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CLIMATE ACTIONS AND JUST TRANSITION: SECOND INTERNATIONAL
CONFERENCE

Towards the Atlas of Unburnable Carbon in Brazil: Critical GIS for the Just Fossil Fuel Transition

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INTRODUCTION: What is Unburnable Carbon?

Fossil fuels (FF) that must remain underground (unextracted and unburnt) through supportive legal tools and actions, in order to successfully reach the set climate change mitigation targets, namely the 1.5°C or 2°C global warming limits (Codato et al, 2023; Welsby et al, 2021).

Arguably the most prominent international campaign for the phaseout of FF production, the **Fossil-Fuel Non Proliferation Treaty**, structures its framework agreement around three pillars of core principle commitments:

- 1) ***Non-proliferation***
- 2) ***Fair phase-out***
- 3) ***Just transition***

The initiative, launched in 2020, has been endorsed by 18 national governments, 143 cities and subnational governments, and over 4,100 organizations (including the World Health Organization and the European Parliament)



Aims and Objectives of the Study

Under the framework of the *World Atlas of Unburnable Carbon* project this research focuses on

locating areas where fossil fuels should be left underground in Brazil

by identifying and quantifying FF-related spatial conflicts with environmentally and socio-culturally sensitive areas through GIS-based analysis



Overlap Analysis



MCDA



Proximity Analysis

Using GIS analysis as a tool to support climate policy making, and to advance climate and spatial justice.

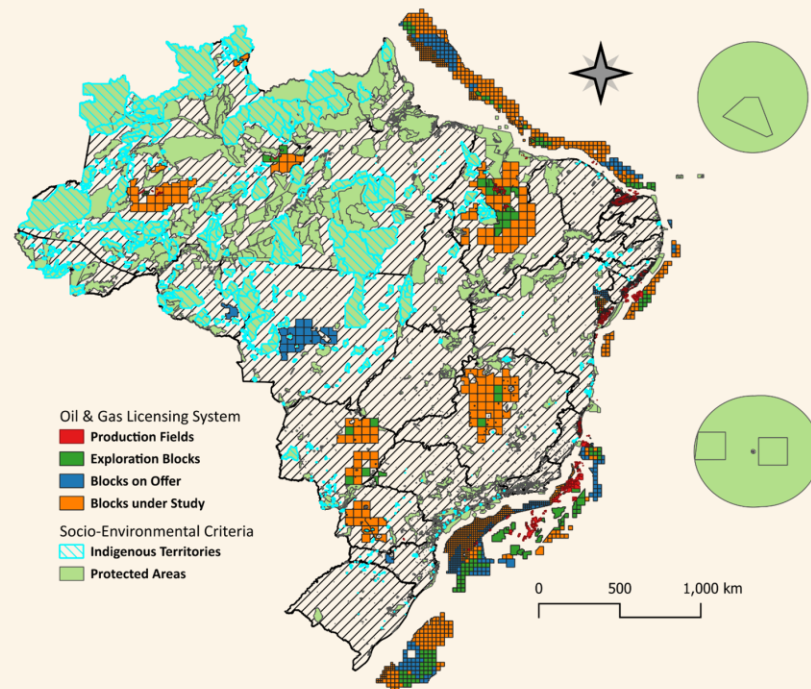
INTRODUCTION: Why Brazil?

- One of the top 10 largest fossil fuel producers globally (as well as one of the largest exporters)
- Its oil and gas production are expected to increase for 20% by 2030
- One of the largest CO₂ emitters in the world
- COP30 hosting country
- One of 17 “megadiverse countries”
- Brazilian Amazon is recognized as the most crucial open-sky carbon stock
- 200 Indigenous communities and 5.000 *Quilombos*

DATA & METHODOLOGY

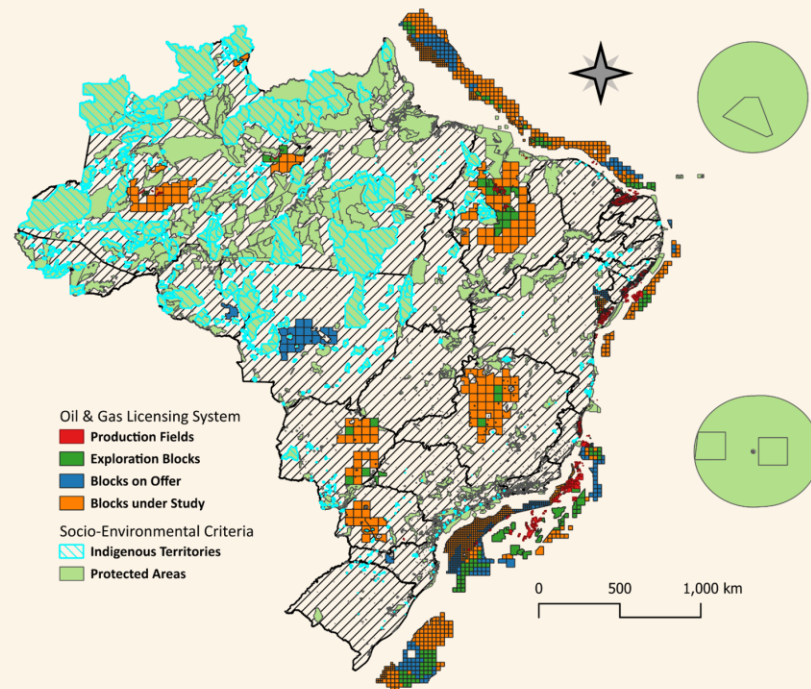
- 1) **Resources and Infrastructure Criteria**
- 1) **Socio-Cultural Criteria** (human population, traditional people's territories, sub-national GDP, etc.)
- 1) **Ecological Criteria** (protected areas, priority areas for biodiversity conservation, coral reefs, mangrove habitats, critical natural assets, etc.)

Sources: Government agencies, “spatial data” sections in scientific articles, or elsewhere through searching by the keyword in the shapefile format



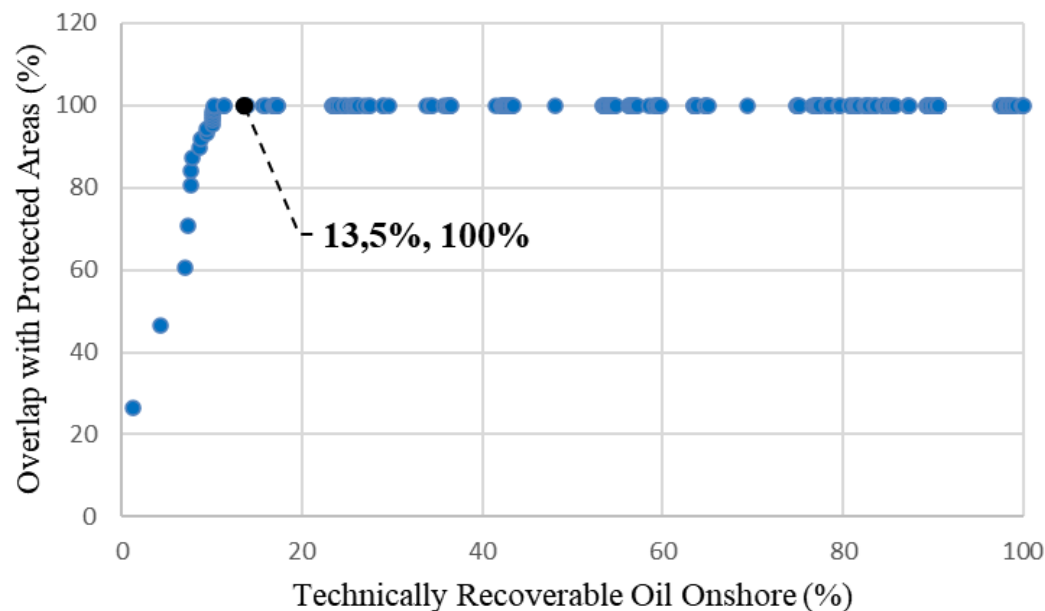
DATA & METHODOLOGY

- a) **Overlap Analysis** to measure areas where oil and gas licences directly coincide with socio-environmentally sensitive features
- a) **Proximity Analysis** to count the number of oil and gas wells within buffer zones around socio-environmentally sensitive areas
- a) **Multi-Criteria Decision Analysis (MCDA)** to identify unextractable oil fields based on spatial justice criteria and the budgets from Welsby et al. 2021



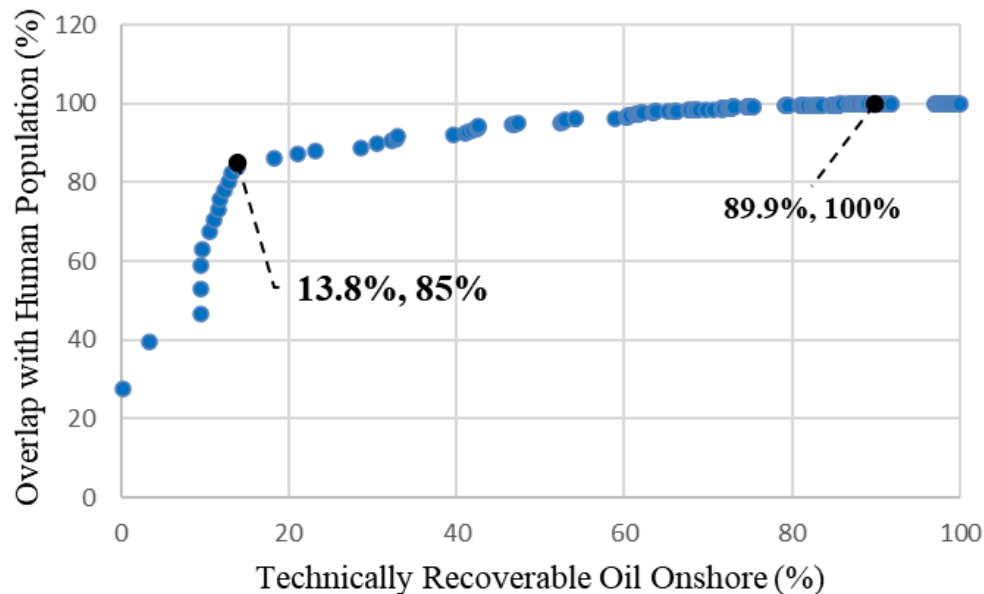
RESULTS: Overlap Analysis

By phasing out **13,5%** of Brazil's total **onshore oil resources**, all spatial overlaps can be eliminated with the country's **protected areas**.



RESULTS: Overlap Analysis

By phasing out **13.8%** of Brazil's total **onshore oil** resources, we can eliminate direct spatial overlaps with **85%** the country's **population**, whilst in order to cover the whole population it would take roughly **90%** of onshore oil.



RESULTS: Proximity Analysis

GIS-based analysis of the **number of wells intercepting a 5 km buffer zone** around socio-environmentally sensitive areas in Brazil. The wells located directly inside these areas were excluded from this table.

Proximity with Wells			Well Category			
			Production Wells	Exploration Wells	Other Wells	All Together
Feature	Environment					
Indigenous Land	Onshore	(num.)	0.00	23	0.00	23
		(%)	0.00	0.48%	0.00	0.10%
Quilombos	Onshore	(num.)	1,578	309	422	2,309
		(%)	9.11%	6.43%	32.81%	9.86%
Protected Areas	Onshore	(num.)	1,857	818	141	2,816
		(%)	10.72%	17.02%	10.96%	12.03%
	Offshore	(num.)	57	82	1	140
		(%)	1.70%	2.69%	0.14%	4.16%
Priority Areas for Biodiversity Conservation	Onshore	(num.)	7,858	1,178	643	9,679
		(%)	45.36%	24.51%	50.00%	41.34%
	Offshore	(num.)	332	249	103	684
		(%)	9.88%	8.18%	14.11%	20.35%
Coral Reefs	Offshore	(num.)	335	257	93	685
		(%)	9.96%	8.45%	12.74%	20.37%
Total number of onshore wells:			17,323	4,806	1,286	23,415
Total number of offshore wells:			3,362	3,043	730	3,362

RESULTS: Proximity Analysis

For certain categories of sensitive areas, **there are substantially more oil and gas wells inside 5km buffer zones**, than directly inside these areas.

This suggests that spatial planning of oil and gas licences in Brazil seriously **failed to consider impacts from proximities with fossil fuel infrastructure**.

			No of Directly Overlapping Wells	No of Wells inside 5km Buffer Zones
Feature	Environment			
Indigenous Land	<i>Onshore</i>	(num.) (%)	22 0.09%	23 0.10%
Quilombos	<i>Onshore</i>	(num.) (%)	187 0.80%	2,309 9.86%
Protected Areas	<i>Onshore</i>	(num.) (%)	640 2.73%	2,816 12.03%
	<i>Offshore</i>	(num.) (%)	701 9.82%	140 4.16%
Priority Areas for Biodiversity Conservation	<i>Onshore</i>	(num.) (%)	8,347 35.65%	9,679 41.34%
	<i>Offshore</i>	(num.) (%)	1,722 24.13%	684 20.35%
Coral Reefs	<i>Offshore</i>	(num.) (%)	3,578 50.15%	685 20.37%

Multi-Criteria Decision Analysis

Multi-criteria decision analysis (MCDA) is a decision-making tool that compares alternative scenarios by systematically evaluating and weighting multiple, often conflicting, criteria.

$$\text{Development Scenario} = (\text{EC index} * \text{weight} + \text{SC index} * \text{weight}) - (\text{R\&I index} * \text{weight})$$

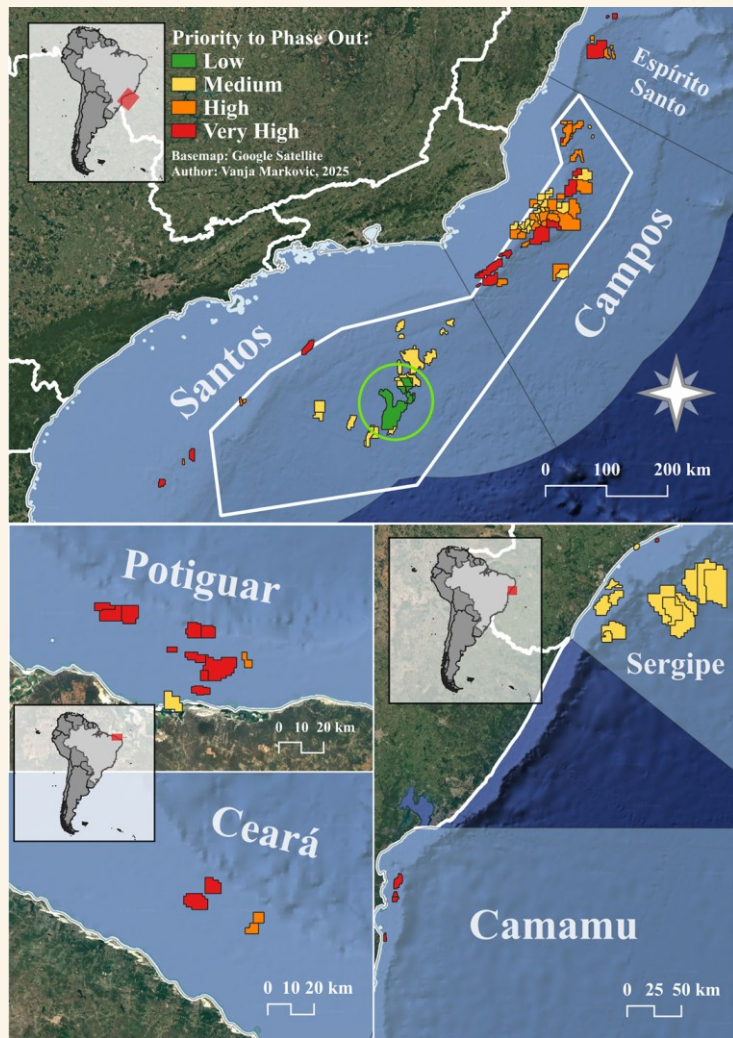
Our MCDA results consist of two distinct alternative scenarios



Environmental Scenario, in which higher weight was assigned to the ecological (EC) and socio-cultural (SC) indexes, thus prioritizing socio-environmental impacts according to the findings of the proximity and overlap analysis



Economic Scenario, in which higher weight was assigned to resources and infrastructure (R&I) index, thereby favoring oil production potential

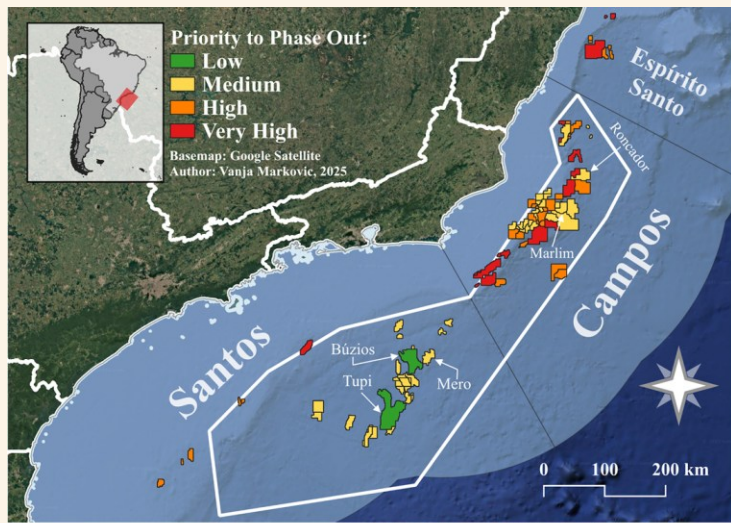


RESULTS: MCDA Environmental Scenario

Prioritizing nature protection whilst staying within the climate targets

$$\text{Scenario} = \text{EC index} * 0.6 - \text{R\&I index} * 0.4$$

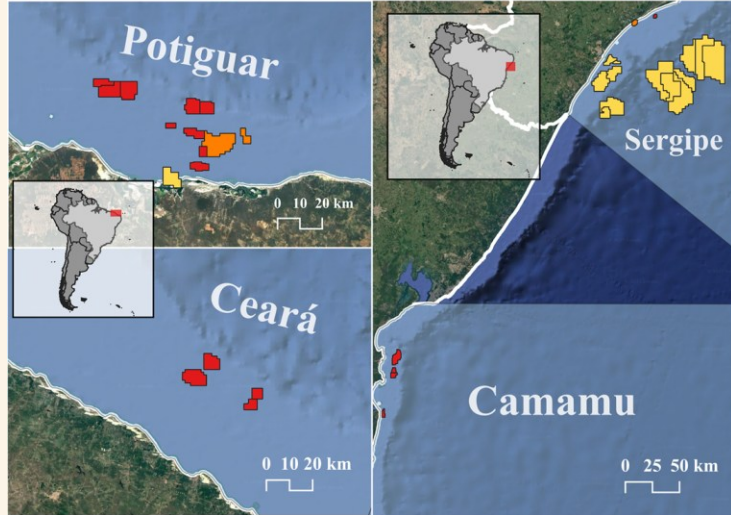
- The fields shown in yellow, orange and red hold **81%** of Brazil's offshore **oil resources** and, under climate budget threshold should be phased out immediately
- Differentiation in priority between the Pre-salt basins - Santos fields are more economically productive and less environmentally impactful



RESULTS: MCDA Economic Scenario

Prioritizing economic potential whilst staying within the climate targets

$$\text{Scenario} = \text{EC index} * 0.4 - \text{R\&I index} * 0.6$$



- The two largest fields (Tupi and Búzios) alone hold 19% of Brazil's offshore oil, which is compatible with the carbon budget. These fields are also estimated to be less environmentally hazardous

Concluding Thoughts:

Together, these results expose **clear spatial patterns of environmental and social jeopardy, reinforcing the need for an end in the production of fossil fuels**. In line with the pillar principles of the Fossil Fuel Non-Proliferation Treaty, Brazil should commit to:

- 1) ***Non-proliferation*** by halting the expansion of FF production, especially in areas critical to biodiversity protection and traditional communities
- 2) A managed ***phase-out*** according to the climate targets should prioritize high-productivity fields with minimal environmental and socio-spatial conflicts
- 3) Achieving a ***just transition*** through novel mechanisms, such as the “green royalties” fund, to reward conservation, support sustainable investment and diversification, and strengthen human and environmental protections



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Thank you for your time and attention!

I'd be happy to answer your questions

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