International Initiatives and Programs / CCS Outside the U.S.

Opportunities for CO2 Capture and Geological Storage in Brazil: The CARBMAP Project

J. Marcelo Ketzer*, Jorge Alberto Villwock, Giancarlo Caporale, Luiz Henrique da Rocha, Gabriela Rockett, Henry Braum, Lucia Giraffa

*Presenter`s contact: marcelo.ketzer@pucrs.br
Pontifical Catholic University of Rio Grande do Sul,
CO2 Storage Research Center

Outline of the talk

- Introduction
- Methodology and definitions
- Stationary CO_2 sources
- Geological sinks and storage capacity
- CO_2 Source-sink matching
- Opportunities for CCS in Brazil
- Conclusions

Introduction

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- Assessment of stationary sources in Brazil and associated geological sinks for identification of CCS opportunities

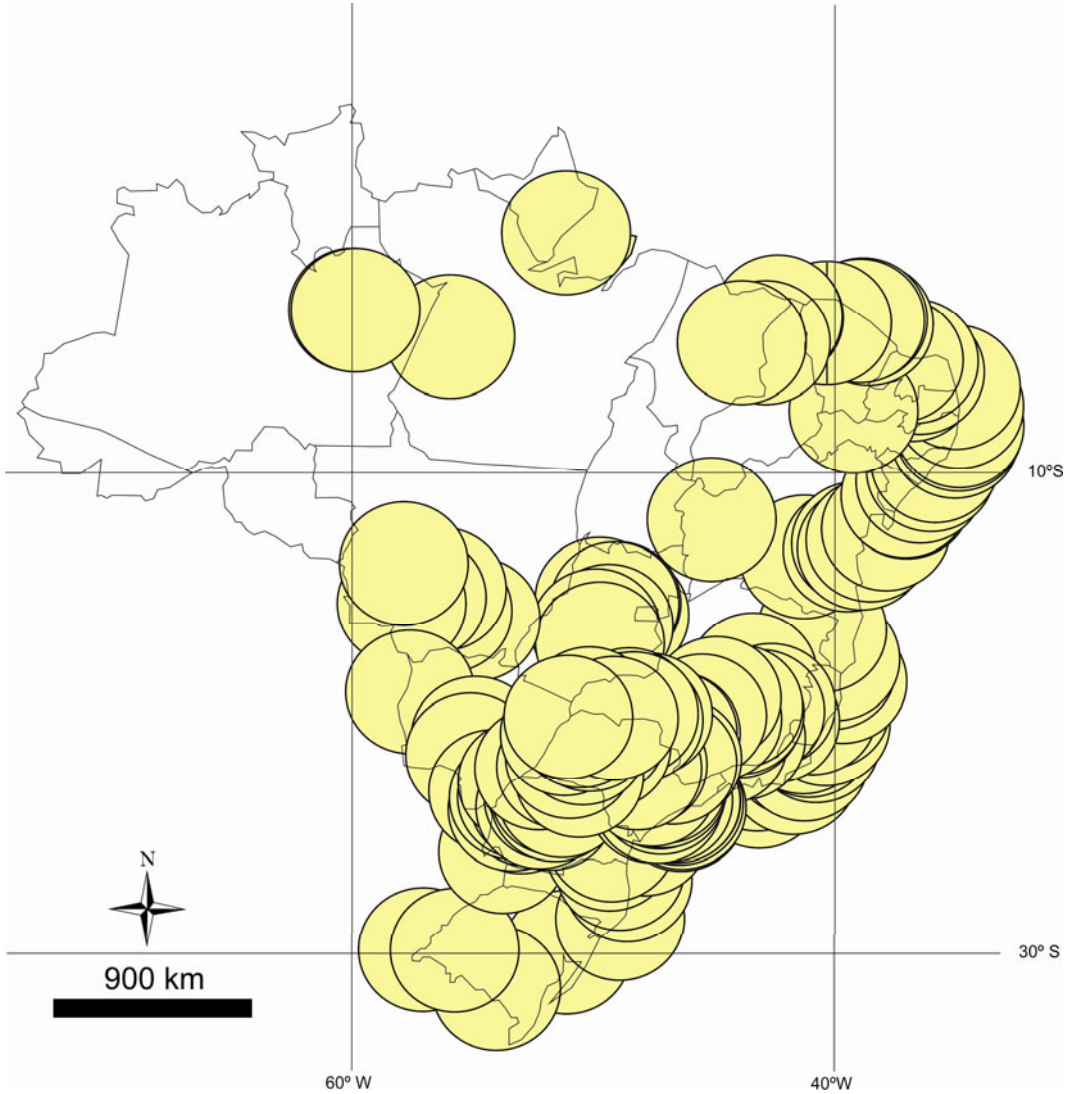
- Country- to basin-scale assessment

- Ongoing project → preliminary results

- Most of the work done in petroleum fields

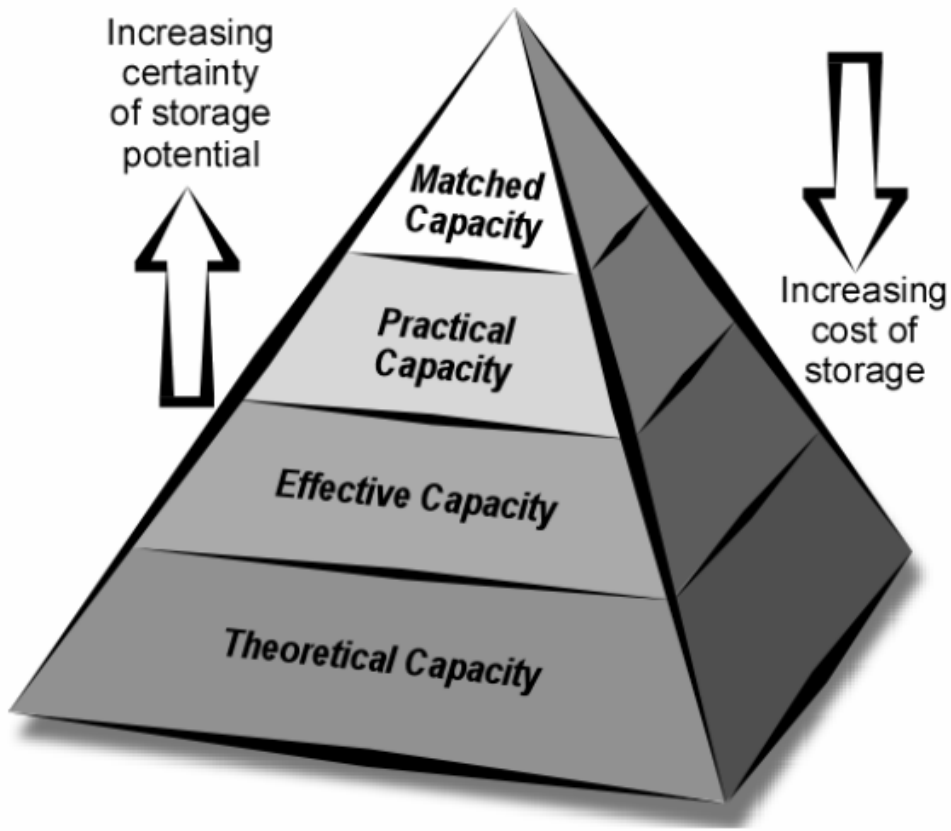
Methodology

Source-sink matching: 300 km nodes



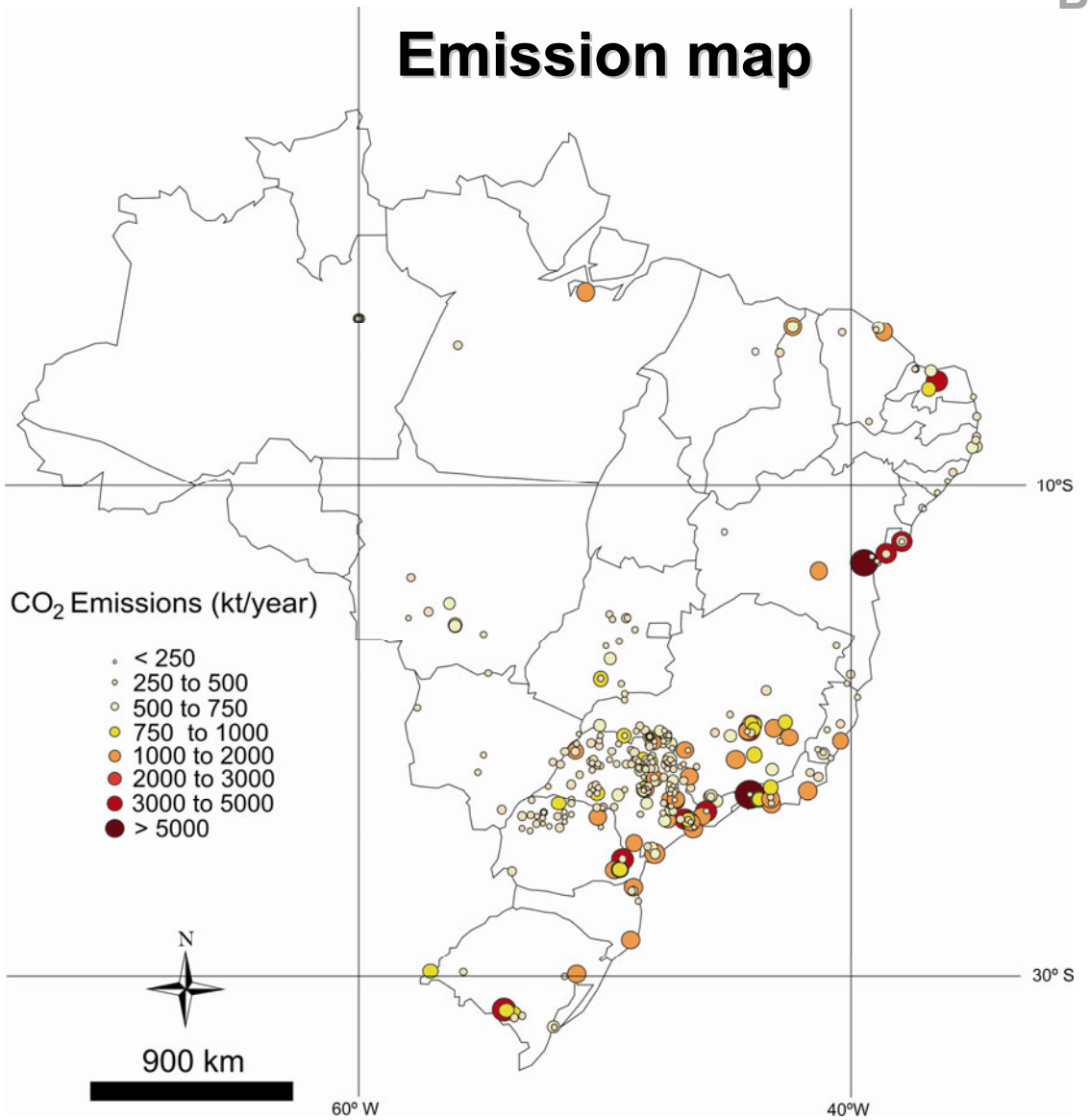
Definitions

Storage capacity



Source: CSLF Task Force for Review and Identification of Standards for CO2 Storage Capacity Estimation Phase II Final Report

Stationary CO2 sources



Database: IEA Greenhouse gas R&D Programme (2001)

Stationary CO2 sources

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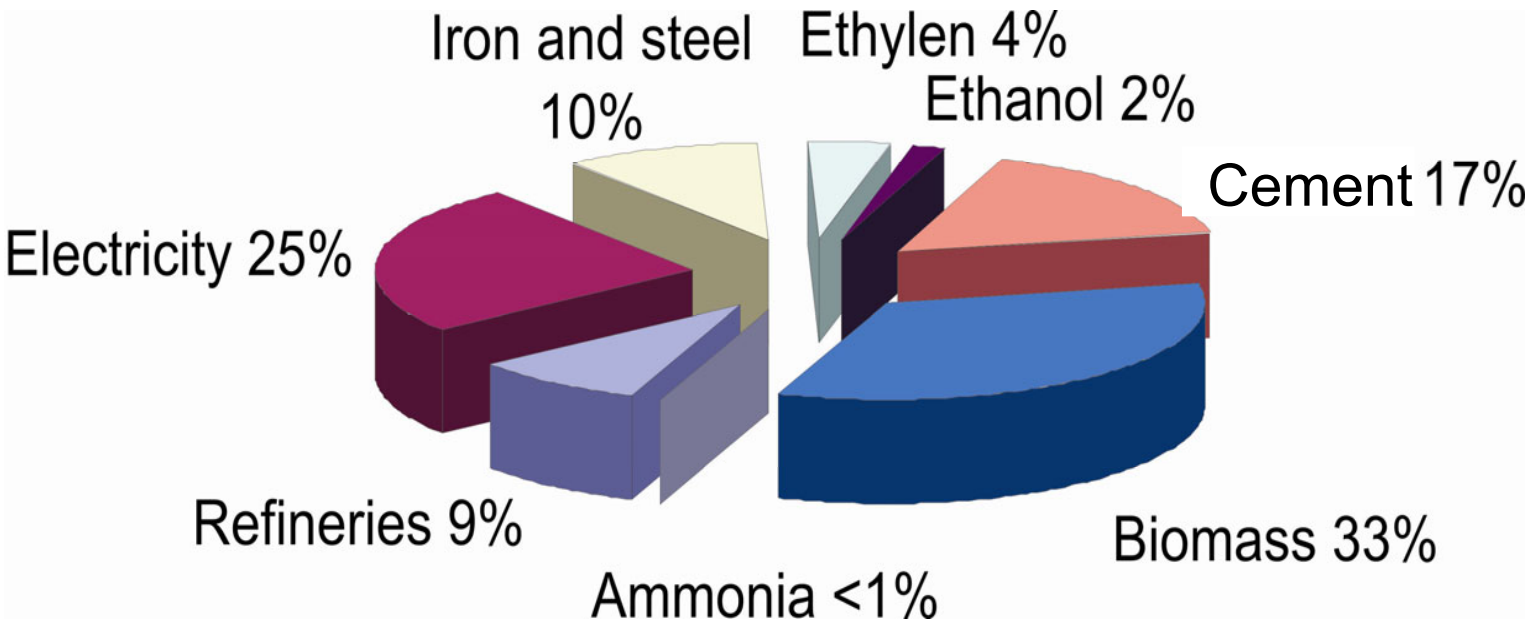
Total emissions from stationary sources: ca. 200 Mt



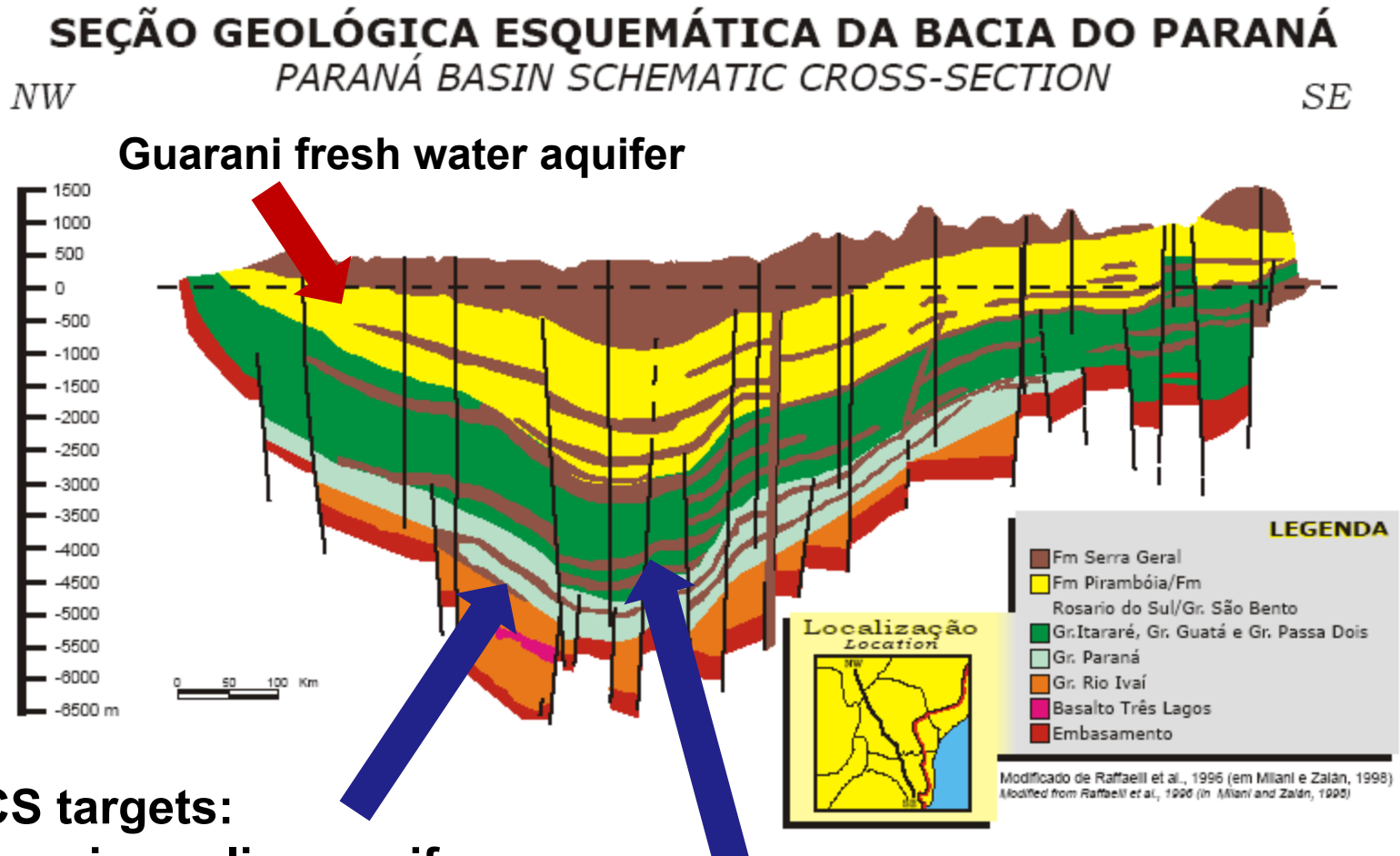
Database: IEA Greenhouse gas R&D Programme (2001)

Geological sinks

Brazil's sedimentary basins: 4.8 millions km^2

(50% of country`s surface area)

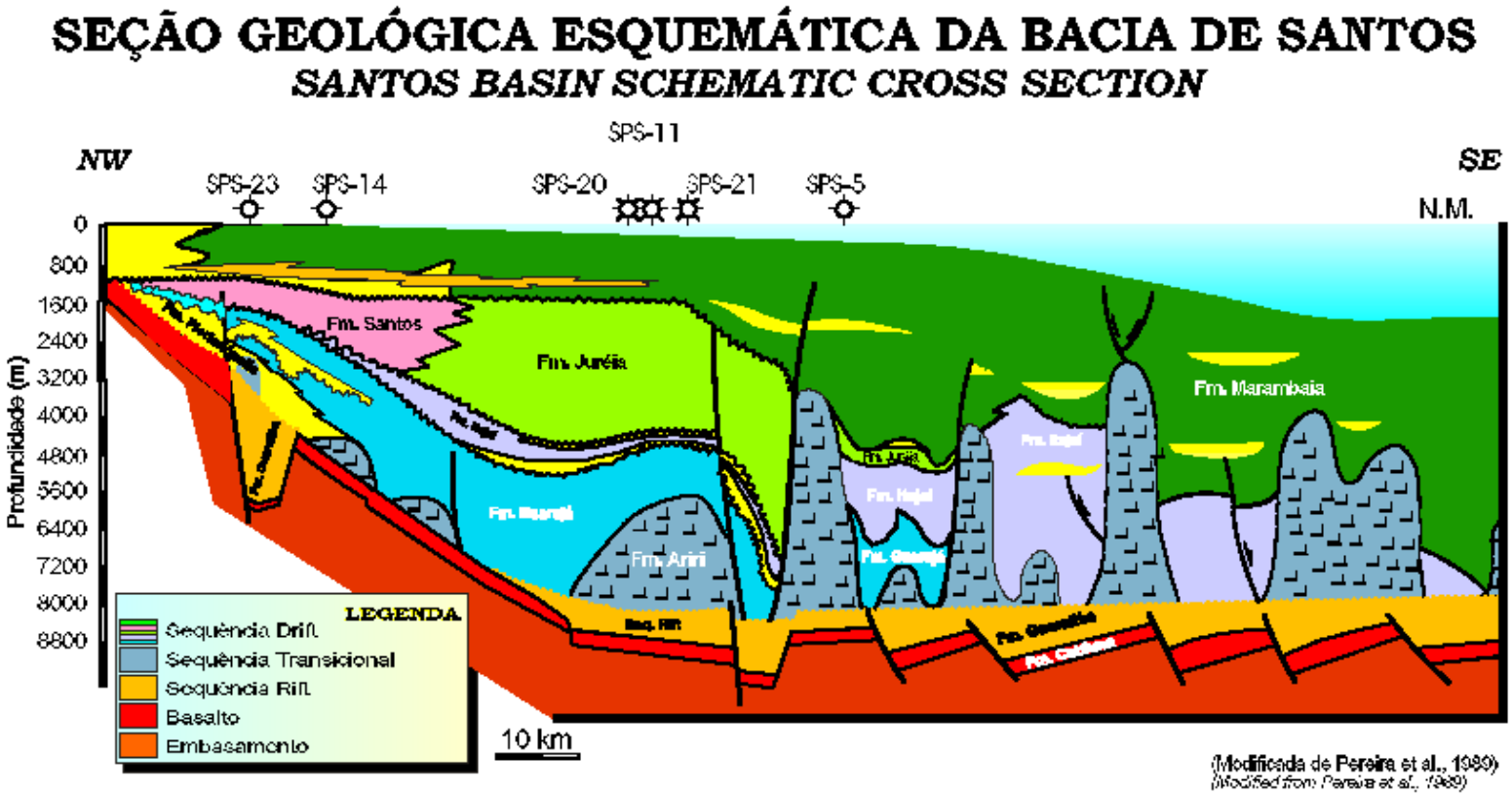
Geological sinks



Guarani fresh water aquifer

CCS targets:
Devonian saline aquifers
Permian saline aquifers and coal seams

Geological sinks



Cretaceous and Tertiary petroleum reservoirs and saline aquifers

Storage capacity of saline aquifers

Saline aquifers:

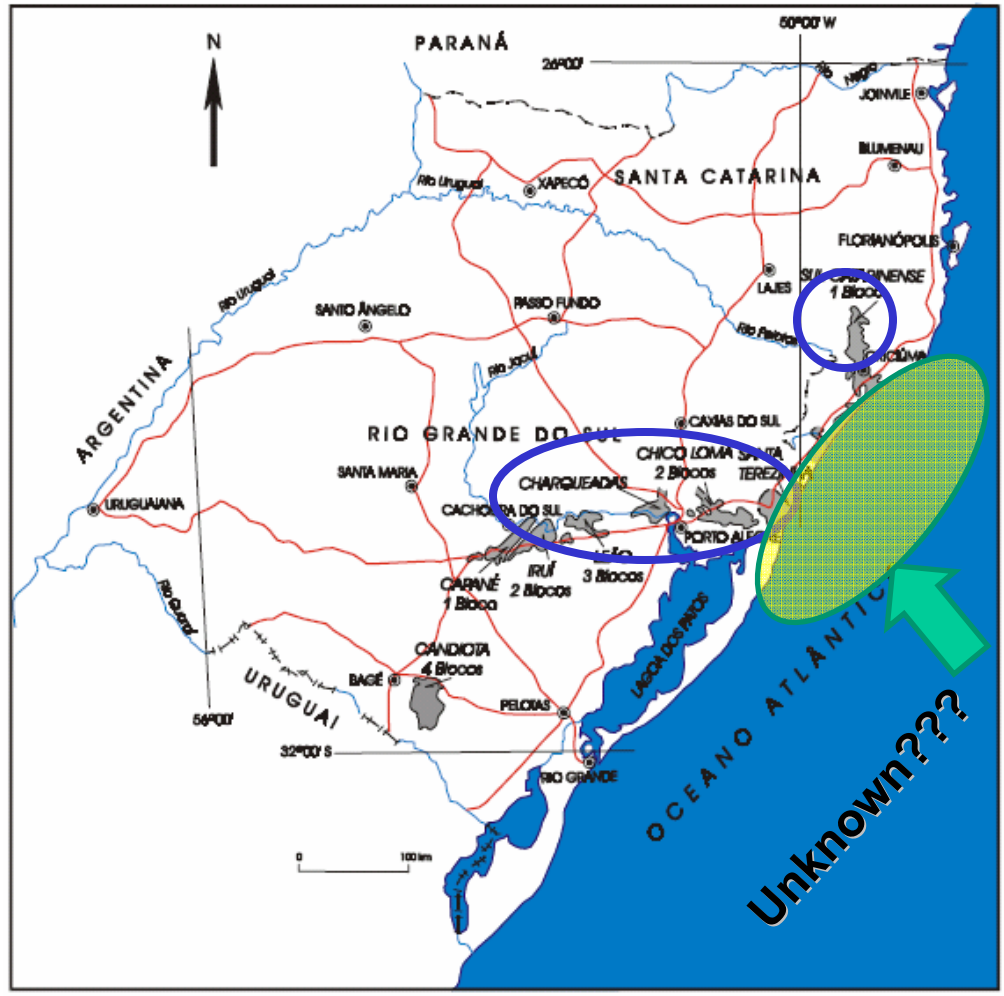
- **Theoretical capacity is nearly unlimited!**
- **Effective capacity (geological constrains) is ca. 2000 Gt**

Mercosul Aquifer (freshwater, Paraná Basin) pore volume: $5.7 \times 10^{13} m^3$ (Araujo et al., 1999)

Utsira Formation pore volume: $6.0 \times 10^{11} m^3$ (Chadwick et al., 2005)

Storage capacity of coal seams

Occurrence of deep (>300 m) seams in the Paraná Basin

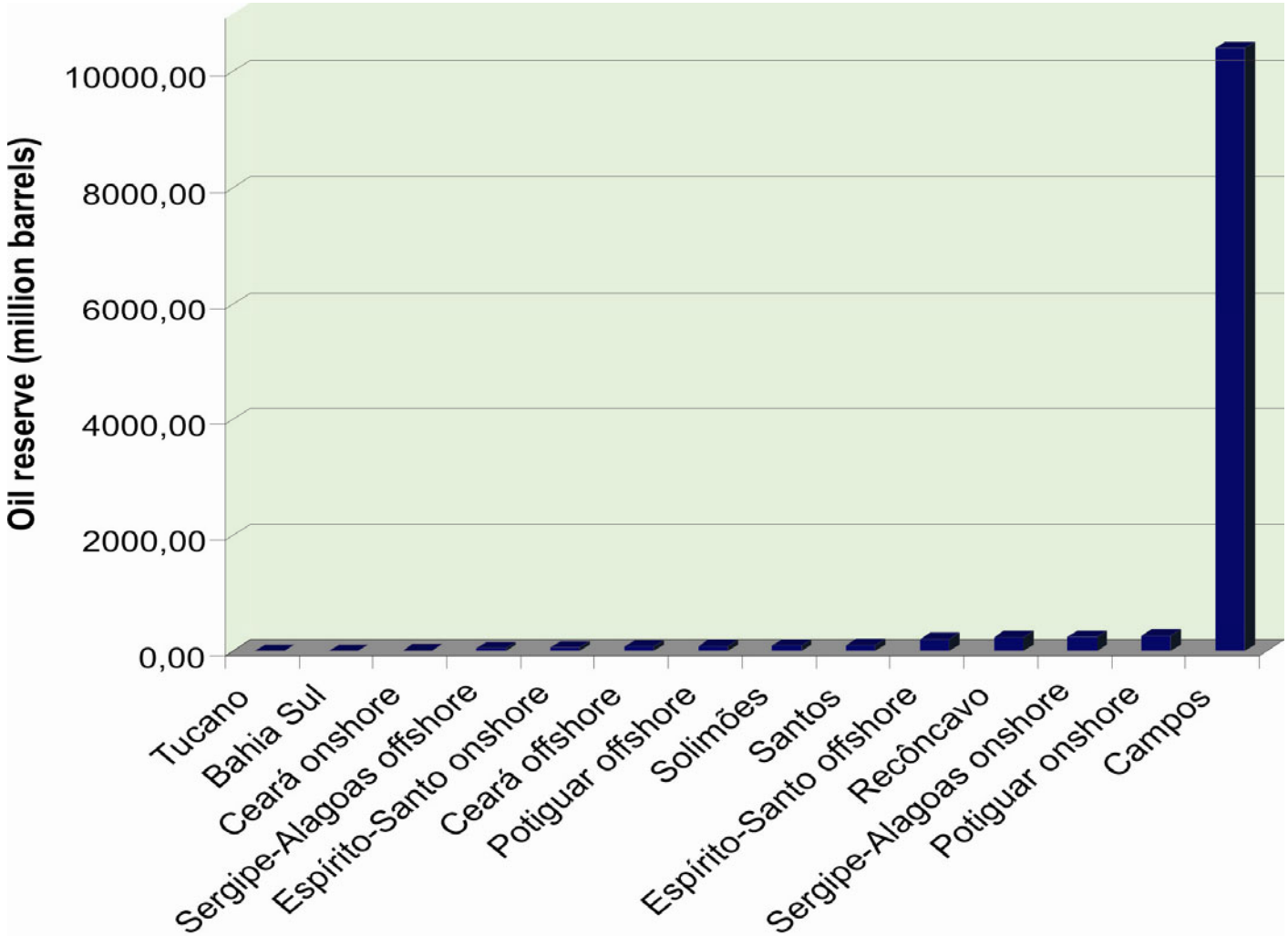


Source: CPRM/DNPM (1986)

High ash (up to 50%), sub-betuminous and betuminous coal

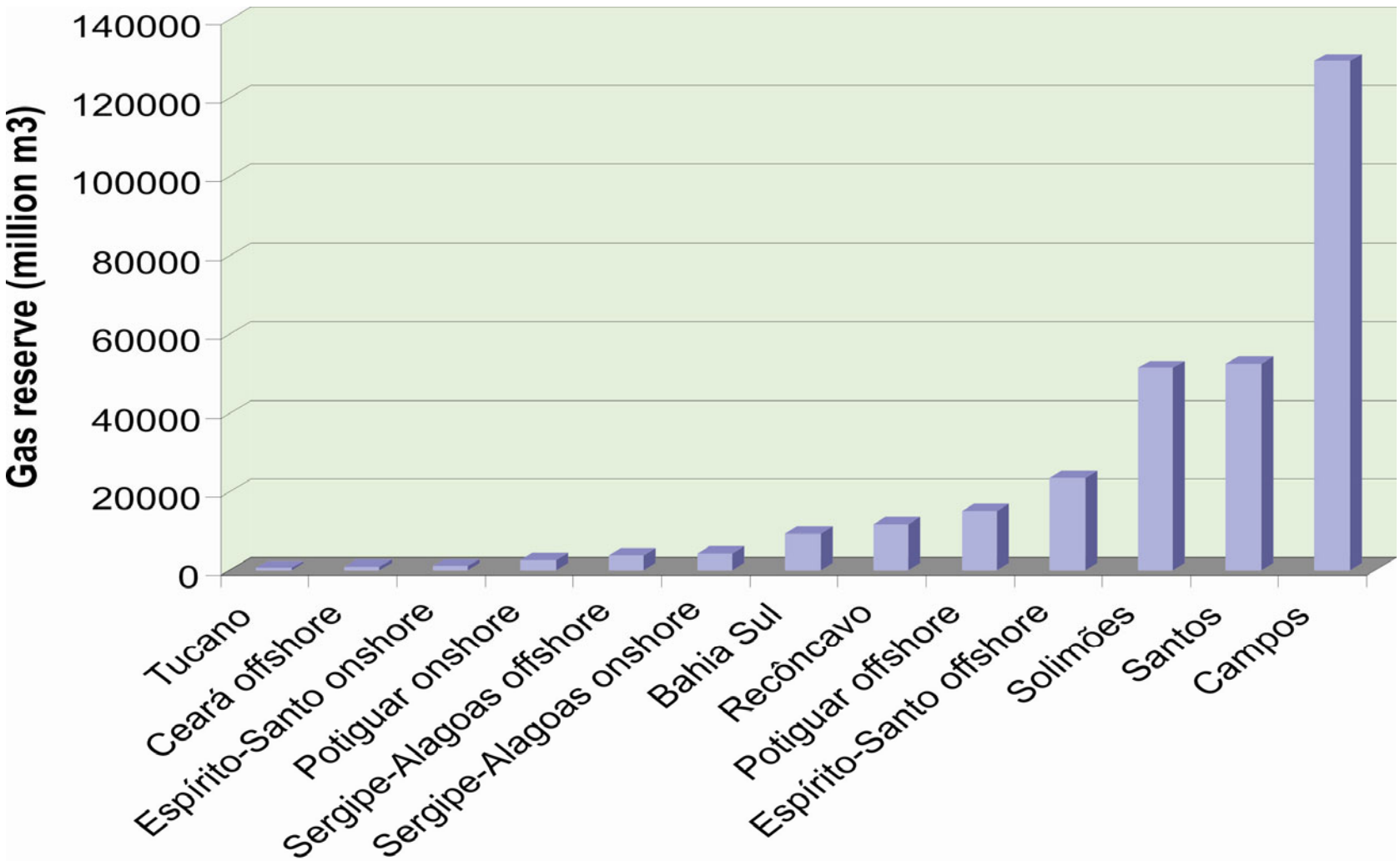
- **Reserves of deep coal (> 300m): ca. 11,691 millions t**
- **Preliminary theoretical capacity: ca. 200 Mt CO2**

Storage capacity of petroleum fields



Source: ANP (National Petroleum Agency)

Storage capacity of petroleum fields



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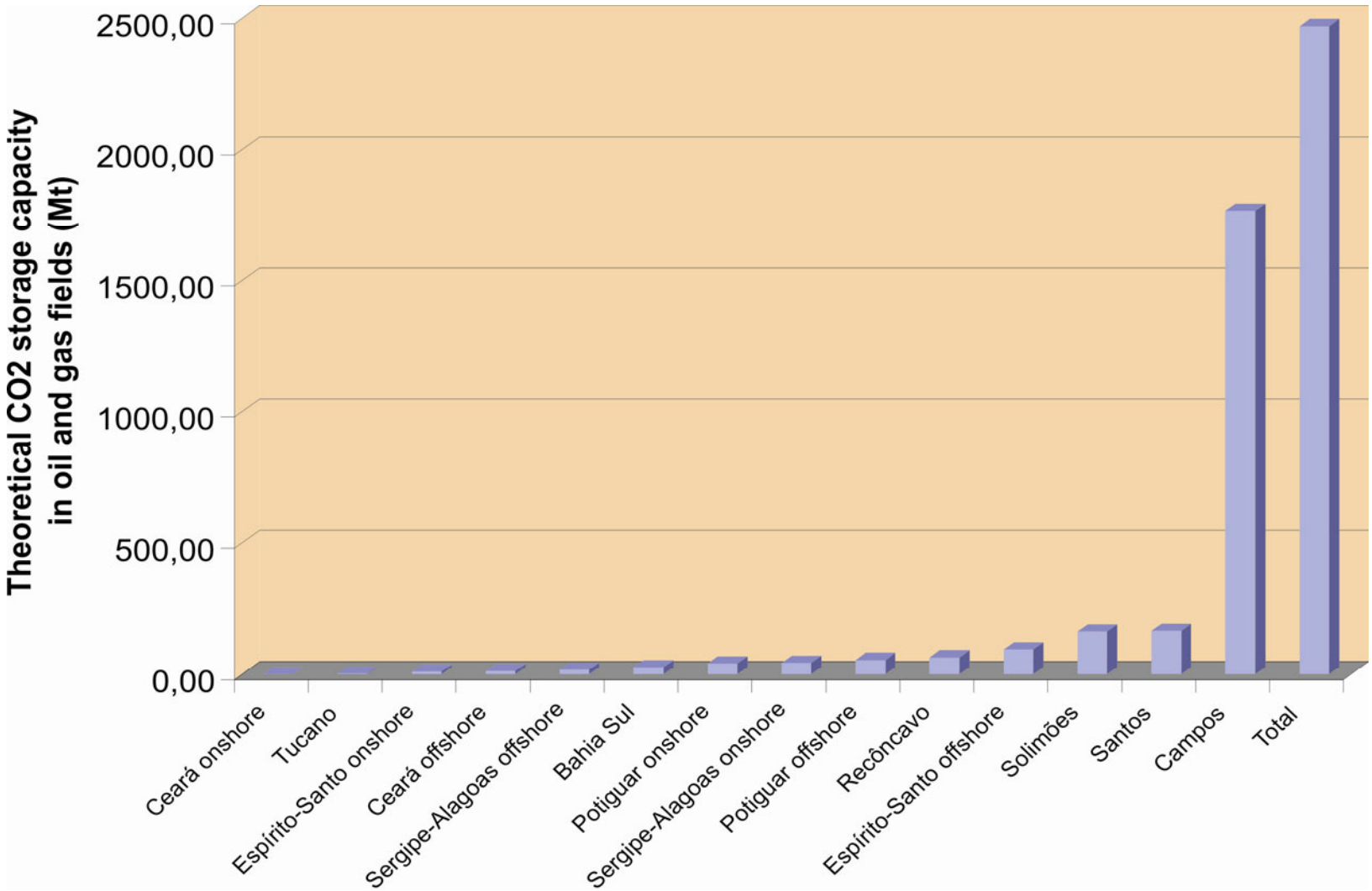
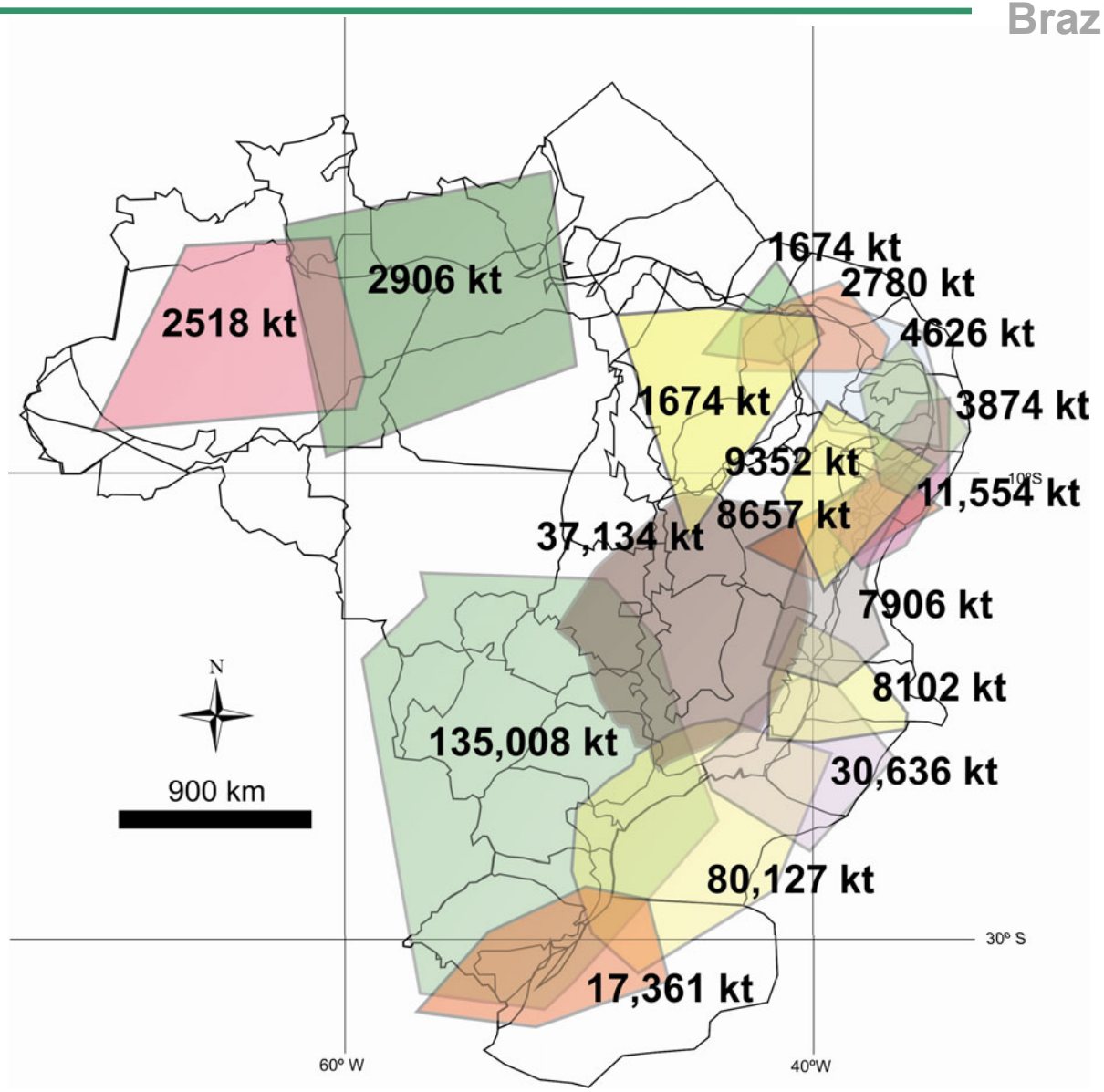
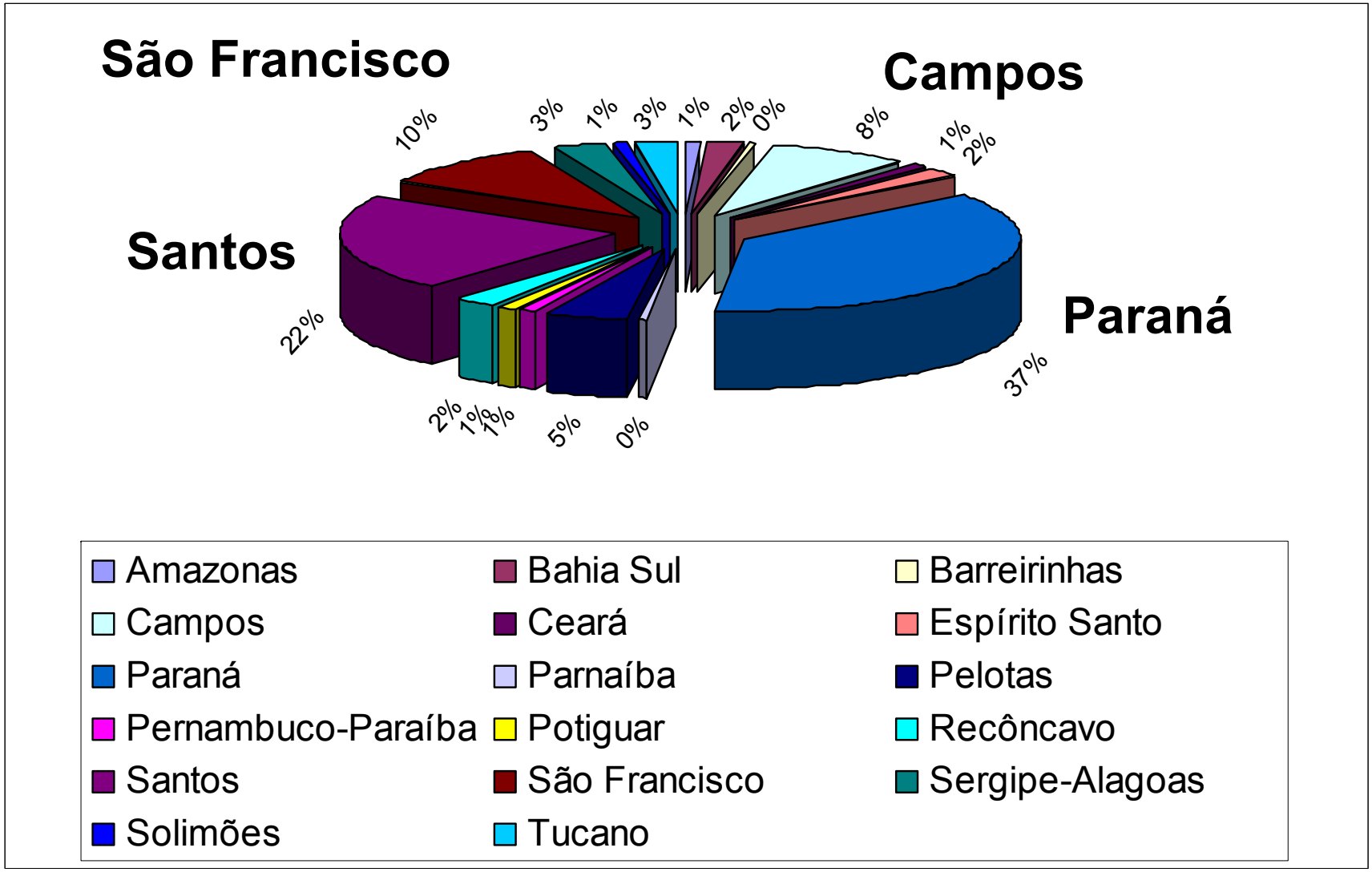
Storage capacity of petroleum fields



CO_2 source-sink matching



Opportunities for CCS in Brazil



Opportunities for CCS in Brazil

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EOR + CO_2 in natural gas	**Santos Basin** (offshore) → hydrocarbon fields saline aquifers **Campos Basin** (offshore) → hydrocarbon fields saline aquifers
Reservoir quality? (Proterozoic)	**São Francisco Basin** (onshore) → saline aquifers
EOR experience + infra-structure	**Recôncavo Basin** (onshore) → hydrocarbon fields saline aquifers
Location + Availability	**Paraná Basin** (onshore) → saline aquifers coal seams

CCS opportunities in Brazil

<u>Campos Basin</u>
(petroleum fields and saline aquifers)

Theoretical capacity of oil and gas fields:
ca. 1800 Mt (reserves)
ca. 2700 Mt (reserve + produced)

Effective capacity of saline aquifers:
ca. 4800 Mt

Matched capacity
ca. 31 Mt CO_2/year

CCS opportunities in Brazil

<u>Santos Basin</u>
(petroleum fields and saline aquifers)

Theoretical capacity of oil and gas fields:
ca. 167 Mt (reserves)

Capacity of saline aquifers:
ca. 148,000 Mt

Matched capacity
ca. 80 Mt CO_2/year

CCS opportunities in Brazil

<u>Solimões Basin</u>
(gas fields and saline aquifers)

Theoretical capacity of gas fields:
ca. 163 Mt (reserves)

Effective capacity of Saline aquifers:
ca. 252,000 Mt

Matched capacity
ca. 2.5 Mt CO_2/year

CCS opportunities in Brazil

<u>Paraná Basin</u>
(coal seams and saline aquifers)

Theoretical capacity of saline aquifers:
ca. 462,000 Mt

Theoretical capacity in deep coal seams:
ca. 200 Mt

Matched capacity
ca. 135 Mt CO_2/year
(Lots of storage time!)

Conclusions

Brazil has a large storage capacity of ca. 2000 Gt. (USA capacity 3900 Gt)

Majority of stationary sources are in the southeastern Brazil where most of petroleum fields and saline aquifers are located - “Good matching”.

There is a “mismatching” between sources and sinks in basins in northern Brazil (e.g., Solimões).

Brazil`s large storage capacity → encouraging for future CCS action.

Conclusions

Opportunities for CCS:

Paraná Basin
(saline aquifers and deep coal)

Campos Basin
(petroleum fields and saline aquifers)

Santos Basin
(petroleum fields and saline aquifers)

Recôncavo Basin
(petroleum fields and saline aquifers)
→ EOR activity since 1987

Acknowledgements

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