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| **On the Value of Aerial and Terrestrial 3D Point Cloud Fusion** |
| **Introduction/Aim:**  Over the past decade light detection and ranging (LiDAR) technology has become a dominant remote sensing tool for modelling and monitoring forest attributes. It is used by both forest managers and researchers and may be deployed aerially (on manned or unmanned platforms) and terrestrially. The 3D point clouds obtained from these instantiations may then be used to model and monitor a range of forest and individual tree properties. Each deployment option enjoys, and suffers from, its own advantages and disadvantages.  In this paper we discuss the value proposition of stand-alone point clouds obtained from modestly priced terrestrial and aerial LiDAR sensors, and the forest attributes derived from them. We also fuse the data from each single source to provide a more complete point cloud and examine the pros and cons of this additional step by measuring the accuracy and efficacy of a range of attributes obtained using standard techniques.  **Methods:**  Numerous studies have shown that LiDAR-based remote sensing techniques and tools can successfully and cost-effectively model and quantify forest structure at the plot and individual tree levels. For each point cloud (individual and fused), we compare the accuracy and coverage of key attributes like tree height, diameter at breast height, and tree crown metrics (e.g., projection area, width, and volume), which correlate highly to biomass production and carbon sequestration. These are compared to the benchmarked attributes that are measured by hand.  **Results:**  The density of the aerial point clouds offer advantage above 12 – 15m and in terms of coverage, and most noticeably in terms of canopy modelling and measurement. On the other hand, the terrestrial point clouds offer significantly higher point densities below this height but suffer from coverage deficiencies; and the fused data set is, of course, constrained by the terrestrial coverage. The individual tree attributes obtained using each method, however, offer the opportunity to impute attributes from within the merged sector of the cloud to the aerially observed data set.  **Conclusion:**  The value of stand-alone aerial and terrestrial LiDAR remote sensing observations are evaluated using several tree metrics for radiata pine. The results indicate fusion from high-performance equipment can improve the 3D mapping of forest structure and thus the modelling and observation of individual tree attributes. Whilst there are research benefits of fusing the point clouds (e.g., in imputation modelling and propagation studies), it is found that this additional step is unlikely to find operational utility for forest managers at present. |