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# Assessing Forest and Wetland Ecosystem Productivity and Change Trajectories Associated with Hydrology using a Data Fusion Approach within the Oil Sands Region, Canada

Laura Chasmer (1), Richard Petrone (2), Sean Carey (3), Justin Straker (4), and Trevor Baker (4)

(1) Dept. of Geography, University of Lethbridge, Lethbridge AB T1K 3M4 Canada (laura.chasmer@uleth.ca), (2) Dept. of Geography and Environmental Management, University of Waterloo, Waterloo ON N2L 3G1 Canada (rich.petrone@uwaterloo.ca), (3) School of Geography and Earth Sciences, McMaster University, Hamilton ON L8S 4L8 (careysk@mcmaster.ca), (4) IEG Consulting, 330 Duncan Street, Duncan BC V9L 3W4 Canada (jsaker@iegconsulting.com; tbaker@iegconsulting.com)

Net ecosystem production (NEP) provides an estimate of the carbon (C) balance of an ecosystem, including all uptake through photosynthesis and storage, and loss to respiration. Monitoring of ecosystem productivity over temporal and spatial scales provides important indicators of ecosystem condition, often associated with local hydrology and biomass growth, while continuous monitoring of changing C, land use management and C-climate feedbacks is needed for greenhouse gas monitoring. Within the Oil Sands region of Western Canada, reclamation of wetland and forest environments following oil and gas extraction and disturbance (via roads, harvesting, and water withdrawal) require monitoring over broad regions and long time periods. Cumulative NEP estimated from $CO_2$ gas exchanges may be used to quantify C uptake and growth of biomass over relatively short time periods, but is limited in terms of spatial extent of measurements and scalability.

In this study, we use a nested data fusion approach to test the use of time series remote sensing datasets for estimating biomass accumulation at up to 10 sites of variable land cover types and soil hydrology compared with plot-level allometry, cumulative NEP from multiple eddy covariance systems, airborne LiDAR data and optical imagery (SPOT and Landsat TM). The results of this study illustrate differences between eddy covariance NEP and vegetation rates of growth (change in biomass) following disturbance and changes in hydrology at sites. While not directly related to NEP, trends in vegetation growth indices and land cover edge detection from SPOT (2.5 m, 5 m) and Landsat TM (30 m) optical imagery may be used to identify biomass changes related to spatially varying changes in water balance and ecosystem condition over time since disturbance. While optical methods do not represent a definitive solution for monitoring, datasets may indicate areas of greater or lesser change, and sensitivity to hydrological, geological and local climatological driving mechanisms.