

Exploratory analysis of Recurrent deforestation warnings in the Brazilian Amazon

Alber Sanchez
alber.ipia@inpe.br



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Introduction

- ▶ Deforestation by successive degradation remains a challenging question in the scientific literature.
- ▶ We think an answer to this question lies down in DETER data.
- ▶ This answer could play an important role, for example, in the brazilian estimation of greenhouse gases.
- ▶ We used DETER data from 2016 to 2021 of the Amazon Biome in Brazil.

What is DETER?

- ▶ DETER is a GIS which produces a fast assessment of deforestation and forest degradation in the Brazilian Amazon [SDA⁺06].
- ▶ DETER is an important tool for environmental protection and effective law enforcement.
- ▶ DETER employs Linear Mixture Models of CBERS imagery and human experts to deter and issue warnings of deforested (or degraded) areas larger than 3 ha [DAMV⁺22].
- ▶ Annually, DETER takes from PRODES the current forested area, starting anew issuing warnings.

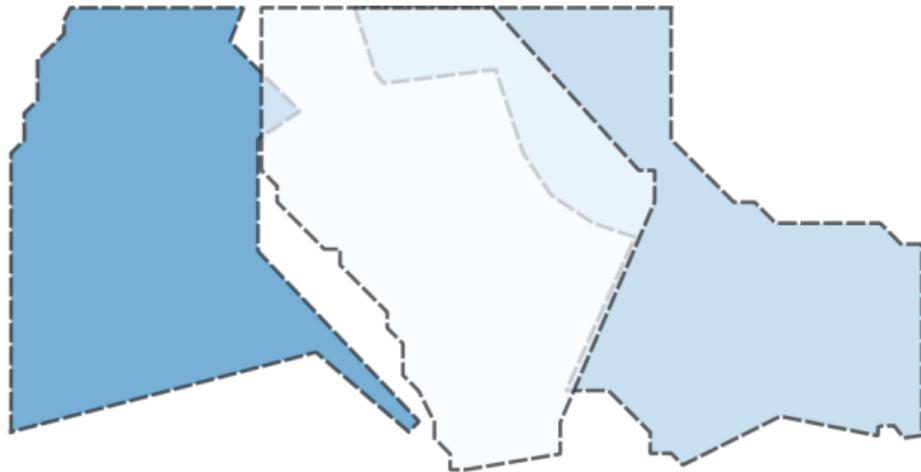
DETER warnings



DETER warnings and time

- ▶ The spatial properties of DETER warning are inconsistent along time (shape, size, position, orientation).

Warnings are inconsistent along time

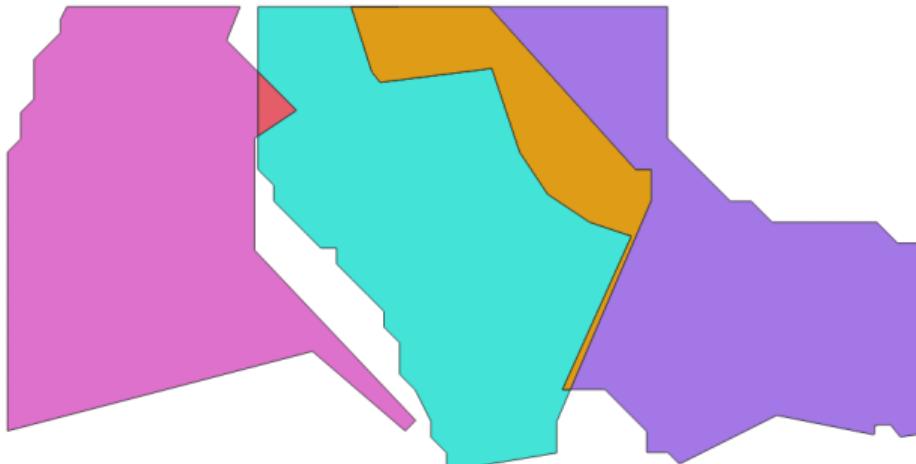


DETER warnings don't fit along time.

DETER subareas

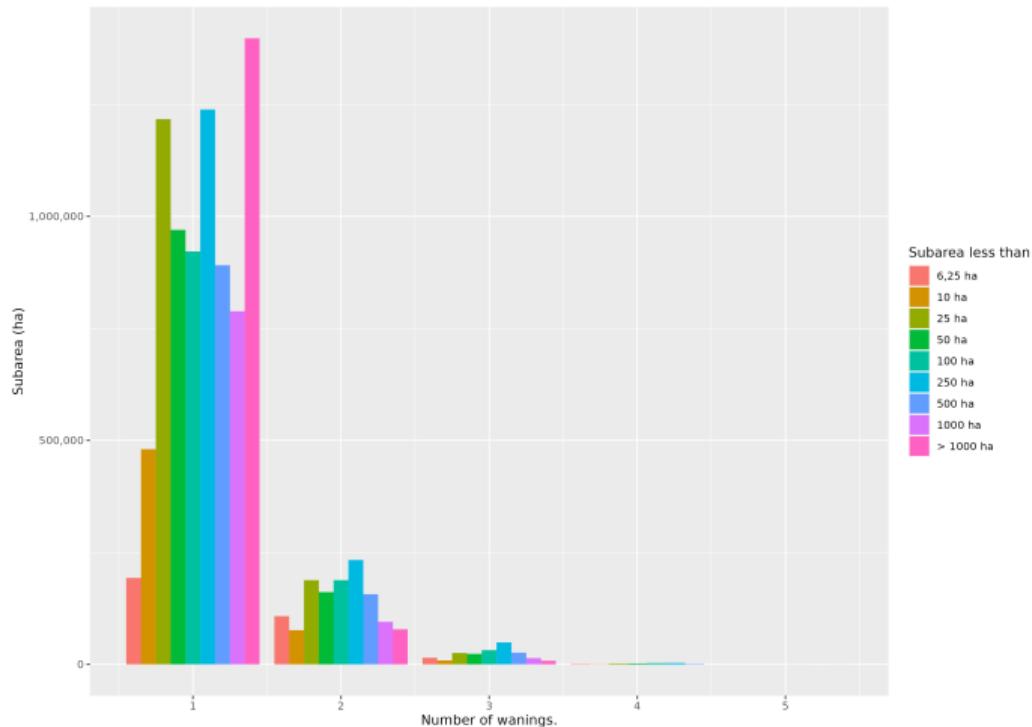
- ▶ The spatial properties of DETER warning are inconsistent along time (shape, size, area, position).
- ▶ DETER subareas maintain their spatial properties along time.

DETER subareas



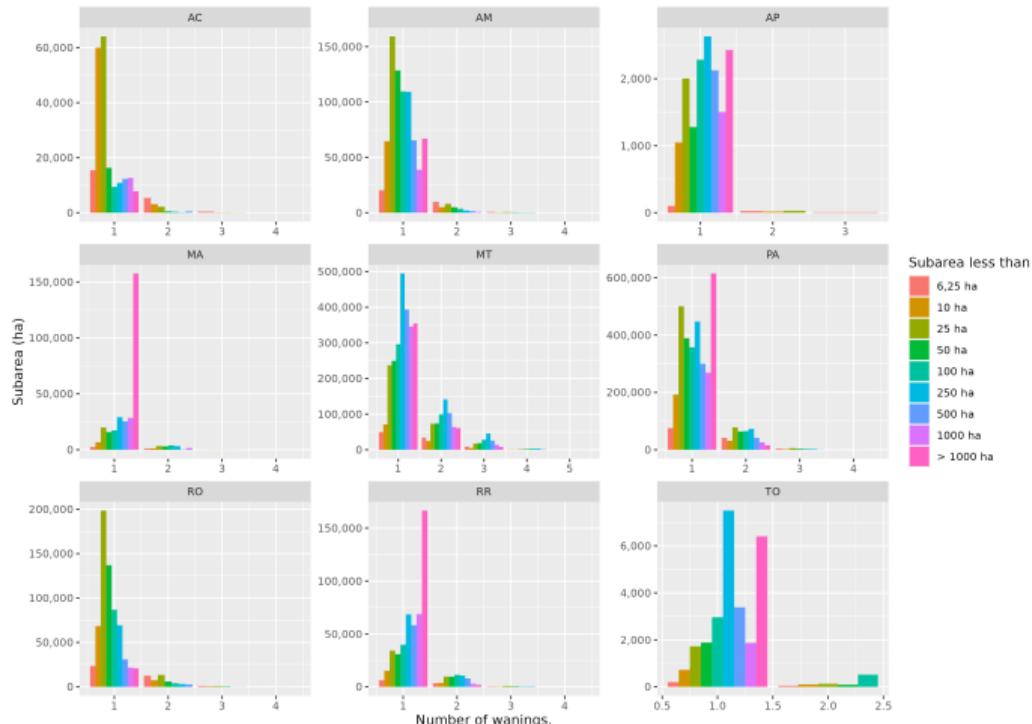
From 3 DETER warnings, we get 7 subareas!

DETER subareas



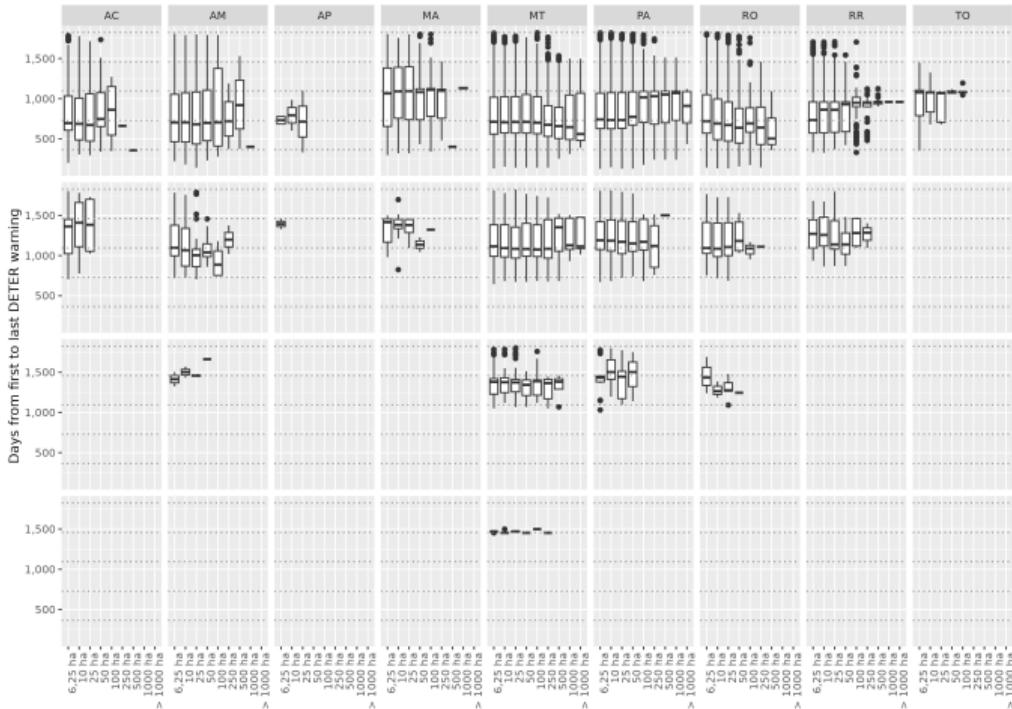
There are subareas with up to 5 recurrent warnings.

DETER subareas



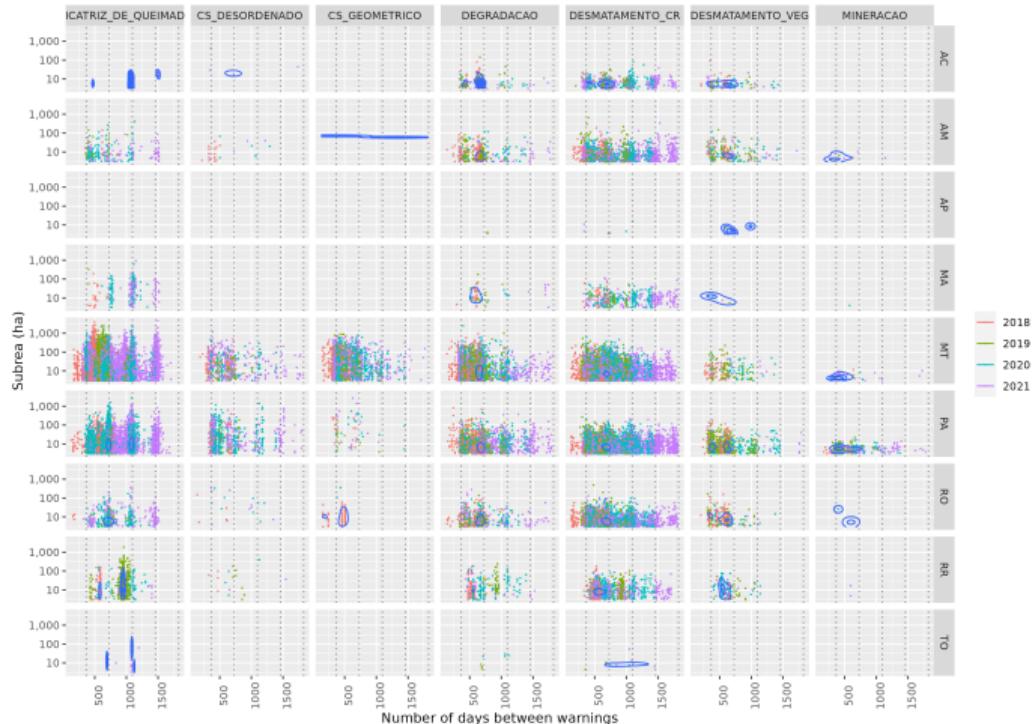
The warning recurrence changes by brazilian state.

DETER subareas



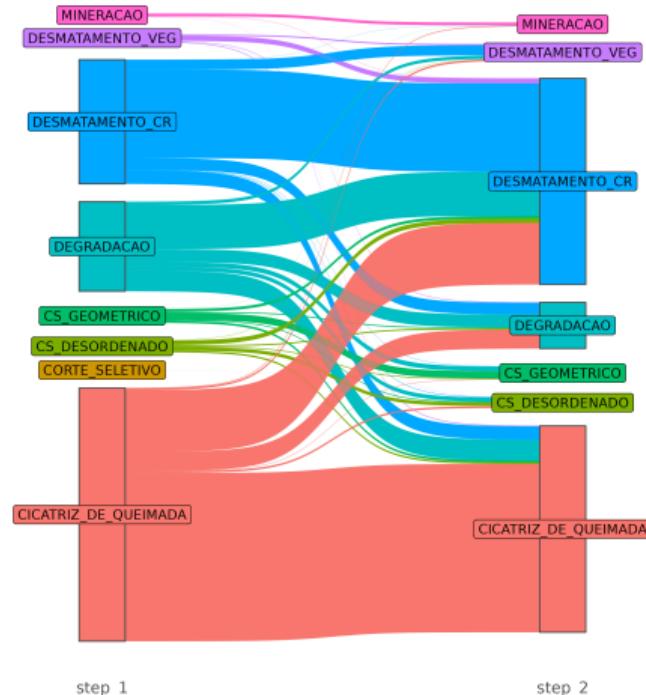
Number of days between first and last warning.

DETER subareas



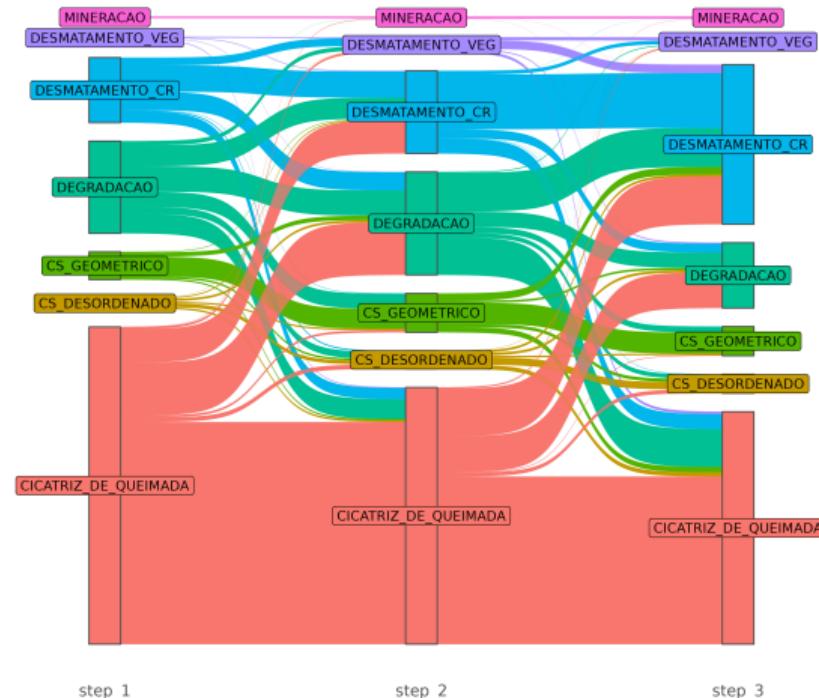
The number of days between warnings behaviour in space and time.

DETER subareas



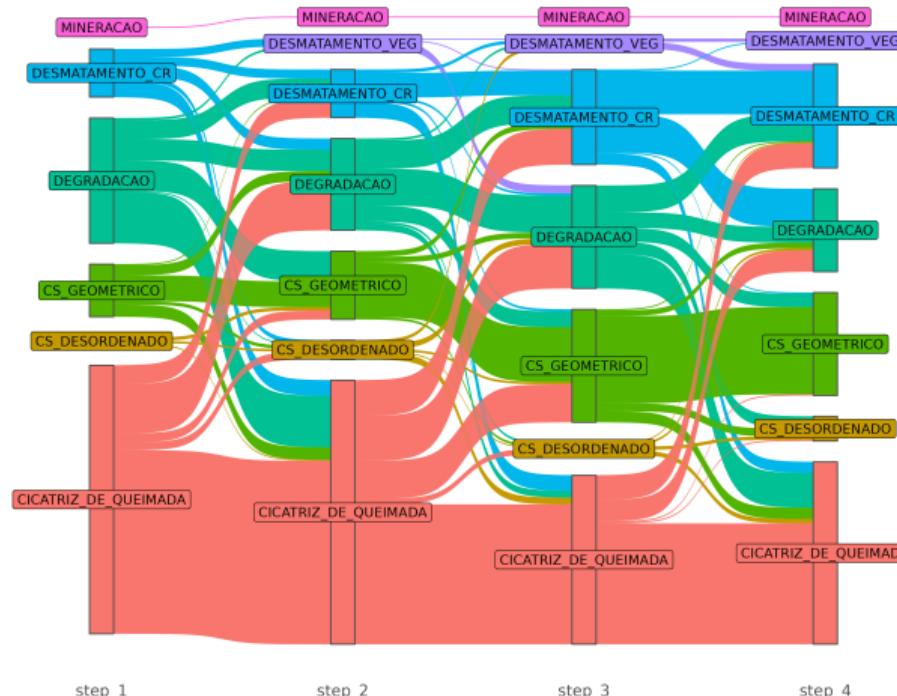
Trajectory of subareas with 2 wanings.

DETER subareas



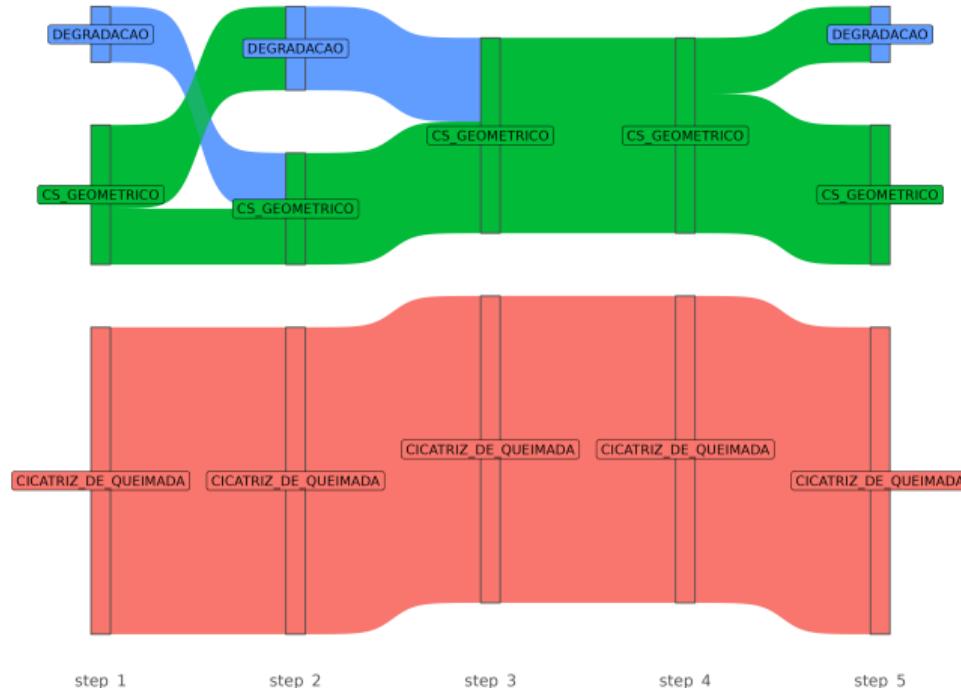
Trajectory of subareas with 3 wanings.

DETER subareas



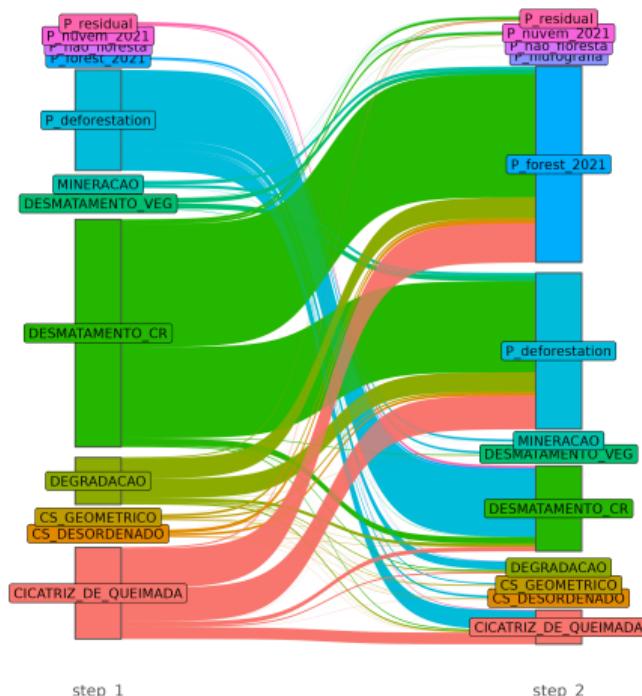
Trajectory of subareas with 4 wanings.

DETER subareas



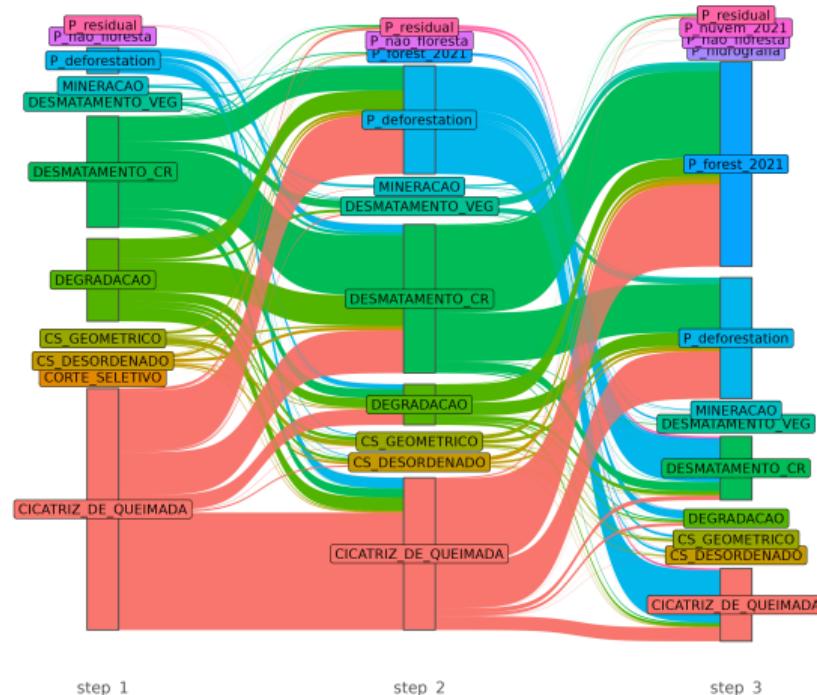
Trajectory of subareas with 5 wanings.

DETER - PRODES subareas



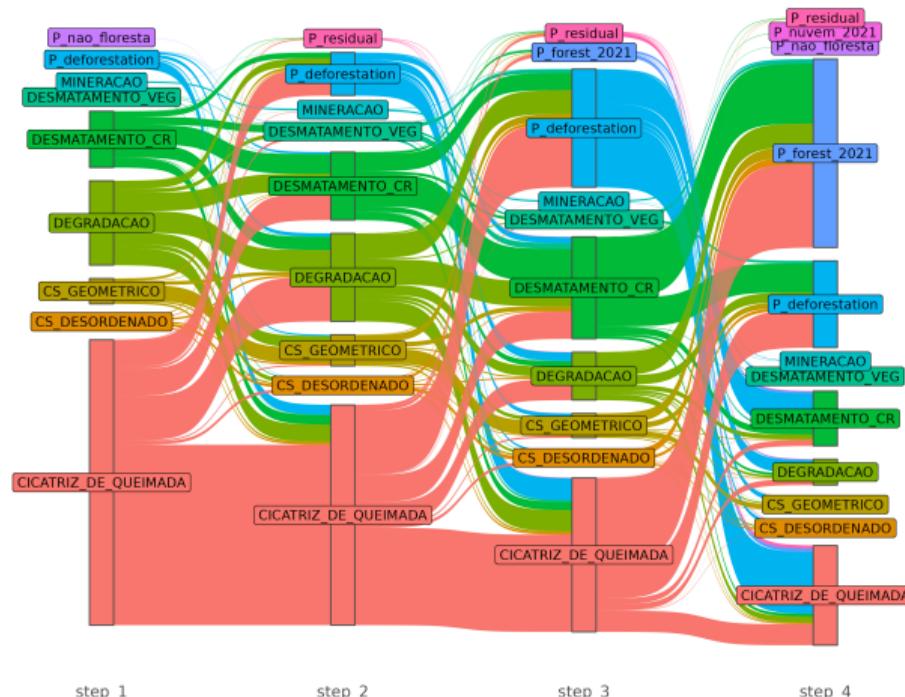
Trajectory of subareas with 2 wanings.

DETER - PRODES subareas



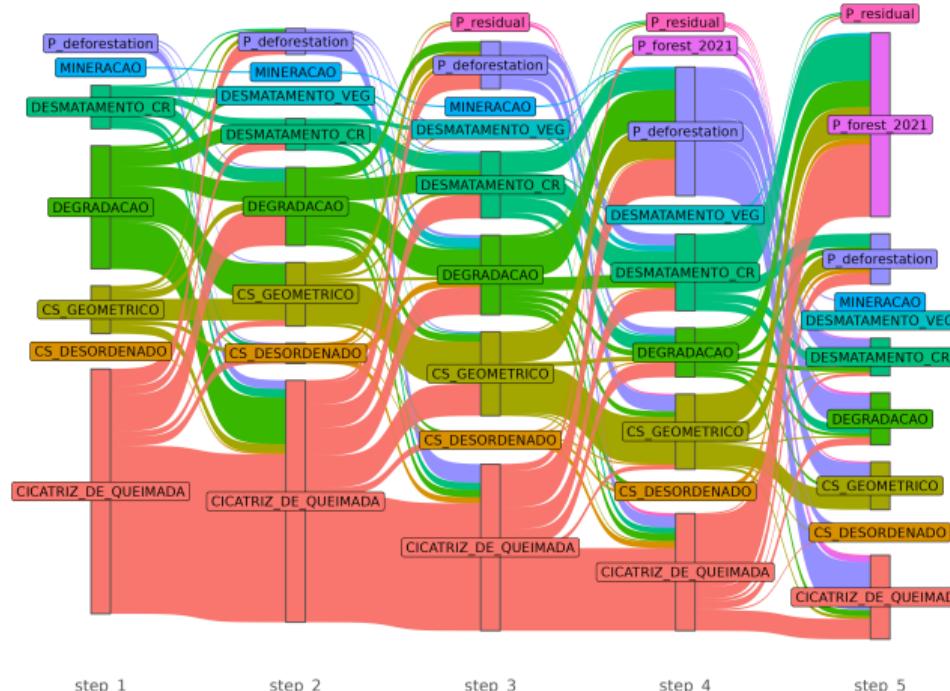
Trajectory of subareas with 3 wanings.

DETER - PRODES subareas



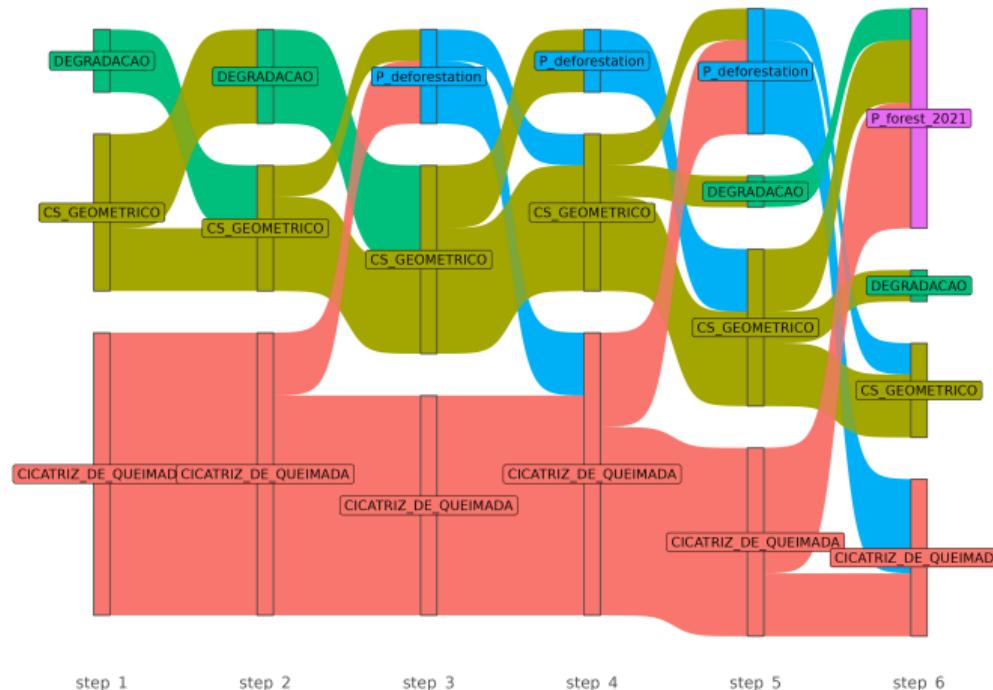
Trajectory of subareas with 4 wanings.

DETER - PRODES subareas



Trajectory of subareas with 5 wanings.

DETER - PRODES subareas



Trajectory of subareas with 6 wanings.

Final remarks

- ▶ The analysis of DETER warning subareas along time could improve the characterization of forest degradation along time.
- ▶ 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>

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 - 2a Edição (atualizada)*, Tech. report, Instituto Nacional de Pesquisas Espaciais (INPE), 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.