The Total Operating Characteristic requires updates to its use and software

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Outline

- Terminology
- Background
- Research Objectives
- Case Study
- Literature Analysis
- Conclusions

Terminology

TOC - Total Operating Characteristic

AUC - Area Under the Curve

Hit - simulated presence and actual presence

Miss - simulated absence and actual presence

False alarm - simulated presence and actual absence

Correct rejection - simulated absence and actual absence

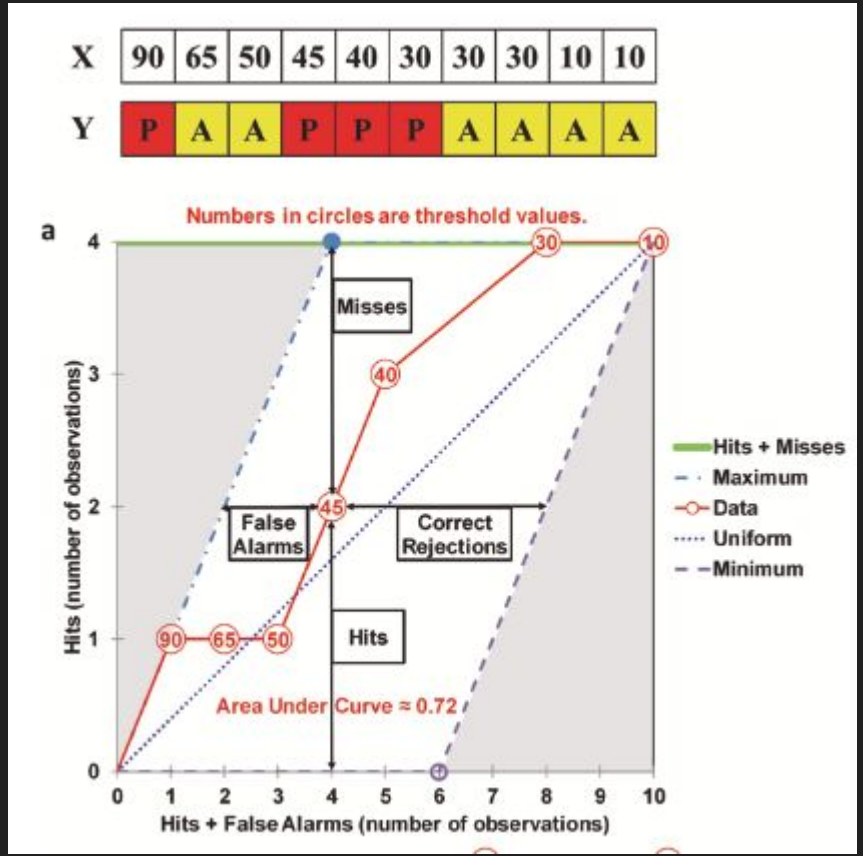
Temporary crops - crops with a growing cycle of less than one year

Background

The Total Operating Characteristic (TOC) was designed to analyze land cover change over a given time interval (Pontius Jr & Si, 2014).

Inputs to TOC:

- Index raster with ranked pixels
- Boolean raster with pixels that changed
- Mask raster with pixels eligible for change



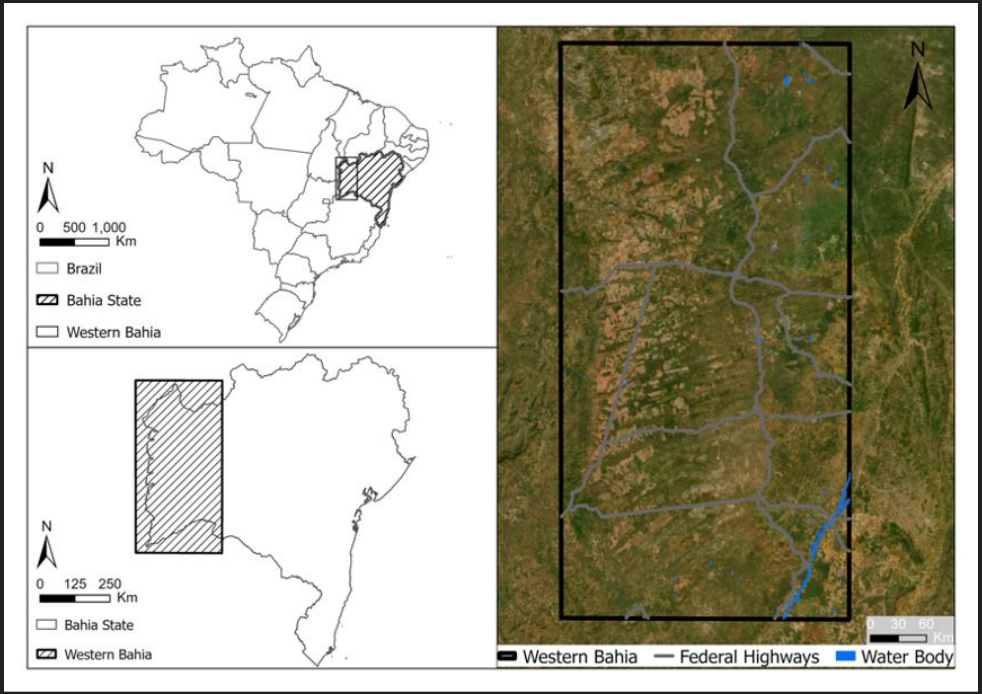
Pontius Jr, R. G. (2022). Metrics that make a difference. Springer Nature Switzerland AG: Cham, Switzerland.

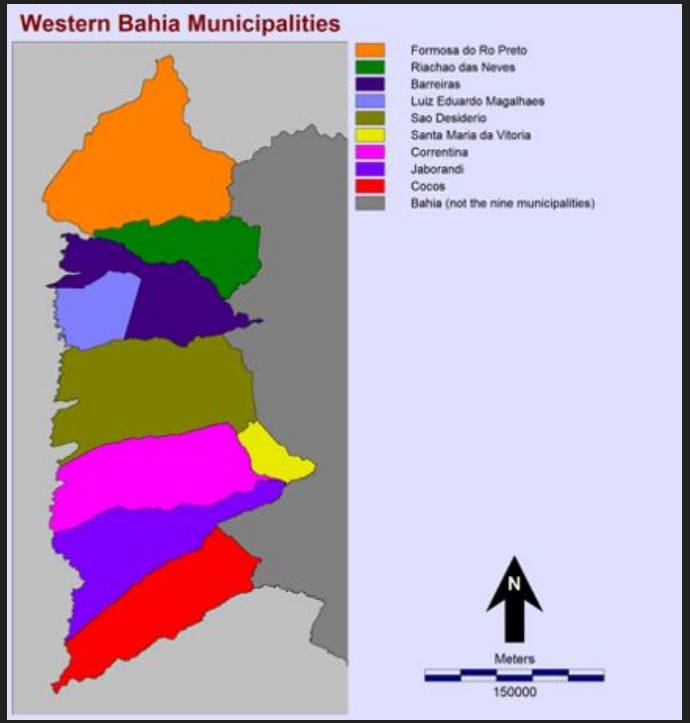
Research Objectives

Demonstrate the correct use of TOC

Analyzes publications on their use of TOC

Case Study



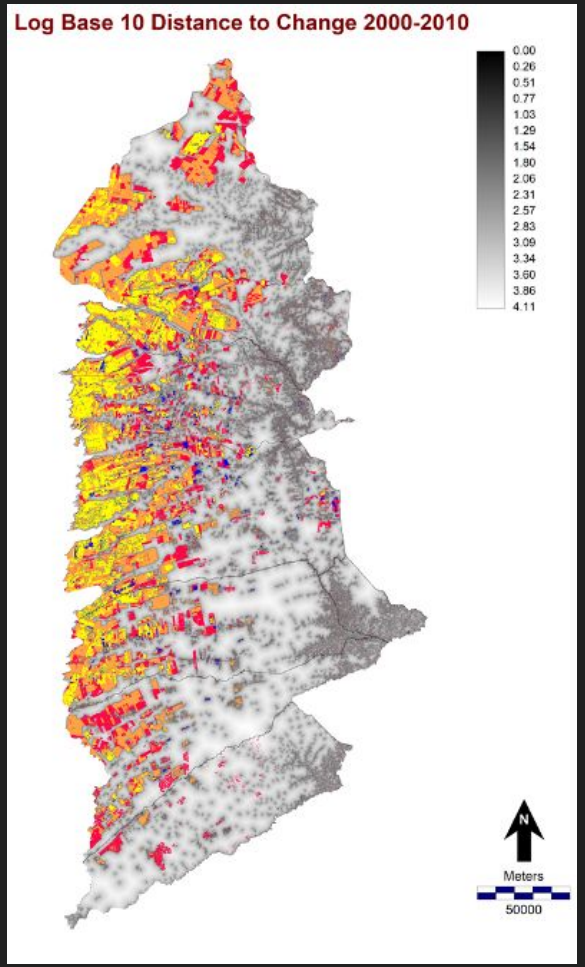


Pontius Jr, Robert Gilmore, Thomas Bilintoh, Gustavo de L. T. Oliveira, Julia Z. Shimbo. 2023. Trajectories of losses and gains of soybean cultivation during multiple time intervals in western bahia, BRAZIL. Space Week Nordeste. Fortaleza, Brazil.

Case Study

This study analyzes temporary crops from 2000-2010 and from 2010-2020.

The data is at a 30 meter resolution.

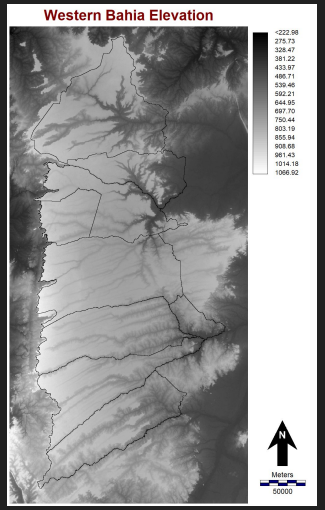


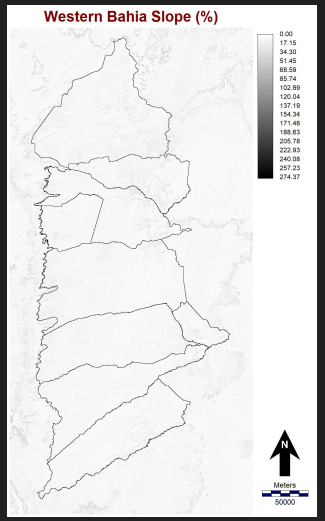
Yellow: Persistence from 2000-2010
Orange: Gain from 2000-2010
Blue: Loss from 2000-2010
Red: Gain from 2010-2020
Black Pixels are closest to change
White pixels are the furthest from change

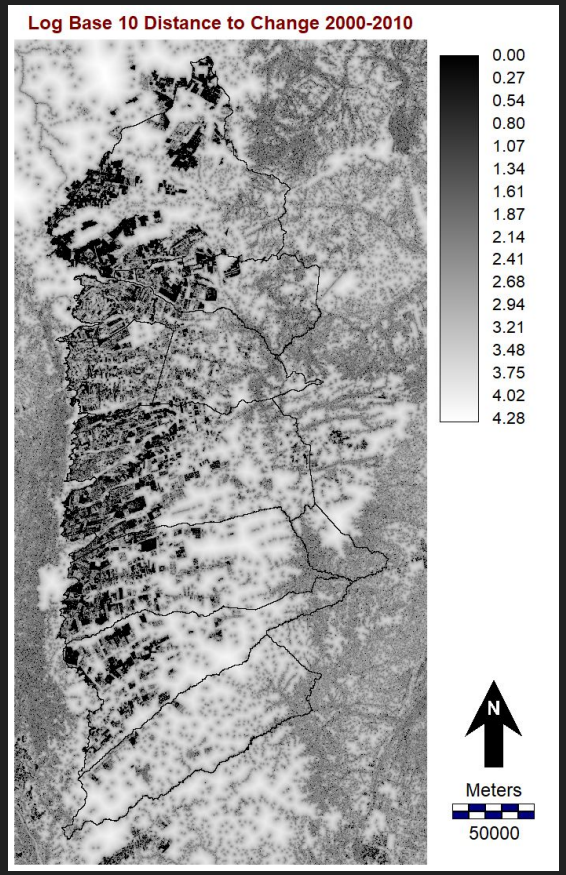
Methods

Case Study

- A calibration period from 2000-2010 and a validation period from 2010-2020 are used in the creation of 2 models.
  - Model 1 uses Distance to Change from 2000-2010.
  - Model 2 uses the Multi-Layer Perceptron with Distance to Change 2000-2010, Elevation, and Slope as drivers.
- The results are compared using TOC.







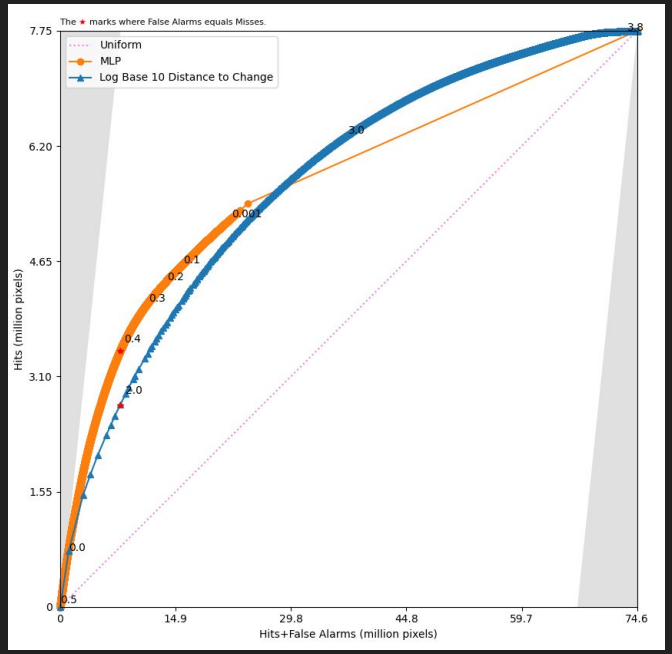
Methods

Literature Analysis

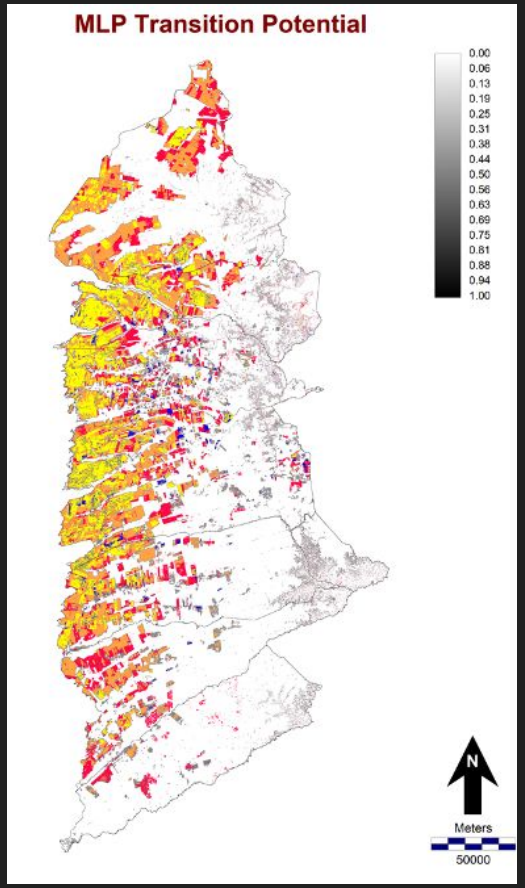
- Analyze 10 publications which cite Pontius & Si, 2014 and use TOC in the analysis
- Use the 7 best practices below to assess

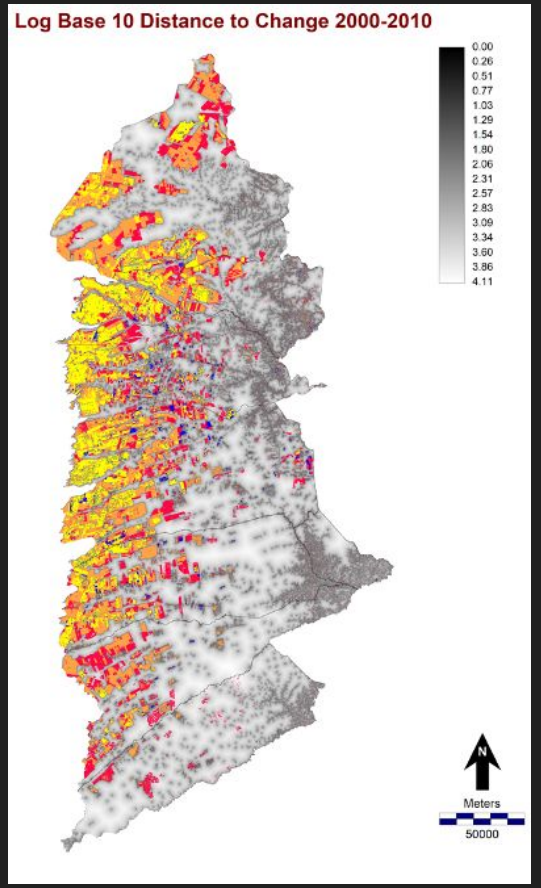
ID	Description
1	Assesses data quality in an appropriate manner
2	Shows the maps in a clear manner
3	Masks pixels that are not candidates for the particular type of change
4	Avoids using AUC to claim model performance such as acceptable, fair, good, excellent
5	Shows the TOC curve as opposed to the ROC curves
6	Interprets the shape of the TOC curve to the left of the point of true quantity versus to the right of the point of true quantity
7	Compares a baseline suitability map to an alternate suitability map

Case Study Results



AUC of Distance to Change: 0.766
AUC of MLP: 0.755





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Publication	**Criteria ID**							
	1	2	3	4	5	6	7	Total ✓
Chen et al. (2020)	X	X	X	X	X	X	X	**0**
Estoque & Murayama (2016)	X	✓	?	X	X	?	X	**1**
Zhuang et al. (2022)	✓	✓	?	X	X	X	X	**2**
Chakraborti et al. (2018)	X	✓	X	X	✓	X	X	**2**
Amato et al. (2018)	X	✓	?	?	✓	?	X	**2**
Naghibi et al. (2016)	X	✓	X	✓	✓	X	X	**3**
Kamusoko & Gamba (2015)	✓	✓	✓	X	✓	X	?	**4**
Deng & Quan (2022)	✓	✓	X	✓	✓	?	X	**4**
Shojaei et al. (2022)	X	✓	✓	✓	✓	X	✓	**5**
Cushman et al. (2017)	✓	✓	✓	✓	✓	?	✓	**6**
Total ✓	**4**	**9**	**3**	**4**	**7**	**0**	**2**	

None of the selected publications use all of the best practices.

9 out of 10 publications show the maps in a clear manner.

Only 2 out of 10 compare a baseline suitability map to an alternate suitability map.

Conclusions

Further research concerning an alternative to TOC needs to be done.

- TOC does not work well with the Multi-Layer Perceptron.

The best practices outlined are sometimes followed.

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Professor Pontius, Professor Williams, and Thomas Bilintoh provided advice for this work.

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MapBiomas provided data for free.

Thank you

Questions?