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| **Individual tree biomass estimation of durable eucalyptus using UAV LiDAR** |
| **Introduction/Aim:**  Fast-growing and naturally durable eucalyptus species, including *Eucalyptus globoidea* (*E. globoidea*) and *Eucalyptus bosistoana* (*E. bosistoana*), growing in the Marlborough region of New Zealand, have the potential to enhance sustainability and reduce greenhouse gas emissions in the region’s wine industry. There is a need for accurate estimation of total biomass production and total carbon sequestration. However, the extent of carbon sequestration by these eucalyptus species remains unexplored. This study aimed to efficiently and accurately estimate individual tree dimensions (diameter at breast height (DBH)) and above-ground biomass (AGB) for *E. globoidea* and *E. bosistoana* using light detection and ranging (LiDAR) data acquired by an unpiloted aerial vehicle (UAV) and destructive sampled ground truth data.  **Methods:**  LiDAR data were captured with a Zenmuse L1 LiDAR sensor mounted on a DJI Matrice 300 RTK drone over nine sites, followed by destructive sampling to quantify individual tree biomass. In total, 96 individual tree LiDAR metrics were extracted and were used as explanatory variables for training and predicting DBH and AGB models. Three machine learning (ML) models, including Partial Least Squares Regression (PLSR), Random Forest (RF), and Extreme Gradient Boosting (XGBoost), were trained using a grid-search strategy and repeated cross-validation. Model performance was evaluated using root mean square error (RMSE) and R², while SHapley Additive exPlanations (SHAP) analysis was employed to explain model predictions and evaluate input variables.  **Results:**  Preliminary results showed that among the ML models, XGBoost and PLSR demonstrated superior performance, with the former yielding the highest R² value of 0.861 and the lowest RMSE of 53.897 for AGB, and the latter achieving the highest R² value of 0.840 and the lowest RMSE of 3.657 for DBH. SHAP analysis highlighted that height and voxel metrics are the most important factors influencing AGB and DBH prediction.  **Conclusion:**  These findings prove that using UAV LiDAR could estimate carbon sequestration of eucalyptus plantations efficiently and accurately, and can support sustainable practices in the Marlborough region's wine industry. |

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