

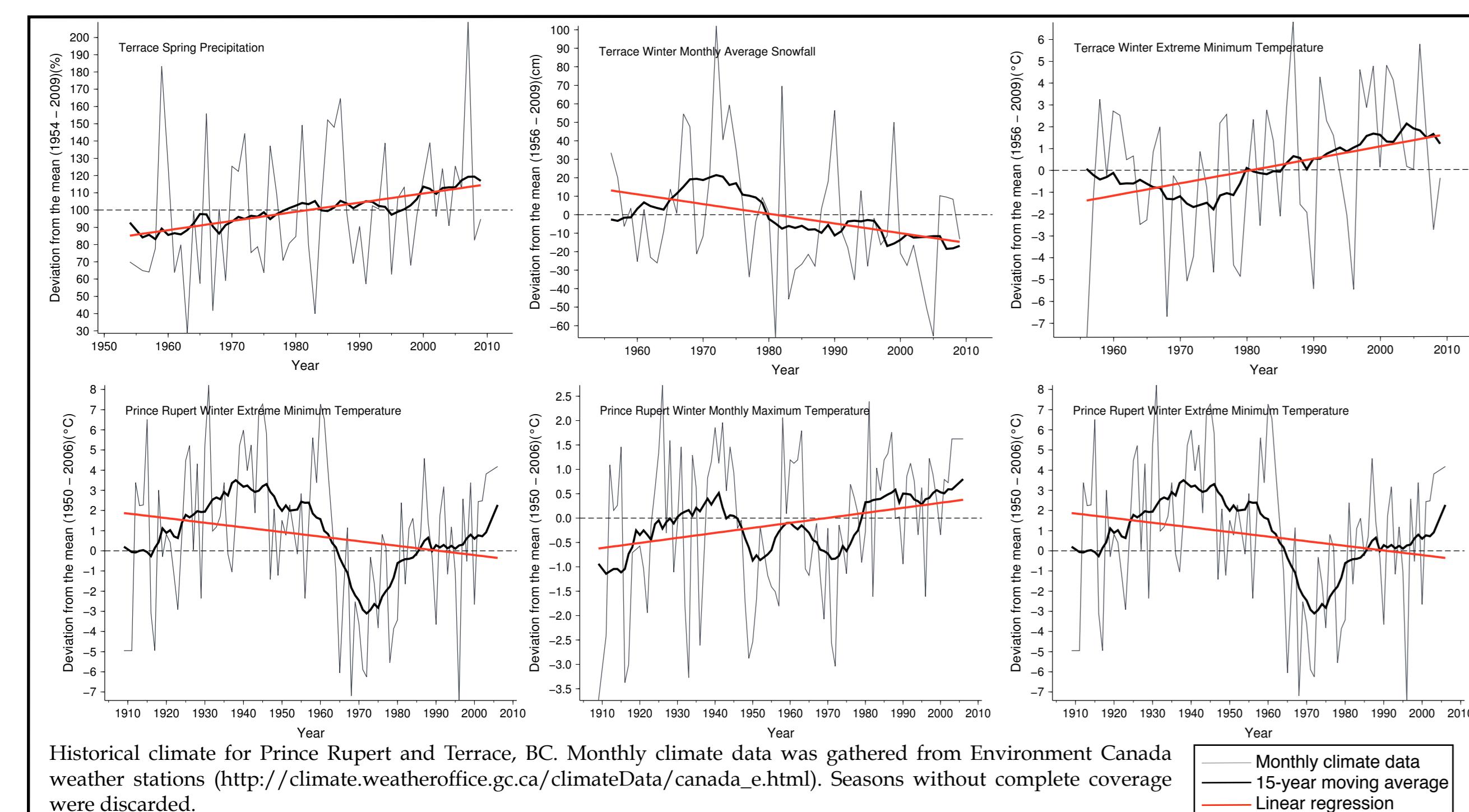


Process-based regional dynamic vegetation modelling of the Skeena Region of British Columbia: Investigating forest response to projected climate change

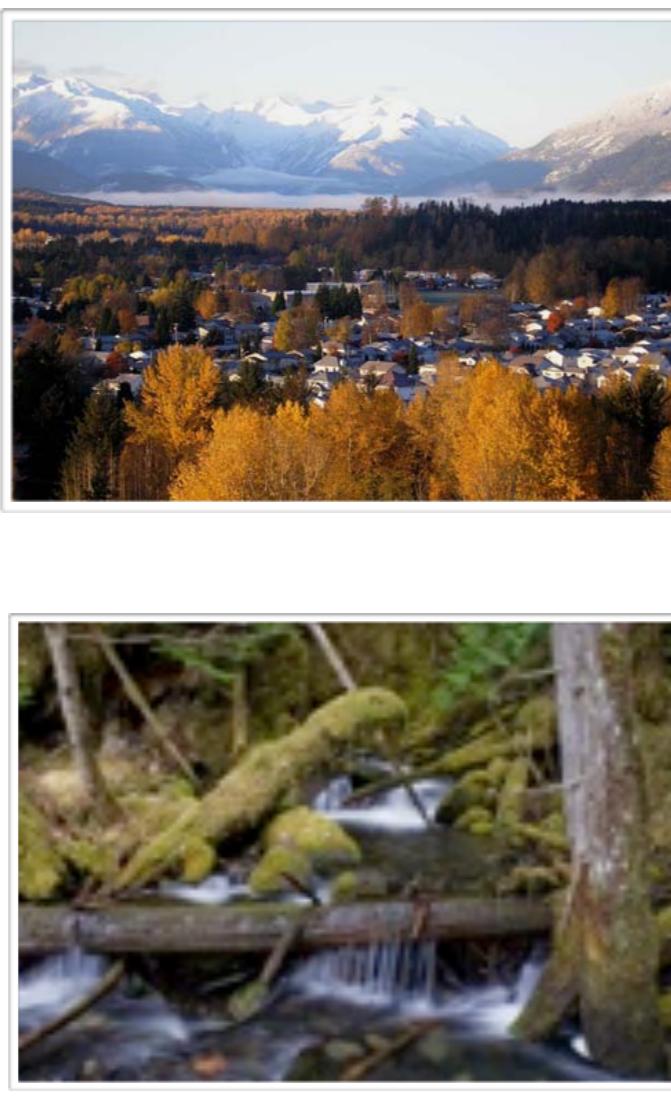
Joe Melton, Don Robinson & Jed O. Kaplan

Introduction

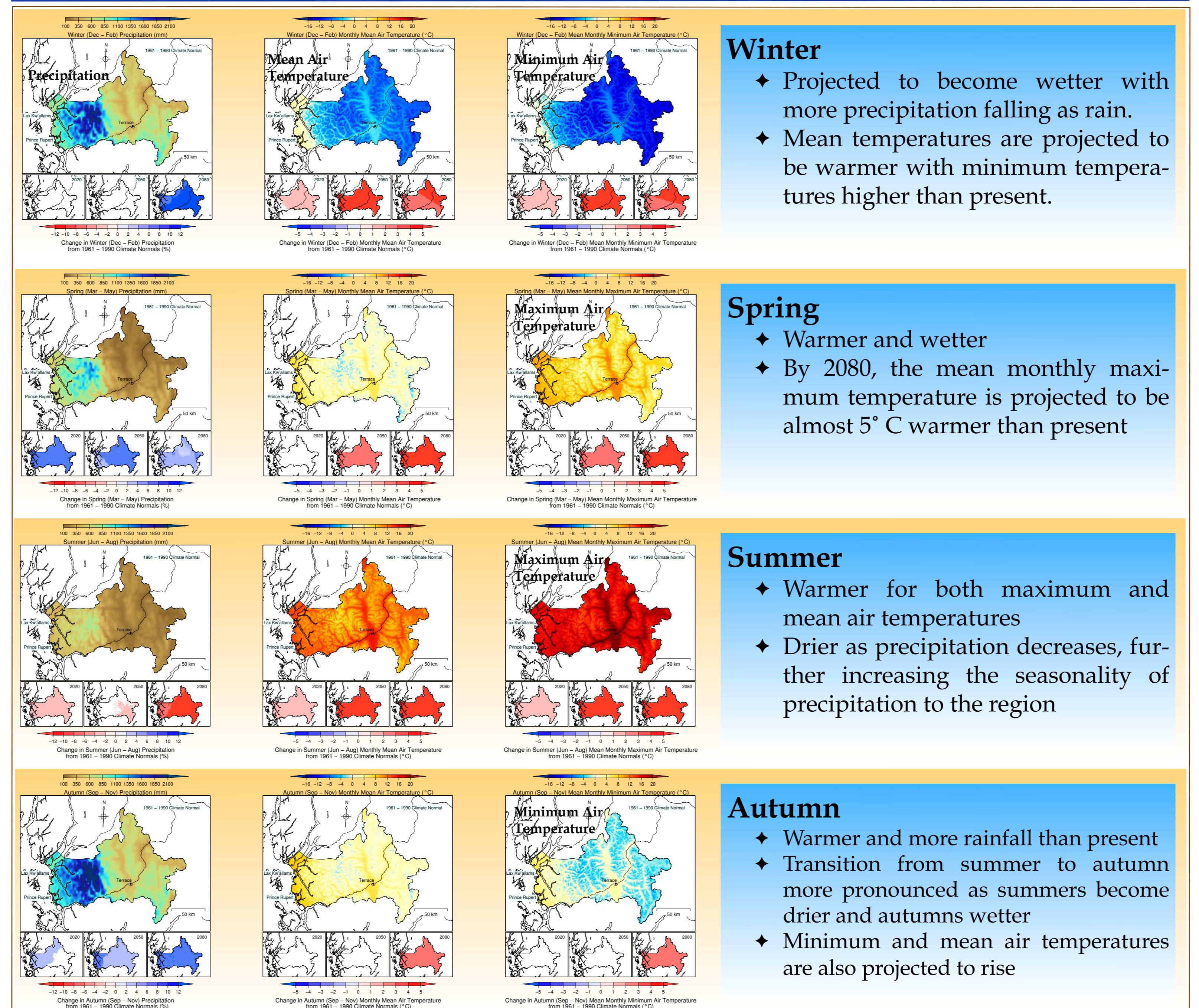
- The N.W. Skeena region has already experienced noticeable changes in climate over the last several decades.



- N.W. Skeena First Nations and municipalities want to reduce their vulnerability to the effects of climate change in the surrounding forest ecosystems.
- Effective adaptation planning requires quantified projections of changes in forest ecosystems under different possible future climate change scenarios.
- Here we report progress to date using a regional-scale process-based regional dynamic vegetation model (RDVM) forced with downscaled General Circulation Model (GCM) climate output (ClimateWNA; Wang et al. 2006) to estimate changes in the Skeena region forests up to the year 2100.



Projected Climate Change in the Skeena Region (Scenario A2, CGCM3)



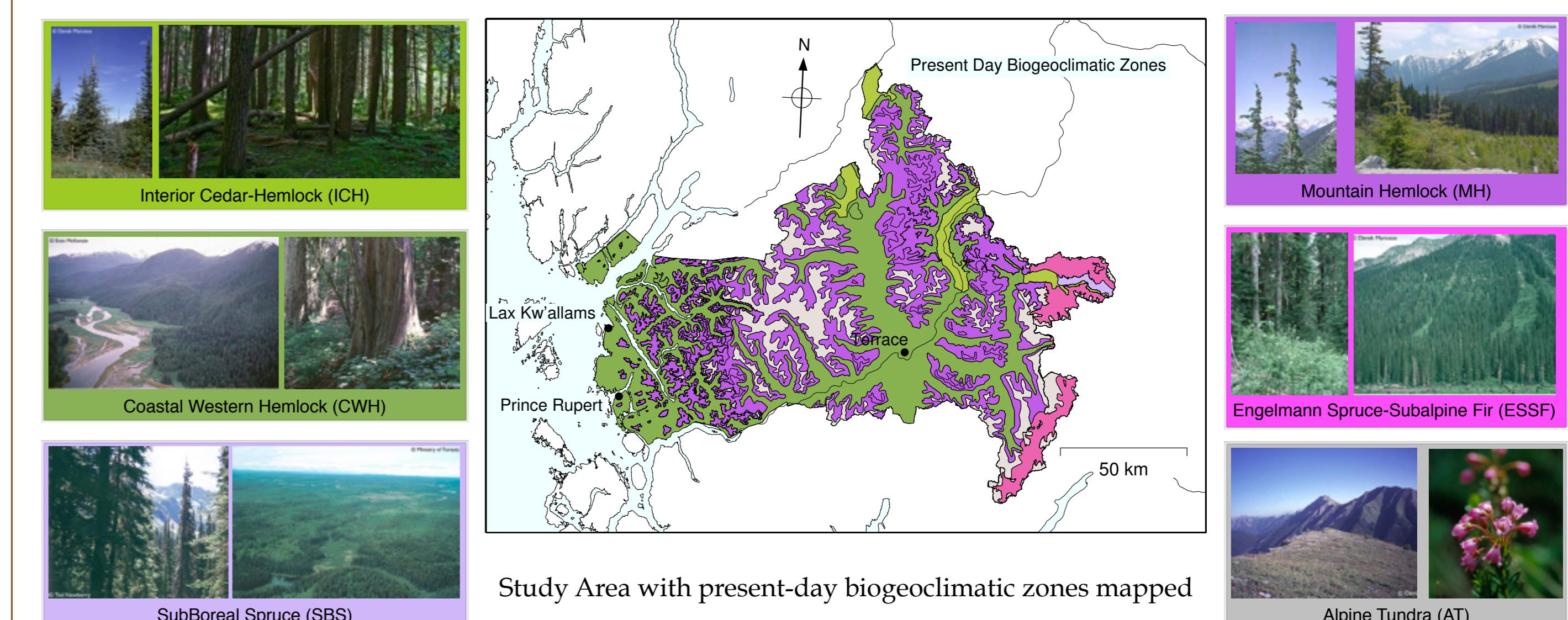
- Winter**
- Projected to become wetter with more precipitation falling as rain.
 - Mean temperatures are projected to be warmer with minimum temperatures higher than present.

- Spring**
- Warmer and wetter
 - By 2080, the mean monthly maximum temperature is projected to be almost 5°C warmer than present

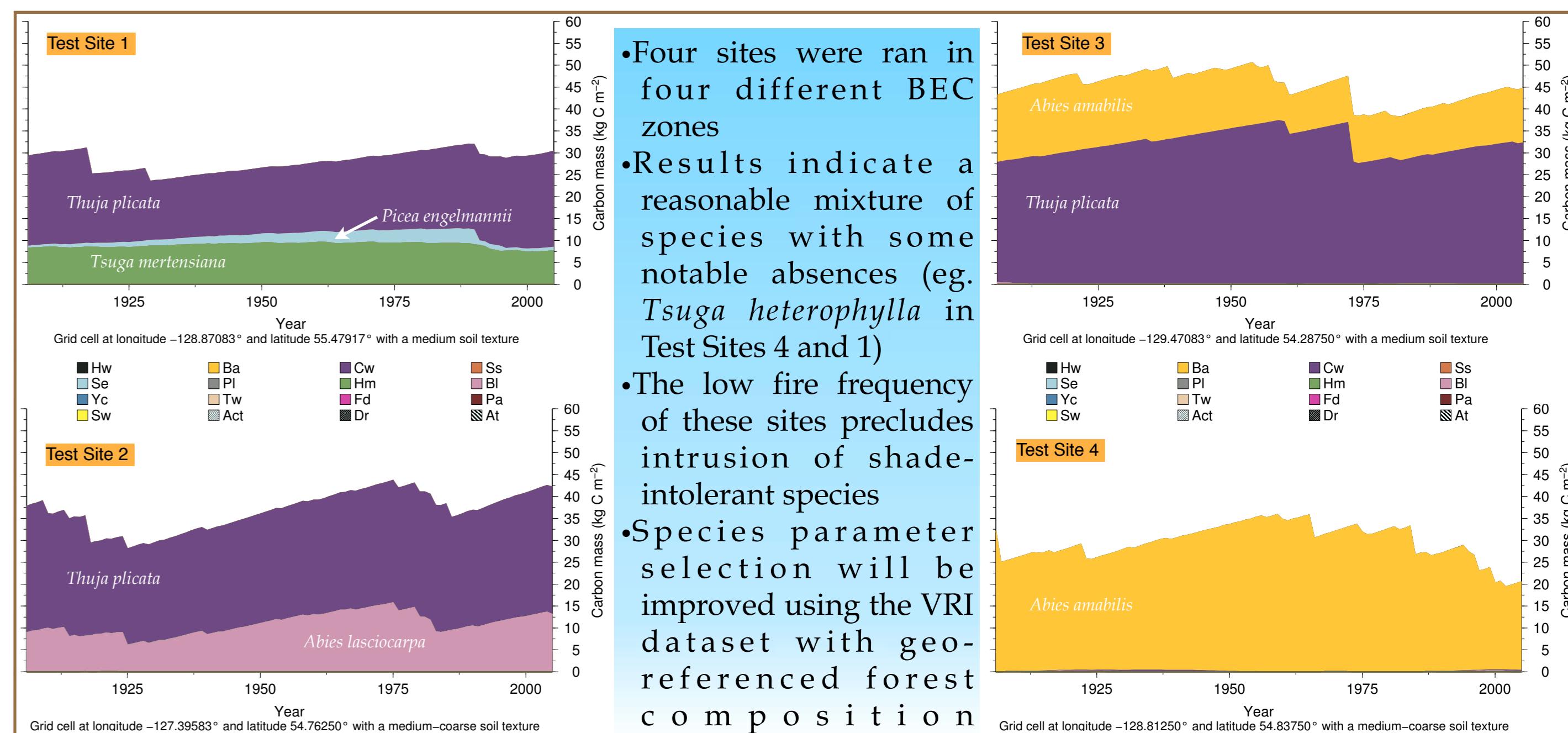
- Summer**
- Warmer for both maximum and mean air temperatures
 - Drier as precipitation decreases, further increasing the seasonality of precipitation to the region

- Autumn**
- Warmer and more rainfall than present
 - Transition from summer to autumn more pronounced as summers become drier and autumns wetter
 - Minimum and mean air temperatures are also projected to rise

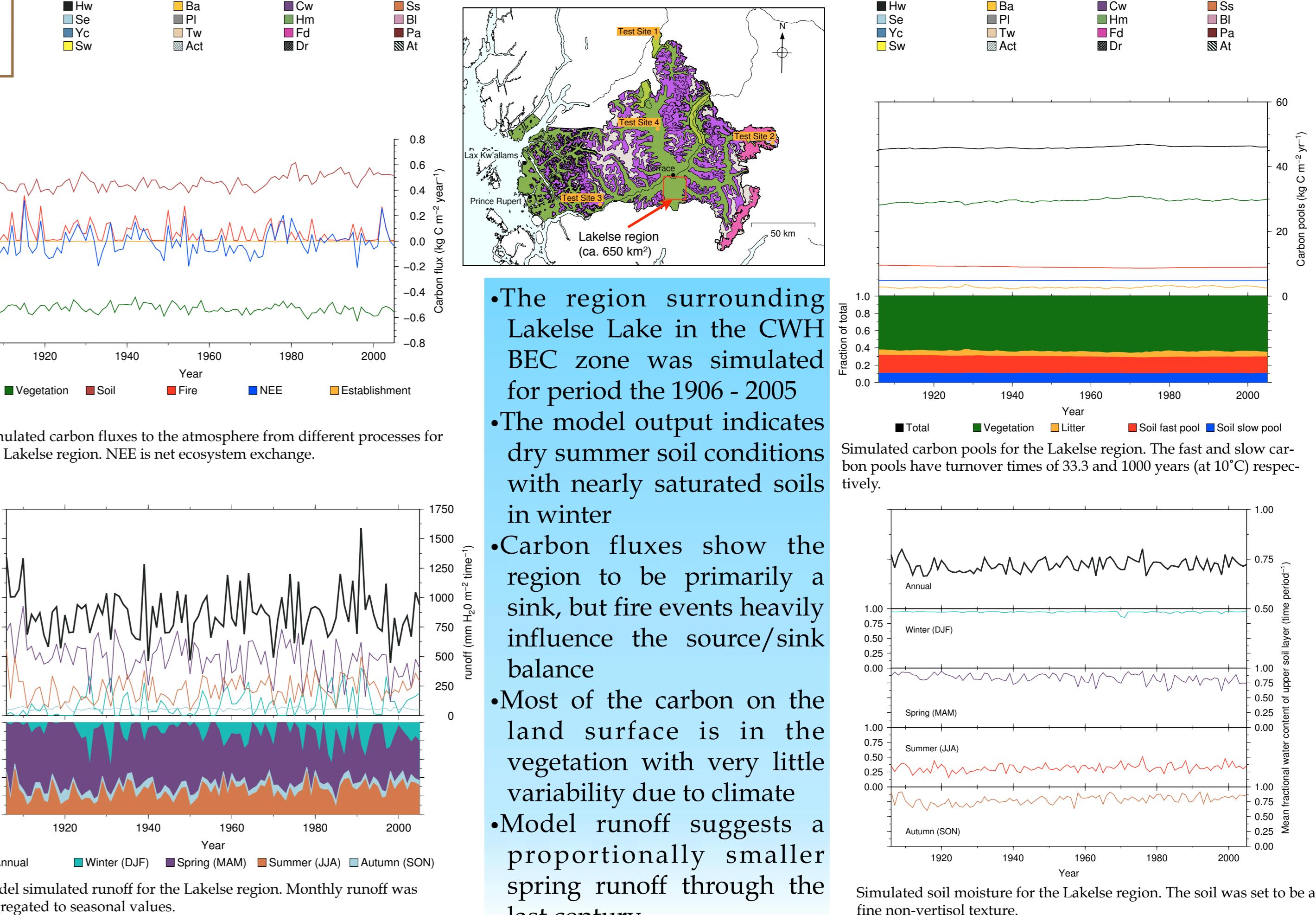
BEC Zones of the Study Region



Early Results



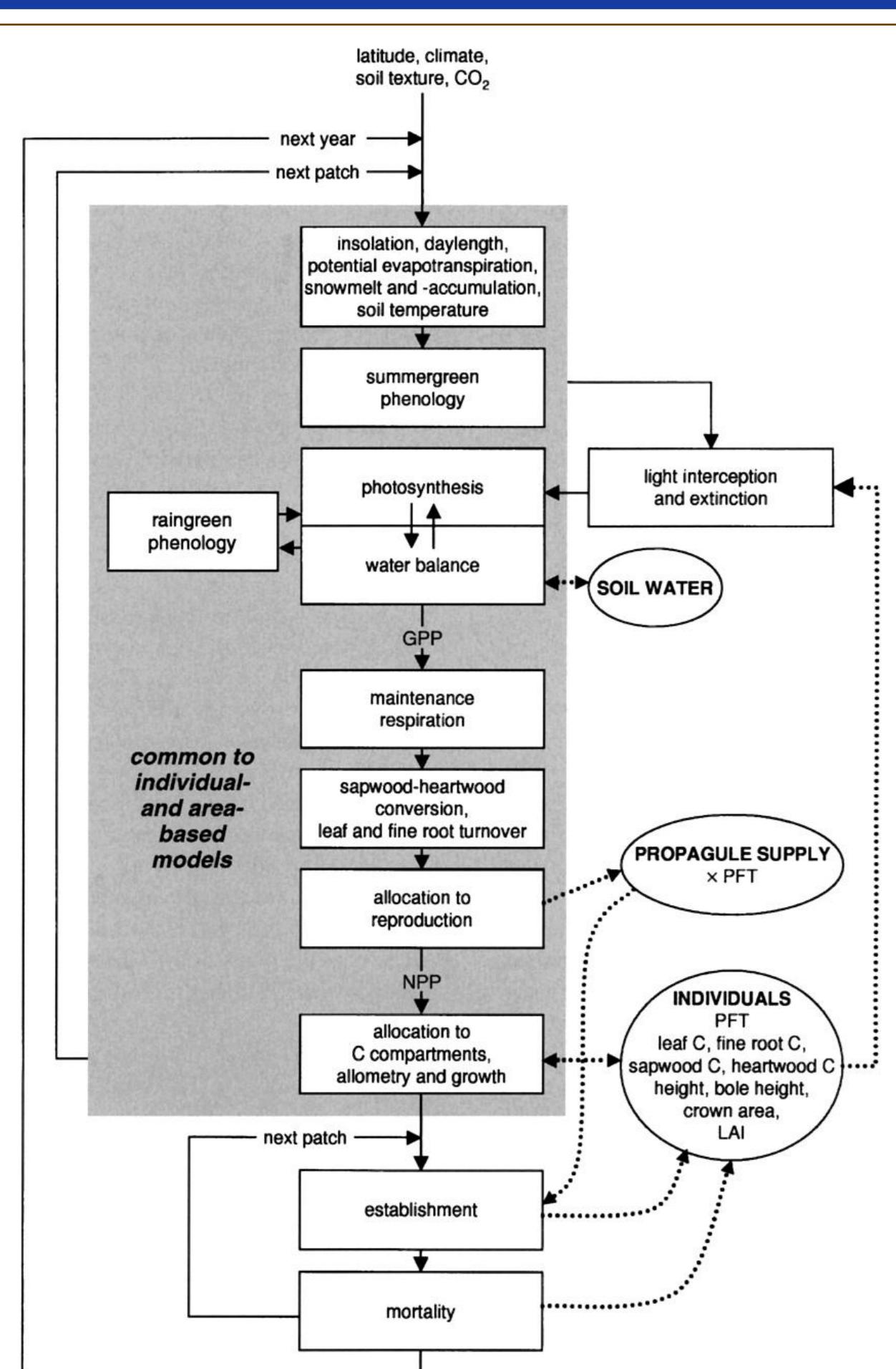
- Four sites were ran in four different BEC zones
- Results indicate a reasonable mixture of species with some notable absences (e.g. *Tsuga heterophylla* in Test Sites 4 and 1)
- The low fire frequency of these sites precludes intrusion of shade-intolerant species
- Species parameter selection will be improved using the VRI dataset with geo-referenced forest composition



Future Work

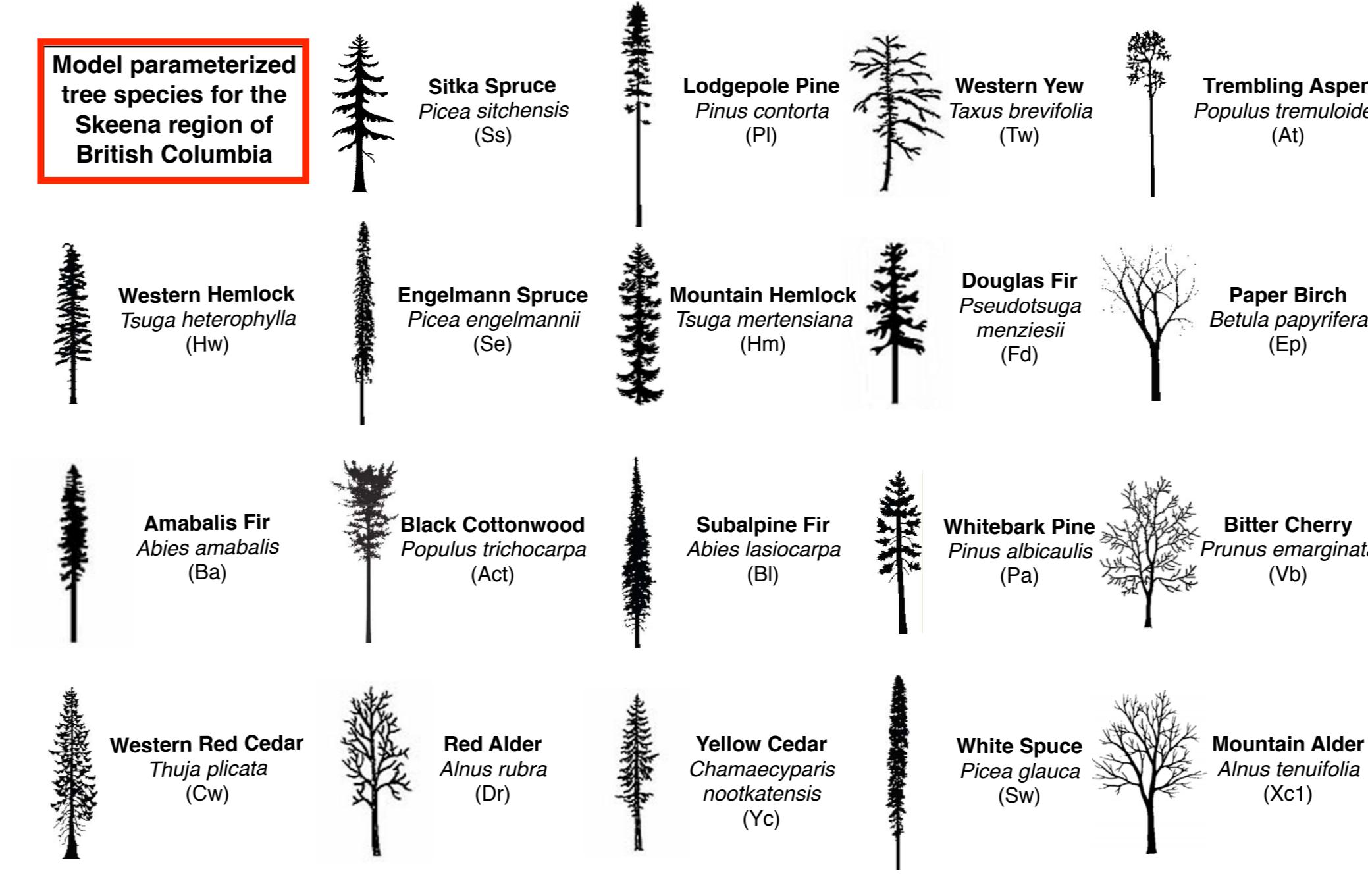
- Refine species parameterization using geospatial-referenced data (e.g. BC VRI) for species mixture and standing carbon stocks
- Implement a scheme to account for past land-use in the region to improve the accuracy of the model projections. Possibly using VRI database date of harvest
- Perform future simulations including effects of land-use changes to select regions of the study area

Process-Based Regional Dynamic Vegetation Modelling



Schematic of the LPJ-GUESS model (Smith et al 2001, Tang et al. 2010). Within the model 'patches' are simulated where individuals are distinguished and compete with other individuals for light and soil moisture within the same patch.

- The RDVM model chosen, LPJ-GUESS, is particularly well-suited to examining possible future trajectories of the forests in the Skeena region as the model is sensitive to CO₂ concentration, moisture, and temperature.
- Explicitly simulates growth and competition among individual plants with stochastic establishment and disturbance (fire), necessitating replicate patches for statistically robust results.
- Grid resolution of 30 arc seconds (~1 km²) (ca. 32,000 grid cells)
- 15 tree taxa parameterized
 - Parameterization based upon literature values and adaptation of parameters from the FVS (Prognosis) model
- LPJ-GUESS outputs carbon fluxes due to photosynthesis, respiration, and organic matter decomposition suitable for comparison to flux measurement data (Hickler et al. 2008)
- Past and future land - use can be prescribed with stand replacing, selective species removal, and thinning options for harvesting
- The effects of different forest management practices on variables such as soil carbon, runoff, vegetation carbon stocks, NEE, and NPP can be investigated.



Suite of IPCC AR4-GCM output used to drive LPJ-GUESS:
(following Spittlehouse & Murdoch, 2010)

Conditions	Model	Emissions	run
Hot and dry	HadGEM	A1B	1
Warm and wet	CGCM3	A2	4
Cooler and less moist	HadCM3	B1	1

References:

Hickler, T., Smith, B., Prentice, I. C., Mjøfors, K., Miller, P., Arneth, A., and Sykes, M. T. (2008), CO₂ fertilization in temperate FACE experiments not representative of boreal and tropical forests. *Global Change Biology*, 14, 1531-1542.

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Tang, G., Beckage, B., Smith, B., and Miller, P. (2010). Estimating potential forest NPP, biomass and their climatic sensitivity in New England using a dynamic ecosystem model. *Ecosphere*, 1(6), art. 18.

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