SOUTHERN FORESTS WATER FUTURES

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How will the water and carbon budgets of southeastern Canadian forest ecosystems respond to future climate change, extreme weather events and management/disturbance activities?

Project Description

Climate warming is accelerating the hydrological cycle, thereby altering the growth, evapotranspiration rate, water balance, soil-plant nutrient cycling and associated feedbacks in forest ecosystems (IPCC 2013, Zhang et al., 2010). Changes in water and carbon fluxes can alter the composition, structure and functioning of forest ecosystems calling for a clear understanding of functioning of forest ecosystems and their response to climatic changes and extreme weather events. Future climate change scenarios suggest that forest managers will have to employ climate tailored management regimes to help the forests adapt to the uncertain impacts of climate change and extreme events (Millar et al 2007).

This project explores how the water and carbon budgets of southeastern Canadian forests will respond to future climate change, extreme weather events and management/disturbance activities.

Project Goals

- Evaluate carbon uptake potential of different-age conifer (2002, 1974 & 1939 plantations) and a mature deciduous forest to offset greenhouse gas emissions.
- Evaluate how these forests may be affected by extreme weather events and future climate changes.
- Improve ecosystem models used in Canadian regional and global climate models using these data sets.

Linkages to United Nations Sustainable Development Goals

Goal 6: Clean Water and Sanitation

Ensure access to water and sanitation for all

SFWF aims to explore the water budget of SE Canadian forests in order to protect our freshwater resources

(Objectives 1-5)

Goal 13: Climate Action

Take urgent action to combat climate change and its impacts

This project collects continuous measurements to monitor and report the impacts of climate change on SE Canadian forests and make recommendations for mitigation

(Objective 1)

Goal 15: Life on Land

Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

(Objectives 1-5)

Objectives

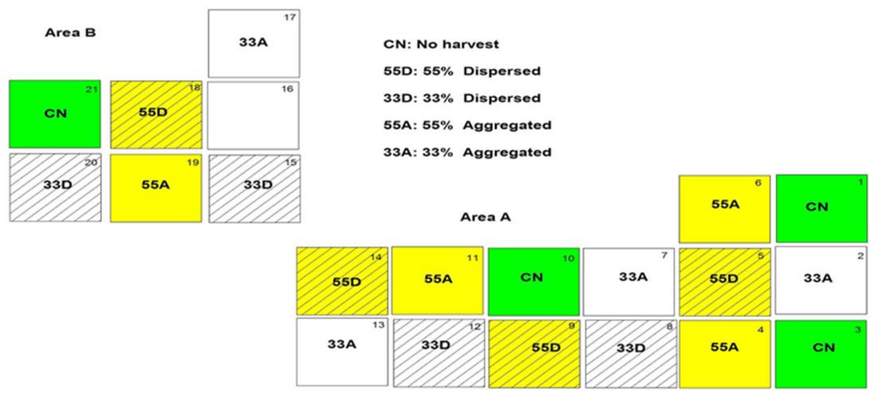
1. Make continuous measurements of water, energy and carbon fluxes and ecological parameters in conifer age-sequence plantations and deciduous forest over the next three years at TPFS, extending the long-term observational data record

Instrumentation tower at white pine forest (TP39)

Top left: 3-D sonic anemometer measures carbon and water fluxes; Top right: weighted rain gauge measures precipitation; Bottom: automated soil gas flux system measures soil respiration

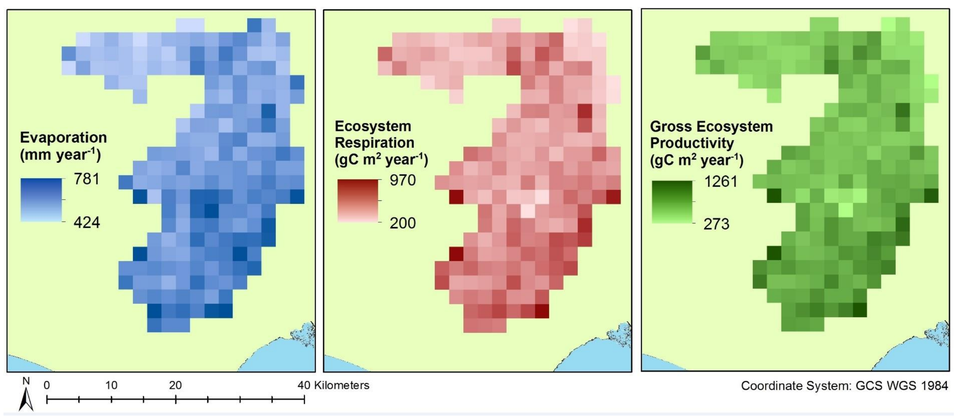
2. Determine major shifts in forest structure and their hydrologic and carbon sequestration functions in response to major climatic (e.g drought, heatwave) and disturbance (e.g. thinning) events over their full lifespans

3. Determine how different forest management treatments (e.g. variable retention harvesting (VRH)) will impact the forest growth trajectory, hydrologic regime and their ability to respond to future climate stresses and extremes (e.g. drought, heat and nutrient status)



Schematic diagram of harvesting treatments in the VRH site in Turkey Point, ON.

4. Use above data sets to further develop and test the Canadian Land Surface Scheme - Canadian Terrestrial Ecosystem Model (CLASS-CTEM) to accurately simulate eco-hydrological processes in cold regions. Develop and test the eco-hydrological model MESH-CTEM-N+ model.



Estimation of annual Evapotranspiration, Respiration and GEP over the Big Creek watershed in southern Ontario between 2004 - 2011 using the coupled MESH-CTEM model.

5. Develop a tight water-carbon coupling scheme in the two-leaf BEPS model to simulate national-scale carbon and water budgets.