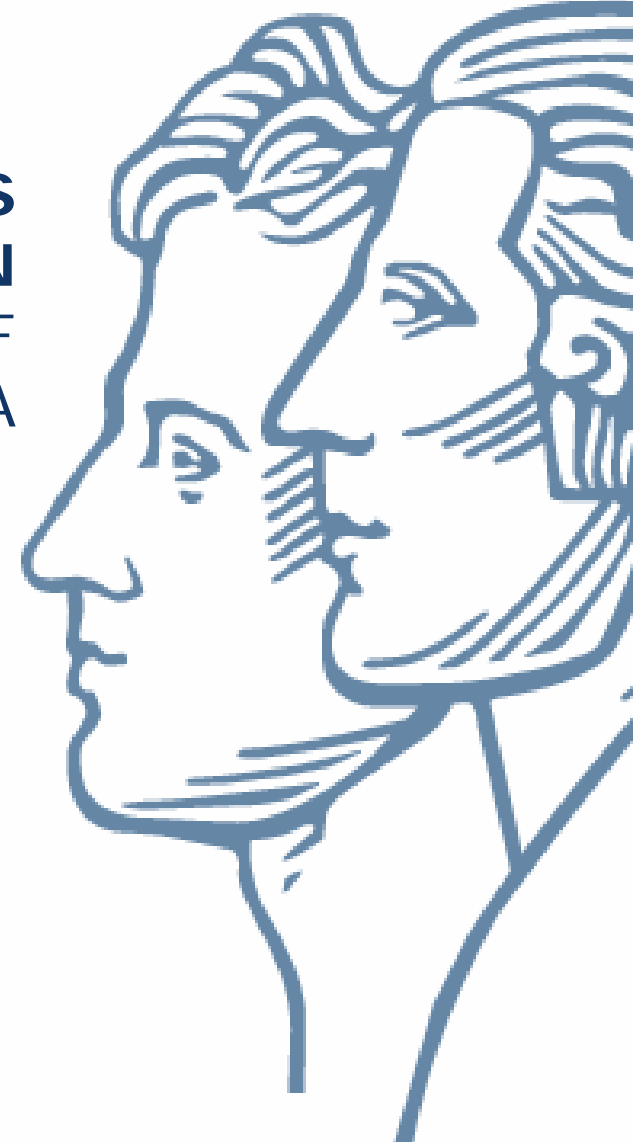# SECONDARY VEGETATION DYNAMICS IN THE BRAZILIAN AMAZON
DERIVED FROM A 28-YEAR RECORD OF LANDSAT TM AND ETM+ DATA

Philippe Rufin, Hannes Müller,
Dirk Pflugmacher, Patrick Hostert
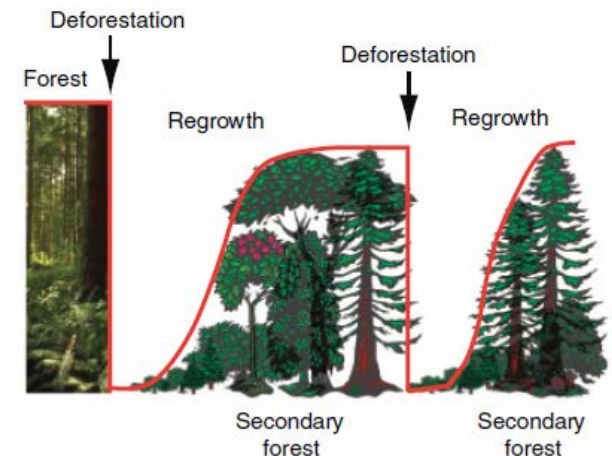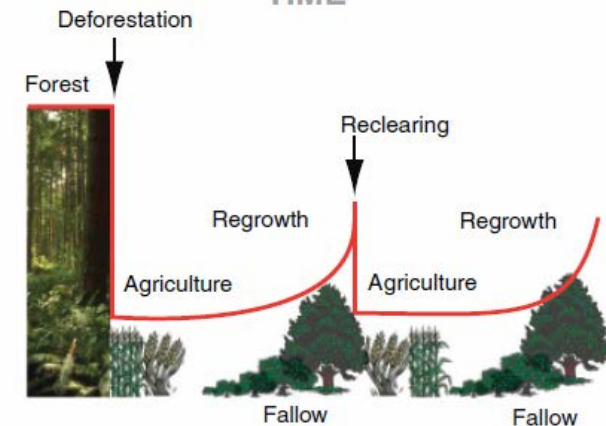
*Geography Department
Humboldt-Universität zu Berlin*

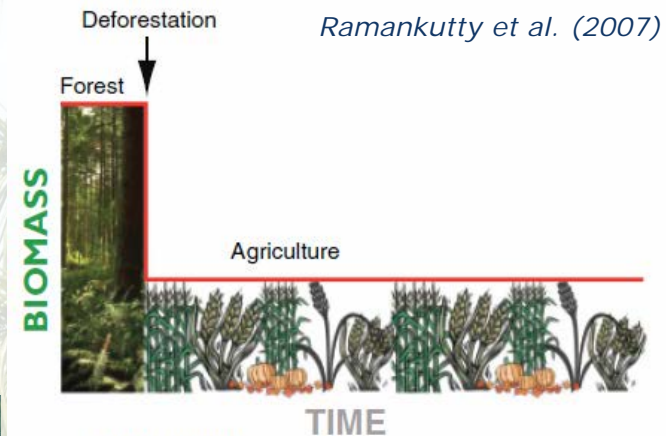# **Rationale:** Secondary Vegetation

Ramankutty et al. (2007)

→ Post-deforestation vegetation dynamics are complex and depend on growth rates and land management.

→ Knowledge on spatial and temporal configuration of tropical secondary vegetation is sparse.

Rationale: Objectives

A 28-year time-series of Landsat TM & ETM+ imagery (1985 – 2012) was used to:

1) Capture regional scale secondary vegetation trajectories in the extensive pastoral system of southern Pará.

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2) Perform a large-scale analysis of the spatial configuration of secondary vegetation over a gradient of land use systems.

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1) **Methods:** Metrics Computation

Computation of annual statistical metrics from cloud-free observations (Griffiths et al. 2013).

Vegetation phenology allows for distinction of spectrally similar land cover types

(Müller, Rufin et al. 2015).

Dry-season temporal window (DOY 145-250) to emphasize relevant phenological characteristics (Rufin et al. 2015).
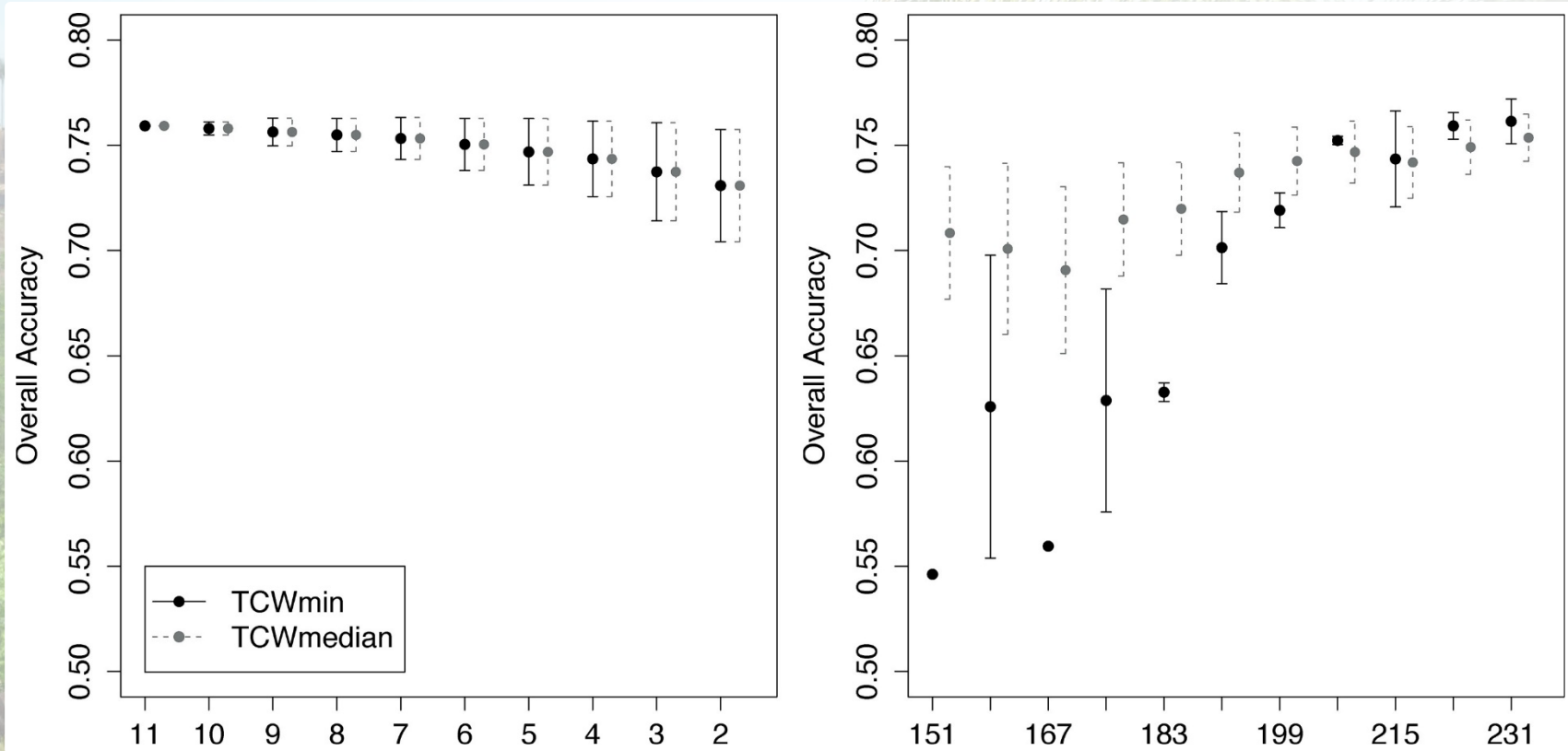

Rufin et al. (2015)

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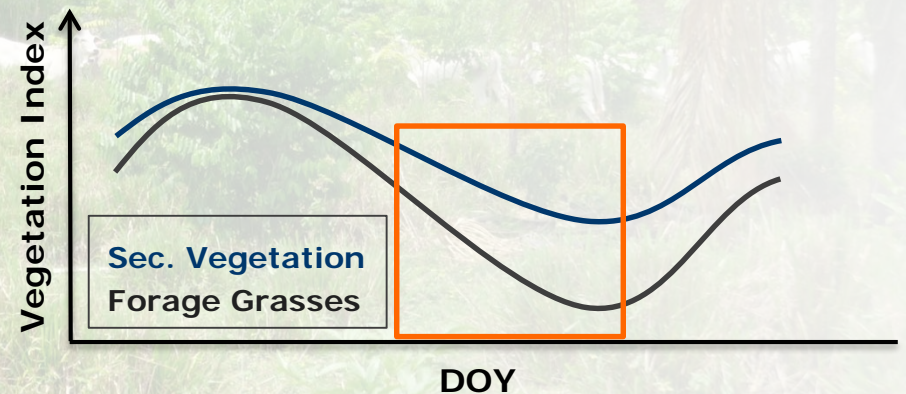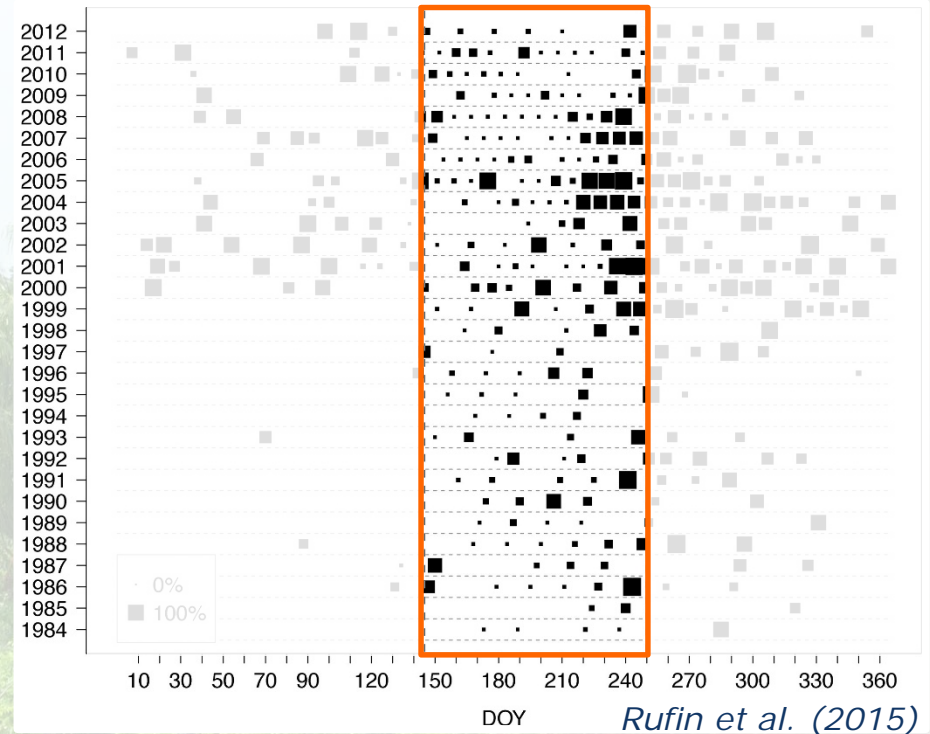
Methods: Secondary Vegetation Phenology

- Landsat TCW data (2008)

- 10,000 samples of grass-dominated areas (bright grey) and secondary vegetation (dark grey)
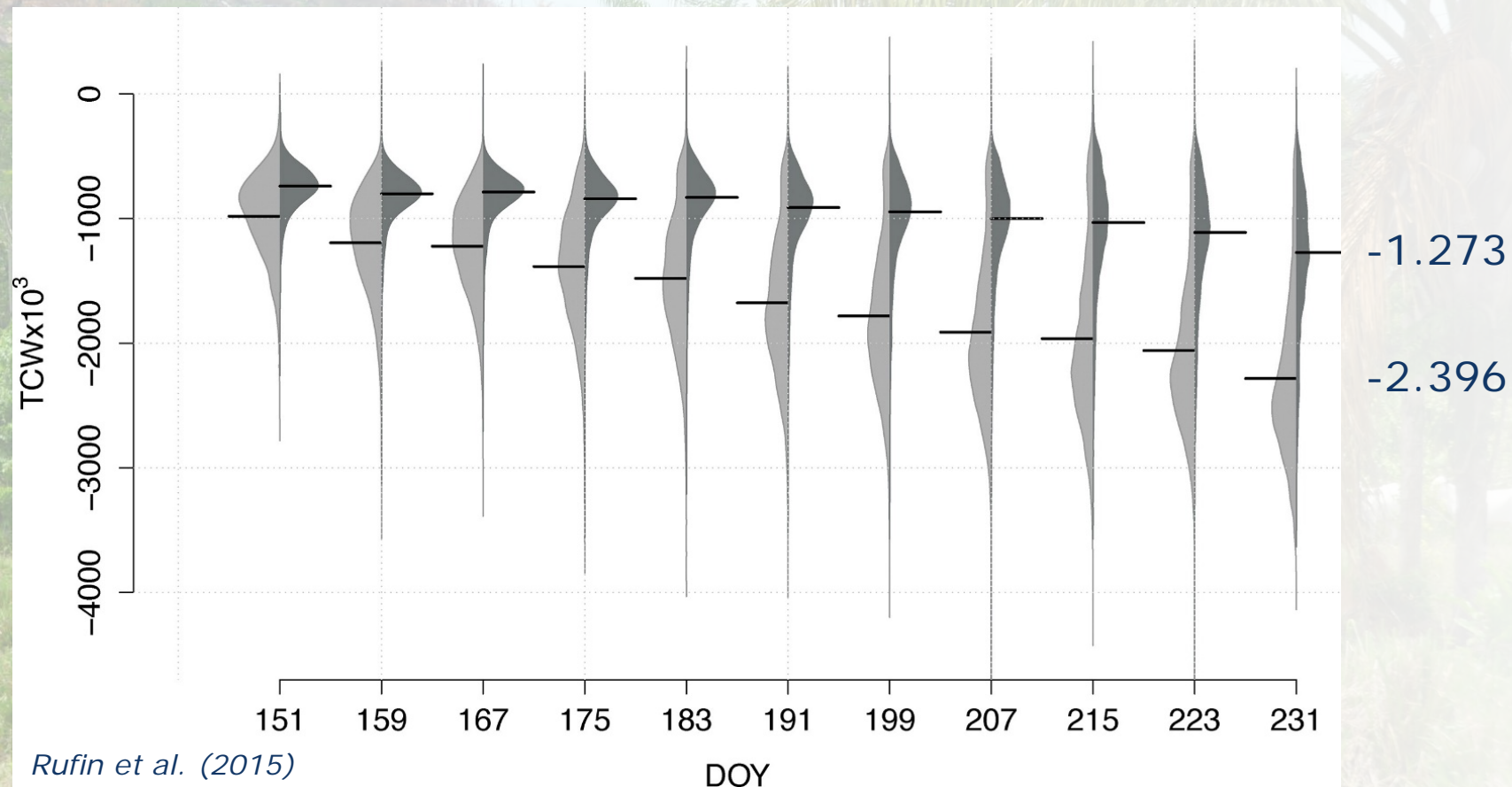
Rufin et al. (2015)

Methods: Metrics Robustness

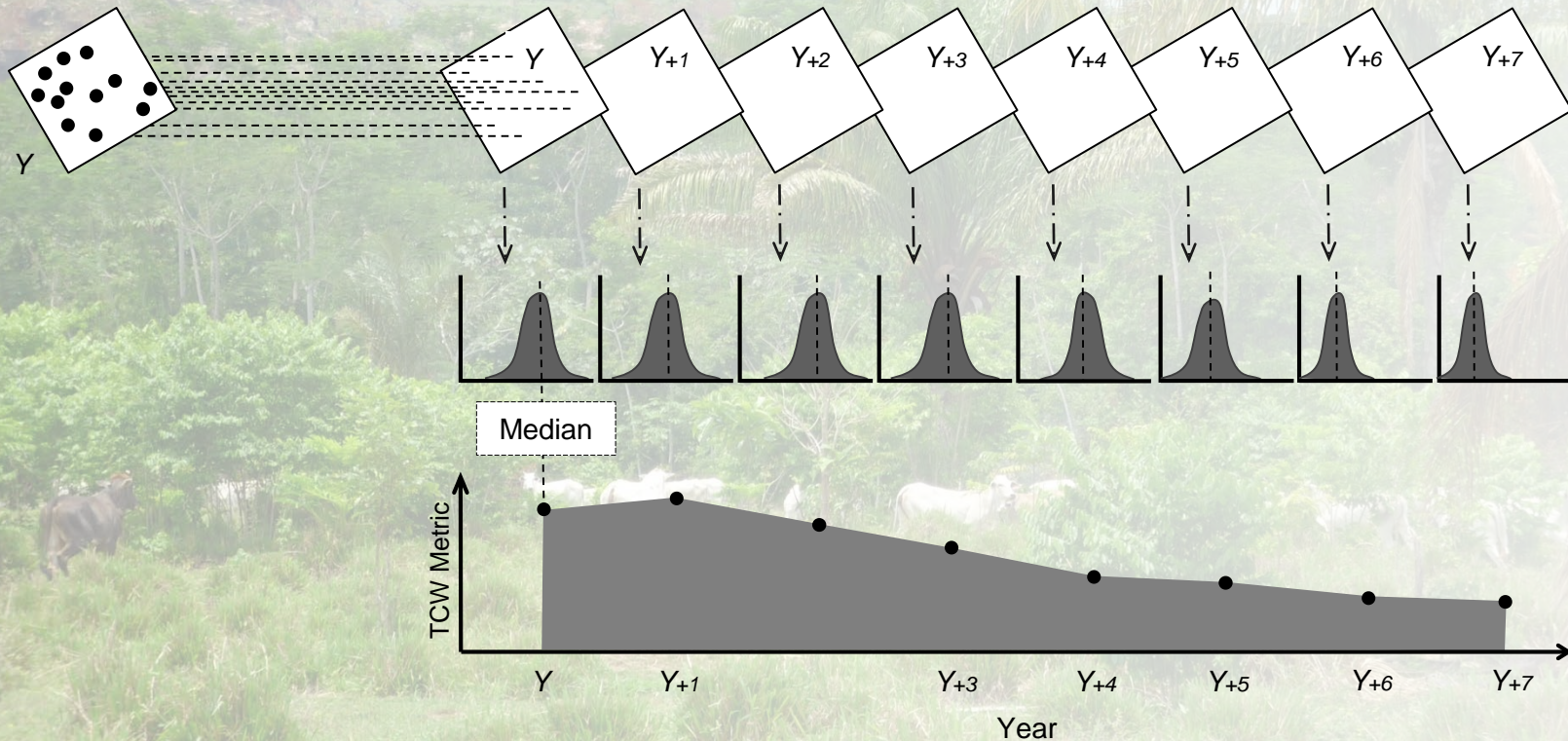→ Overall accuracies (OA) with changing observation density:

Rufin et al. (2015)

- Mean OA ± one standard deviation (vertical bars) for a decreased number of available observations.

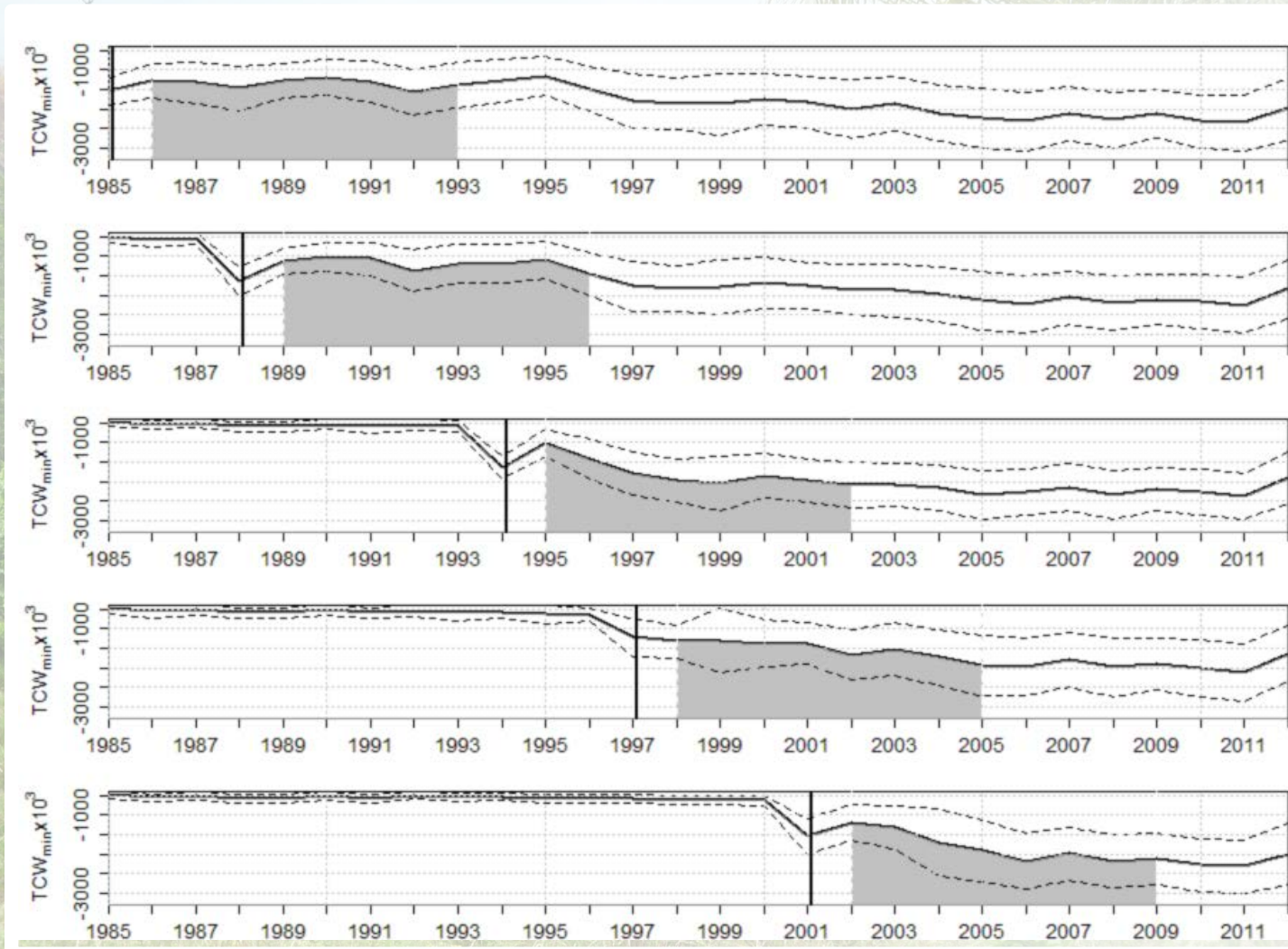- Effect of last available observation timing on OA.

1) **Methods:** Trajectory Aggregation

→ Capture regional scale secondary vegetation dynamics using trajectories of dry season metrics.

# 1) **Results & Discussion:** Sec. Vegetation Trajectories

→ Region-wide vegetation dynamics on cleared lands.
→ Values ~ -1.2 commonly found in secondary vegetation cover.
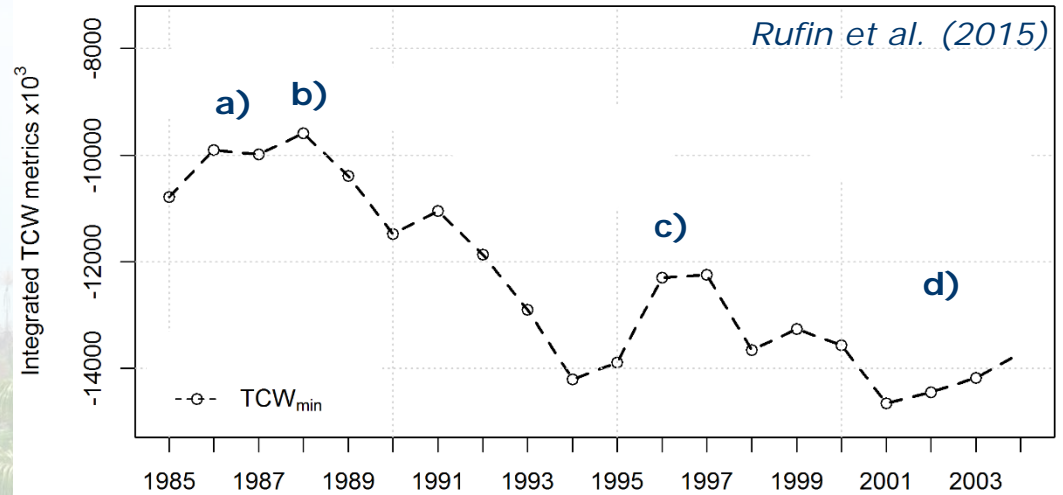

Rufin et al. (2015)

1) Methods: Trajectory Aggregation

→ Differences in trajectories indicate varying time-frames with increased secondary vegetation cover.

→ Integral allows for comparison between trajectories.
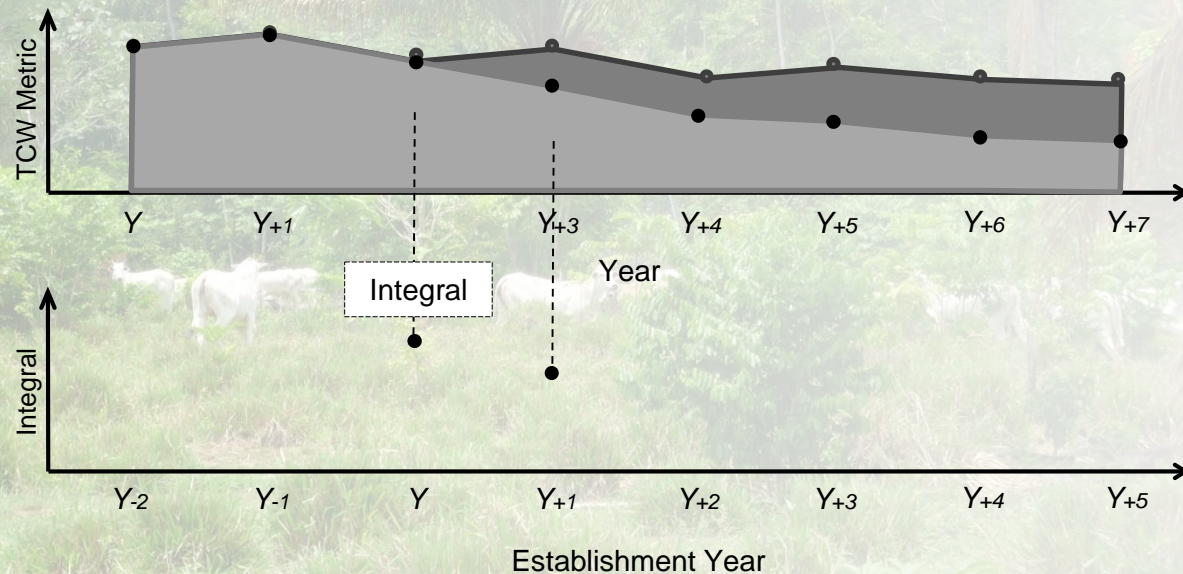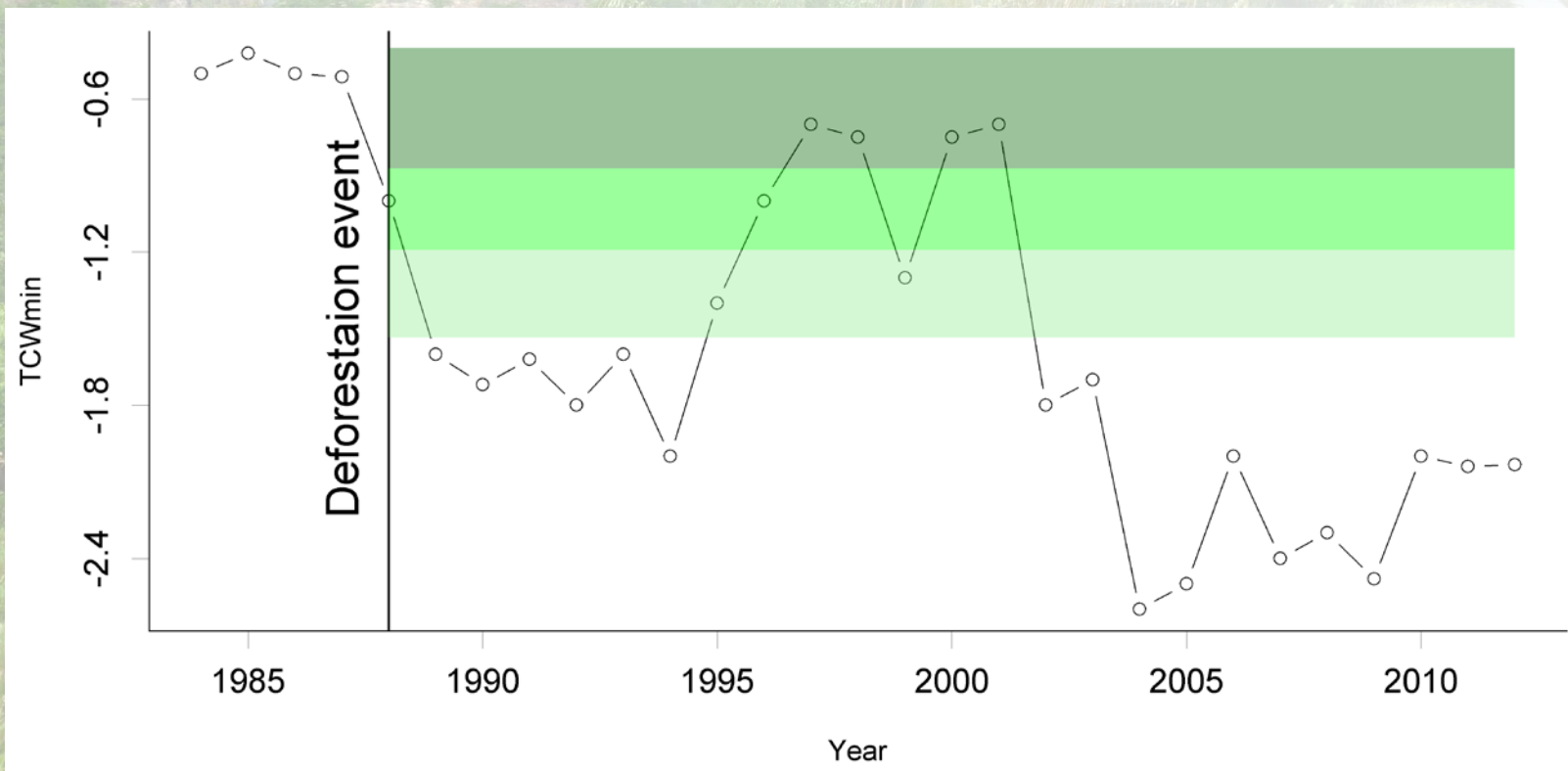
1) **Results & Discussion:** Integral Time Series

→ Integral changes responding to environmental policies and market dynamics?

Rufin et al. (2015)

|	Period	Incentive	Sec. Veg.	Reference
a)	Before 1988	Extensive pastoralism as means of land appropriation and governmental subsidies for extensive land use	+	Fearnside, 2001; Mertens et al., 2002
b)	1988 / 89	New national constitution with emphasis on forest conservation and establishment of environmental protection agency / Launch of deforestation monitoring program	-	Fearnside, 2001 INPE, 2013
c)	In 1996	Revision of the national forest code requires land owners to maintain a share of 80% in a state of secondary vegetation	+	Bowman et al., 2012
d)	Early /mid-2000s	Displacement of pastoralism by crop cultivation from Mato Grosso northwards / southern Pará opened for international beef trade	-	Barona et al., 2010; Gollnow and Lakes, 2014 Nepstad et al., 2006

2) Methods: Pixel-Based Thresholding

→ Analyzing the spatial configuration of secondary vegetation (1985-2012).

→ Empirically derived spectral and temporal thresholds for mapping secondary vegetation.

Müller et al. (in prep)

2) Results & Discussion: Spatial Configuration

→ 33% of the deforested area is covered by secondary vegetation.

→ Secondary vegetation clusters in proximity to forest edges.

Sec. Veg. normalized to deforestation area

Müller et al. (in prep)
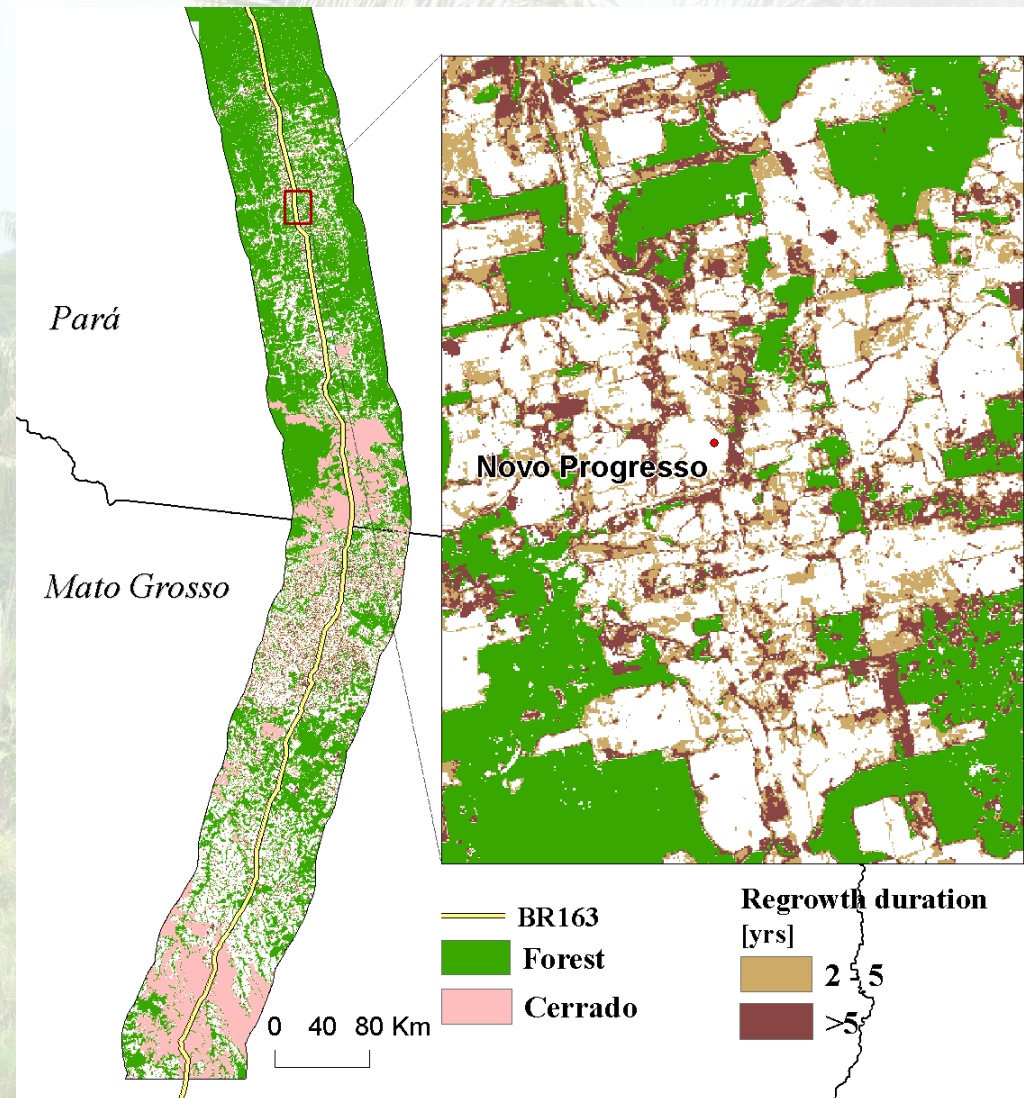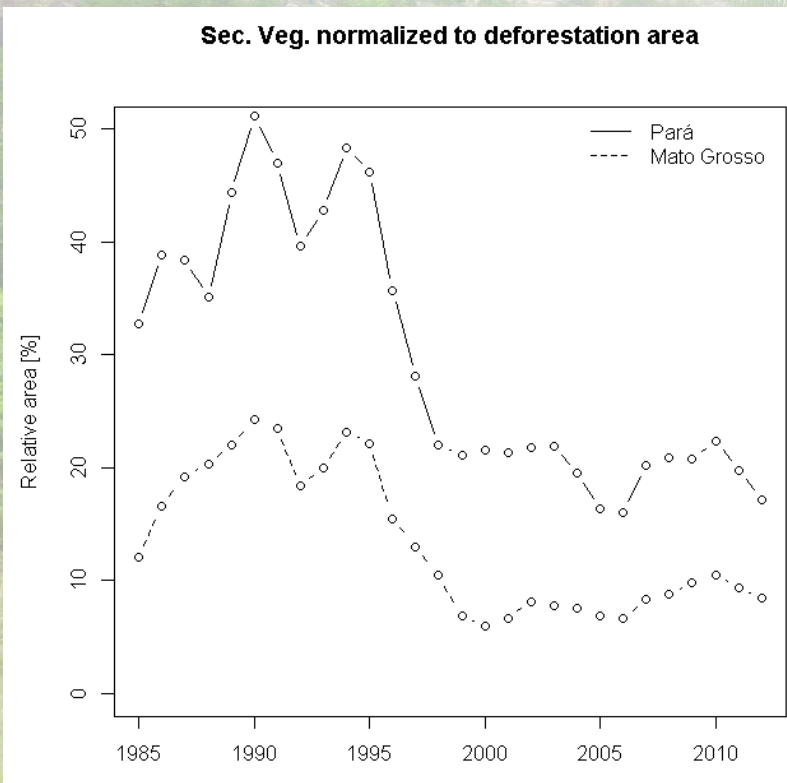
Concluding remarks

→ Landsat-based metric time series carry potential for monitoring post-deforestation vegetation dynamics in the tropics (1,2).

→ On a regional scale, levels of secondary vegetation decline with increasing land use age (1).

→ Changes in environmental policy and food markets potentially contribute to secondary vegetation dynamics (1).

→ Over the study periods, one third of the cleared areas were covered by secondary vegetation, with a declining tendency since the early 2000s (2).

Thank you for listening!

References

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Acknowledgments