

Global Water Futures 2021 Operations Team Meeting – Project Reporting Template

Instructions: All GWF projects are asked to provide a summary update on their activities and accomplishments in preparation for the upcoming Operations Team meeting. **Please submit these by email to chris.debeer@usask.ca by no later than December 2.** These will be used to help guide discussions and breakout synthesis activities and will be made generally accessible on our website in advance of the meeting.

Project Name:	Southern Forests Water Futures
Our major accomplishments to date are:	
<ul style="list-style-type: none">• Evaluation of heat and drought impact on carbon exchanges in different age southern temperate managed forest ecosystems. Results indicate that the timing, frequency and concurrent or consecutive occurrence of extreme weather events may have significant implications for growth and carbon sequestration in these forests. Study results will help in developing climate resilient and sustainable forestry practices to offset atmospheric greenhouse gas emissions and conserve water resources.• Evaluation of four different Variable retention harvesting (VRH) treatments in southern forests to increase water use efficiency, growth and carbon sequestration and forest biodiversity.• Development of coupled hydrologic and carbon cycle model (MESH-CTEM) to study coupled water and carbon cycle processes as watershed scales under different climate change scenarios.• Publication of peer-reviewed papers on water and carbon exchanges in the southern managed forest ecosystems that have advanced our understand of processes.• Provision of long-term high-quality data of water, carbon and energy flux, meteorological, hydrological and biometric data sets in different-age and species of southern temperate forests for research and model development by research from Canada and across the world• Collaboration with the GWF Co-creation of indigenous water quality tools and ecosystem health group to conduct modelling studies at McKenzie Creek to explore the impacts of climate change on hydrological processes and water resources in the Six Nations Community.	
Our current activities are:	
<ul style="list-style-type: none">• We have continued our energy, water and carbon flux and meteorological data measurements. We use eddy covariance systems, weather stations, sapflow probes, rain gauges and plant physiological and remote sensing sensors. These data are being archived at the GWF Central Data System with the help from GWF Core Data Management team at McMaster University.• Four PhD and two M.Sc students are working on the project currently and several publications are in progress.	

- We provide information to the GWF Knowledge Mobilization Team for dissemination of project results to end users and policy makers.
- We also collaborate with members of McMaster Centre for Climate Change for various activities such as Twitter feeds, sponsored public and academic lectures, conference sponsorship to disseminate project results and conduct community outreach.
- We collaborate with the GWF Co-creation of indigenous water quality tools and ecosystem health project team members for climate change and hydrologic studies in the Six Nations Community.
- We are working on the developing and testing MESH-CLASSIC model to conduct water and carbon cycle studies in selected watershed across Canada in collaboration with researchers from Environment and Climate Change Canada and Natural Resources Canada.

The main accomplishments expected by the end of the project are:

- Improved knowledge of hydrologic and carbon exchange processes and their coupling in Southern Canadian Forests.
- Climate adopted forest management strategies for southern forest ecosystems to provide sustainable and clean water resources and enhanced carbon sink capabilities.
- Well tested and improved coupled hydrologic and biogeochemical model (MESH-CLASSIC) for application and research as watershed scale and explore impacts of climate change.
- Well trained and skilled future generation of students and researchers
- Community engagement and dissemination of results to enhance awareness about water resources and their security in changing climate.
- High quality water, carbon and energy flux, meteorological, hydrological and biometric data sets for research and model development by research from Canada and across the world

Here is a key visual from the project (figure, photo, table, graph, etc.)



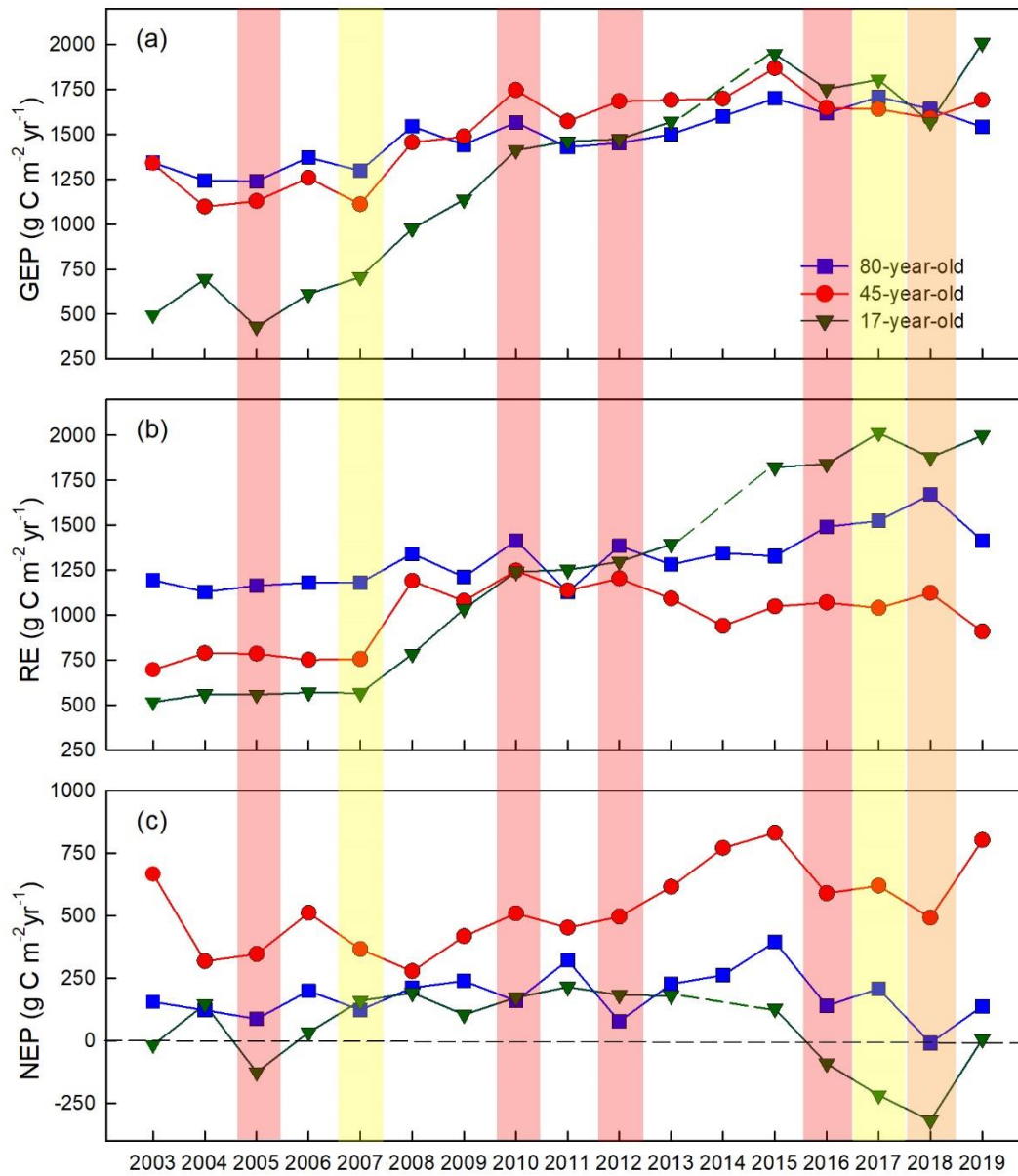


Figure. Annual total (a) gross ecosystem productivity (GEP), (b) ecosystem respiration (RE), and (c) net ecosystem productivity (NEP) in the 80-, 45-, and 17-year-old forests. Dry years are shaded as yellow (2007, 2017), hot year is shaded as orange (2018), and concurrent hot and dry years are shaded as red (2005, 2010, 2012 and 2016).

Arain M.A., Xu B., Brodeur J.J., Khomik M., Peichl M., Beamesderfer E., Restrepo-Couple N., Thorne R., 2021. Heat and drought impact on carbon exchange in an age-sequence of temperate pine forests. *Ecological Processes* (in press).

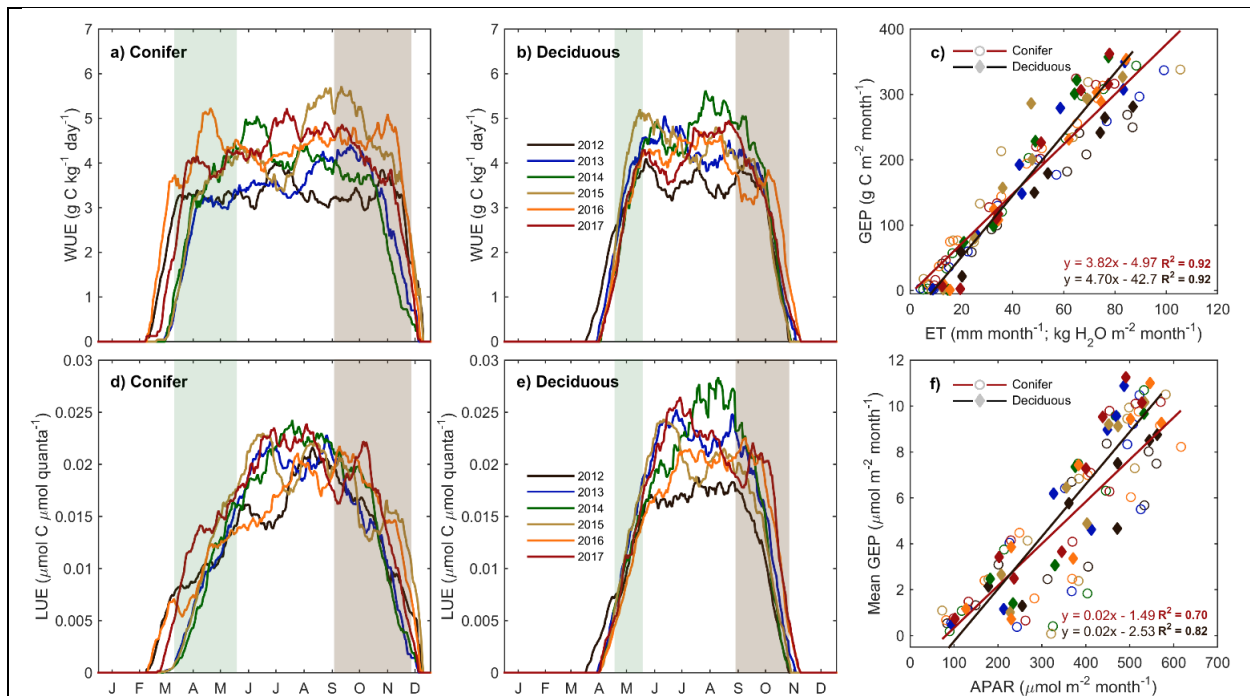


Figure. Annual smoothed (1-month moving average) time series of the (a) conifer (TP39) and (b) deciduous forest water use efficiency (WUE; GEP ET^{-1}), and (c) monthly linear relationships between GEP and ET at both sites from 2012 to 2017. Similarly, light use efficiency (LUE; GEP APAR^{-1}) calculations are shown for (d) the conifer and (e) deciduous forests, with linear relationships (f) of monthly GEP and APAR also shown. Green and brown shading corresponds to site-specific 6-year mean phenological spring and autumn periods (Table 2), respectively. Linear fit equations and R^2 values also shown (c & f).

Beamesderfer, E.R., Arain, M.A., Khomik, M., Jason J. B., Burns B.M., 2020. Response of carbon and water fluxes to meteorological and phenological variability in two eastern North American forests of similar age but contrasting species composition - a multiyear comparison. *Biogeosciences*, 17(13) 3563-3587. DOI: 10.5194/bg-17-3563-2020.