Methods for estimating the peak season in time series data

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Outline

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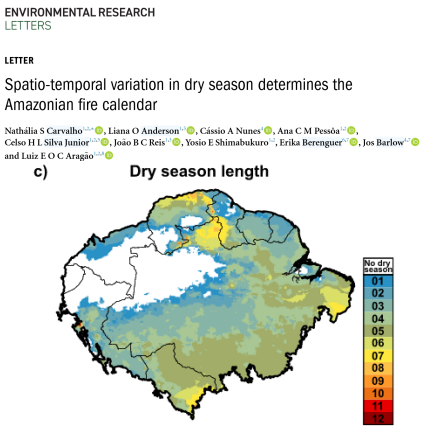
Introduction

- Better estimations of the fire season in the Amazon forest could foster better town planing and improve responses to excessive fire smoke.
- Previous studies focused on the dry rather than the fire season and its regional patterns.
- Besides, it is common practice to assume a fixed fire season.
- We present pixel-wise estimation of the fire season in the Amazon based on fire spot detected by VIIRS.
- We developed a new method for estimating peak-seasons given intensity data over time.

Deforestation by slash and cut (*Corte e queima*). Source: [DAMV+22].

Amazon fire calendar

- Stratification of the Amazon basin according to the dry season start and end.
- It uses the mean monthly rainfall (CHIRPS) from 1989 to 2019 over a 10 km grid.
- The dry season is made of the consecutive months with rainfall below 100 mm.
- Regions are neighborhoods of pixels with the same start and end.
- Their results are available online online.



Source: [CAN+21].

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Software

- R language [IG96].
- R packages *dplyr* and *ggplot2*.
- R packages for vector (*sf* [Peb18]) and raster (*terra* [Hij20]) data.
- R package *sicegar* for double sigmoid regression [CTW18].
- Analysis code available on GitHub.

Data

- We used fire data from VIIRS NPP.

Peak and threshold

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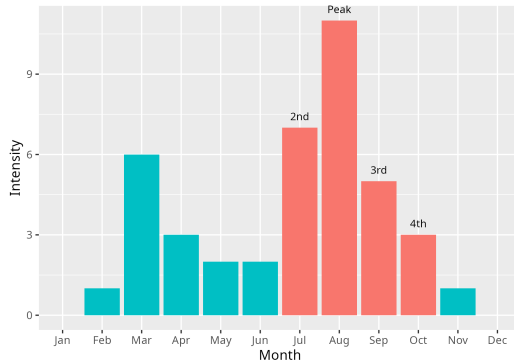
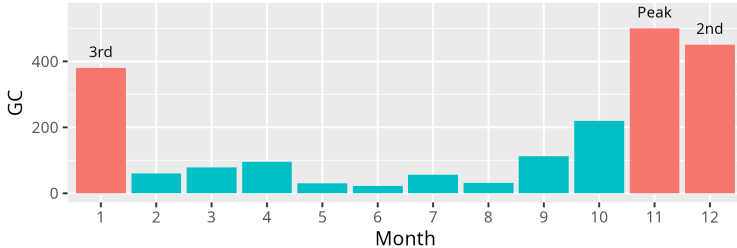
- Proposed by Guilherme Mataveli.
- A season is a subset of contiguous months that host the peak and at least 60% of the total intensity (observations) of a phenomenon.



Peak and threshold example

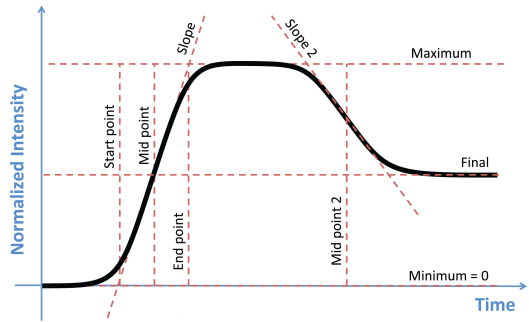
Month	GC
1	380
2	60
3	78
4	96
5	30
6	22
7	56
8	32
9	112
10	220
11	500
12	450



Iteration	Test Months	Chosen	Season	Cum. Sum
1	Peak	11	11	500 (25%)
2	10 or 12	12	11-12	950 (47%)
3	10 or 1	1	11-12-1	1330 (65%)

Double sigmoidal fitting

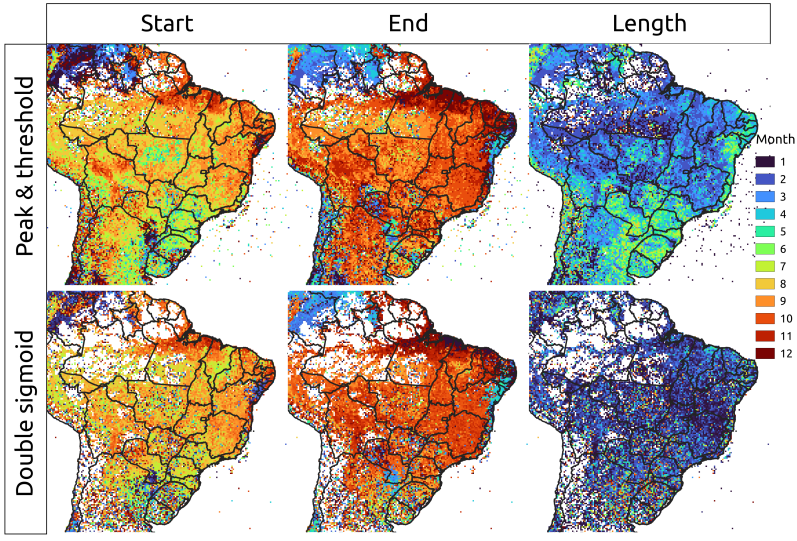
- Input data represents intensity measured over time.
- Growth happens in two phases: exponential intensity increase until level off at a maximum level (first sigmoid function); decay to a lower intensity or even zero (second sigmoid).
- The midpoints are assumed as the start and end of the season.



Source: [CTW18].

Outline

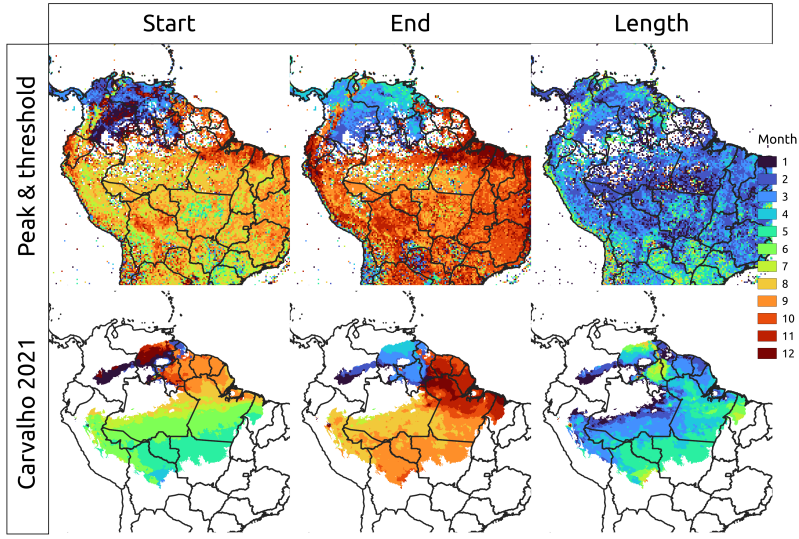
Results


Start
End
Length
Peak & threshold
Double sigmoid
Month
1
2
3
4
5
6
7
8
9
10
11
12

Result comparison

- Carvalho et al., [CAN+21] is actually about the establishing the dry and rainy seasons rather than the fire season.
- They use the fire spots to validate their results.
- Instead, we're using the fire spots to estimate the fire season and use [CAN+21], to validate them.

Result comparison



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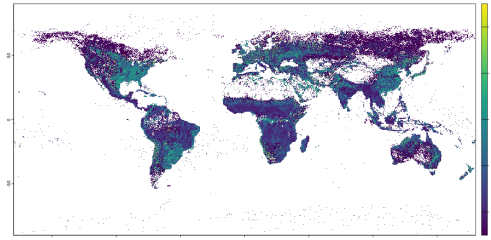
Final remarks

- We ran both methods for the world.
- Both peak & threshold and double sigmoid methods can be employed to estimate season of Earth Observation phenomena besides fire.
- Source code available at https://github.com/albhasan/seasonmetrics.



Length of the fire season using Peak & Threshold.

References I

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References II

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- Ross Ihaka and Robert Gentleman, *R: A Language for Data Analysis and Graphics*, Journal of Computational and Graphical Statistics **5** (1996), no. 3, 299.
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