



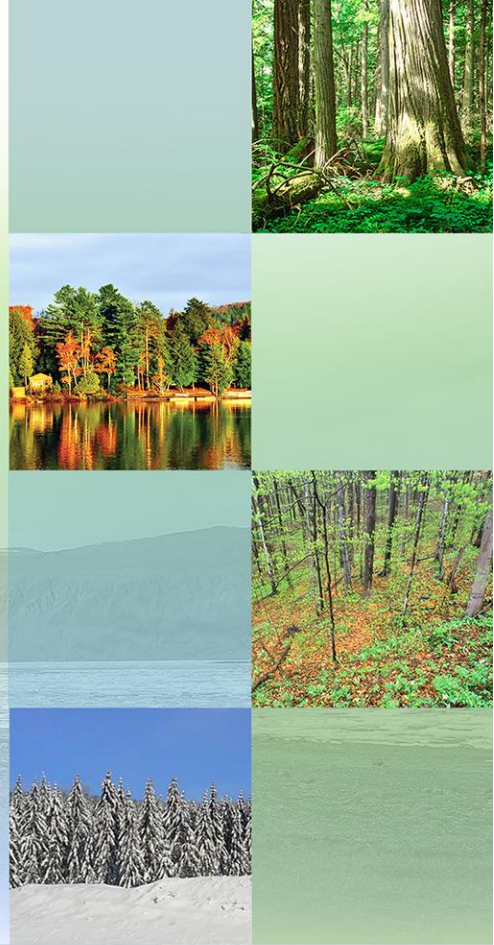
Natural Resources
Canada

Ressources naturelles
Canada

Assessing Climate Change in Ecological and Social Systems:

a regional integrated assessment
of climate change adaptation in
Newfoundland forests

Doug Piercey and Joe Bowden



Canada



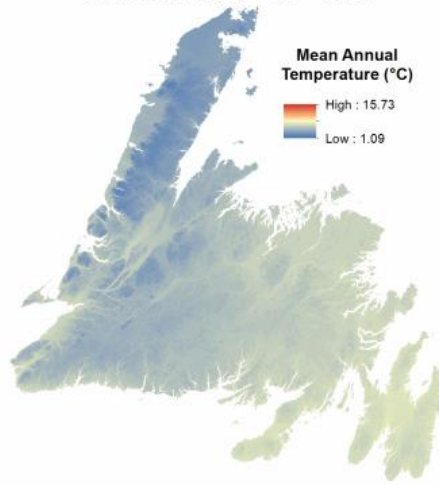
What we know about CC
impacts

True Impacts/Implications of CC

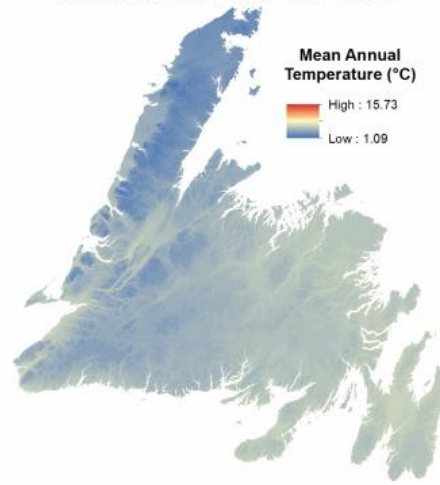
Development of Adaptation and
Mitigation Strategies that Work

Mean annual temp
Corner Brook
 $5.17^{\circ}\text{C} \pm 1.52$ (SE)
(1961-1990)

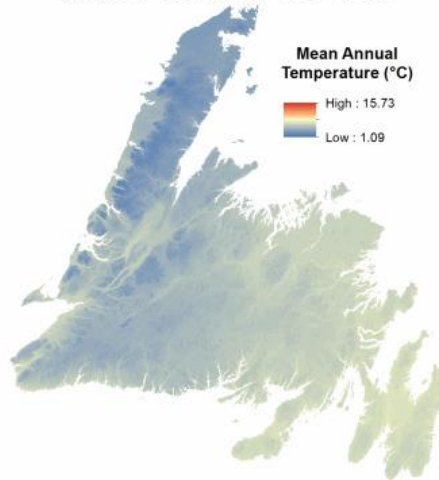
CanESM2 RCP 8.5 - 2020



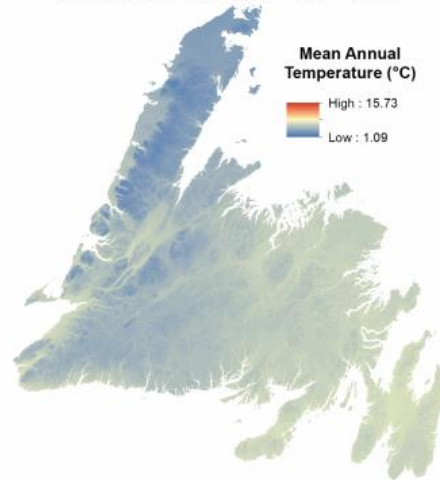
HadGEM2-ES RCP 8.5 - 2020



MIROC-ESM RCP 8.5 - 2020

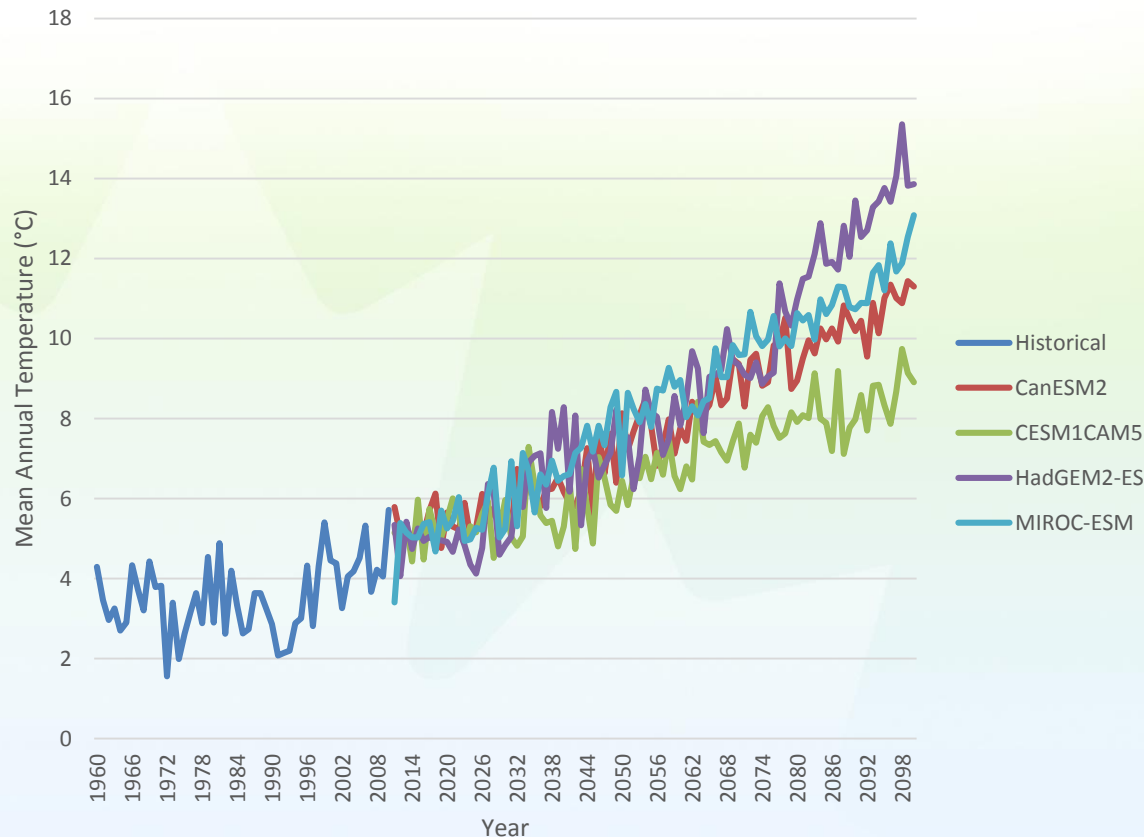


NCAR-CESM1 RCP 8.5 - 2020



NL Precipitation Projections

Return Period	10 Years			
	Hist	2020s	2050s	2080s
Newfoundland and Labrador	Precip. (mm)	Precip. (mm)	Precip. (mm)	Precip. (mm)
<i>Gander CGCM2</i>	59.4	65.8	65.5	62.1
<i>Gander HadCM3</i>	59.4	61.7	70.7	81.3
<i>St Johns CGCM2</i>	75.9	113.2	118.5	107.2
<i>St. Johns HadCM3</i>	75.9	103.5	139.1	110.8



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017

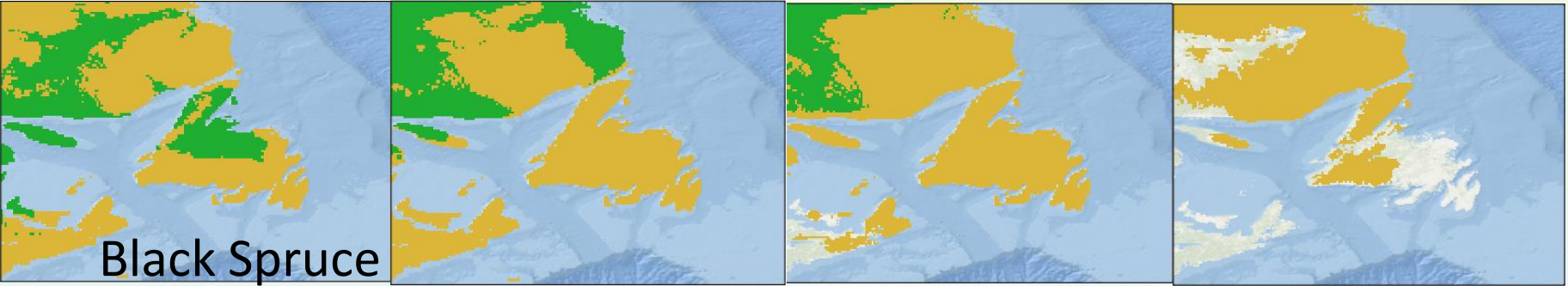


Natural Resources
Canada

Ressources naturelles
Canada

Canada

Northward Shift of Climate 'Envelopes'

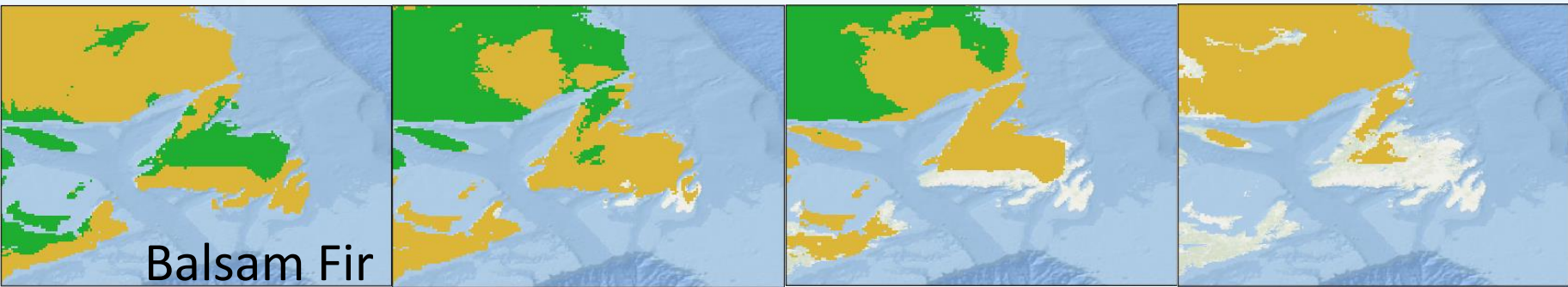


1971-2000

2011-2040

2041-2070

2071-2100



Balsam Fir

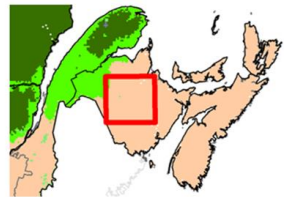
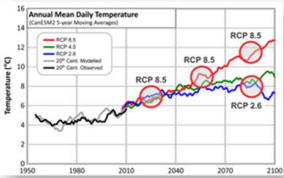
Forest Composition is Changing

Panel 4-1

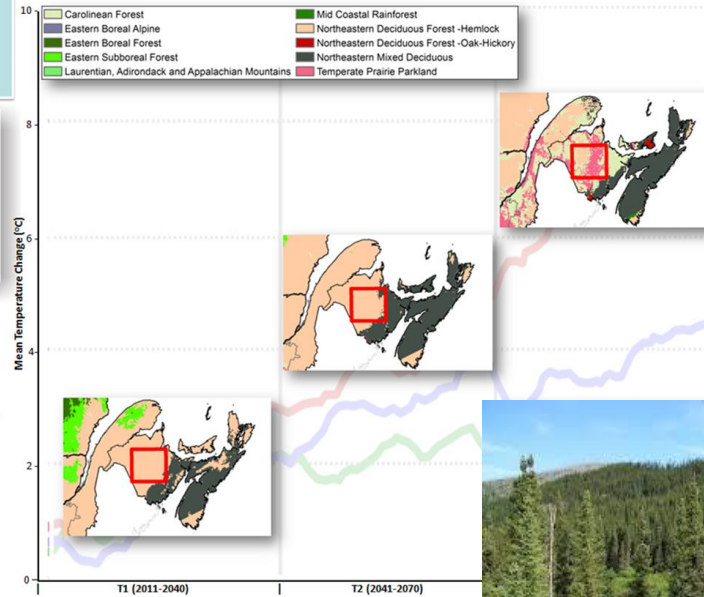
Attribute: Forest Composition

Ecozone: Atlantic Maritime

Models: BIOME



T0 - Baseline (2001)



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



Natural Resources
Canada

Ressources naturelles
Canada

Canada

Forest Disturbance



Growing Season Getting Longer

Growing season length

under different climate scenarios and timeframes

REFERENCE PERIOD

1981–2010

Growing season length

Days

0 to 20
21 to 40
41 to 60
61 to 80
81 to 100
101 to 120
121 to 140
141 to 160
161 to 180
181 to 200
201 to 220
221 to 240
241 to 260
261 to 280
280 to 300
301 to 320

— Provincial Boundaries

0 500 1000 km

RCP 8.5

CONTINUED EMISSIONS INCREASES

2071–2100

RCP 2.6

RAPID EMISSIONS REDUCTIONS

2011–2040

2041–2070

2071–2100



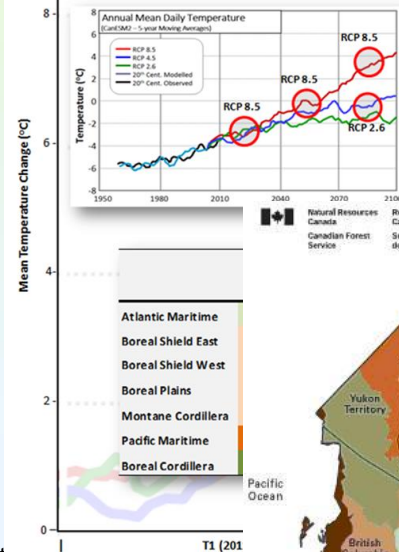
Forest Productivity is Changing

Panel 4-14

Attribute: Forest Productivity

Ecozone: All Ecozones

Models: PICUS and LANDIS

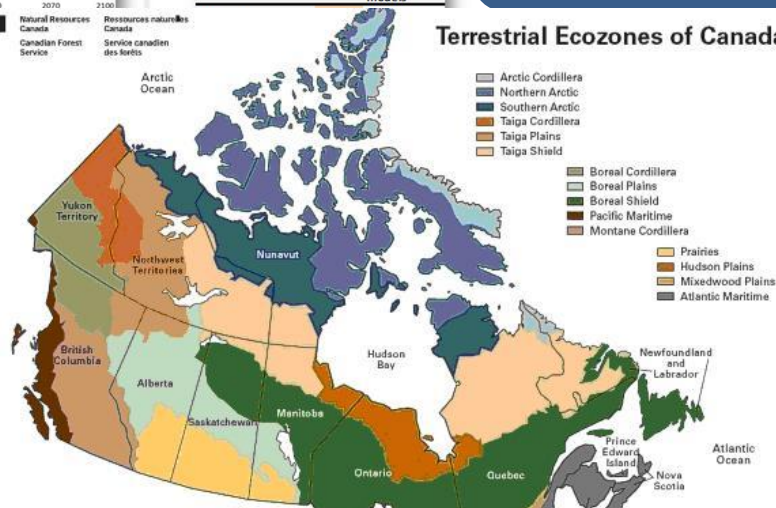


Change in Productivity	Increase
Large Increase (>50%)	↑↑↑
Moderate Increase (26-50%)	↑↑
Small Increase (5-25%)	↑
No Significant Change	nsc
Small Decrease (5-25%)	↓
Moderate Decrease (26-50%)	↓↓
Large Decrease (>50%)	↓↓↓
	Decrease

Agreement between models

	Agreement between models
Atlantic Maritime	↓↓↓ strong
Boreal Shield East	↓↓↓ strong
Boreal Shield West	↓↓↓ strong
Boreal Plains	↓↓↓ strong
Montane Cordillera	↓↓↓ strong
Pacific Maritime	↓↓↓ strong
Boreal Cordillera	↓ strong

Terrestrial Ecozones of Canada



© Her Majesty the Queen



Natural Resources Canada

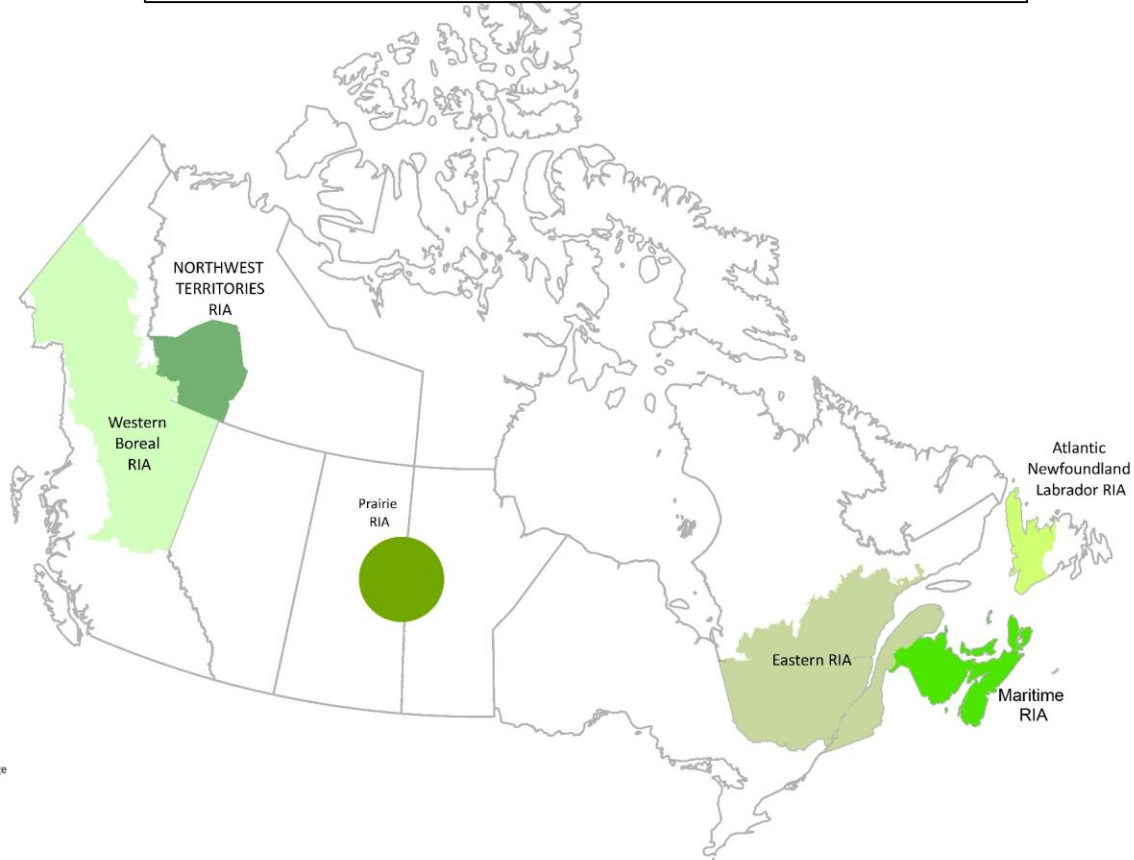
Res Can

Canada

The Boreal is the Largest Forest on Earth



RIAs Across Canada



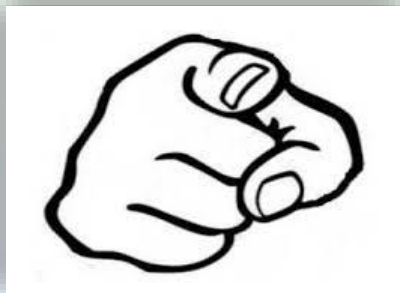
Source
NRCan - CFS www.cfs.nrcan.gc.ca/forestchange
Projection
Canada Lambert Conformal Conic
Standard Parallels 49N 77N
Central Meridian: -95
Date
April 26, 2018

 Natural Resources Canada  Resources naturelles Canada

ACCESS

Assessing Climate Change in Ecological and Social Systems

Goal: Assess the potential impacts of climate change on multiple values within the study area through collaborative efforts with stakeholder groups and subject-area experts



Should this include you?

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



Natural Resources
Canada

Ressources naturelles
Canada

Canada

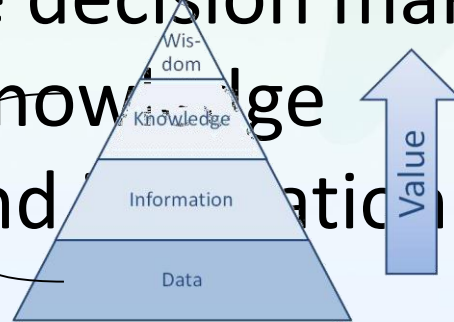
ACCESS

Assessing Climate Change in Ecological and Social Systems

Why?

-facilitate the application of scientific information to inform policy, improve decision making and enhance knowledge mobilization and education

MIND THE GAP



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



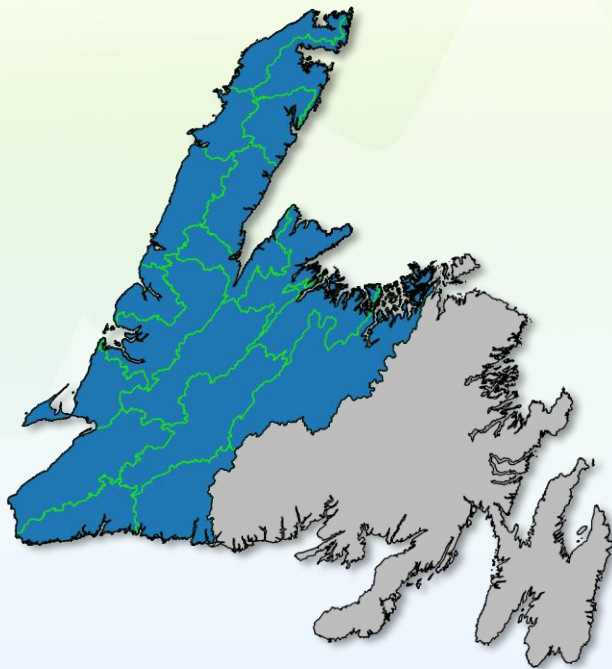
Natural Resources
Canada

Ressources naturelles
Canada

Canada

ACCESS

Assessing Climate Change in Ecological and Social Systems



ACCESS Study Area

- Western-Central Insular NL
- ~60,000km²
- Defined by NHN
- Main NL Forest Planning Zones
- Gros Morne NP
- Mixed EcoDistricts within Boreal Shield
- Fir/Spruce dominant
- First Nations
- Disturbance

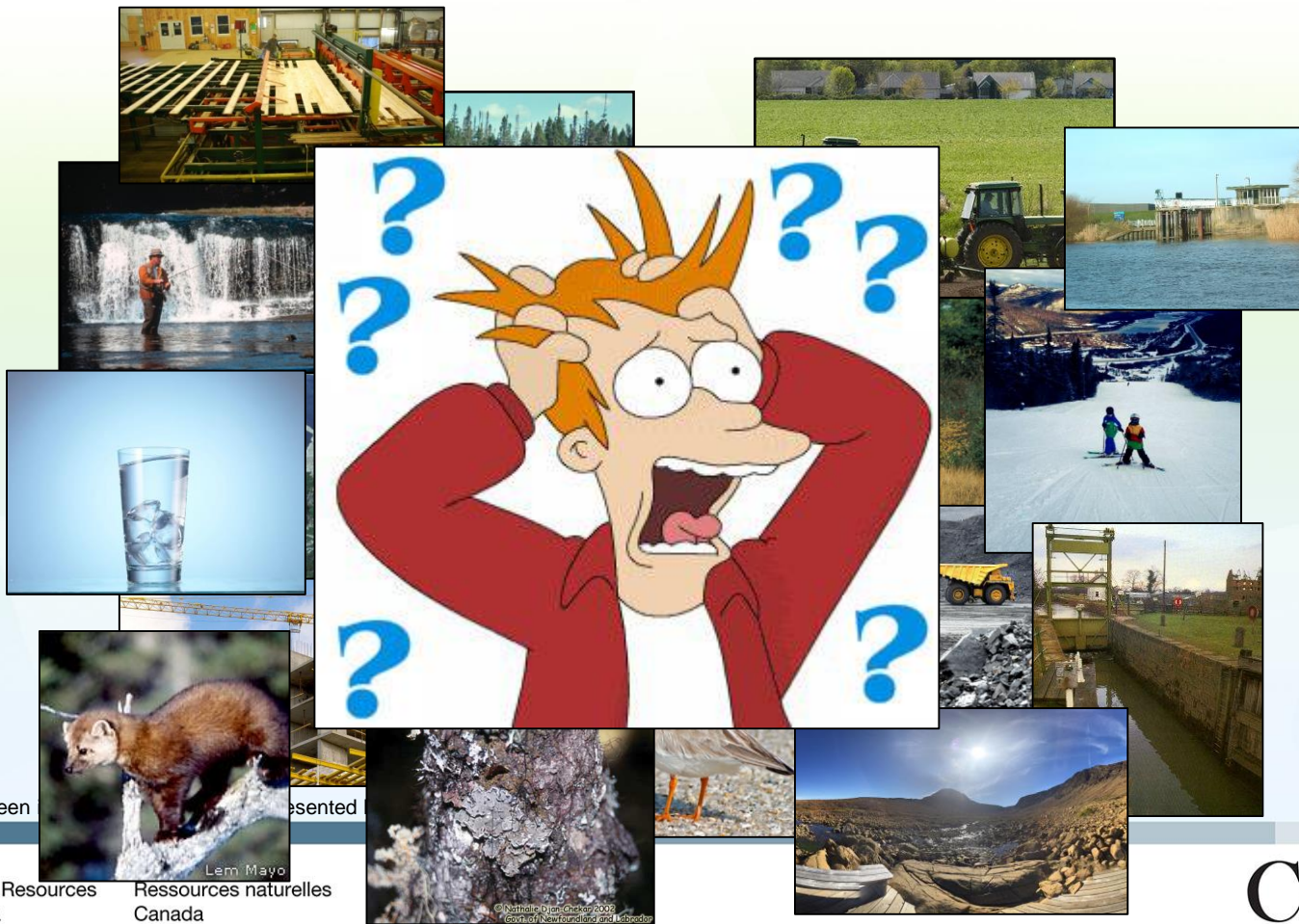
© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



Natural Resources
Canada

Ressources naturelles
Canada

Canada



© Her Majesty the Queen

presented



Natural Resources
Canada

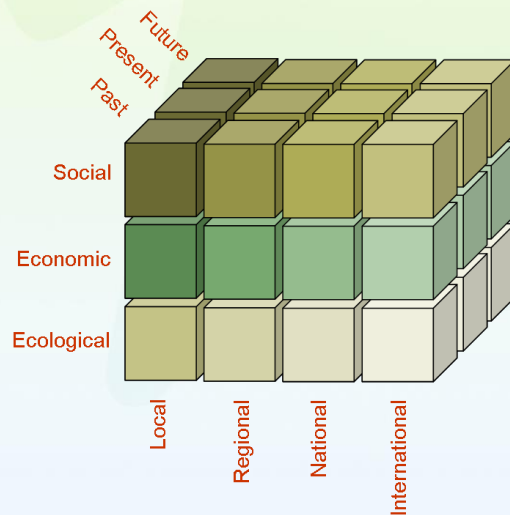
Ressources naturelles
Canada



Canada 

How do we get there?

- Recognition that social-ecological systems are complex, multi-dimensional phenomenon



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



Natural Resources
Canada

Ressources naturelles
Canada

Canada

How do we get there?

- Technology change
 - black box vs human computer interaction
- Combining computer processing with people's capacity for insight



“There is need for a technology of design that can work in tandem with the human decision-making process” (Goodchild, Gyo et al. 2012)

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



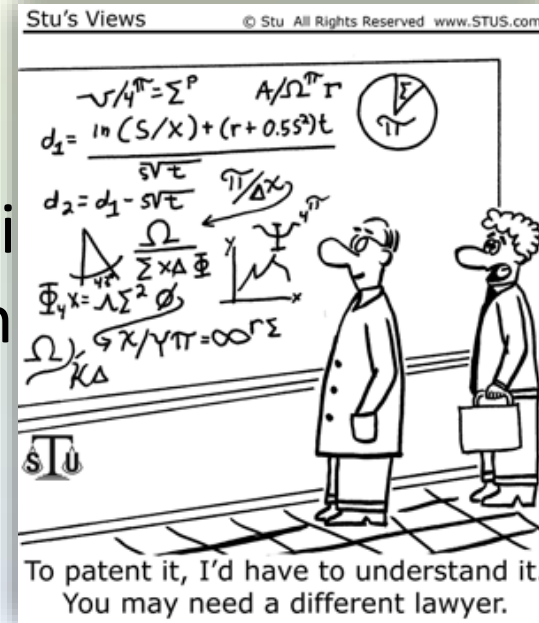
Natural Resources
Canada

Ressources naturelles
Canada

Canada

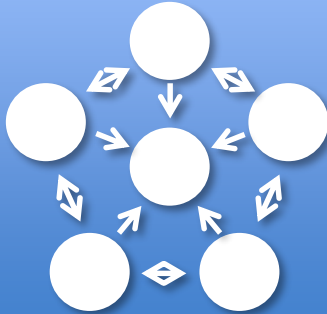
How do we get there?

- Methods/technologies must be usable in real world situations!

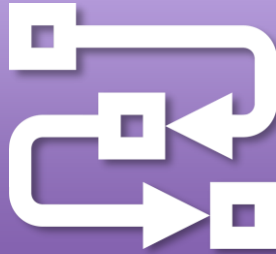


The platform to get there!

Descriptive
Framework



Operational
Framework



Software



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017

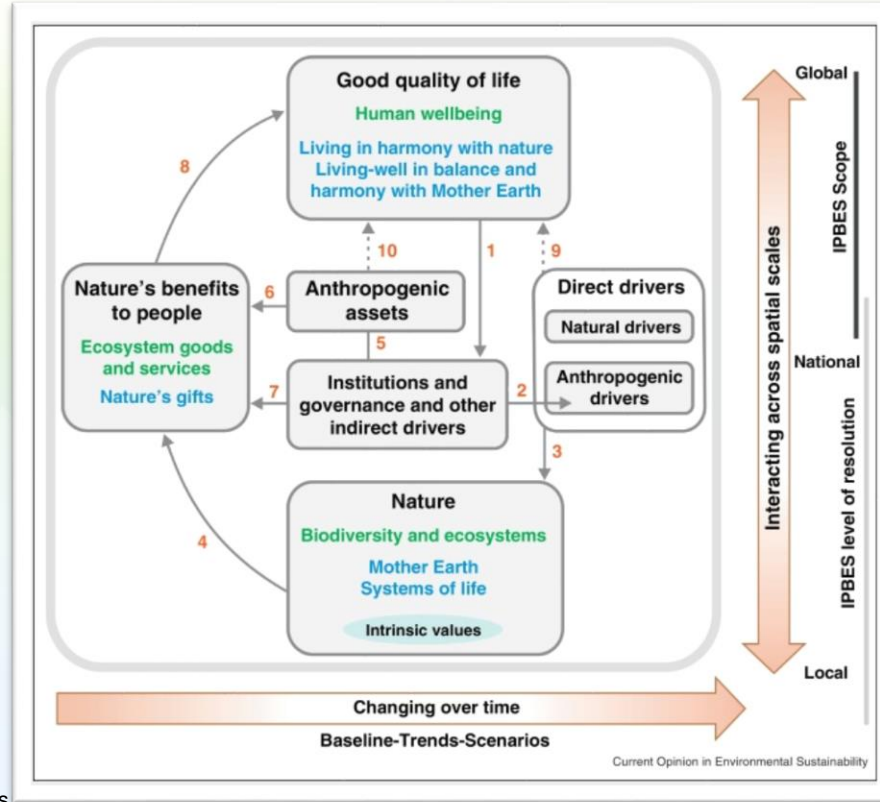


Natural Resources
Canada

Ressources naturelles
Canada

Canada

Descriptive Framework



www.ipbes.net

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017.



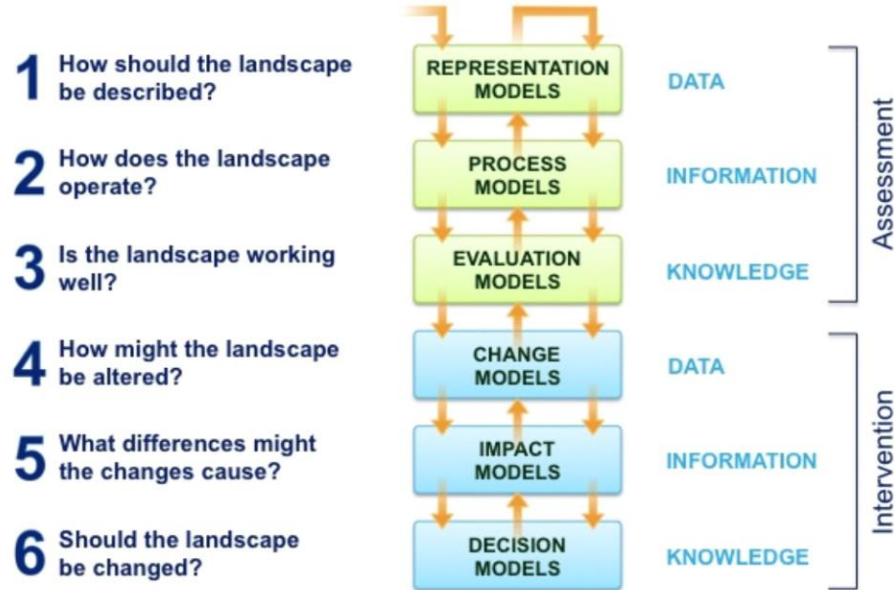
Natural Resources
Canada

Ressources naturelles
Canada

Canada

Operational Framework

The geodesign framework – by Carl Steinitz



Steinitz 2012

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



Natural Resources
Canada

Ressources naturelles
Canada

Canada

Software Platform

Holistic Interactive Visualization Environment

- Data models
- Geoprocessing tools
- Geovisual analytics
- Interactive feedback displays
- Scenario management tools
- Collaboration tools



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017

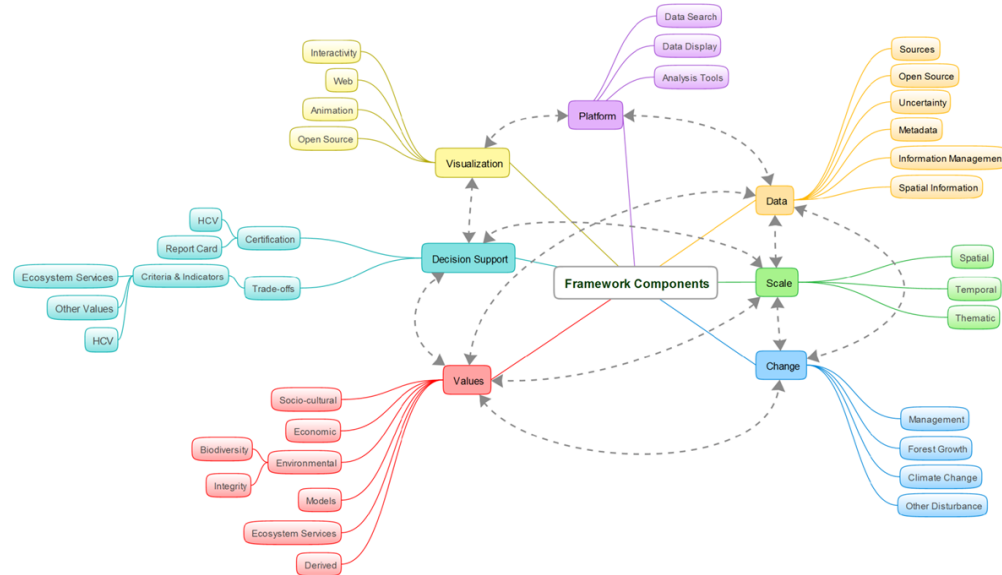


Natural Resources
Canada

Ressources naturelles
Canada

Canada

Mind Mapping



© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017

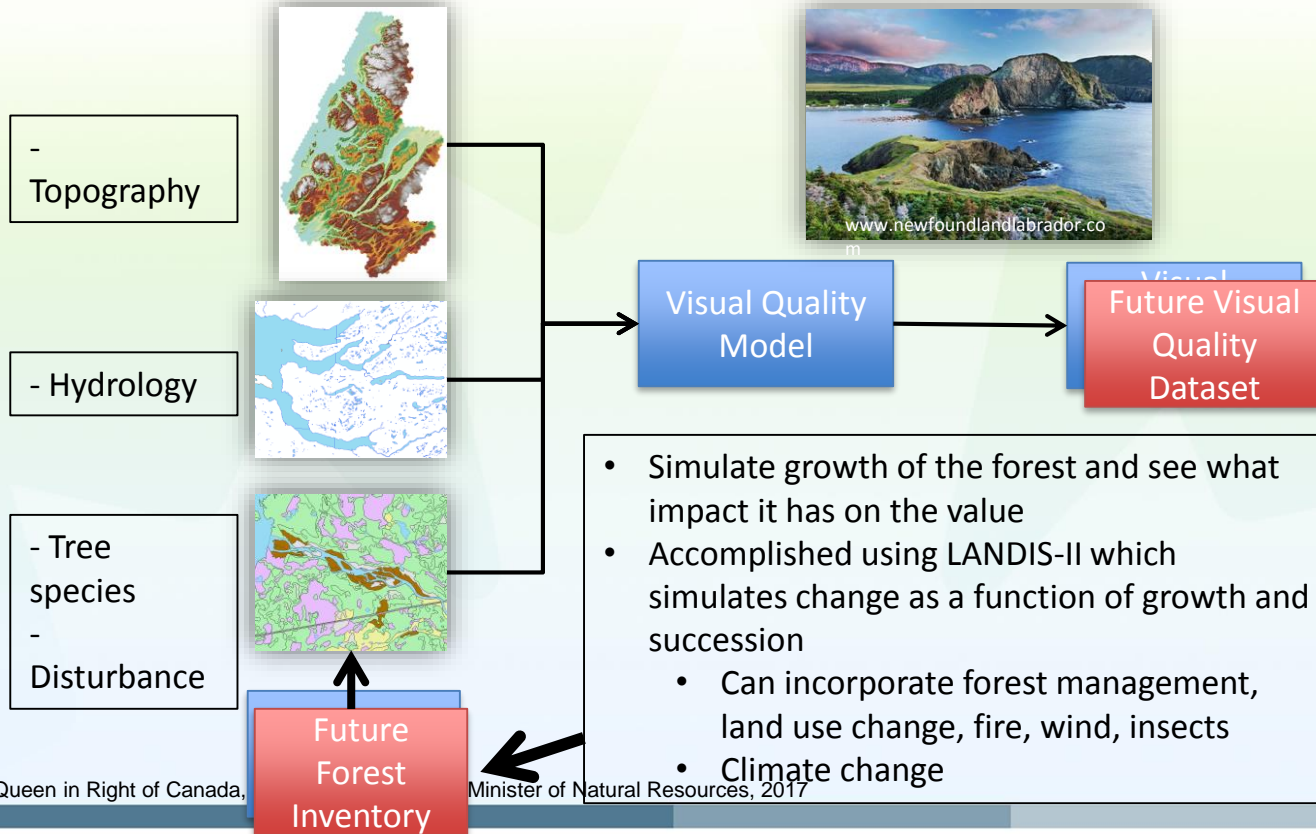


Natural Resources
Canada

Ressources naturelles
Canada

Canada

Changing Values – Visual Quality



© Her Majesty the Queen in Right of Canada,

Minister of Natural Resources, 2017

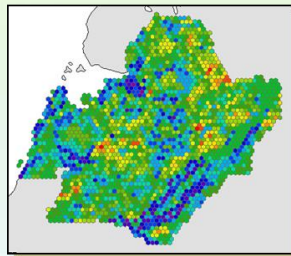


Natural Resources
Canada

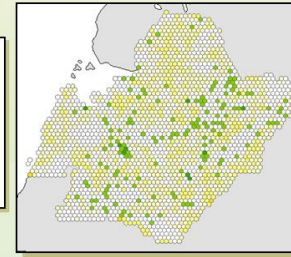
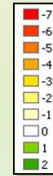
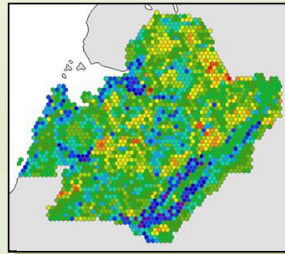
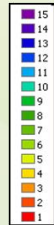
Ressources naturelles
Canada

Canada

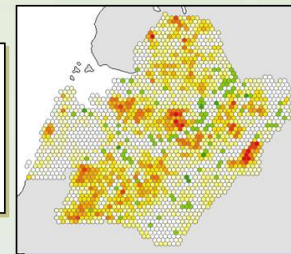
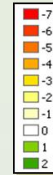
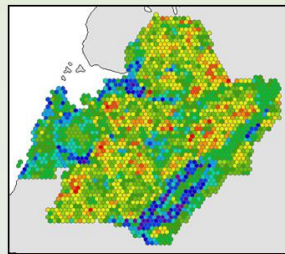
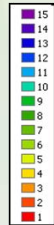
Scenario Comparison



Time 0 Visual Quality

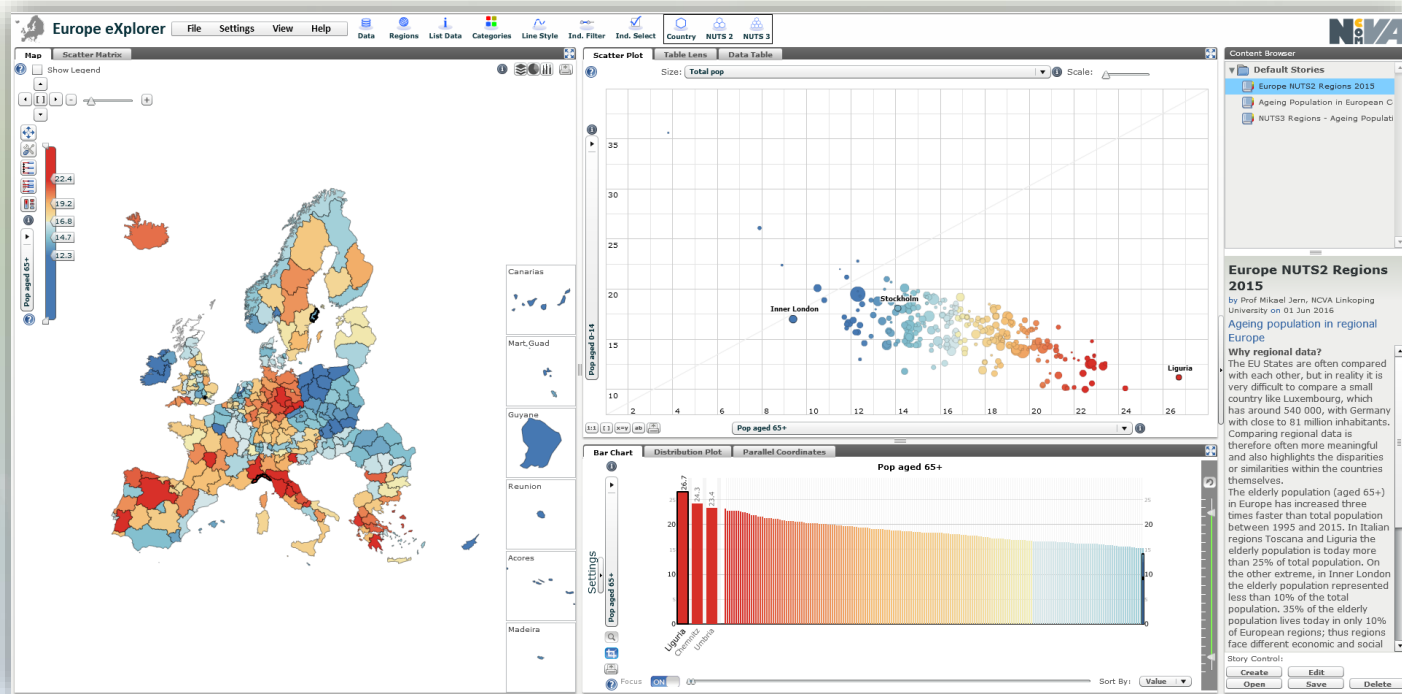


Time 30 Visual Quality – Natural Succession Scenario



Time 30 Visual Quality – Forest Management Scenario

Interactive Visualizations



<https://mitweb.itn.liu.se/geovis/eXplorer/euro/>

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



Natural Resources
Canada

Ressources naturelles
Canada

Canada

Summary

- Impacts are complex, not mutually exclusive
- Must fully understand impacts in order to develop meaningful adaptation actions
- Adaptation actions must be co-developed
- Impacts, adaptation modelled using multiple future climate scenarios – within HIVE
- Monitoring is key to understanding CC impacts and evaluate effectiveness of adaptation actions

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



Natural Resources
Canada

Ressources naturelles
Canada

Canada

Acknowledgements

- Kate Edwards
- Robert LeBlanc
- Doreen Churchill



Environment and
Climate Change Canada

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017



Natural Resources
Canada

Ressources naturelles
Canada

