Estimation of forest carbon storage in Chinese fir plantation by UAV-Lidar

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Abstract:【Objective】Forest carbon storage is an important index to measure the basic characteristics of forest ecosystem. Traditional carbon storage estimation method requires a lot of time, manpower and material resources. In this study, unmanned aerial vehicle equipped with Lidar was used to acquire airborne laser data and establish a forest carbon storage estimation model to provide reference for obtaining forest carbon storage within the region, so as to better monitor forest resources.【Method】In this study, we took Chinese fir plantation as the research object, and used the airborne lidar point cloud data to obtain the point cloud characteristic variables, which were used as modeling variables for model establishment. The modeling variables were selected through different screening variables, and the nonlinear regression model, linear regression model and random forest model were established and evaluated respectively. The optimal model was selected by comparingR2, RMSE and MAE of the models for subsequent research.【Results】(1) The best fitting effect of the three models was random forest, whose R2, RMSE and MAE were 0.95, 0.53 t/hm2 and 0.44 t/hm2. In the non-linear regression model, R2 was 0.71, RMSE was 0.66t/hm2 and MAE was 0.56 t/hm2. In the linear regression model, R2 was 0.67, RMSE was 0.88t/hm2 and MAE was 0.80t/hm2. (2) In this study, a total of 101 point cloud characteristic variables were extracted. Through variable screening, it was found that height variables and density variables were greater than intensity variables in both correlation and importance.(3) The effect of adding preferred variables on the accuracy of random forest was compared. After adding preferred variables, model R2 did not change, but RMSE and MAE were smaller than those without adding preferred variables.【Conclusion】The point cloud characteristic variables obtained by airborne LiDAR point cloud data were used to establish a model. Compared with nonlinear regression and linear regression models, the random forest model had the highest accuracy, and the carbon storage in the study area was estimated to be 480.65t by using it, which was the closest to the measured value. Therefore, the stochastic forest model is more suitable for estimating regional forest carbon storage.

基于无人机激光雷达数据的杉木人工林碳储量估测方法研究

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摘要：【目的】森林碳储量是衡量森林生态系统基本特征的重要指标，传统碳储量估测方式需要耗费大量的时间、人力、物力等，本研究利用无人机搭载激光雷达获取机载激光数据并建立森林碳储量估测模型，为获取区域内森林碳储量提供参考，从而更好地对森林资源进行监测。【方法】本研究以杉木人工林为研究对象，利用机载激光雷达点云数据获取点云特征变量，以此作为建模变量进行模型研建。通过不同筛选变量方式选择建模变量，分别建立非线性回归模型、线性回归模型和随机森林模型并进行模型评价，通过对比模型的 R^2、RMSE 和 MAE 选出最优模型，用于后续研究。【结果】（1）三种模型拟合效果最佳的为随机森林模型，其 R^2 为 0.94，RMSE 为 0.53 t/hm^2，MAE 为 0.44 t/hm^2。非线性回归模型 R^2 为 0.71，RMSE 为 0.66 t/hm^2，MAE 为 0.56 t/hm^2；线性回归模型 R^2 为 0.67，RMSE 为 0.88 t/hm^2，MAE 为 0.80 t/hm^2。（2）本研究共计提取 101 个点云特征变量，通过变量筛选发现高度变量、密度变量无论是相关性还是重要性，均大于强度变量。（3）对比是否加入优选变量对随机森林模型预测精度的影响，加入优选变量后模型 R^2 没有变化，但 RMSE 与 MAE 小于未加入优选变量，精度有所提高。【结论】利用机载激光雷达点云数据获取的点云特征变量建立模型，对比非线性回归和线性回归模型，随机森林模型精度最高，用其估算得到研究区内碳储量为 480.65t，与实测值最相近。因此随机森林模型更适合于区域森林碳储量的估测。