Defining current and future Homogeneous Fire Regime zones in Canada

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Background

- Environment characteristics are likely to be spatially correlated (similar over ± large spatial scales)

- **Ecological classification:**

  Homogeneity of processes/patterns at a given scale

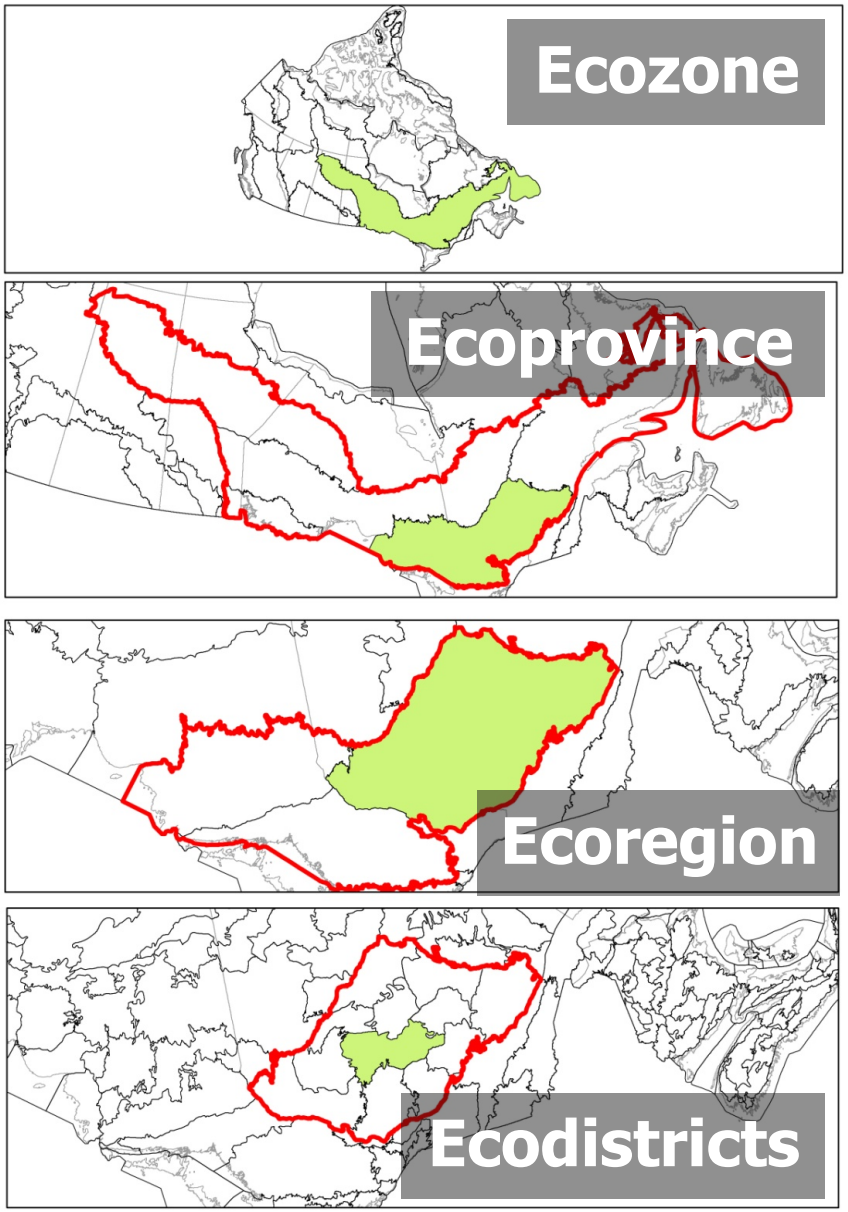
- Effective environmental decision-making
- Monitoring
- Prediction

Ecological classification

Example:
National Ecological Framework of Canada (NEFC)

"One fits all"

- Biodiversity
- Carbon balance
- Disturbances



Fire regime as an example

1.8 million of ha burned per year (1959-97)
(Stocks et al. 2002)

Fire regime

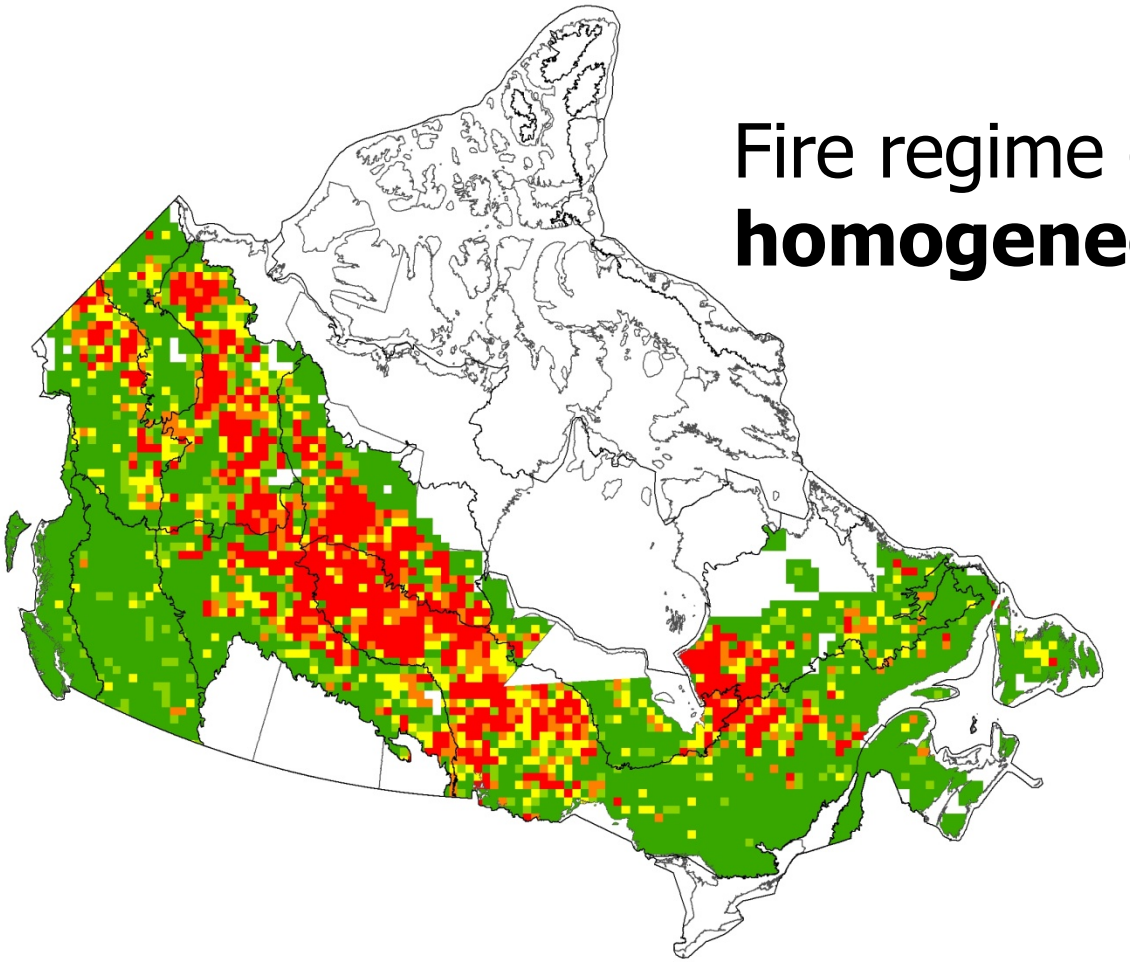
- Area burned
- Fire occurrence
- Seasonality
- Fire size
- Fire severity
- …

Multi-scale patterns

- Ignition sources
- Climate
- Fuel

Fire regime likely to be **correlated** (similar) over large spatial scales

Spatial variability in Canada's fire regime



Fire regime clearly **not homogeneous**

Consequences on **spatial accuracy** at this scale

Homogeneous fire regime (HFR) zones

There is a need to define current and future homogeneous fire regime (HFR) zones

- Large scale fire risk + land management planning
- Regional forest productivity
- Biodiversity
- Modelling C balance

- Tool for practitioners
- Present + future conditions
- Adaptation to climate change

Boulanger, Gauthier, Burton, Vaillancourt. 2012. "*An alternative fire regime zonation for Canada*". International Journal of Wildland Fire, in press

How the NEFC differs from a homogeneous fire regime (HFR) zonation based on arbitrary units ?

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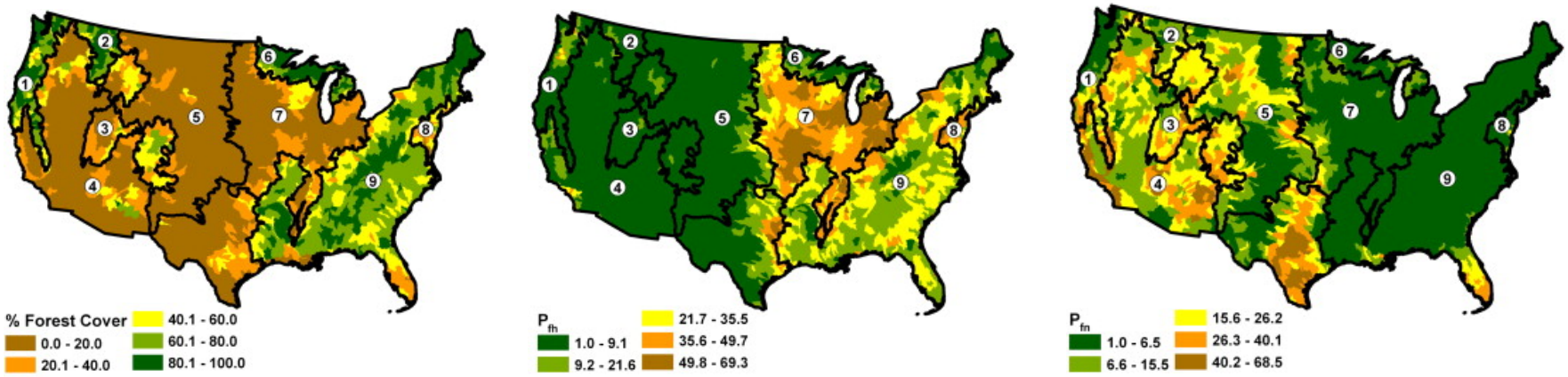
Defining homogeneous zones

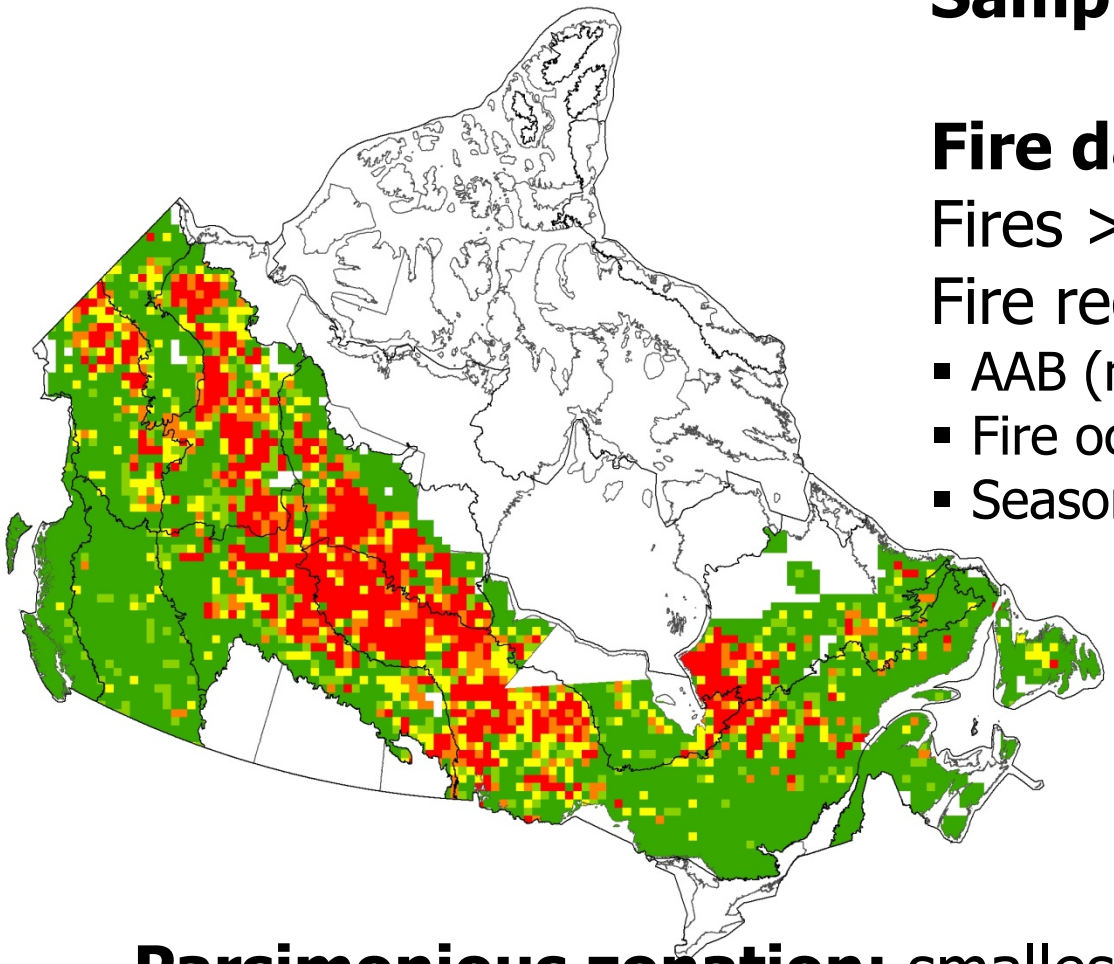
Aggregation of **similar**, **spatially contiguous** units into homogeneous zones

Ex.: Regionalization of forest metrics by watersheds in US (Kupfer et al. 2012)



Essentially, **spatially constrained** hierarchical clustering

Sampling strategy



Sampling units: 40-km cells

Fire data (NFDB)

Fires > 1 ha, 1980-99

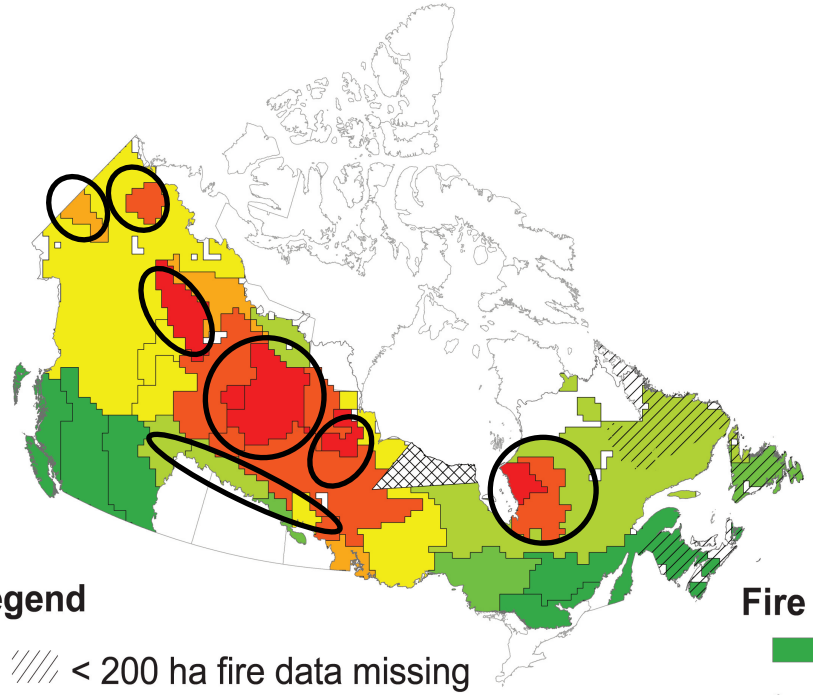
Fire regime defined as:

- AAB (natural/human)
- Fire occurrence (natural/human)
- Seasonality

Parsimonious zonation: smallest number of zones explaining the maximum of spatial variation in fire regime

Results: 33 HFR zones

A) HFR zonation

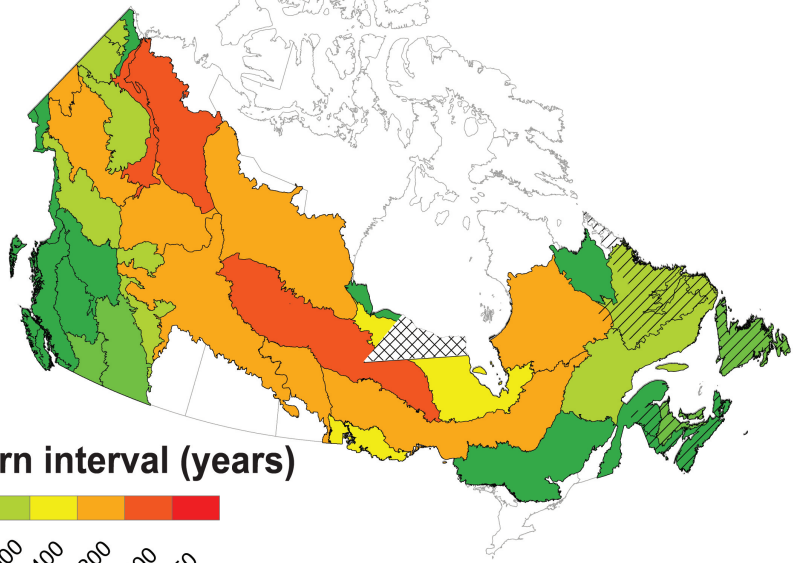


Legend

< 200 ha fire data missing

No fire data

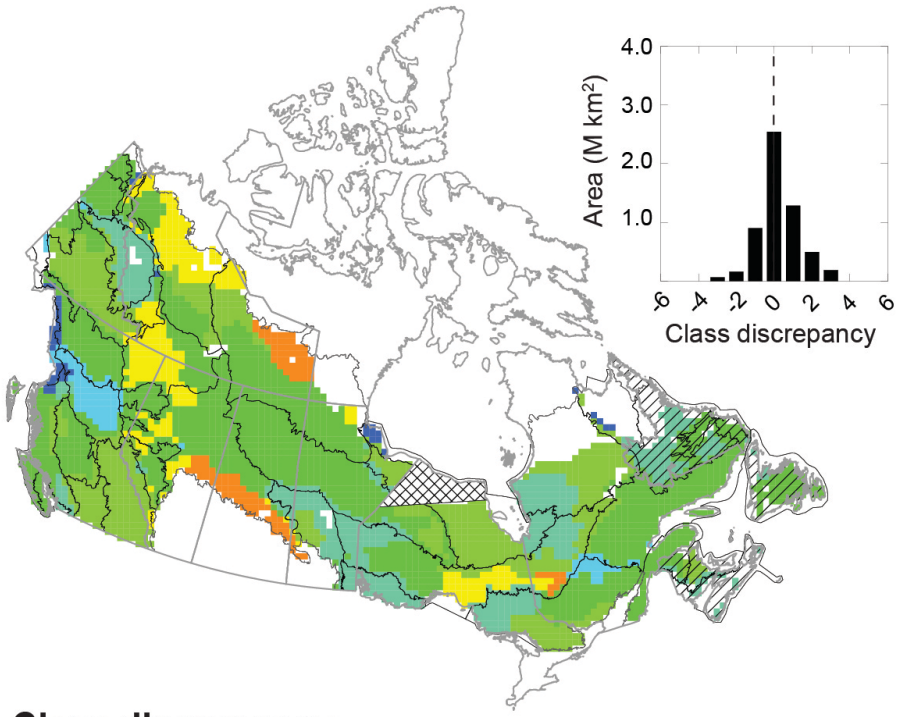
B) Ecoprovinces

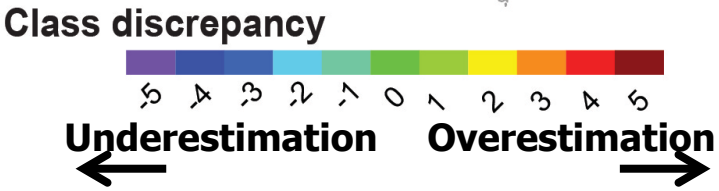


Zonation	N. of zones	Adj-R^2
HFR	33	0.613
Ecoprovinces	36	0.369

Discrepancy between HFR and Ecoprovinces

Fire return interval





HFR zonation captures **more heterogeneity**

NEFC not an exact proxy for FR

HFR →
More accurate delineation of **ignition** and **propagation risk**

Boulanger, Gauthier, Burton, in prep.

A refinement of models predicting future Canadian fire regimes using HFR zones

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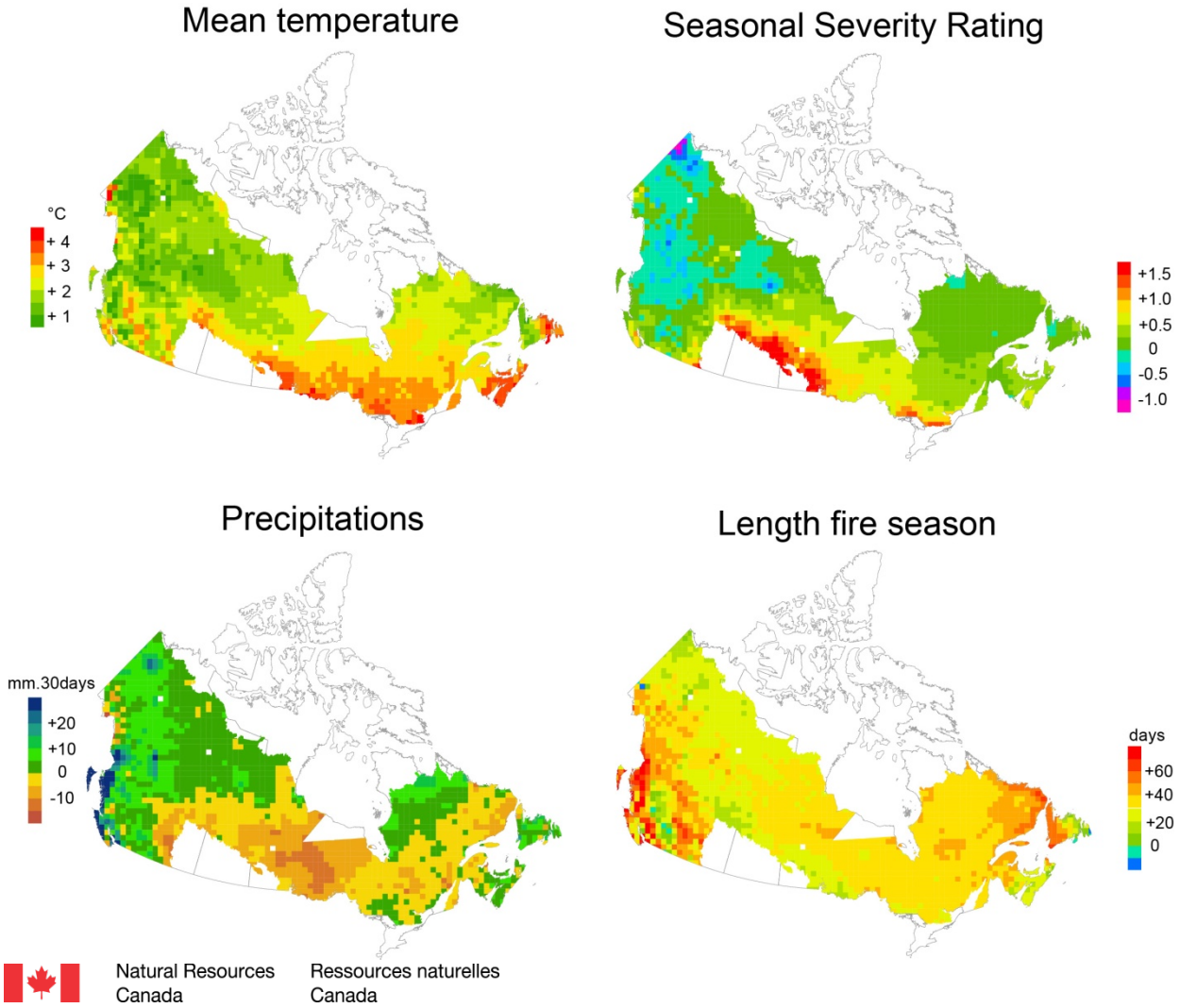
Future fire-weather and fire regimes

Climate change: changes in fire-weather



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Future fire-weather and fire regimes

- **Climate change**: changes in fire-weather

  → Changes in **fire regime**

- Mostly assessed using the **NEFC**

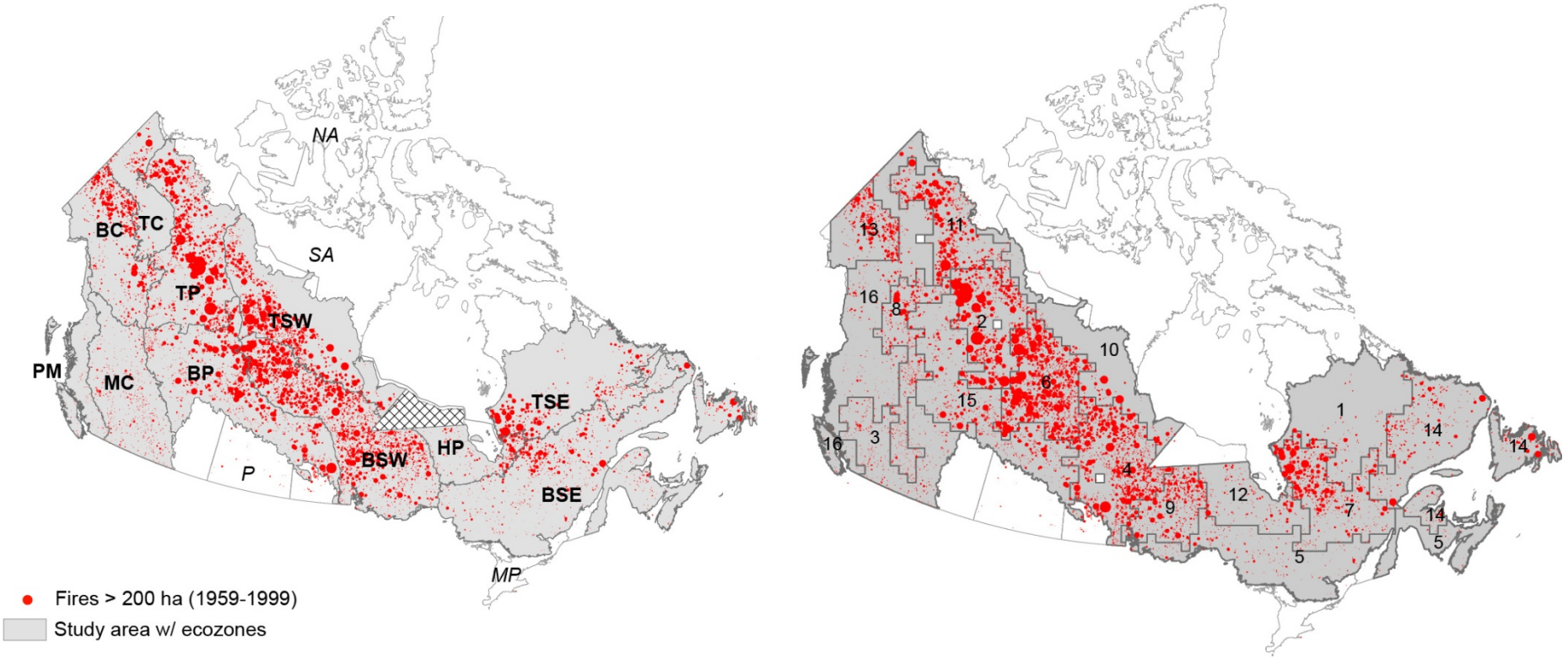
- **HFR zones** may better outline the **large-scale variation** in **future fire conditions**

Analysing steps

- **New HFR zonation**: Area burned + Fire counts (1959-99)
- Modelling (MARS) **monthly area burned** and **fire counts** using
  a) HFR zones
  b) Ecozones
- Projected changes for 3 future periods :

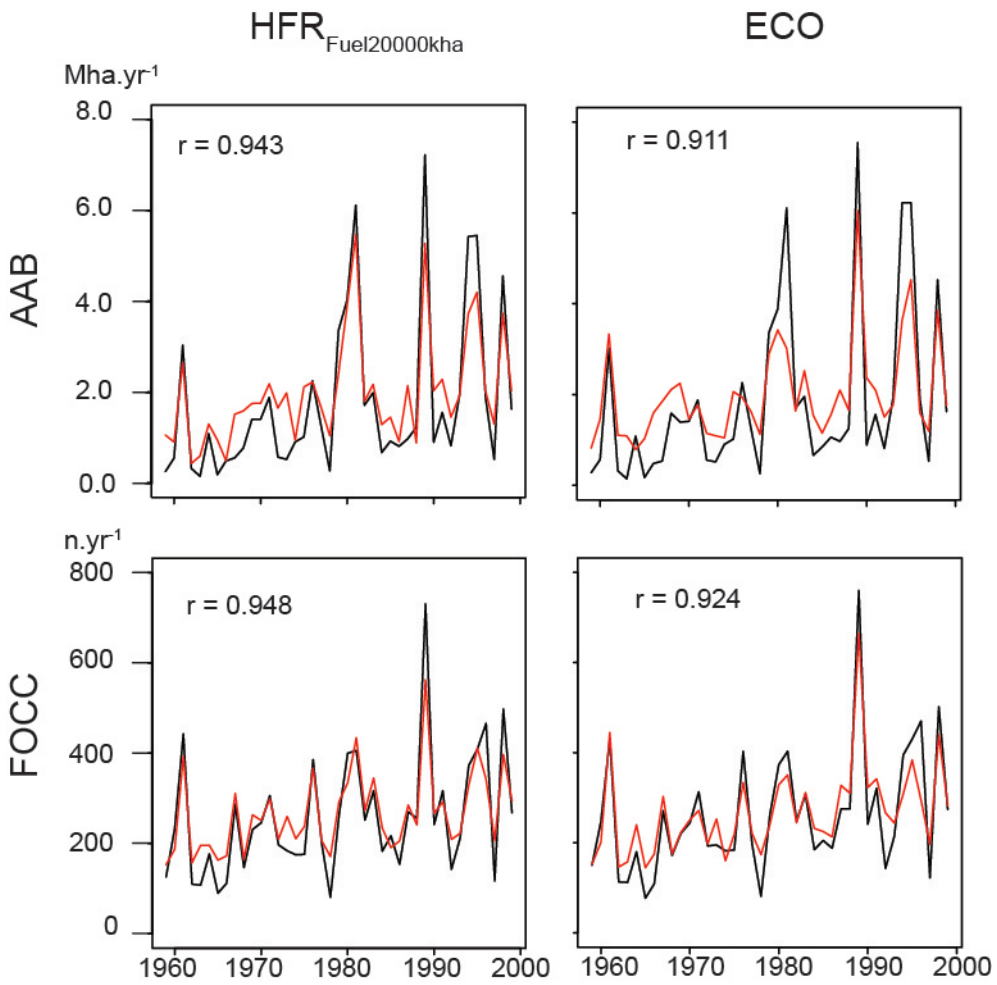
  2011-40; 2041-70; 2071-2100
- Canadian Regional Climate Model outputs
- IPCC A2 scenario (still realistic...)

Ecozones vs HFR zonation



Zonation	N. of units	R^2_a
Ecozones	12	0.190
HFR	16	0.477

Model predictive ability



- Predictive ability very high for both HFR and ecozones

Predicted
Observed

HFR zones vs Ecozones

At the national scale:

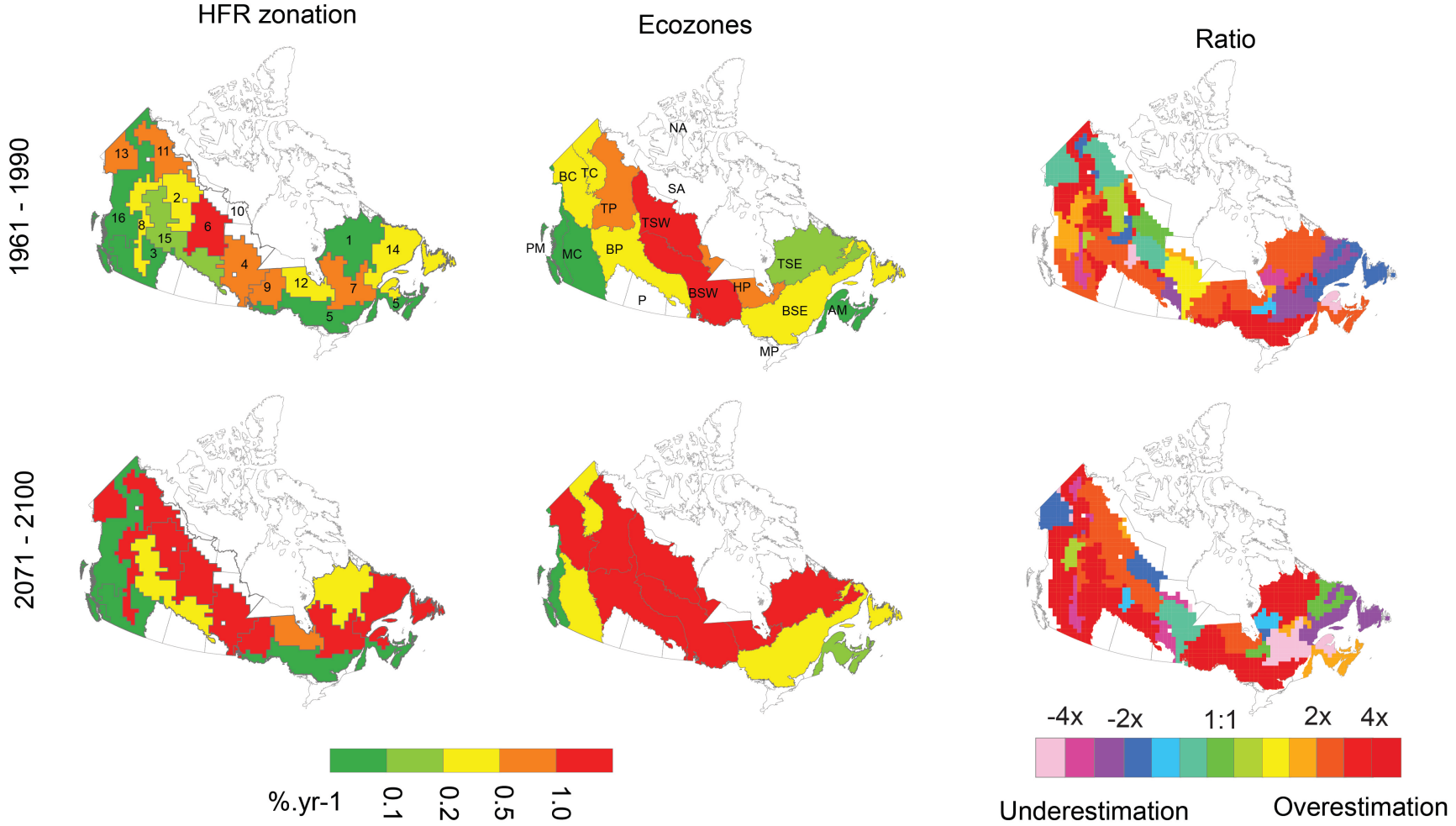
	AAB ($\%.Yr^{-1}$)			FIREOCC ($n.100Mkm^{-2}.Yr^{-1}$)		
	1961-1990	**2071-2100**	**Ratio**	**1961-1990**	**2071-2100**	**Ratio**
HFR	0.35	1.55	4.40	5.1	15.2	3.00
Ecozones	0.42	1.67	4.01	4.8	16.0	3.32

Very small differences

however...

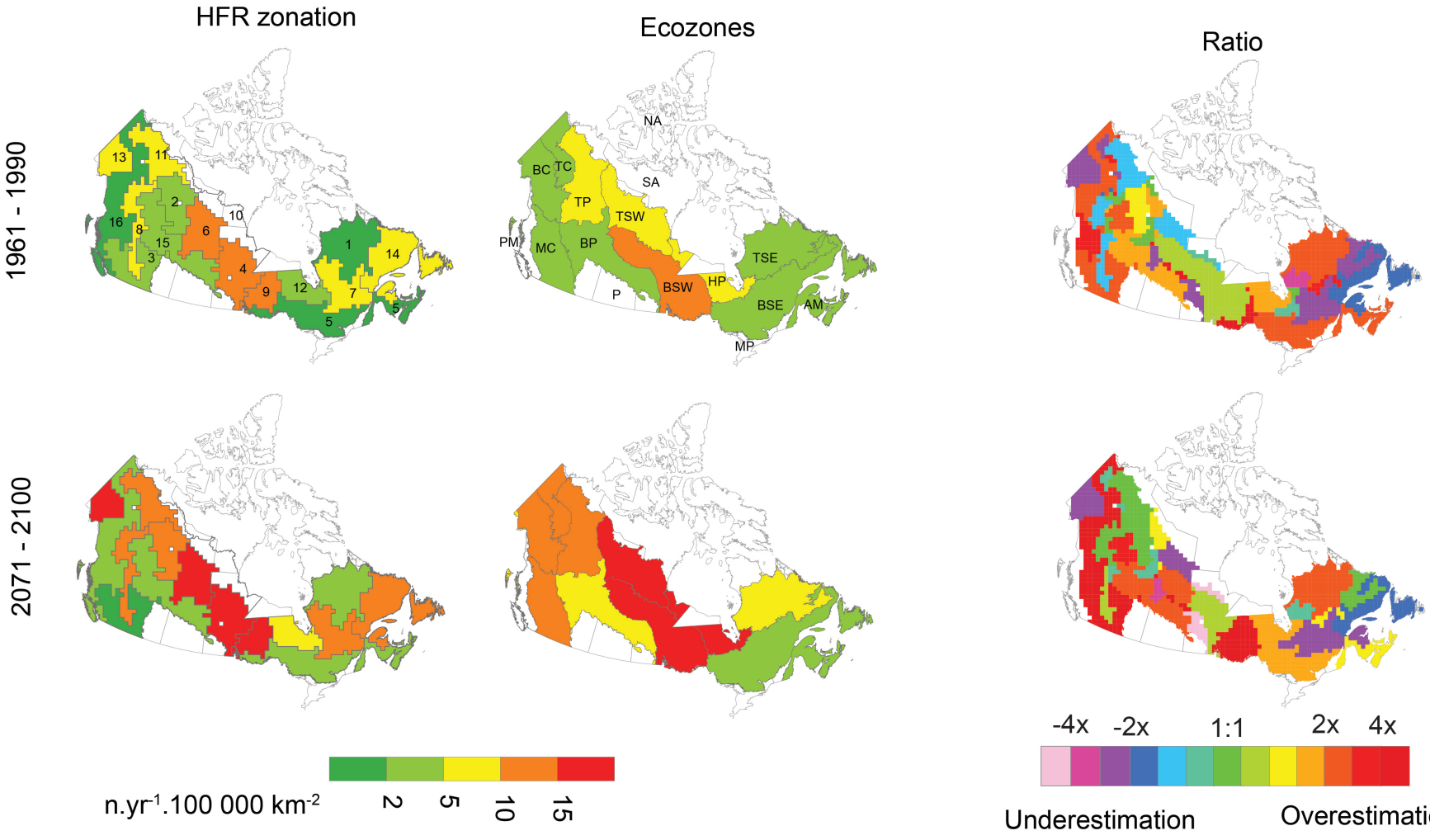
Projected fire regimes (HFR zones)

Annual area burned



Projected fire regimes (HFR zones)

Fire occurrence



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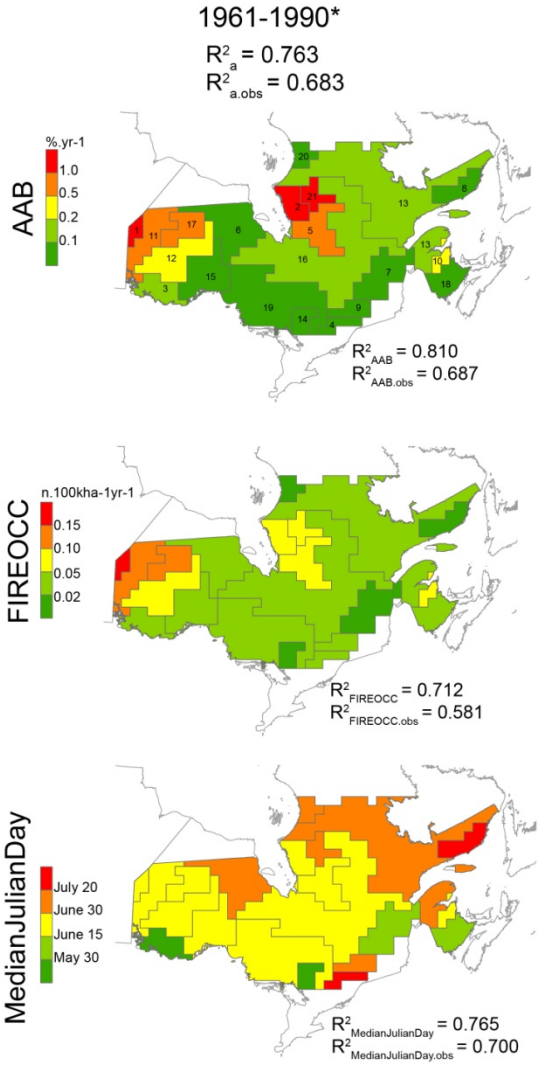
Conclusions

- **HFR** zonation captures **more heterogeneity in the fire regime** than multipurpose classification;
- As when using NEFC units, large increase in area burned and fire occurrence;
- But, may provide more spatially accurate estimates of future fire regime than NEFC;

- HFR zonation reveals areas where current and/or future fire risk will be very high (overlooked when using NEFC);
- Large impact for studies using current/future fire regime **at that scale** (e.g., C balance, biodiversity, etc.)

HFR zonation as part of a toolkit for practitioners



- Zonation analyses are very **flexible**
- Can be modulated **by sample units, attributes, temporal depth** and **spatial scale**

Future work

In progress:

- **HFR zones**: large scale patterns in **forest productivity** (A. Taylor, P. Bernier et al.)
- Integrating **other insects**: Homogeneous **Disturbance** Regime (HDR) zones
- Pilot project in **BC** (Pettit, Burton, Boulanger et al.)

Other potential avenues

- Evaluate forest vulnerability to pests in conjunction with HDR zones
- Future plant distribution integrating disturbance regime

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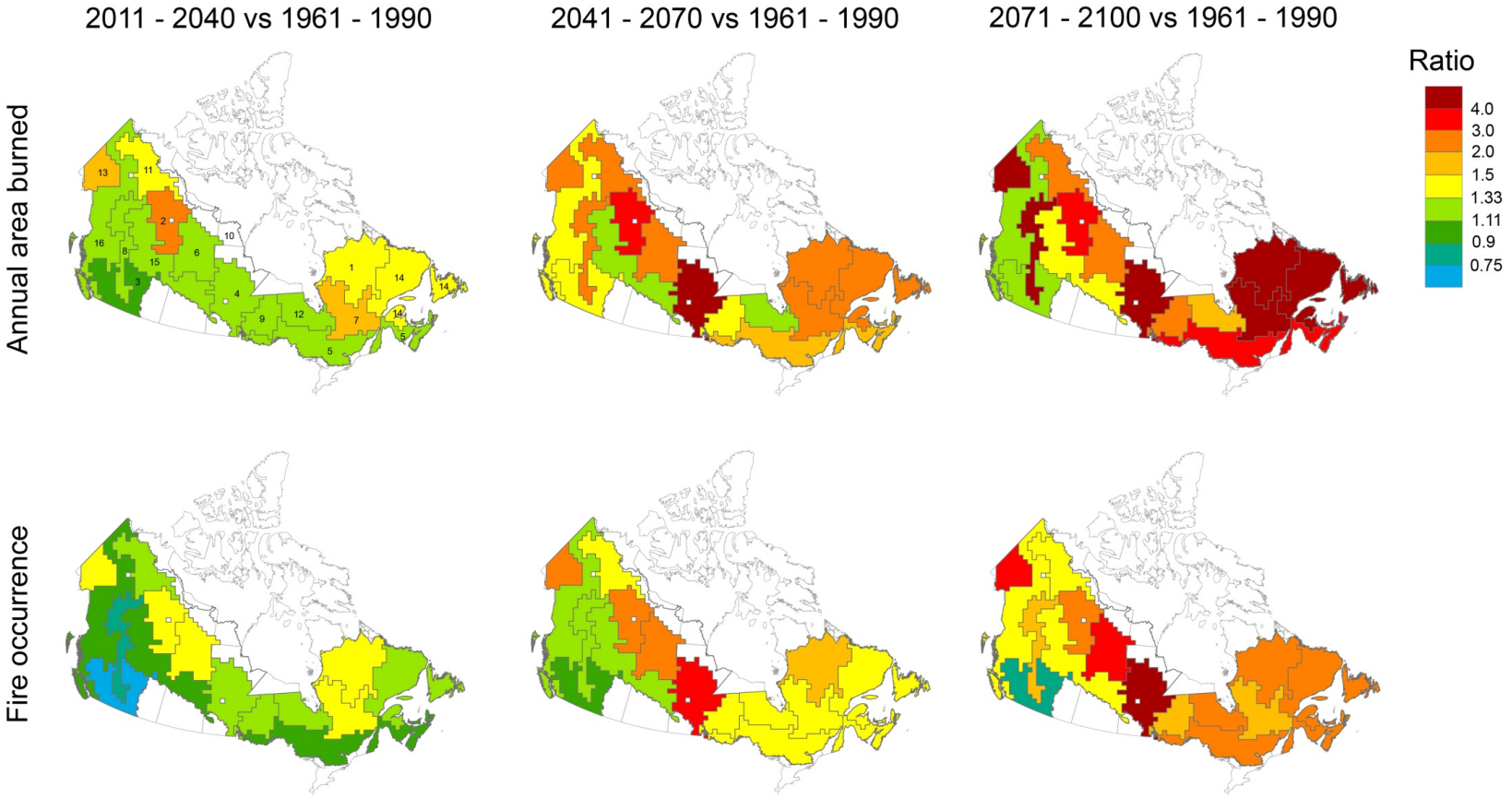
- BC Future Forest Ecosystems Science Council (FFESC)
- FORREX Forum for Research and Extension in Natural Resources
- Forest Change and the new Adaptation program
- 'Forest Productivity and Dynamics' project

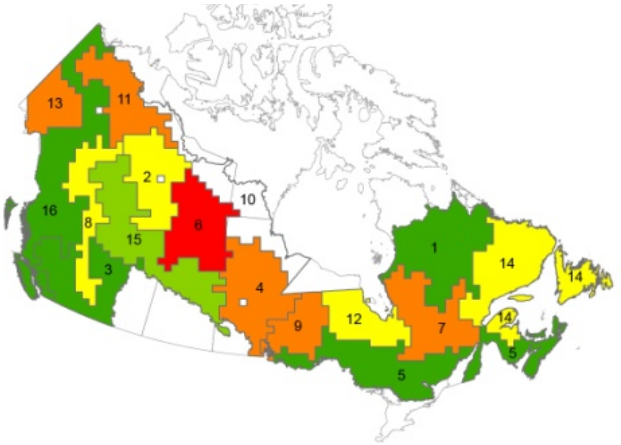
Supplementary slides

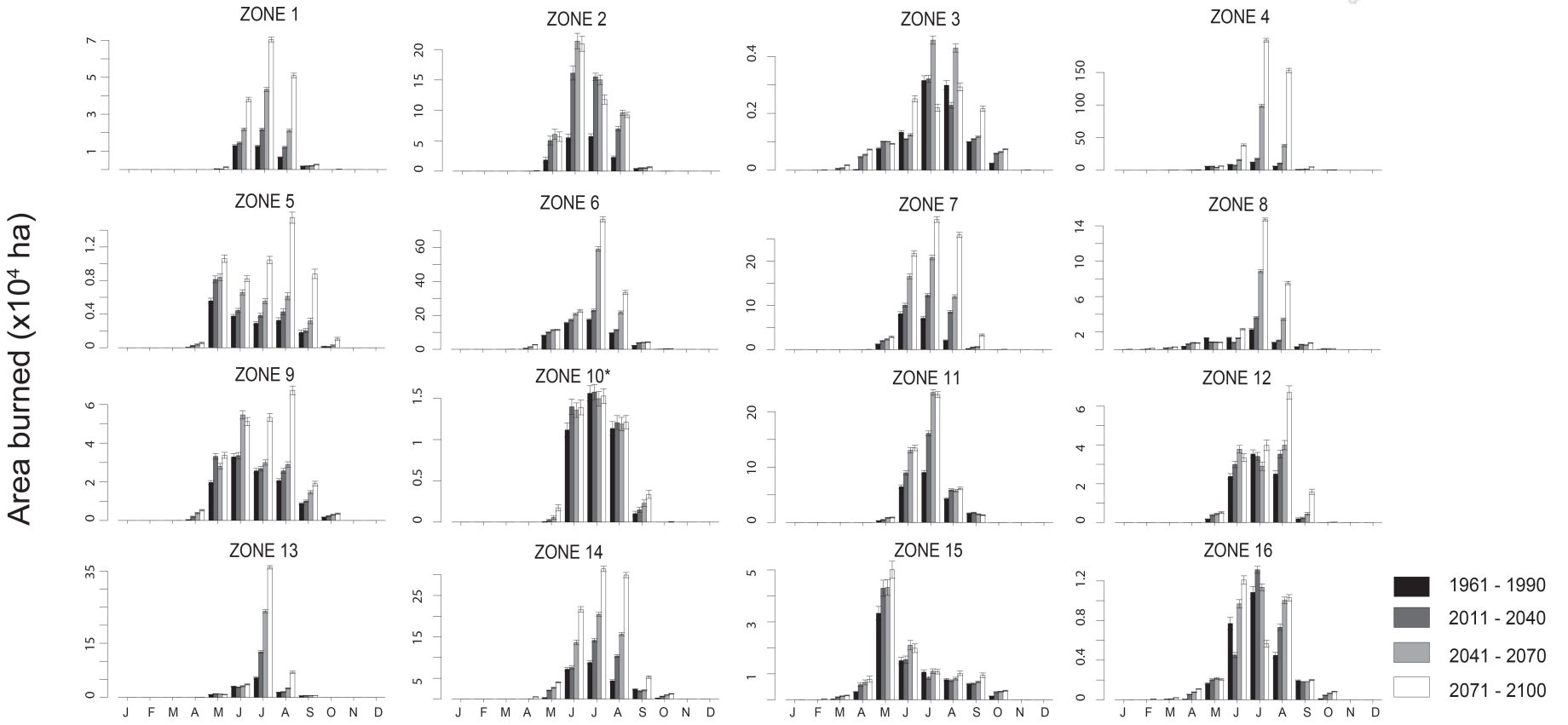
Projected changes in fire regimes (HFR zones)



Changes are very heterogeneous throughout Canada

Projected fire seasonality





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