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| **Simplified Tree Competition Analysis: Introducing *TreeCompR* for Inventory Data and 3D Point Clouds** |
| **Introduction/Aim:** The 2018/19 drought in Central Europe has highlighted the importance of identifying and understanding factors that influence tree vitality, especially in the face of future climate uncertainties. The creation of variability within tree neighbourhoods or the release of competition are discussed as factors influencing the resilience of forest stands. Therefore, we need to assess the competitive situation of trees. However, collecting ground-based inventory data is time-consuming and often difficult in dense forests. Furthermore, there is no single universally applicable index for quantifying competition, which complicates the decision-making process. To guide users through the different options of competition indices (CIs), we here present the open-source R package *TreeCompR*, which can process 3D point clouds in different formats as well as in situ inventory data. This open-source tool is designed to assist users in selecting appropriate competition indices (CIs) and data options for assessing tree competition and structural variability in forest stands.**Methods:** With *TreeCompR*, users can choose between point cloud-based and conventional distance-dependent CIs. The package provides fast output of different CIs for all trees within a plot or specified target trees. We demonstrate the functionality of the package through application examples and a comparison of point cloud-based (e.g. search cone method) and distance-dependent indices (e.g. Hegyi index). We also advise on how the data should be pre-processed, assess potential uncertainties associated with these methods and suggest strategies to mitigate them.**Results:** We used the tools of *TreeCompR* to analyse data from mobile and airborne laser scans and to assess the competitive status and neighbourhood structure of 308 European beech trees. The trees are distributed across 13 forest sites in northern Bavaria, Germany, along an environmental gradient. All sites were affected by the 2018/19 Central European drought and differ in crown damage and vitality status. The CIs were all found to correlate with structural parameters such as crown projection area (CPA) or box dimension (Db) of the target trees, while the traditional distance-based approach appears to be more effective in predicting structural parameters than the point cloud-based CIs. We found a high sensitivity of CI values to the chosen search radius or the number of neighbouring trees, which can be highly dependent on the data source and pre-processing.**Conclusion:** *TreeCompR* serves as a valuable tool for ecologists and foresters, facilitating efficient and accurate assessment of tree competition and structural variability within forest stands. Users are free to choose whether to use original 3D point clouds or inventory data (ground-based or derived from point clouds), depending on their research questions and data availability. We recommend that certain types of data (e.g. from airborne laser scans) should be supplemented by ground observations and that the search radius should be adjusted according to the average crown diameter of target trees. |