Characterization of deforestation patterns in Amazon

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Abstract

Amazon rainforest has been subject to intensive deforestation in the last decades, for example, illegal logging and creating pasture areas. A characteristic pattern of deforestation seen from space is the "fishbone" shape, which usually appears near roads, rivers and its tributaries. Indeed, others, more subtle, still need to be identified. These fishbone images are spatiotemporal patterns that need to be more explored with feature extraction methods. In computer vision, morphological features such as flatness, compactness, circularity, perimeter, area, and centroid are well-known to characterize the appearance of an object. In this work, we aim to characterize the shapes of deforestation in its early stages and its evolution in time, particularly in the Amazon rainforest. Thus, we propose to analyze satellite images of these regions to crop and segment by using shape features.

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TEIXEIRA, M.[1,3] (iD) ; MACHICAO, J.[2] (iD) ; BASTOS, R.[2] (iD) ; MARQUES, A.[2] (iD) ; ALMEIDA, F.[2] (iD) ; ALMEIDA, W.[2] (iD) ; FRANCO, M[1,3] (iD) ; CORRÊA, P.[2,3] (iD) ; MACHADO, L.[1,3] (iD)

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MOTIVATION

The objective of this work is to identify deforestation patterns using statistical and machine learning techniques. Inputs are yearly images of land use and land coverage (LULC) from MapBiomas platform.

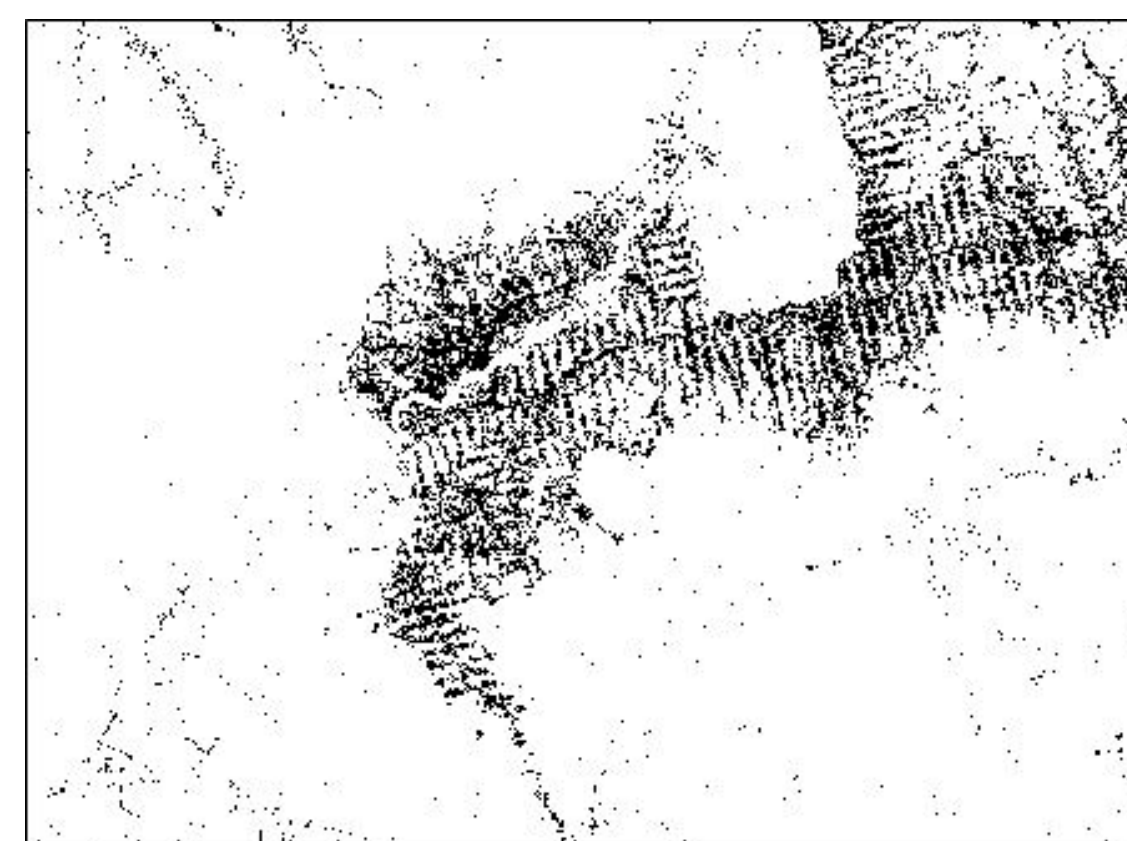Two regions of interest (ROIs) were selected with relatively low and high deforestation
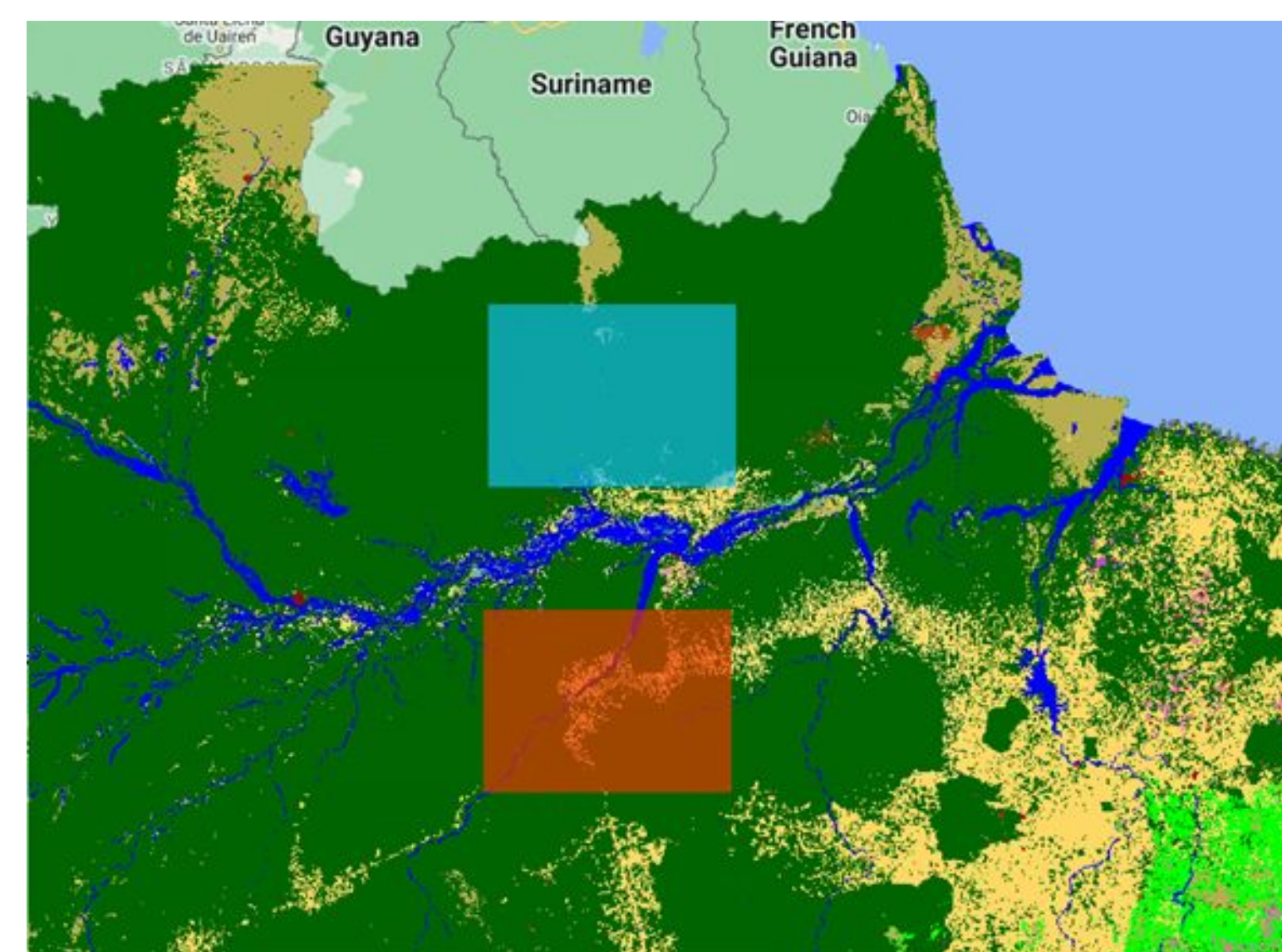
ROIs in the Amazon rainforest (blue and red rectangles) in 2020. Yellow shows deforestation areas. Resolution: 30 m / pixel *Source: MapBiomas*
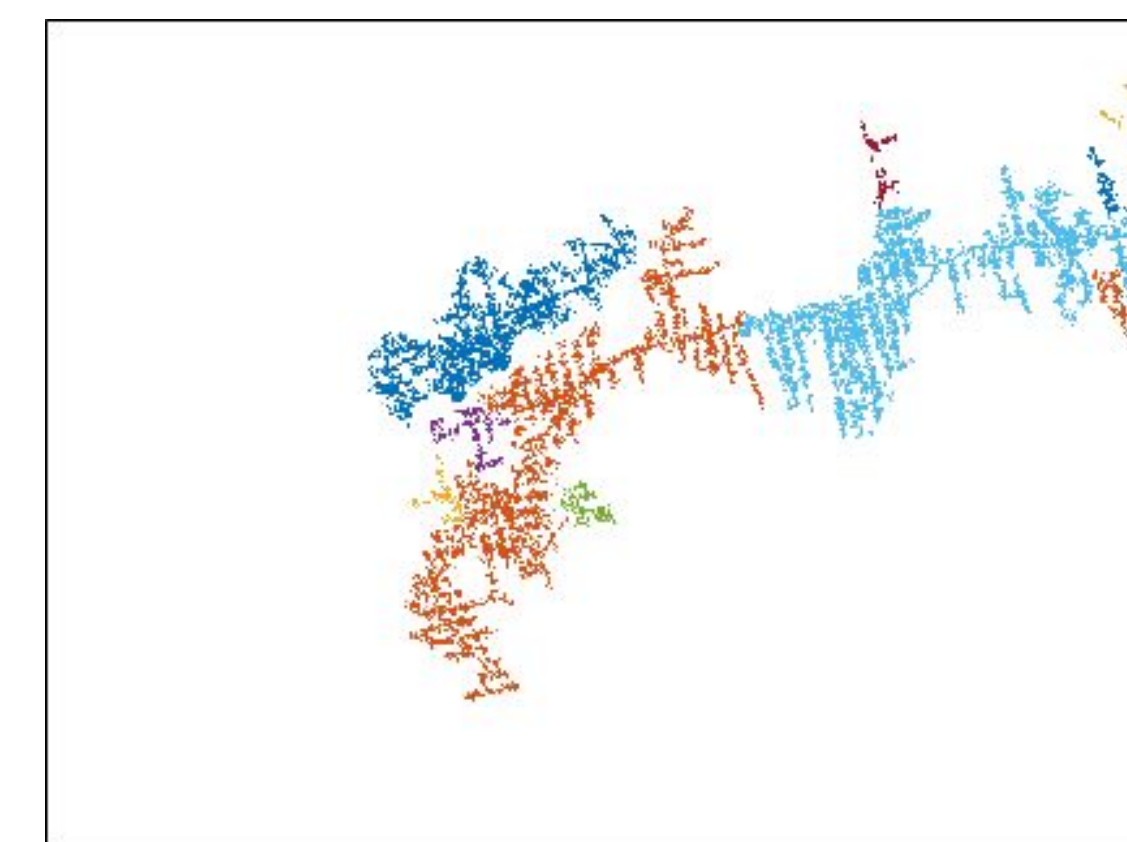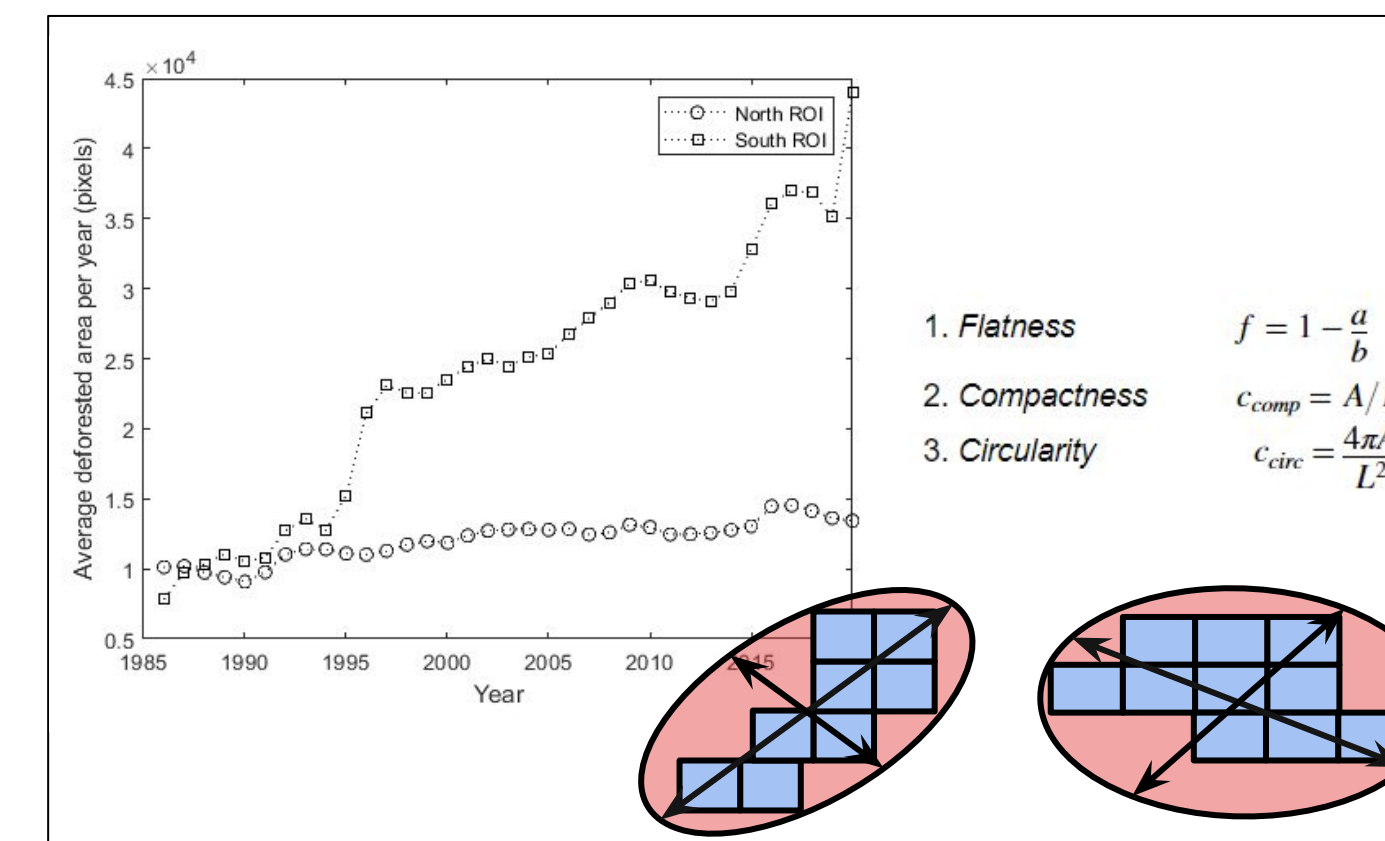
METHODOLOGY
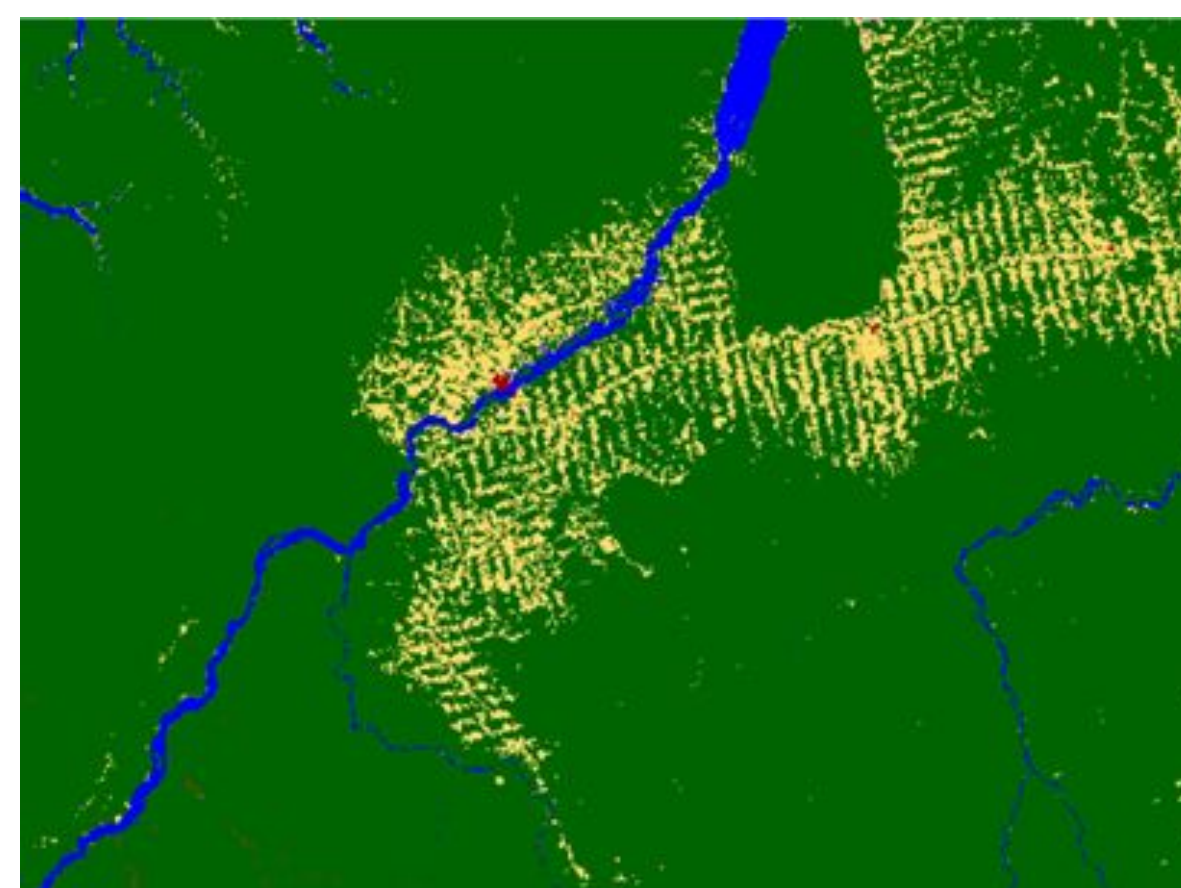
Step 1: select ROI and year

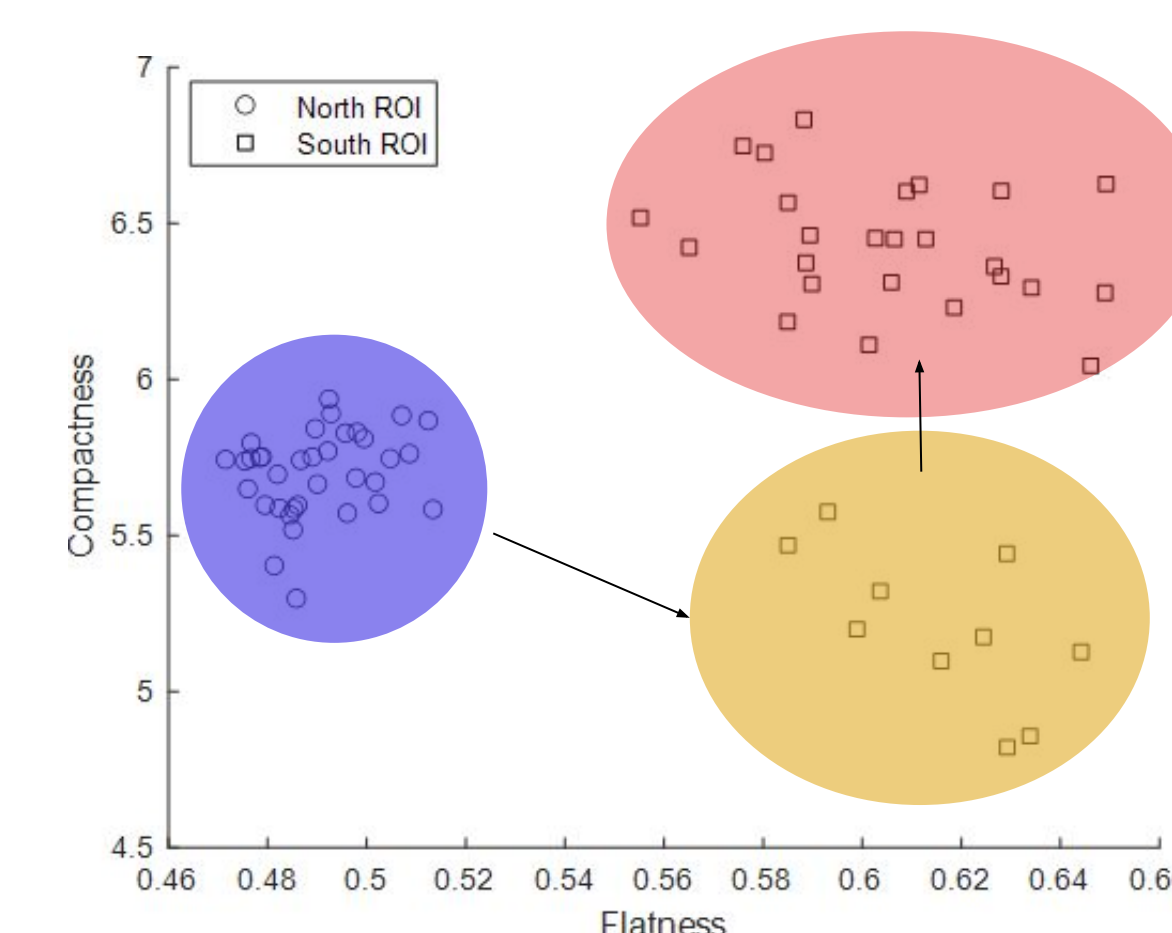Step 2: binarize (deforestation = 1; else = 0) and filter (less than 20 pixels)

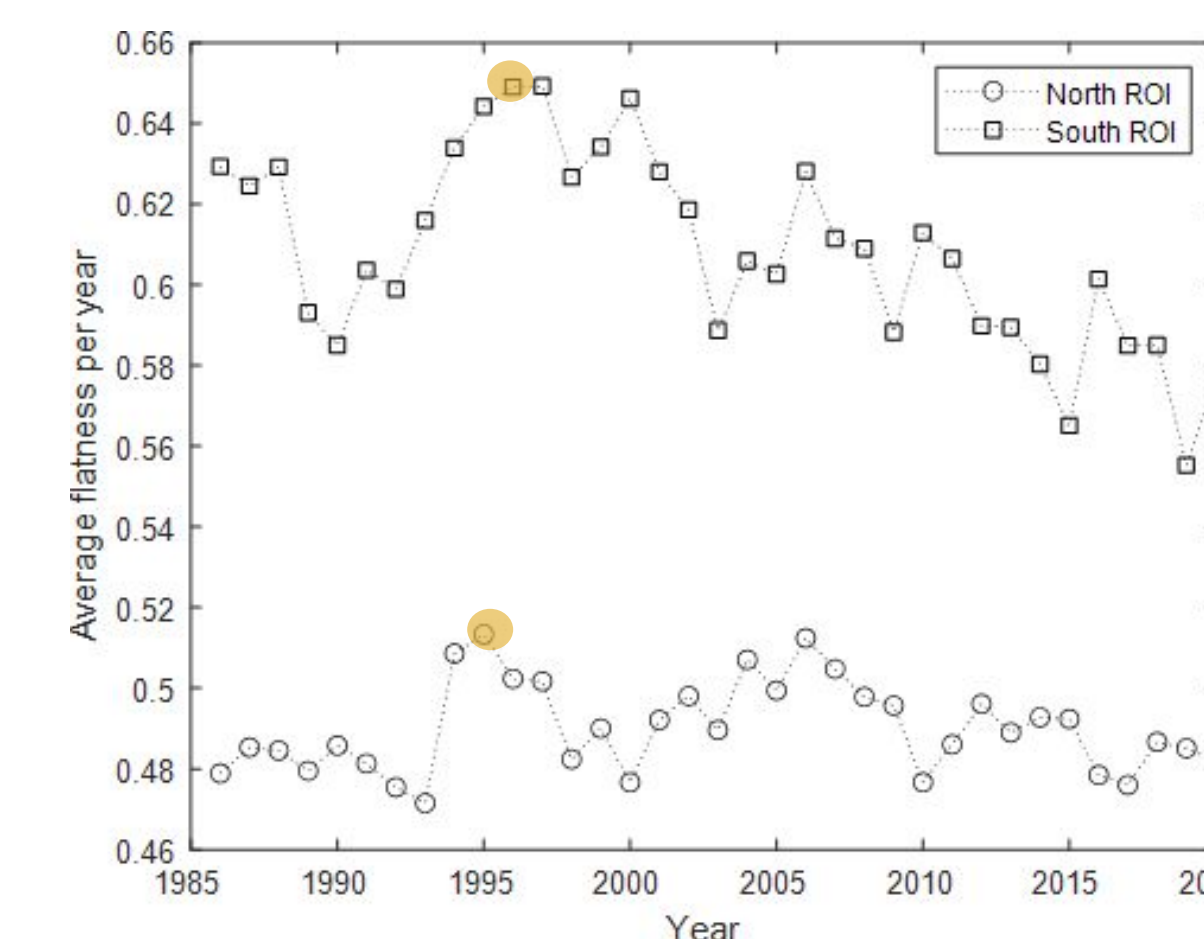
Step 3: Label deforested areas (shown top 10)

Step 4: Get metrics, statistics and time series for ROIs

1. *Flatness* $f = 1 - \frac{a}{b}$
2. *Compactness* $c_{comp} = A/L$
3. *Circularity* $c_{circ} = \frac{4\pi A}{L^2}$

PRELIMINARY RESULTS

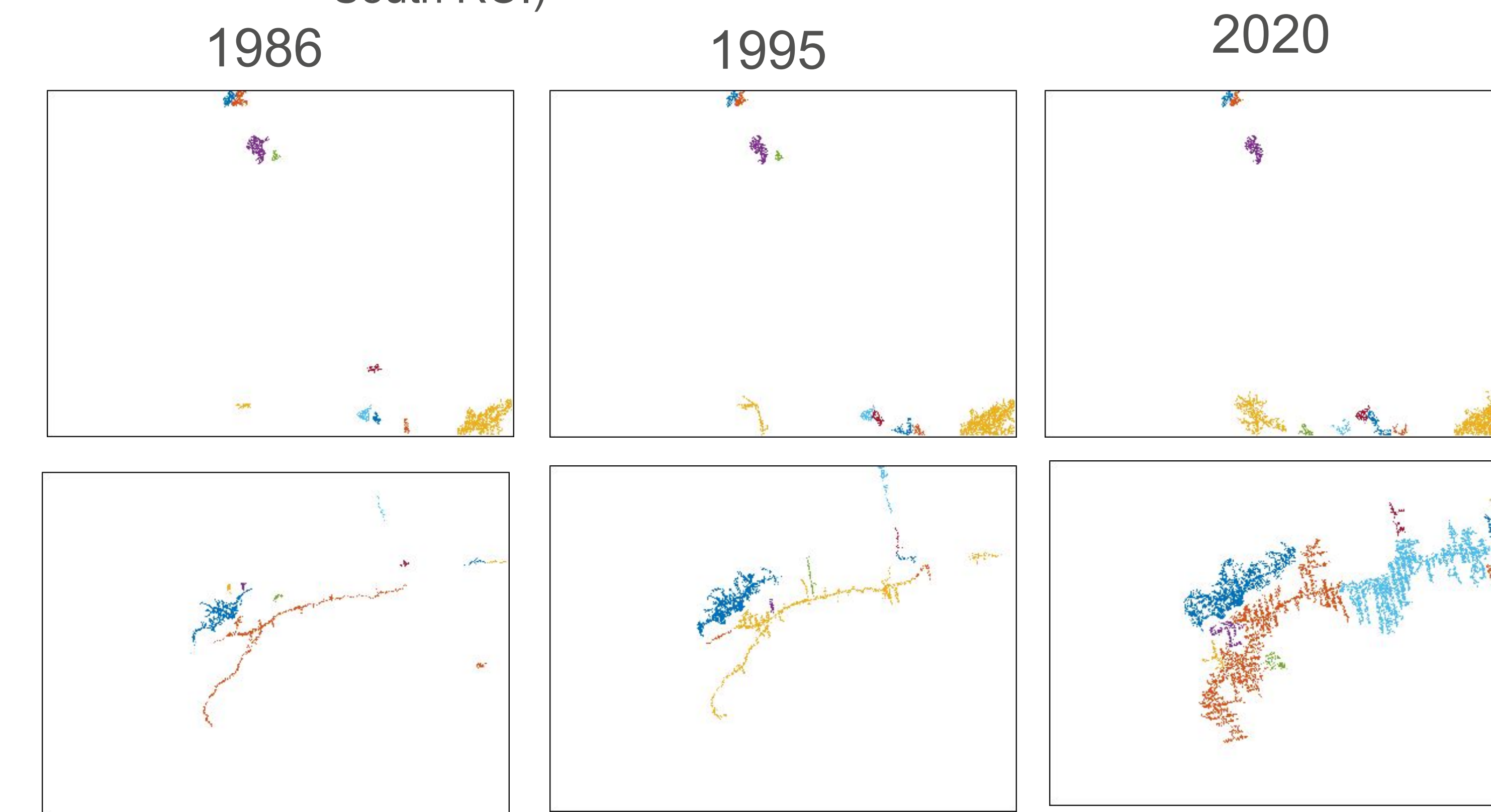Average of top 100 deforested areas in both ROIs

Features to feed deep learning (DL) model (clusters)

Fishbone deforested areas show higher flatness

Deforestation (Top panels North ROI; Bottom South ROI)

1986   1995   2020

FUTURE ACTIVITIES

- Track the deforestation patterns along time and correlate with LULC
- Correlate multiple deforestation patterns using metrics (flatness, compactness etc.)
- Train a DL model using identified metrics
- Use the trained model to forecast deforestation and use as input to Earth System Model - CESM

References:
[1] MapBiomas: https://plataforma.brasil.mapbiomas.org/. Accessed on 13-Sep-22
[2] Castleman, K. R. (1996). *Digital image processing*. Prentice Hall Press
[3] Ball, J. G. C., Petrova, K., Coomes, D., & Flaxman, S. (2021). *Using deep convolutional neural networks to forecast spatial patterns of Amazonian deforestation*. bioRxiv., https://doi.org/10.1101/2021.12.14.472442. Accessed on 13-Sep-22

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