Can experimental simulation tell us about future environments in a changing climate?

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Western
Biotron Experimental
Climate Change Research

The Problem

We are faced with the challenge of predicting the response of ecosystems to future climate conditions.

Why do we care?

- Ecosystem/ecozone shifts and transition
- Species expansion/extinction
- Increases/decreases in diversity
- Changes in ecosystem function (carbon storage, nutrient/element cycling)

Approaches

Approach
Observation
Experimentation
Modelling

Observation

- Reliance on observation of natural systems alone is insufficient if our objective is to inform policy and societal adaptation

- Occurs over the same time frame as the environmental change itself.

- Potentially already past its ‘tipping point’ by the time change is observed.

Experimentation

- Can hypothesis test
- Experimentation can provide unexpected insights
- Tangible evidence of ecosystem responses to environmental forcing
- Not without challenges (more later…)

Modelling

- Modelling is a sound approach based on best available knowledge.
- Can hypothesis generate, but not test.
- cannot account for unexpected synergistic/antagonistic interactions (i.e. cannot know the unknowns).

BIOTRON

- Centre for Experimental Climate Change Research
- Canada Foundation for Innovation
- Opened in 2007

Environmental Chambers and Incubators

- Roof-top Biomes (6)

- Earth Science Biome (1)

- Walk-in/Reach-in Environmental Chambers (36)

- Microbiology Incubators (20)

Biological Response and Adaptation to Climate and Environment (BRACE)

- Experimental simulation of climate change effects on boreal peatland ecosystems

- Integrated measures of ecosystem response to climate change stressors (Temp, moisture and CO_2).

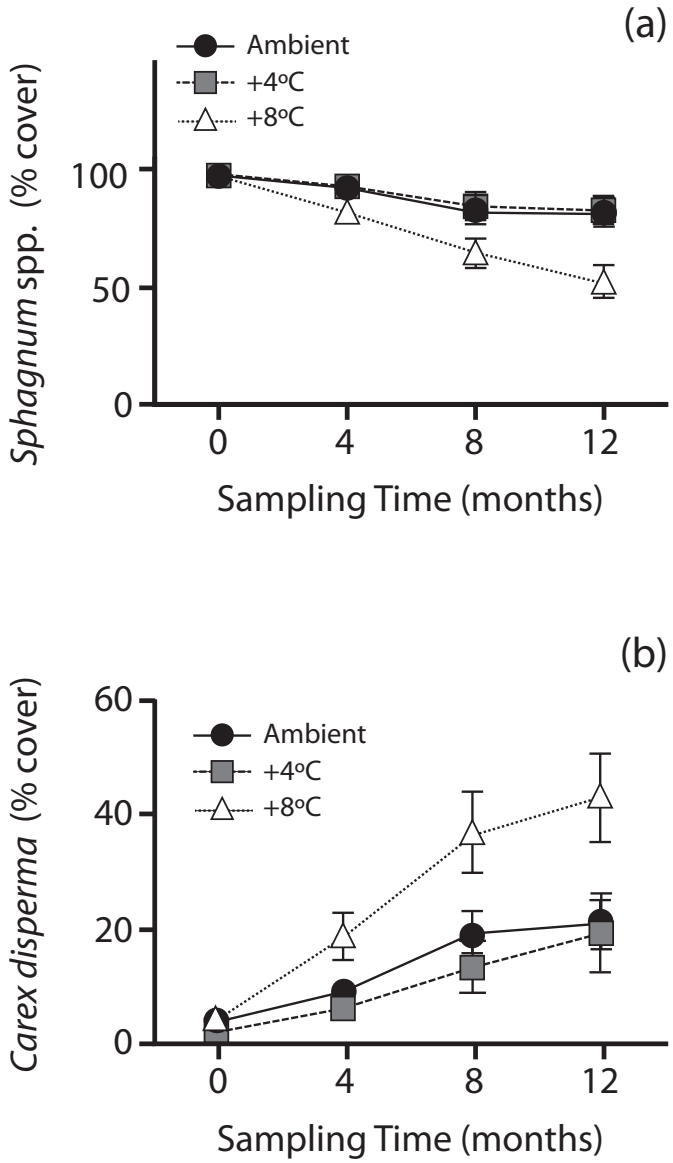
BRACE - Approach

- ~100 peatland mescosms subjected to experimental climate change conditions (T; CO_2; WT; factorial design).

- Measures of plant community, meso and micro-faunal composition, decomposition and water quality over 16 months

BRACE - Results

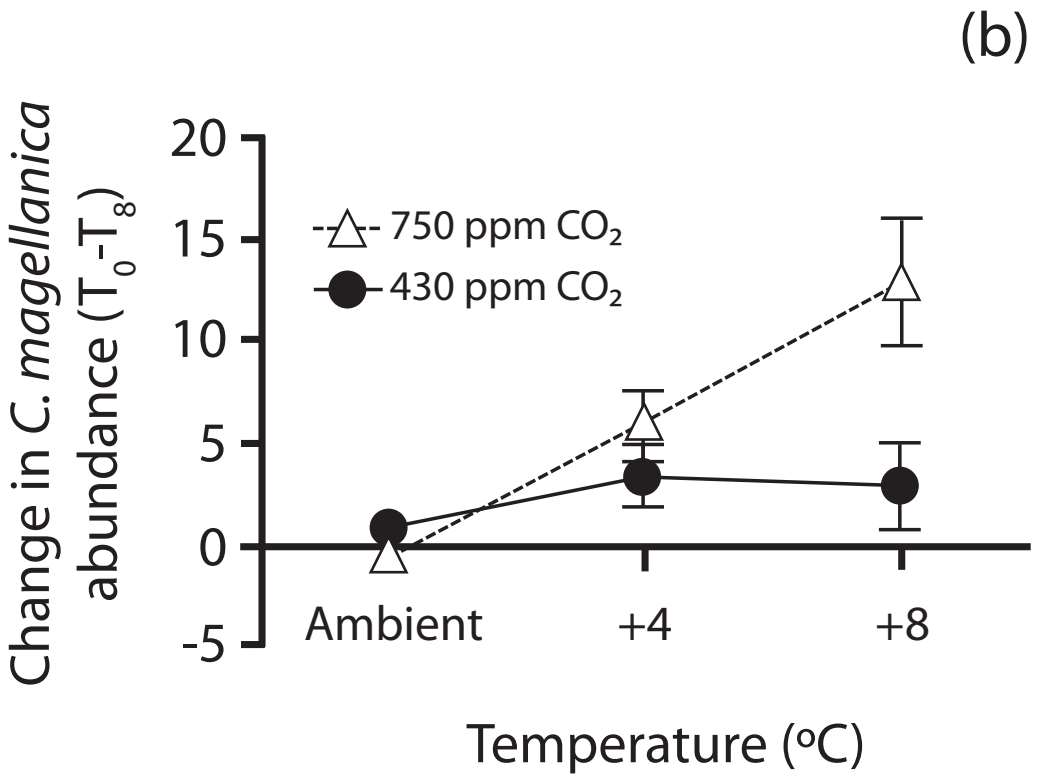
- Temperature drives a change in plant community composition.
- Loss of C-accumulating species (Sphagnum)



Dieleman, Branfireun, McLaughlin & Lindo, Glob. Change Biol. (accepted).

BRACE - Results

- Synergistic effects between temperature and CO_2 for some plant species.



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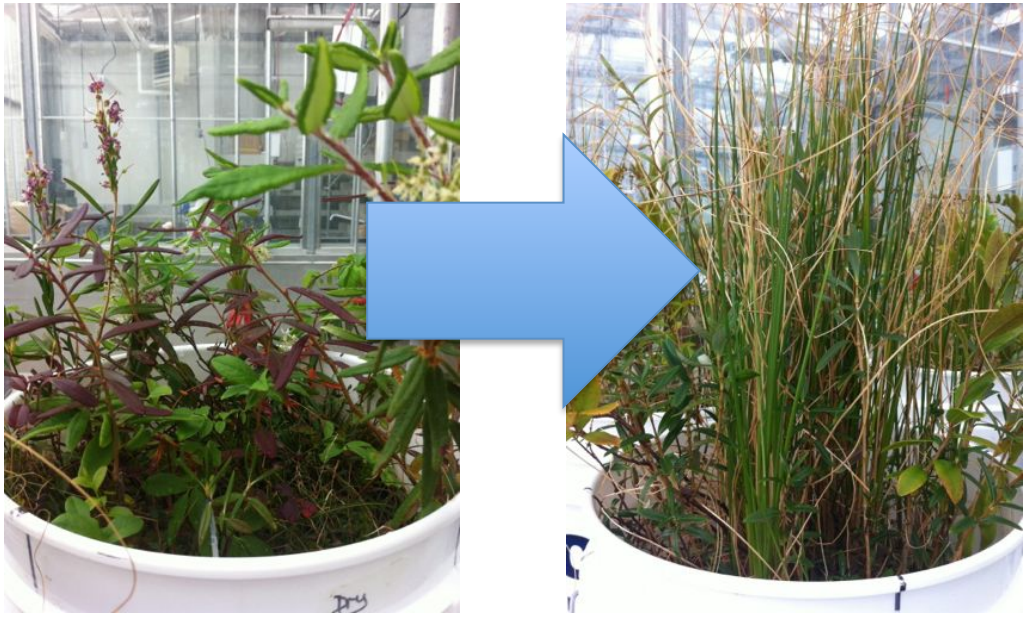
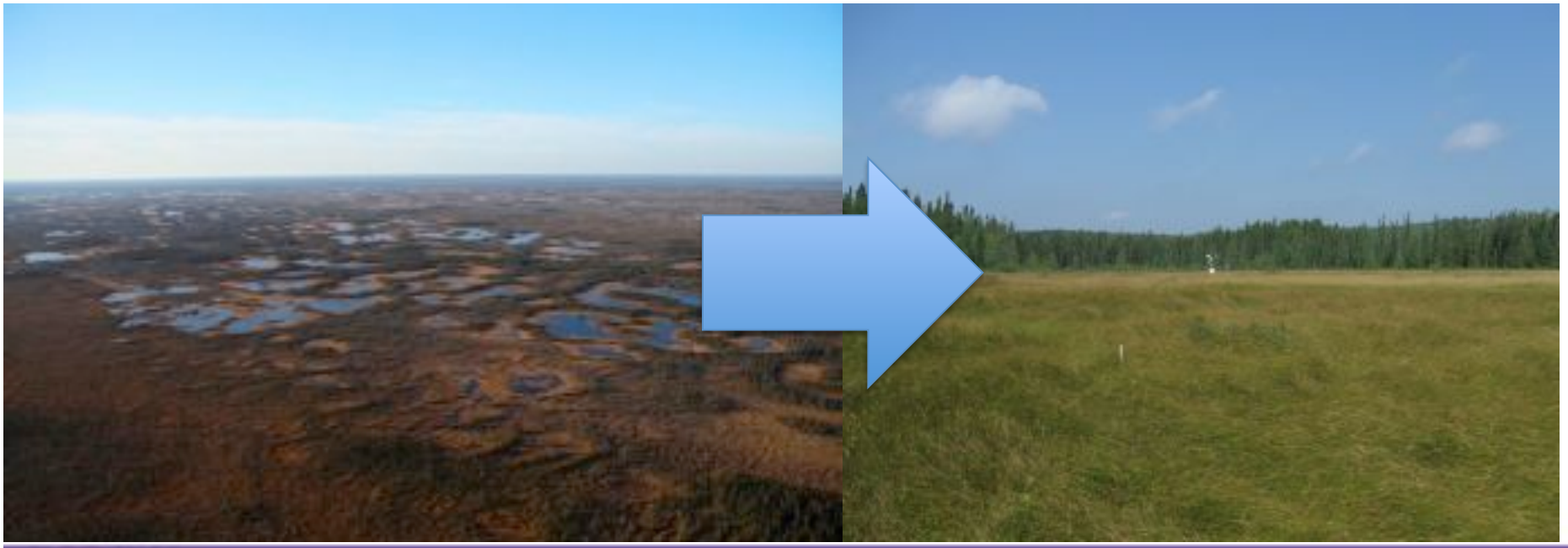
BRACE - Results

- Result is diverging plant community composition
- Implications for Canadian ecosystem stability and carbon stocks

BRACE - Results





Experimental Challenges

- Representativeness
- Generalizability
- Artifacts

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Experimental Benefits

- The power of demonstration
- Compelling **empirical evidence** of antagonistic and synergistic relationships IF the mechanisms are consistent with theory

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