

Exploratory analysis of recurrent deforestation warnings in the the Brazilian Amazon

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October 15, 2024

Outline

Introduction

Materials and methods

Results

Exploratory data analysis

Trajectories

Trajectories (including PRODES)

Final remarks

Deforestation

It's a conversion by suppression of areas of primary vegetation due to anthropogenic actions [DAMV⁺22].

- ▶ Clear-cut deforestation is the complete removal of forest cover in a short period of time [DAMV⁺22].
- ▶ Progressive forest degradation. It's the same as clear-cut deforestation, but it takes longer (years).

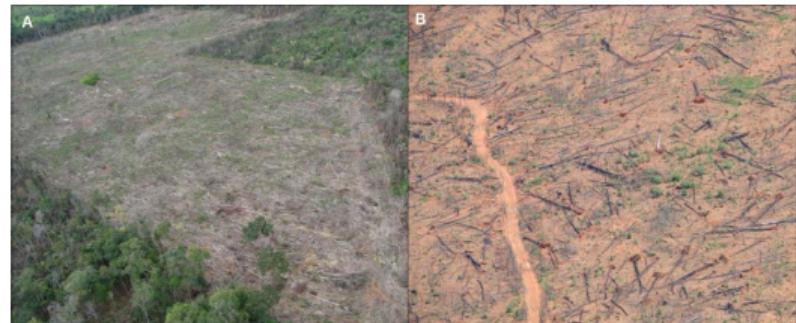


Figure: Clear-cut deforestation in two Mato Grosso's towns: (A) Tapurah, (B) Santa Carmen. Source [DAMV⁺22]

Deforestation processes

- ▶ Clear-cut deforestation.
- ▶ Progressive forest degradation.

Deforestation due to Progressive Forest Degradation

1. Removal of trees with the highest value wood, then wood for construction and light wood trees for plywood and boards.
2. Smaller trees are felled and undergrowth is destroyed. Pasture sowing occurs, and it is burned during the second year (second cleaning). Then cattle is introduced and year more fire destroys the remaining forest (third year).
3. Complete loss of the canopy, collapse of forest's structure and loss of ecological functions. No more forests' self-regeneration.



Figure: Progressive forest degradation.
Source [DAMV⁺22].

Deforestation due to Progressive Forest Degradation

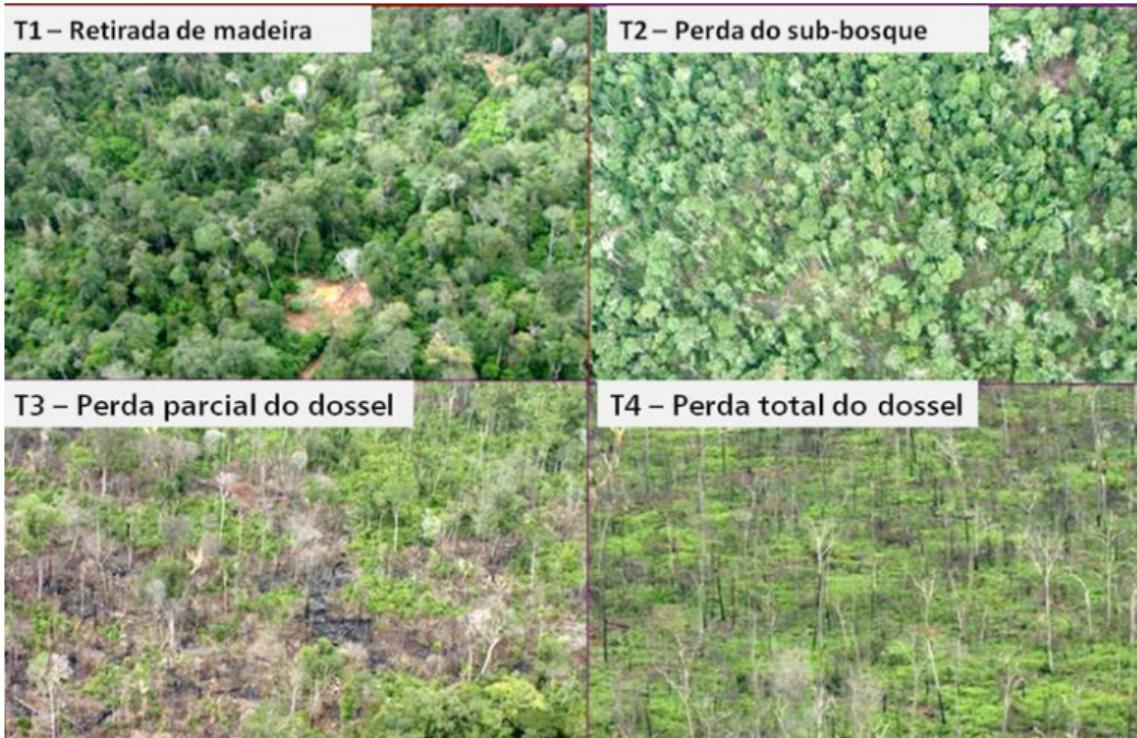


Figure: Process of progressive forest degradation. Source [DAMV⁺22].

Challenges

- ▶ Deforestation by successive degradation remains a challenging question in the scientific literature.
- ▶ We think a potential answer to this question could be found in DETER's warnings.
- ▶ This answer could play an important role, for example, for improving the national estimation of greenhouse gases.

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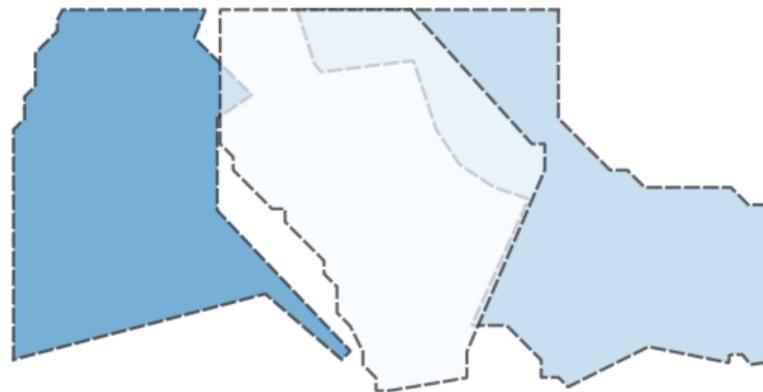
What is DETER?

- ▶ It is a GIS which produces a fast assessment of deforestation and forest degradation in the Brazilian Amazon [SDA⁺06].
- ▶ It employs experts to detect and issue warnings of deforested or degraded areas [DAMV⁺22].
- ▶ Annually, DETER takes from PRODES the current forested area, starting anew issuing warnings.
- ▶ Data publicly available from Terrabrasilis.

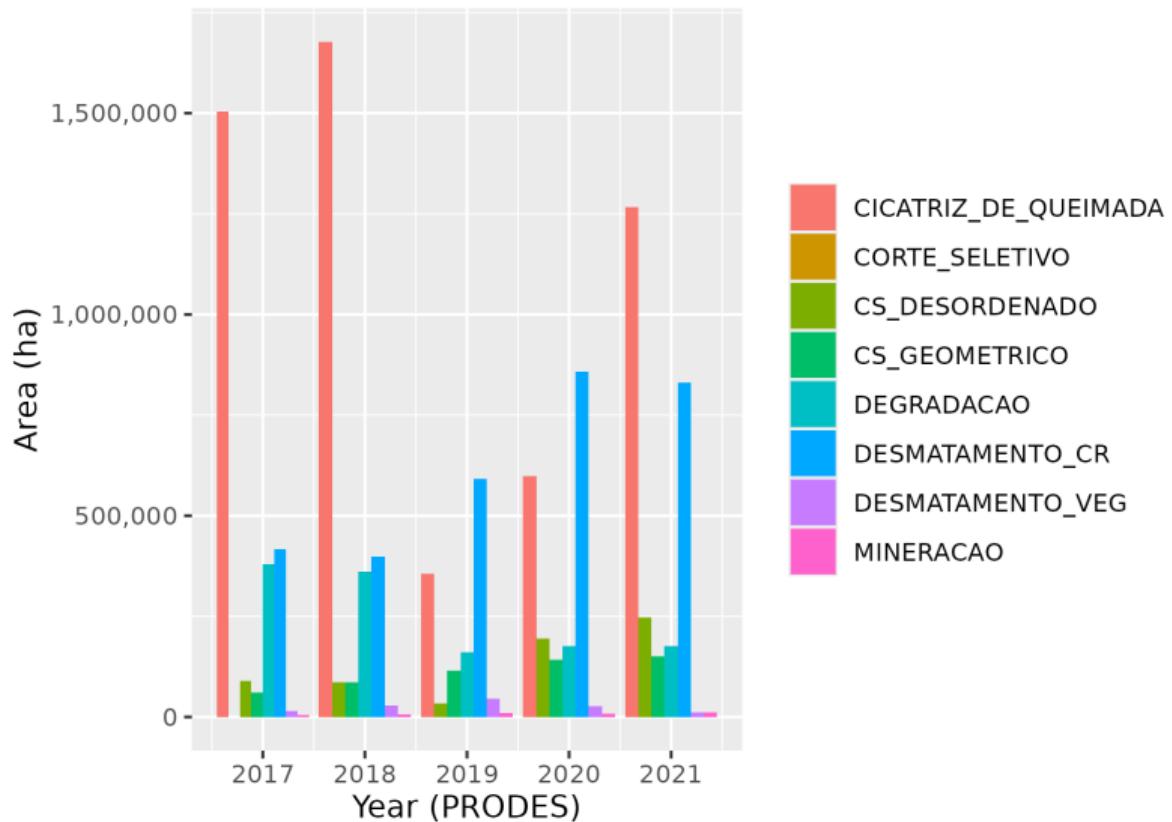


DETER warnings

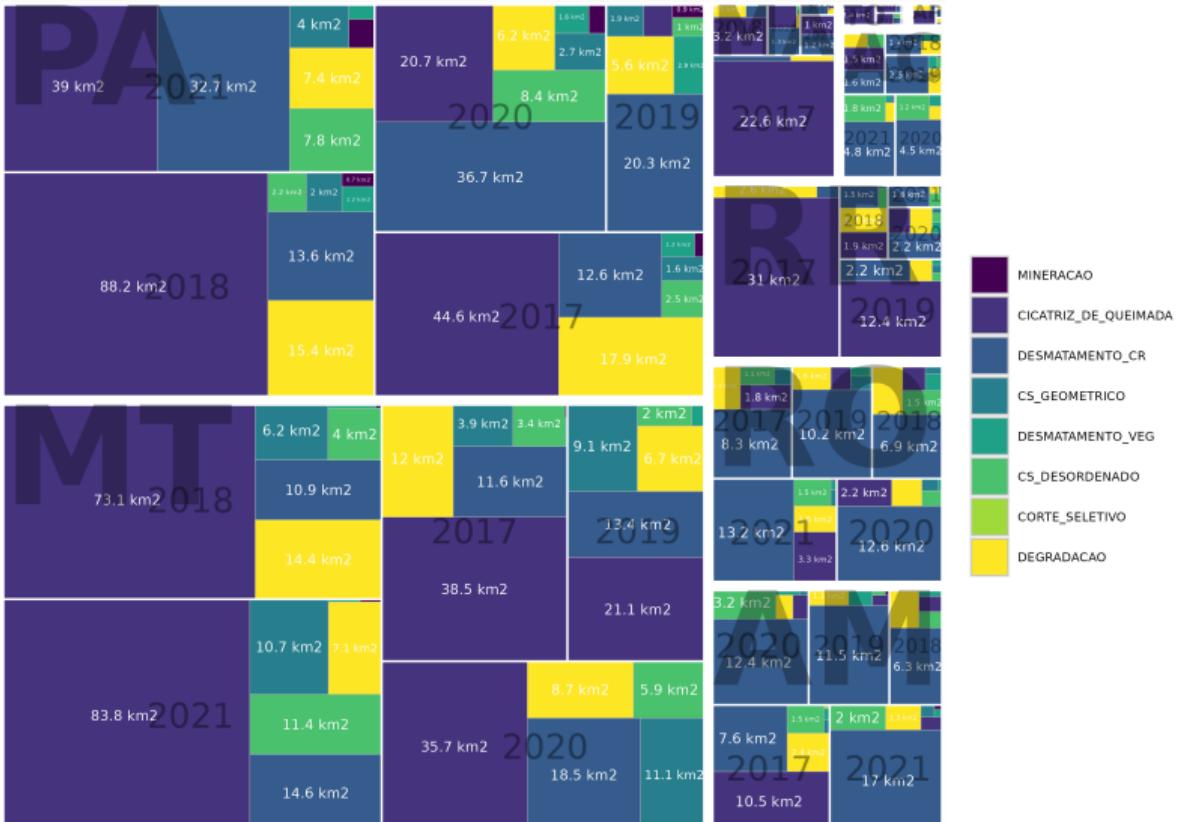
- ▶ Polygons from 2016 to 2021.
- ▶ Note that, the spatial properties of DETER warnings are inconsistent along time (shape, size, area, position).
- ▶ The figure shows 3 DETER warnings from different dates with partial overlap.



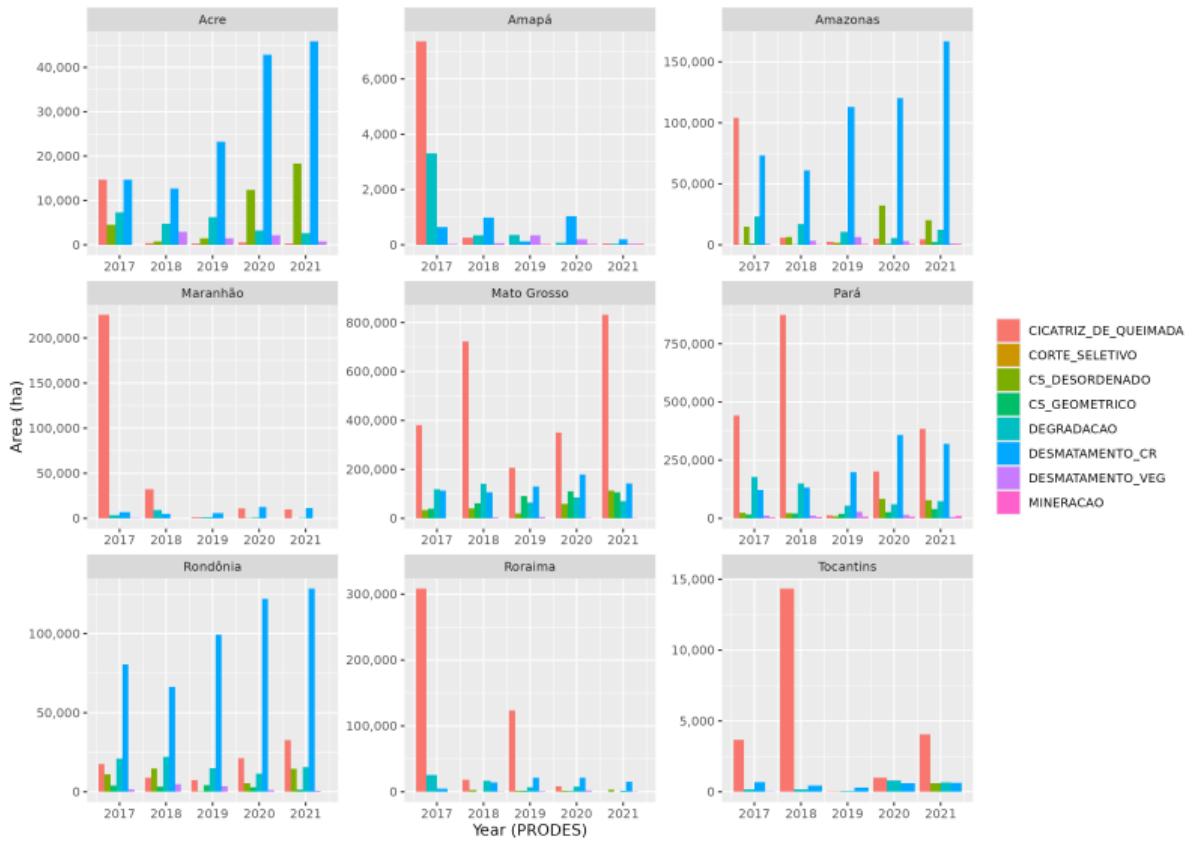
Area of DETER warnings



Area of DETER warnings

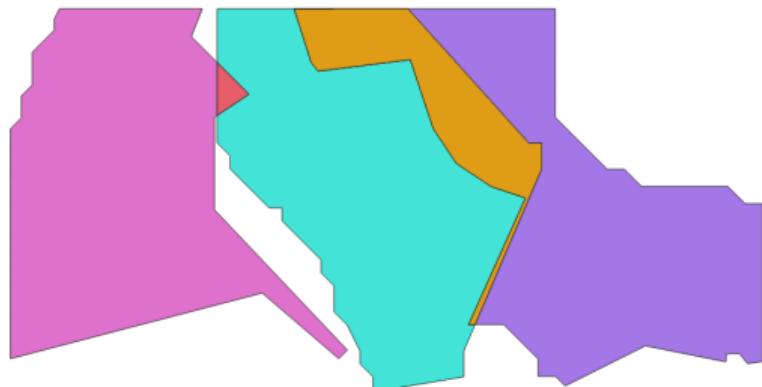


Area of DETER warnings



DETER subareas

- ▶ The spatial properties of DETER warnings are inconsistent along time (shape, size, area, position).
- ▶ On the other hand, DETER subareas maintain keep properties.
- ▶ Following the example from before, subareas from 3 DETER warnings. we obtained 7 subareas



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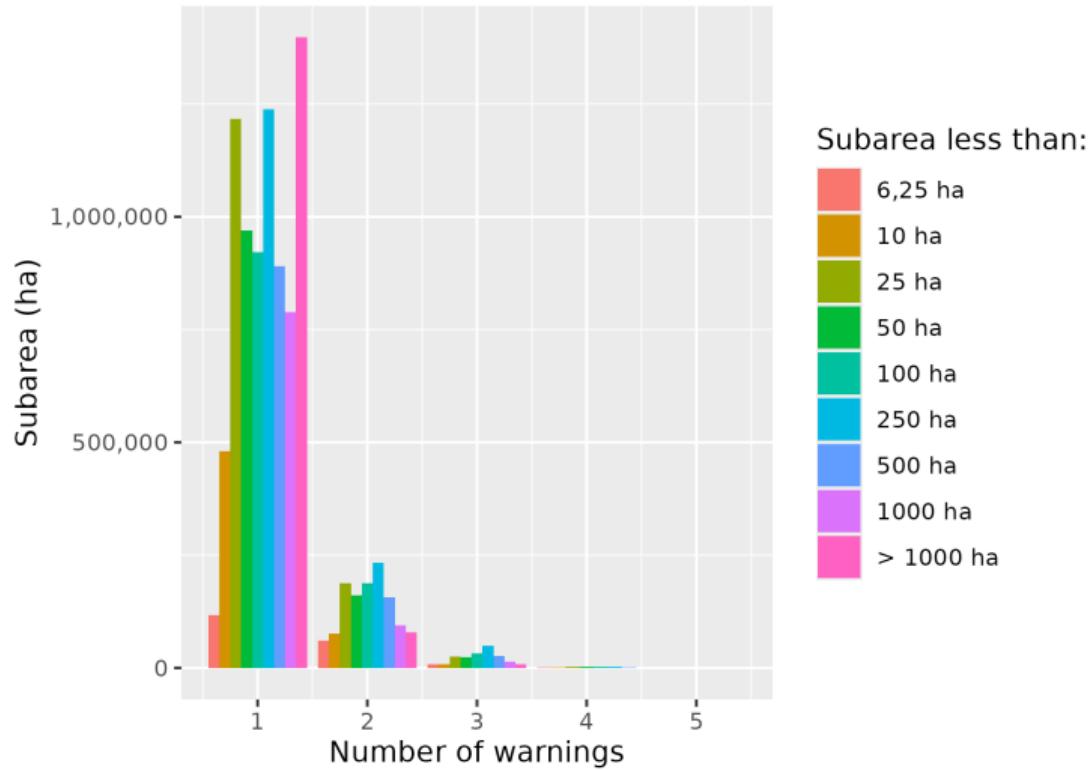
Exploratory data analysis

Trajectories

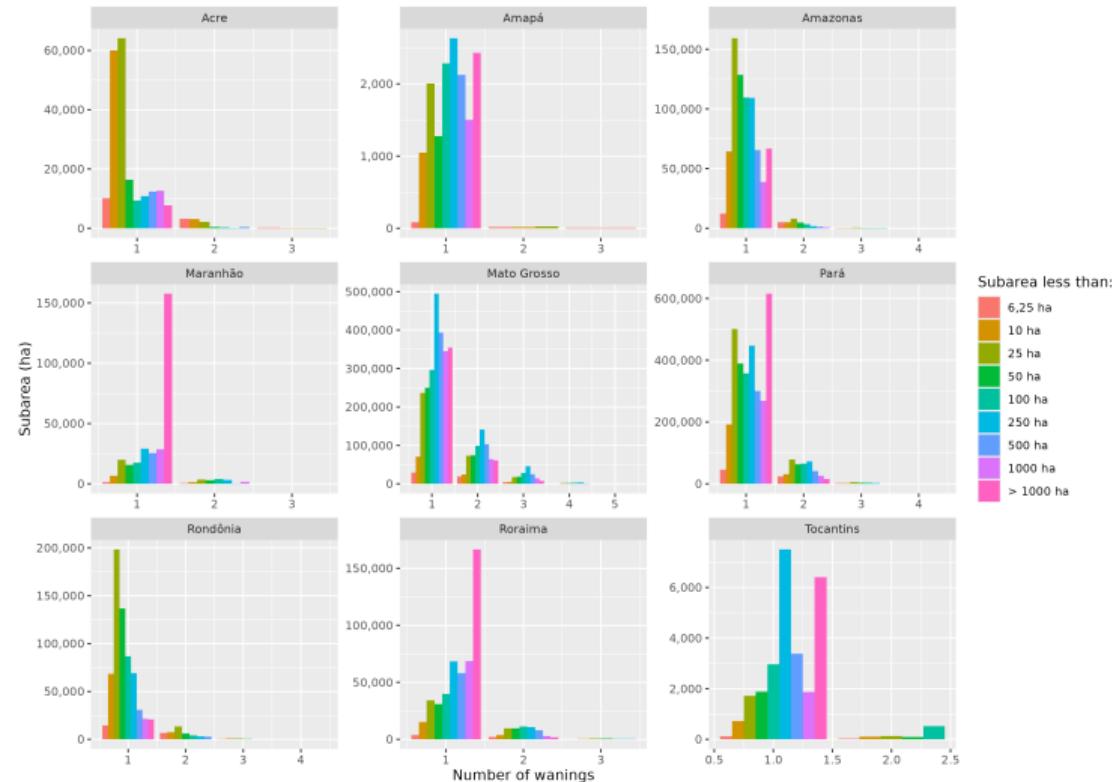
Trajectories (including PRODES)

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Subareas by number of warnings



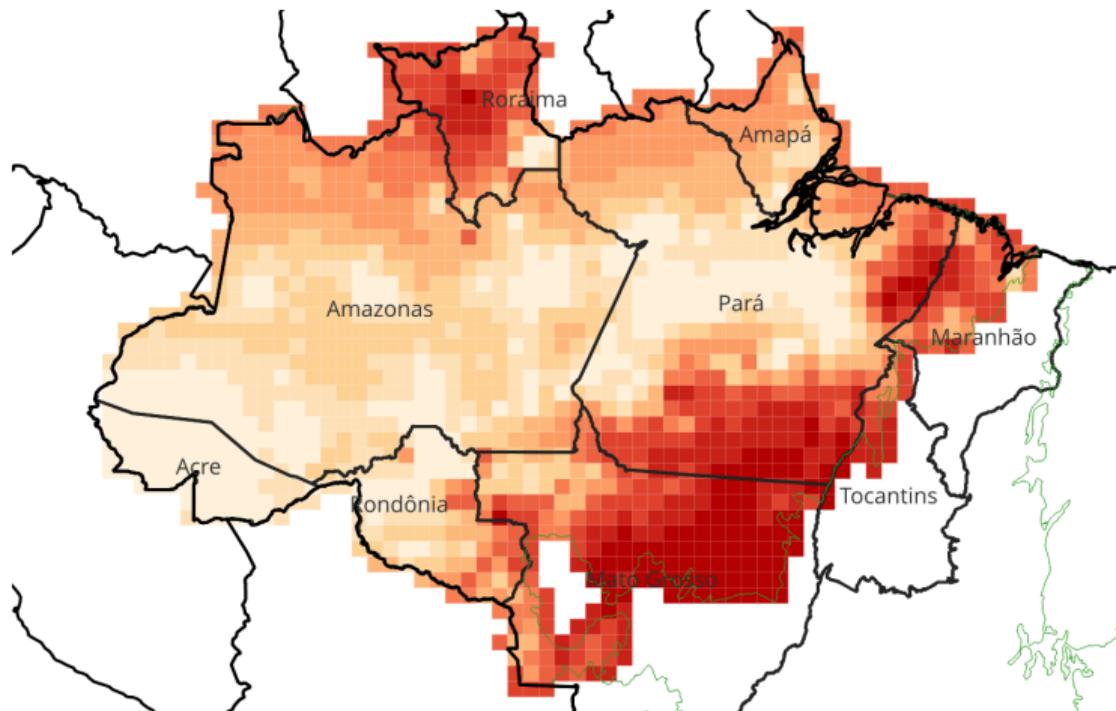
Subareas by number of warnings



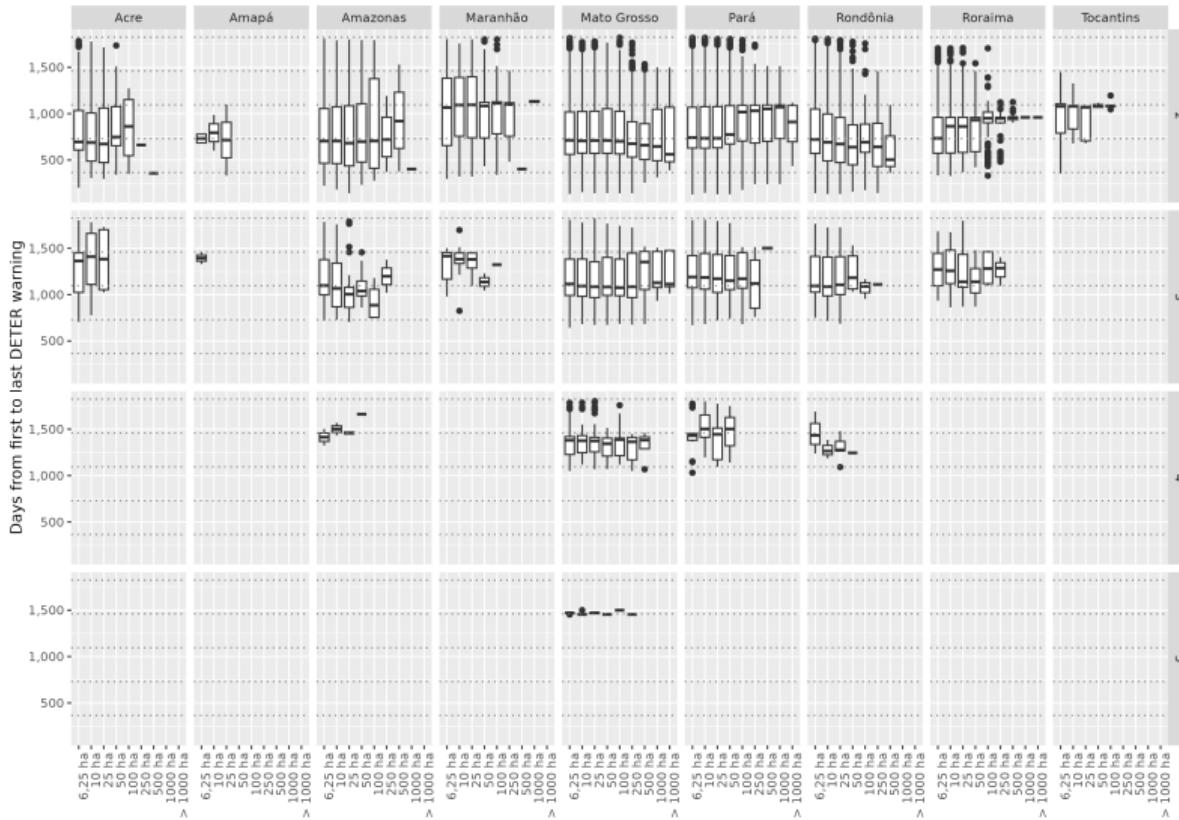
Subarea less than:

- 6.25 ha
- 10 ha
- 25 ha
- 50 ha
- 100 ha
- 250 ha
- 500 ha
- 1000 ha
- > 1000 ha

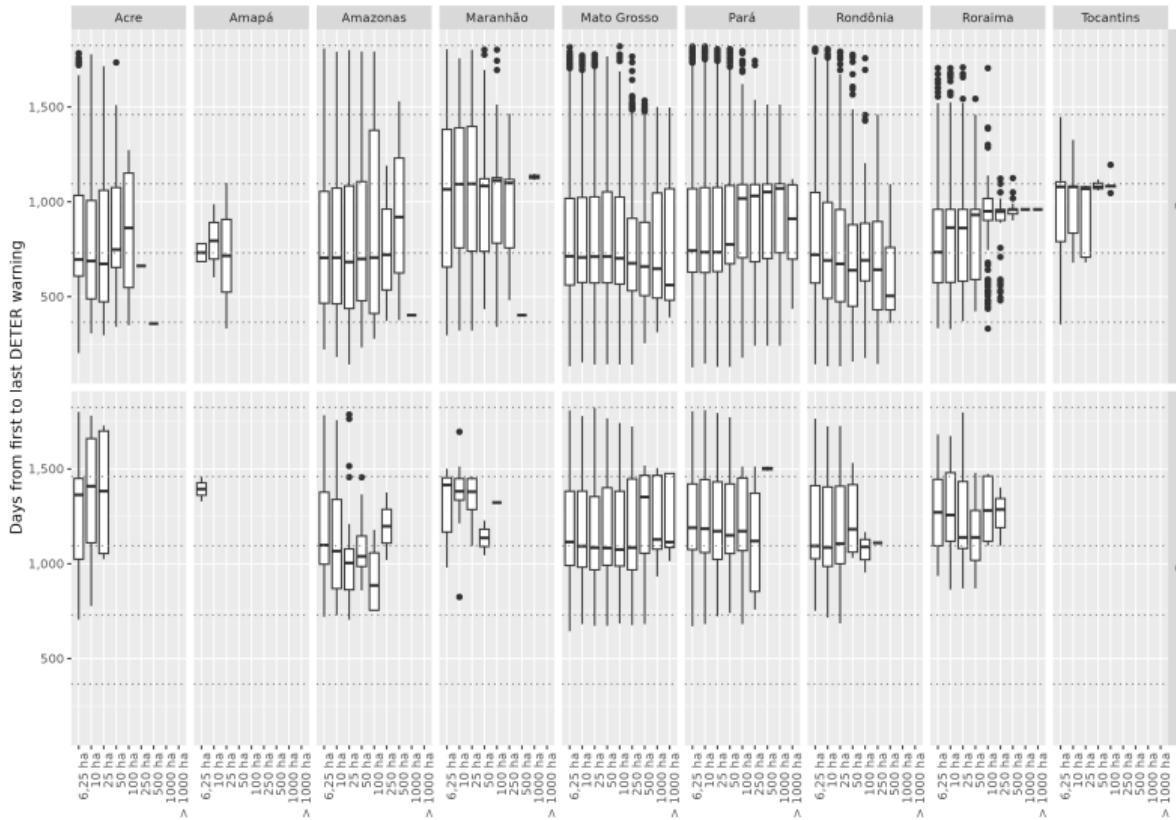
Subareas by number of warnings



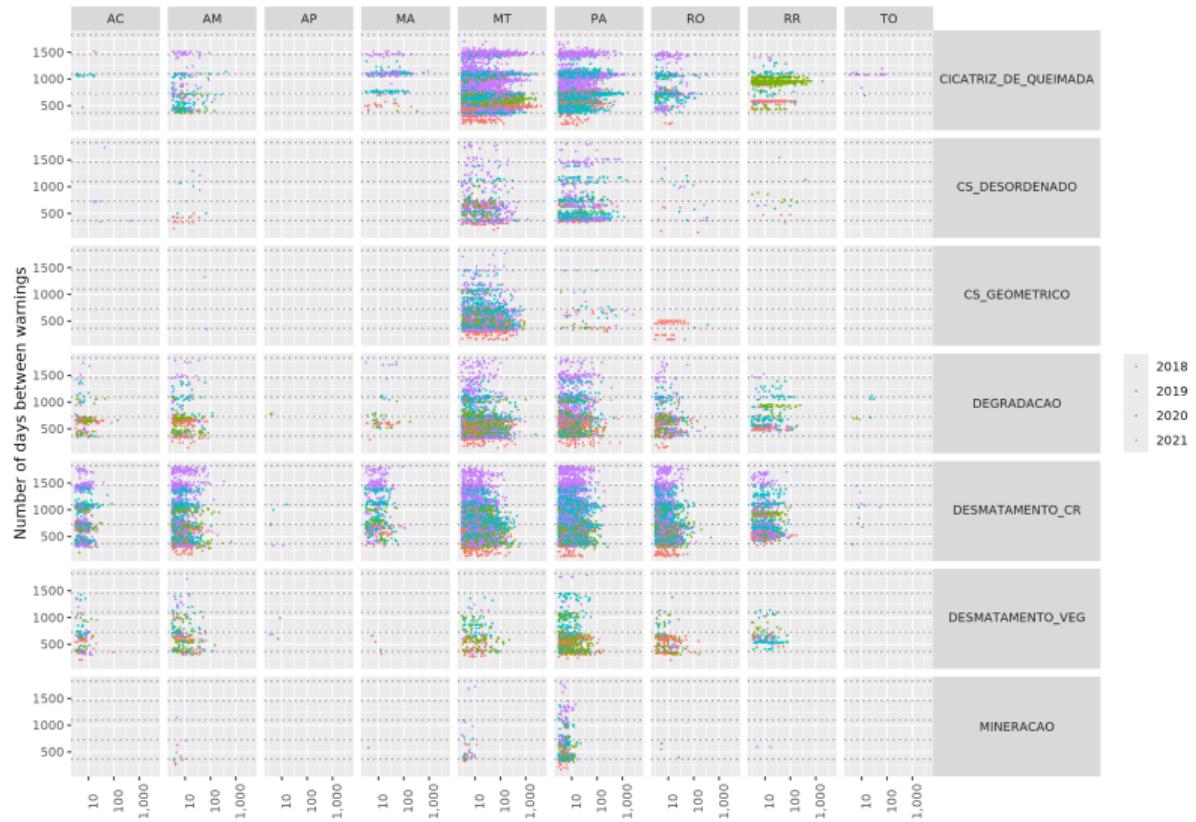
Days from first to last warning



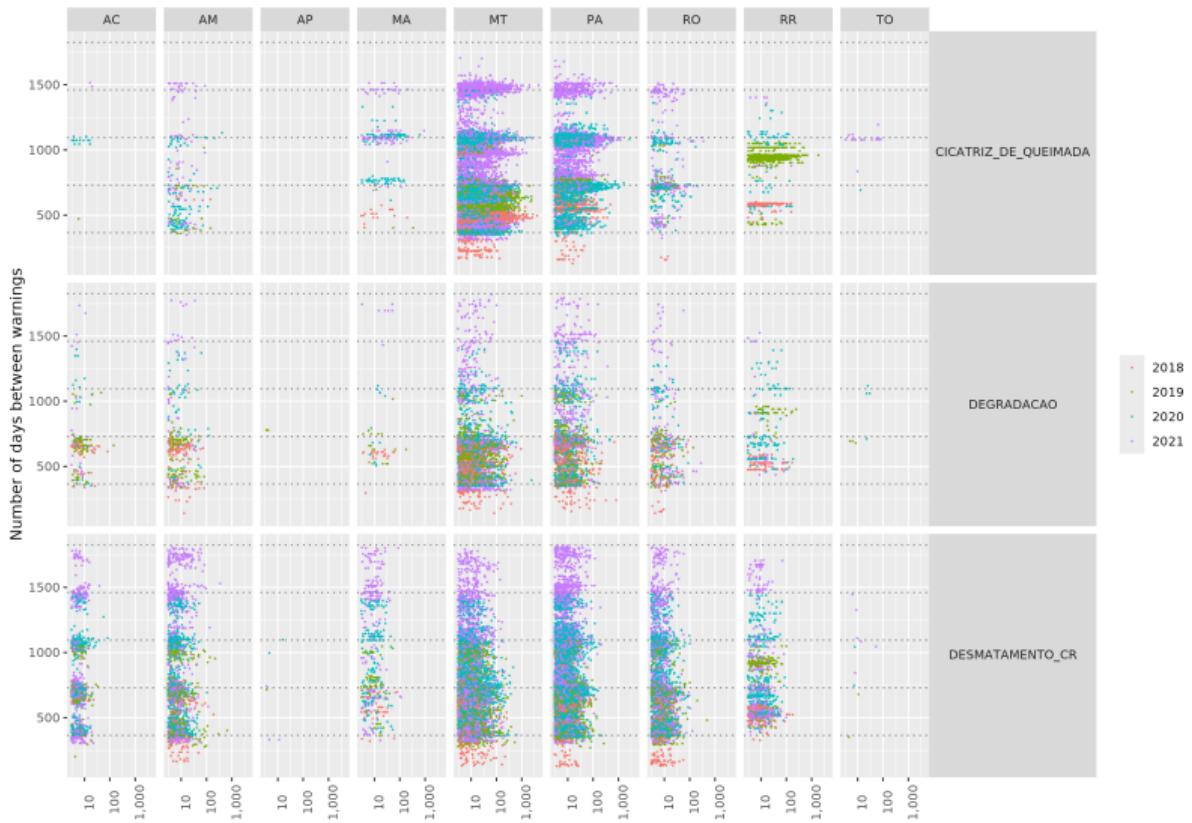
Days from first to last warning (zoom)



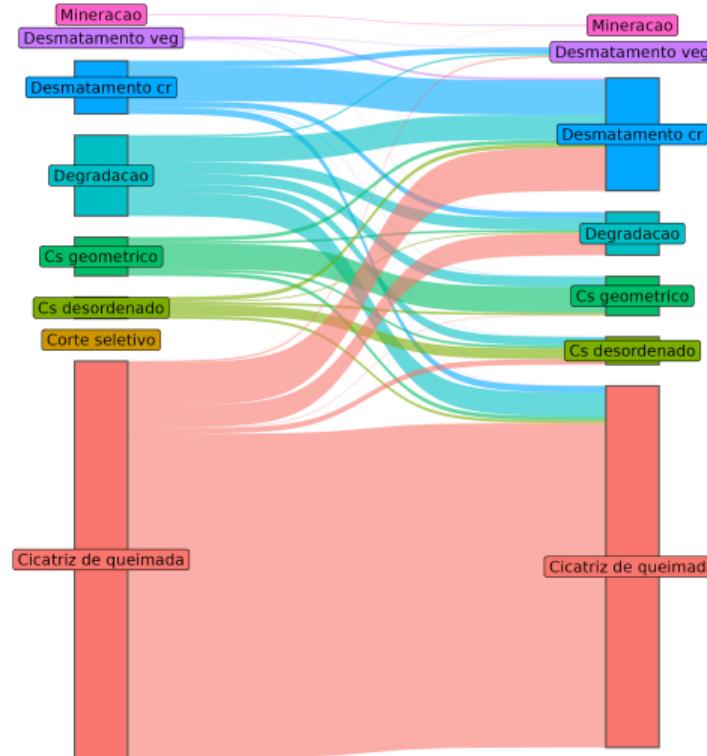
Days between warnings



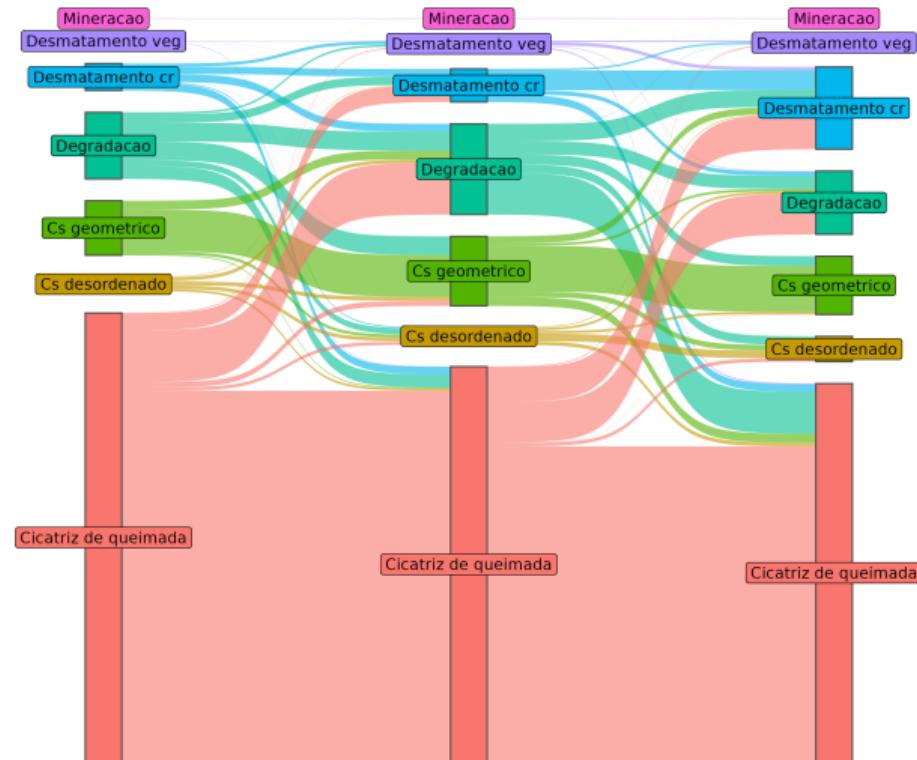
Days between warnings (zoom)



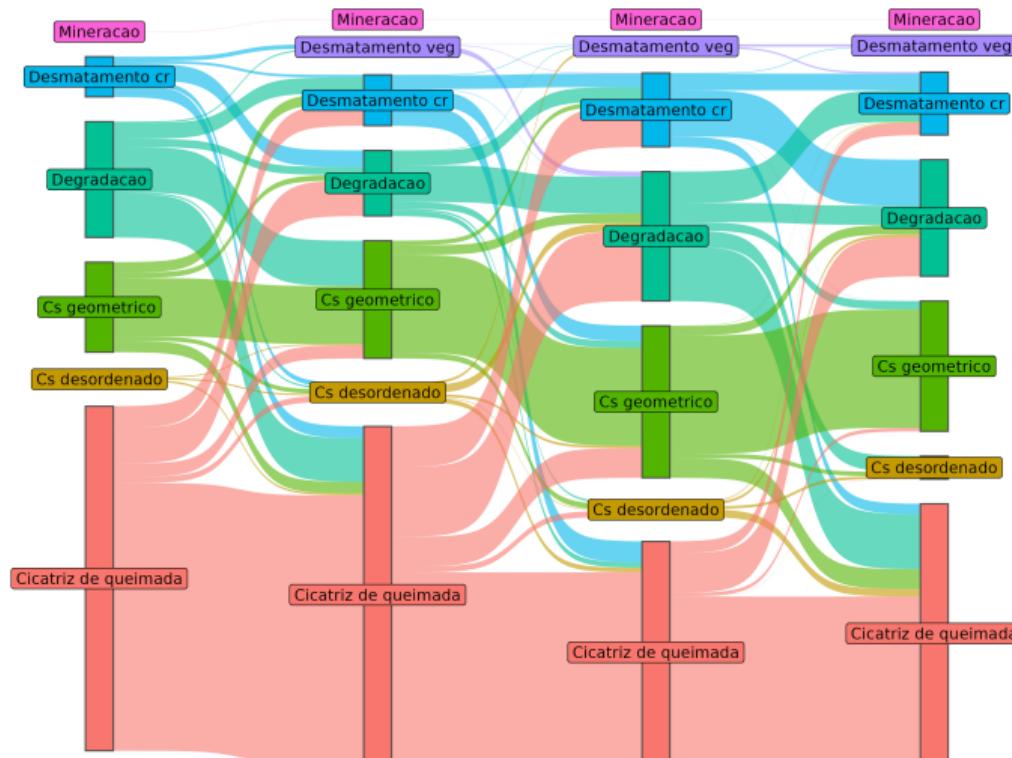
Subarea trajectories (2 warnings)



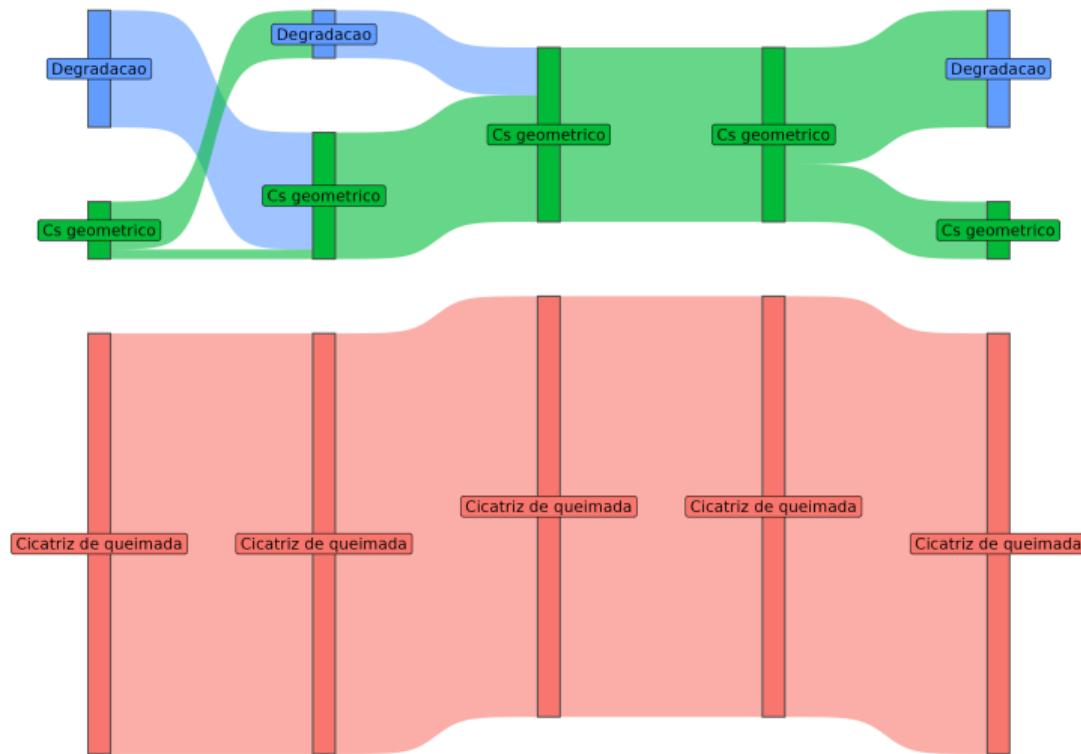
Subarea trajectories (3 warnings)



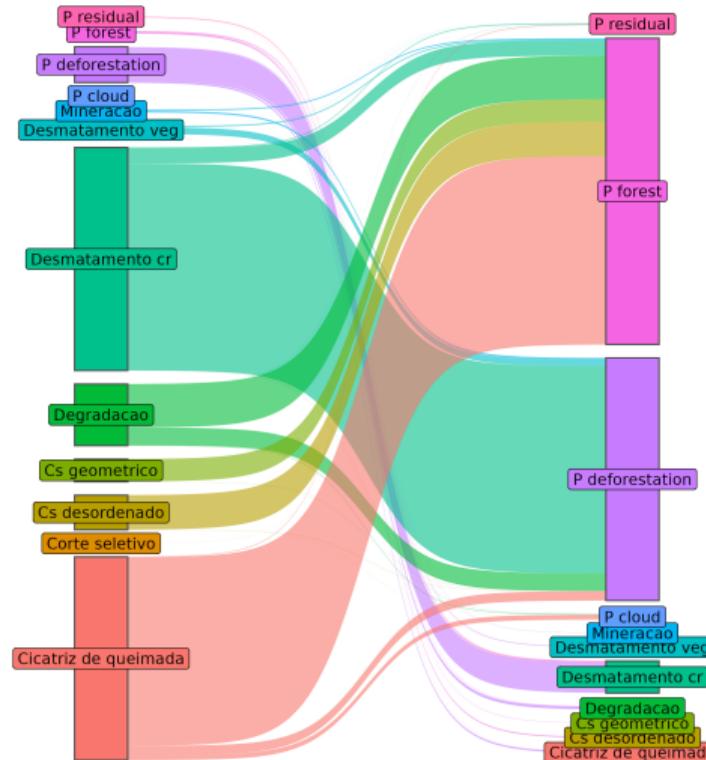
Subarea trajectories (4 warnings)



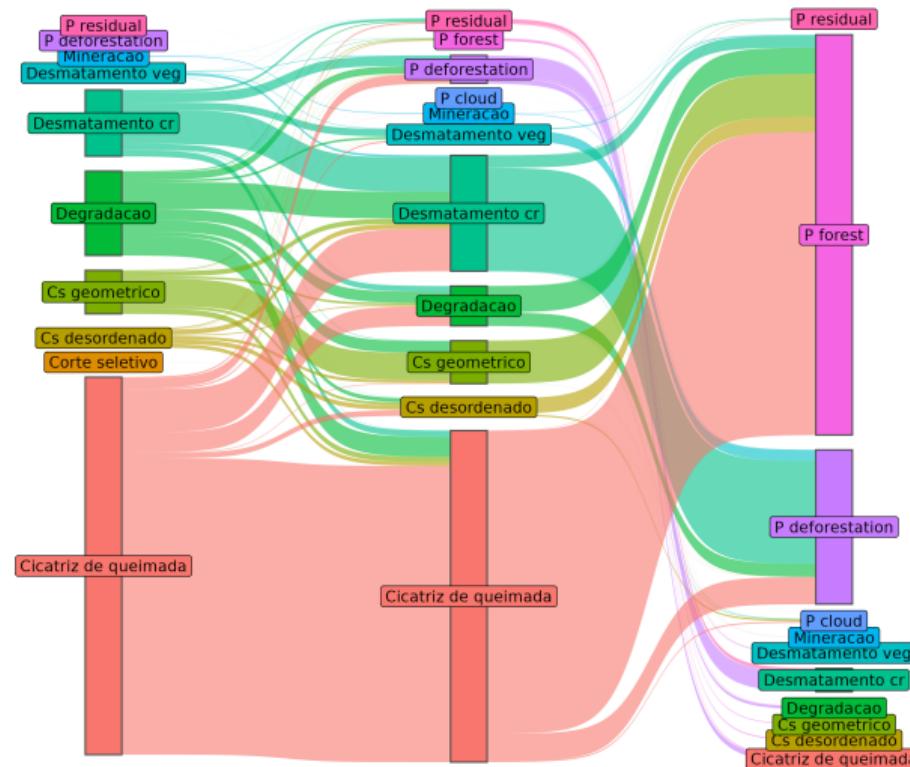
Subarea trajectories (5 warnings)



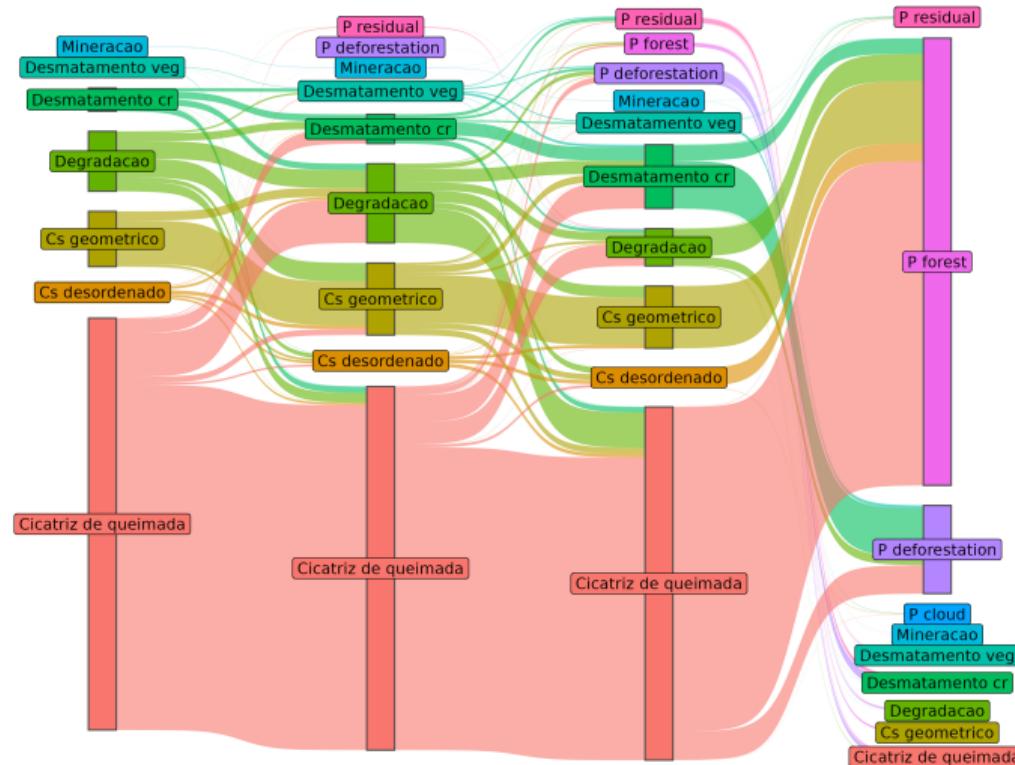
Subarea trajectories PRODES (2 warnings)



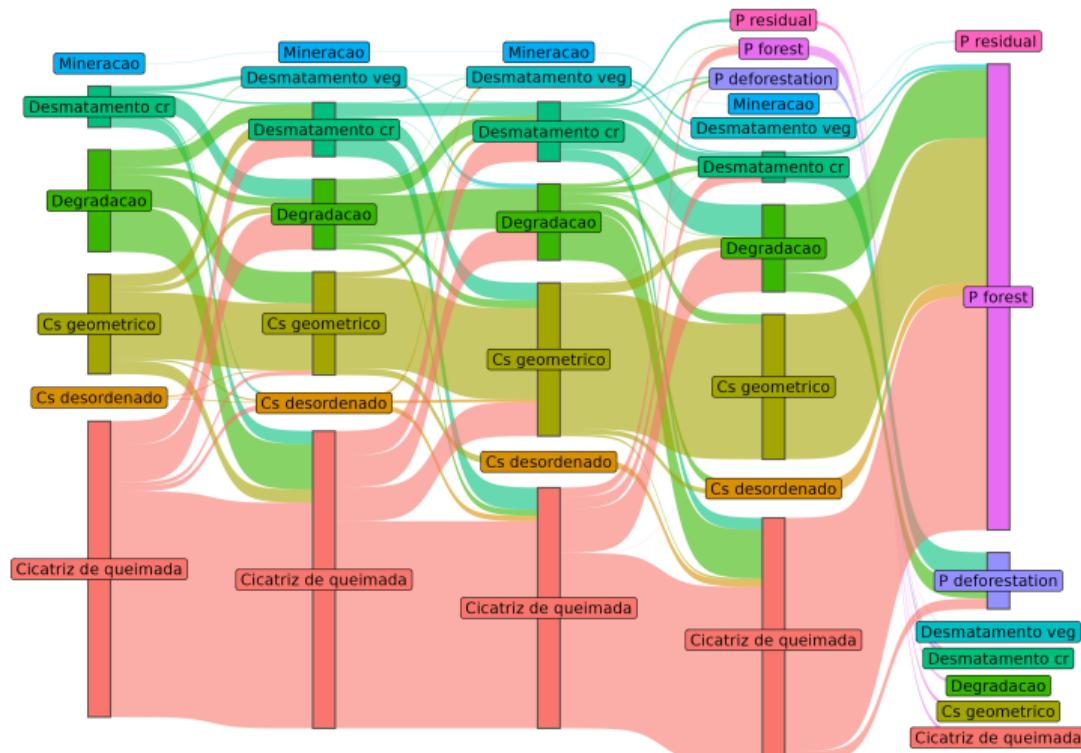
Subarea trajectories PRODES (3 warnings)



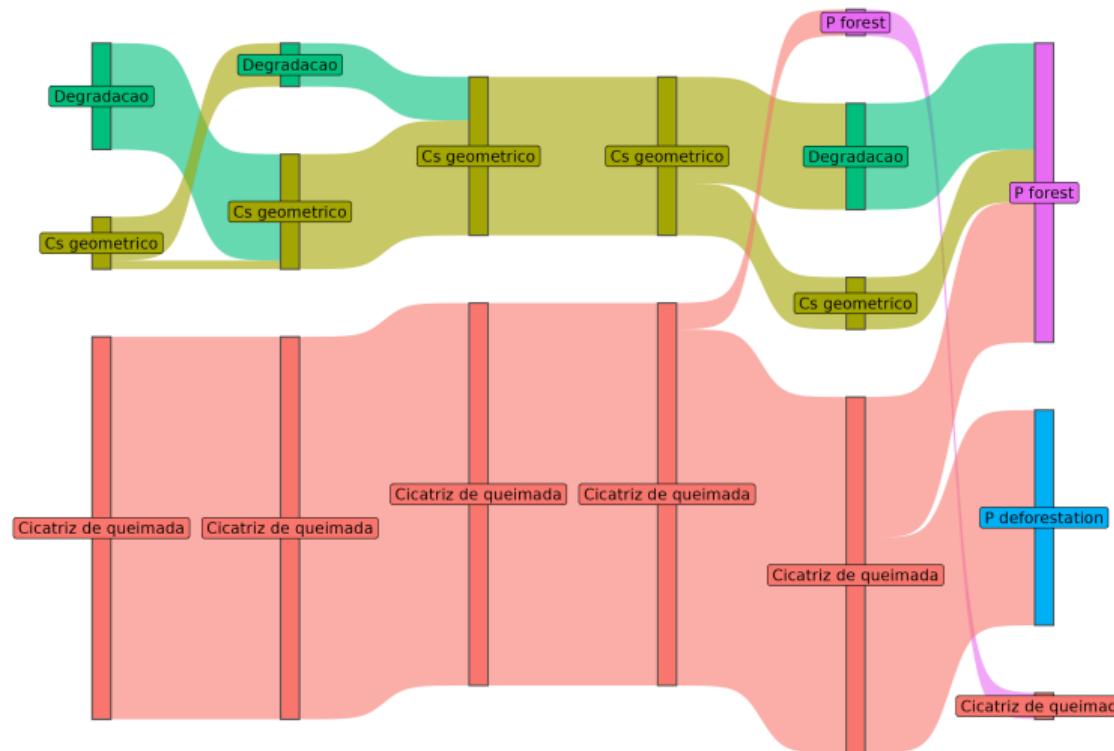
Subarea trajectories PRODES (4 warnings)



Subarea trajectories PRODES (5 warnings)



Subarea trajectories PRODES (6 warnings)



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- ▶ The analysis of DETER warning subareas along time could improve the characterization of forest degradation.
- ▶ Potential applications of our work are:
 - ▶ Improve estimation of emissions of greenhouse gases, i.e. our data could help avoiding double counting.
 - ▶ Identify spatio-temporal areas which could help training Machine-Learning algorithms for automatic identification of forest degradation.
- ▶ Code available at <https://github.com/albhasan/treesburnareas>
- ▶ This is a follow-up of the work presented at the XX Brazilian Symposium on Remote Sensing [SMP⁺23].

References I

-  Claudio Aparecido De Almeida, Luis Maurano, Dalton M. Valeriano, Gilberto Câmara, Lúbia Vinhas, Marisa Da Motta, Alessandra Rodrigues Gomes, Antonio Miguel Vieira Monteiro, Arlesson Antônio De Almeida Souza, Cassiano Gustavo Messias, Camilo Daleles Rennó, Marcos Adami, Maria Isabel Sobral Escada, Luciana De Souza Soler, and Silvana Amaral, *METODOLOGIA UTILIZADA NOS SISTEMAS PRODES E DETER -2 a EDIÇÃO (ATUALIZADA) INPE São José dos Campos 2022.*
-  Yosio Shimabukuro, Valdete Duarte, Liana Anderson, Dalton Valeriano, Egídio Arai, Ramon Freitas, Bernardo Rudorff, and Maurício Moreira, *Near real time detection of deforestation in the Brazilian Amazon using MODIS imagery*, Ambiente e Água - An Interdisciplinary Journal of Applied Science **1** (2006), no. 1, 37–47.

References II

-  Alber Sanchez, Guilherme Mataveli, Aline Pontes-Lopes, Sulimar Nogueira, and Luiz Aragão, *Exploratory analysis of recurrent deforestation warnings in São Félix do Xingu - Brazilian Amazon*, Anais Do XX Simpósio Brasileiro de Sensoriamento Remoto (Florianópolis, SC, Brazil), April 2023, pp. 2821–2824.