

DIFFICULT MIGRATION OF TEMPERATE TREE SPECIES IN THE BOREAL FOREST UNDER CLIMATE CHANGE?

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Quantifying and mapping the impact of climate change
on forest productivity in Eastern Canada



INTRODUCTION OBJECTIVE

Main objective: Assess range shift and migration rate of the temperate forest community toward boreal forest under climate change.

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Why ?

- ▶ Predict the future distribution of temperate species community in Quebec
- ▶ Improve and adapt our forests management practices under CC

CONTEXT THE BOREAL-TEMPERATE ECOTONE

The surface of the boreal-temperate forests ecotone is **expected to shift in the next decades.**



CONTEXT THE BOREAL-TEMPERATE ECOTONE

1. The location of this ecotone is responsive to the climate.



CONTEXT FUTURE SPECIES DISTRIBUTION PREDICTED

2. Several temperate forest species are predicted to **shift northward** under CC

For instance:

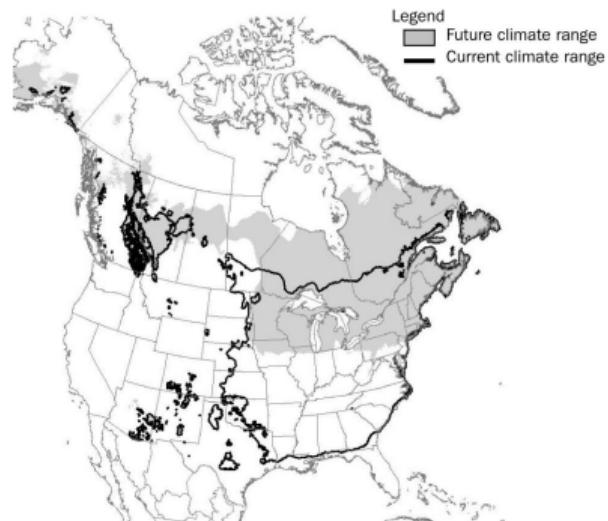
- ▶ Sugar maple
- ▶ Yellow birch
- ▶ American ash
- ▶ Red oak
- ▶ ...

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Future climate enveloppe of Sugar maple
(2071-2100) - McKenney et al, 2007

NEW APPROACH WHICH TOOL IS MORE APPROPRIATE?

Forest have:

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2. Slow population dynamics
3. Successional stages based on facilitation and/or competition processes

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- ▶ Dispersal rate

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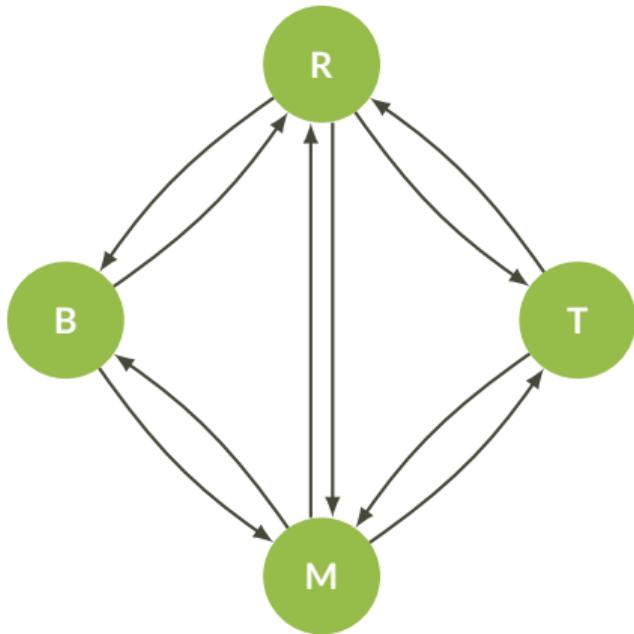
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Those processes are affected by the future climate

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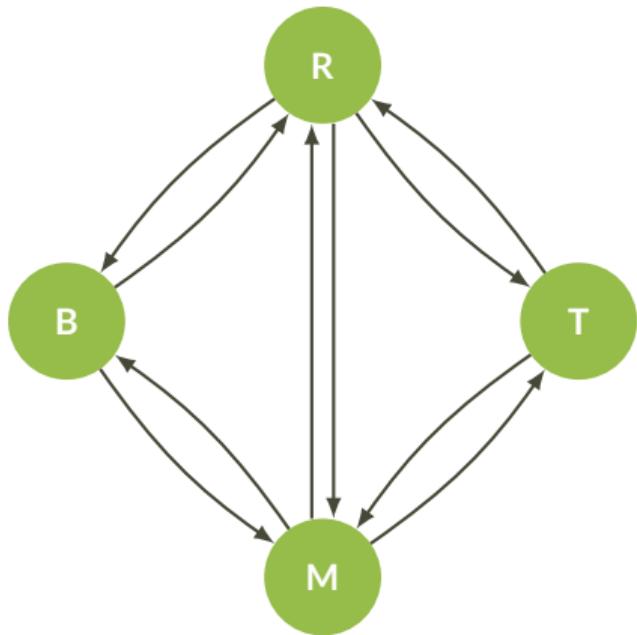
Diagram: Model tools

METHOD STATE AND TRANSITIONAL MODEL



- ▶ Landscape modelling scale
- ▶ 4 States (**R,B,T,M**)
- ▶ **R** corresponds to a post-disturbance patch
- ▶ Probability of transition given climatic conditions
- ▶ Spatially explicit and stochastic model

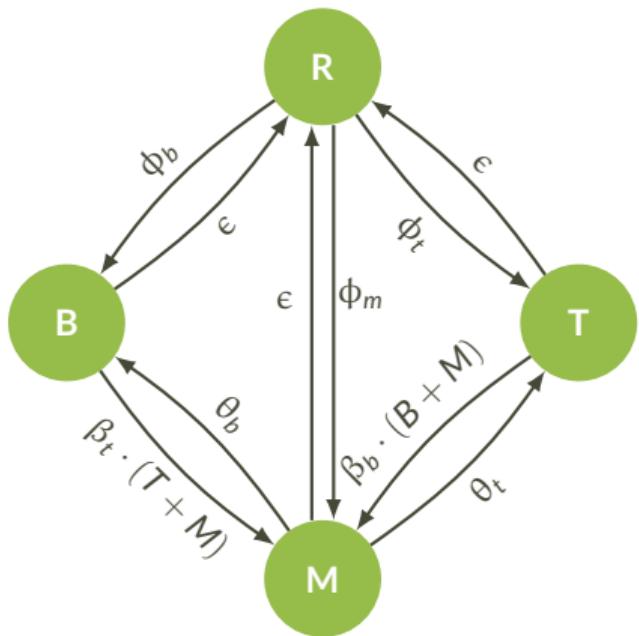
METHOD STATE AND TRANSITIONAL MODEL



States	Classification
T	$Ba_t \geq 75\%$
M	$Ba_b \geq 25\% \text{ and } Ba_t \geq 25\%$
B	$Ba_b \geq 75\%$
R	$Ba_r \geq 75\%$

See with Dom for the new classification

METHOD STATE AND TRANSITIONAL MODEL



Parameters:

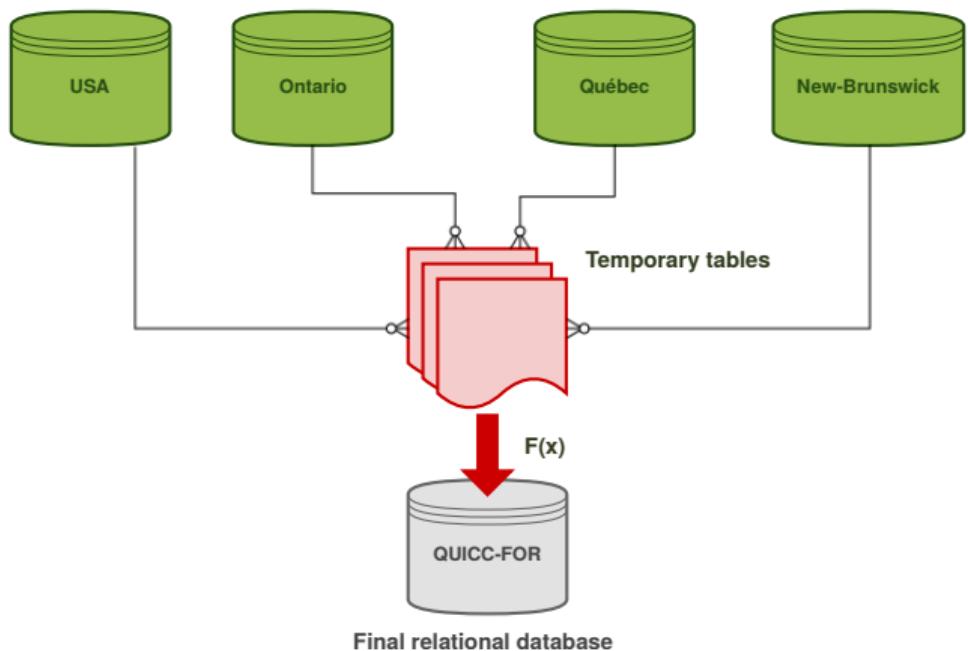
- β : Colonization rate
- θ : Succession rate
- ϕ : Regeneration functions
- ϵ : Disturbance rate

Each rate depends of:

- Proportion of states available in the neighborhood
- Climatic conditions encounter by the patch (Precipitation, Temperature)

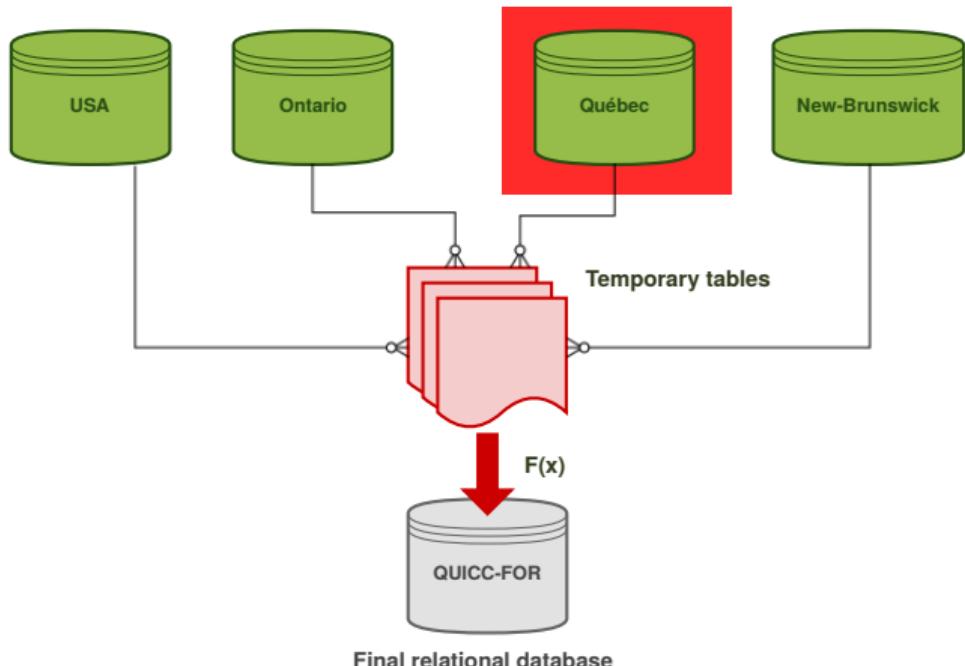
DATA USED THE QUICC-FOR DATABASE

Merge several databases of forest permanent plots survey



DATA USED CALIBRATION

Preliminary results include only the Quebec database



METHOD CALIBRATION

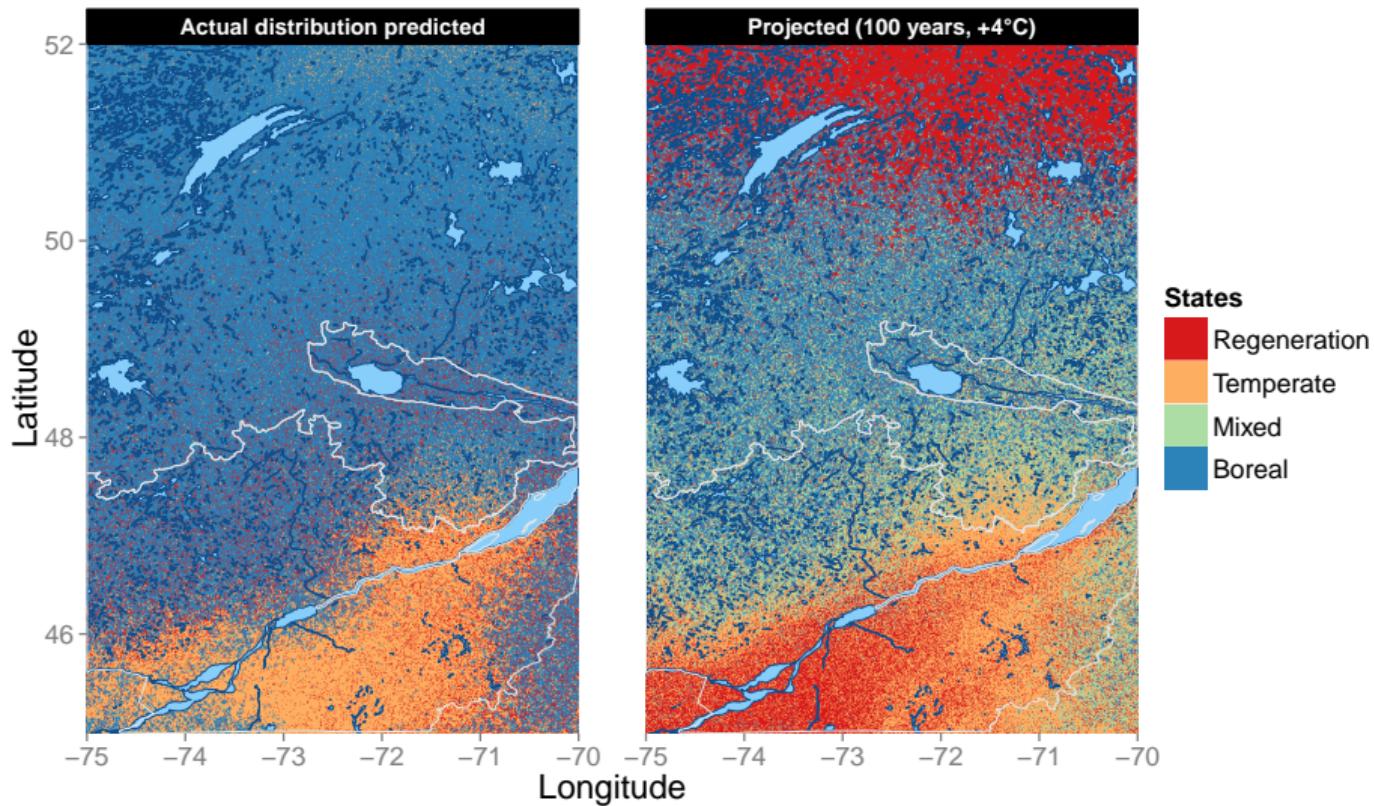
Raster informations

Probability space

RESULTS PROBABILITIES DISTRIBUTION

Figure: PDFs

RESULTS ACTUAL PREDICTED LANDSCAPE



INCOMINGS

Next steps:

1. Add all data from the QUICC-FOR database
2. Improve the calibration
3. Proceed a real validation
4. Perform simulations using Regional Climate Models (RCM)

QUESTIONS

Thanks for your attention.
Any Questions ?