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| **Remote sensing-based aboveground biomass yield curves for dominant boreal tree species** |
| **Introduction/Aim:** Forest aboveground biomass (AGB) is a crucial parameter for carbon storage, forest function, and habitat assessment. Accurate knowledge of current AGB and its dynamics is essential for sustainable forest management and carbon monitoring. Common methods for estimating AGB, such as permanent sample plots, yield curves, or simulations, often lack spatial and forest structural representation. To address these limitations, we present an integrated model-driven, data-informed approach for developing AGB yield curves exclusively from remote sensing data.**Methods:** Our approach leverages Landsat time series data of annual AGB values, tree species composition, and age. We applied this methodology to a 76.5 million-hectare study area in Alberta, Canada, encompassing diverse forest conditions, species, and ages, partitioned into 34 150×150-km analysis tiles to account for local variation. The 37-year AGB time series (1984–2021) were filtered to create a representative and noise-reduced sample set for developing remote sensing-derived AGB yield curves. Using a nonlinear mixed-effects modeling framework, we generated 127 models for eight tree species across the study area. The development process included filtering steps to address uncertainties in pixel-level AGB estimates and to ensure the use of best-available data.**Results:** Developed yield curves offered insights into AGB dynamics across different forest types and conditions. The performance of the models was evaluated using three independent datasets: permanent sample plots, existing yield curves, and an established growth and yield simulator. Model assessment showed the influence of geographic position and tree species representation in the reference data. In general, the models tended to underestimate AGB and AGB increment, with relative RMSE ranging between 22.66% and 70.30% for permanent sample plots. Despite these challenges, the large number of available time series of AGB allowed for the development of models for less abundant species that are often grouped into broader species groups when traditional methods are used.**Conclusion:** Our findings confirm the feasibility of developing AGB yield curves exclusively from remotely sensed data, covering a wide range of species and stand structural conditions representing a large spatial extent. The methodology developed provides insights into the use of Landsat time-series data for yield curve development, emphasizing the importance of modeling, data filtering, and recognition of the challenges of model assessment. The results serve as a foundation for future research and the practical application of remotely sensed data in various aspects of sustainable forest management, carbon monitoring, and growth and yield modeling. Additionally, these models have the potential to create large-area maps of historical forest growth and to map projected future biomass values. |