Detecting Invasive Shrub Species by Utilizing High-Density Airborne LiDAR Data and Spectral Image

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Abstract

In the Chicago region, common buckthorn and bush honeysuckle stand out as dominant invasive species, accounting for over 40% of the regional forest coverage. Their proliferation leads to the formation of dense thickets that hinder sunlight penetration, resulting in diminished native plant diversity in the understory. Accurate detection of these species across this region is essential for the effective management of these invasives. Airborne LiDAR datasets show strong potential in detecting the distinctive structural patterns created by these thickets. Previous studies have utilized multi-temporal spectral imagery to track the phenological shifts of invasive species. However, in the Chicago region, it is difficult to employ multi-temporal spectral imagery due to substantial cloud cover during early spring and late autumn. Consequently, our research adopted the use of dense airborne LiDAR datasets specific to the Chicago area. Preliminary results indicate that invaded plots manifest less complex vertical structure, higher vegetation area index in the subcanopy, and lower NDVI values compared to their non-invaded plots. Notably, LiDAR-derived metrics surpass NDVI-based ones in estimation. Using binomial logistic regression (with an AUC of 0.97), we assessed the presence and absence of these invasive species across Chicago's forests, achieving an accuracy rate of 0.92. Alarmingly, our findings suggest that these invasive species have affected over 75% of the forest patches in Chicago. In summary, our research highlights the important role of LiDAR datasets in regional-scale invasive species detection.