Reforestation: Species Selection and Climate Change


Photo credit: Graham Hues
Douglas-fir

A presentation to the
WFP West Island Woodlands Advisory Group
February 19, 2015
Annette van Niejenhuis, RPF
Tree Improvement Forester,
WFP Saanich Forestry Centre

Overview:

Climate & Climate Change
- Climate and tree growth
- Climate change models

Species Selection
- Objectives
- Regulations
- Climate envelopes' BEC
- Climate related hazards
- Seed sources
- Mixtures

Climate Versus Weather

"The difference between weather and climate is a measure of time. Weather is what conditions of the atmosphere are over a short period of time, and climate is how the atmosphere "behaves" over relatively long periods of time....

...Most people think of weather in terms of temperature, humidity, precipitation, cloudiness, brightness, visibility, wind, and atmospheric pressure, as in high and low pressure.

In most places, weather can change from minute to minute, hour to hour, day to day, and season to season. Climate, however, is the average of weather over time and space....

http://www.nasa.gov/mission_pages/noaa-s/climate/climate_weather.html

Climate and tree growth

Effects on resources required by trees
- Moisture availability
- Nutrient availability
- CO2 fertilization

Effects on site conditions
- Permafrost melting
- Drying of wetlands
- Creation of wetlands
- Changes in snow depth
- Soil erosion
- Water logged soils

Effects on disturbance
- Extreme weather (including drought)
- Wildfire
- Insects
- Diseases
- Freeze thaw cycles
- Flooding

Effects on individual organisms
- Phenology
- Respiration
- Photosynthesis
- Metabolism
- Growth
- Health
- Mortality
- Reproduction
- Water use efficiency

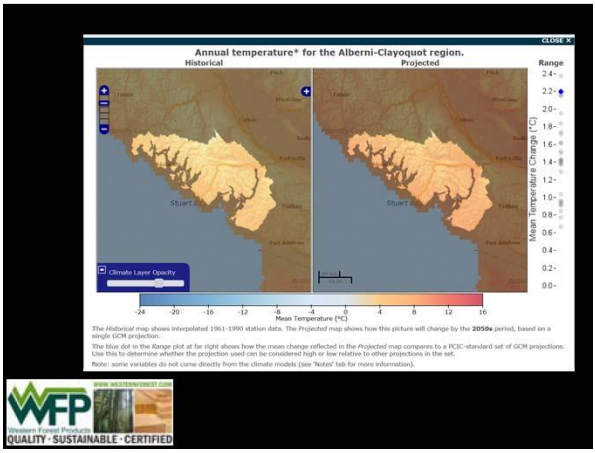
Adapted from "Figure 2: A map of climate change impacts on forests" in Williamson, T.B., S.L. Colombo, P.N. Duinker, P.J. Gray, R.J. Hennessey, D. Houle, M.H. Johnson, A.C. Ogden, and D.J. Spittlehouse. 2009. Climate change and forests of the future: Managing in the face of uncertainty. For. Chron. 85: 178-184.

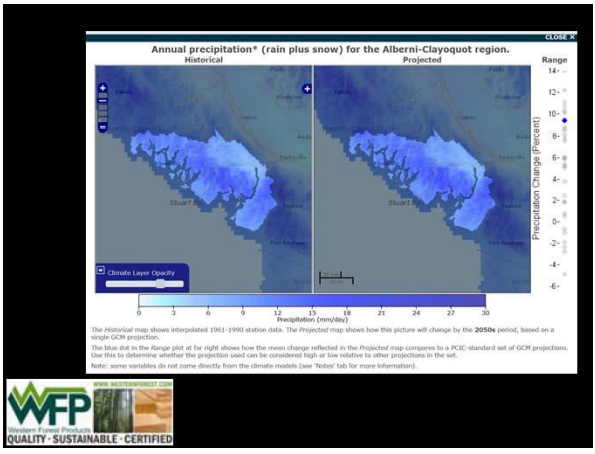
Climate and tree growth

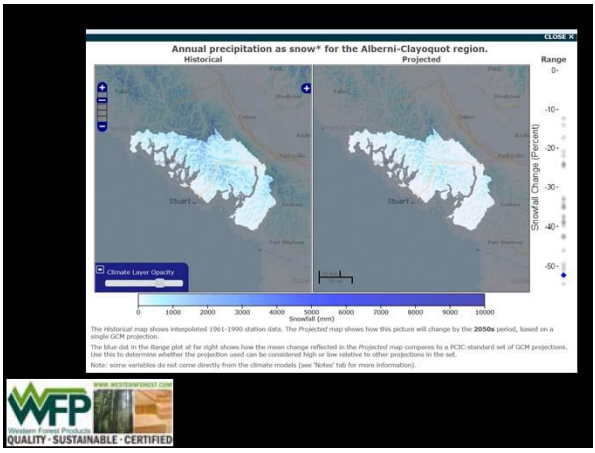
Contributing factors to scale of impact
- Age of trees
- Actual weather
- Location
- Site conditions
- Species interactions – native and new species
- Synchrony of phenology
- Tolerance of individuals
- Acclimatization (phenotypic change)
- Biological adaptation (genotypic change)
- Ability to migrate
- Human adaptive efforts

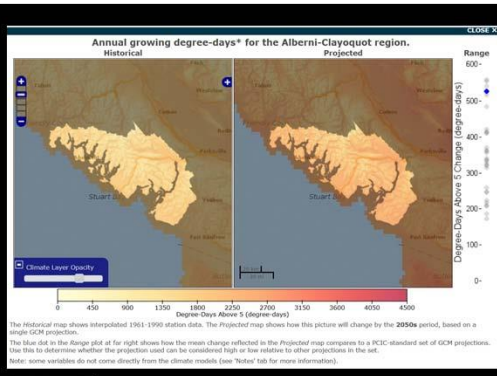
Adapted from "Figure 2: A map of climate change impacts on forests" in Williamson, T.B., S.L. Colombo, P.N. Duinker, P.J. Gray, R.J. Hennessey, D. Houle, M.H. Johnson, A.C. Ogden, and D.J. Spittlehouse. 2009. Climate change and forests of the future: Managing in the face of uncertainty. For. Chron. 85: 178-184.

Climate change models


CLOSE X
Annual temperature* for the Alberni-Clayoquot region.
Historical
Projected
Range
Mean Temperature Change (°C)
Climate Layer Opacity
-24 -20 -16 -12 -8 -4 0 4 8 12 16
Mean Temperature (°C)
The Historical map shows interpolated 1961-1990 station data. The Projected map shows how this picture will change by the 2050s period, based on a single GCM projection.
The blue dot in the Range plot at far right shows how the mean change reflected in the Projected map compares to a PCIC-standard set of GCM projections. Use this to determine whether the projection used can be considered high or low relative to other projections in the set.
Note: some variables do not come directly from the climate models (see 'Notes' tab for more information).


CLOSE X
Annual precipitation* (rain plus snow) for the Alberni-Clayoquot region.
Historical
Projected
Range
Precipitation Change (Percent)
Climate Layer Opacity
0 3 6 9 12 15 18 21 24 27 30
Precipitation (mm/day)
The Historical map shows interpolated 1961-1990 station data. The Projected map shows how this picture will change by the 2050s period, based on a single GCM projection.
The blue dot in the Range plot at far right shows how the mean change reflected in the Projected map compares to a PCIC-standard set of GCM projections. Use this to determine whether the projection used can be considered high or low relative to other projections in the set.
Note: some variables do not come directly from the climate models (see 'Notes' tab for more information).


CLOSE X
Annual precipitation as snow* for the Alberni-Clayoquot region.
Historical
Projected
Range
Snowfall Change (Percent)
Climate Layer Opacity
0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Snowfall (mm)
The Historical map shows interpolated 1961-1990 station data. The Projected map shows how this picture will change by the 2050s period, based on a single GCM projection.
The blue dot in the Range plot at far right shows how the mean change reflected in the Projected map compares to a PCIC-standard set of GCM projections. Use this to determine whether the projection used can be considered high or low relative to other projections in the set.
Note: some variables do not come directly from the climate models (see 'Notes' tab for more information).



Species Selection

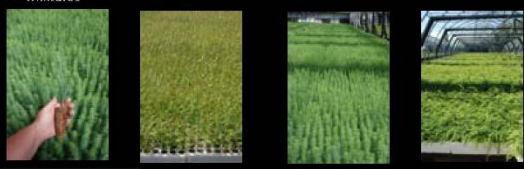
- Objectives
  1. Maintain or enhance the long term productivity and viability of WFP forest tenures;
  2. Minimize risk to the present and future profitability of WFP Timberlands operations;"
  3. Support the sustainability goals of WFP s certification systems and Western Forest Strategy.

From Beese et al, 2014,
Silviculture strategy for climate change impacts: adaptat on and m tigation
Framework and Recommendations, WFP interna document

- Regulations
- Climate 'envelopes' - BEC
- Climate-related hazards
- Seed sources
- Mixtures

Species Selection

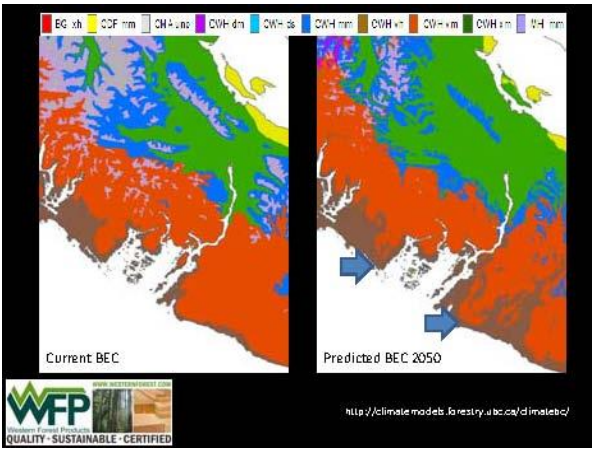
- Objectives
- Regulations
  1. Forest and Range Practices Act – Forest Stewardship Plan (FSP)
  2. Forest Planning and Practices Regulation – FSP Content – Stocking Standards
  3. Chief Forester s Standards for Seed Use – no GMO, native species, seed sources
- Climate 'envelopes' - BEC
- Climate-related hazards
- Seed sources
- Mixtures

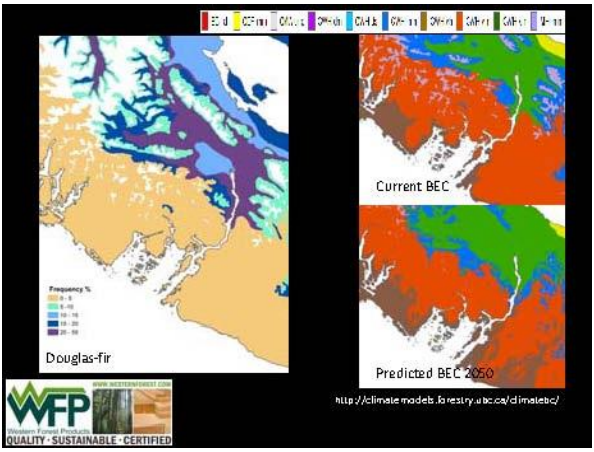


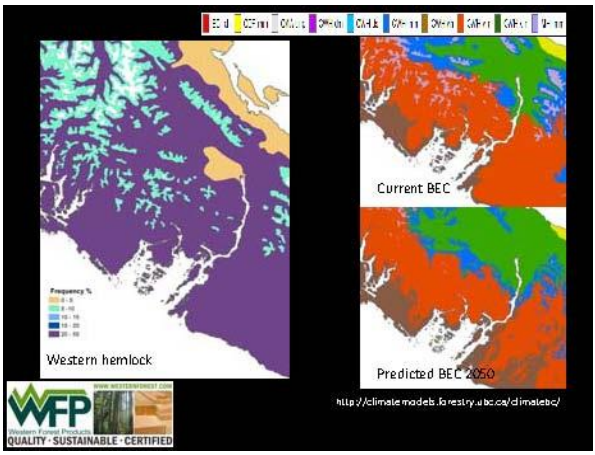
Species Selection

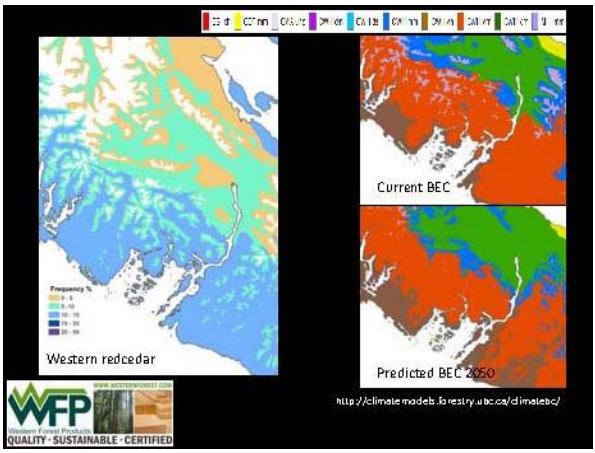
- Climate 'envelopes' – BEC – The BEC Framework and Climate Change
  - ❖ Biogeoclimatic ecosystem classification is a framework for understanding the important components of terrestrial ecological systems. These components include climate, site factors, and associated vegetation.
  - ❖ The classification is a tool for reducing complexity and organizing and communicating ecological knowledge between users.
  - ❖ BEC has two spatial scales of focus. The site component addresses environment drivers at a local scale to differentiate relative site quality. And a zonal or climatic component describes and maps regional bioclimates.

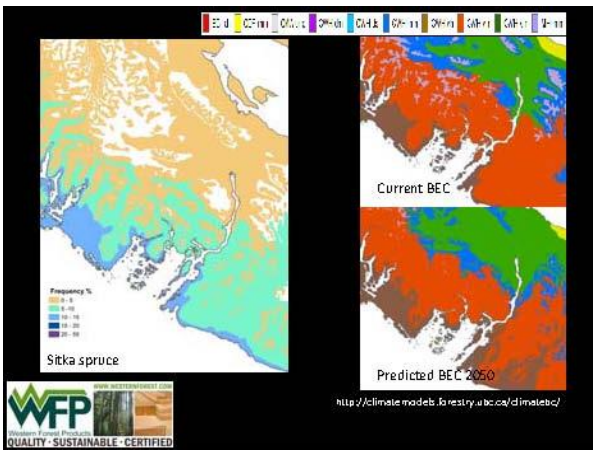
http://www.for.gov.bc.ca/HRE/becweb/program/climate%20change/index.html






Western hemlock
Current BEC
Predicted BEC 2050
http://climatemodels.forestry.ubc.ca/climatebc/
QUALITY · SUSTAINABLE · CERTIFIED


Western redcedar
Current BEC
Predicted BEC 2050
http://climatemodels.forestry.ubc.ca/climatebc/
QUALITY · SUSTAINABLE · CERTIFIED


Sitka spruce
Current BEC
Predicted BEC 2050
http://climatemodels.forestry.ubc.ca/climatebc/
QUALITY · SUSTAINABLE · CERTIFIED

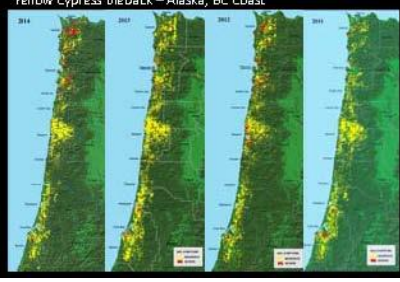
BEC Changes – Zonal Sites – from Forest Stewardship Plan

	BEC Unit	Site Series	Preferred and Acceptable Species / Free Growing Heights (from FSP)										
Currently	CWH vm1	1	Cw/1.5	Fd/3.0	Hw/3.0	Yc/1.5	Ss/3.0	Ba/1.7					
Mode	CWH vh1	1	Cw/1.5	Fd/2.0	Hw/2.0	Yc/1.5	Ss/3.0	Ba/1.7			P /1.5		
				††	††								
Currently	CWH mm1	1	Cw/1.5	Fd/3.0	Hw/2.0	Yc/1.5		Ba/0.7	Bp/2.0				
Mode	CWH vm1	1	Cw/1.5	Fd/3.0	Hw/3.0	Yc/1.5	Ss/3.0	Ba/1.7					
					†								
Currently	MH mm1	1			Hw/1.0	Yc/1.0		Ba/0.6	Bp/1.0	Hm/1.0			
Mode	CWH mm2	1	Cw/1.0	Fd/2.2	Hw/1.2	Yc/1.0		Ba/0.7	Bp/1.0	Hm/1.0			
					†			†					
Currently	MH mm1	1			Hw/1.0	Yc/1.0		Ba/0.6	Bp/1.0	Hm/1.0			
Mode	CWH vm2	1	Cw/1.5	Fd/2.2	Hw/2.5	Yc/1.5	Ss/3.0	Ba/1.7		Hm/1.0			
					†	†		†					
Currently	MH mm1	1			Hw/1.0	Yc/1.0		Ba/0.6	Bp/1.0	Hm/1.0			
Mode	CWH xm	1	Cw/1.5	Fd/3.0	Hw/2.0							Pw/2.5	Dr/4.0
					†								
			† More productive								†† Less Productive		

Species Selection

- Objectives
- Regulations
- Climate 'envelopes' - BEC
- Climate related hazards
  - ❖ Insects .... Mountain Pine Beetle (BC Interior)
  - ❖ Diseases – Swiss Needle Cast (Douglas fir) Pacific NW
  - ❖ Abiotic factors Yellow Cypress dieback – Alaska, BC Coast
- Seed sources
- Mixtures

http://snoc.forestry.oregonstate.edu/survey_maps



Species Selection

- Objectives
- Regulations
- Climate 'envelopes' - BEC
- Climate-related hazards
- Seed sources
  - ❖ Transfer limits wild seed
  - ❖ Transfer limits orchard seed
  - ❖ American parents in breeding programs
- Mixtures

Photo Credit: Jamie Meyers

http://blogs.ubc.ca/siteniels/author/jelleo/

Species Selection

- Objectives
- Regulations
- Climate 'envelopes' - BEC
- Climate-related hazards
- Seed sources
- Mixtures
  - *Multi species patchwork mixtures*
  - *Multi species intimate mixtures*
  - *Single species seed source mixtures*

Photo credit: Ryan Dvorak

http://www.for.gov.bc.ca/hre/forgen/interior/AMAT.htm