Post-fire succession in North American boreal forests increases rates of evapotranspiration

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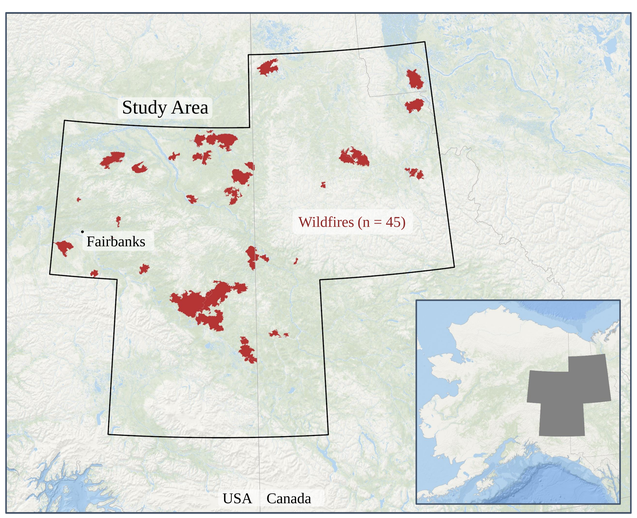
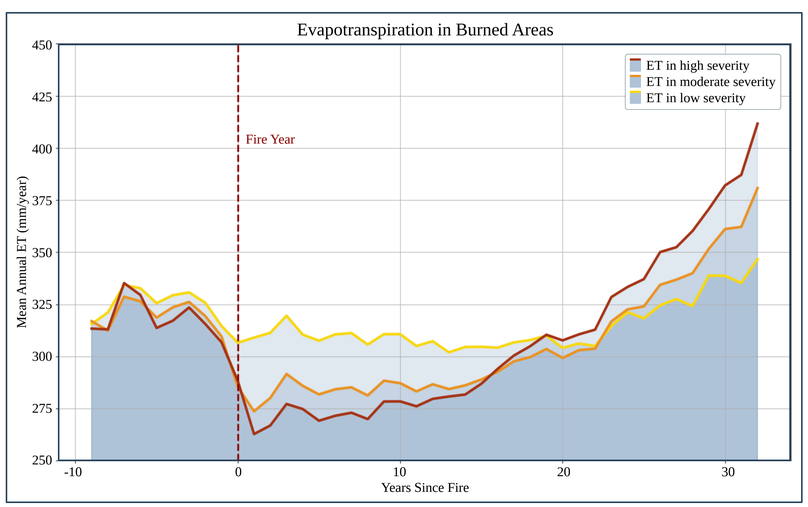


Introduction

Increased wildfire activity threatens the resilience of North American boreal forests by altering the composition, structure, and function of the ecosystem (Baltzer et al., 2021; Portier et al., 2018). Evidence suggests that boreal forest communities in burned areas are shifting from predominantly evergreen needleleaf forest to deciduous broadleaf and mixed forests, potentially altering ecosystem functions such as evapotranspiration (ET). **This study introduces a process-based ET model using the MOD16 framework that incorporates the ABoVE Annual Dominant Land Cover product (Wang et al., 2019) and gap-filled estimates of fPAR and LAI from HISTARFM (Moreno-Martinez et al., 2020).** The resulting product has a spatial resolution of 30 meters and outperformed MOD16 in validation against boreal flux tower data. We assessed region-wide trends in ET and performed a space-for-time study in fire perimeters to understand trends in regenerating boreal ecosystems.

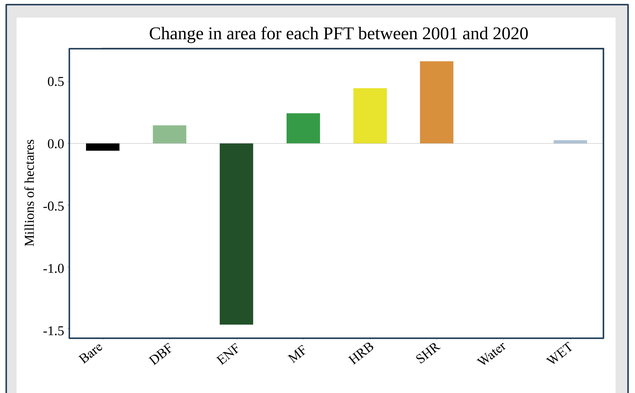
Trends in regenerating fire scars

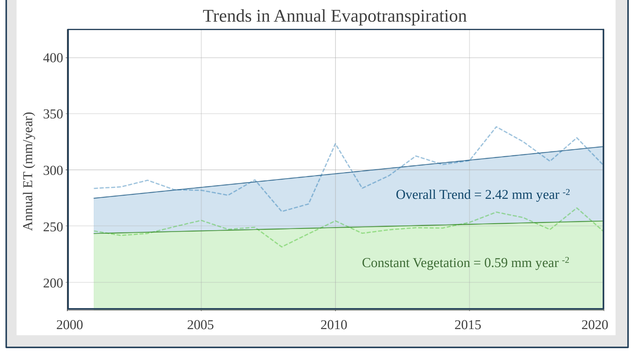
This space-for-time study investigates trends in boreal forest composition (land cover), structure (aboveground biomass), and function (evapotranspiration) during a three-decade period of regeneration following wildfire events. Forty five fire scars were used in the study, with at least one fire per year from 1985-2010. The ABoVE Annual Dominant Land Cover (Wang et al., 2019) and Annual Aboveground Biomass (Wang et al., 2021) products are used to measure vegetative recovery. Evapotranspiration (ET) is estimated using BorealET, a novel adaptation of the MOD16 algorithm. **Results of the study confirm that burned areas in North American boreal forests are generally undergoing successional trajectories toward deciduous and mixed forests. Rates of ET, while negatively impacted immediately after wildfire events rebound and surpass pre-fire levels after about 20 years.** Trends in all variables are sensitive to wildfire severity.

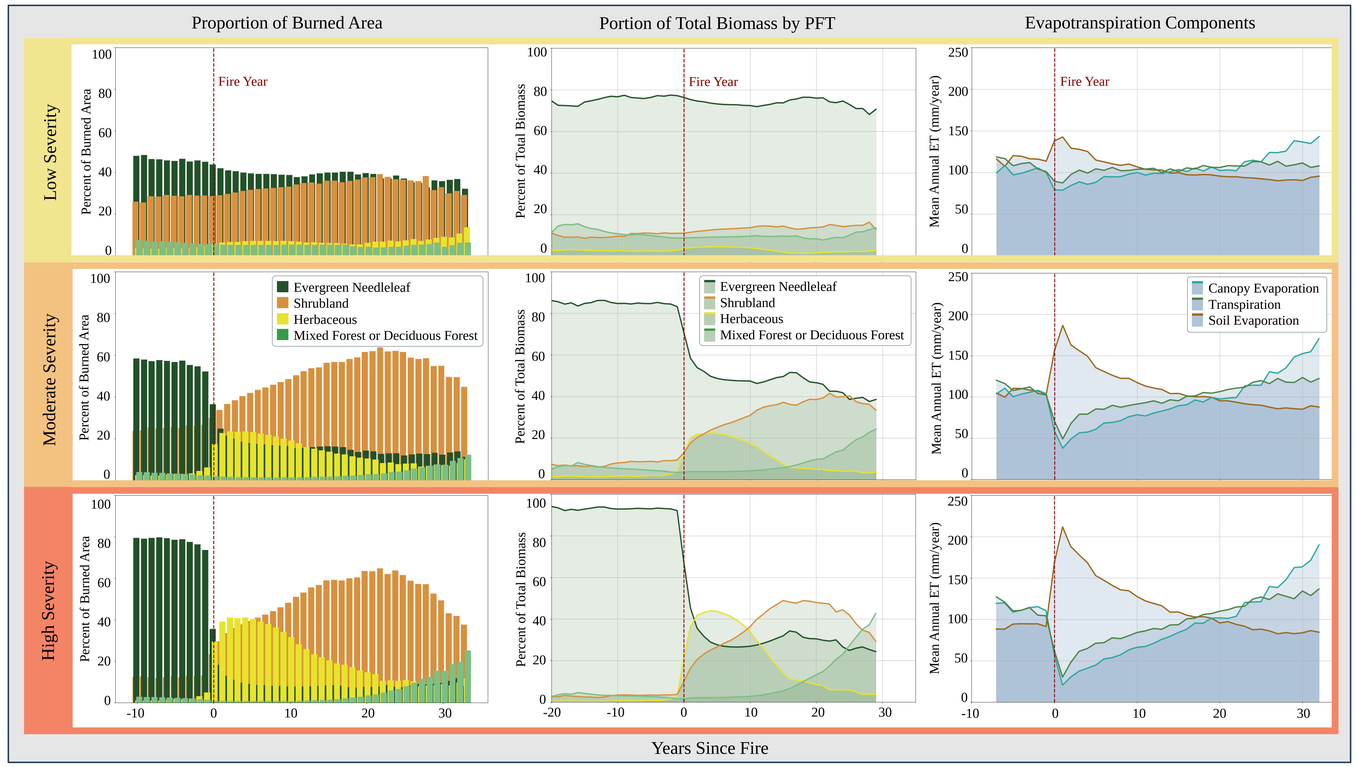


Region-wide trends

Trends in ET were assessed across the study region with simulations to isolate the direct effects of climate change from the effects of land cover change. From 2001-2020, it was estimated that **ET is generally increasing across the study region at a rate of 2.42 mm year-2, with three quarters of the trend (1.83 mm year-2) attributable to land cover change**, suggesting that the inclusion of a dynamic land cover component is an important advancement in process-based ET models.







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