Using Multi-Temporal Remote Sensing to Improve Provincial Harvest Monitoring

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ABSTRACT

The Forest Analysis and Inventory Branch (FAIB) of British Columbia's Ministry of Forests is responsible for the inventory and continuous monitoring for growth and disturbance of nearly 60 million ha of forested land. The standard forest inventory program - vegetation resources inventory (VRI) predominately uses aerial photography and ground sampling to estimate forest cover attributes such as height, species composition, diameter at breast height (dbh), volume, and trees per ha. Since the VRI is used to inform annual allowable cut determinations made by the province's Chief Forester, it is necessary to project annual forest growth and make annual updates to the VRI to account for stand replacing disturbances (i.e. harvest and wildfire). When it comes to harvest monitoring, the province relies heavily on licensee reporting of harvest activities. However, these data can be temporally imprecise, with reported disturbance start and end dates not always representative of when harvest activities took place. Additionally, the submission and integration of the information into the provincial database can be delayed by up to 18 months due to the large of volume of data and submission deadlines.

Traditionally, FAIB has relied on two-date change detection during the summer season to identify harvested areas throughout the province. However, this approach can be data intensive and provides an incomplete picture of harvest activity because individual scenes are used, with any missed harvest captured in the following year. Annual time-series methods that leverage cloud-based data and algorithms such Landtrendr (Kennedy et al., 2010) have shown considerable improvement, capturing more harvest area than two-date change detection. However, similarly to the two-date change detection, harvest activity that occurred in the late fall/winter months is assigned to the subsequent year (i.e. harvest that occurred in November 2021 will be assigned a harvest year of 2022). Though this is acceptable for updating the VRI, as we are more interested in harvest extent than exact timing, recently it has become apparent that timely and accurate disturbance dates are necessary for supporting forest management decision making. As a result, we investigated a number of sub-annual, time-series change detection methods including Continuous Change Detection and Classification (CCDC), Breaks for Additive Season and Trend (BFAST), and simple tracking of spectral indices within individual forested areas of interest (Verbesselt et al., 2010; Zhu & Woodcock, 2014). Using, CCDC and provincial permit data we have successfully produced quarterly harvest maps, allowing us to improve our understanding of harvest timing throughout the province.

This work serves as an update on the harvest monitoring activities of the Forest Analysis and Inventory Branch of British Columbia's Ministry of Forests. With the wider availability of cloud-based data and tools such as Google Earth Engine, introduction of new platforms (e.g. Landsat-9), combined with increased need for sub-annual monitoring, substantial gains have been made in the uptake of satellite multispectral imagery and time-series algorithms for forest inventory. However, harvest tracking in near real-time remains a priority for the organization, and we will discuss opportunities and potential challenges for this work.

***Keywords*—** forest inventory, British Columbia, multispectral, time-series, disturbance, change detection

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