



Le réchauffement climatique comme bouc émissaire

Quantifier l'importance du climat
dans la rétraction vers le nord de
l'aire de distribution du caribou
forestier au Québec depuis 1850

Chloé Morineau, Yan Boulanger &
Martin-Hugues St-Laurent

Introduction

➤ Ongoing loss of biodiversity worldwide



Habitat change



Pollution



Over-exploitation

**DIRECT
DRIVERS**



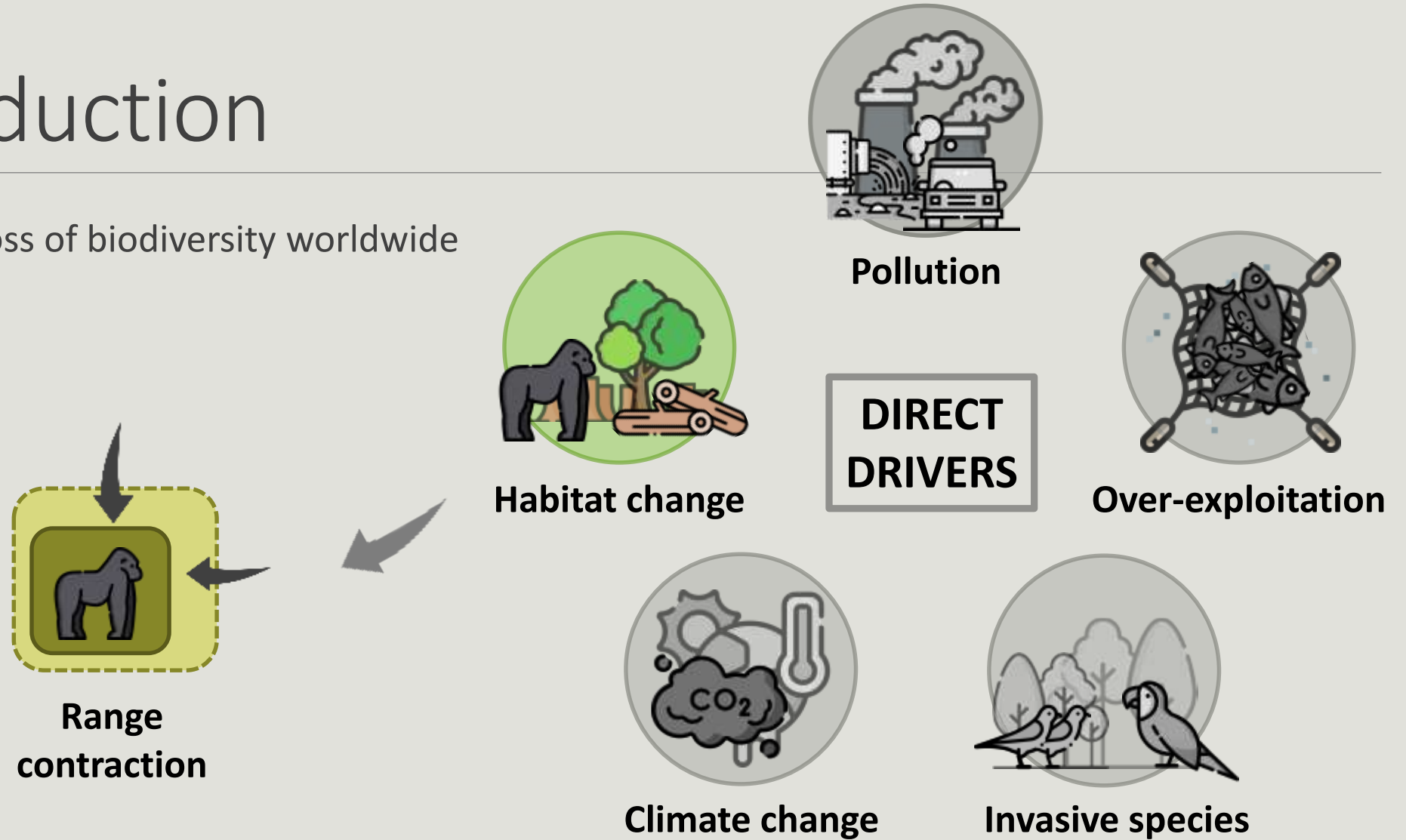
Climate change



Invasive species

Introduction

➤ Ongoing loss of biodiversity worldwide



Introduction

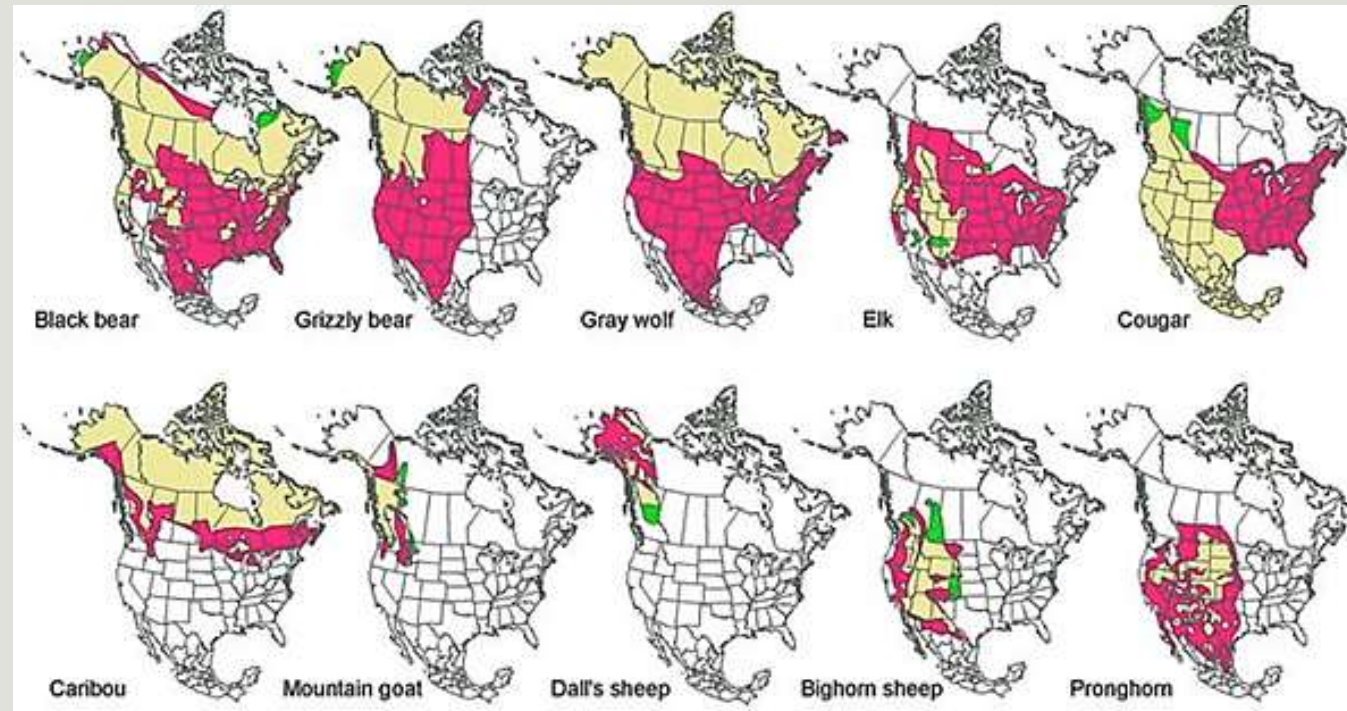
➤ Anthropogenic habitat alteration



■ Contraction

■ Persistence

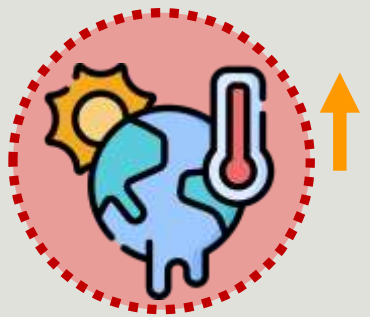
■ Expansion



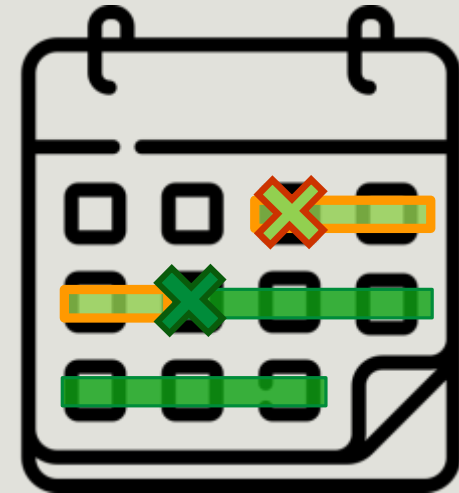
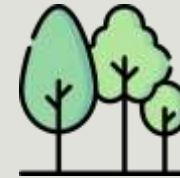
after Laliberté & Ripple 2004

Introduction

➤ Climate change

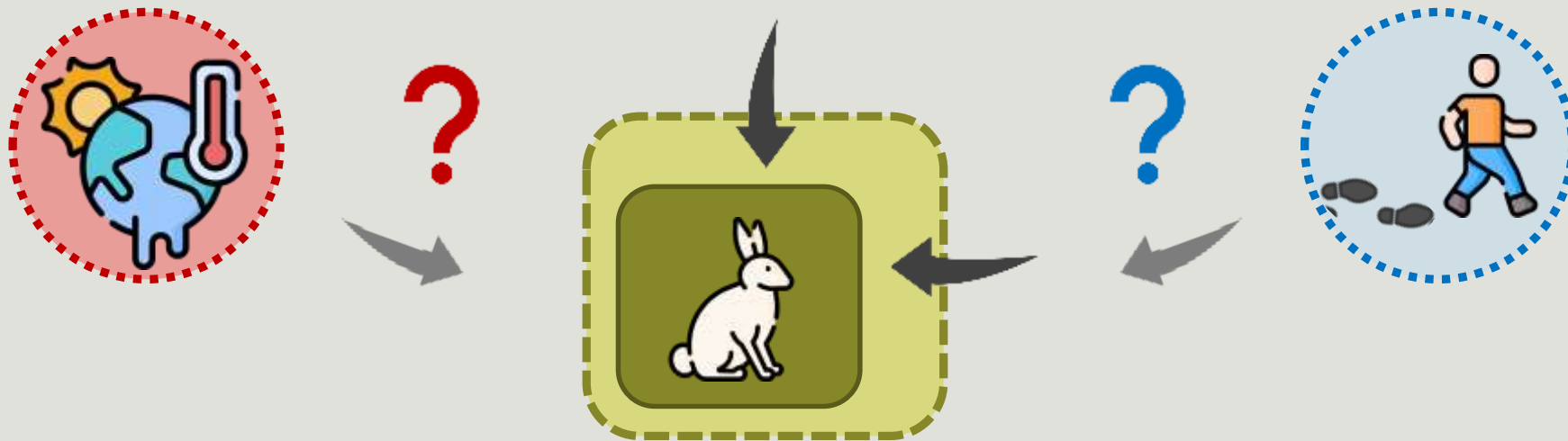


20°C
20°C



Introduction

- Combined effects of climatic and anthropogenic threats

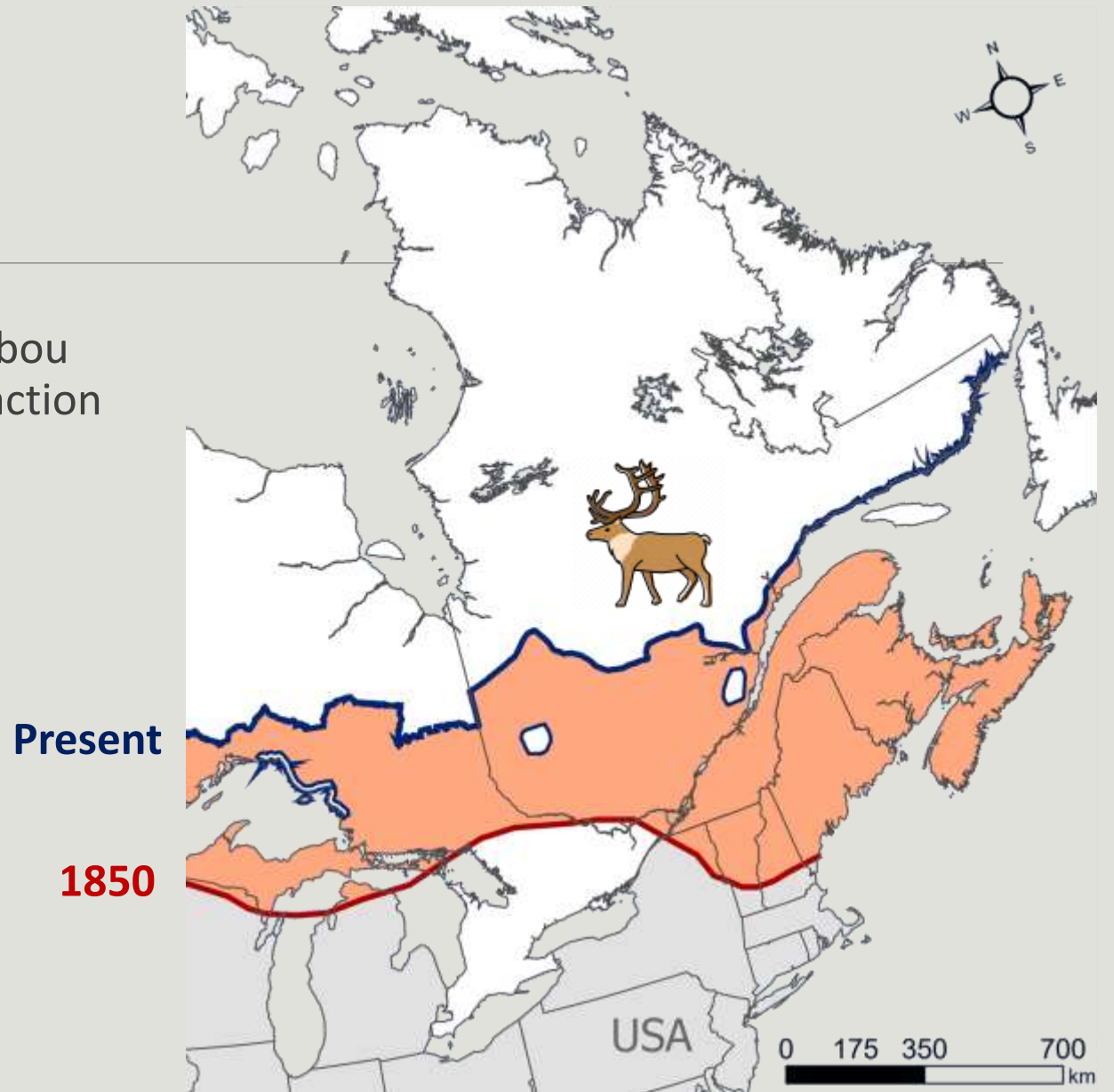


Introduction

- Boreal caribou (ecotype of woodland caribou subspecies) → important northward contraction of trailing edge of distribution since 1850



©Robert McCaw



Introduction



Apparent competition



Human presence

Forest cuts

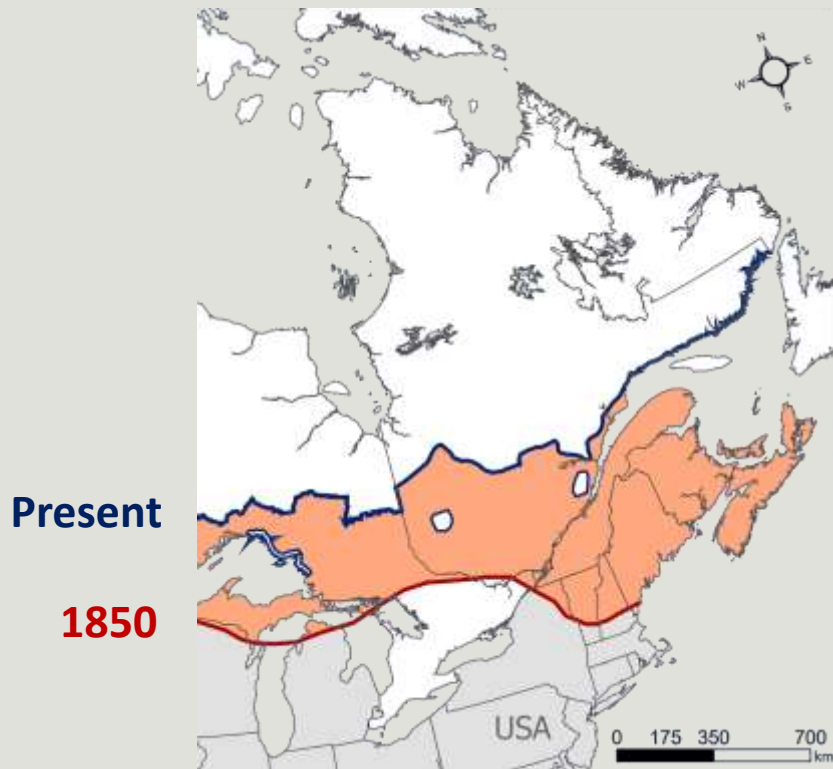
Roads

Fragmentation



Introduction

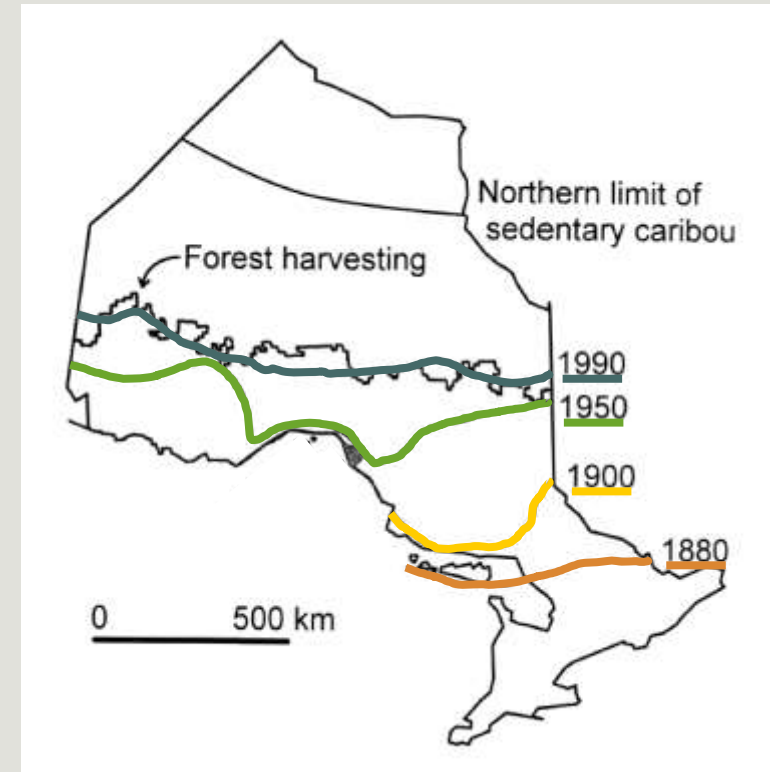
- Limited literature on woodland caribou range recession and climate change



Research Note

Long-Term Range Recession and the Persistence of Caribou in the Taiga

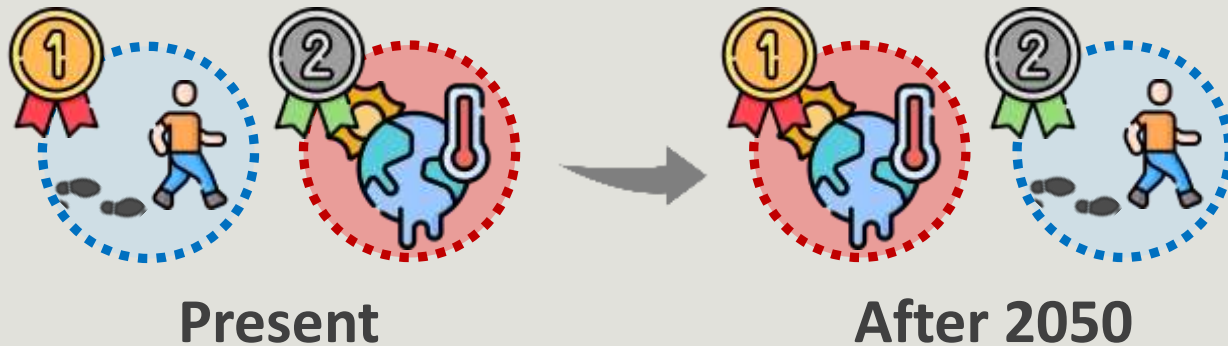
JAMES A. SCHAEFER



after Schaefer 2003

Introduction

- Limited literature on boreal caribou range recession and climate change (forecast)



The direct and habitat-mediated influence of climate on the biogeography of boreal caribou in Canada

E.W. Neilson^{a,*}, C. Castillo-Ayala^a, J.F. Beckers^a, C.A. Johnson^b, M.H. St-Laurent^c, N. Mansuy^a, D. Price^a, A. Kelly^d, M.A. Parisien^a



Lowering the rate of timber harvesting to mitigate impacts of climate change on boreal caribou habitat quality in eastern Canada

Martin-Hugues St-Laurent^{a,*}, Yan Boulanger^b, Dominic Cyr^c, Francis Manka^b, Pierre Drapeau^d, Sylvie Gauthier^b

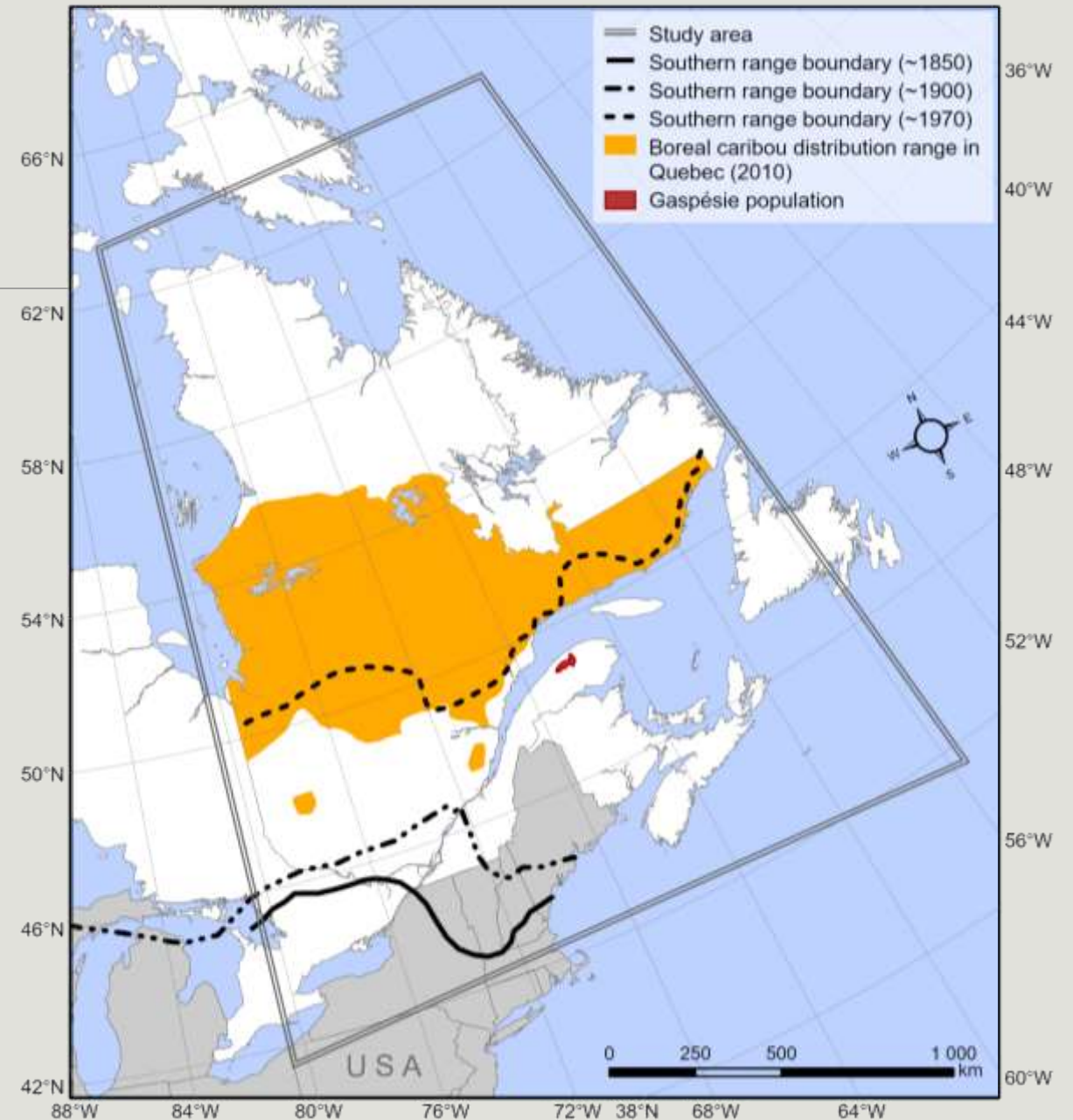


Objective

- **What is the impact of recent climate change on the northward contraction of boreal caribou distribution in Quebec since 1850 ?**
- **Hypothesis : Climate change is not the main factor of northward contraction**

Methods - Data

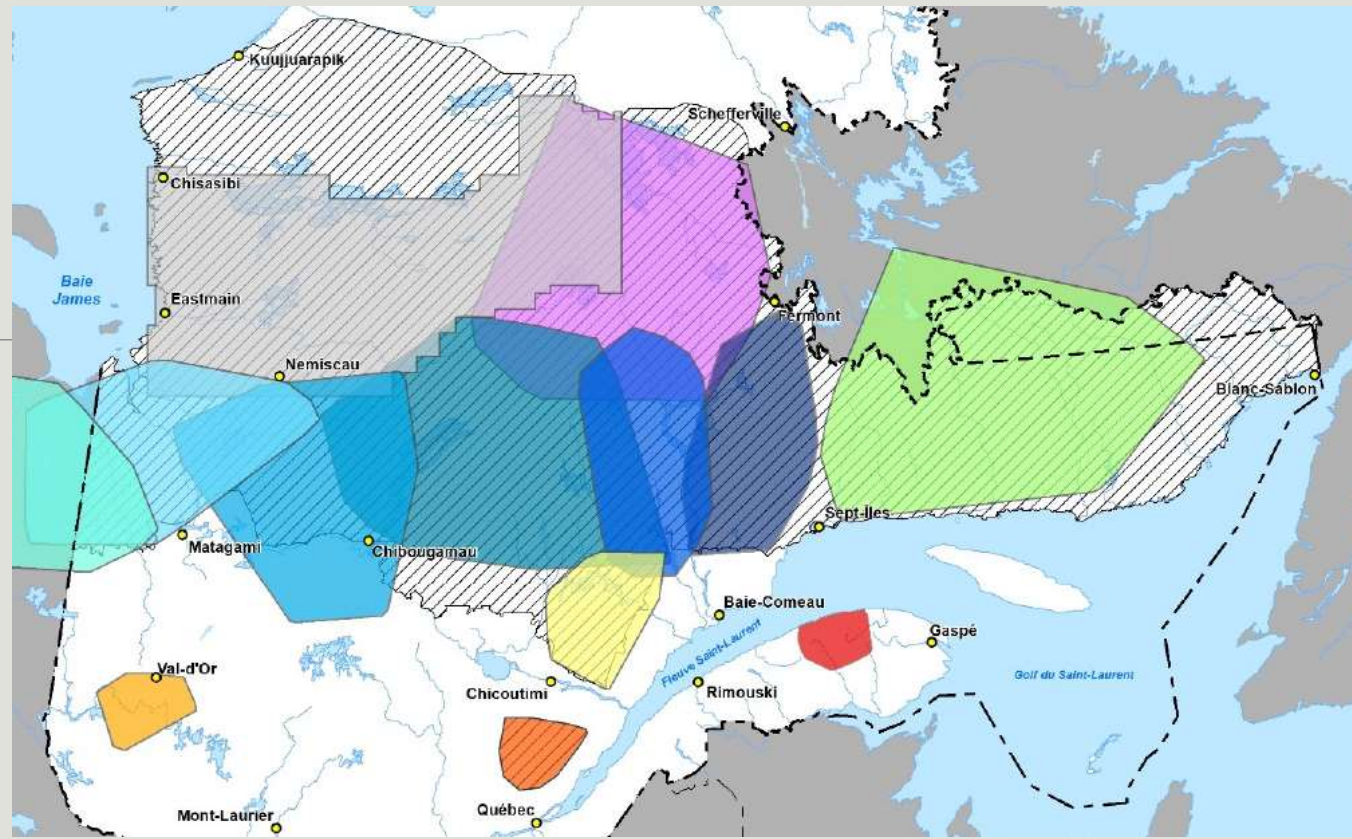
- Southern limits of distribution range from past timesteps



Methods - Data

➤ Caribou telemetry data (2004-2019)

- Nottaway
 - Assinica
 - Témiscamie
 - Manicouagan
 - Basse-Côte-Nord
- Romaine
 - Pipmuacan
 - Val-d'Or
 - Charlevoix
 - Gaspésie



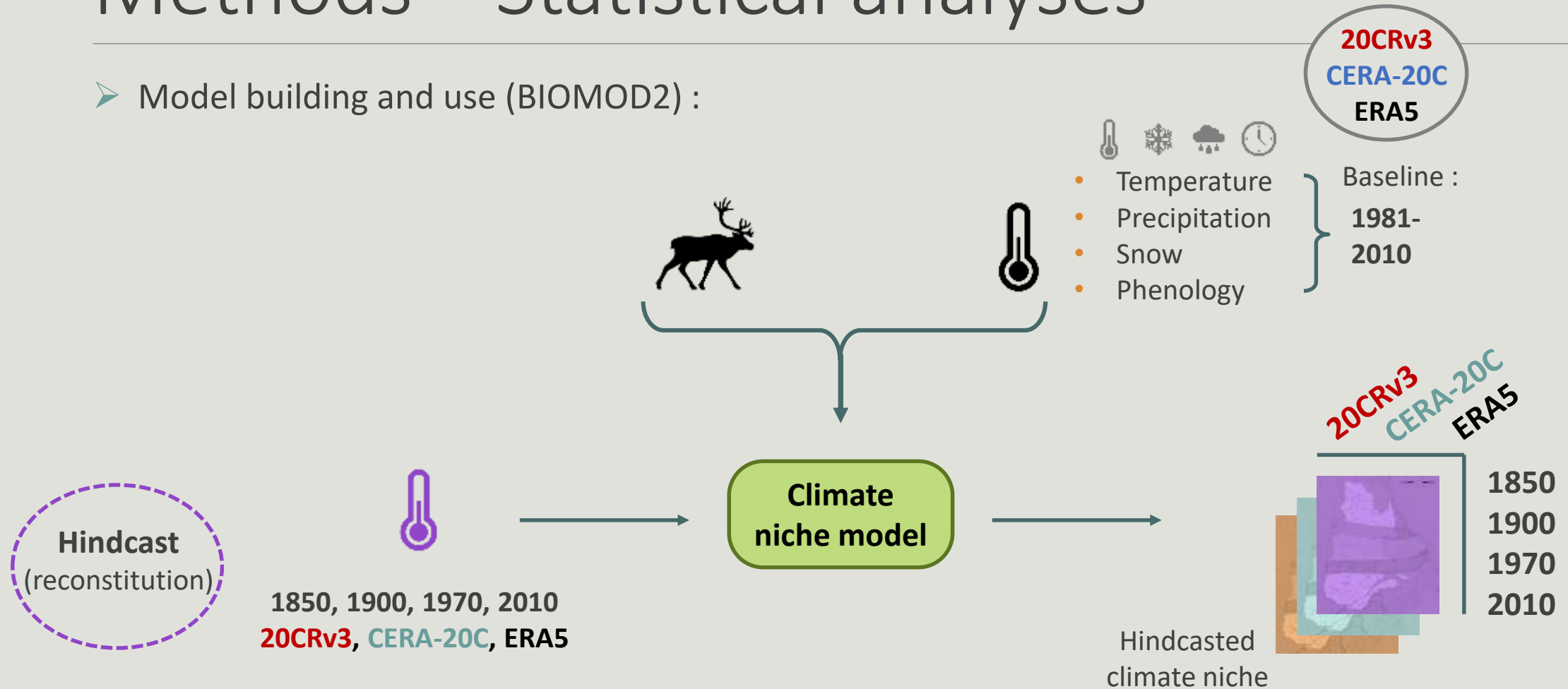
after MFFP 2021

➤ Climate data :

| Reanalysis | Period covered | Spatial resolution |
|------------|----------------|--------------------|
| 20CRv3 | 1850-2015 | 1° x 1° |
| CERA-20C | 1901-2010 | 1° x 1° |
| ERA5 | 1950-2019 | 0,25° x 0,25° |

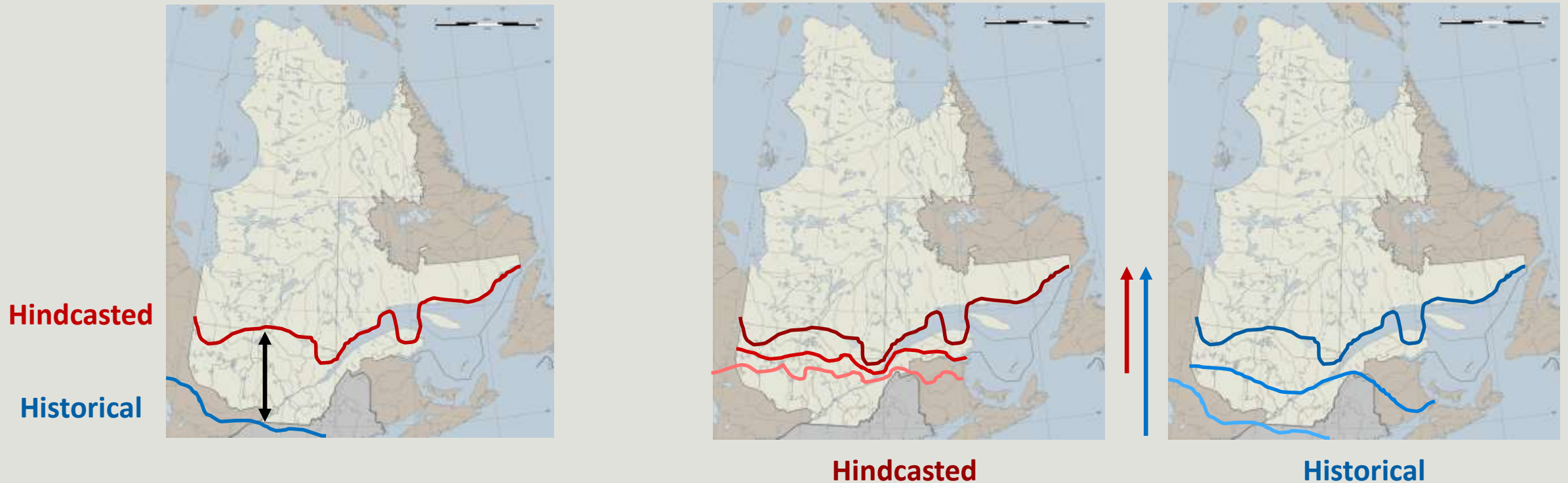
Methods – Statistical analyses

➤ Model building and use (BIOMOD2) :

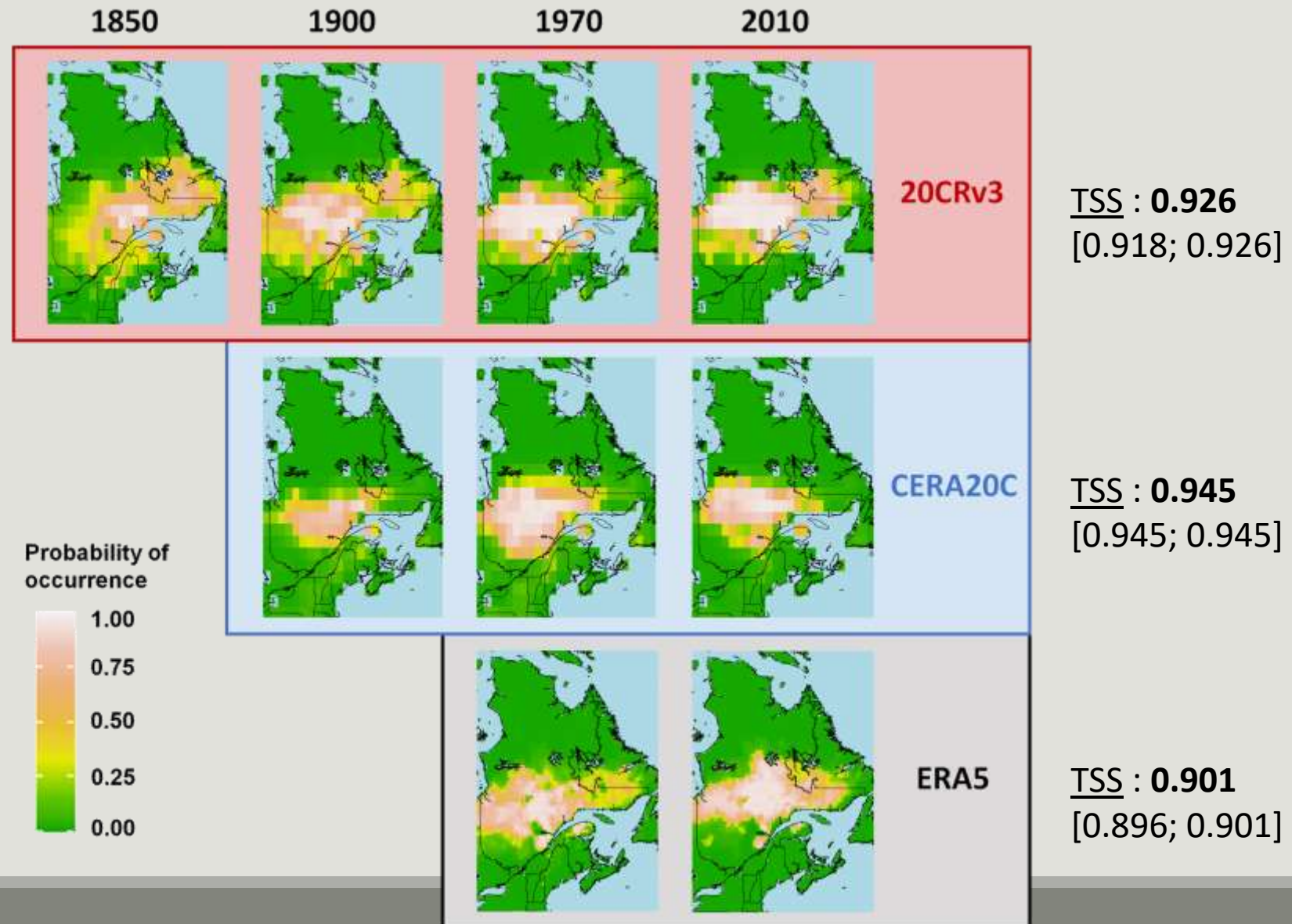


Methods – Statistical analyses

- Quantification of discrepancies between historical and hindcasted southern limits



Results – Reconstitutions of past distribution ranges



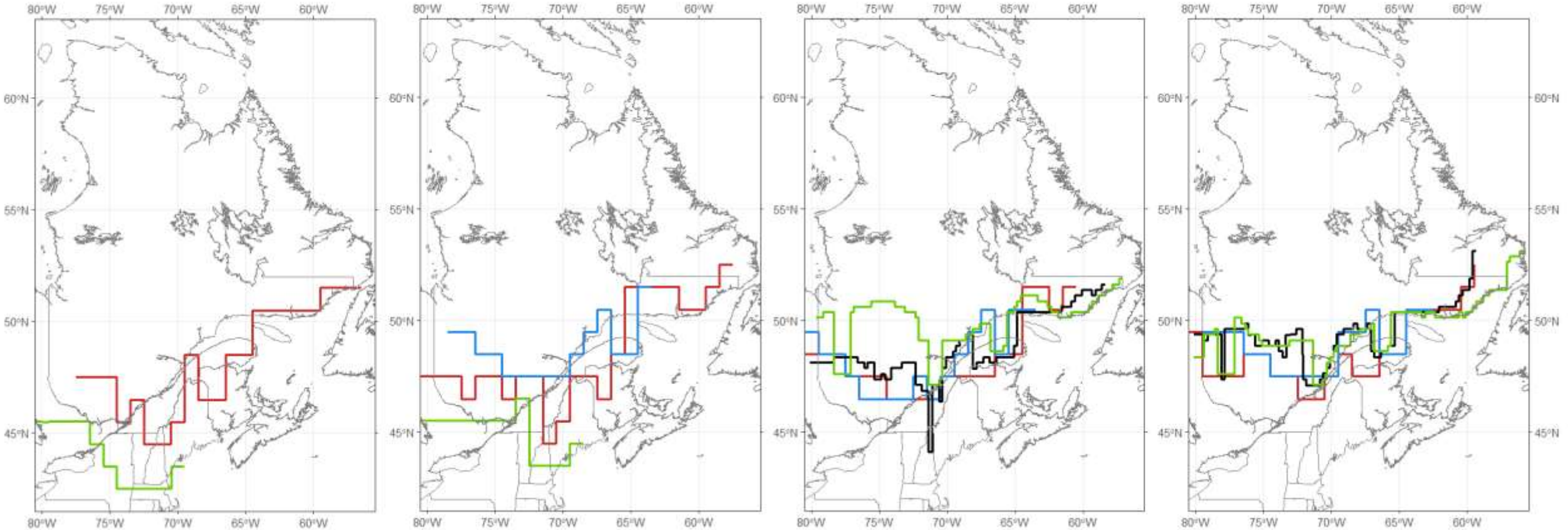
Results – Hindcast of past southern limits

1850

1900

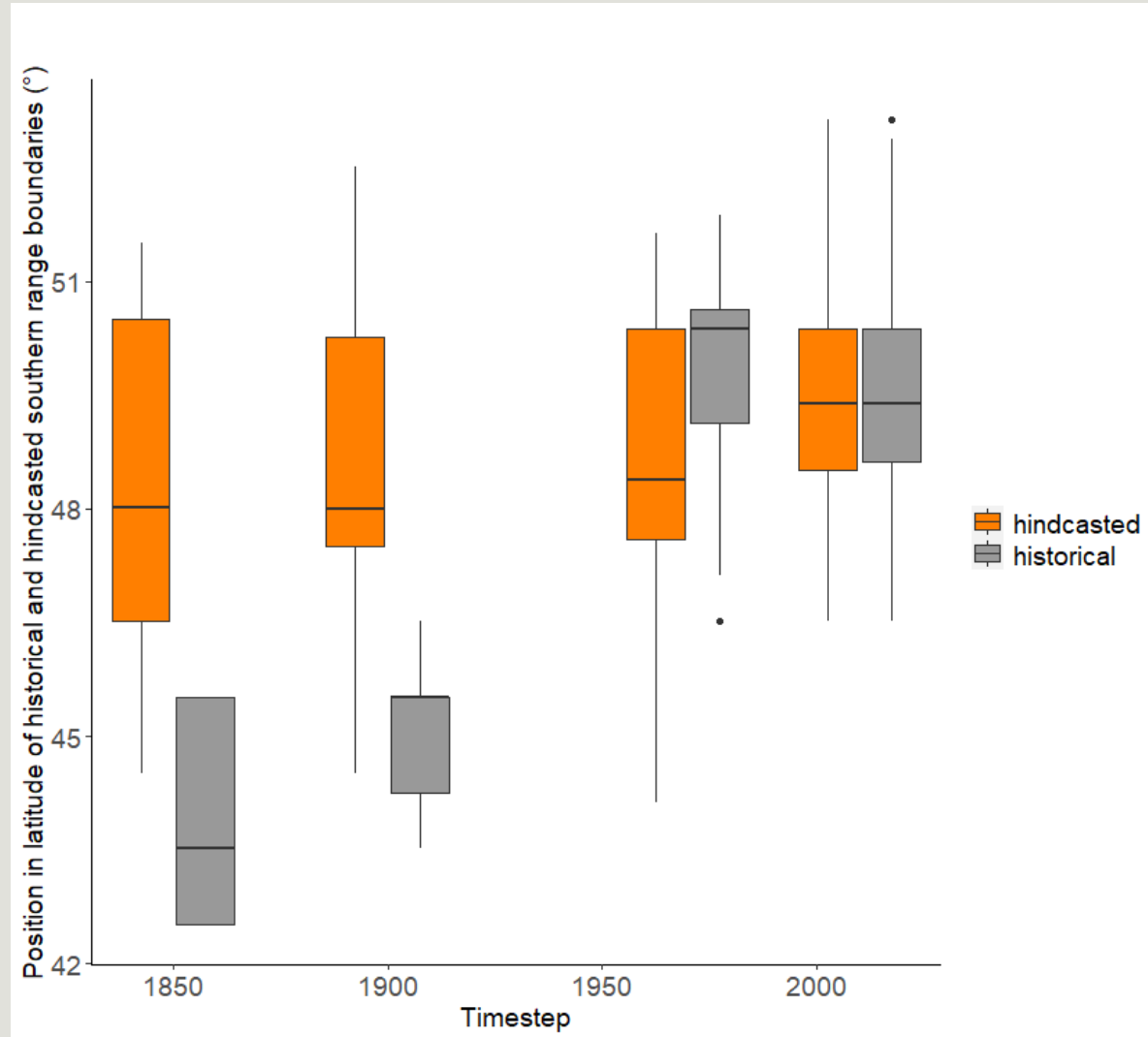
1970

2010



green : Historical red : 20CRv3 blue : CERA-20C black : ERA5

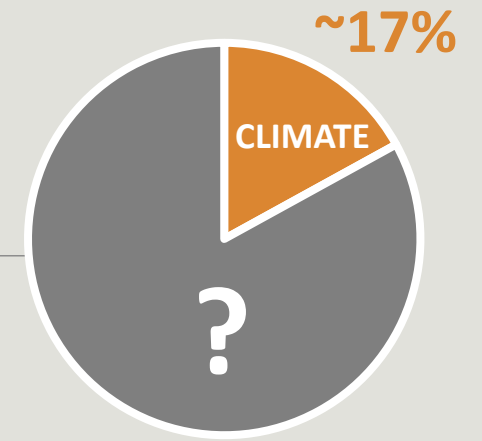
Results – Hindcast of past southern limits



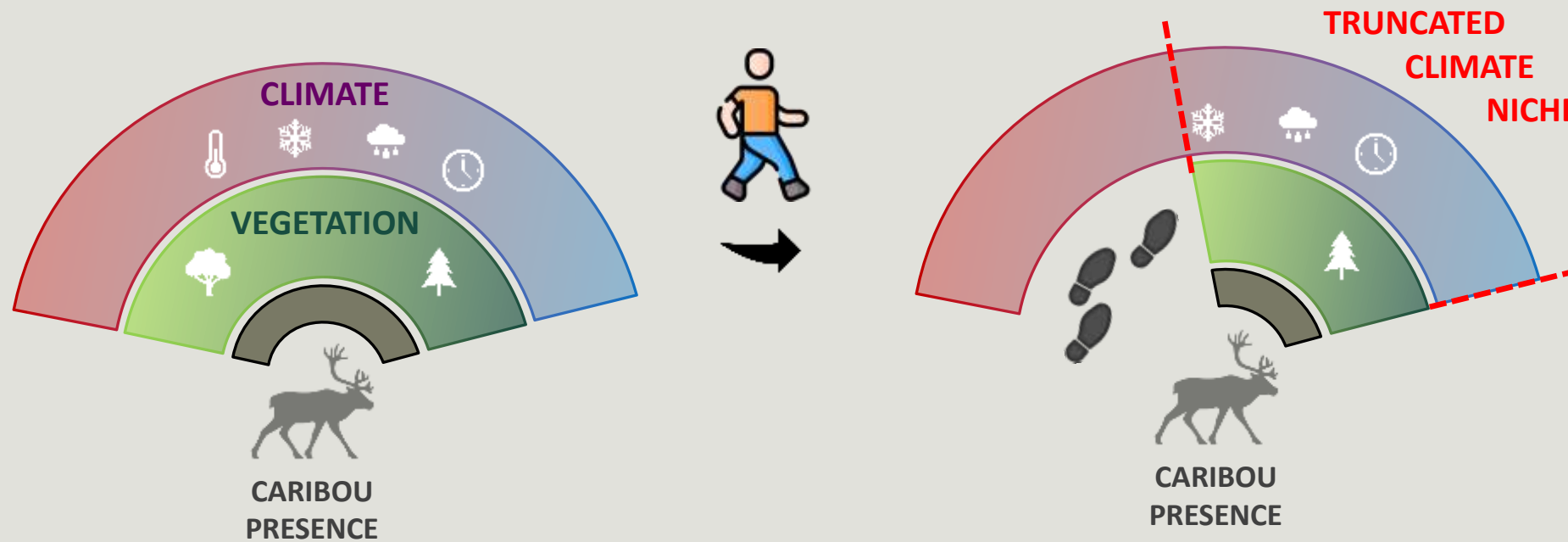
105 km
vs
620 km

Climate
~17%

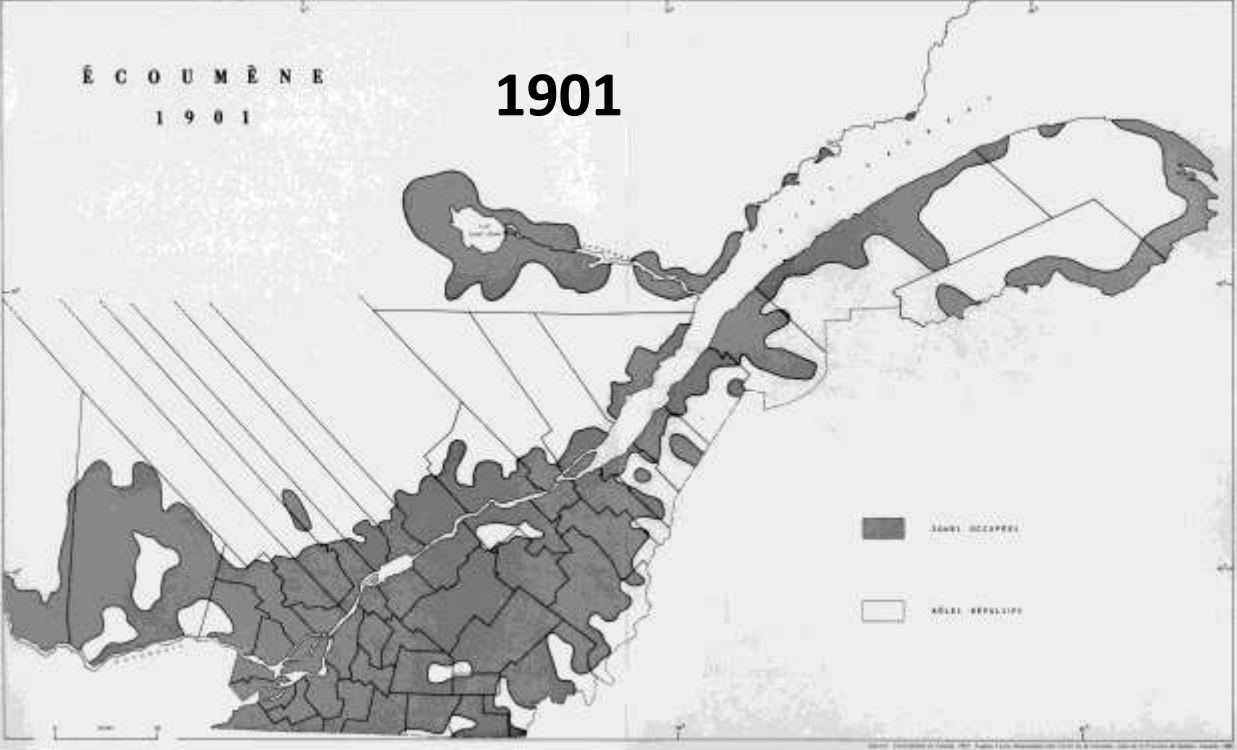
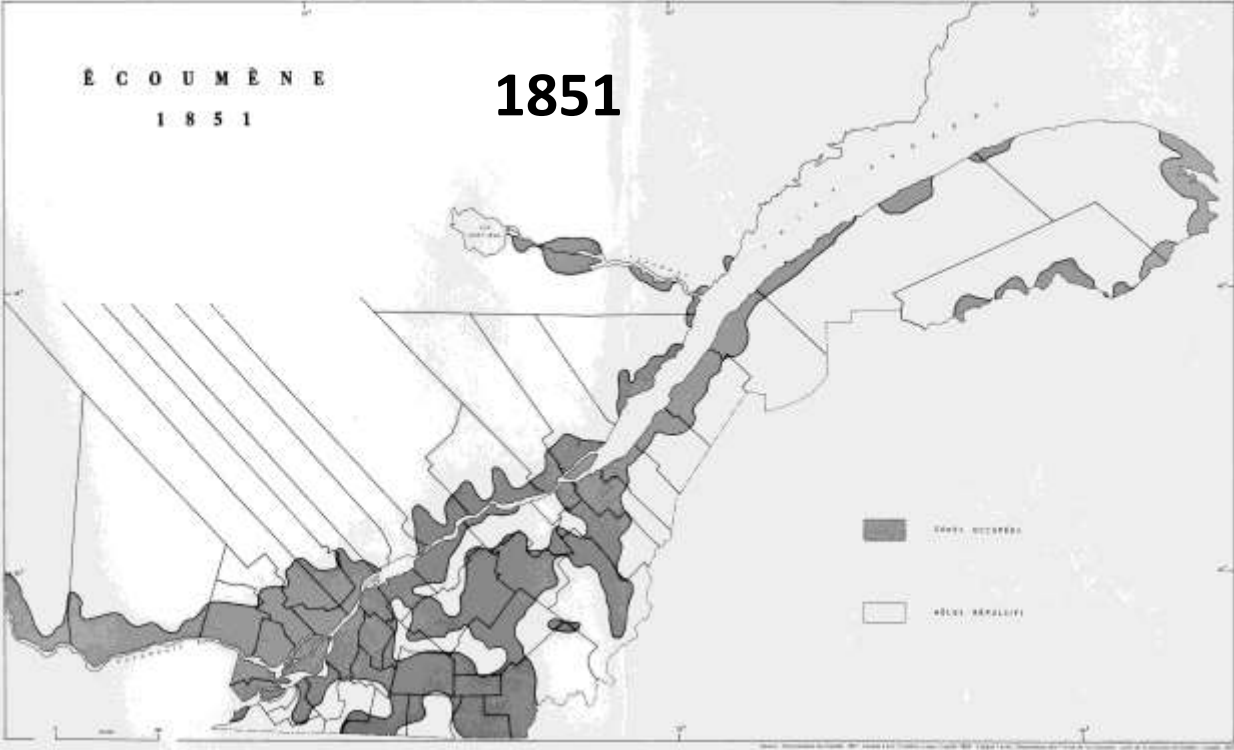
Discussion



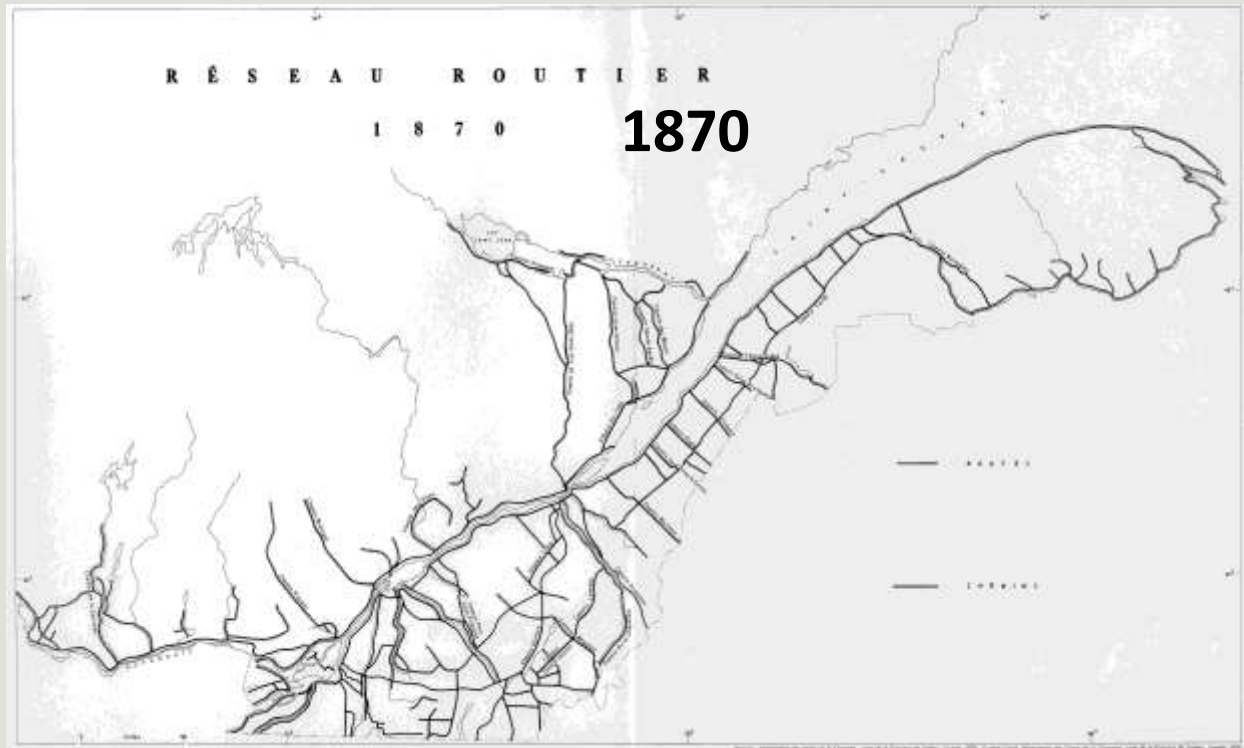
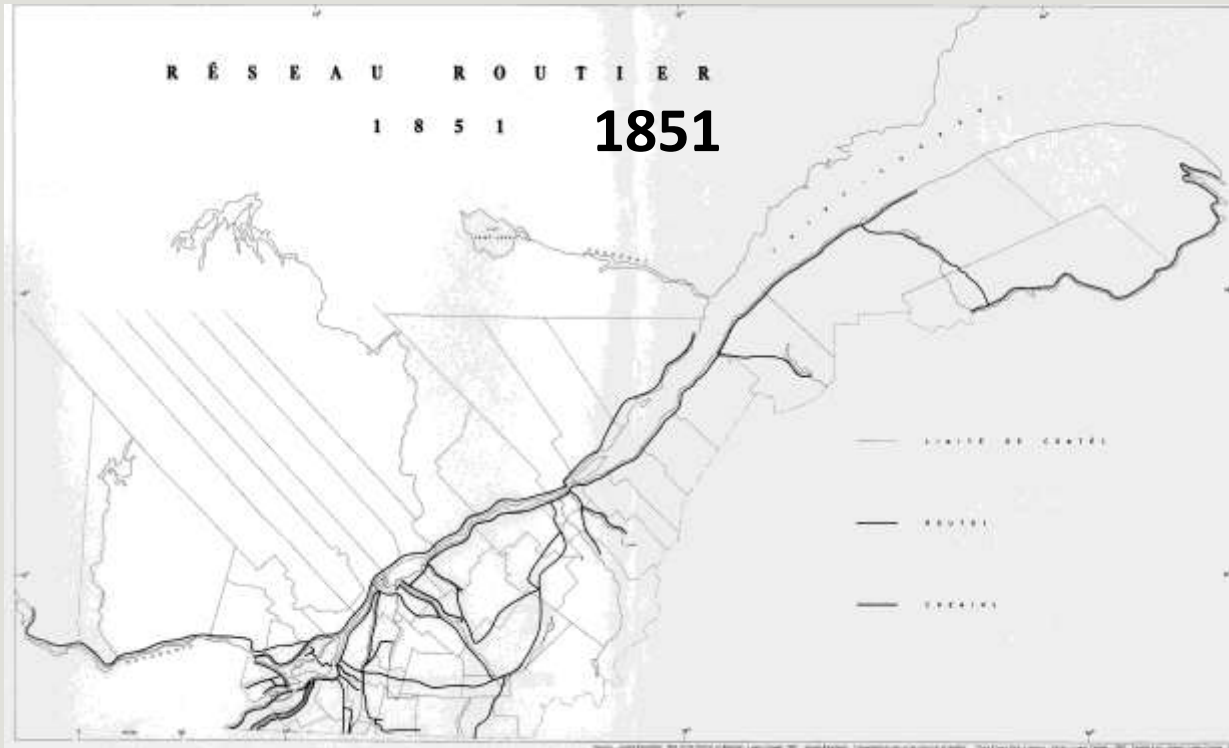
- Key condition: species at equilibrium with its environment






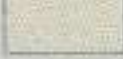
Discussion



Discussion



Legend

-  Southern Forest, largely cleared
-  Southern Forest, densely wooded
-  Northern Forest, densely wooded
-  Northern Forest, not densely wooded

1915

- Carya amara*—Bitter hickory
- Carya opata*—Shell-bark hickory
- Carya porcina*—Hog-nut hickory
- Carya alba*—White heart hickory
- Carya microcarpa*—Small-fruite
- Azimina triloba*—Cucumber-tree
- Liriodendron tulipifera*—Tulip t
- Gymnocladus Canadensis*—Kent coffee-tree
- Cercis Canadensis*—Judas-tree
- Gleditsia triacanthos*—Honey loc
- Malus coronaria*—Crab-apple
- Amelanchier Canadensis*—June
- Cornus florida*—Flowering dogw
- Nyssa sylvatica*—Sour gum
- Sassafras officinale*—Sassafras
- Platanus occidentalis*—Buttonw
- Castanea dentata*—Chestnut

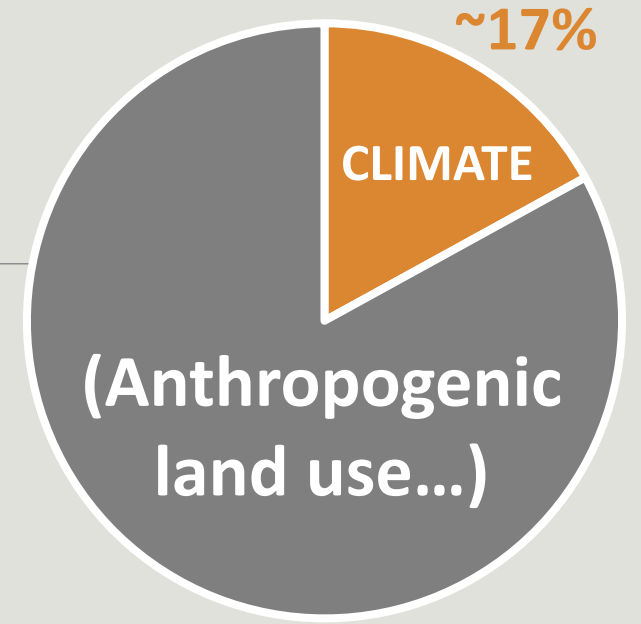
*These species are found on south-western peninsula of C



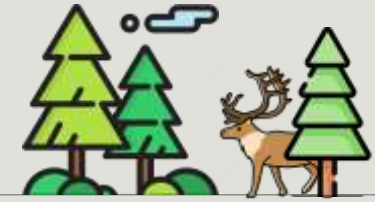
©Department of the Interior
Canada & Chalifour 1915

Discussion

- Negative effects of human activities on caribou populations
 - Logging
 - Roads
 - Human presence
 - Apparent competition



Take-home messages



- Climate change since 1850 = ~17% of observed caribou range recession in Quebec
- High quality data **BUT** disrupted equilibrium state + robust models = biased reconstitutions
 - Quantification of bias → **corrected forecast**
- Better tools for hindcast/forecast and decision making
- Important to question the limits of niche models for endangered big mammals + use of historical data



Thank you !

Martin-Hugues St-Laurent

Yan Boulanger

Philippe Gachon

Guillaume Dueymes

Clémence Benoit

Daniel Fortin

Sabrina Plante

**Étudiant.e.s et professionnelles du laboratoire de
recherche en gestion de la faune terrestre**

**Forêts, Faune
et Parcs**

Québec 



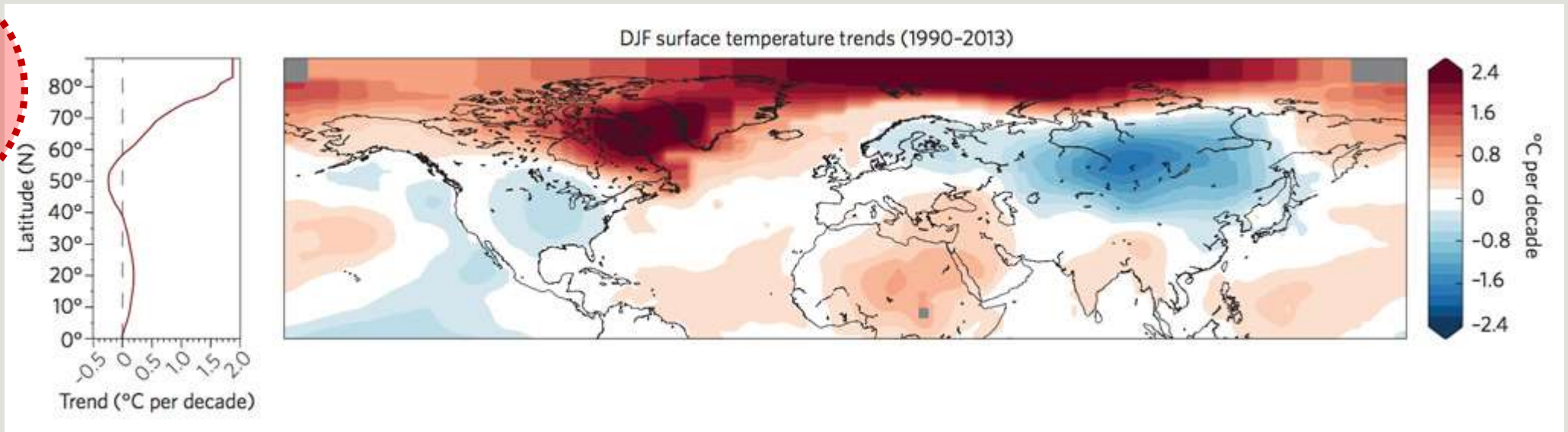
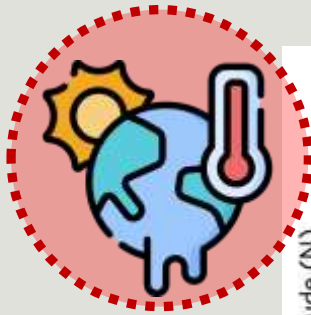
Questions ?



Supplementary material

DJF = Dec-Jan-Feb

- Arctic amplification threatens high latitude mammals

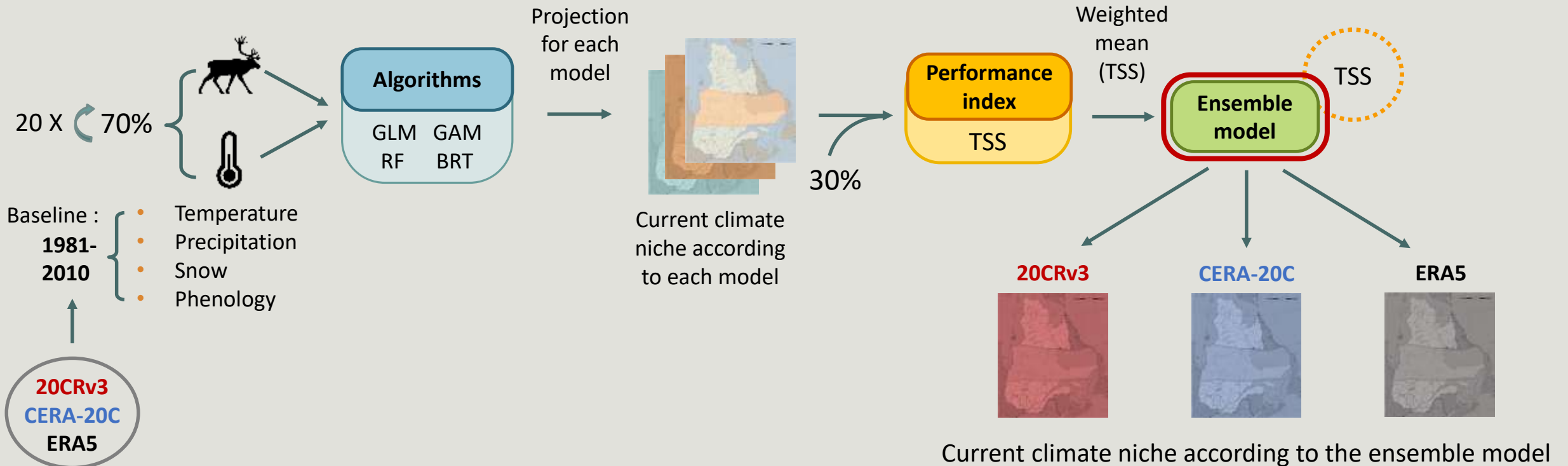


Cohen et al. 2014

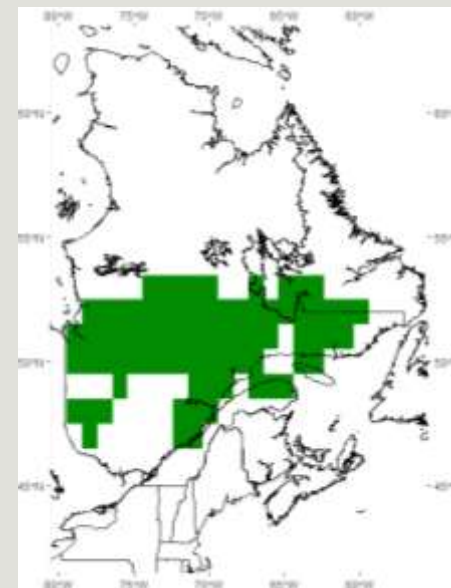
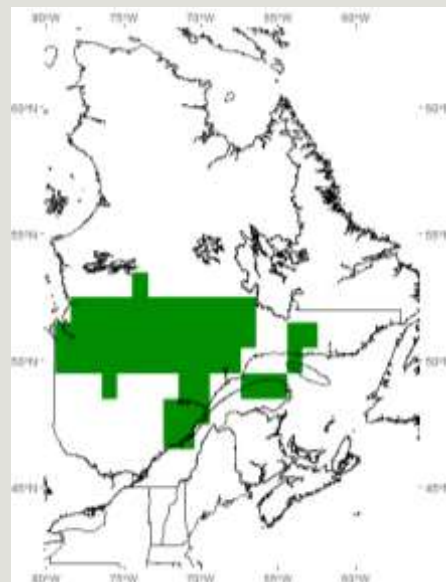
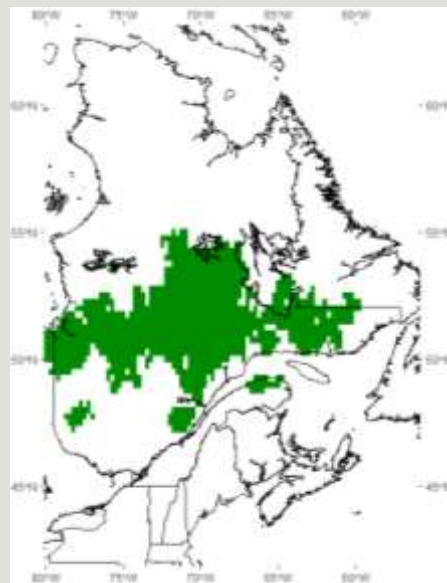
©Dave J. Doe

Supplementary material

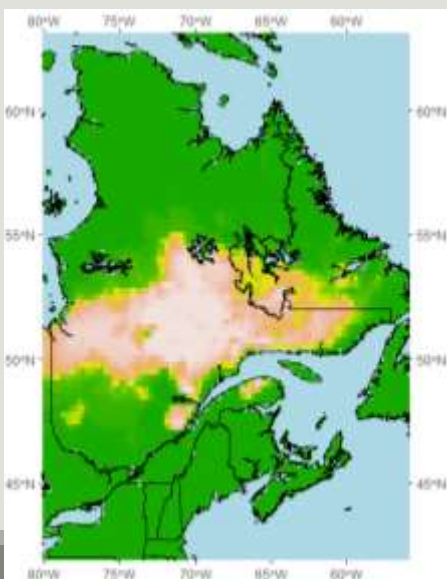
➤ Model building (BIOMOD2) :



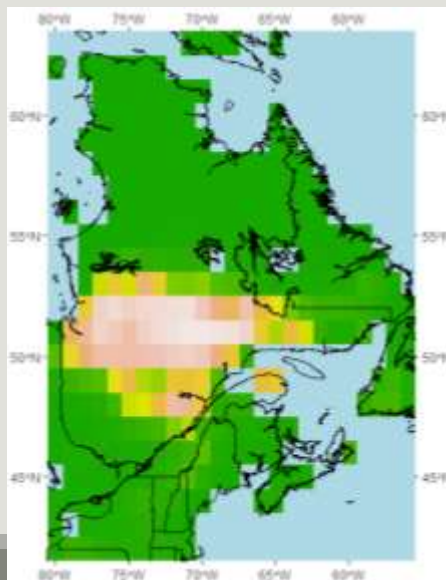
Supplementary material



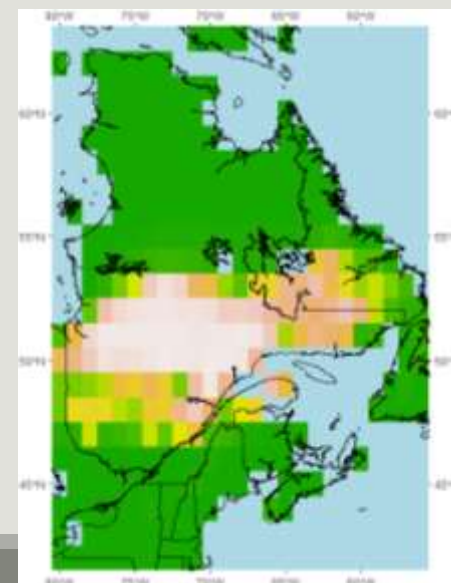
■ Presence
□ Absence



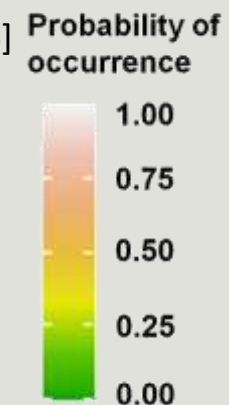
ERA5
TSS : **0,901**
[0.896; 0.901]



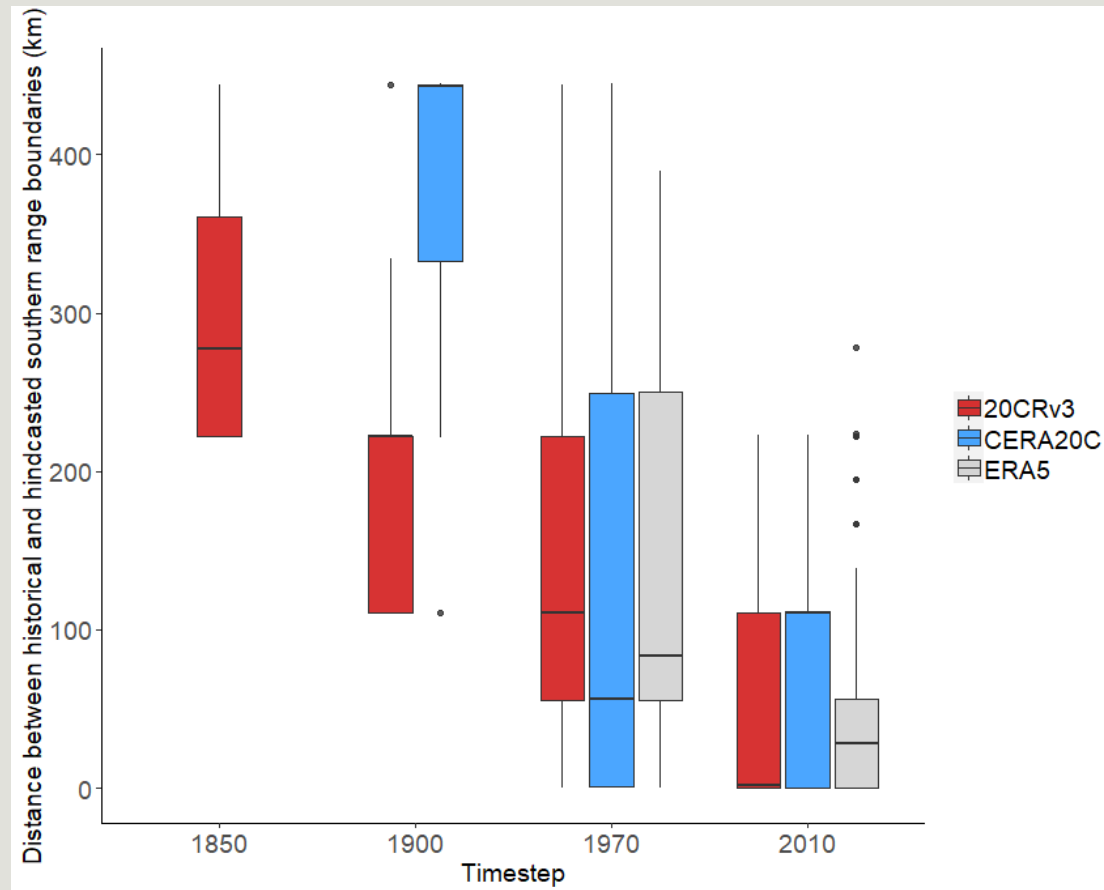
CERA20C
TSS : **0,945**
[0.945; 0.945]

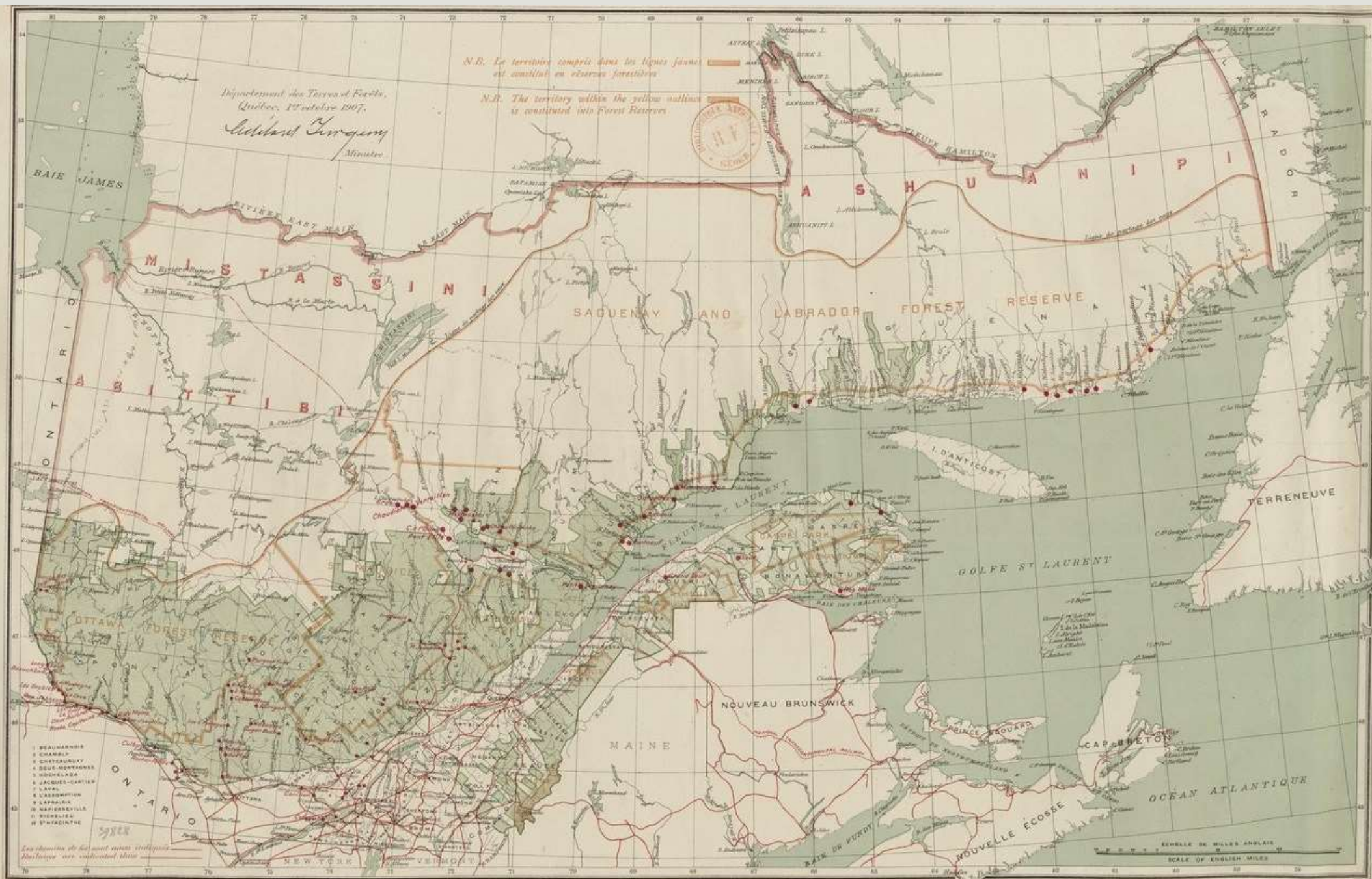


20CRv3
TSS : **0,926**
[0.918; 0.926]



Supplementary material





Reproduit et déposé par Charles Martel, Agence de la Province de Québec pour E.S. Tuckey

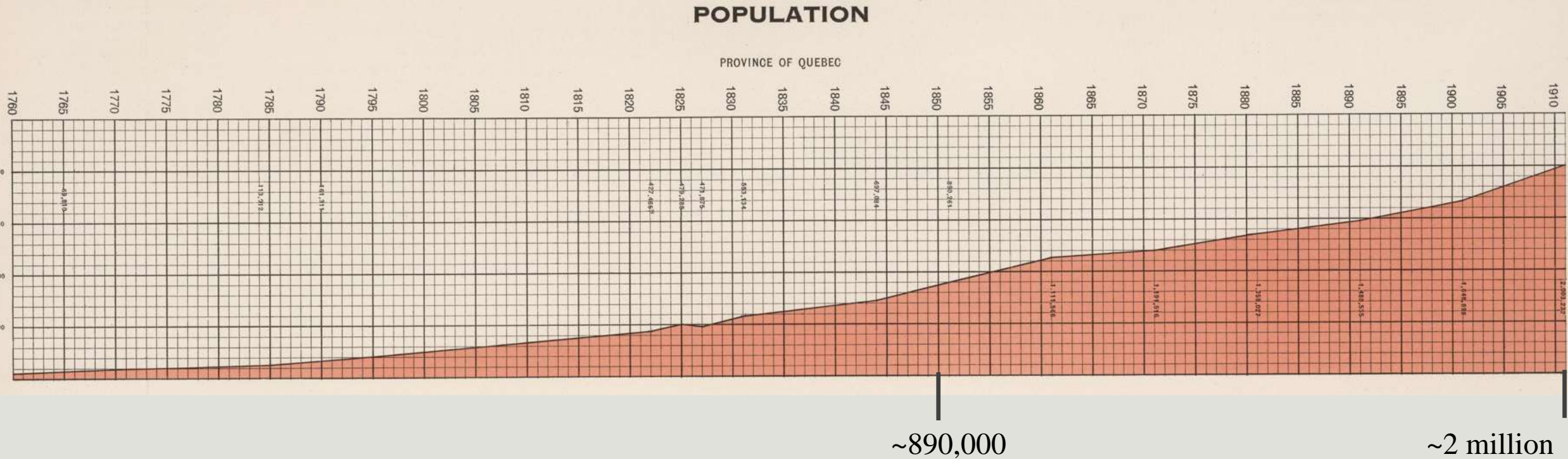
N.B. Le territoire ainsi indiqué est sous permis de coup de bois
N.B. The territory coloured thus is under license to cut timber

N.B. Les principaux rapides & chutes maintenant disponibles sont aussi indiqués
N.B. The principal falls & rapids now available and disposable are marked thus

MAP OF THE PROVINCE OF QUEBEC
INDICATING ITS NORTH WESTERN, NORTHERN AND NORTH EASTERN BOUNDARIES AS DECLARED BY THE STATUTES OF CANADA, 61 VICTORIA, CAP. 3.

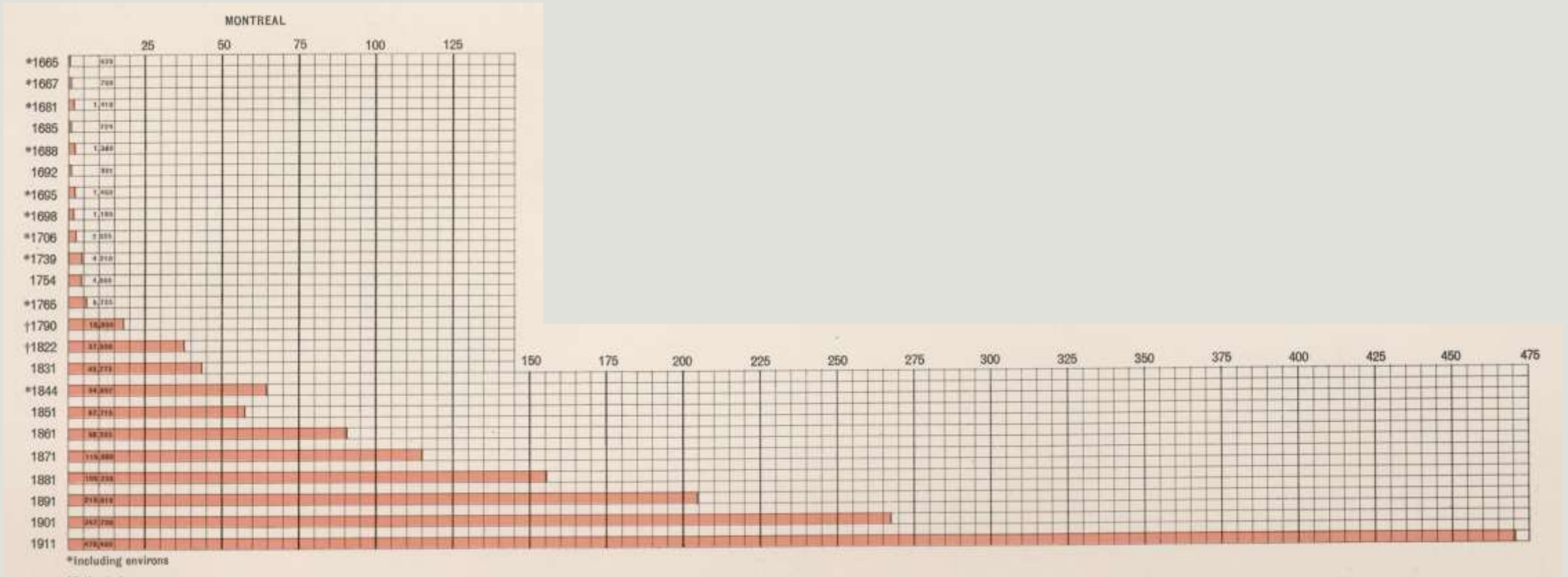
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Supplementary material



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Supplementary material



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