Analysing the Regional Distribution of a Key Canopy Palm Species Using a Convolutional Network in an Amazon Forest

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Mapping plant species at landscape scale to provide information for ecologists and forest managers is a new challenge for the remote sensing community. Here, we use a deep learning algorithm associated with very high-resolution multispectral images (0.5 m) from GeoEye satellite to identify and segment a palm tree species, Attalea speciosa, in the canopy of an Amazon forest.

This study was conducted in a region of the critically endangered Brazilian Amazon Rainforest, between two deforestation fronts, which is a global conservation priority due to its abundance of species of flora and fauna and its carbon stock.

The convolutional network generated in this study for identifying palm trees was trained with about 1024 high-resolution true colour optical images and their labelled masks. Additionally, we analysed the spatial distribution of the palm trees at the regional scale based on patches locations and edaphic conditions.

Our deep learning network segmented palm trees patches with overall accuracies of 95.5 % and Dice coefficients of 0.67. Then, the segmentation of tree species was produced over a region >2500 km² using GeoEye Red, Green and Blue bands pan-sharpened at 0.5 m.

We found that the palm trees covered 5 % of the natural forest canopies and were distributed in more than one million patches. Our results based on the palm trees distribution shown that their abundance tends to vary primarily with local soil water content over the landscape. Overall, their distribution over the region seems to indicate a relatively pristine landscape. However, we observed that they are sparsely distributed in secondary forests and could likely be used as an indicator of large past perturbation.

Our work shows how deep learning algorithm can support applications such as mapping plant species to understand plant distributions and landscape features.

Publication:
American Geophysical Union, Fall Meeting 2019, abstract #B23E-04

Pub Date:
December 2019

Bibcode:
2019AGUFM.B23E..04W

Keywords:
0410 Biodiversity; BIOGEOSCIENCES; 0476 Plant ecology; BIOGEOSCIENCES; 1615 Biogeochemical cycles; processes; and modeling; GLOBAL CHANGE; 1616 Climate variability; GLOBAL CHANGE