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Forest structure analysis combining laser scanning with digital airborne photogrammetry

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The interest of Light Detection and Ranging (LiDAR) for vegetation structure analysis has been demonstrated in several research context. Indeed, airborne or ground Lidar surveys can provide detailed three-dimensional data of the forest structure from understorey forest to the canopy. To characterize at different timescale the vegetation components in dense cedar forests we can combine several sources point clouds from Lidar survey and photogrammetry data. For our study, Terrestrial Laser Scanning (TLS-Leica ScanStation C10 processed with Cyclone software) have been lead in three forest areas ($\approx$ 200m^2 each zone) mainly composed of japanese cedar (Japonica cryptomeria), in the region of Fukushima (Japan). The study areas are characterized by various vegetation densities. For the 3 areas, Terrestrial laser scanning has been performed from several location points and several heights. Various floors shootings (ground, 4m, 6m and 18m high) were able with the use of a several meters high tower implanted to study the canopy evolution following the Fukushima Daiishi nuclear power plant accident. The combination of all scanners provides a very dense 3D point cloud of ground and canopy structure (average 300 000 000 points).
For the Tochigi forest area, a first test of a low-cost Unmanned Aerial Vehicle (UAV) photogrammetry has been lead and calibrated by ground GPS measurements to determine the coordinates of points. TLS combined to UAV photogrammetry make it possible to obtain information on vertical and horizontal structure of the Tochigi forest. This combination of technologies will allow the forest structure mapping, morphometry analysis and the assessment of biomass volume evolution from multi-temporal point clouds. In our research, we used a low-cost UAV 3 Advanced (200 m^2 cover, 1300 pictures...). Data processing were performed using PotoScan Pro software to obtain a very dense point clouds to combine to TLS data set. This low-cost UAV photogrammetry data has been successfully used to derive information on the canopy cover. The purpose of this poster is to present the usability of combined remote sensing methods for forest structure analysis and 3D model reconstitution for a trend analysis of the forest changes.