Supplementary Information

Substantial blue carbon sequestration in the world's largest seagrass meadow

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Supplementary Table 1. Location, main features and number of sediment cores of the sampled seagrass meadows in The Bahamas.

Site name	Latitude	Longitude	Seagrass species	Seagrass density	N C_{org} cores	N ^{210}Pb cores
S1	-75.70761	23.49614	*Thalassia testudinum*	Moderate	2	1
S2	-75.80477	23.53387	*T. testudinum*+ *Syringodium filiforme*	Moderate	2	1
S3	-75.86002	23.58456	*T. testudinum*	Moderate	2	1
S4	-75.75391	23.51049	*T. testudinum*	Dense	2	
S5	-76.07485	23.74173	*T. testudinum*	Dense	2	1
S6	-76.04701	23.73557	*T. testudinum*	Moderate	2	1
S7	-76.10755	23.76910	*T. testudinum*	Moderate	1	1
S8	-76.12758	23.78310	*T. testudinum*	Dense	1	1
S9	-76.02600	23.72511	*T. testudinum*	Moderate	1	1
S10	-76.03386	23.72584	*T. testudinum*	Sparse	1	1

Supplementary Table 2. Summary of previously reported sediment C_{org} stocks and accumulation rates in carbonate seagrass meadows (Mean±SE).

Location	Seagrass species	C_{org} stock Mg C ha^{-1}	CAR g C m^{-2} yr^{-1}	Reference
The Bahamas	*Thalassia testudinum, Syringodium filiforme*	63.3	22.5	This study
Florida Bay, USA	*T. testudinum, Halodule wrightii*	175.0±10.2	140*	Howard et al., 2018
Mexico Bay	*S. filiforme, H. wrightii, T. testudinum*	130±17	30.7±2.8	Ruiz-Fernandez et al., 2020
Southeastern Brazil	*H. wrightii, Halophila decipiens, Halodule emarginata*	67.6±14.7		Howard et al., 2018
Abu Dhabi, UAE	*Halodula uninervis, Halophila ovalis, Halophila stipulacea*	49.1±7.0		Campbell et al., 2015
Arabian Gulf	*H. uninervis, H. ovalis, H. stipulacea*	76.2±5.9	9.0±12.0	Cusack et al., 2018
Red Sea, Saudi Arabia	*H. uninervis, H. ovalis, H. stipulacea, T. testudinum, Enhalus acoroides, Thalassodendrum ciliatum*	34±3	6.8±1.7	Serrano et al., 2016
South China Sea, China	*H. ovalis, Zostera japonica, Halophila beccarii*	109.5±23.8	45	Fu et al., 2021
Shark Bay, Australia	*Posidonia oceanica, Amphibolis antarctica*	128±7	46±13	Arias-Ortiz et al., 2018
Great Barrier Reef, Australia	*H. Ovalis, H. Decipiens, H. Spinulosa, H. uninervis, T. hemprichii*	11±5		York et al., 2018
Madagascar	*E. acoroides, Cymodocea rotundata/serrulata, T. hemprichii, T. ciliatum*	86±11	no recent net accumulation	Asplund et al., 2021
Global		77	138±38	Kennedy et al., 2022; Duarte et al., 2013

C_{org}, organic carbon; CAR, organic carbon accumulation rate.

*Calculated based on sediment C_{org} density from Howard et al., (2018) and sediment accretion rate from Cheng et al., (2012).

Supplementary Table 3. Seagrass density, coverage, and a photographic example of the sampling site in The Bahamas.

Seagrass density	Seagrass coverage	Sampling site	Photo example
Dense	> 70%	S4, S5, S8	
Moderate	30-70 %	S1, S2, S3, S6, S7, S9	
Sparse	<30%	S10	

Photo credit: Cristina Mittermeier for Beneath The Waves (first photo) and Wilson Haynes (second and third photos) for Beneath The Waves.

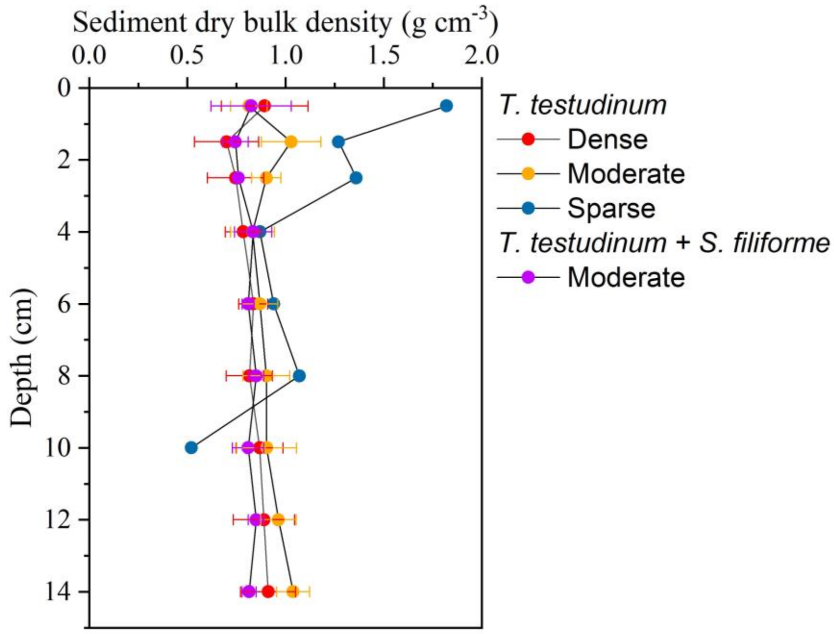
Supplementary Table 4. δ^{13}C and C/N molar ratio of the Bahamian seagrasses, cyanobacteria, macroalgae, epiphytes, phytoplankton and mangroves.

Endmember	Species/sample type	δ^{13}C (‰)	C/N molar ratio	Reference
Seagrass fragment	*T. testudinum*	-8.11	45.36	This study
	T. testudinum	-7.81	50.02	
	S. filiforme	-6.74	48.68	
	S. filiforme	-6.65	48.46	
	T. testudinum	-6.80	39.81	
	T. testudinum	-6.49	43.83	
	T. testudinum	-5.41	43.41	
	T. testudinum	-5.45	35.49	
	T. testudinum	-5.40	38.64	
	T. testudinum	-5.40	40.08	
	T. testudinum	-6.19	40.28	
	T. testudinum	-5.59	52.49	
	T. testudinum	-6.78	41.45	
	T. testudinum	-5.19	58.99	
	T. testudinum	-5.46	34.20	
	Median	**-6.19**	**43.41**	
	SD	**0.92**	**6.69**	
Cyanobacteria	Cyanobacterial mat	-18.7		Stoner and Waite, 1991
	Cyanobacterial mat		12.23	Yannarell et al., 2007
	Cyanobacterial extracellular polymeric secretions		6.3	Decho et al., 2005
			3.6	
			8.1	
			2.4	
			7.1	
	Median	**-18.7**	**6.70**	
	SD	**0.5***	**5.93**	
Macroalgae	*Penicillus*	-10.2		Kieckbusch et al., 2004
	Halimeda	-6.8		
	Batophora oerstedii	-13.3		
		-13.9		
	Laurenica spp.	-11.1		
		-11.2		
	Cladophoropis membrabacea	-11.4		
	Gracilaria compressa	-14.8		
	Batophora oearstedii	-13.3		

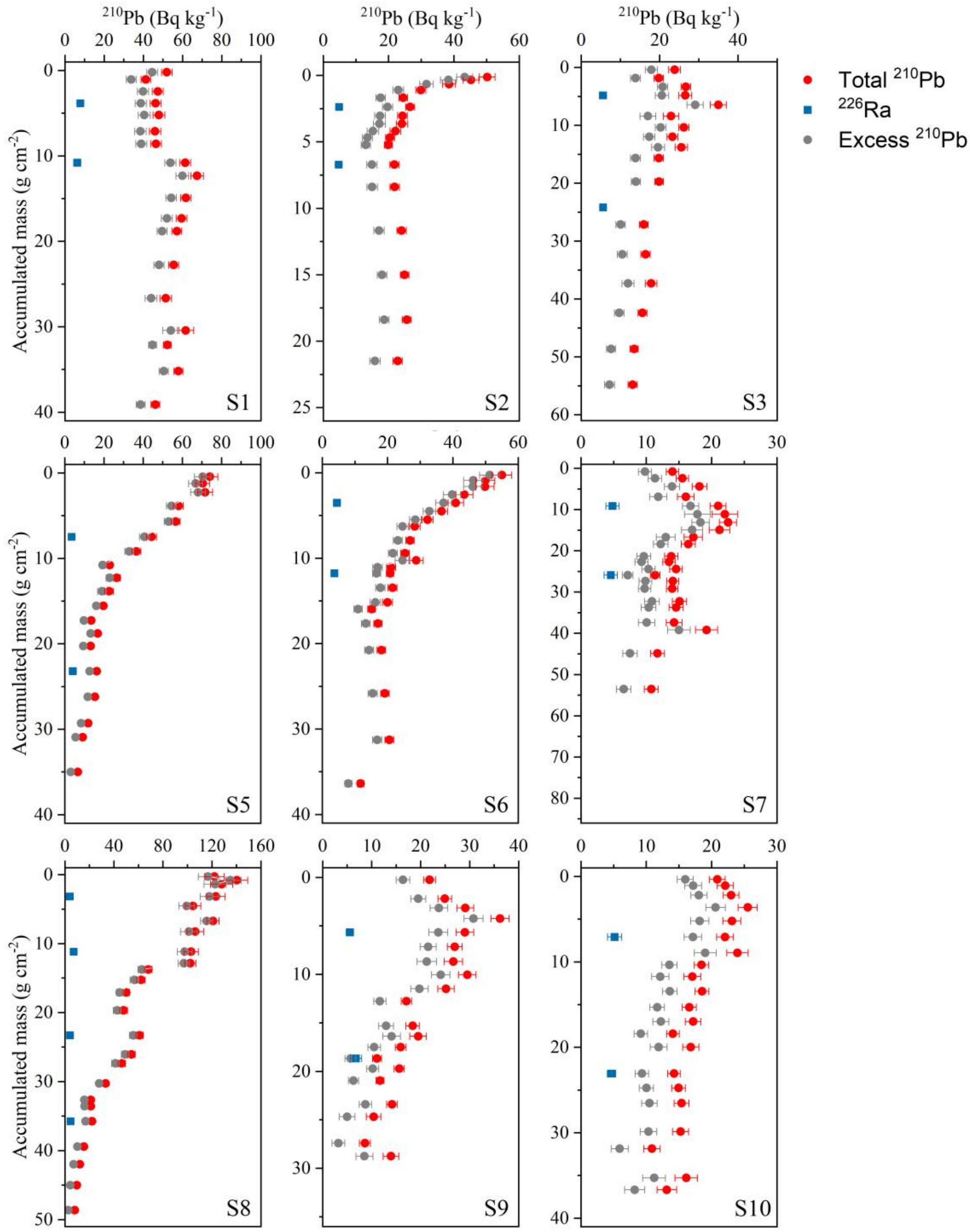
		-13.9		
	Sargassum pteropleuron	-16.6		
	Red algae	-21.08±11.24		Gillis et al., 2018
		-11.13±5.88		
	Green algae	-10.97±5.19		
		-8.63±4.53		
	Macroalgae	-14.2		O'Farrell et al., 2014
	Algae turf	-11.8		
	Lobophora sp.	-14.1		Shipley et al., 2018
	Sargassum sp.	-16.71		
	Sargassum hystrix		14.0	Lapointe et al., 1992
	Lobophora variegata		49.9	
	Codium isthmocladum		14.4	
	Bryopsis pennata		7.7	
	Microdictyon marinum		24.4	
	Hypnea musciformis		19.6	
	Laurencia intricata		21.8	
	Digenea simplex		17.7	
	Laurencia intricata		17.4	
	Cladophora catenata		22.5	
	Laurencia intricata		16.3	
	Digenea simplex		38.1	
	Laurencia intricata		35.2	
	Microdictyon marinum		24.5	
	Cladophora catenata		28.8	
	Laurencia intricata		30.3	
	Digenea simplex		47.4	
	Microdictyon marinum		44.4	
	Cladophora catenata		34.6	
	Laurencia intricata		33.4	
	Laurencia intricata		21.1	
	Laurencia intricate		19.6	
Epiphyte	*T. testudinum epiphytes*	-10.5		Kieckbusch et al., 2004
	T. testudinum epiphytes	-15.7		Stoner and Waite, 1991
		-15.6		
phytoplankton		-16.4±3.3		O'Farrell et al., 2014

benthic algae		-14.4±2.1		O'Farrell et al., 2014
	Median	**-13.60**	**24.40**	
	SD	**3.27**	**11.60**	
Mangrove	*Avicennia germinans*	-26.04		Shipley et al., 2018
	Rhizophora mangle	-26.32		
	Laguncularia racemosa	-26.45		
	Rhizophora mamgle (detritus)	-27.90		Kieckbusch et al., 2004
	Rhizophora mangle (senescent)	-27.70		
	Rhizophora mangle (blades)	-28.20		
*	*Rhizophora mangle (Leaf)*	-29.8	52.40	Vane et al., 2013
*	*Rhizophora mangle (Stem)*	-28.5	82.30	
*	*Avicennia germinans (Leaf)*	-28.5	23.10	
*	*Avicennia germinans (Pneumatophores)*	-26.6	53.60	
*	*Avicennia germinans (Stem)*	-26.7	114.50	
*	*Laguncularia racemose (Leaf)*	-27.9	30.00	
*	*Laguncularia racemose (Pneumatophores)*	-24.2	90.70	
*	*Laguncularia racemosa (Stem)*	-25.6	77.60	
	Median	**-27.20**	**65.60**	
	SD	**1.45**	**31.25**	

*Note: We assumed standard deviation (SD) = 0.5 to reflect similar variability of the isotopic signatures for the replicated sources of C_{org} (Röhr et al., 2018).
Since the C/N ratio of the Bahamian mangroves was not available in published literature, we used the C/N from Puerto Rico mangroves as a proxy, with also their $\delta^{13}C$ values included.



Supplementary Figure 1. Sediment dry bulk density depth profiles of the Bahamian seagrass meadows. Data are mean values ± standard error (SE).



Supplementary Figure 2. Concentration profiles of total and excess ^{210}Pb and ^{226}Ra in the Bahamian seagrass sediment cores.

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