Using LiDAR and WorldView-3 imagery to map individual tree species

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ABSTRACT

Forest area mapping is traditionally obtained from the interpretation of aerial photographs. Although this approach has yielded interesting results since the introduction of new photo-interpretation procedures, it remains tedious, time-consuming, costly and has some limitations to characterize stands. Indeed, the photo-interpreter must manually delineate contours according to the characteristics observed, identified and interpreted. The list of these characteristics proves to be long for the classification of forest stands, especially for the interpretation of forest species.

The objective of the project was to explore these two issues: 1) the delineation of stands and 2) the mapping of forest tree species. As the goal was to get this information for a large territory, an effort has been made on the automation of these processes. First, a field campaign was carried out from which we created a library of spectral signatures for tree species in the private territory of Kenauk, in the Province of Quebec, Canada. Next, images of the WordView-3 satellite were acquired in the summer of 2016 and airborne lidar data in the summer of 2015. Once these data were pre-processed and combined, segmentation was carried out by an object-based approach to generate an individual tree crowns. A validation depicted that each of these objects corresponded to a single tree species for 87%. From this segmentation, it was possible to attribute one of tree species classes to the whole image. A hierarchical approach was chosen and led to a first classification of conifers and hardwoods, estimated at 96% accuracy. Subsequently, the most discriminatory species were classified in order of priority. Species with a better score for the conifers were red pine and hemlock. The overall score was lower for hardwoods then conifers, but some species had good scores such as sugar maple and beech. These results confirm that the object-based approach is effective but has its limitations in the deciduous forest.