**Stand density mapping by integrating Airborne Laser Scanning data, Sentinel-1, Sentinel-2 and topographic information in Daxinganling forests**

Jinchen W. 1, Xuan M. 2 and Dan Z. 3\*

1 Graduate Student, Aerospace Information Research Institute, Chinese Academy of Sciences, China

2 Graduate Student, Aerospace Information Research Institute, Chinese Academy of Sciences, China

3 Associate Professor, Aerospace Information Research Institute, Chinese Academy of Sciences, China

\*zhaodan@aircas.ac.cn

***ABSTRACT***

Stand density, pivotal in forest structure, profoundly influences growth by altering tree growing space and resource availability, shaping ecological factors and impacting species diversity and structure, thus facilitating accurate estimation crucial for scientific forest management and planning. In this study, we combine airborne laser scanning (ALS) with field-based estimates using an algorithm that incorporates stepwise multiple linear regression with new integration parameters for inferring stand density estimates and stand density mapping (R2=0.750, %RMSE =23.596). And then based on that result mapping stand density by integrating Sentinel-1, Sentinel-2 and topographic information on the prediction of spatial distribution of stand density. Random forest (RF) algorithm was used to develop models. It was observed that R2 = 0.527 and %RMSE = 29.266%. The final RF model was applied across the Daxinganling forest region, revealing the influence of elevation gradient, hydrothermal conditions, and human activities on stand density through spatial distribution mapping. Meanwhile the spatial distribution results were also utilized to provide practical recommendations for forest management across the entire Daxinganling forest region, including suggestions for Selective harvesting and thinning as well as other management strategies. Our findings affirm the viability of estimating absolute stand density at a 30m resolution using a combined approach of multi-source remote sensing data. This is crucial for forest management planning in forest stands.

**Keywords:** stand density, Daxinganling forest region, forest monitoring, Multi-source remote sensing data, Airborne laser scanning