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A tool for better forest management: LiDAR data improves accuracy of land-cover maps, Spain

A study of two forest ecosystems in Spain has found that land-cover maps of watersheds, ecosystems hosting key interactions between vegetation, wildlife, and water, are made more accurate by the inclusion of LiDAR data — a type of remote sensing that pulses laser light at a target to measure vertical distances for use in 3D-mapping an environment. This has important implications for ecosystem monitoring, flood mitigation, and forest management, fields in which accurately characterising an environment is key.

Watersheds are ecosystems with important hydrological, ecological, and environmental functions. They provide habitat for vegetation and wildlife that interact with the physical or biological characteristics of the water, and facilitate the flow of water throughout a natural environment. Forest ecosystems are important watersheds; tree canopies can decrease the quantity of rainfall falling upon the soil surface, and intercept and reduce run-off. These interactions depend heavily on the intensity and amount of rainfall, tree density and type, and the vertical structure of the forest.

Characterising and managing such watersheds is important in fields such as flood management and ecosystem monitoring; this is increasingly done by creating high-accuracy land-cover maps of forest watersheds, using remote sensing techniques, but it can be difficult to distinguish between different kinds of forest vegetation — namely 'overstory' (larger-scale trees and canopy cover) and 'understory' (plant life located beneath the canopy) — using this method.

This study explored two neighbouring Mediterranean forest watersheds in the Badajoz province of Spain: San Juan and Palomillas. The two watersheds span 146 and 194 square kilometres respectively, and mainly comprise a mix of perennial forest with residual conifers (at the overstory), and shrubs and herbaceous plants (at the understory). The researchers aimed to analyse how the accuracy of watershed-scale mapping of understory and overstory vegetation improved when using different combinations of seasonal and annual images from the Sentinel-2 satellites, soil and vegetation indices, and LiDAR (Light Detection and Ranging) data.

Using several soil-vegetation variations, the researchers first explored the accuracy of their mapping for each season, and then annually, before including LiDAR data in each scenario.

The results showed that, overall, annual mapping based on imagery was more accurate than seasonal mapping (with overall accuracies of 73% and 71%, respectively), and that the accuracy of both was highly improved by including LiDAR data, which allowed models to better discriminate between under- and overstory strata. The best results were obtained for summer and autumn, which hit accuracies of 83% when including LiDAR data. Autumn mapping was the most accurate overall; the researchers suggest that this may be due to the seasonal variability of the vegetation within the watershed at that time of year, which is more easily distinguishable spectrally.

These results suggest that data analysis and mapping for watersheds could benefit from the large-scale inclusion of LiDAR data. Improving the accuracy of forest ecosystem maps is crucial in understanding the structure and spatial distribution of vegetation, say the researchers, and is thus a central factor in successful and optimal ecosystem management.

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