Matching planting stock with environments for reforestation under changing climate

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Planting the future forests

Revising seed zones and breeding regions to match planting stock to new climate realities will become an important tool in the future to maintain forest health and productivity. Two decisions have to be made when planting trees in forestry programs. First, an appropriate **species has to be chosen** for a planting site. Secondly, planting stock has to be selected that is **genetically well-adapted** to the target environment.

The objective of this project is to guide foresters in both species and genotype selection for **15 tree species of commercial importance** in western Canada: Douglas-fir, lodgepole pine, western white pine, poderosa pine, western hemlock, yellow cedar, western redcedar, pacific silver fir, black spruce, white spruce, Engelman spruce, western larch and trembling aspen. Here we show results for the first step, **species choice**, using Douglas-fir as an example.

Modeling approach

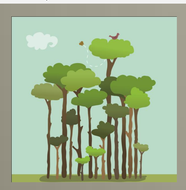
Current & Projected Climate (10 Variables)

56 Model Runs – Summarized

- 5 GCMs implemented by modeling groups (CGCM2, Canada; CSIRO2, Australia; HADCM3, UK; ECHAM4, Europe; PCM, USA)
- 4 Emission and population growth scenarios (ranging from extreme economic and population growth to low population growth and environmentally sustainable economies)
- Modeled under 2 current periods (1961-1990 normal period & 1997-2006 observed climate change period – 1 run each period)
- Modeled under 3 projected future periods (2020s, 2050s and 2080s – 18 runs each period)

Predicted using the Random Forest regression tree classification method

Ecosystem Classes



Species Frequencies & Genotypes

- Known for each ecosystem class
- After ecosystem classes are located on the landscape under projected climate, species frequencies and/or genotypes are assigned back
- Mean value of all projected climate model runs is used for map outputs

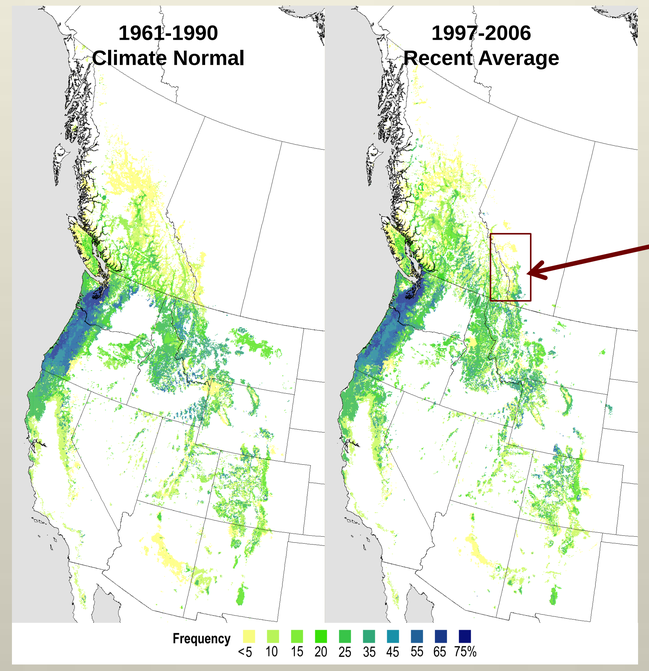
Predicted Douglas-fir habitat

Results show that under observed climate change over the last 25 years (represented by the 1997-2006 average) both the suitable habitat and frequency of Douglas fir has **increased and expanded** north in British Columbia and Alberta.

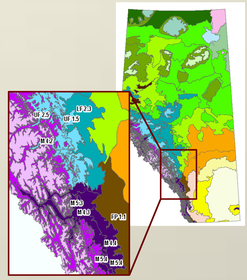
The expansion is expected to continue for the 2020s, 2050s and 2080s. However, note that **model agreement drops** the further into the future we project, indicated by the light blue and yellow tones in the 2050 and 2080 maps.

Based on the current and 2020s projections, a reforestation recommendation for the Alberta foothills region is derived in the upper-right box.

Model predictions under current climate



Evaluation for Alberta's seed zones

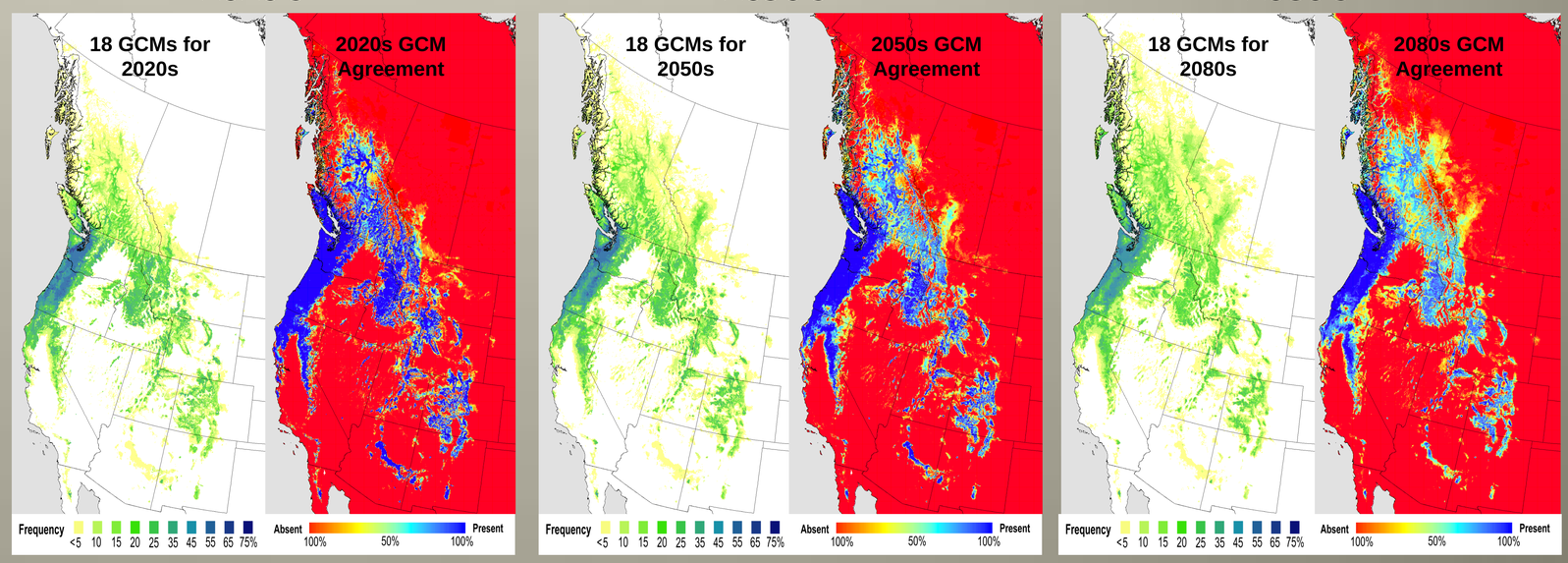


There are 5 seed zones (M 4.3, 4.4, 5.3, 5.5, and 5.6) where Douglas-fir is currently planted in southern Alberta.

The evaluation below shows that three adjacent seedzones could be considered for reforestation with Douglas-fir (UF 1.5, LF 2.3, and FP 1.1). In those areas we see increased potential habitat under current and predicted climate change.

	Presence			Predicted Frequency if Present (%)			
Seed Zone	61-90	97-06	2020s	61-90	97-06	2020s	
M 5.3	Yes	Yes	99%	5	3	5	CURRENT
M 4.3	Yes	Yes	96%	7	9	7	
M 4.4	Yes	Yes	99%	1	19	11	
LF 2.3	No	Yes	93%	-	10	10	NEW RECOMENDATIONS
UF 1.5	No	Yes	94%	-	1	3	
FP 1.1	No	Yes	72%	-	17	20	

Model predictions under projected climate change



If you are interested in any of the other 14 commercial tree species we analyzed, please contact us using the information at the top of the poster.

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