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| **Canopy laser scanning to study the complex architecture of large old trees** |
| Large trees are keystone structures providing multiple ecosystem functions in forests all around the world: they disproportionately contribute to forest biomass and biodiversity. Large trees can have an extremely complex structure, housing many epiphytes on their stem and branches. High point-density 3D point clouds, in which leaves and epiphytes in the tree can be distinguished, are useful to make the link between the distribution of organisms on the tree, the tree architecture and its microclimate. In addition, a comprehensive branching model can improve above ground biomass (AGB) estimates. Highly detailed, complete point clouds of large trees are, however, exceptionally difficult to derive. With terrestrial laser scanning, the state-of-the-art method to capture 3D tree structure, the plant material blocks the view of (or, occludes) the top part of the dense crown. Drone or airborne laser scanning data on the other hand, lacks detail in the subcanopy. Combining these two methods minimises occlusion; however, increased distance from the tree to the scanner still leads to a relatively low resolution of the canopy point clouds. To improve the level of precision of the tree point clouds, we introduce a new concept, called canopy laser scanning (CLS). With CLS, a laser scanner is operated statically inside the tree canopy, reducing the distance between the area of interest and the instrument. We lifted a high-end laser scanner (RIEGL vz-400(i)) inside the canopy of six large emergent trees. Four of these trees are located in different types of tropical rainforests in Colombia, Brazil and Peru. They are part of biodiversity programs in which organisms and their spatial distributions are studied (Life On Trees, Araçá). The two other trees are famous giants located in the wet temperate eucalypt forests of southern Tasmania. We will present the practical aspects of CLS, evaluate the extra value of using canopy scans, looking at occlusion and point cloud precision, estimate epiphyte cover and AGB. We demonstrate that canopy laser scanning opens up new opportunities in sciences in which multi-disciplinary teams perform in depth research on large individual trees. |

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