Using ALS and MODIS data to evaluate degradation in different forests types over the Xingu basin - Brazilian Amazon

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Degradation of Amazon rainforests represents a vital threat to carbon storage, climate regulation and biodiversity; however its effect on tropical ecosystems is largely unknown. In this study we evaluate the effects of forest degradation on forest structure and functioning over the Xingu Basin in the Brazilian Amazon. The vegetation types in the area is dominated by Open Ombrophilous Forest (Asc), Semi-decidiuous Forest (Fse) and Dense Ombrophilous Forest (Dse). We used Airborne Laser Scanning (ALS) data together with time series of optical remote sensing images from the Moderate Resolution Imaging Spectroradiometer (MODIS) bi-directional corrected using the Multi-Angle Implementation for Atmospheric Correction (MAIAC). We derive time-series (2008 to 2016) of the Enhanced Vegetation Index (EVI) and Green-Red Normalized Difference (GRND) to analyze the dynamics of degraded areas with related changes in canopy structure and greenness values, respectively. Airborne ALS measurements showed the largest tree heights in the Dse class with values up to 40m tall. Asc and Fse vegetation types reached up to 30m and 25m in height, respectively. Differences in canopy structure were also evident from the analysis of canopy volume models (CVMs). Asc showed higher proportion of sunlit, as expected for open forest types. Fse showed gaps predominantly in lower height levels, and a higher overall proportion of shaded crown. Full canopy closure was reached at about15 m height for both Asc and Dse, and at about 20 m height for Fse. We also used a base map of degraded areas (available from Imazon - Instituto do Homen e Meio Ambiente da Amazônia) to follow these regions throughout time using EVI and GRND from MODIS. All three forest types displayed seasonal cycles. Notable differences in amplitude were detected during the periods when degradation occurred and both indexes showed a decrease in their response. However, there were marked differences in timing and amplitude depending on forest type. These responses were influenced by the spatial resolution of 1km of the MODIS images, limited the ability to observe small degraded regions. In conclusion, ASL

together with optical remote sensing used in a straight multi-scale approach may contribute to understand the impacts of degradation in the structure and functioning of tropical forest.

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