BLUE CARBON ECOSSYSTEMS FROM SOUTH AMERICA

the role on carbon sequestration and mitigation of climate changes

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ECOLOGIA VEGETAL COSTEIRA

Blue Carbon

Carbon stored, sequestered or released from vegetatedcoastal ecosystems - mangroves, tidal marshes, and seagrass meadows.

When coastal ecosystems are degraded or destroyed, that carbon is released back into the atmosphere as CO_2 emissions.

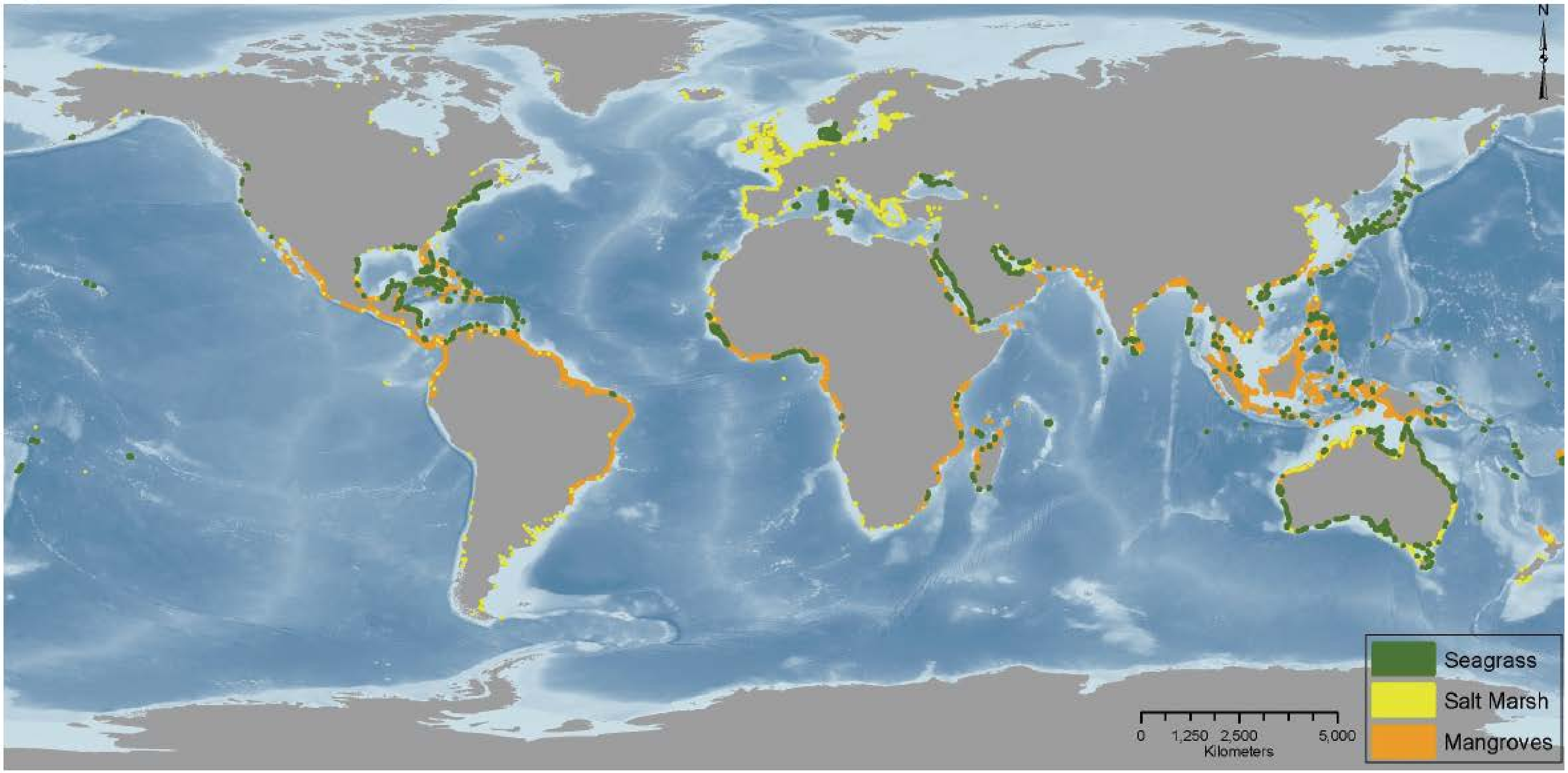
Thus, effective management and conservation of coastal wetlands is now a critical priority, especially in regions where people are highly dependent on these ecosystems for critical services.

Vegetated coastal ecosystems

mainly mangroves, tidal marshes and seagrass meadows

recognized as having very high levels of carbon stocks and sequestration rates

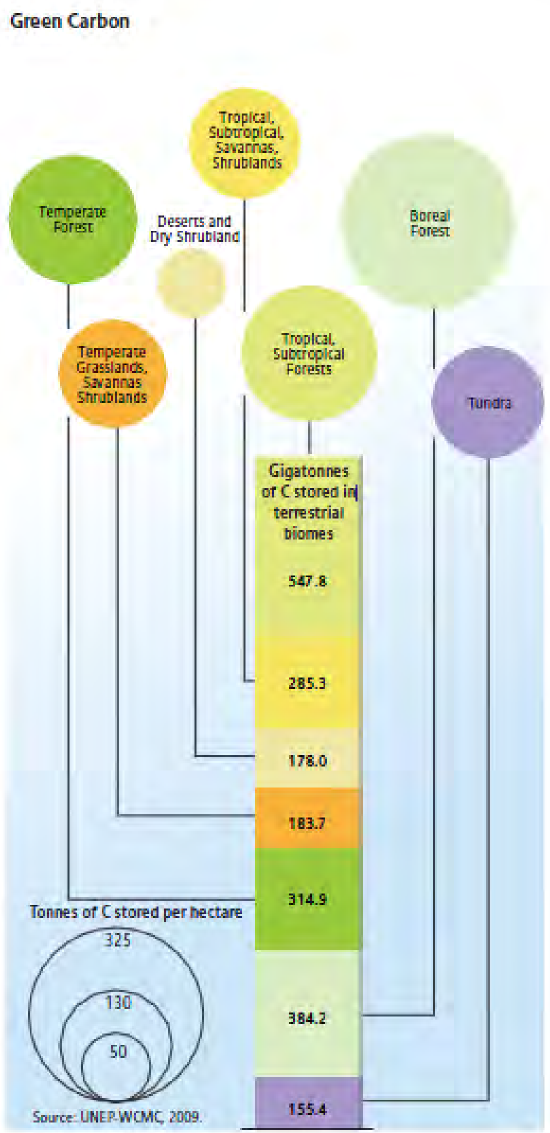
Global distribuition of seagrasses, salt marsh and mangrove



Globally ~2.3 – 7 million km² - cover 0,2 - 2 % of the marine bottoms corresponding to less than 3% of terrestrial vegetation

Sources: Seagrasses (version 2.0) of the global polygon and point dataset compiled by UNEP World Conservation Monitoring Centre (UNEP-WCMC), 2005.

Blue Carbon Systems account for 46% of total carbon burial in the ocean sediments



sinks.

Despite the small fraction of ocean surface, mangroves, salt marshes and seagrasses account together for 46% of total carbon burial in the oean sediments.

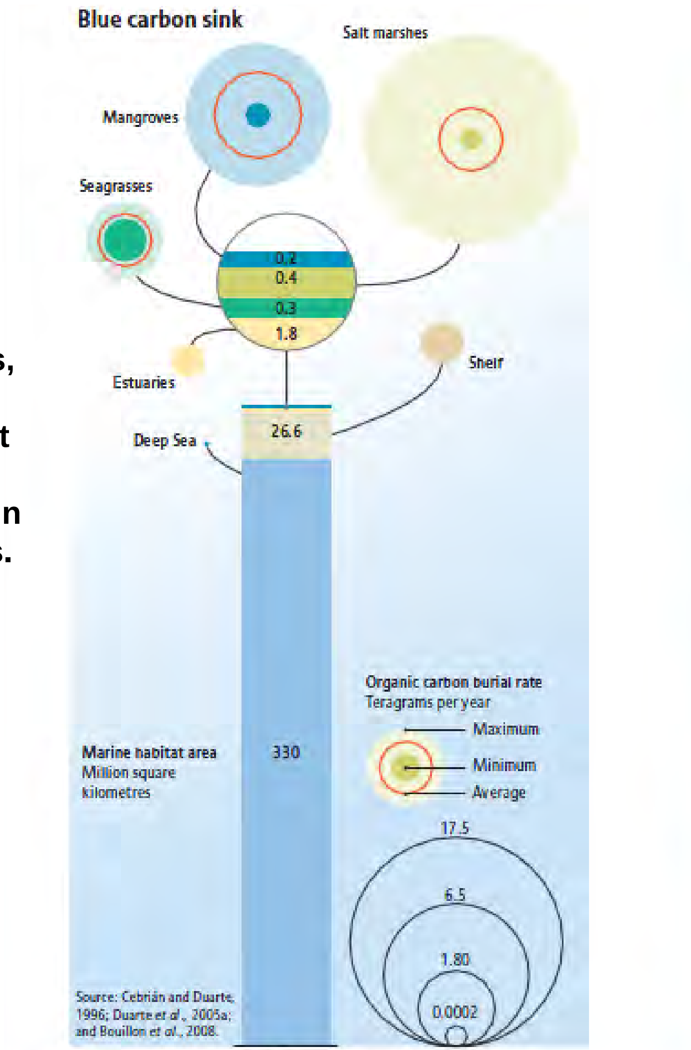
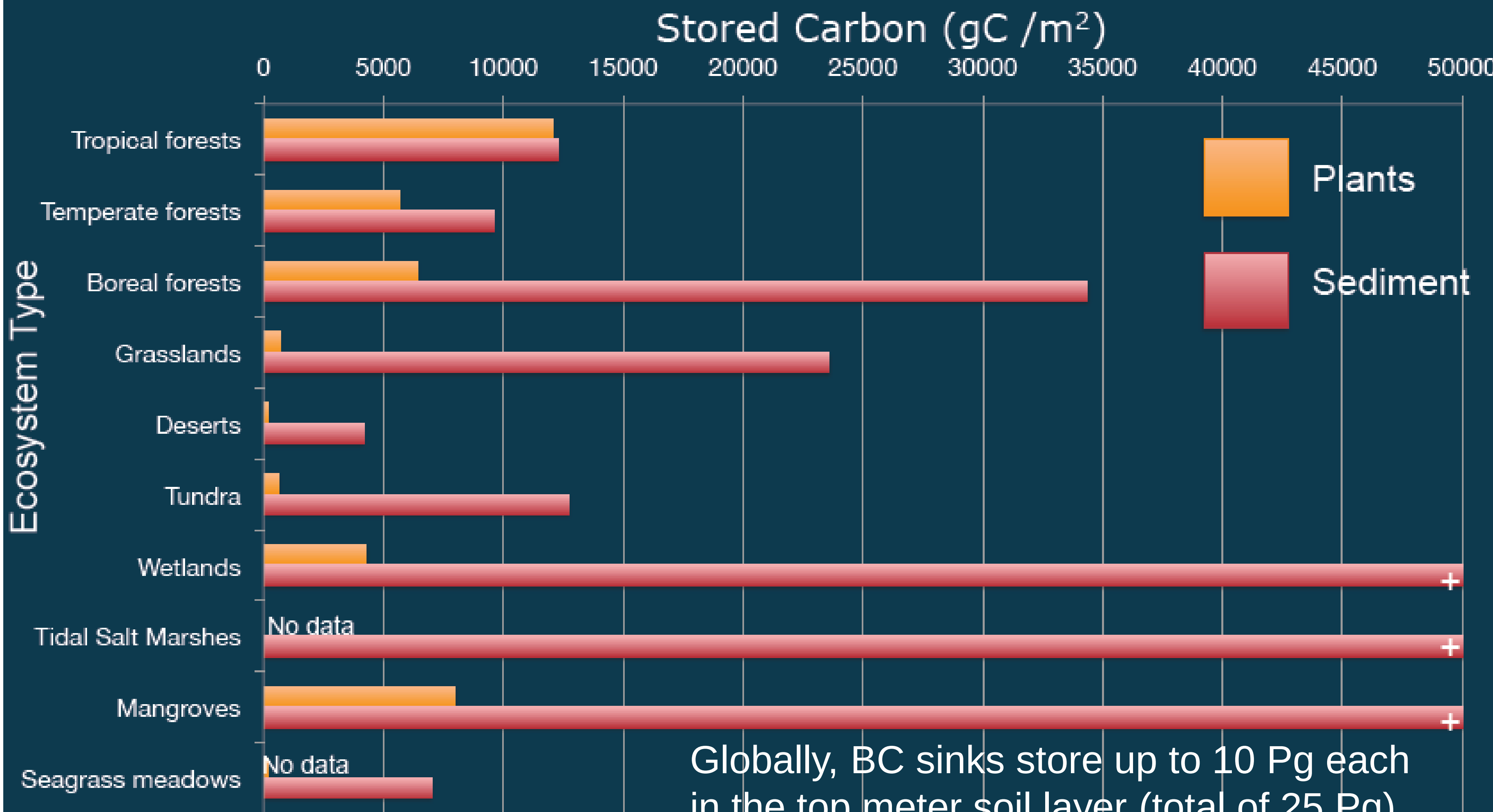


Figure 17: Blue carbon sinks.

Coastal ecosystems store large amounts of carbon in the sediment

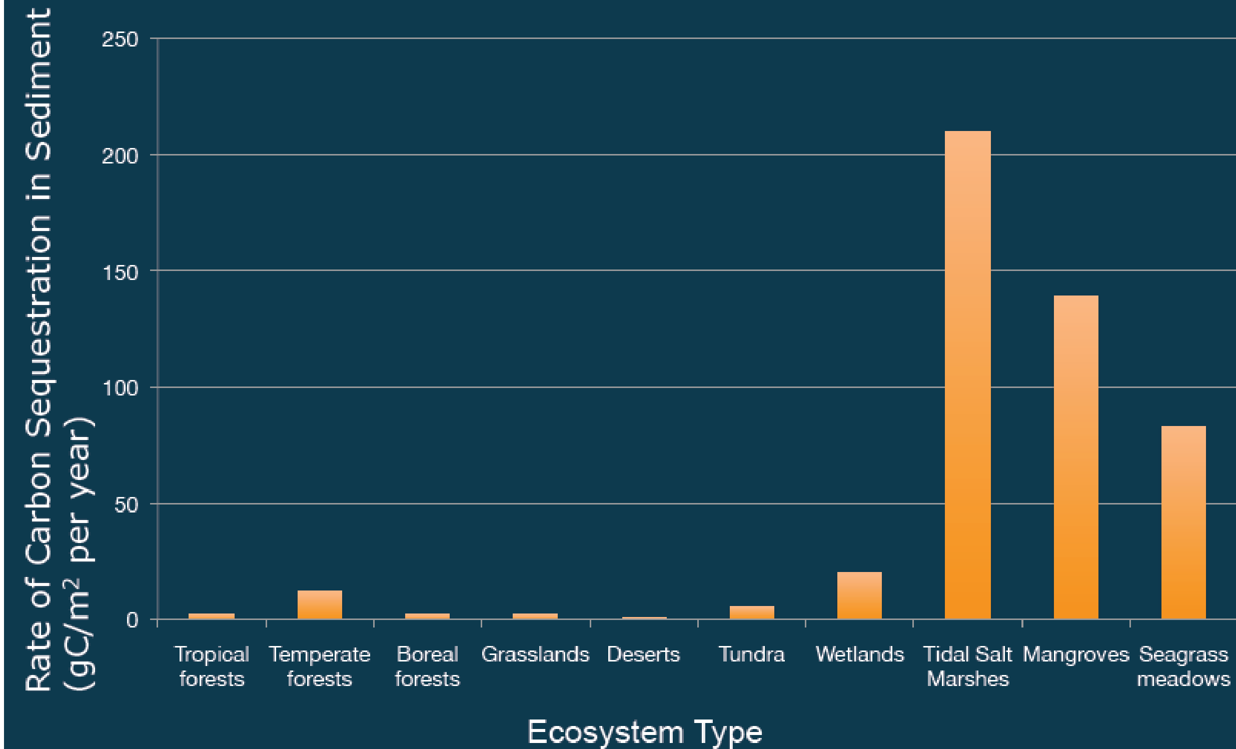


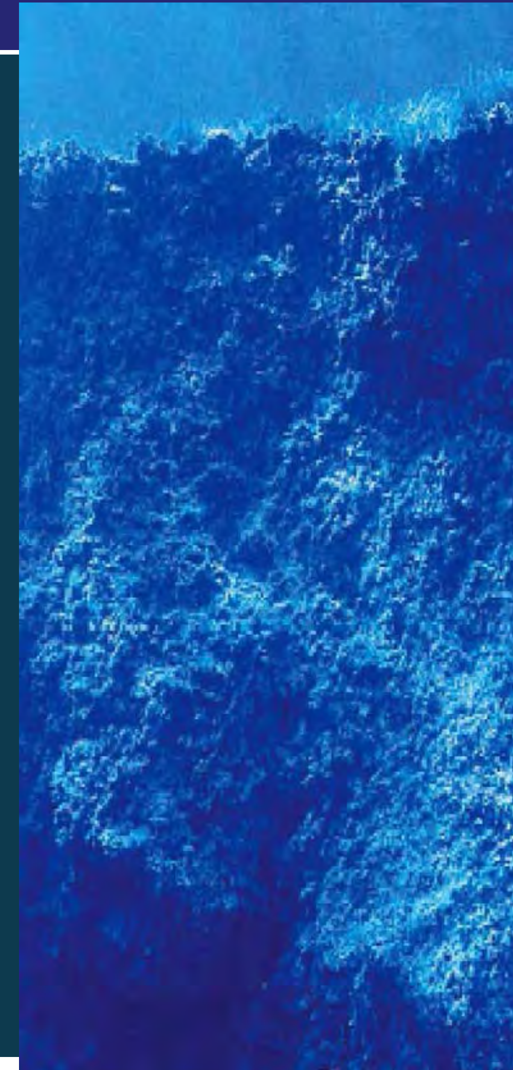
Globally, BC sinks store up to 10 Pg each in the top meter soil layer (total of 25 Pg)

Pg = 10^{15}

Management of Natural Coastal Carbon Sinks IUCN 2009

Coastal ecosystems have very high rates of carbon sequestration.





Burial rates in mangroves, salt marshes and seagrasses are exceptionally high, exceeding those in the soils of terrestrial forest by 30-50 fold.

Bury similar amount of OC to terrestrial forest annually, despite the extent of less than 3% of that forests

Among the most valuable ecosystem on earth

Constanza et al. 1997

- USD $1.6 billion in ecosystem services annually

- play an essential role in the livelihoods and well being of billions of people

- Regulate nutrient fluxes,
- Provide habitat
- Climate regulation
- Coastal protection
- CO_2 sinks

Coastal areas are among the most threatened natural ecosystems on Earth

Alongi 2002, Waycott et al. 2009, Saintilan et al. 2009, Donato et al. 2010

Coastal ecosystems are being lost in fast rates

Habitat Type	Global extent (km²)	Conversion drivers	Annual Loss Rate (~1980–2000)	Total Historical Loss (%)
Seagrass	300,000–600,000[a]	Water quality degradation, mechanical damage	1.2%–2%[b]	29[c]
Tidal Marsh	400,000[d]	Historical reclamation for agriculture & salt ponds; real estate development	1%–2%[e]	Centuries of conversion[f]
Mangroves	137,000–170,000[g]	Aquaculture, forestry uses, Agriculture	0.8%–2.1%[h]	35[i]

Sources: (a) Charpy-Roubaud and Sournia 1990, Duarte et al. 2005; (b) Short and Wyllie-Echeverria 1996; adapted from Waycott et al. 2009; (c) Waycott et al. 2009; (d) Nellemann et al. 2009; (e) Adam 2002; Duarte et al. 2008; (f) Bromberg Gedan et al. 2009; (g) Valiela et al. 2001; FAO 2007; (h) Valiela 2001; FAO 2007; Giri et al. 2011; (i) Valiela 2001; Duke et al. 2007. See Appendix for complete references.

Even providing us an estimated USD $1.6 billion in ecosystem services annually and play an essential role in the livelihoods and well being of billions of people, coastal areas are among the most threatened natural ecosystems on Earth.

Degradation causes Emissions of GHG

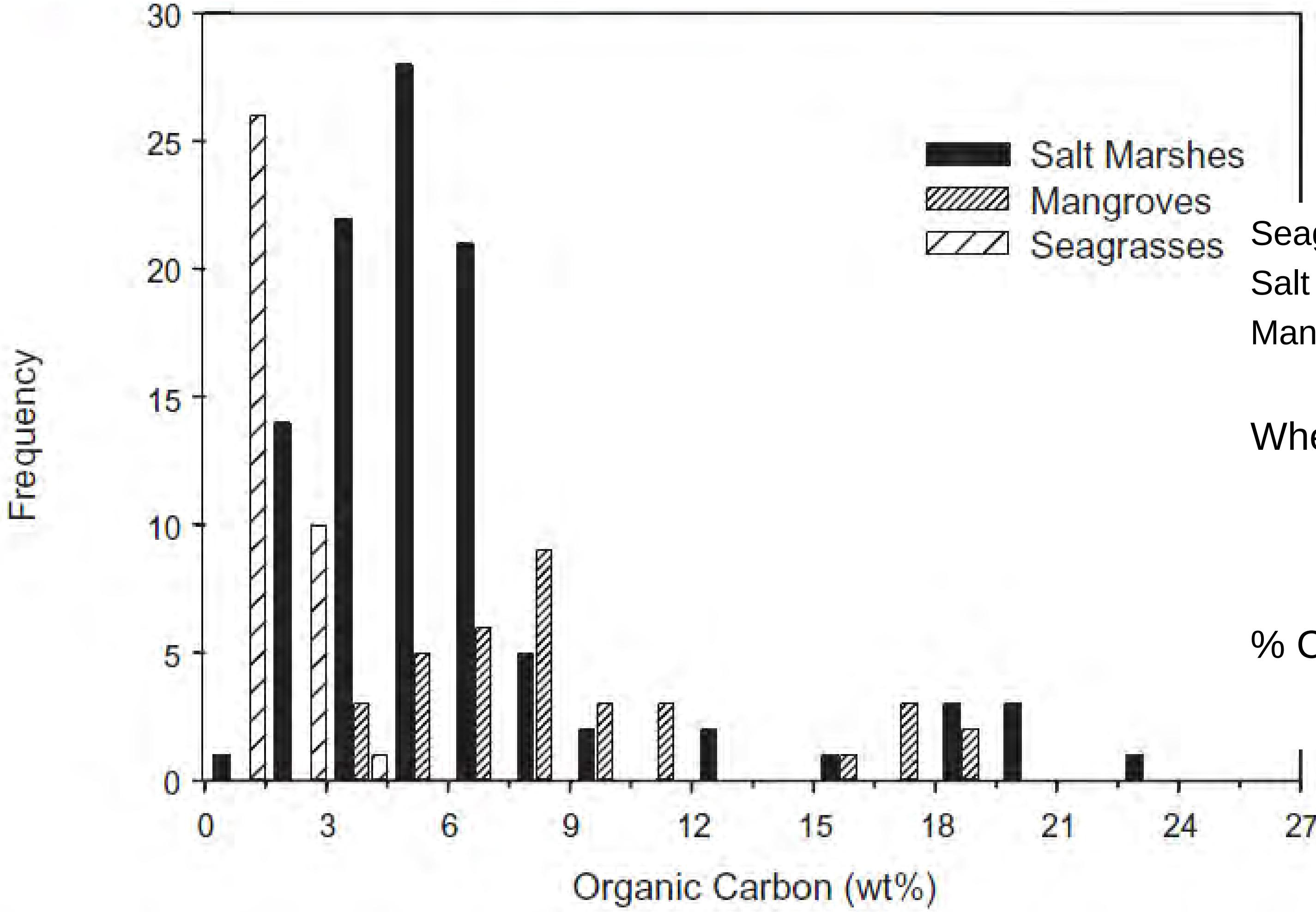
Pendelton et al. 2012

Habitats	Soil Organic C at risk (tCO2e/ha)	Total C at Risk (tCO2e/ha)	Habitat Extent (Mha)	Annual C loss 0.7% rate (BtCO2e)	Annual C loss 2% rate (BtCO2e)
Salt Marsh	250	282	5.1	0.01	0.029
Mangroves	1298	1762	13.8	0.17	0.49
Seagrass	500	511	30	0.107	0.31
Total			**48.9**	**0.287**	**0.829**

Equivalent to 5-20 % from emissions by deforestation and land use change

Variability of Organic Carbon in sedinment

Duarte et al. 2005. Biogeosciences



Seagrasses ~ 2% C

Salt Marshes ~ 5%

Mangroves ~ 8.5% C

Where are the hot spots and conditions for their formation?

% C corresponding to burial rates?

Fig. 2. Frequency distribution of organic carbon content in salt marsh, mangrove and seagrass sediments. Data sources in Table 2.

GHG emission reduction (up to 25%) could be achieved by conservation and recovering of green and blue carbon

Green carbon: Reducing deforestation rates by 50% by 2050 would avoid the direct release of up to 50 Gt C, equivalent to 12–15% of the emissions reductions needed to keep atmospheric concentrations of carbon dioxide below 450 ppm (Trumper *et al.*, 2009).

Blue carbon: protection, improved management and restoration of the ocean's blue carbon sinks would result in preventing the annual loss of up to 450 Tg C yr–1, corresponding 10% of the emissions reductions needed (Nellemann at al. 2009).

the BLUE CARBON initiative

CONSERVATION INTERNATIONAL

IUCN

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

NASA

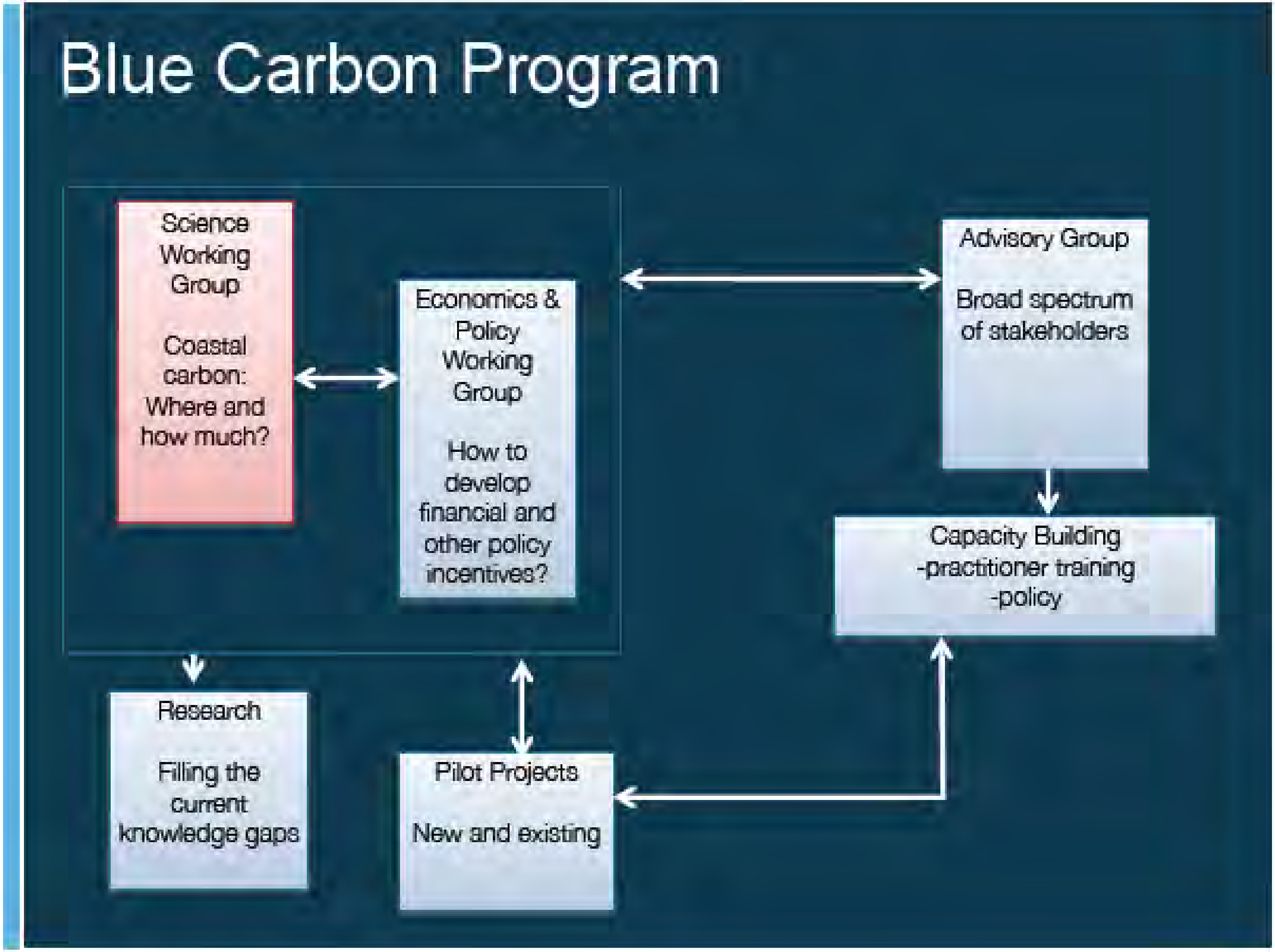
KIOST KOREA INSTITUTE OF OCEAN SCIENCE & TECHNOLOGY

The WALTON FAMILY FOUNDATION

thewaterloofoundation

International and integrated program focused on mitigating climate change by conserving and restoring coastal marine ecosystems globally.

Led by CI, IUCN and UNESCO, works with partners from national governments, research institutions, nongovernmental organizations, coastal communities, inter-governmental and international bodies and other relevant stakeholders.


Blue Carbon Program
Science Working Group
Coastal carbon: Where and how much?
Economics & Policy Working Group
How to develop financial and other policy incentives?
Advisory Group
Broad spectrum of stakeholders
Capacity Building
-practitioner training
-policy
Research
Filling the current knowledge gaps
Pilot Projects
New and existing

Blue Carbon Scientific Working Group

Provides the scientific foundation for the Blue Carbon Initiative.

Focused on synthesizing current and emerging science on blue carbon and providing the robust scientific basis for coastal carbon conservation, management, and accounting.

The International Working Group on Coastal "Blue" Carbon was formed in February 2011 to address the global significance of climate change mitigation through the sequestration of carbon by coastal ecosystems – specifically mangroves, tidal marshes and seagrasses. The working group reviews current scientific knowledge of coastal carbon, develops guidelines for maximizing storage and sequestration of coastal carbon and provides recommendations for quantifying and monitoring carbon, and emissions thereof, in coastal systems.


Minimizing Carbon Emissions and Maximizing Carbon Sequestration and Storage by Seagrasses, Tidal Marshes, Mangroves
Recommendations from the International Working Group on Coastal "Blue" Carbon

Enhanced international recognition of coastal carbon ecosystems

Current international actions to reduce the impacts of climate change do not recognize the greenhouse gas emissions resulting from the degradation of coastal wetlands or the role of healthy coastal ecosystems in sequestering carbon dioxide.

Enhanced national and international research efforts

Building on existing scientific data, analysis, and available technologies, a coherent and programmatic global data gathering and assessment effort is needed.

Enhanced local and regional management measures

Existing knowledge of the large carbon stocks, sequestration potential, and emissions from degraded or converted coastal ecosystems is sufficient to warrant enhanced management actions now.

Blue Carbon International Scientific Working Group

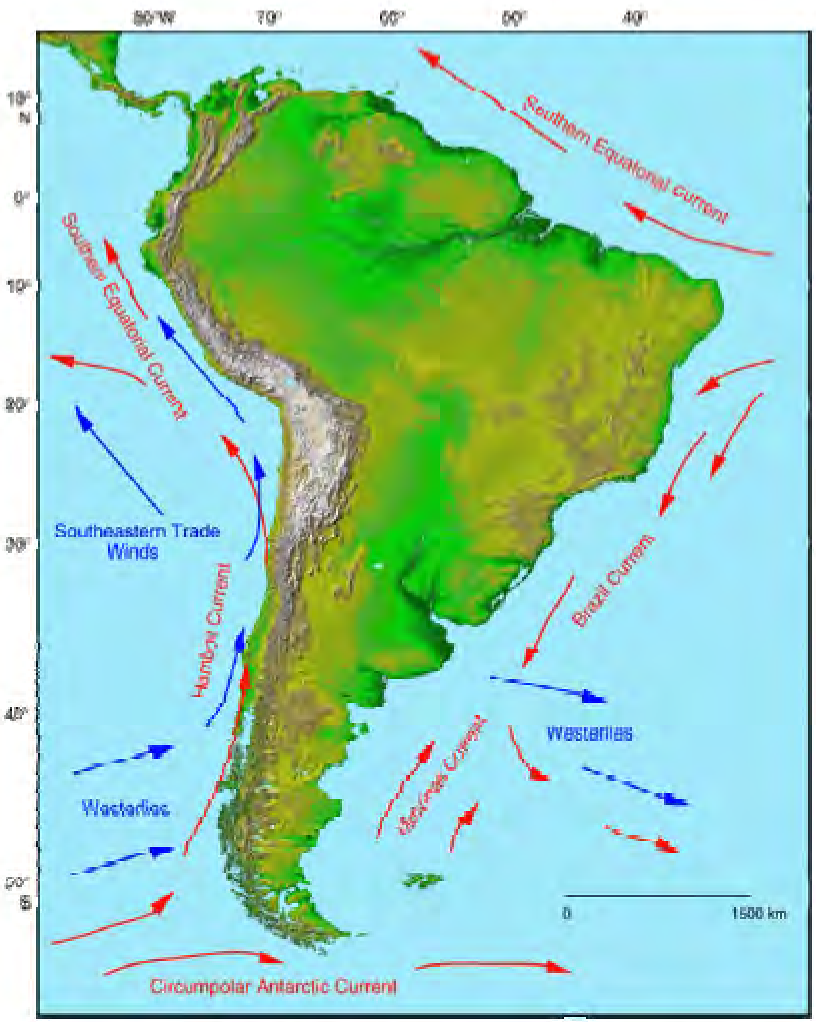
October 20-23, 2014

FURG, Rio Grande – Brazil

the BLUE CARBON initiative

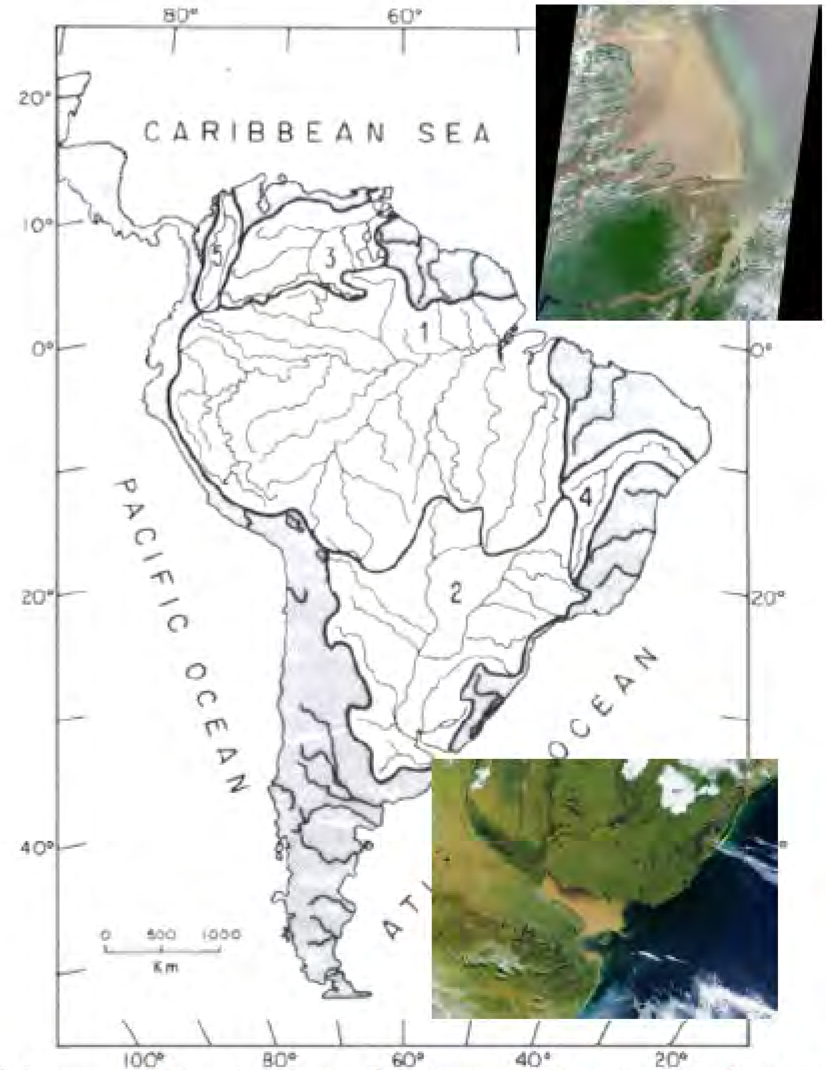
South America

Flow paths of major ocean currents



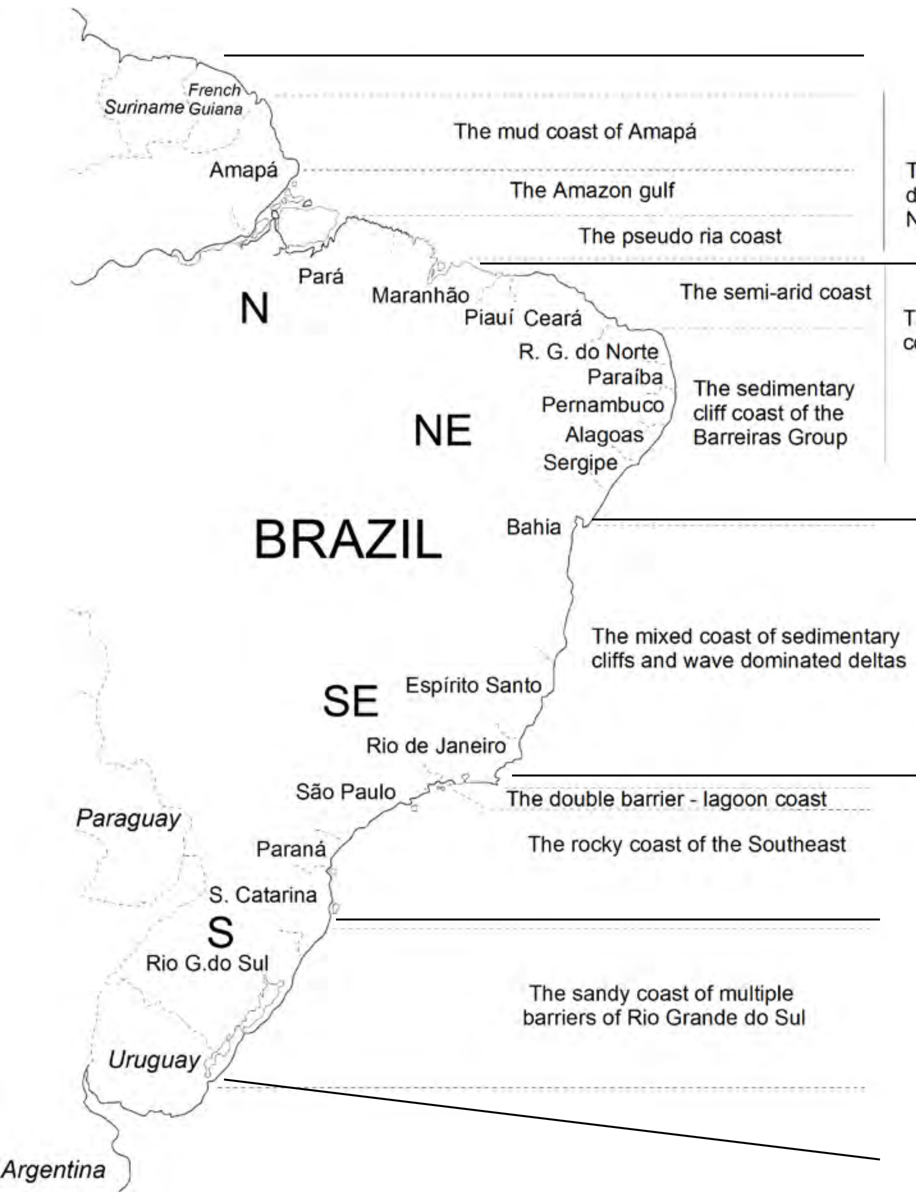
SA surrounded by water masses of different origins and properties, which have a great

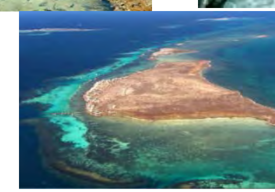
Hidrographic Basins

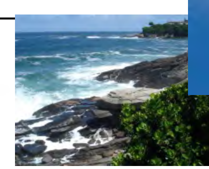


Disharge of river basins affect coastal geomorphology and water properties (turbidity, salinity, temperature, nutrients etc.). Plume of the Amazonas and La Plata rivers make th major coastal barriers for marine organisms.

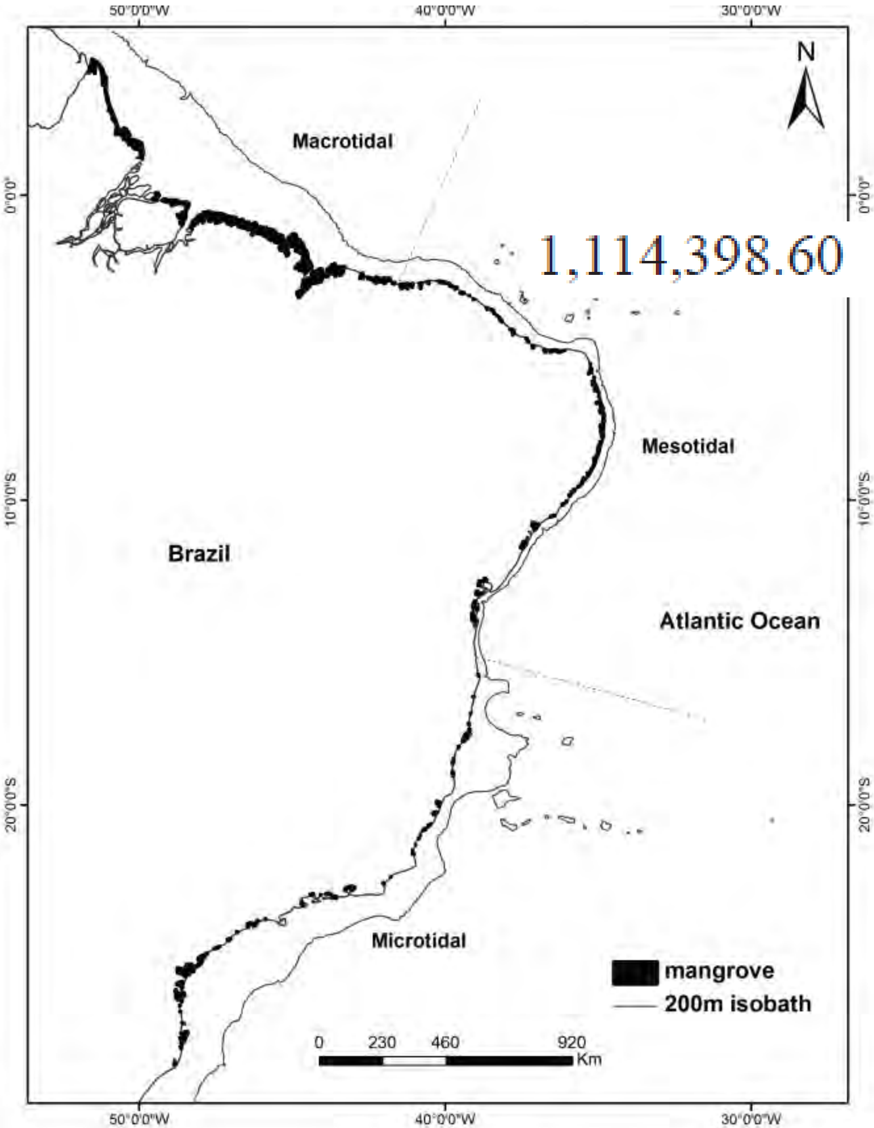
Geomorphology of Brazilian Coast line (according to Dieter 2010)







Brazilian mangrove forest



1,114,398.60 hectares

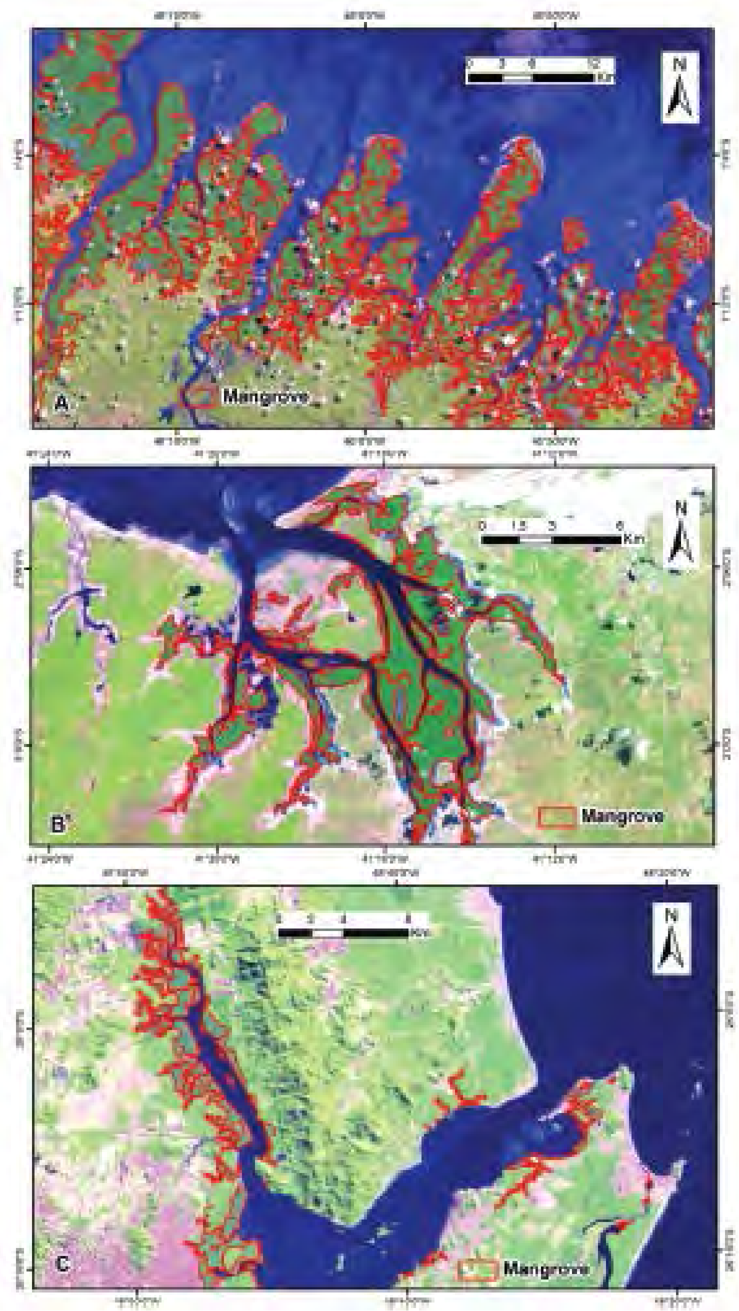
R. MAGRIS & R. BARRETO

Pan-American Journal of Aquatic Sciences (2010), 5(4):546-556

Spalding et al. (2010)

"World Atlas of Mangroves"

Country	Mangrove area (km^2)	Proportion of global total
Indonesia	31,894	20.9%
Brazil	13,000	8.5%
Australia	9910	6.5%
Mexico	7701	5.0%
Nigeria	7356	4.8%
Malaysia	7097	4.7%
Myanmar	5029	3.3%
Bangladesh	4951	3.2%
Cuba	4944	3.2%
India	4326	2.8%
Papua New Guinea	4265	2.8%
Colombia	4079	2.7%



Brazilian mangrove forest

Total 1,114,398.60 hectares

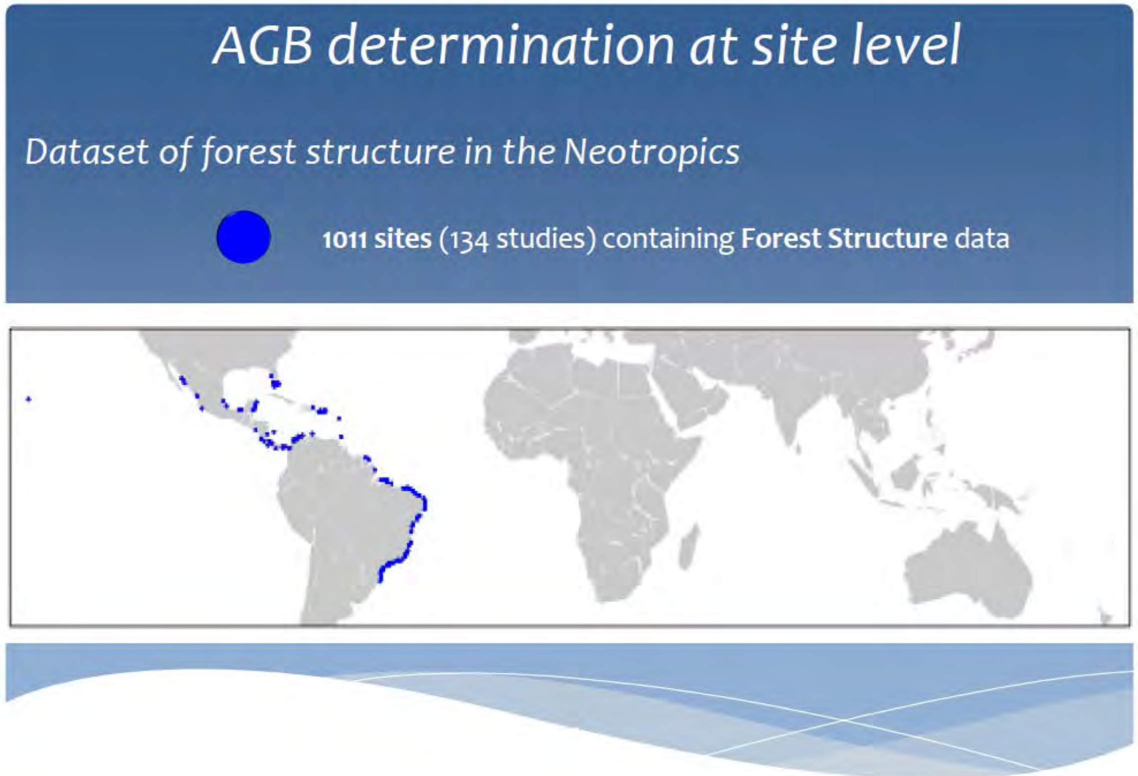
Protected Areas

425,530.57 hectares of protected mangrove forest were registered: 201,123.52 ha under strict protection and 224,407.05 ha under sustainable use.

Coastal sector	Mangrove in protected areas	
	Area (ha)	%
Macrotidal	810,892.96	87.98
Mesotidal	27,178.53	23.09
Microtidal	52,080.99	69.38

Geophysical and Climate Drivers in Mangrove Aboveground Biomass in the Neotropics

Pagliosa et al. (in review)



Geophysical - tides, river discharge, wave energy
Climate - temperature, precipitation

Model mangrove AGB in the Neotropics

Dr. Paulo Pagliosa,
Dra. Alessandra Fonseca,
MSc Andre Rovai - UFSC

Geophysical and Climate Drivers in Mangrove Aboveground Biomass in the Neotropics

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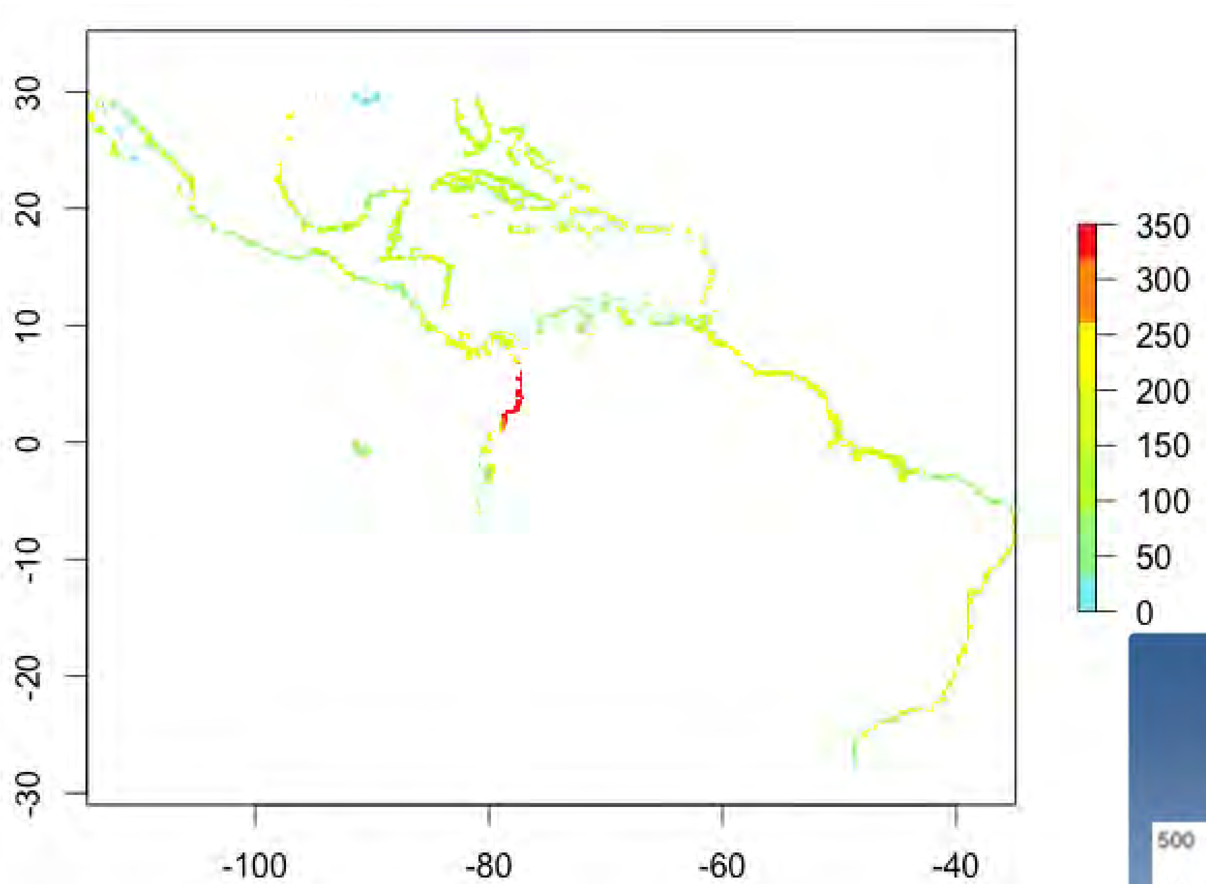
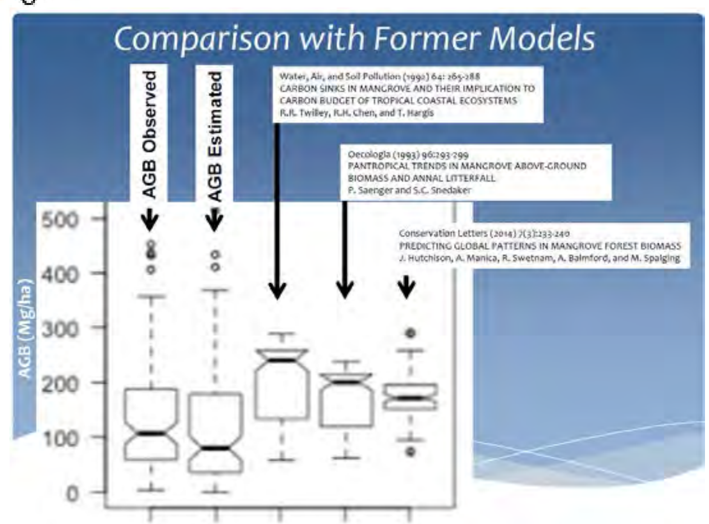
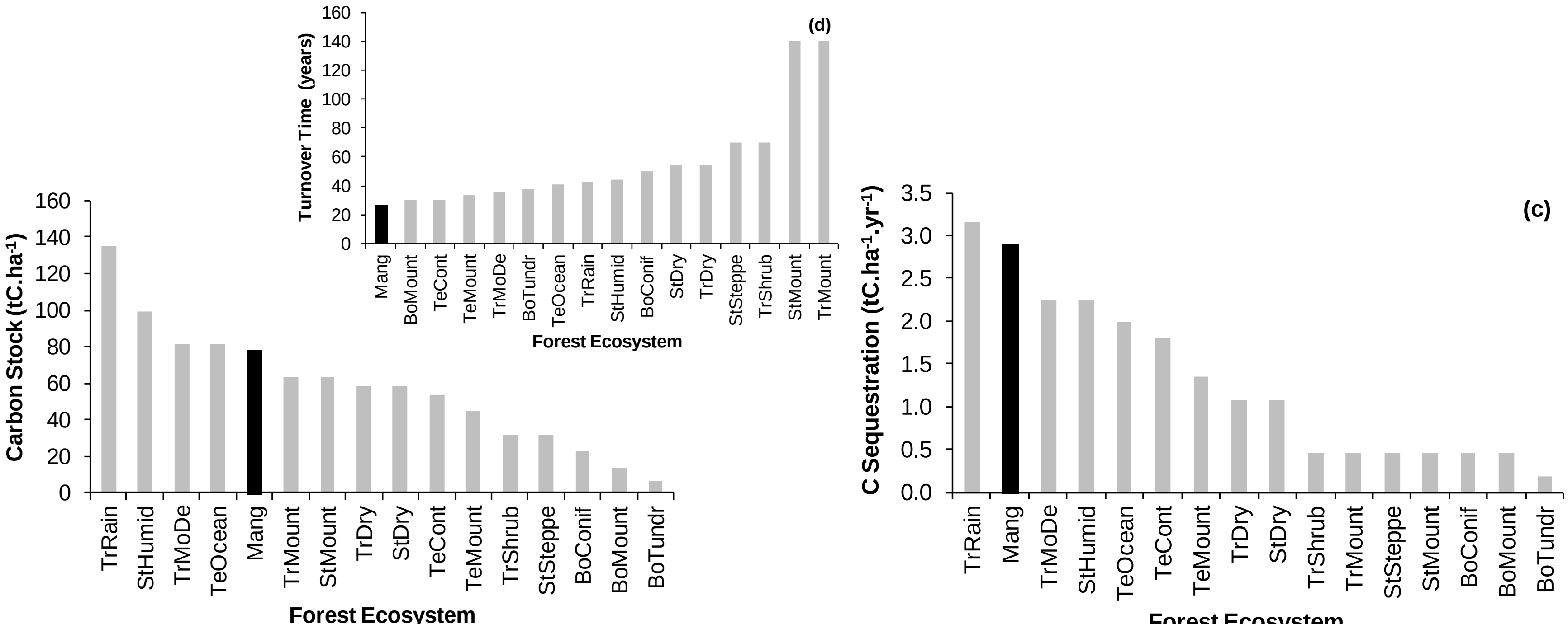




GLOBAL AVERAGES OF CARBON STOCK AND SEQUESTRATION

Estrada et al. 2014 *Estuarine Coastal Shelf Science*)

	Mean ± SD	Max	Min	Articles (Values)
Carbon Stock ($tC.ha^{-1}$)	78.0 ± 64.5	418.5	0.9	69 (316)
Carbon Sequestration ($tC.ha^{-1}.ano^{-1}$)	2.9 ± 2.2	9.7	0.4	26 (101)



Data of forest ecosystems from: IPCC (2003) and IPCC (2006)

Mapping changes in the largest continuous Amazonian mangrove belt using object-based classification of multisensor satellite imagery

W.R. Nascimento Jr. et al. / Estuarine, Coastal and Shelf Science 117 (2013) 83–93

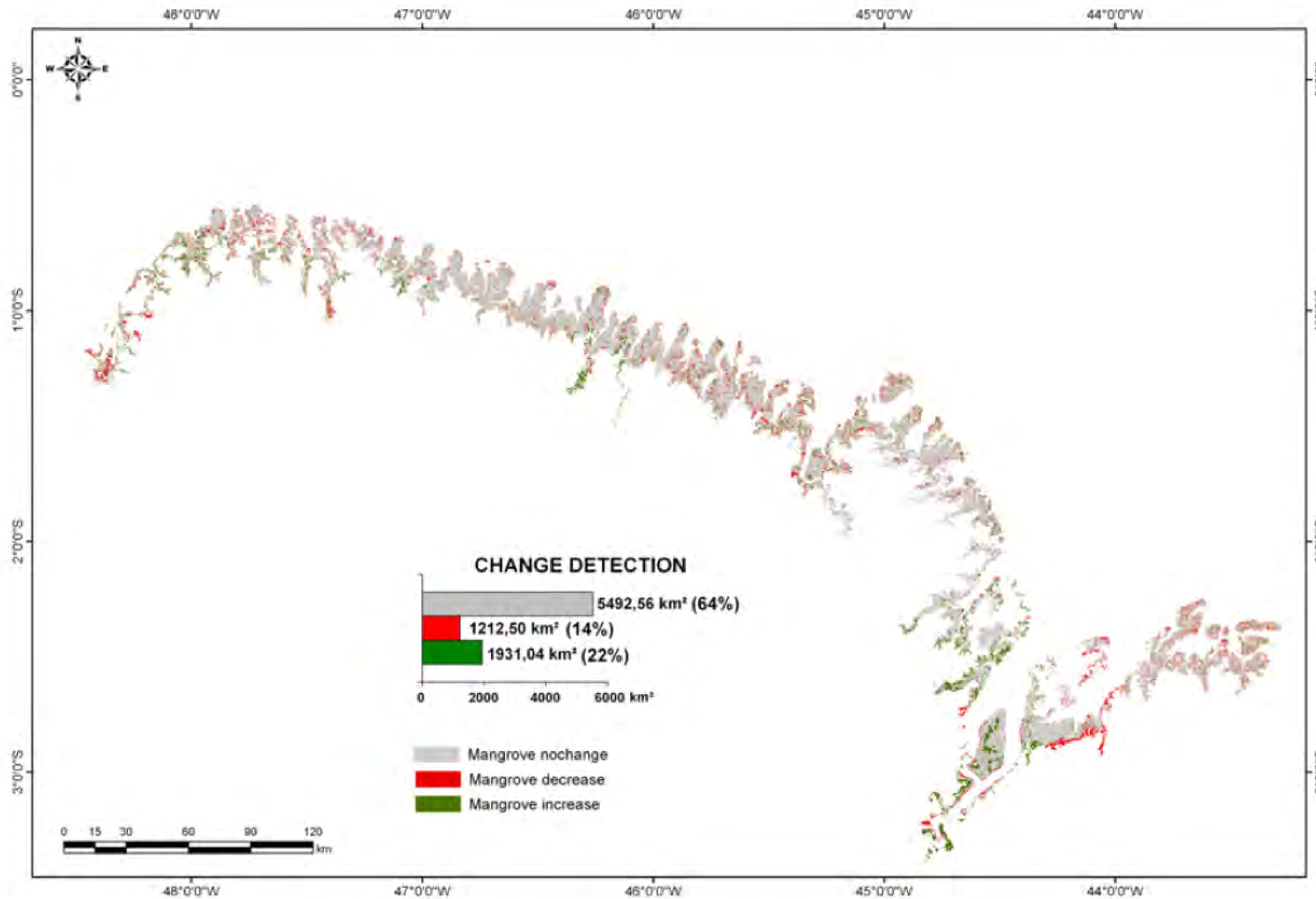
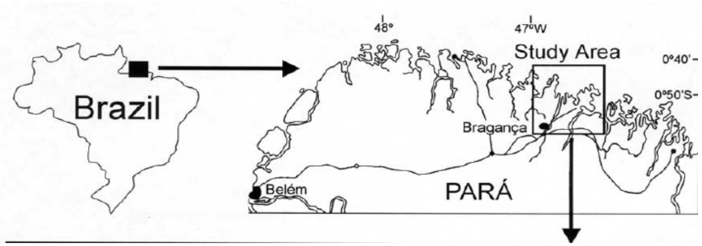


Fig. 7. Amazon mangrove forest change from 1996 to 2008.

Coastal erosion Northern Brazil



an 25-year period (1972–1997).

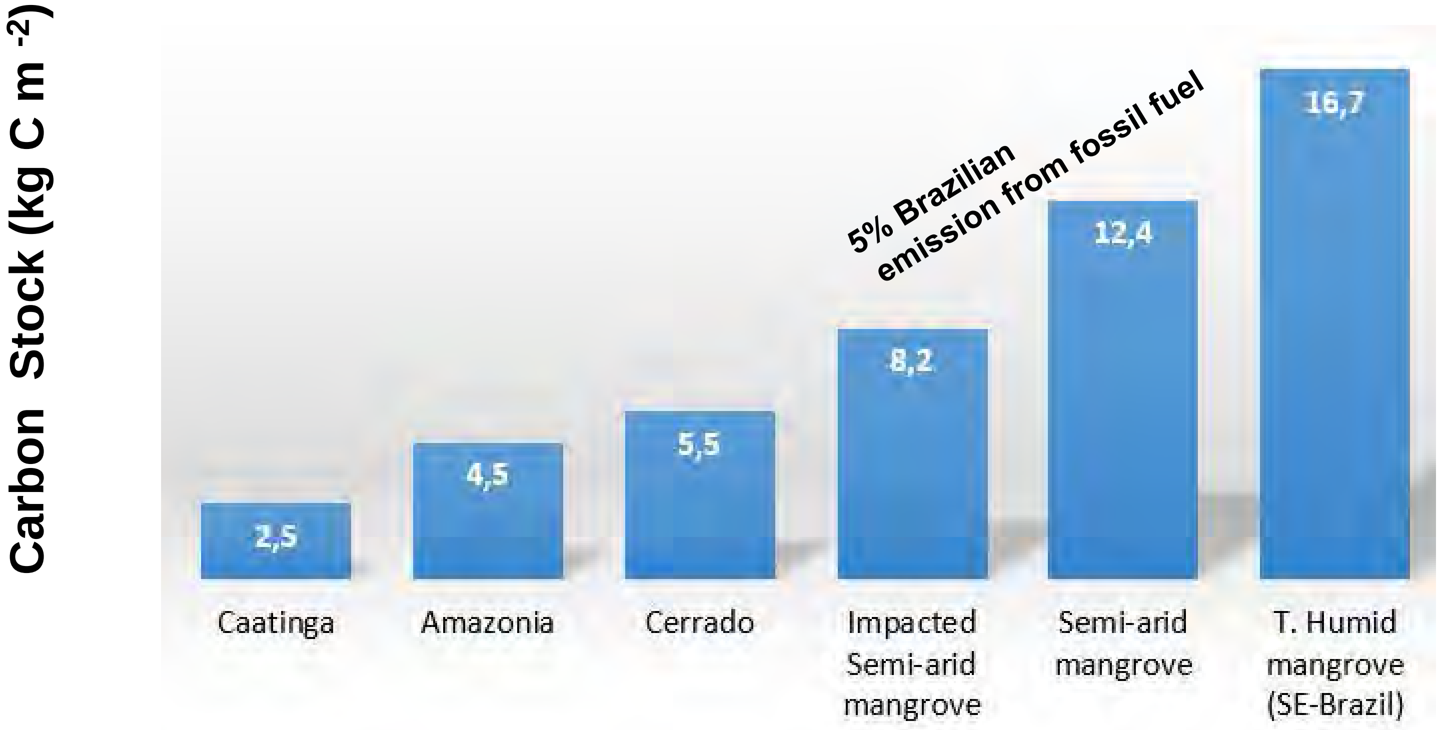
Table 1. Vegetation coverage changes along the studied sector of the Pará coastline including Bragança.

Overall	72–86	86–91	91–97	72–97
Initial mangrove area (km^2)	592	585	583	592
Loss along coastline length (%)	37	40	42	42
Gain along coastline length (%)	19	16	5	19
Stable coastline length (%)	44	44	53	39
Gross loss (km^2)	18	9	12	39
Gross gain (km^2)	11	7	2	20
Net loss (km^2)	7	2	10	19
Net loss rate (km^2/yr)	0.5	0.4	1.6	0.8

PEDRO W.M. SOUZA-FILHO and WALDIR R. PARADELLA *An Acad Bras Cienc* (2003) 75


Soils or Sediments

Soil Carbon Stock in Brazilian Biomes or Ecossystems



Nóbrega et al (2015.)

@ Dr. Tiago O. Ferreira, ESALQ – USP
Soil Science

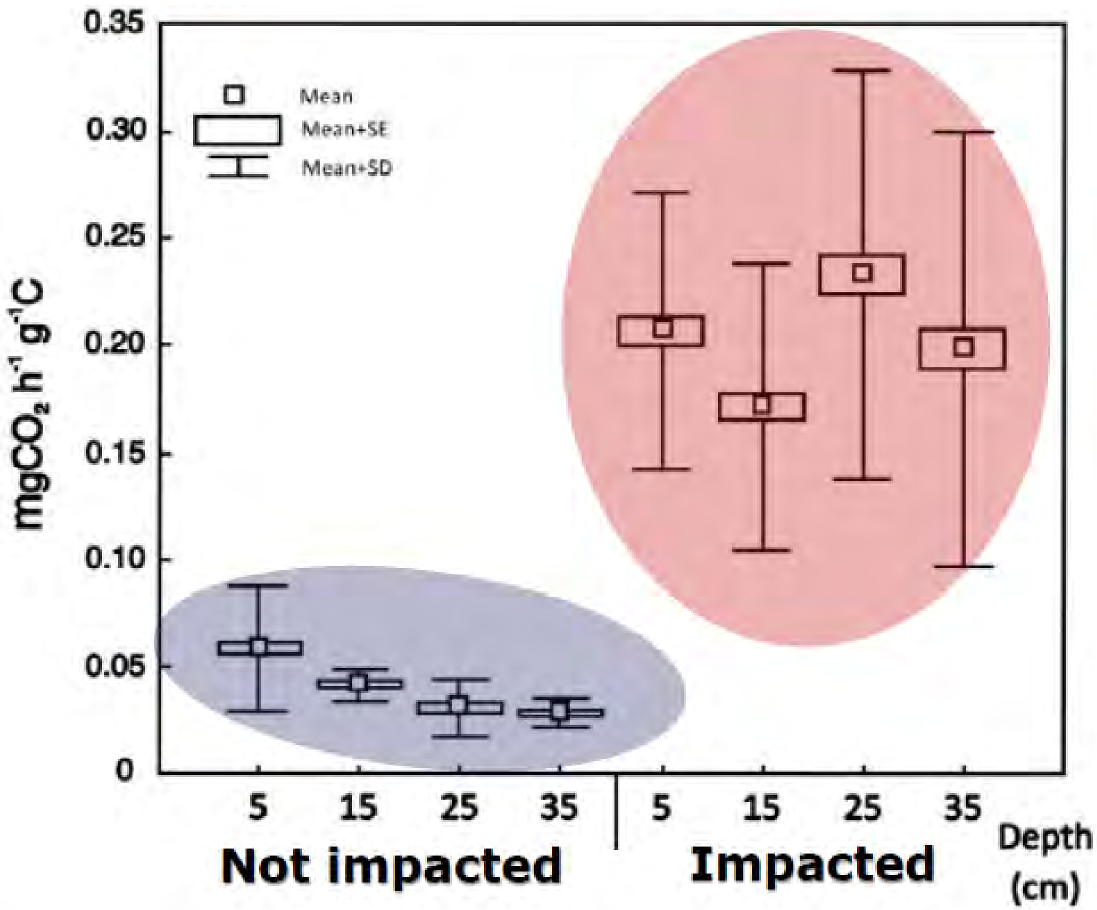
$$5FeS_{2(s)} + 14NO_3^-(aq) + 4H^+_{(aq)} \Rightarrow 7N_{2(g)} + 10SO_4^{2-}(aq) + 5Fe^{2+}_{(aq)} + 2H_2O_{(aq)}$$

5FeS

5Fe

Carbon dioxide emissions rate in NO- impacted and impacted soils by waste aquaculture

Geoderma 213 (2014) 551–559

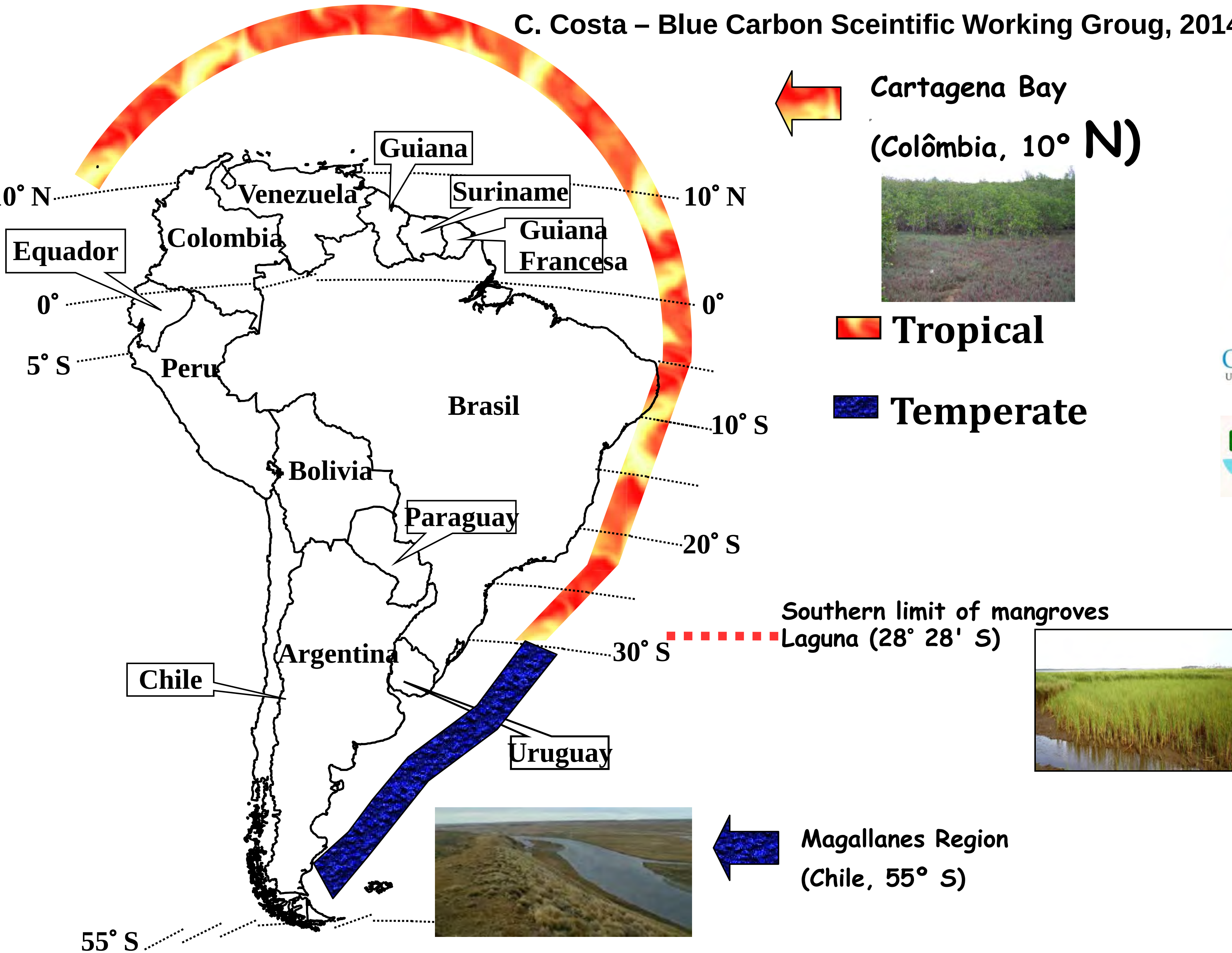


@ T. O. Ferreira,
ESALQ – USP
Soil Science

Fig. 4. Carbon dioxide emission rate (mg CO_2–C h^{-1} g^{-1}) in Non-WAM soils and WAM soils under *Rhizophora* sp. stands sampled in the wet season.

Salt marshes of the Atlantic South America

C. Costa – Blue Carbon Sceintific Working Groug, 2014



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ECOLOGIA VEGETAL COSTEIRA

Atlantic Tropical Salt Marshes

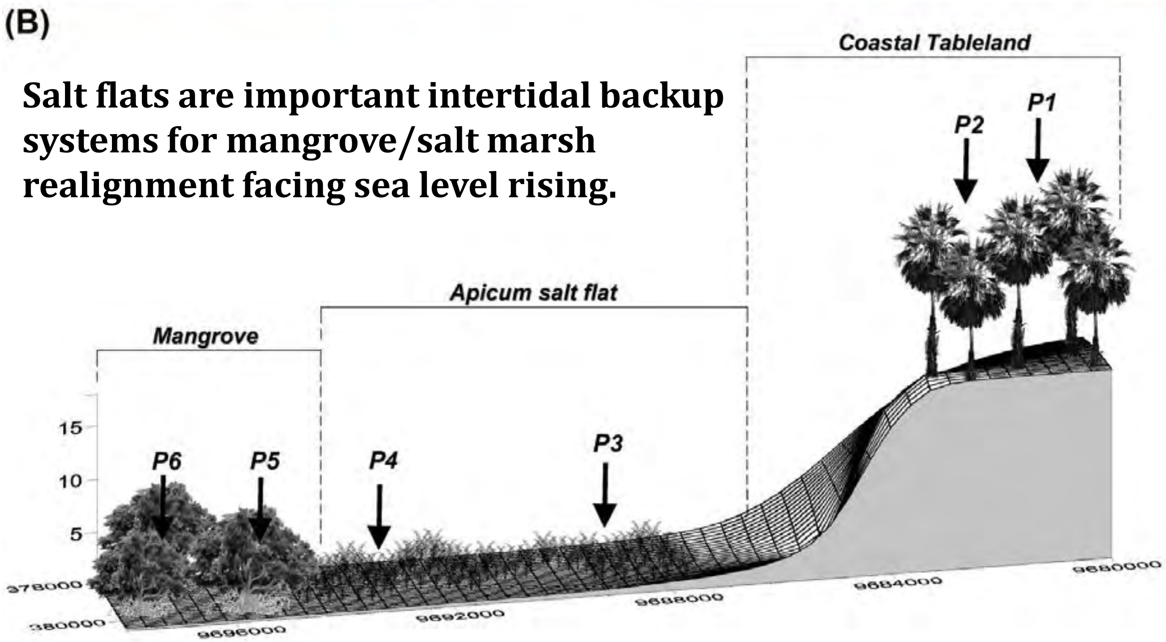
- Total extension is unknown.
- Estimates from few studies (% of marsh cover)

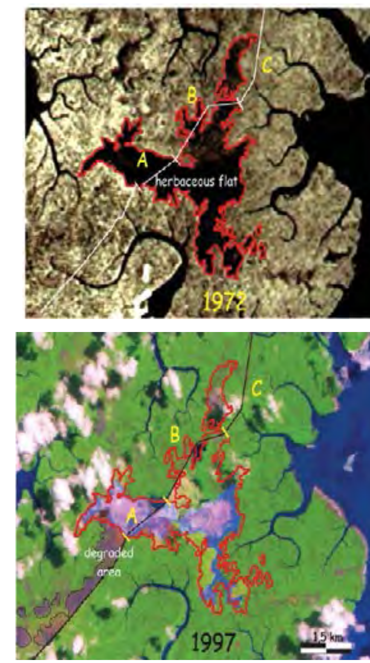
Inability to distinguish bare salt flats and marshes with spaced herbaceous plants by the resolution of satellite image used.

Salt flats are important intertidal backup systems for mangrove/salt marsh realignment facing sea level rising

Apicum – Salt flats associated to mangroves

Salt flats are important intertidal backup systems for mangrove/salt marsh realignment facing sea level rising.





Salt Flats

Y	Km^2
72->	9.0
86->	7.1
88->	6.3
91->	6.2
97->	5.6

Net gain $3.4\ Km^2$

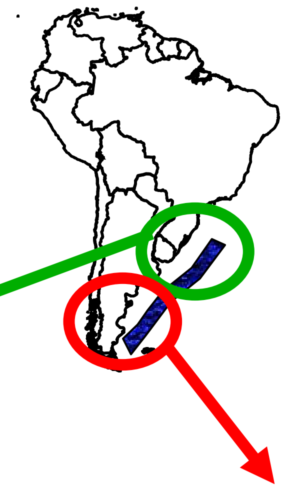
Cohen[1,*] & Rubén J. Lara[2]
Wetlands Ecology and Management 11: 223–231, 2003.

APICUM:
1.5 % TOC

Ferreira et al. Soil Research 52: 140–154 (2014)

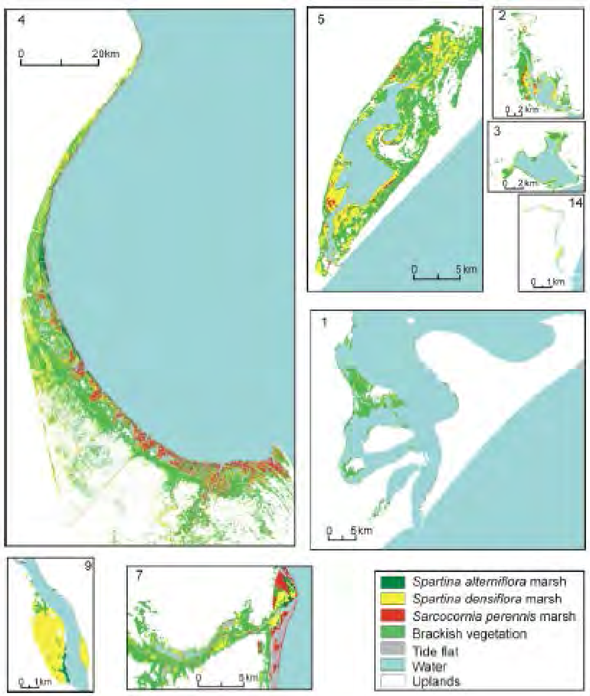
Atlantic Temperate Salt Marshes

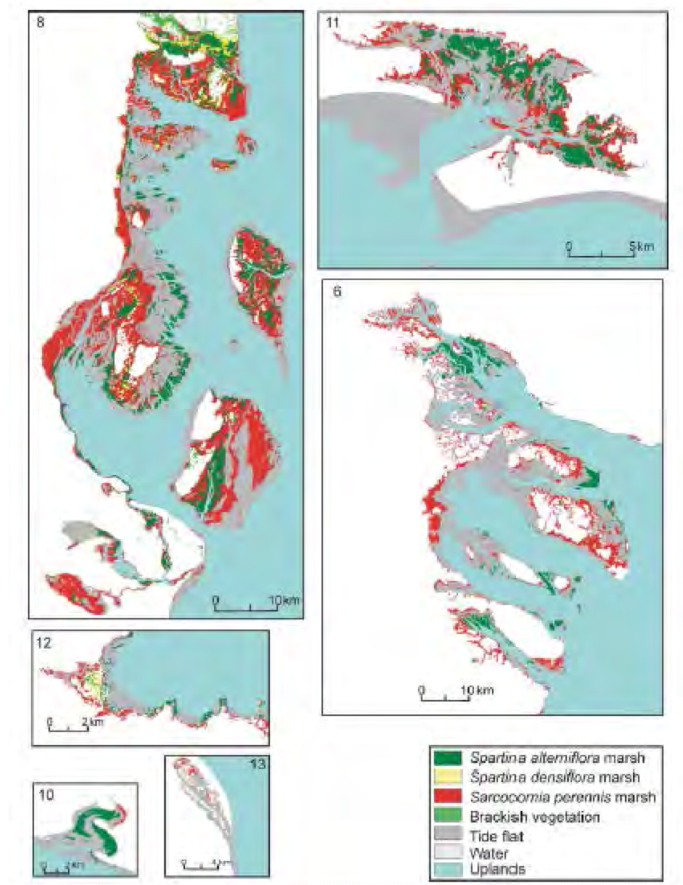
- Areal extent
- (Isaach et al. 2006).



Salty macrotidal marshes

Brackish microtidal marshes





C. Costa et al. – Blue Carbon Sceintific Working Groug, 2014

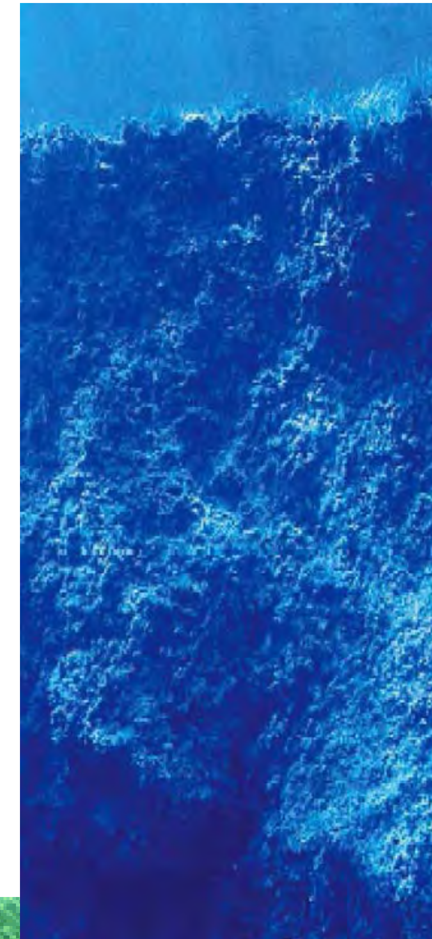
Atlantic Temperate Salt Marshes

Habitats' areas

~ 218. 964 Hecs

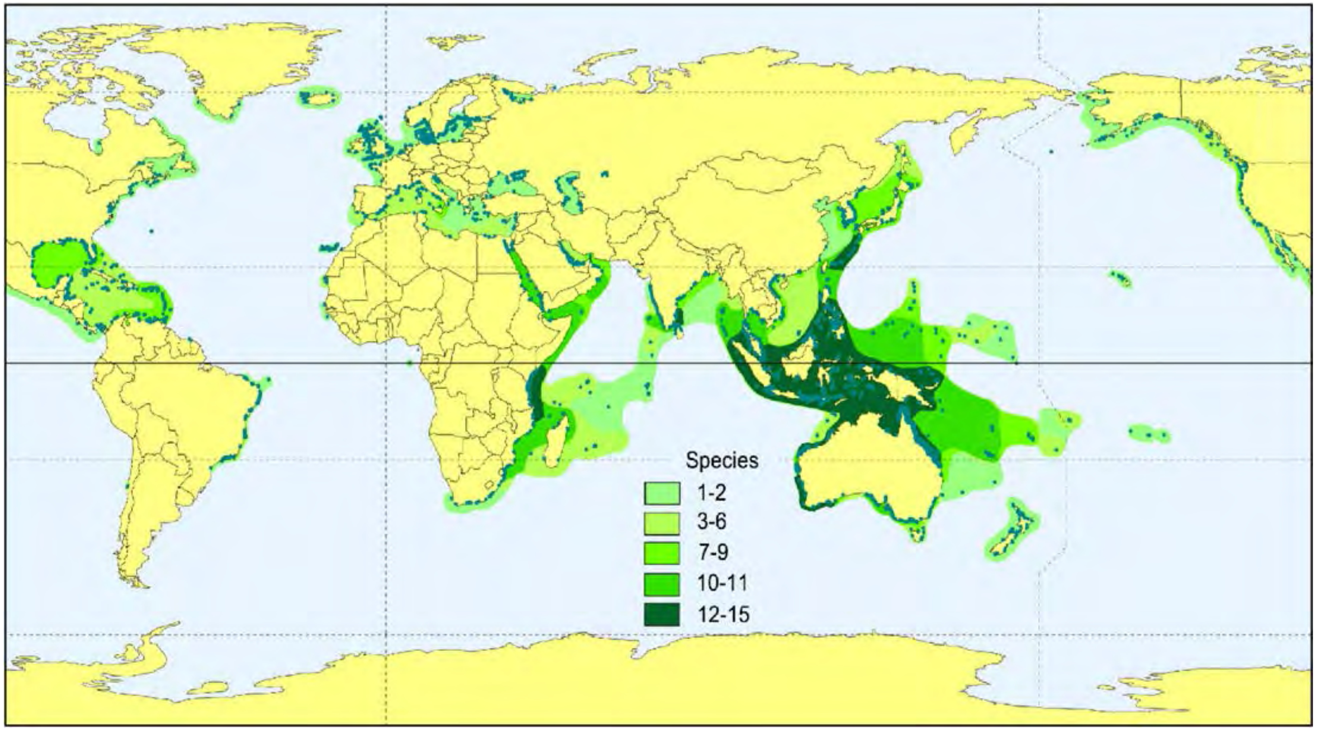
Stock ~ 5 Ton C / ha

C. Costa et al. – Blue Carbon Sceintific Working Groug, 2014



Seagrasses

Seagrass meadows distribuition and area (Km²)



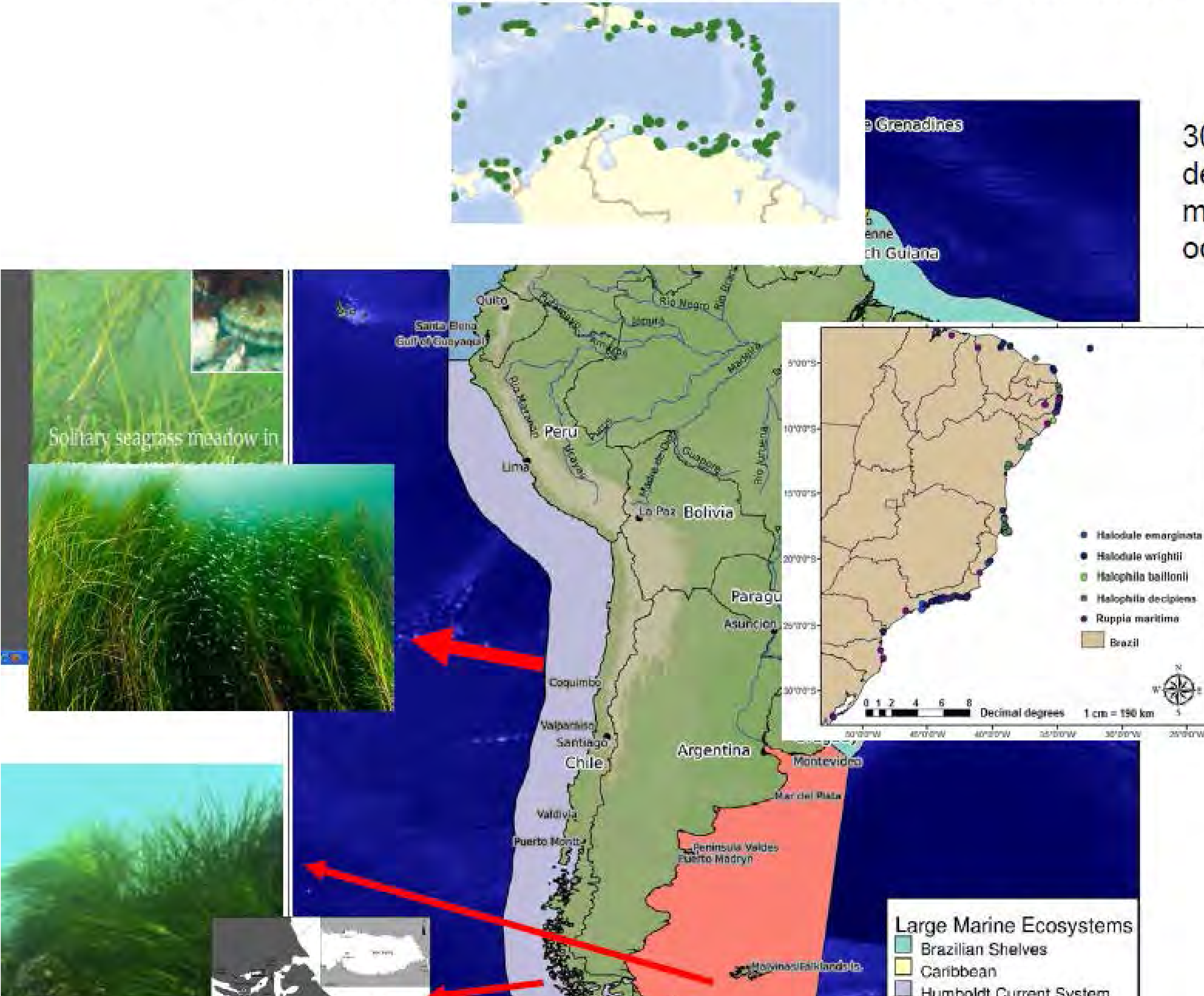
Larger uncertantities about area and distribuition globally

Short et al, 2010
2005, UNEP-WCMC

Based on moddeling, with few validation sites

	Temperate Northern Hemisphere	Temperate Southern Hemisphere	Tropical Americas	Tropical Asia	Africa	Mediterranean	**Global (km2)**
Min Max	68.000 136.000	21.000 42.000	45.000 89.500	123.000 246.000	29.500 59.000	13.500 50.000	**300.000** **600.000**

Distribuition of Seagrasses across South America



30.000 km of Coastde de costa, with distinct morphology and oceanographic influen

Seagrass habitas concentrated in Caribean Region a Brazil

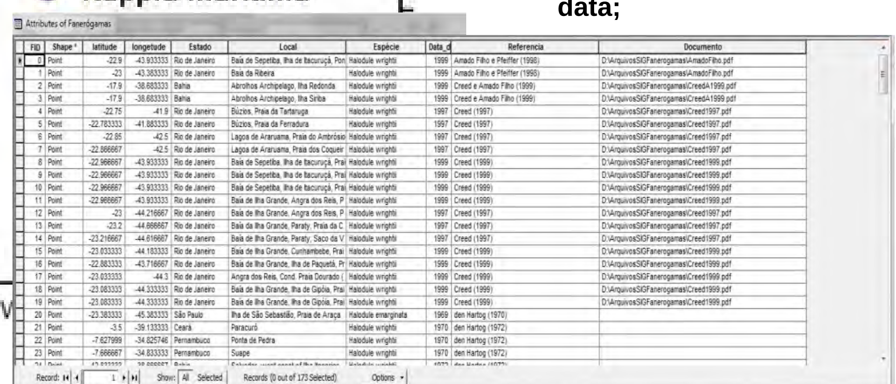
Distribution of seagrasses (including eurihaline species) in South America

Coast	Clim. Zone	Country/ Region	N	Species (dominant in bold)	Area (ha)
Caribe	*Equatorial (10º N)*	Colômbia	6	***Thalassia testudinum***, *Syringodium filiforme, Halodule wrightti, Halophila decipiens, H. bailoni, Ruppia maritima*	43.225 mapped
		Venezuela	6	***T. testudinum***, *S. filiforme , H. wrightti, H. decipiens, H. bailoni, H. engelmani*	~ 80.000 potential
		Trinidad & Tobago	4	***T. testudinum***, *H. wrightti, H. decipiens, S. filiforme*	~ 500 potential
Atlântico	*Tropical (0 to 25º S)*	Brasil (NE, SE)	5	***H. wrightti***, *H. emarginata, H. decipiens, H. bailoni, R. maritima*	> 30.000 estimated
	Subtropical/ Temperado (28 to 40º S)	Brasil Sul/ Uruguai/ Argentina/	3	***R. maritima***, *H. wrightii, Zannichellia palustris*	~15.000 mapeado/ estimated
	SubAntartic (>50º S)	Magalhães/ I. Malvinas	1	***Ruppia filifolia***	~ 5.000 estimated
Pacífico	*Subtropical (27 to 30º S)*	Norte do Chile	1	***Heterozostera tasmanica***	~ 250 mapped
TOTAL South America (estimated)			**11**	***~1/6 total species***	**>173.975**
TOTAL Globe (estimated)			**60**	***< 1% total area***	**30 - 60 Mha**

Distribution of seagrass species along Brazilian coast based on studies and observations

Review and metadata

- List of Studies on Brazilian seagrasses
- Locations and geographic coordinates;
- Parameters collected;
- Methodologies used;
- Period or date of collection;
- Publications associated to the data;

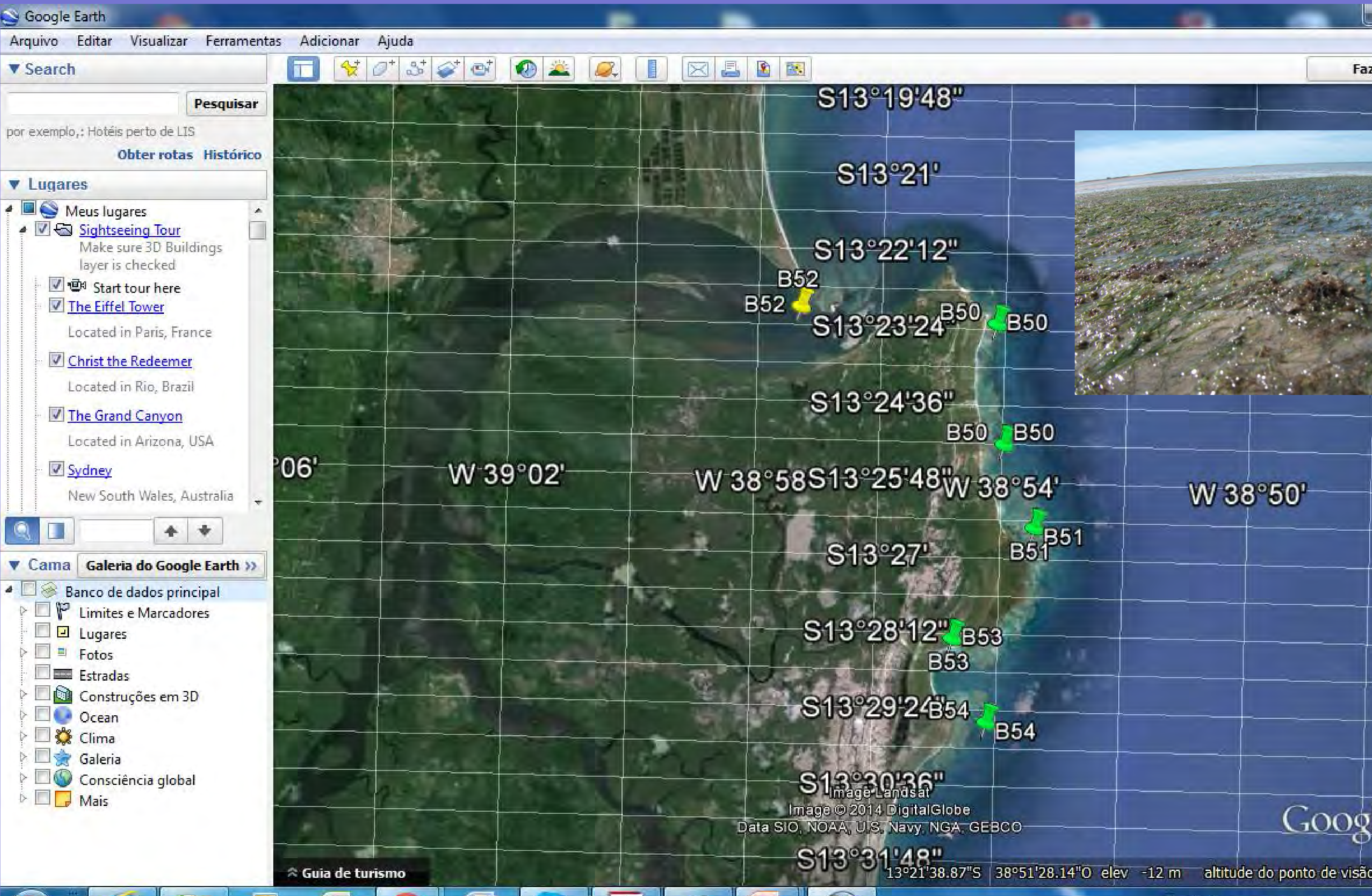


Attributes of Fanerógamas

FID	Shape *	latitude	longetude	Estado	Local	Espécie	Data_d	Referencia	Documento
0	Point	-22.9	-43.933333	Rio de Janeiro	Baía de Sepetiba, Ilha de Itacuruçá, Pon	Halodule wrightii	1999	Amado Filho e Pfeiffer (1998)	D:\ArquivosSIGFanerogamas\AmadoFilho.pdf
1	Point	-23	-43.383333	Rio de Janeiro	Baía da Ribeira	Halodule wrightii	1999	Amado Filho e Pfeiffer (1998)	D:\ArquivosSIGFanerogamas\AmadoFilho.pdf
2	Point	-17.9	-38.683333	Bahia	Abrolhos Archipelago, Ilha Redonda	Halodule wrightii	1999	Creed e Amado Filho (1999)	D:\ArquivosSIGFanerogamas\CreedA1999.pdf
3	Point	-17.9	-38.683333	Bahia	Abrolhos Archipelago, Ilha Siriba	Halodule wrightii	1999	Creed e Amado Filho (1999)	D:\ArquivosSIGFanerogamas\CreedA1999.pdf
4	Point	-22.75	-41.9	Rio de Janeiro	Búzios, Praia da Tartaruga	Halodule wrightii	1997	Creed (1997)	D:\ArquivosSIGFanerogamas\Creed1997.pdf
5	Point	-22.783333	-41.883333	Rio de Janeiro	Búzios, Praia da Ferradura	Halodule wrightii	1997	Creed (1997)	D:\ArquivosSIGFanerogamas\Creed1997.pdf
6	Point	-22.85	-42.5	Rio de Janeiro	Lagoa de Araruama, Praia do Ambrósio	Halodule wrightii	1997	Creed (1997)	D:\ArquivosSIGFanerogamas\Creed1997.pdf
7	Point	-22.866667	-42.5	Rio de Janeiro	Lagoa de Araruama, Praia dos Coqueir	Halodule wrightii	1997	Creed (1997)	D:\ArquivosSIGFanerogamas\Creed1997.pdf
8	Point	-22.966667	-43.933333	Rio de Janeiro	Baía de Sepetiba, Ilha de Itacuruçá, Prai	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
9	Point	-22.966667	-43.933333	Rio de Janeiro	Baía de Sepetiba, Ilha de Itacuruçá, Prai	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
10	Point	-22.966667	-43.933333	Rio de Janeiro	Baía de Sepetiba, Ilha de Itacuruçá, Prai	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
11	Point	-22.966667	-43.933333	Rio de Janeiro	Baía de Ilha Grande, Angra dos Reis, P	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
12	Point	-23	-44.216667	Rio de Janeiro	Baía de Ilha Grande, Angra dos Reis, P	Halodule wrightii	1997	Creed (1997)	D:\ArquivosSIGFanerogamas\Creed1997.pdf
13	Point	-23.2	-44.666667	Rio de Janeiro	Baía da Ilha Grande, Paraty, Praia da C	Halodule wrightii	1997	Creed (1997)	D:\ArquivosSIGFanerogamas\Creed1997.pdf
14	Point	-23.216667	-44.616667	Rio de Janeiro	Baía de Ilha Grande, Paraty, Saco da V	Halodule wrightii	1997	Creed (1997)	D:\ArquivosSIGFanerogamas\Creed1997.pdf
15	Point	-23.033333	-44.183333	Rio de Janeiro	Baía de Ilha Grande, Cunhambebe, Prai	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
16	Point	-22.883333	-43.716667	Rio de Janeiro	Baía de Ilha Grande, Ilha de Paquetá, Pr	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
17	Point	-23.033333	-44.3	Rio de Janeiro	Angra dos Reis, Cond. Praia Dourado (	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
18	Point	-23.083333	-44.333333	Rio de Janeiro	Baía de Ilha Grande, Ilha de Gipóia, Prai	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
19	Point	-23.083333	-44.333333	Rio de Janeiro	Baía de Ilha Grande, Ilha de Gipóia, Prai	Halodule wrightii	1999	Creed (1999)	D:\ArquivosSIGFanerogamas\Creed1999.pdf
20	Point	-23.383333	-45.383333	São Paulo	Ilha de São Sebastião, Praia de Araça	Halodule emarginata	1969	den Hartog (1970)	
21	Point	-3.5	-39.133333	Ceará	Paracuró	Halodule wrightii	1970	den Hartog (1972)	
22	Point	-7.627999	-34.825746	Pernambuco	Ponta de Pedra	Halodule wrightii	1970	den Hartog (1972)	
23	Point	-7.666667	-34.833333	Pernambuco	Suape	Halodule wrightii	1970	den Hartog (1972)	

Record: 1 Show: All Selected Records (0 out of 173 Selected) Options

Seagrass distributional mapping



Seagrass monitoring in Brazil

- Ilha do Japonês, Cabo Frio, RJ - 19 years monitoring *Halodule wrightii* (**S**eagrassNet site since 2002)
- **Lagoa dos Patos, Rio Grande, RS – 34 years monitoring *Ruppia maritima.* Site PELD-FURG) since 1999)**
- Abrolhos**, BA e Tamandaré, PE SegrassNet sites since 2002**

Biomass values of *H. wrightii*: comparison among different parts of Brazil and tropical world (from Barros 2008)

Brazil

Values are higher in Pernambuco (NE, protected coasts), similar to other tropical places

Decreasing towards North and South

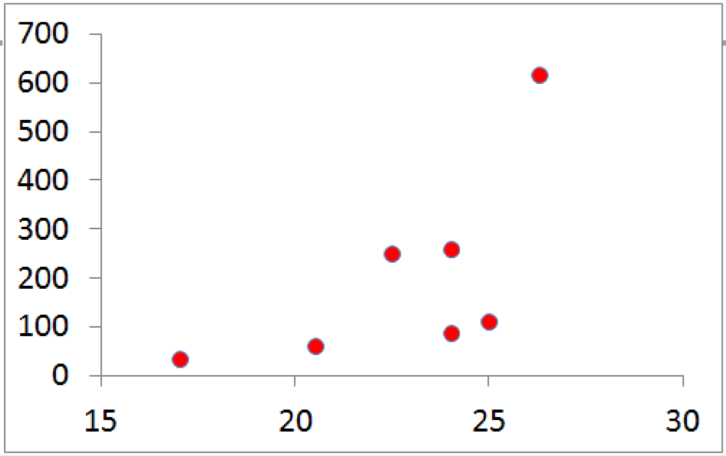
Local	g DW m^{-2}	Reference	Plant part
Tampa Bay (USA)	4,0 a 27	Zieman, 1987*	Above
Tampa Bay (USA)	38 a 50	Philips & Lewis, 1983*	
São Paulo (Brasil)	4,0 a 33	Oliveira et. al., 1997	
Ilha de Itamaracá (Brasil)	20,92***	Magalhães et. al., 1997	
Inhaca Island (Moçambique)	16±22,2 (verão) 6,9±5,5 (inverno)	Boer, 2000	
Baía de Suape (Brasil)	1,1-148,7	Magalhães et. al., 2003	
Ceará (Brasil)	**1,569 (seco)***** **2,56 (chuvoso)*****	**Barros 2008**	
Tampa Bay (USA)	60 a 140	Philips & Lewis, 1983*	Bellow
São Paulo (Brasil)	16 a 55	Oliveira et. al., 1997	
Ilha de Itamaracá (Brasil)	123,41***	Magalhães et. al., 1997	
Inhaca Island (Moçambique)	17,1±14,5 (verão) 7,4±3,4 (inverno)	Boer, 2000	
Baía de Suape (Brasil)	4,0 a 338,4	Magalhães et. al., 2003	
Ceará (Brasil)	**13,529 (seco)***** **18,4 (chuvoso)*****	**Barros 2008**	
São Paulo (Brasil)	20 a 88	Oliveira et. al., 1997	All Plant
Ilha de Itamaracá (Brasil)	20,34 a 133,16	Magalhães et. al., 1997	
Inhaca Island (Moçambique)	21,2±17 (verão) 22,9±8,2 (inverno)	Boer, 2000	
Baía de Suape (Brasil)	8 - 635	Magalhães et. al. (2003)	
Baía de Suape (Brasil)	53,25 a 619,41	Reis, 2007	
Pernambuco (Brasil)	14,3±14,2 (verão) 1114,7±190 (inverno)	Reis, 2007	
Texas (EUA)	150 a 500	Dunton, 1994**	
Texas (EUA)	166 a 610	Burd & Dunton, 2001**	
Flórida (EUA)	50 a 250	Zieman, 1987**	
Flórida (EUA)	50 a 140	Gallegos e Kenwoethy, 1966**	
Alabama (EUA)	328 a 1354	Gallegos et. al., 1994**	
México	40 a 600		
Ceará (Brasil)	3,13 (seco) ***	Picanço, 2004	
Ceará (Brasil	**15,139 (seco)***** **52,1 (chuvoso)*****	**Barros 2008**	

Biomass values of *H. wrightii*: comparison across latitude of Americas (Sordo et al. 2011)

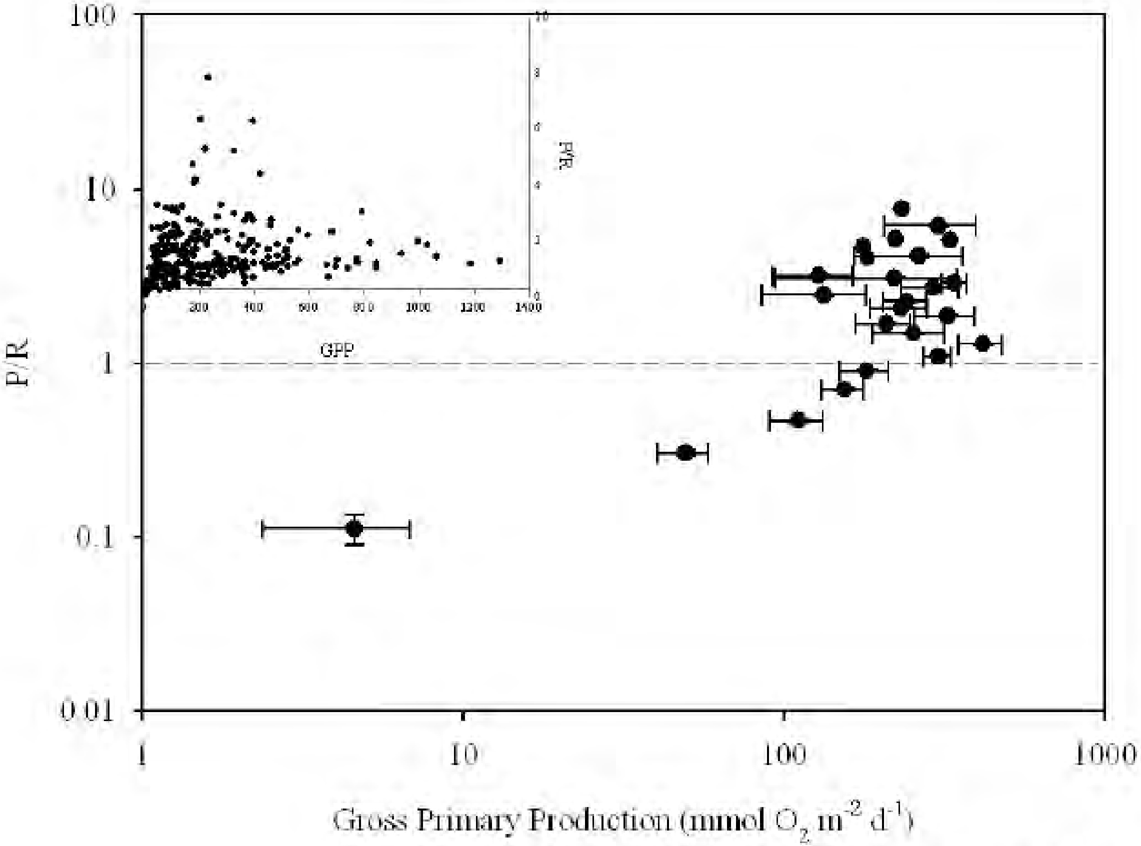
Table 4 *Halodule wrightii*: sites of occurence across the Americas: location and climate, mean DW biomass, mean annual air temperatures and references.

Location (climates)	Latitude (longitude)	DW biomass (g DW m^{-2})	Temperature (°C)	Reference
San Antonio Bay, USA (subtropical)	27°54′N (97°29′W)	22–62	20.5	Dunton 1994
South Florida, USA (tropical)	26°39′N (80°43′W)	50–250	22.5	Zieman 1987
Puerto Morelos, Mexico (tropical)	21°N (87°W)	616	26.30	Gallegos et al. 1994
Pernambuco, Brazil (tropical)	08°47′S (35°07′W)	33.17–260	24	Short et al. 2006
Rio de Janeiro, Brazil (tropical)	22°53′S (42°00′W)	11.5–112.6	25	Creed 1999
São Sebastião, Brazil (subtropical)	23°50′S (45°26′W)	88	24	Oliveira et al. 1997
Paraná, Brazil (subtropical)	25°32′S (48°24′W)	5.46–35.6	17	Present study

Trend in biomass decreases according to mean annual temperature

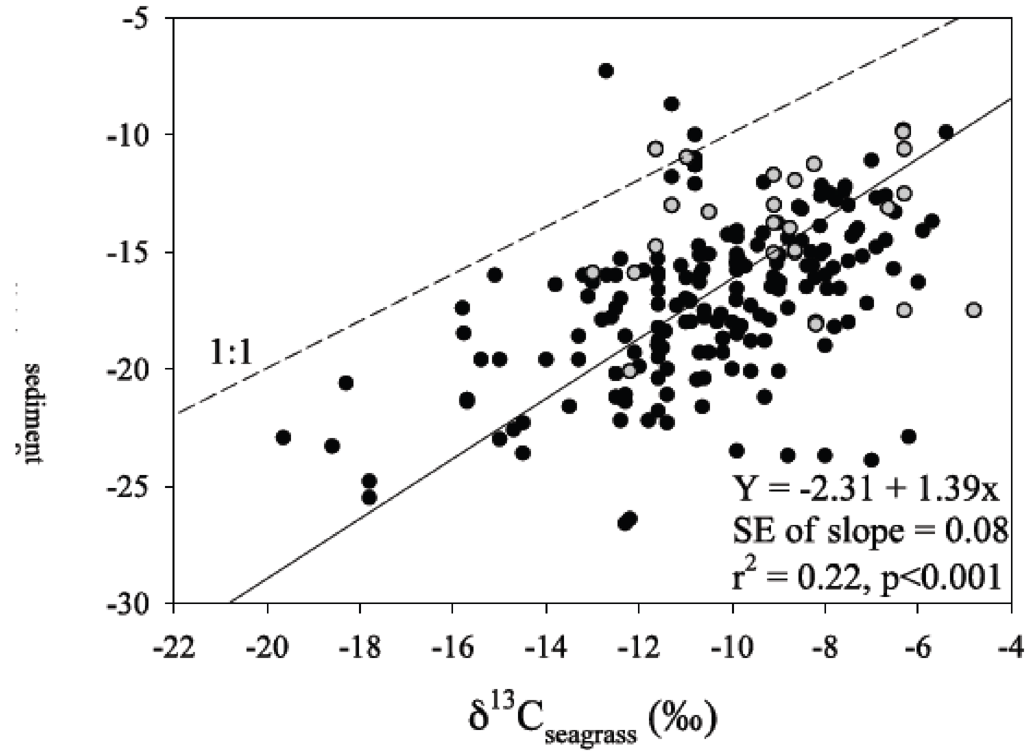


Dense seagrass beds fix more CO2 than they consume



Duarte et al. 2010 GBC

Only about half of the C buried in seagrass beds is derived from seagrass



Kennedy et al. 2010 GBC

A very rough estimate of South American C stocks in segrass meadows

Assuming average biomasses and soil C content (estimated from OM)

Above ground 0,70 – 0,95 Mg C/ ha
Bellow ground 1,756 – 2.5 Mg C/ha
Total biomass 2,514 – 3.0 Mg C/ ha

Average soil Corg content: 2% (but in caribe values range from 8% to 20%)
Soil Bulky Density: 1 %

% C	**Total Biomass (Mg C/ha)**	**Habitat Extent (ha)**	**C Stock (Mg C)**
2-16	2,5 – 3,5	**173,975**	435-609

Based in a very much conservative approach, according to Fourqurean et al. 2013

Will conservation and restoration of coastal ecosystems impact GHG mitigation?

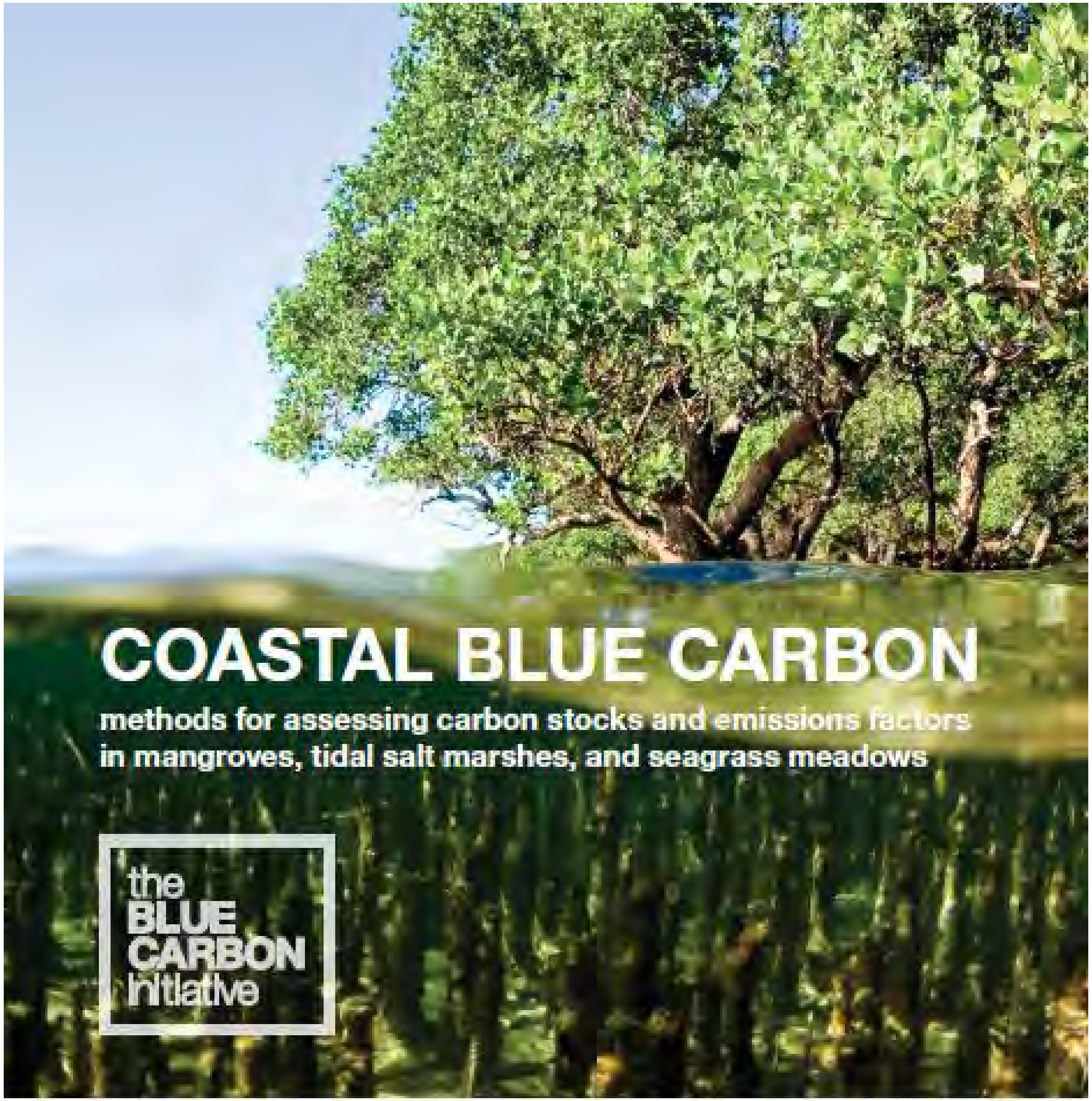
How much carbon is stored/sequestered by coastal systems? Is it significant to global GHG inventories? Where is it?

What are the GHG emissions when these systems? Where do the GHGs go? What are the main causes?

How do we inventory and monitor GHG storage and sequestration in coastal systems? On local scales? On national scales?

How does carbon vary between coastal systems? What are the major sources of variance?

How do we manage coastal systems to ensure their GHG storage and sequestration capacity?



1 – Why Measure Carbon Stocks
2 – Conceptualizing the Project and Developing a Field Measurement Plan
3 – Field Sampling of Soil Carbon Pools in Coastal Ecosystems
4 – Field Sampling of Vegetative Carbon Pools in Coastal Ecosystems
5 – How to Estimate Carbon Dioxide Emissions
6 – Remote Sensing and Mapping
7 – Data Management Appendices
References

Howard, J., Hoyt, S., Isensee, K., Pidgeon, E., Telszewski, M. (eds.) (2014).

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