Land-use change within the western Amazon region: analyzing spatial variations on forest structure with remote sensing-based techniques

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INTRODUCTION

General Context:

- Population growth and acceleration of resource exploitation as vectors of land-use change and ecosystem degradation

- Besides direct land-use change through deforestation, alterations on forest structure might be noted on standing vegetation

- Disrupted ecosystem conditions are reflected on the alteration of biophysical parameters and consequently on biological composition

- Satellite-based assessments on forest structure can be used as a biodiversity proxy

Study Sites:
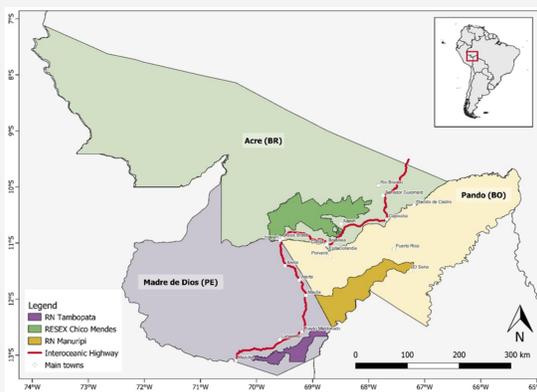
Three Protected areas in the western Amazon region, along the Interoceanic Highway:

- Extractive Reserve [RESEX] Chico Mendes (Brazil)
- Manuripi-Heath Amazonian Wildlife National Reserve (Bolivia)
- Tambopata National Reserve (Peru)

Objectives:

- Update and validate Hansen´s forest structure model, for the year 2020
- Refine the index calculation based on field collected observations
- Carry a comparative assessment among the 3 selected protected areas
- Analyze patterns within the buffers between the reserves and the road

METHODS

Hansen's Forest Structure Condition Index (SCI):

- "The SCI is expected to better predict habitat suitability for forest-structure dependent species and community richness than forest presence or forest intactness." - Hansen et al. (2019)

- Original model: reference date 2012
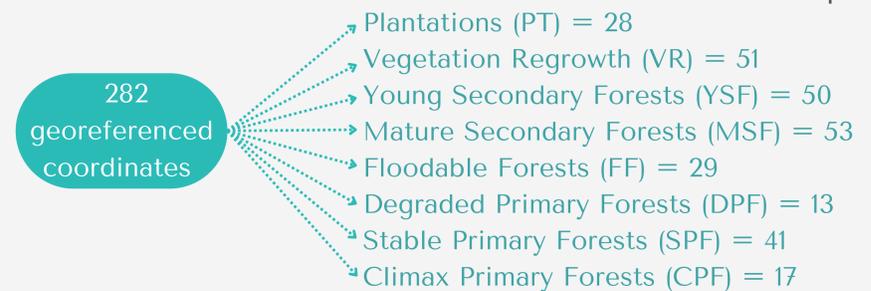
- Model input layers:

	Input Datasets	
	Original	Adapted
Forest Loss	2000-2017	2000-2022
Forest Height	2012	2019
Tree Cover	2010	2015/2020

Forest Structure

- Model classification scheme (implementation with Google Earth Engine):

Loss Year	Forest height (m)										
	Canopy cover (%)	0-5	>5-15			>15-20			>20		
			Canopy cover (%)			Canopy cover (%)			Canopy cover (%)		
	<25%		25-75	>75-95	>95	25-75	>75-95	>95	25-75	>75-95	>95
2013-2017	1	1	1	1	1	1	1	1	1	1	1
2001-2012	1	1	2	3	4	5	6	7	8	9	10
<=2000	1	1	10	11	12	13	14	15	16	17	18

Adaptations: (i) Loss year ranges: 2020-2022 and 2001-2019; (ii) Forest height thresholds: 15-27, >27; (iii) Canopy cover ranges: 25-65, 65-75; >75

Field-collected Data: basis for model validation and adaptation

282 georeferenced coordinates

- Plantations (PT) = 28
- Vegetation Regrowth (VR) = 51
- Young Secondary Forests (YSF) = 50
- Mature Secondary Forests (MSF) = 53
- Floodable Forests (FF) = 29
- Degraded Primary Forests (DPF) = 13
- Stable Primary Forests (SPF) = 41
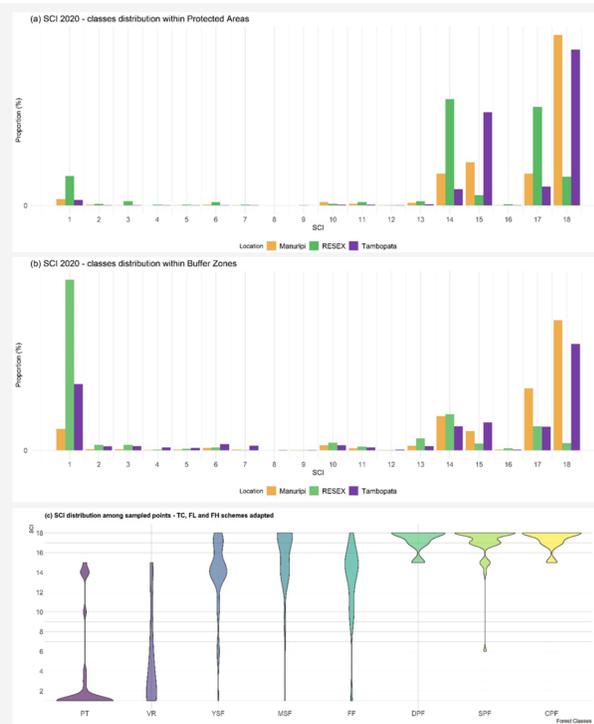- Climax Primary Forests (CPF) = 17
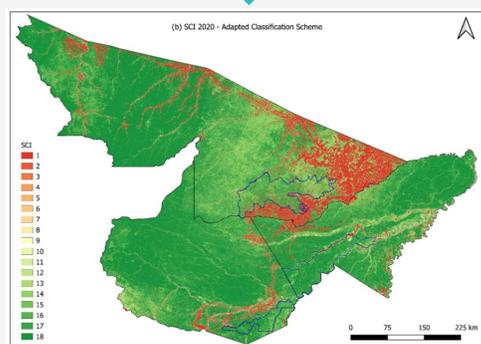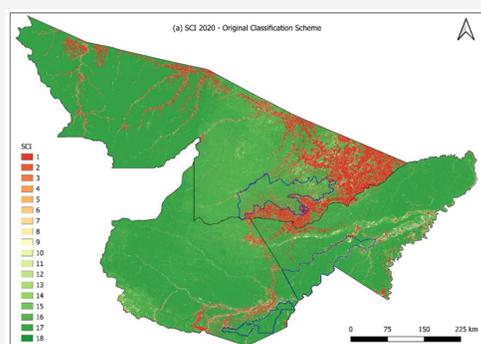
RESULTS

Adapted version generated a more refined forest classification, previously largely saturated on the highest values.
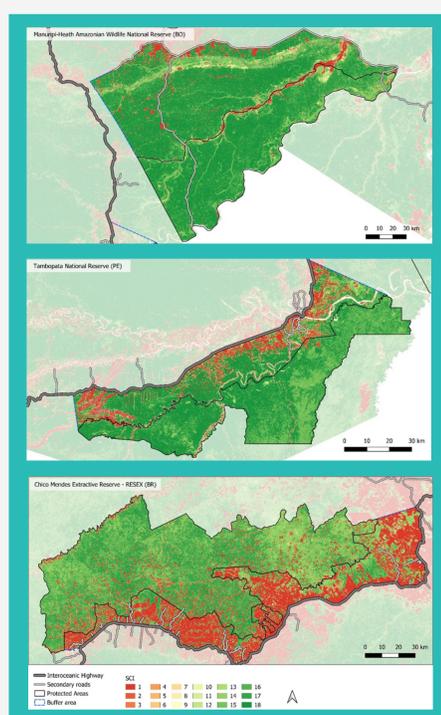
Results reflect the types and intensity of land-use within and around the selected study sites.

Within the Reserves:
SCIs 17+18
- 69% in Manuripi
- 60% in Tambopata
- 43% in RESEX
(less than 10% of SCI-18)

Within the Buffer Zones:
SCIs 17+18
- 67% around Manuripi
- 45%% around Tambopata
- 11% around RESEX

SCI-1
- 7% around Manuripi
- 23% around Tambopata
- 60% around RESEX

- Vegetation of high human intervention (PT+VR): 66% of the sampled data correspond to SCIs 1 to 3, being other 10% related to SCI-14
- Young Secondary Forests (YSF): 50% of sampled data related to SCI-14 and -15, being still 20% linked to SCI-17 and 10% to SCI-18
- Primary Forests (DPF+SPF+CPF): 86% of sampled data related to SCI-17 and -18, and the remaining coordinates mostly associated to SCI-15 (11%)

CONCLUSION

- Overarching categories can be fairly well distinguished, although not sensible enough to reflect all on-field observed vegetation categories
- Index allows for large scale-assessments that support identification of major patterns and priority areas for conservation. - Ex: the need of adopting special strategies at RESEX considering local particularities.

AKNOWLEDGEMENTS

Tropentag 2023 - Berlin

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