SPATIO-TEMPORAL DYNAMICS OF THE FOREST AND SAVANNAH FORMATIONS IN THE BRAZILIAN PANTANAL WETLAND

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INTRODUCTION

. The Pantanal biome is a heterogeneous and dynamic ecosystem located in the heart of the South American continent.

. In the context of climate change, understanding how different plant physiognomies respond to ongoing hydroclimatic regimes is essential information for planning mitigation and adaptation strategies at the landscape level.

. Wetland functional assessment approach could improve the efficiency of environmental management [1].

. Here, we investigate the spatio-temporal variability in the dynamics of the forest and savanna formations in the Pantanal do Abobral, one of the Pantanal's sub-regions.

METHOD

1. Study area

- Pantanal do Abobral (19º18'31''S; 57º03'15''W).

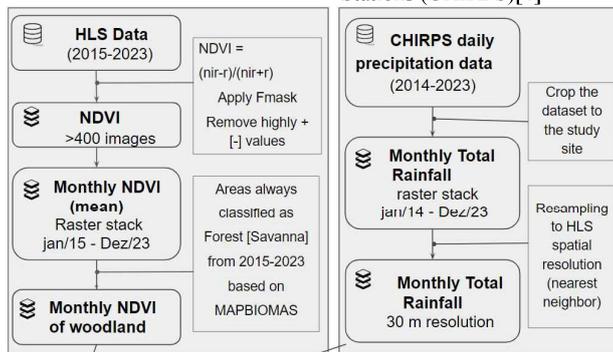- subregion of the Pantanal wetland.

2. Land cover

- Forest and Cerrado (wooded savanna) land cover classes: Brazilian Annual Land Use and Land Cover Mapping Project [2]
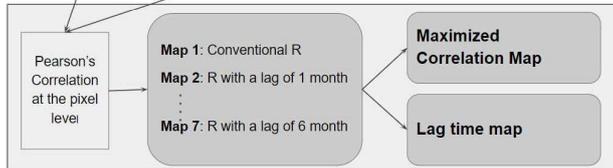
3. Phenology

Data: Harmonized Landat Sentinel-2 (HLS) [3]

4. Rainfall

Data: Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS)[4]

HLS Data (2015-2023)

NDVI = (nir-r)/(nir+r)
Apply Fmask
Remove highly + [-] values

NDVI >400 images

Monthly NDVI (mean) Raster stack jan/15 - Dez/23

Areas always classified as Forest [Savanna] from 2015-2023 based on MAPBIOMAS

Monthly NDVI of woodland

CHIRPS daily precipitation data (2014-2023)

Crop the dataset to the study site

Monthly Total Rainfall raster stack jan/14 - Dez/23

Resampling to HLS spatial resolution (nearest neighbor)

Monthly Total Rainfall 30 m resolution

5. Pointwise Correlation

Pearson's Correlation at the pixel level

Map 1: Conventional R
Map 2: R with a lag of 1 month
...
Map 7: R with a lag of 6 month

Maximized Correlation Map

Lag time map

6. Functional indices

We calculated the average annual cycle from the monthly NDVI betwen 2015-2023, due to the high cloud cover. Negative values were replaced by zeros [5].

- annual NDVI integral (**NDVI-I**): sum of the NDVIs of the average annual cycle;

- Intra-annual relative range (**RREL**): subtraction between the maximum NDVI and the minimum NDVI of the average annual cycle, divided by the NDVI-I.

(R v.4.2.3 software)

RESULTS

Dynamics between phenology and rainfall

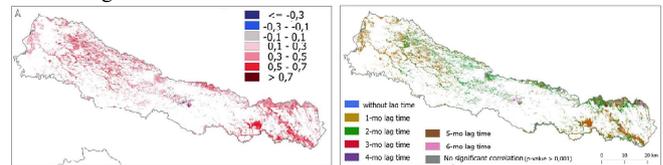In general, tree vegetation responds to rainfall with a one to two months lag time.

Fig. 1. Spatial distribution of the maximised Pearson correlation between monthly NDVI time series of woody vegetation and precipitation for the Pantanal do Abobral (left) and the number of months of lag needed to maximise the correlation (right).

Even within the same land cover class, different typologies respond differently to local precipitation regimes.
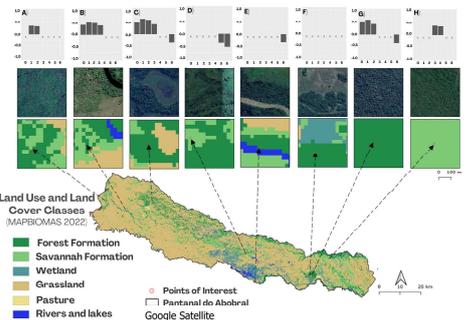
Fig. 2: Land cover in the Abobral Pantanal in 2022 (MapBiomas). Highlight points A-H with graphical representations indicating Pearson's correlations with 0 (conventional correlation) up to 6-month lag.
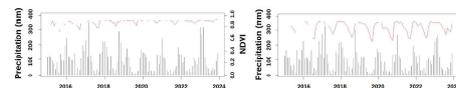
Fig. 3. Monthly NDVI and precipitation from points E (left) and G (right) shown in Fig. 2.

Spatial variations in functional indices

Riparian forests show higher NDVI-I (as a proxy for primary production) and less pronounced RREL (seasonality of carbon fluxes) than other forest typologies in the region.
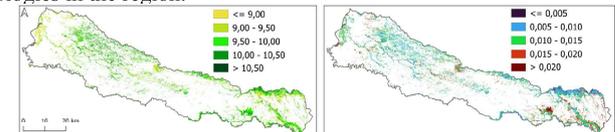
Fig. 4: NDVI-I (left) and RREL (right) of the forest and savannah formations derived from the average annual NDVI cycle (2015-2023), Pantanal do Abobral.

CONCLUSIONS

Although the change from forest to other land uses has received a great deal of monitoring effort in recent years, the habitat diversity of the remaining forests may be silently fading away. Mapping approaches that describe the functional attributes of vegetation can, therefore, contribute to landscape-level planning of mitigation and/or adaptation strategies to the effects of climate change.

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