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The long-term floodplain forest modifications of a regulated tropical river

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The regular flood pulse of large tropical rivers is the main driver of ecological and biogeochemical process in large Amazonian floodplains. Endemic vegetation species developed adaptation to survive in seasonal flood environments and tune their vital process with periodic flood events, water levels, and sedimentary processes. The construction of hydroelectric dam causes alterations of natural hydrological regime and sediment supply, threatening downstream floodplain forest.

An assessment of impact of river regulation on floodplain vegetation is crucial to develop a modern approach to the regulated rivers management in the Neotropics and to mitigate the impact of damming on floodplain environment. Nevertheless, floodplain forest monitoring requires high resolution mapping as vegetation dynamics are in the narrow area at the interface terrestrial and aquatic systems. Most of the existing satellite images that afford land observations have severe limitations due to their coarse resolution or missing data caused by the extreme cloudiness conditions in of tropical regions.

In the present work, we propose an innovative approach based on high-resolution mapping for the monitoring long-term evolution of vegetation in a highly impacted environment (Uatama river) due to Balbina dam regulation. We combine Landsat (30m spatial resolution and 16 days revisit cycle) and the MODIS missions (500m spatial resolution and daily revisit cycle), using HISTARFM algorithm, to reduce noise and produce monthly gap-free high-resolution (30 m) observations over land. Areas characterized by vegetation changes are identified through the analysis of of vegetation index products derived from the high-resolution reflectance data. Furthermore, hydrological modification within these areas are assessed by using a global water surface dataset.

We found a deep redistribution of floodplain forest concentrated in areas that experienced a hydrologic regime transition after dam construction. The vegetation changes comprise not only vegetation degradation of areas with greater hydrological stress but also with large floodplain areas not flooded afterwards, which were invaded by upland forest. Although the dam was built more than 30 years ago, its effects on the vegetation continue and the situation seems far from

reaching a new environmental equilibrium.

The framework proposed offers a practical and novel tool to accurately monitor riparian vegetation dynamics over time even for very remote and poorly accessible areas such as tropical floodplains. Furthermore, the assessment of the impact that the human footprint has on tropical floodplain allows a more careful management of the watersheds.