Potential Assessment of LBI for forest carbon sink measurement

Liming Du[1,2], Yong Pang[1,2,*]

1. Institute of Forest Resource Information Techniques, Chinese Academy of Forestry, Beijing 100091, China;
2. Key Laboratory of Forestry Remote Sensing and Information System, National Forestry and Grassland Administration, Beijing 100091, China;

Corresponding author: Pang Yong Email: pangy@ifrit.ac.cn

Quantitative assessment of forest carbon sequestration capacity is of great significance for maintaining sustainable forest development, improving resource utilization efficiency, and mitigating environmental degradation. This research takes Pu'er City, Yunnan Province as the research area to explore the potential of using LiDAR biomass index (LBI) for precise carbon sequestration measurement of Simao pine species. Firstly, airborne laser scanning (ALS) data of the research area in 2018 and 2023 were obtained, and accurate matching of multiple data periods was achieved. Secondly, based on the 2018 ALS data, we selected the measured individual trees of different diameter classes to calibrate the individual tree level biomass model based on the LBI. Thirdly, the individual tree segmentation of ALS data in 2018 and 2023 were completed using the same segmentation algorithm, respectively. The AGB_LBI model was applied to the segmented laser point cloud data of the two periods to realize biomass estimation. To verify the accuracy of the model, we obtained a certain amount of individual trees with precise positions and forest sample plots from the flight area of the two periods airborne LiDAR. The reference biomass was calculated using the existing allometric equation, and then used to evaluate the applicability accuracy of the 2018 biomass estimation model for the sample plots obtained in 2018 and 2023, respectively. The results indicate that high-precision AGB_LBI model (R^2=0.83, RMSE=15.68 kg) was constructed using 57 individual trees, and high accuracy was obtained when using the model to calculate the biomass of the same year's sample plots (R^2=0.78, RMSE=26.49 t/ha). Meanwhile, when using this model to calculate the biomass of the sample plots obtained in 2023, R^2 of 0.72 and RMSE of 33.11 t/ha were obtained. Therefore, LBI has great potential for measuring carbon sinks in forest stands or even on a larger scale.

LBI 用于森林碳汇测量的潜力评估

杜黎明[1,2]，庞勇[1,2]

1. 中国林业科学研究院资源信息研究所，北京 100091，中国；
2. 国家林业和草原局林业遥感与信息系统重点实验室，北京 100091，中国；

定量评估森林固碳能力对维持森林的可持续发展，提高资源利用效率，减缓环境退化具有重要意义。本文以云南省普洱市为研究区，探索激光雷达生物量指数用于思茅松树种碳汇精确计量的潜力。首先，分别获取了研究区 2018 年和 2023 年的机载激光雷达数据，并实现多期数据的精确匹配。然后，以 2018 年的激光雷达数据为基础，选取不同径级的实测样本单木，用于校准基于激光雷达生物量指数的单木尺度生物量估测模型。第三，利用相同的分割算法分别实现 2018 年和 2023 年 ALS 数据的单木分割，并将生物量估测模型分别用于分割后两期的激光点云数据实现生物量估测。为了验证估测的精度，本研究从两期机载激光雷达的飞行区域分别获取一定数量的具有精确位置的单木数据和森林样地数据。根据现有的异速生长方程计算参考生物量，然后评估 2018 年的生物量估测模型分别对 2018 和 2023 年获取的样地的适用性精度。结果表明，应用 57 株单木即可构建高精度的 AGB_LBI 模型（R^2=0.83, RMSE=15.68 kg）；将该模型用于同年样地尺度的生物量计算，获取了较高的精度（R^2=0.78, RMSE=26.49 t/ha）;将该模型用于 2023 年样地尺度的生物量计算，R^2 为 0.72, RMSE 为 33.11 t/ha。因此，LBI 对于林分甚至更大尺度的碳汇计量具有较大的潜力。