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| **Forest stand segmentation using Landsat and ALS-derived forest attributes** |
| **Introduction/Aim:**  Forest inventories are essential to support forest management and are typically developed using manual stand delineation from aerial imagery. Once stands are delineated, attributes are then estimated via visual interpretation and other established practices, including the use of field plots are used to calibrate and adjust the attributes. Both stand delineation and attribution processes associated with photointerpretation can be costly, time consuming, and subjective.  **Methods:**  We developed an open-source segmentation algorithm designed to automatically delineate forest stands from Landsat spectral reflectance data and a suite of Airborne Laser Scanning (ALS)-derived forest attributes, including height and height variation, gross stem volume, age, and species. To demonstrate the approach, we applied it over five focus sites totalling 45 Mha, representing the diversity of forest landscapes across Canada. In Phase 1, small groups of pixels from the Landsat imagery are grouped based on spectral similarity; in Phase 2, these pixel groups are further merged into forest segments based on the ALS-derived forest attributes. We used two spatial assessment metrics, area-weighted variance (wVar) and Moran’s I (MI), to characterize within-segment variance and between-segment spatial autocorrelation. Agreement between the Phase 2 segments and reference Provincial polygon inventories was assessed using the Adjusted Rand Index (ARI).  **Results:**  Our results showed that height variation minimized wVar in western Canada, while gross stem volume minimized wVar in boreal forests, indicating that stands are generally more homogeneous with respect to these attributes in these regions. Height variation consistently showed the lowest MI across Canada, resulting in stands that are heterogeneous from their neighboring stands. Segments combined using species information produced simpler boundary linework, as reflected in the high ARI value and more closely resembled the reference Provincial polygon inventories.  **Conclusion:**  Forests are constantly changing due to successional and growth processes as well as human and natural disturbances; as such, accurate and up-to-date forest inventories are needed to reflect the present status of forest resources. Our segmentation algorithm uses openly available Landsat imagery, open data products, and ALS-derived forest structure attributes to automatically and consistently delineate stands of different forest types across large forested regions, reducing human intervention and the limitations associated with photointerpretation techniques. |