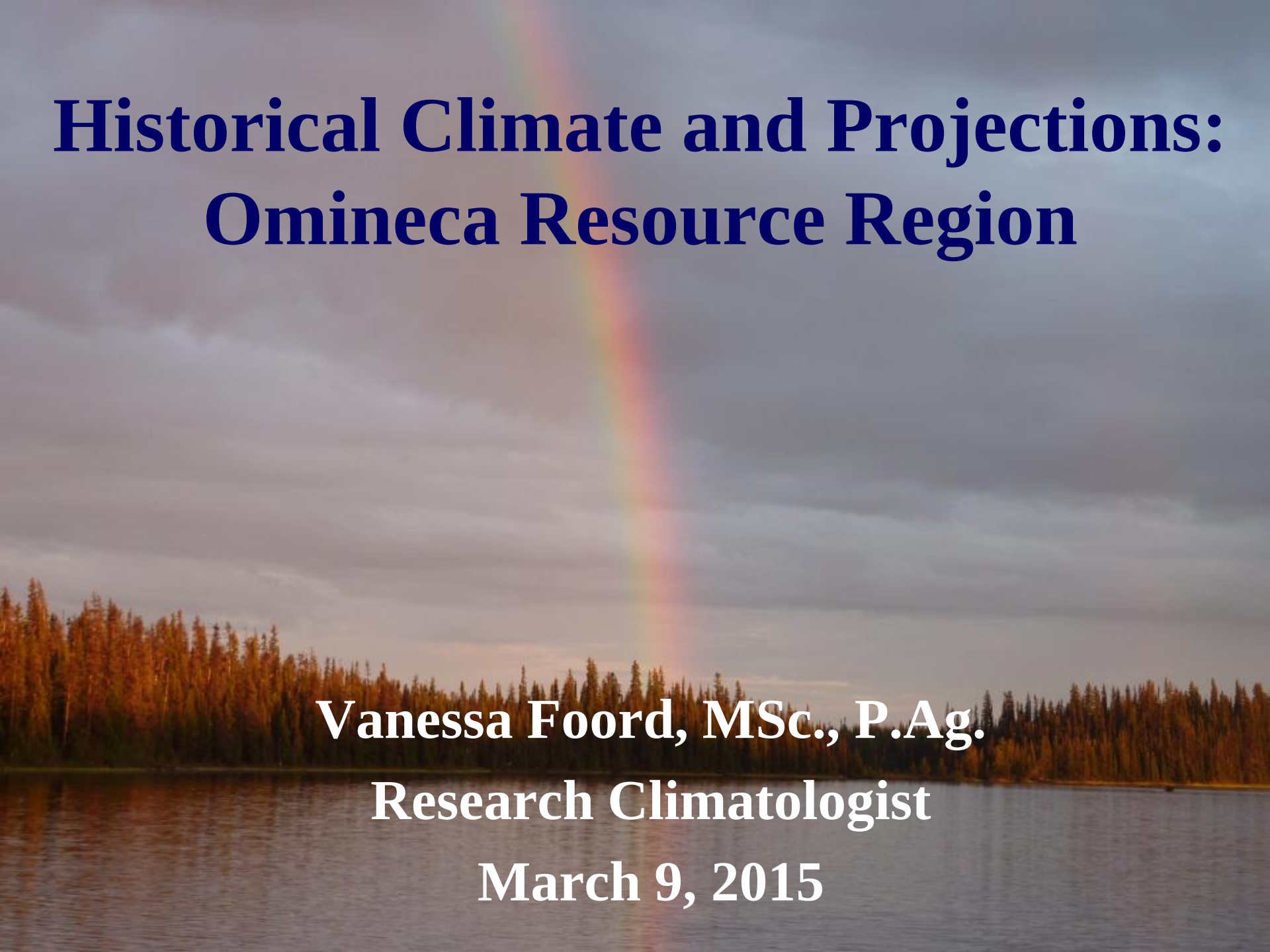


A landscape photograph of a lake with a forest in the background and a rainbow in the sky. The sky is filled with grey, overcast clouds. A vibrant rainbow arches across the center of the frame, extending from the top to the horizon. The foreground shows the calm surface of a lake, reflecting the sky and the rainbow. A dense forest of tall, thin trees, possibly evergreens, lines the far shore of the lake. The overall mood is serene and natural.

Historical Climate and Projections: Omineca Resource Region

Vanessa Foord, MSc., P.Ag.

Research Climatologist

March 9, 2015

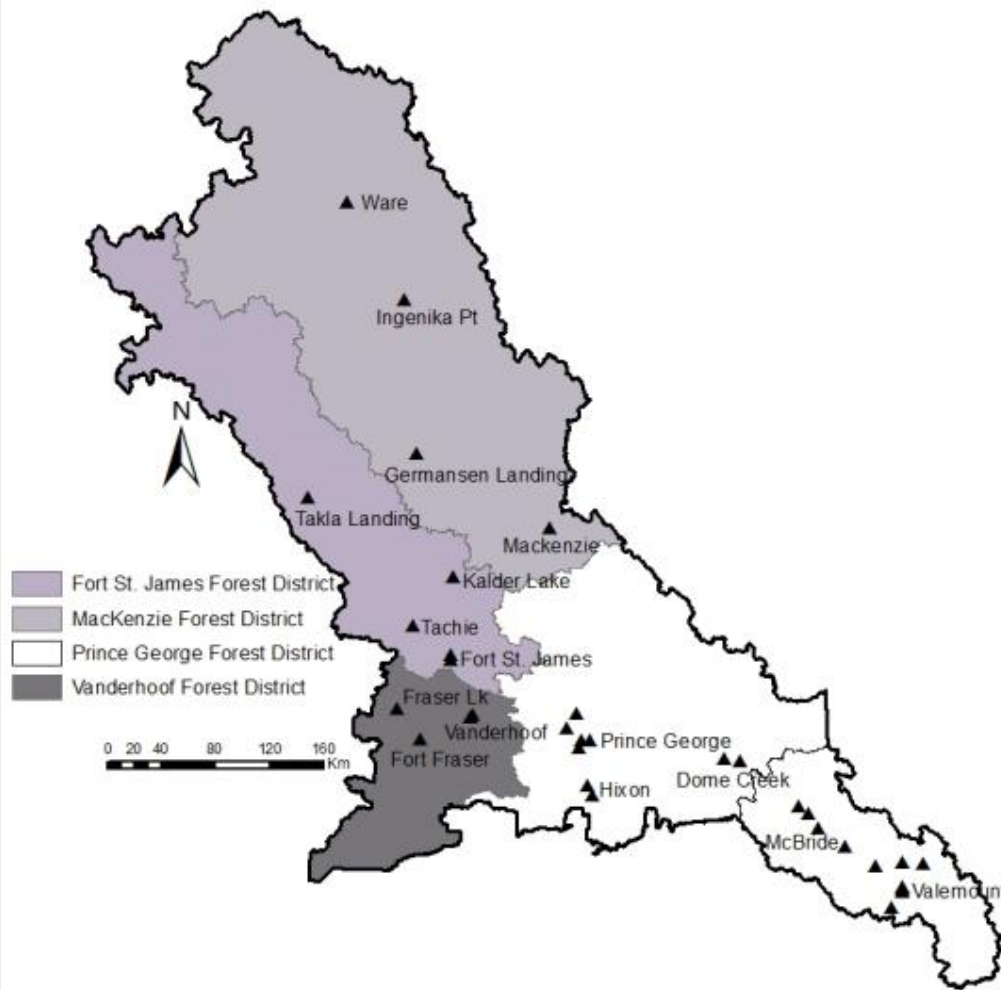
Outline

- Omineca current climate trends
 - Data sources: online
 - Observed impacts
 - Management plans/
Changes to practices
 - Projections
-
- Exercise: How to use ClimateWNA



Omineca Current Climate Trends

Omineca Region climate stations



Environment Canada daily data: 1895-2008

Omineca Climate

Annual Precipitation:

583.3 mm

Mean annual temp:

3.2 °C

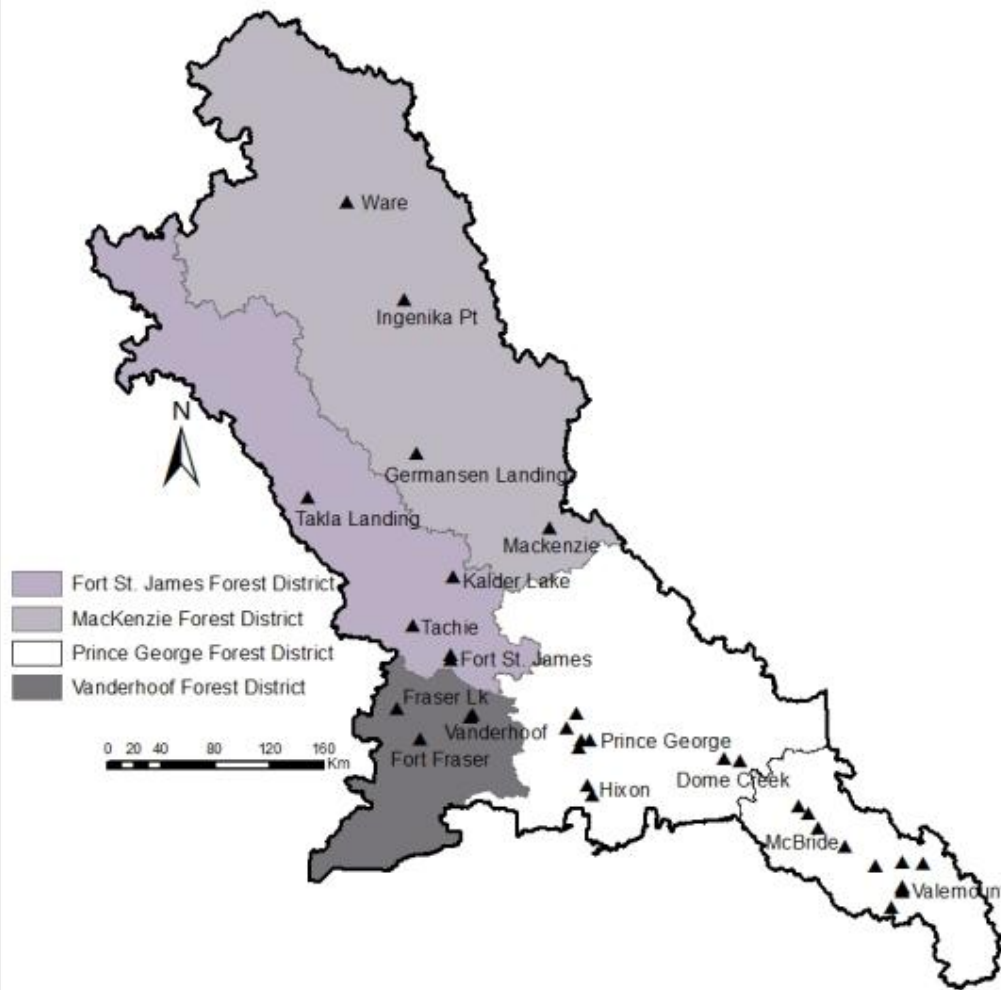
Extreme max temp:

31.8 °C

Extreme min temp:

-37.7 °C

Omineca Region climate stations



Environment Canada daily data: 1895-2008

Climate Change

Annual Precipitation:

+13.3%

Mean annual temp:

+1.3 °C

Extreme max temp:

+0.8 °C

Extreme min temp:

+4.5 °C

District Trends

Change in:	Fort St. James	Mackenzie	Vanderhoof	Prince George	Robson Valley
Precipitation (%)	24.6	3.7	18.9	7.1	14.5
Mean Temperature	2.2	1.7	1.5	1.3	0.6
Max Temperature	0.1	1.1	0.6	1.6	0.5
Min Temperature	5.1	3.7	5.0	5.7	2.9
Record	1895-2008	1951-2008	1916-2008	1912-2008	1914-2008

Very large increases in Minimum Temperatures!

Fort St. James only district with significant increase in Mean Annual Precipitation

Winter Trends

Change in:	Fort St. James	Mackenzie	Vanderhoof	Prince George	Robson Valley	Omineca
Precipitation (%)	13.9	-14.8	-9.5	-17.0	13.3	-1.5
Mean Temperature	2.6	3.8	3.2	2.1	0.8	2.2
Max Temperature	2.0	0.3	1.2	0.1	-0.9	0.3
Min Temperature	4.9	3.8	2.3	5.1	1.3	3.5

Large trends in winter mean and minimum temperatures

Lots of variability in winter precipitation trends

Spring Trends

Change in:	Fort St. James	Mackenzie	Vanderhoof	Prince George	Robson Valley	Omineca
Precipitation (%)	17.8	10.6	31.2	17.9	22.1	20.0
Mean Temperature	2.4	1.5	1.5	1.1	0.5	1.2
Max Temperature	1.2	-0.3	0.1	0.7	1.9	0.6
Min Temperature	9.3	4.2	3.6	2.7	2.2	3.9

Increasing spring precipitation

Large minimum temperatures, west to east trend

Significant increases in mean spring temperatures

Summer Trends

Change in:	Fort St. James	Mackenzie	Vanderhoof	Prince George	Robson Valley	Omineca
Precipitation (%)	29.4	9.2	39.7	13.9	21.9	21.5
Mean Temperature	2.1	1.2	1.1	0.9	0.6	1.1
Max Temperature	-0.2	0.7	1.1	1.7	0.0	0.7
Min Temperature	4.3	1.1	1.1	1.0	1.5	1.7

Large increases in summer precipitation, Fort St. James and Vanderhoof district

Less change in minimum temperature than spring and winter

Fall Trends

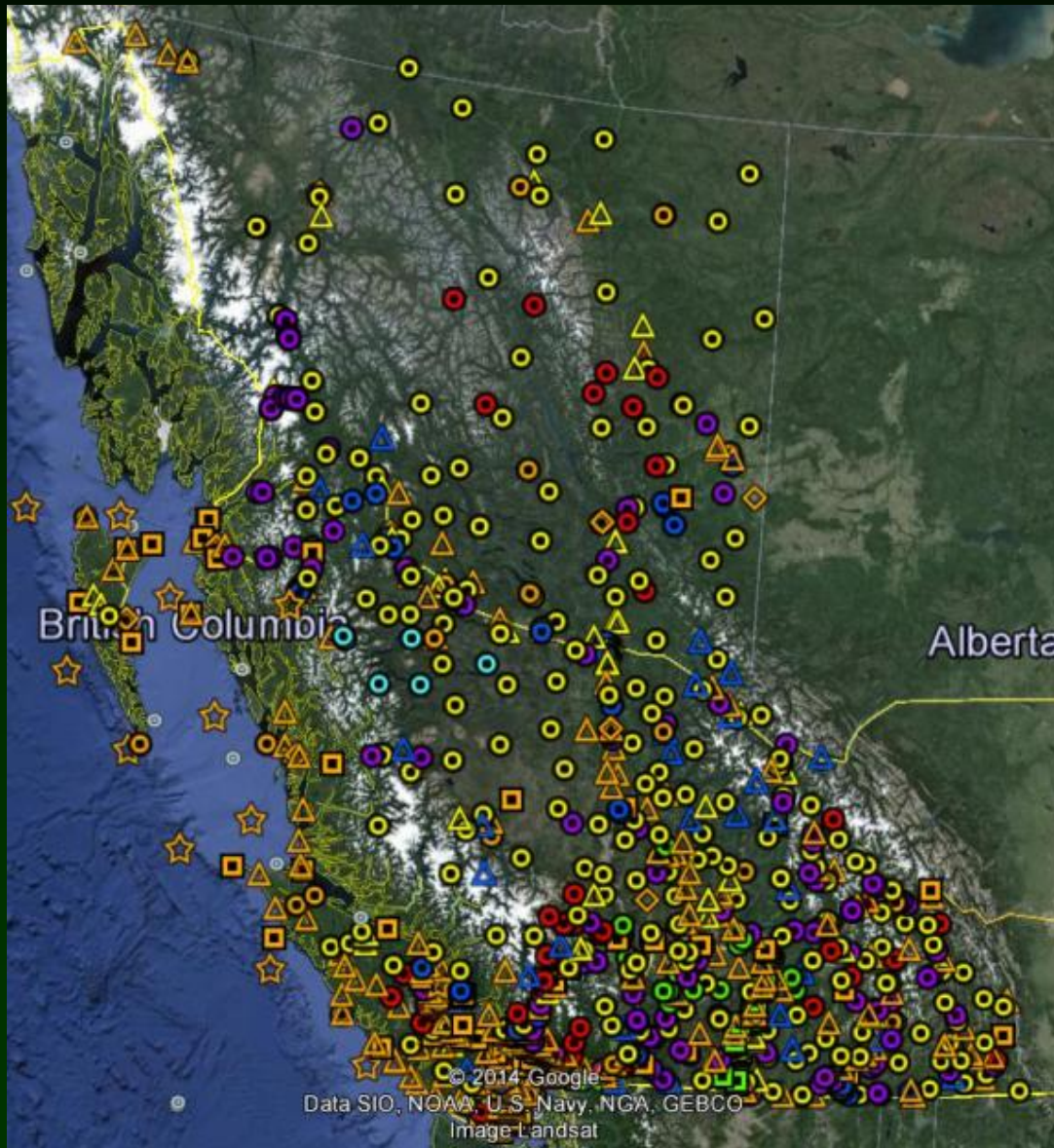
Change in:	Fort St. James	Mackenzie	Vanderhoof	Prince George	Robson Valley	Omineca
Precipitation (%)	23.6	9.2	23.9	19.4	19.1	19.4
Mean Temperature	1.6	0.7	0.8	0.8	-0.1	0.7
Max Temperature	0.1	0.0	0.8	1.5	-0.2	0.5
Min Temperature	4.6	3.3	2.4	2.3	0.3	2.2

Large increases in fall precipitation

Again, large changes in minimum temperatures

Data Sources: Online

Climate Related Monitoring Program



- Over 900 weather stations in the province
- Designed for forecasting, not climatology = **limitations!**
- Working on permanent climate station network
- Download Google Earth file of all active weather stations:

<http://www.env.gov.bc.ca/epd/wamr/crmp.htm>

Environment Canada Data

http://climate.weather.gc.ca/index_e.html

- Historical climate data (hourly, daily, monthly) – advanced search options
- Canadian climate normals
- Engineering datasets (e.g. IDF curves)
- Monthly climate summaries
- Historical radar

Provincial Data

MoTI: Avalanche and Weather Program:

<https://pub-apps.th.gov.bc.ca/saw-paws/weatherstation>

MoE: Air Quality Network:

<http://envistaweb.env.gov.bc.ca/>

MoE Snow Pillow/Survey Network:

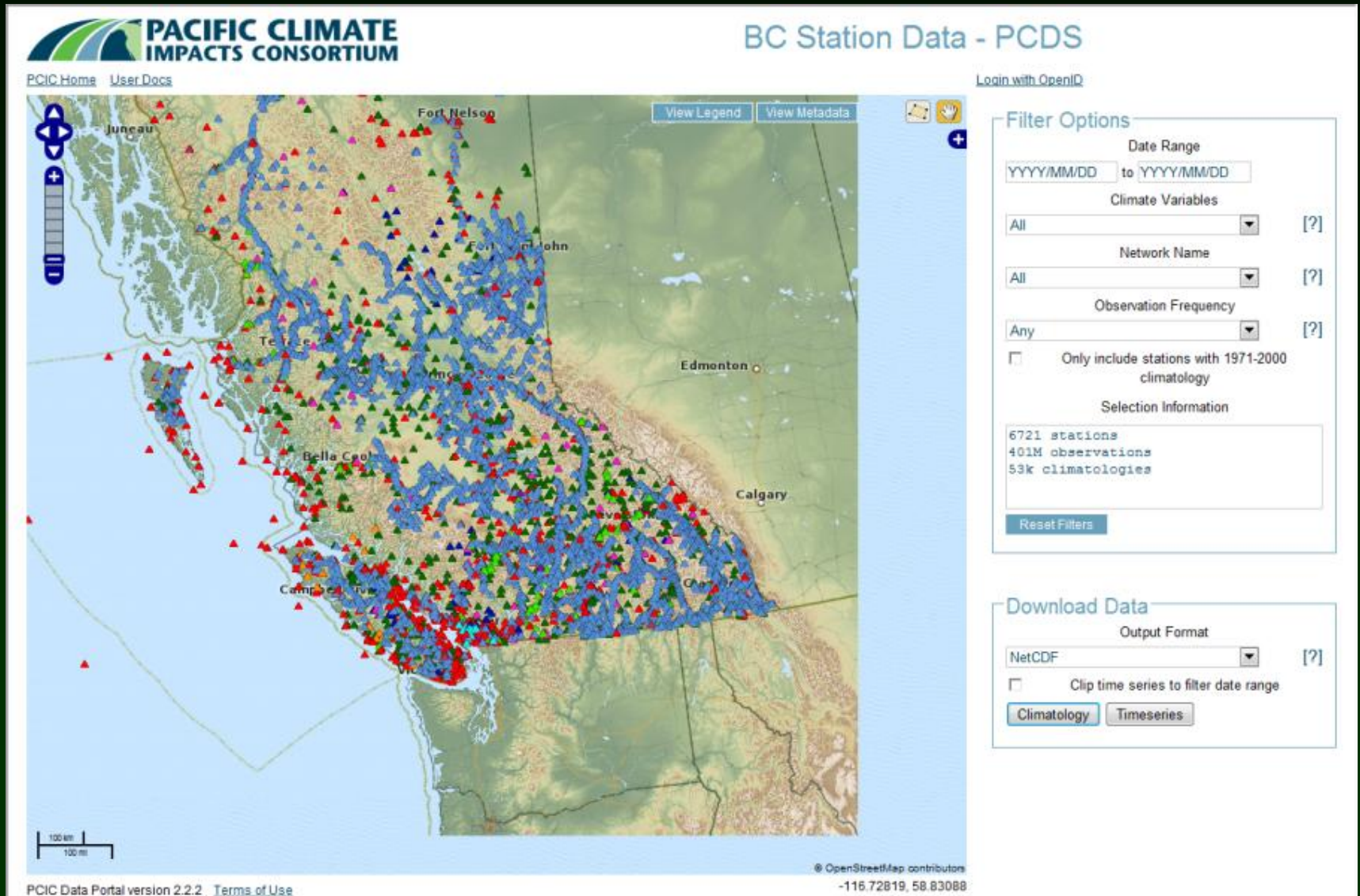
<http://bcrfc.env.gov.bc.ca/data/index.htm>

BC Hydro: Williston Reservoir

https://www.bchydro.com/energy-in-bc/our_system/transmission_reservoir_data/hydrometric_data/peace.html

Data Portal: Pacific Climate Impacts Consortium

http://tools.pacificclimate.org/dataportal/pcds_map/



Observed Impacts: Omineca

Climate/Hydrology:

↓ Snowpack	↑ Minimum temperature	Overall warming	Seasonal shifts
Watershed instability	↑ Fire season length	↑ Fire severity/intensity	Extreme temperatures
Precipitation intensities	↑ Rain	↑ Freeze/thaw switches	Saturated soils
↓ Cold arctic air	↑ Evaporation	Faster snowmelt	↑ Lake temperatures
Summer drought	Isolated rainstorms	↑ Flooding	↑ High-elevation snow
Changing precipitation levels, seasonal difference	Earlier groundwater peak from early snowmelt	↑ River erosion and sediment, channel change	↑ Mid-winter ice jam breakups
↑ Log jams	More “no flows”	Extreme low lake levels	↓ Frost
↑ Rain on snow events	↑ Lake algae blooms	↑ Mild, wet springs	↑ Cloud cover
↑ Extreme weather	↑ Evapotranspiration	Dry soils	↑ Stream temperatures
↑ Return intervals of precipitation events	Changes to watershed storage	Mountain permafrost changes and landslides	Early melt of low elevation snow
↑ Groundwater demands from decreased surface water supply	Groundwater tables dropping quickly and early flow into streams	Retreating glaciers affecting water supply and power generation	↑ Conditions favourable for avalanches
Abrupt weather changes	Snow wetter and heavier		

Ecosystems:

Shifting ecosystems	↓ Survival of edge range plants	Natural systems out of sync	↑ Invasive species
Whitebark pine threatened: phenology, MPB, blister rust	Alder out-competing traditional riparian vegetation	Species shifting up in elevation and north in latitude	Change dynamics for species planting and suitability
Loss of biodiversity with few large leave areas	Overabundance of young seral habitat	Landscape level biodiversity impacts	↑ Grasses
↓ Snow and water availability for ICH	Changes to soil moisture regimes		

Wildlife/Fish:

Changing dynamics: too warm in traditional areas for ungulates	Changes to snow depths affecting ungulate migration	Changes to fish habitat: stream temperatures too warm	↑ Frequency of disturbance: loss of habitat
↑ Elk population	↑ Moose ticks	↓ Bird nesting success	↓ Amphibians
↓ Populations (e.g moose, deer, bear)	Bulltrout threatened, habitats too warm	↑ Total dissolved solids in lakes	↑ Stream temps during spawning seasons
↑ Sediments in streams	Wildlife breaking winter dormancy (e.g. bears)	Changing bird migration patterns and timing	↑ Risks to temperature sensitive streams
↓ Old growth habitat	↓ Specialist species	Phenology changes	↓ Salmon habitat

Pest/Diseases:

MPB epidemic	↑ Rusts	↑ Dothistroma	↑ Spruce Beetle
↑ Invasive species	↑ Blowdown	↑ Moose ticks	Willow poplar weevil
↑ Foliar diseases in young pine plantations	Parasites on white-tail deer	↑ Winter survival of several pests	↑ Defoliators
↑ Douglas fir beetle			

Operations/Landuse:

Longer planting season	↑ Growing season	↑ Harvest season	↓ Winter logger season
Earlier breakup	Planting different species	↓ Mid-term timber supply	↑ Cut size
↑ Harvest from MPB further aggravating climate change impacts	Changes to land absorption and buffering capacity from MPB	Changes to timing and amount of spring freshet from dead pine/harvest	Changes to water availability for power generation
↑ Salvage: ↓ stumpage and revenue	Changes to patch size/matrix composition	Wet soils in summer, loss of operability	↑ Road access and wildlife access
↓ Freezing of soils in winter season	Wildfire management: ↑ demand and costs	↓ Snowmobile season/winter tourism	↓ Well water levels in summer
Seed transfer limits moving north	Planting Douglas Fir and Western Larch	Changing dynamics of species plantings	Changes to stocking standards
↓ Carbon storage	↑ Soil disturbance		

Management Plans/Changes to Practices

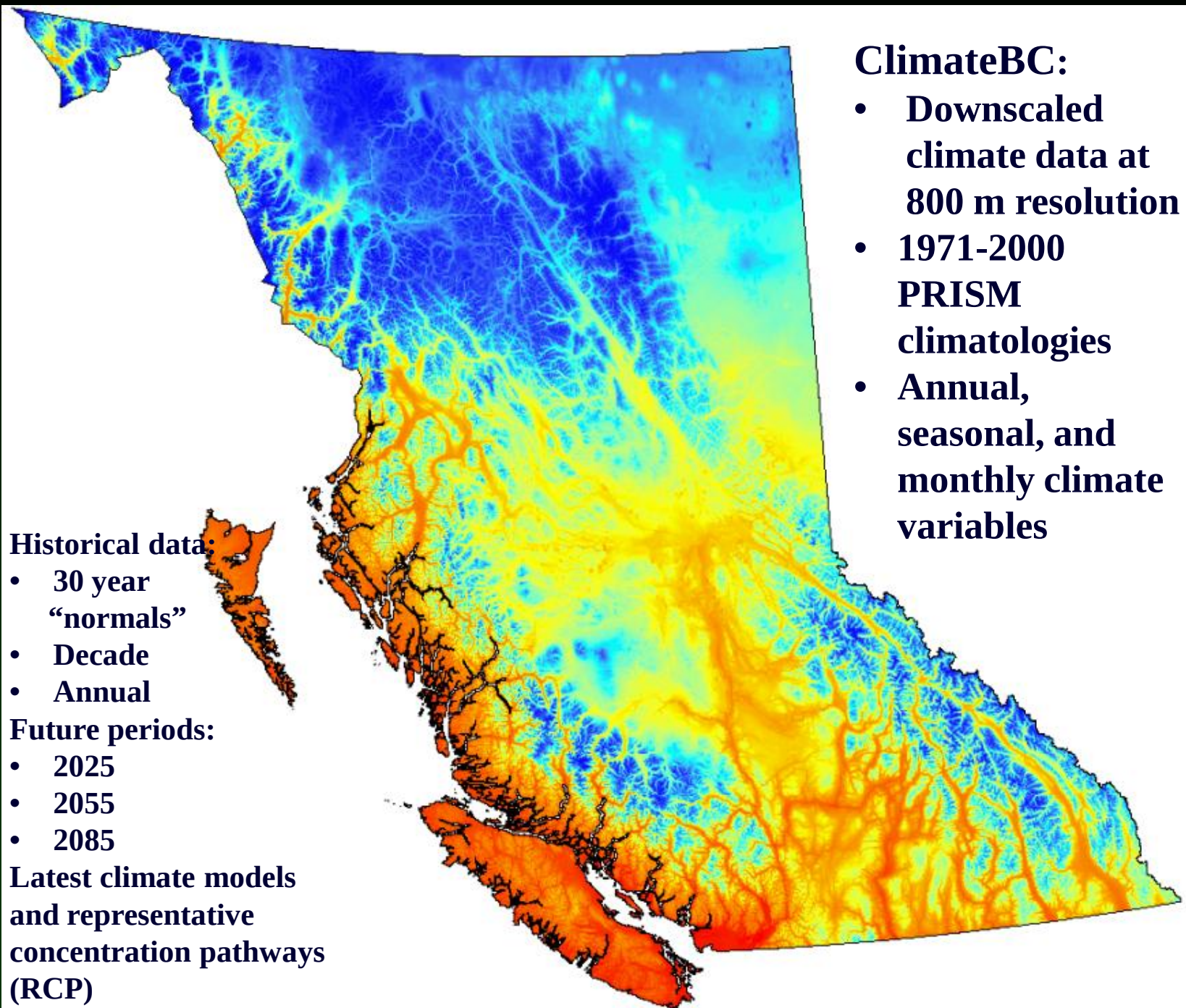
Management Plans and Strategies that consider climate change:

- Omineca Climate Action Plan
- Fire Management Plans
- Omineca Enduring Features Plan
- Omineca Whitebark Management Plan and Whitebark Pine Resistance Recovery Strategy
- Vanderhoof Ecosystem Restoration Strategic Plan
- Incorporating Tier 1, Fisheries Sensitive Watershed Assessments
- Incorporating Type 4 silviculture strategies in the Prince George Timber Supply Area

Examples of Changes to Practices

- Range expansion and planting of Western Larch and Douglas Fir
- Expanding wildlife habitat areas for Bull Trout
- Trials of White Pine, Ponderosa Pine on drier sites
- Increasing planting density, sites with higher disease risk
- Implementing forest health stocking standards, rust stocking standards, increasing minimum free to grow heights
- Increased streamside retention on temperature sensitive streams
- First Nations tenures awarded as carbon trusts/credits
- Building road structures to be more resilient

Projections



ClimateWNA

<http://cfcg.forestry.ubc.ca/projects/climate-data/climatebcwna/>

UBC THE UNIVERSITY OF BRITISH COLUMBIA

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FACULTY OF FORESTRY

ClimateWNA_MAP
— An Interactive Platform for Visualization and Data Access

Centre for Forest Conservation Genetics • CFCG •

Coordinates Input (click on the map or type in coordinates)

Latitude: 53.9169 Longitude: -122.7594

Elev (m): 620 Historical: Select a period

Future: HadGEM2-ES_RCP85_r1i1p1_2055

Quick Tutorial Help Calculate

Annual Variables

MAT = 8.1
MWMT = 20.9
MCMT = -5.3
TD = 26.2
MAP = 881
MSP = 367
AHM = 20.5
SHM = 56.9
DD<0 = 510
DD>5 = 2196
DD<18 = 3851
DD>18 = 253
NFFD = 217
bFFP = 120
eFFP = 280
CCD = 160

Seasonal Variables

Tmax_wt = 0.2
Tmax_sp = 15.1
Tmax_sm = 27
Tmax_at = 12.8
Tmin_wt = -8
Tmin_sp = 2
Tmin_sm = 12.4
Tmin_at = 3
Tave_wt = -3.9
Tave_sp = 8.5
Tave_sm = 19.7
Tave_at = 7.9
PPT_wt = 236
PPT_sp = 166
PPT_sm = 199
PPT_at = 278

Monthly Variables

Tmax(01) = -1.3
Tmax(02) = 1.9
Tmax(03) = 9.4
Tmax(04) = 16.3
Tmax(05) = 19.6
Tmax(06) = 24.6
Tmax(07) = 28.3
Tmax(08) = 28.2
Tmax(09) = 20.4
Tmax(10) = 13.5
Tmax(11) = 4.4
Tmax(12) = 0.1
Tmin(01) = -9.3
Tmin(02) = -7.7
Tmin(03) = -2.5
Tmin(04) = 2.4

Append to: ClimateData.csv Count: 0 Save Clear

Overlays: Climate maps Species ranges Transparency(%)

mat 1961 1990: -25.0 27.0°C

Map Satellite

Copyright(2014) University of British Columbia. All right reserved.
Disclaimer: Predictions of historical and future climates are based on the methodologies

http://climatewna.com/climatewna_map/

Internet | Protected Mode: On

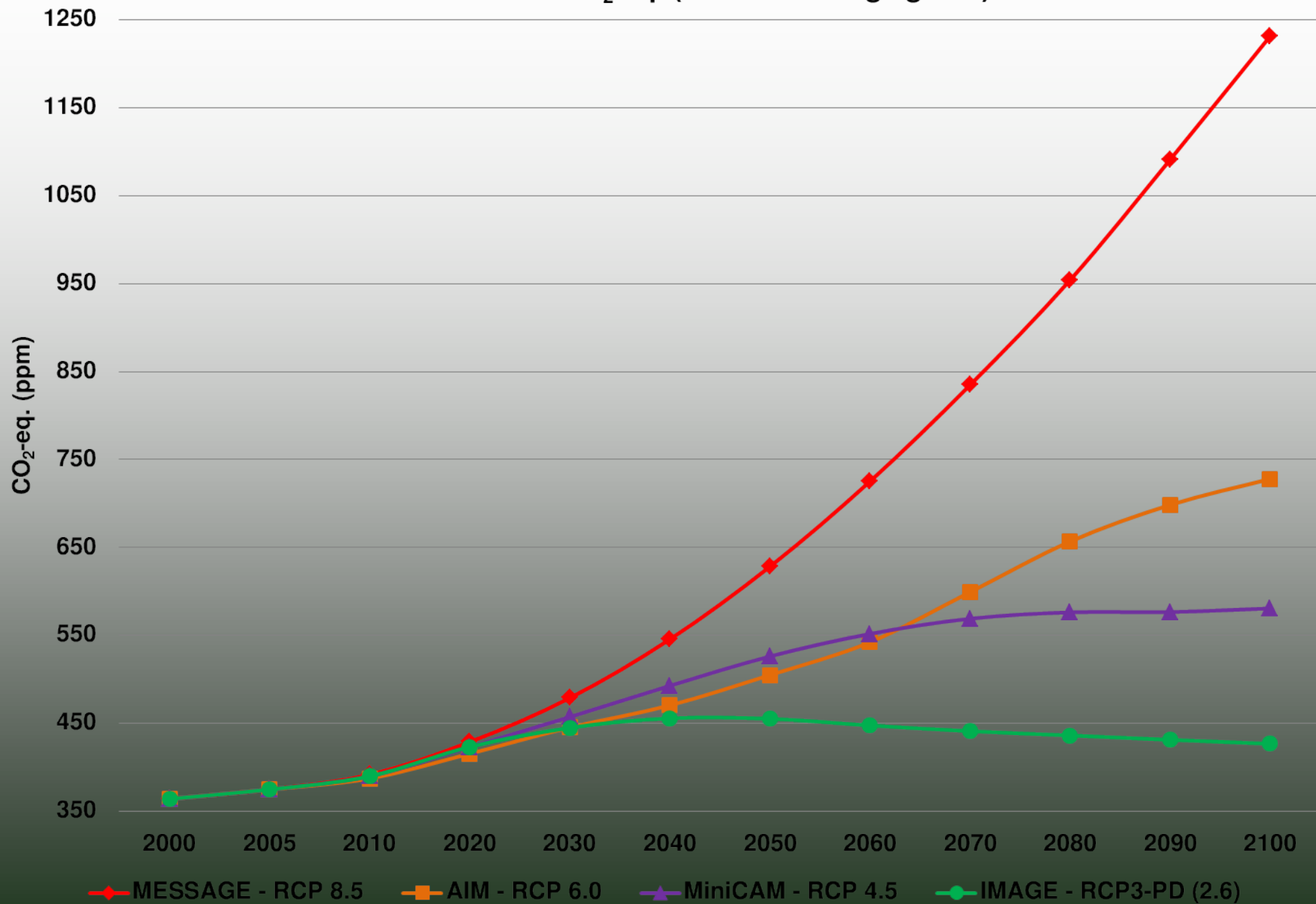
100%

Model Scenarios

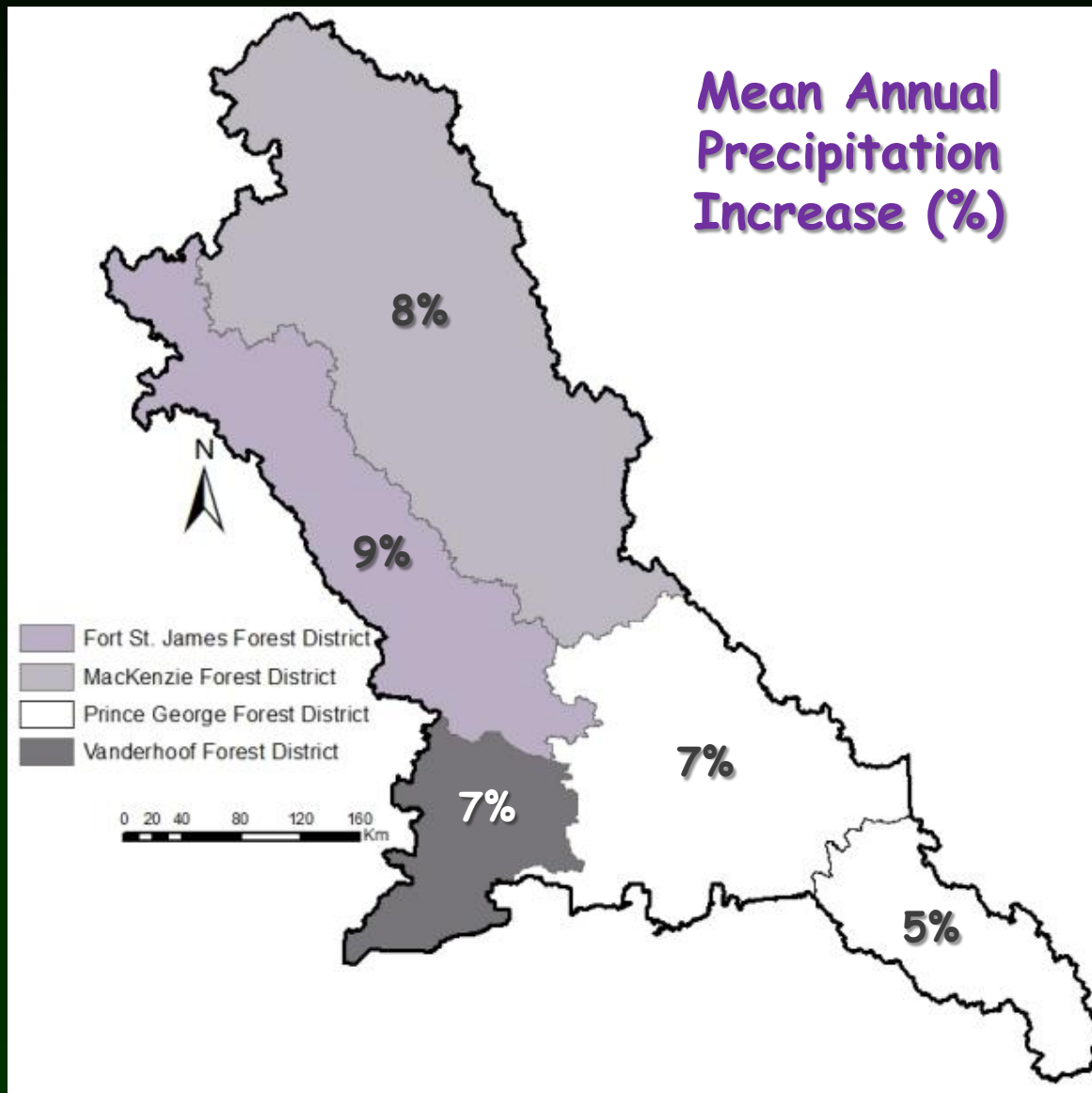
Representative Concentration Pathways:

- Four GHG concentration trajectories adopted by the IPCC Assessment Report 5
- RCP2.6, RCP4.5, RCP6, and RCP8.5, are named after a possible range of radiative forcing values in the year 2100 relative to pre-industrial values (+2.6, +4.5, +6.0, and +8.5 W/m², respectively)
- Based on four different scenarios of the amount of emissions emitted from different social, economic, and environmental decisions

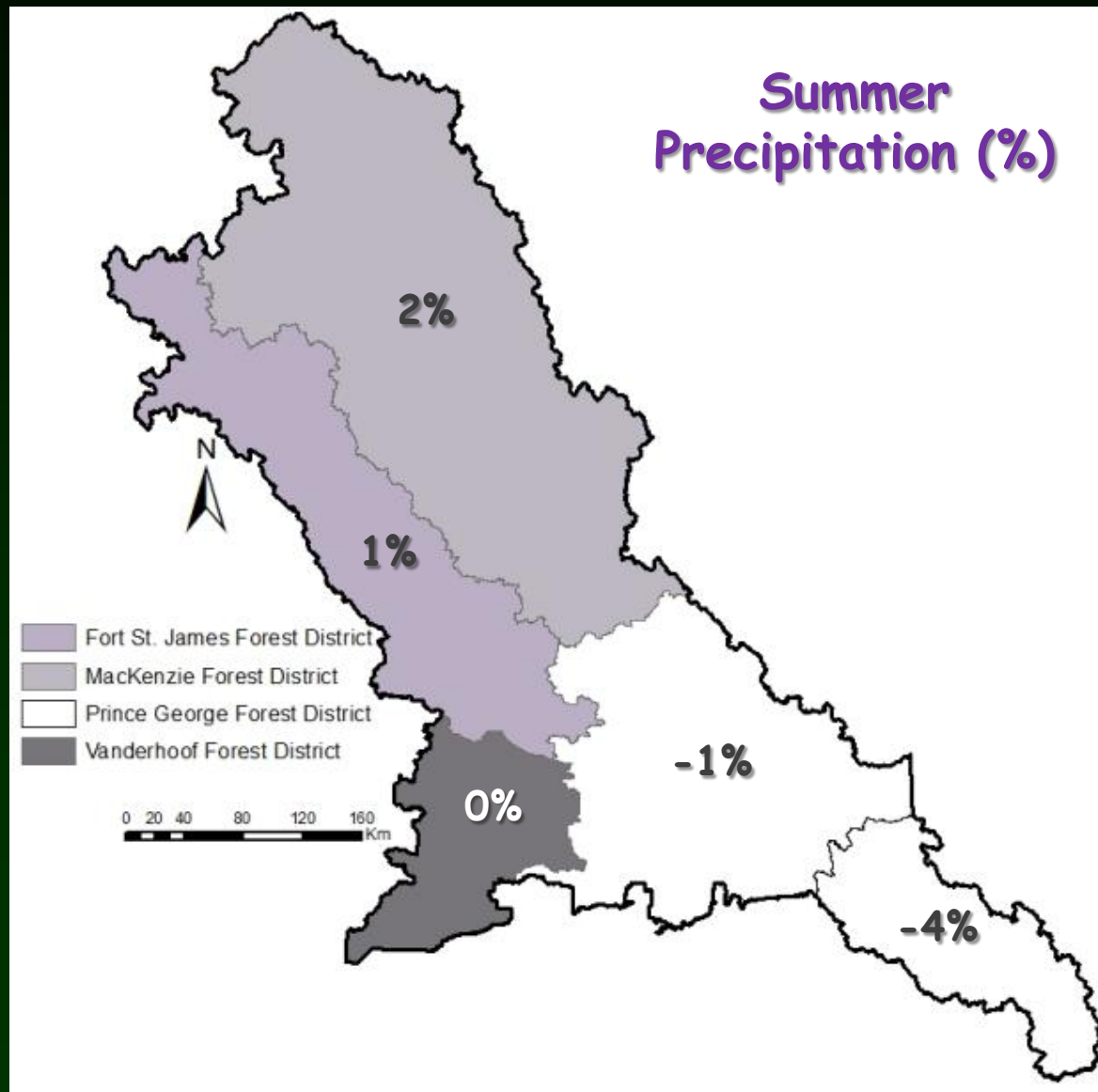
Concentration - CO₂-eq. (incl. all forcing agents)



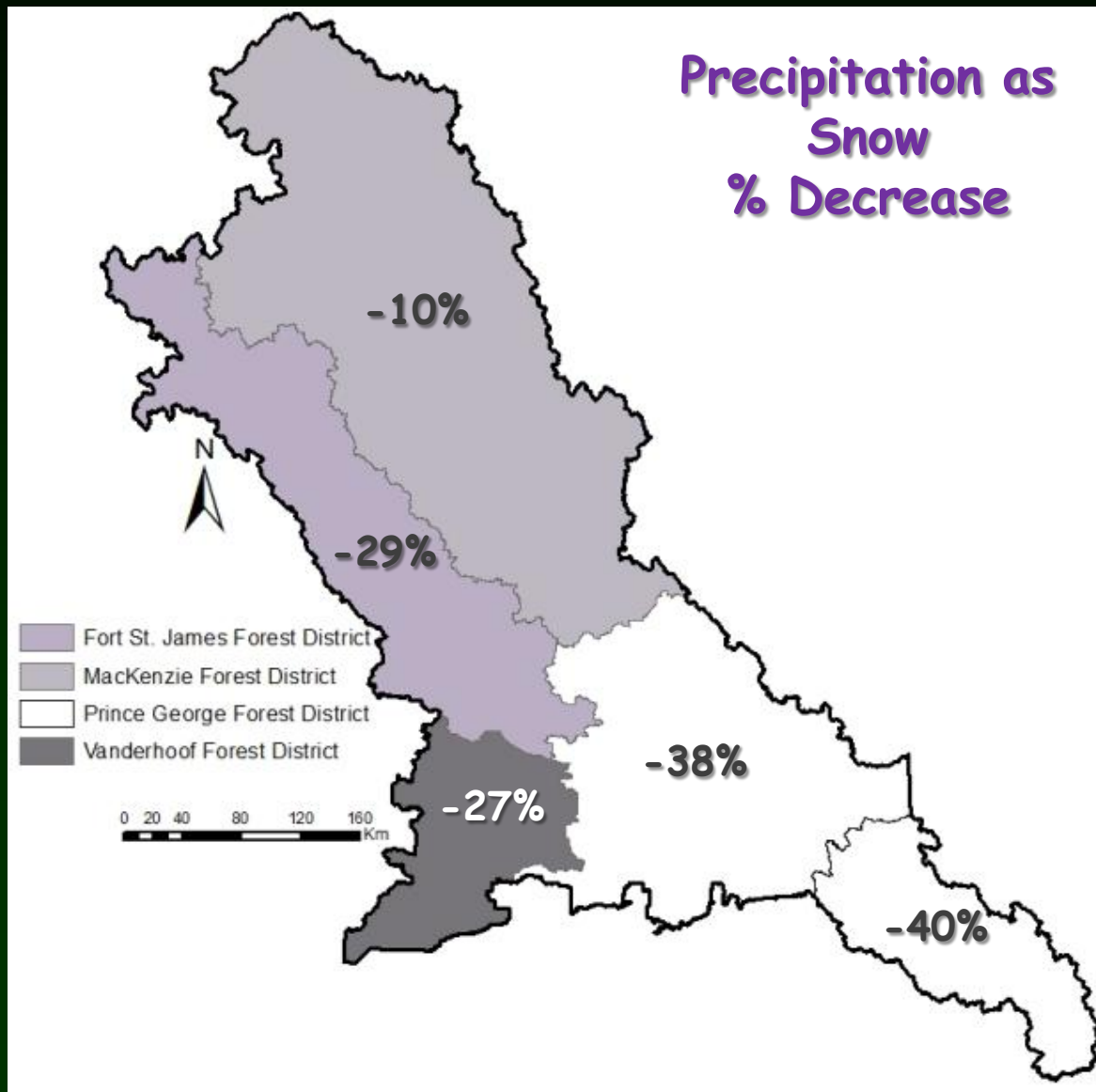
Future change: 2055



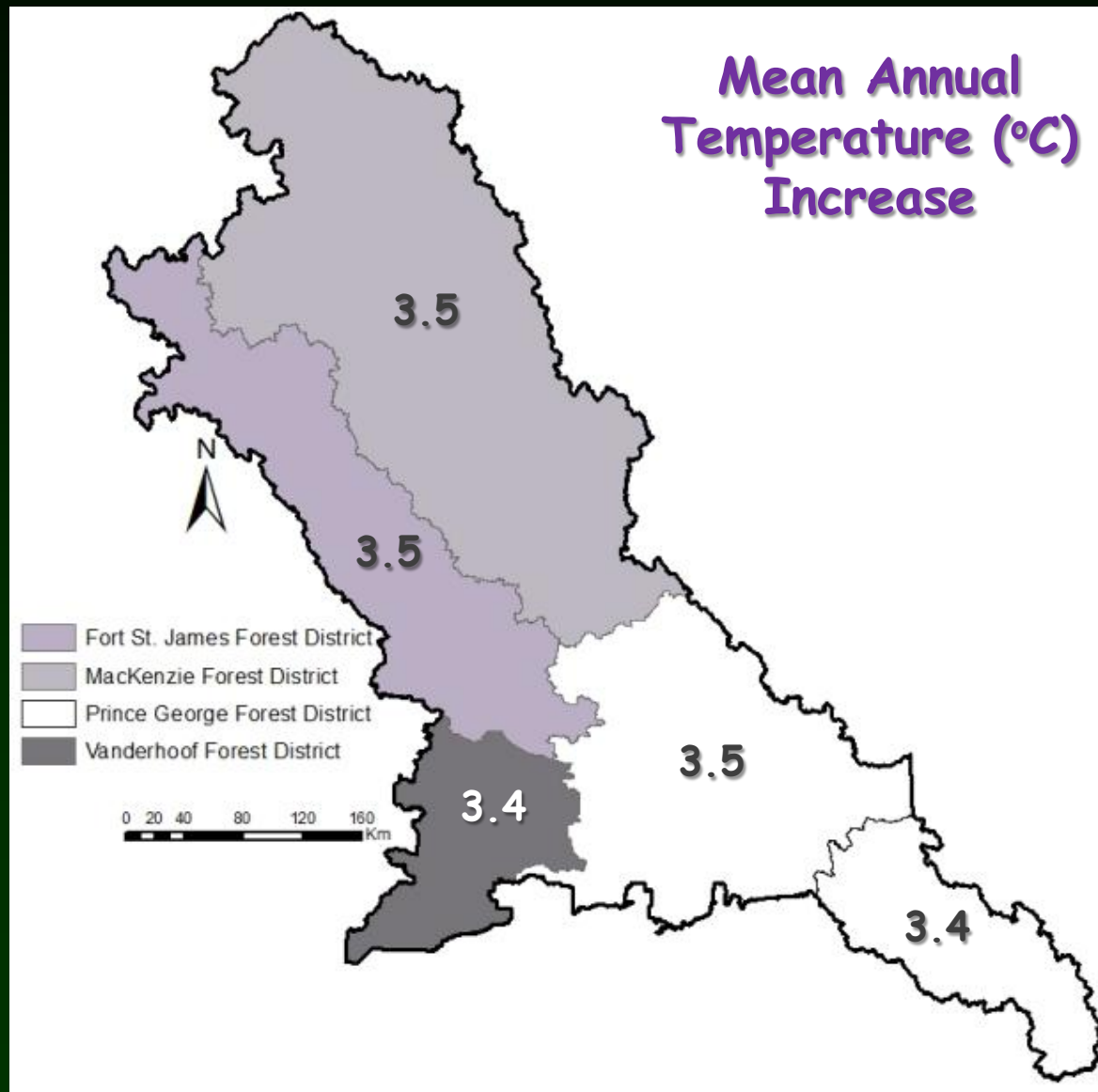
Future change: 2055



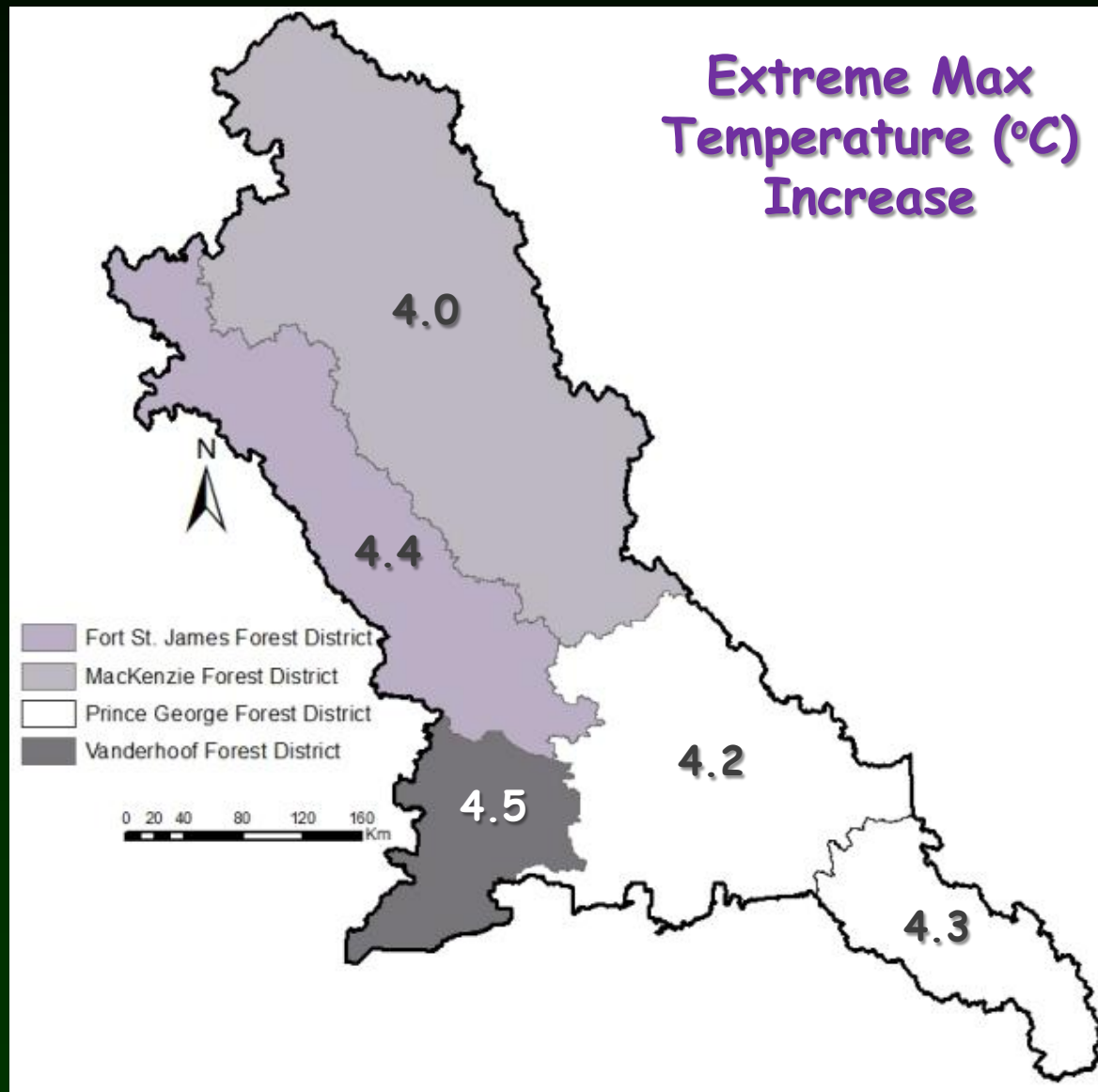
Future change: 2055



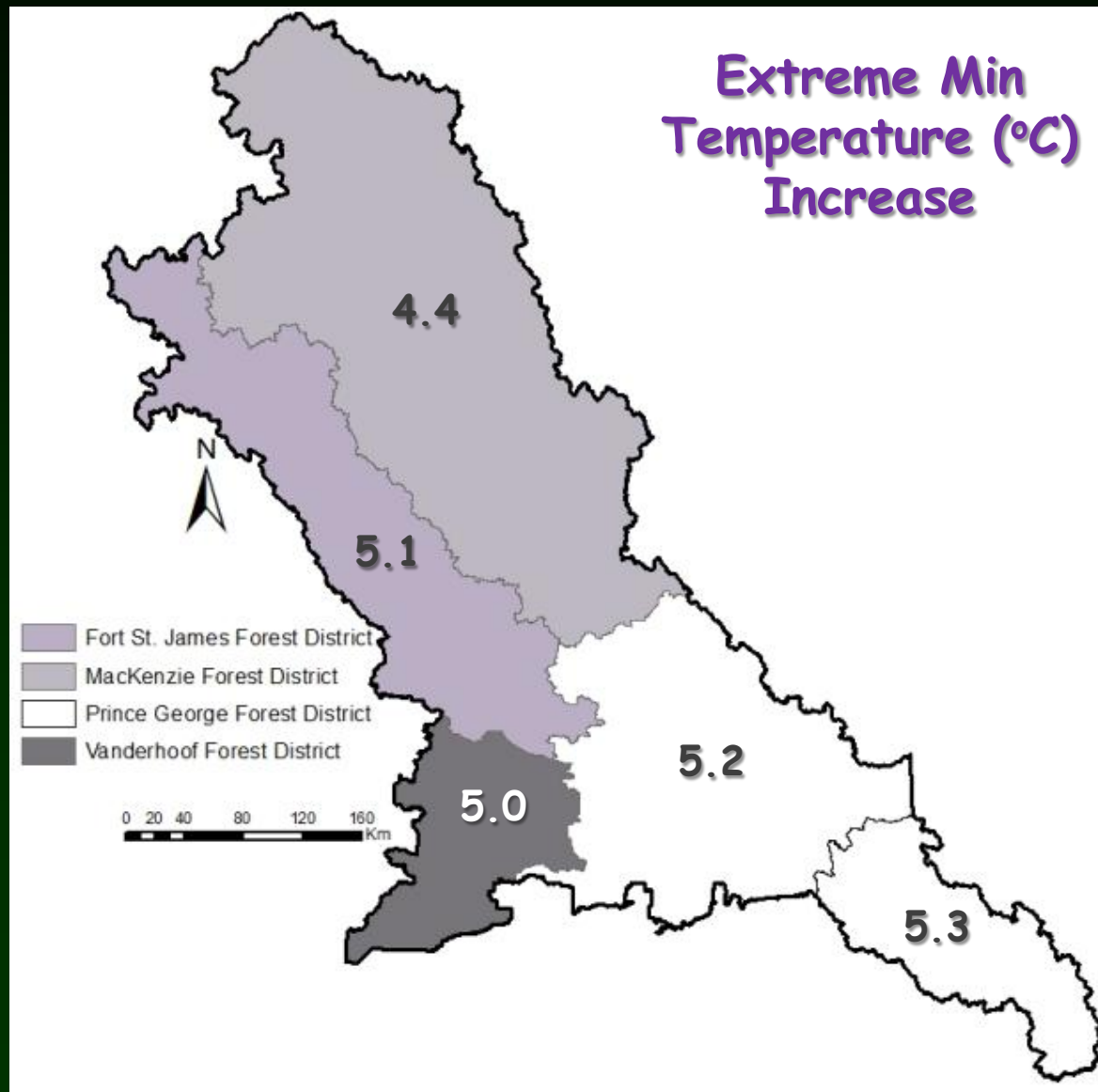
Future change: 2055



Future change: 2055



Future change: 2055





Questions?

Thank You!

Vanessa.Foord@gov.bc.ca

250-565-4333

Omineca Current Climate Change

Omineca - change in:	Annual	Winter	Spring	Summer	Fall
Precipitation (%)	13.3	-1.5	20.0	21.5	19.4
Mean Temperature	1.3	2.2	1.2	1.1	0.7
Max Temperature	0.8	0.3	0.6	0.7	0.5
Min Temperature	4.5	3.5	3.9	1.7	2.2



Exercise: ClimateBC

Download from:

<http://cfcg.forestry.ubc.ca/projects/climate-data/climatebcwna/>

csv file:

<http://www.for.gov.bc.ca/ftp/RNI/external/outgoing/Climate/>