Exceptionally High Carbon Stocks of Mangroves and their Potential Conservation through Global Carbon Markets

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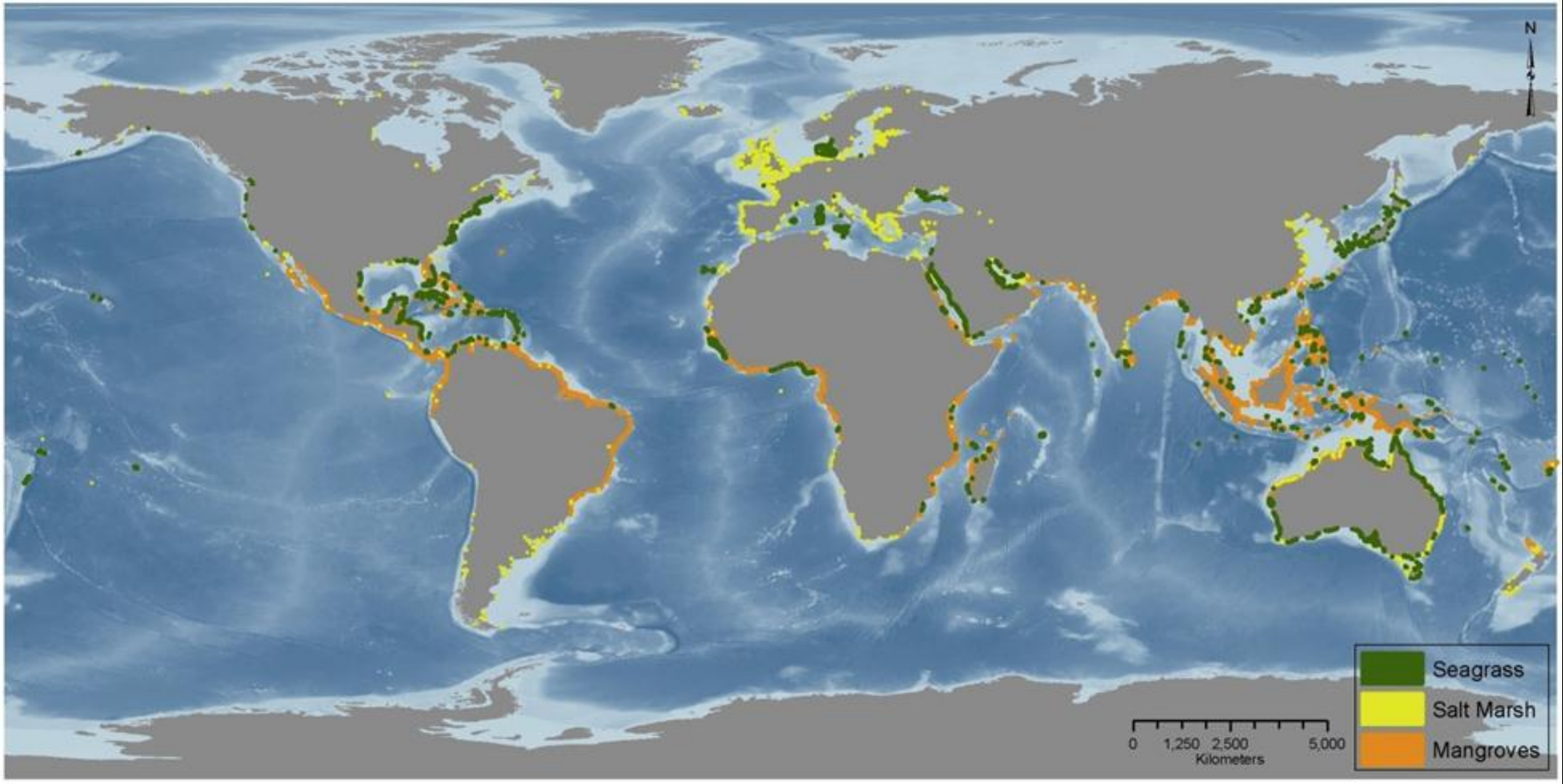

Mangroves – a relatively rare forest type

138,000 – 152,000 Km^2 (145,000 Km^2)

123 countries

Critical provision of ecosystem services

Values - $2000-9000/ha/yr

Spaulding et al. (2010)

Blue Carbon sinks include tall mangrove :Mangle Caballo (*Rhizophora racemosa*) Estero Damas, Costa Rica
Altura de canopia -30-35m
Profundad de suelos - >3m
Otros – *Peliceara rhizophorae, Rhizophora mangle, Avicennia germinans, Laguncu*laria racemosa

Dwarf Mangrove (mangle chaparro), Sian Kaan, MX

Tropical Wetlands Initiative on Climate Change Adaptation and Mitigation (TWINCAM)

A global research project on ecosystem services of tropical wetlands throughout the world.

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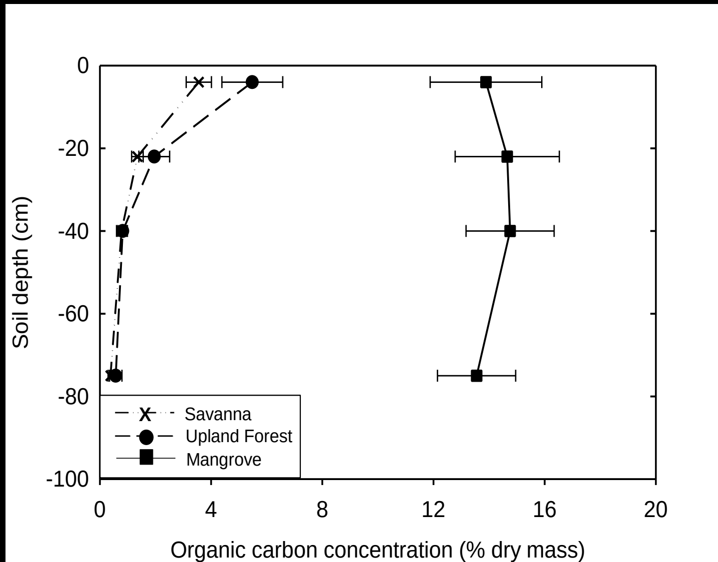
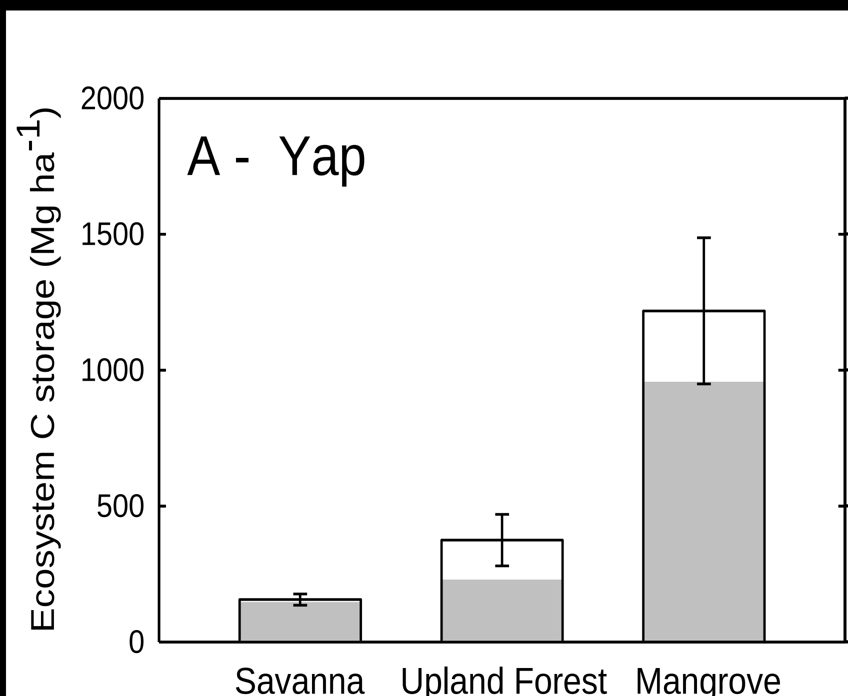
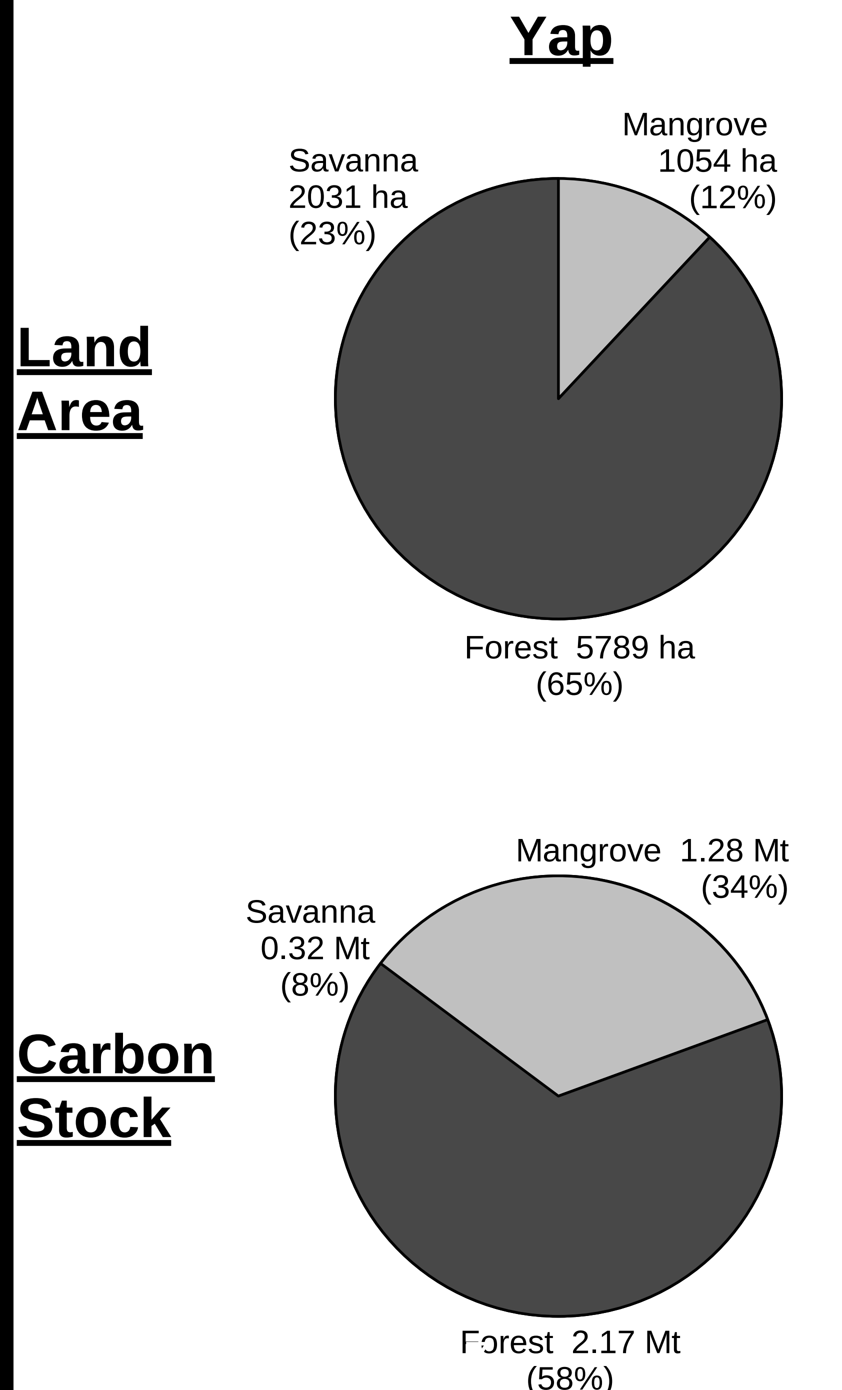
“Small islands, have characteristics which make them especially vulnerable to the effects of climate change, sea level rise and extreme events” (IPCC 2007).
Yap, Federated States of Micronesia

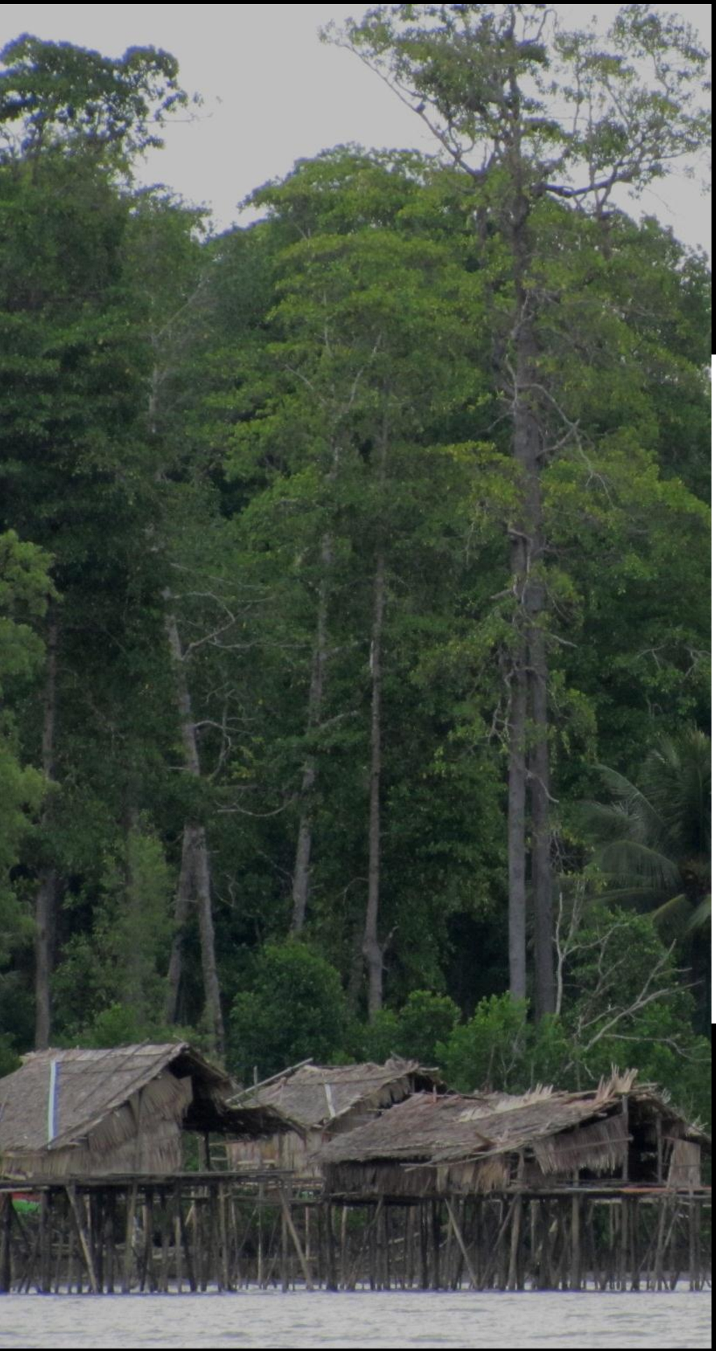


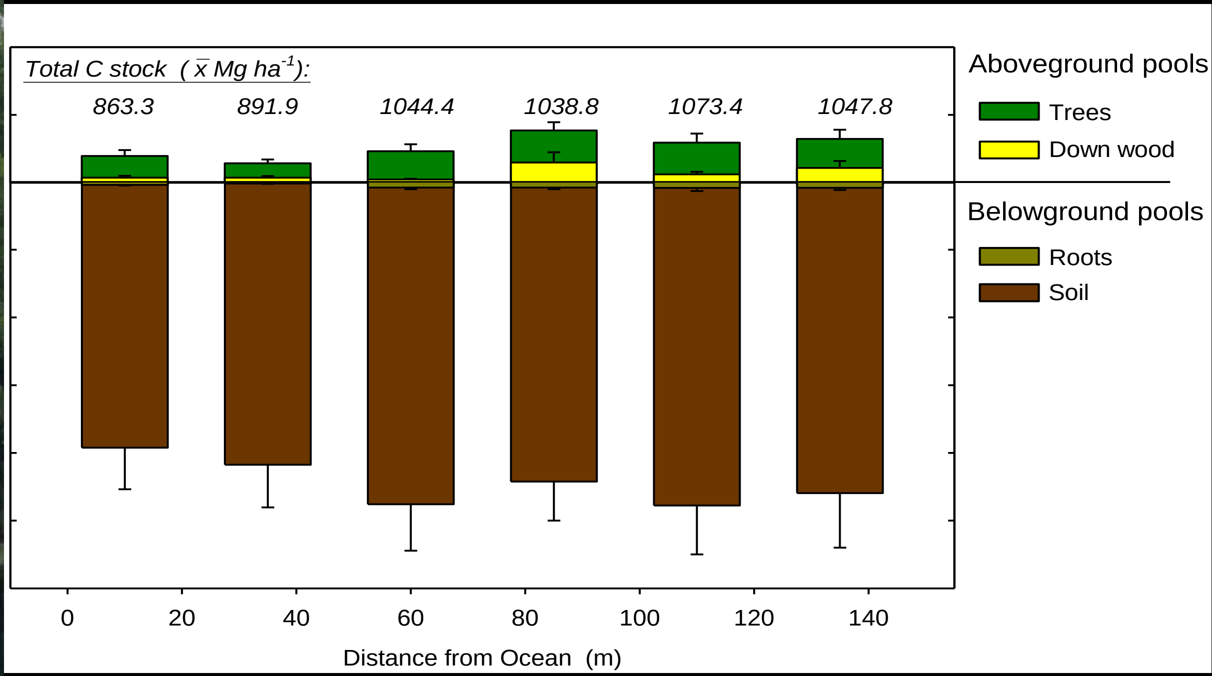




Donato et al. (2012)

C-stocks in mangroves: The Indo-Pacific

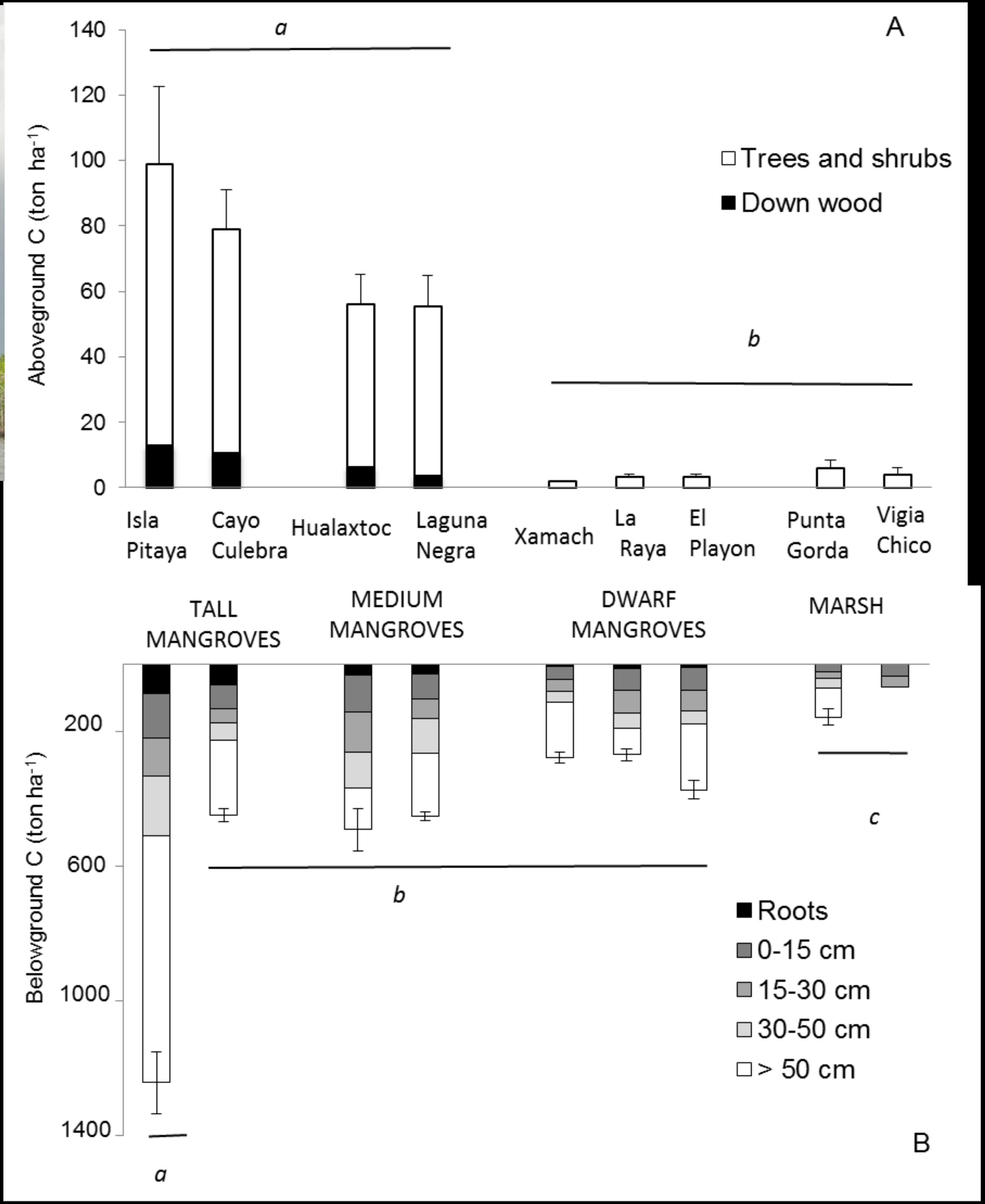




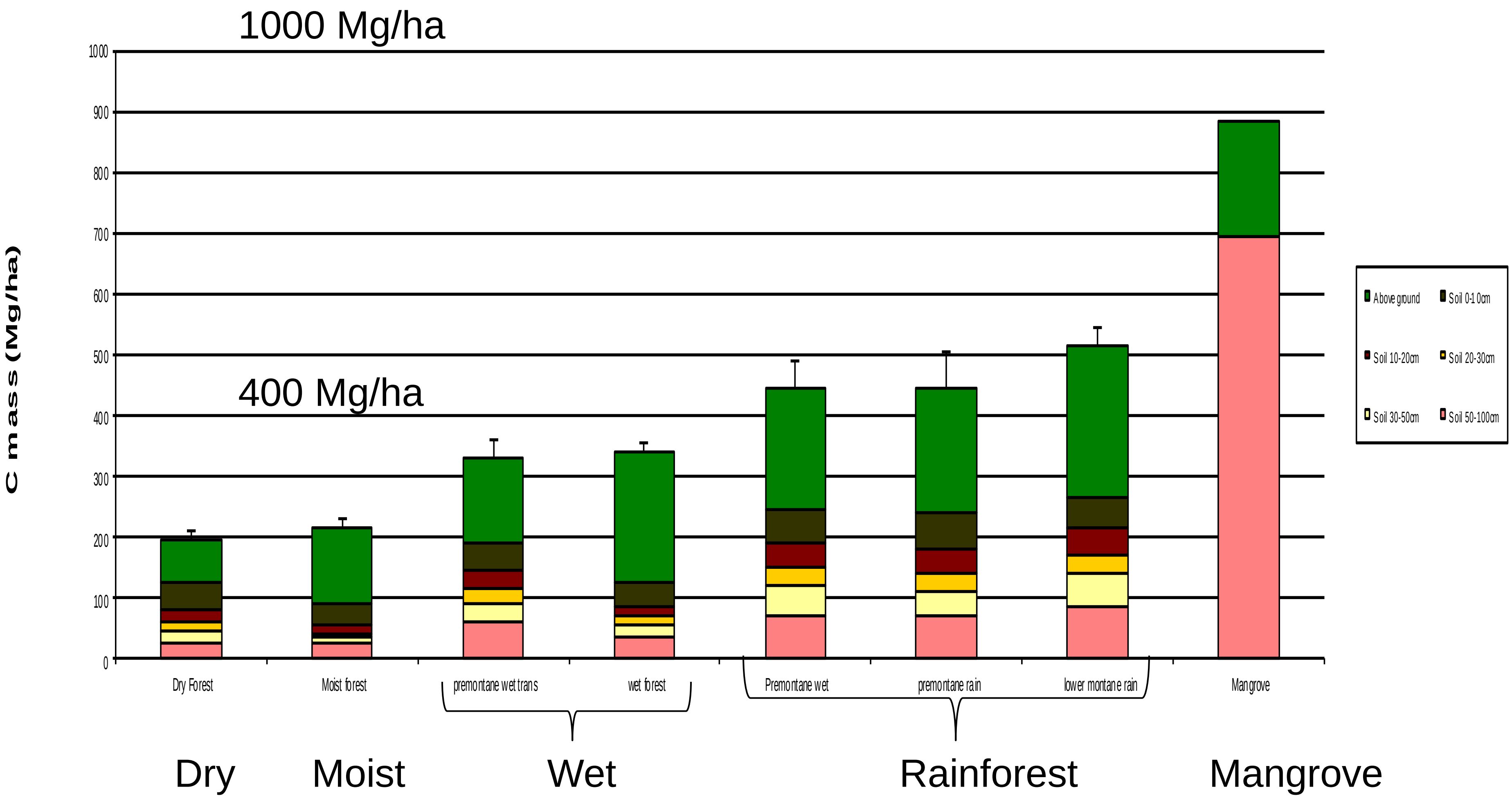
Donato et al 2011; Murdiyarso et al. (2010)

Reserva Biosfera Sian Kaan, Mexico

Ecosystem C stocks, Sian Kaan, MX. Adame et al. (in prep)

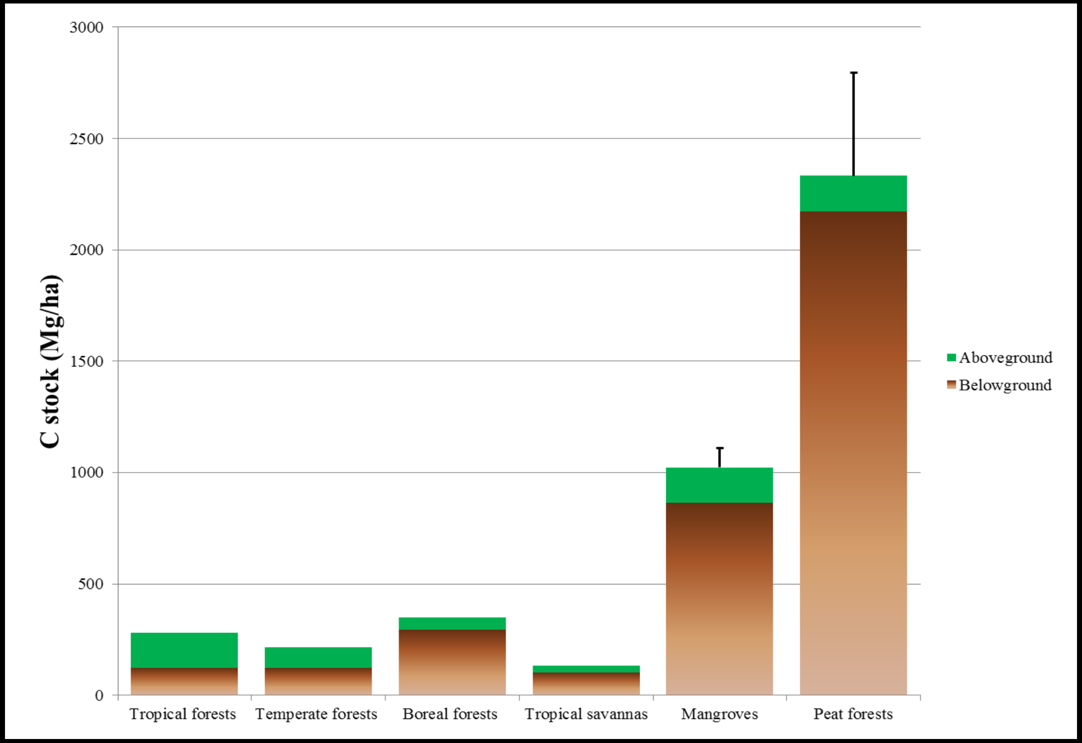


Ecosystem Carbon stocks – Costa Rican upland forests compared to carbon stocks of mangroves



Kauffman, Cifuentes, et al. (In prep)

Forest Carbon stocks



Data are from: IPCC, 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change ; Donato et al. (2011), and Warren et al. (In prep)..

Currently, on average, between 1-7% of blue carbon sinks are being lost annually:

Upstream disruptions

Aquaculture

Rice/Agriculture

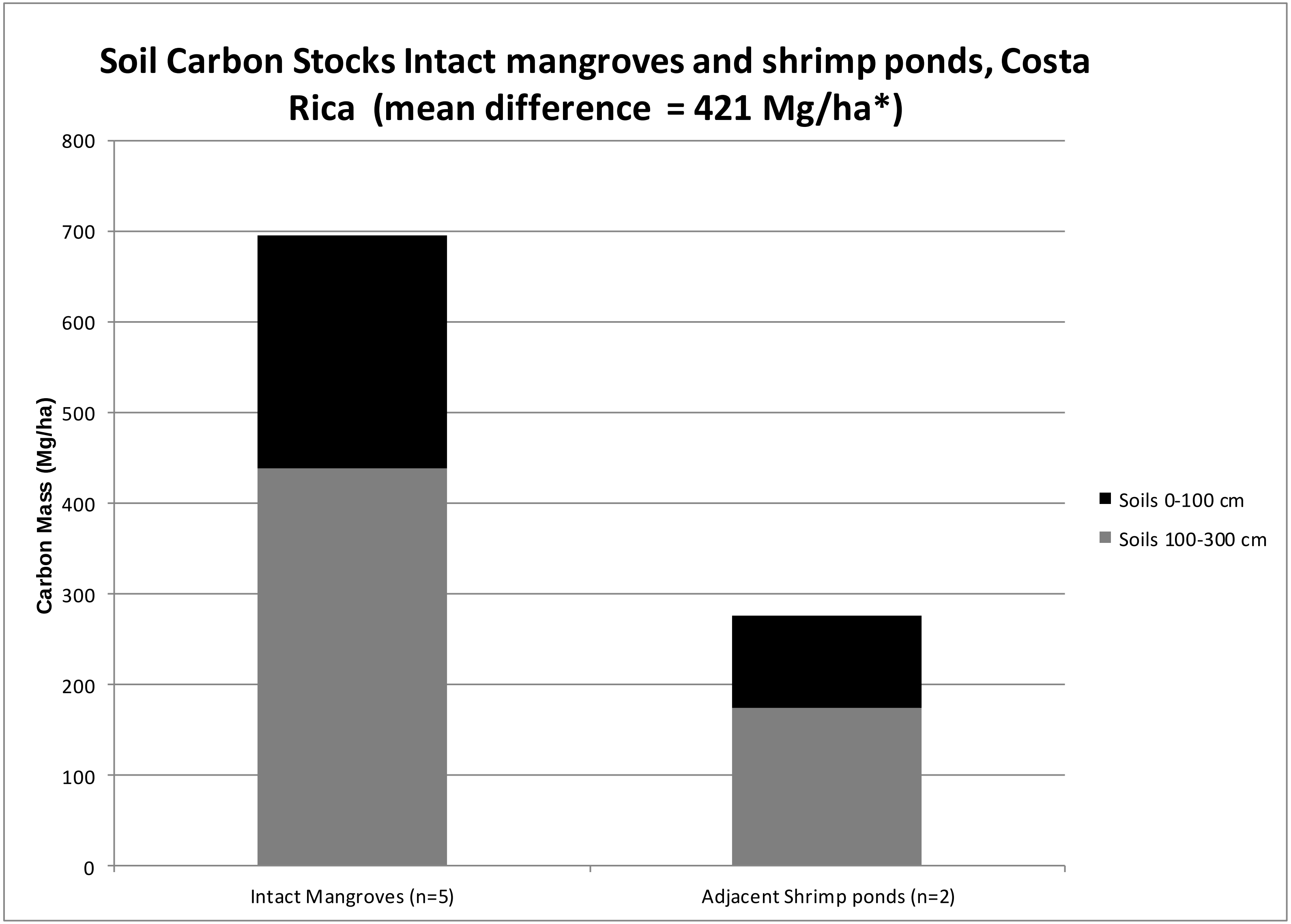
Road development
/hydrological disruptions

Coastal development

Direct evidence of emissions rates from land conversion – mangroves coastal ecosystems?

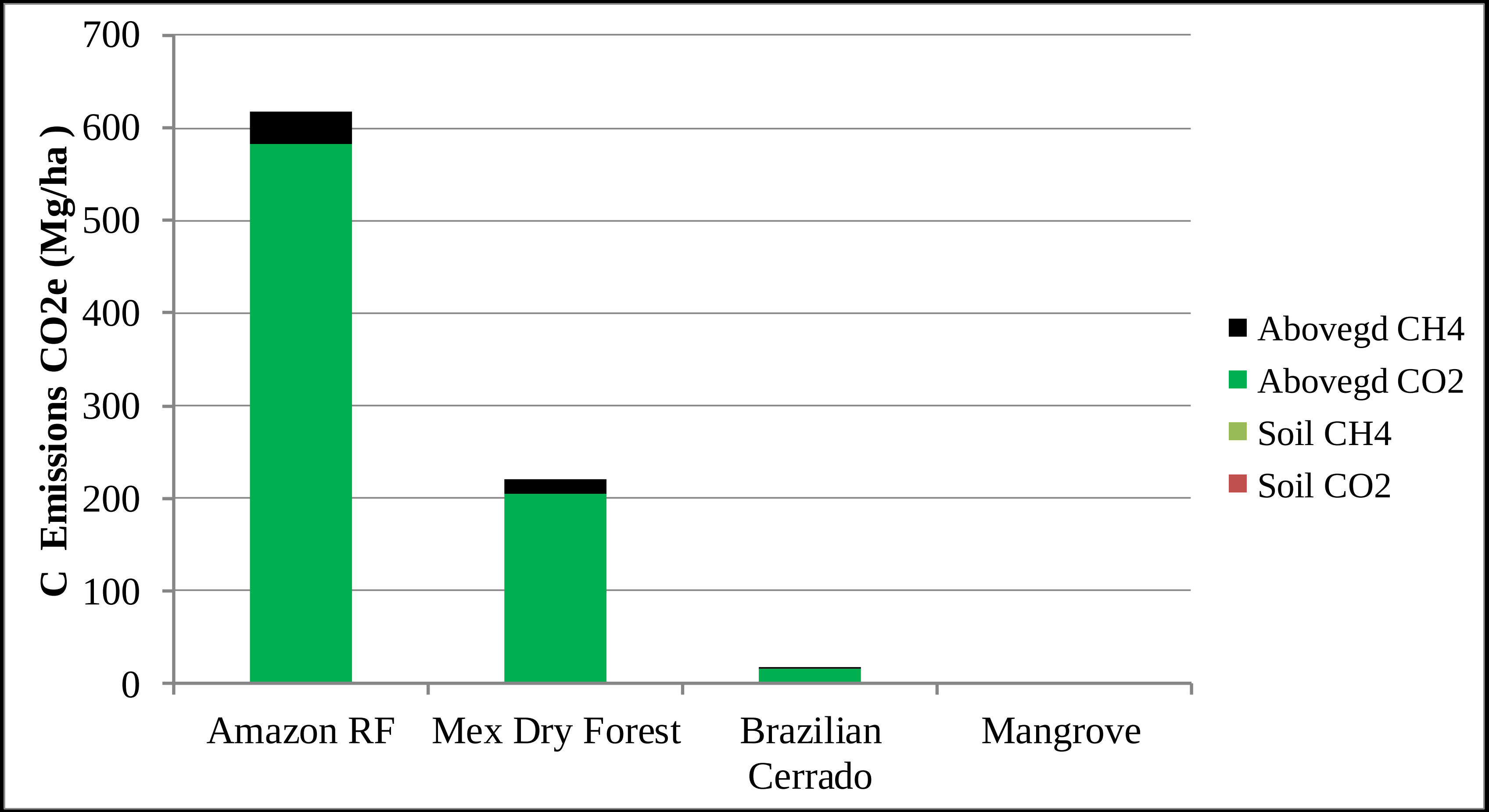
Abandoned shrimp pond with mangroves on the edge, Costa Rica

The core on the left is from an intact mangrove while the core on the right is from an adjacent abandoned shrimp pond formed in mangrove. The differences in carbon and root mass are very apparent suggesting large emissions with conversion



* A CO_2 equivalent of 1545 Mg/ha (C mass * 3.67)

Modeled fire emissions –forest conversion



Data are from Kauffman et al 2004, Steele 2000, de Castro 1996, and Donato et al. 2011
Data from rainforest and methods to predict emissions from fires are from Guild et al. (2004) *Ecol Apps* 14:232-246.
Mangrove emissions are based on the assumptions of the oxidation of top 30 cm of soil C.

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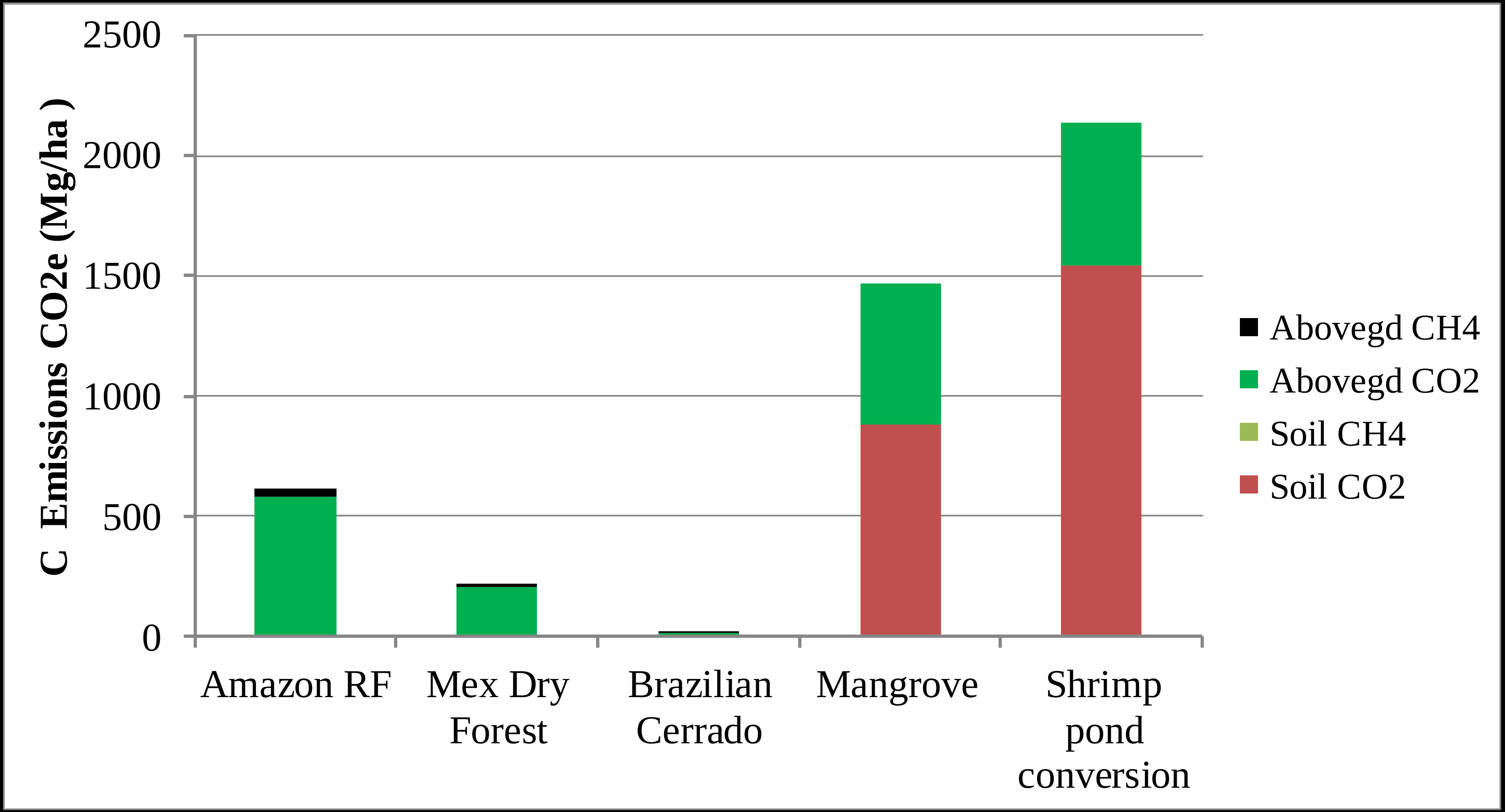

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Mangrove emissions are based on the assumptions of the oxidation of top 30 cm of soils C.
Shrimp pond conversion are calculated emissions from stock change approaches from field measurements Kauffman and Cifuentes In prep)

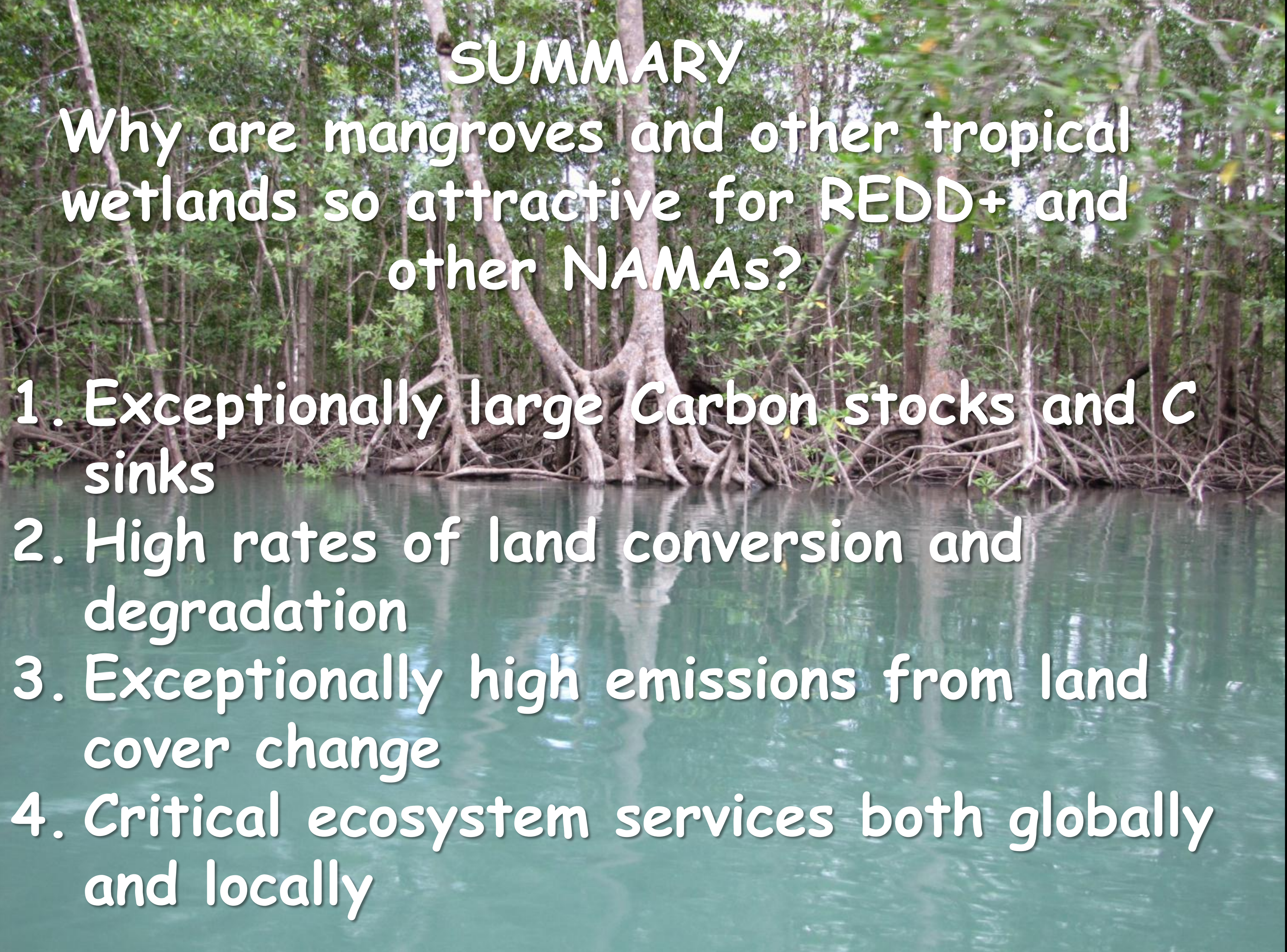
Estimates of carbon released by land-use change in coastal ecosystems. Pendleton et al (In press).

	Inputs			Results
Ecosystem	Global extent (Mha)	Current conversion rate (% yr^{-1})	Near-surface carbon susceptible (top meter soil + biomass, Mg CO_2 ha^{-1})	Carbon emissions (Pg CO_2 yr^{-1})
Tidal Marsh	2.2 – 40 (5.1)	1.0 – 2.0 (1.5)	237 – 949 (593)	0.02 – 0.24 (0.06)
Mangroves	13.8 – 15.2 (14.5)	0.7 – 3.0 (1.9)	373 – 1492 (933)	0.09 – 0.45 (0.24)
Seagrass	17.7 – 60 (30)	0.4 – 2.6 (1.5)	131 – 522 (326)	0.05 – 0.33 (0.15)
Total	33.7 – 115.2 (48.9)			0.15 – 1.02 (0.45)

The net tropical deforestation emission is about 4.8 Pg CO_{2e} $year^{-1}$ (Pan et al. 2011 Science).

REDD+ - Reducing Emissions from Deforestation and Forest Degradation

REDD mechanisms use market/financial incentives to reduce the emission of greenhouse gases from deforestation and forest degradation.


SUMMARY
Why are mangroves and other tropical wetlands so attractive for REDD+ and other NAMAs?
1. Exceptionally large Carbon stocks and C sinks
2. High rates of land conversion and degradation
3. Exceptionally high emissions from land cover change
4. Critical ecosystem services both globally and locally

Thank you!

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