Mapping Peat Groundwater Table Dynamics using Unmanned Aerial Vehicle and Photogrammetric Techniques

* Mir Mustafizur Rahman¹, Greg McDermid¹, Julie Lovitt¹, Maria Strack², Bin Xu³

1. University of Calgary, 2500 University Dr. NW, Calgary AB, T2N1N4 Canada mmraham@ucalgary.ca, mcdermid@ucalgary.ca, julie.lovitt@ucalgary.ca
2. The University of Waterloo, 200 University Ave W, Waterloo, ON N2L 3G1 mstrack@uwaterloo.ca
3. NAIT Boreal Research Institute, 1R2, 8102 99 Ave, Peace River, AB T8S BINX@nait.ca

* Corresponding Author

ABSTRACT

Peatlands cover more than 30% of Alberta’s boreal zone, store a large amount of soil carbon and exchange greenhouse gases (GHG) with the atmosphere. Groundwater Table is one of the key driver of the peatland ecosystem as it controls the emission of GHG. Therefore, to estimate GHG emissions at the local and regional level across different types of peatlands, it is necessary to accurately map the depth to groundwater table without the need to install numerous groundwater monitoring wells. Considering this scenario, the objective of this research is to develop an operational method to map groundwater table in a disturbed bog using UAV data and photogrammetric techniques. Our study area is located north of Peace River, AB within the Shell-Carmon Creek Lease. We propose a new method to map groundwater table by identifying stable open water in peatland and then by creating an interpolated surface of these open water level which is obtained from UAV based 3D point cloud. Our method offers direct estimation of depth to groundwater table in contrast to the existing traditional models that describe a passive relation between the biophysical variables (moisture content, composition and distribution of vegetation, etc.) and the groundwater table depth. Our preliminary results suggest that our technique is able to successfully map depth to groundwater table at a ~ 1 km*1 km classical bog site that is disturbed by oil-sand exploration activity. However, as our method uses locations of open water to map groundwater table, inadequacy of open water in areas ends up with underestimation of the depth to groundwater table. The proposed method offers a great potential of deriving depth to groundwater table in disturbed and undisturbed peatlands and low lying areas, and thereby aid in estimating the GHG emission from them. Once successfully verified over diverse peatland types (bog, fen, swamp), our research will provide a pragmatic solution to reliably mapping depth to groundwater table using advance remote sensing and photogrammetric techniques, which has numerous applications across disciplines.