Exploratory analysis of recurrent deforestation warnings in the Brazilian Amazon

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XXI SIMPÓSIO BRASILEIRO DE SENSORIAMENTO REMOTO

Introduction

Current advances in Ecology, Remote Sensing, and Computer Science have enabled the development of regional, continental and global deforestation monitoring systems (e.g., DETER, MapBiomas, Global Forest Watch). However, detecting and monitoring forest degradation remains more challenging than detecting deforestation [Lambin 1999, Mitchell et al. 2017]. Given the importance of this issue, here we present the spatial distribution of recurrent forest degradation in the Brazilian Amazon, which could help address the challenges in detecting it. We think that deforestation real-time forest monitoring systems, such as DETER that continuously issues deforestation alerts, inadvertently captures forest degradation processes at various stages. The findings presented here are the results of processing 5 years of DETER alerts. This paper extends the findings introduced in [Sanchez et al. 2023].

Data

In our analysis, we used DETER data from August 2016 to July 2021. DETER has produced fast assessments of forest degradation and deforestation in the Brazilian Amazon since 2004 [Shimabukuro et al. 2006]. Figure 1 show an initial assesment of DETER data.

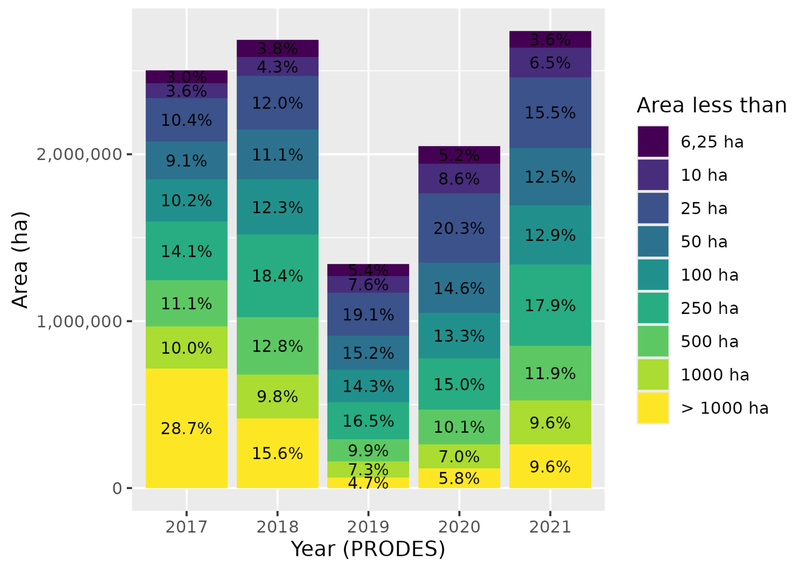

Figure 1: Area of DETER alerts by year and size. The total area covered by alerts peaked in 2018 and 2021 while the peak of largest areas was in 2017. Note the increasing trend since 2019 and how their area distribution is relatively homogeneous along in 2021.

Methods

- We downloaded DETER data from the TerraBrasilis portal [F. G. Assis et al. 2019].
- Then we self-intersected the data (union operation) and re-projected them to the coordinate reference system UTM 22s.
- We removed duplicated vertices and enforced the right-hand rule for polygons, and fixed geometry errors.
- We removed alerts smaller than 3 ha.
- We computed the PRODES year (August to July).
- The results are what we call subareas.

Results

Moreover, the number of DETER alerts during the same period shows a somewhat similar pattern, characterized by the fact that half of yearly DETER alerts are issued for small areas (Figure **??**).

From August to October is when most DETER alerts are issued, and September, the peak month, presents an increasing trend in area, reaching its maximum in 2021. This period corresponds to the fire season in most of the Brazilian Amazon [Carvalho et al. 2021] (see Figure **??**).

Most DETER subareas are issued a single alert and never more than five, following an exponential decay pattern.

The time period between DETER alerts in the same subarea is one year, except for subareas with two alerts, when it is two years (Figure 2).

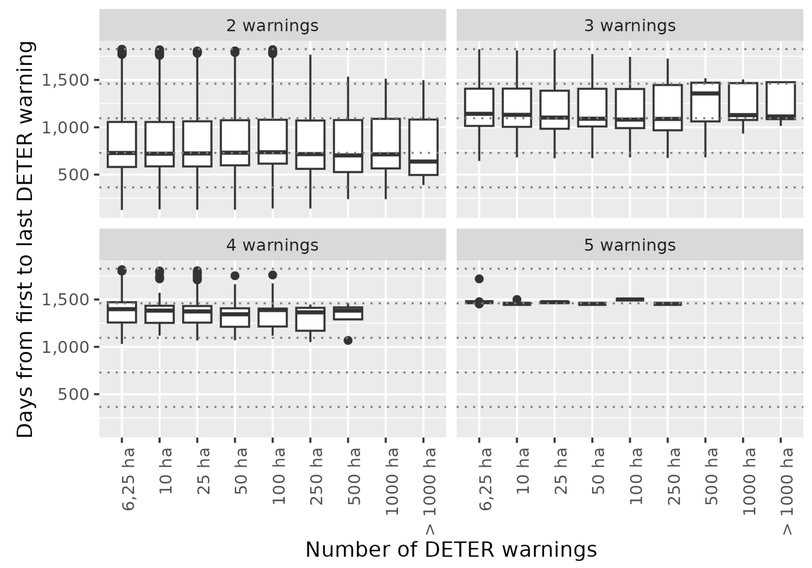

Figure 2: Number of days between the first and last DETER alerts. The horizontal dashed black lines represent intervals of 365 days. DETER subareas with 2 warnings tend to be two years apart and then increase one year with each additional alert. Also note that the distribution by area tend to have long tails towards longer periods between the first and lat DETER alert.

The map in Figure **??** shows the distribution of recurrent deforestation warnings, that is, a surface interpolation of the number of DETER alerts.

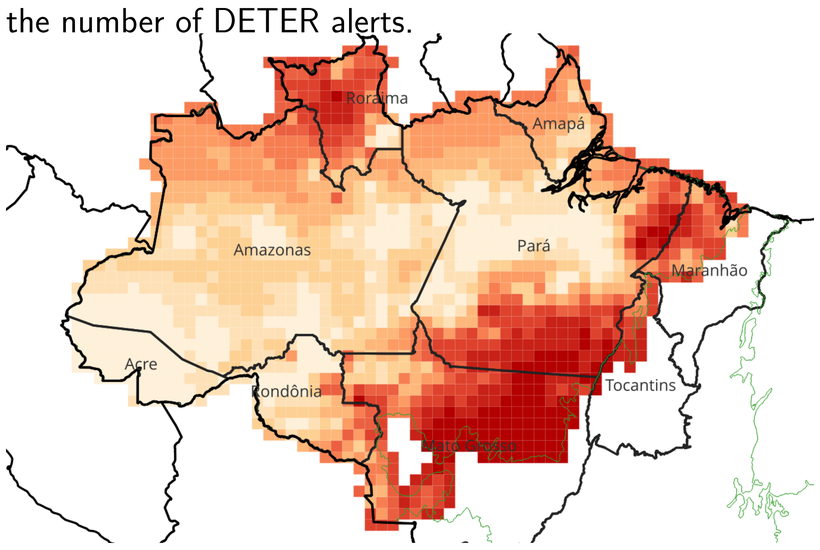

Figure 3: Spatial distribution of recurrent degradation (number of alerts by subarea) in the Brazilian Amazon. Amazon's east front is where most of recurrent DETER alerts area found.

Final remarks

TODO.

References

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[F. G. Assis et al. 2019] F. G. Assis, L. F., Ferreira, K. R., Vinhas, L., Maurano, L., Almeida, C., Carvalho, A., Rodrigues, J., Maciel, A., and Camargo, C. (2019). TerraBrasilis: A Spatial Data Analytics Infrastructure for Large-Scale Thematic Mapping. *ISPRS International Journal of Geo-Information*, 8(11):513.

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[Sanchez et al. 2023] Sanchez, A., Mataveli, G., Pontes-Lopes, A., Nogueira, S., and Aragão, L. (2023). Exploratory analysis of recurrent deforestation warnings in São Félix do Xingu - Brazilian Amazon. In *Anais Do XX Simpósio Brasileiro de Sensoriamento Remoto*, pages 2821–2824, Florianópolis, SC, Brazil.

[Shimabukuro et al. 2006] Shimabukuro, Y., Duarte, V., Anderson, L., Valeriano, D., Arai, E., Freitas, R., Rudorff, B., and Moreira, M. (2006). Near real time detection of deforestation in the Brazilian Amazon using MODIS imagery. *Ambiente e Agua - An Interdisciplinary Journal of Applied Science*, 1(1):37–47.

Links

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- Email: alber.ipia@inpe.br
- Code: `https://github.com/albhasan/prioritizedeforestationhotspots`