



Supplement of

Mangrove sediment organic carbon storage and sources in relation to forest age and position along a deltaic salinity gradient

Rey Harvey Suello et al.

Correspondence to: Rey Harvey Suello (suello.reyharvey@uantwerpen.be)

The copyright of individual parts of the supplement might differ from the article licence.

SUPPLEMENTARY INFORMATION

Table S1. Coordinates of the sampling locations.

Site Name	Latitude	Longitude
Upstream Young	-2.230183035	-79.83072496
Upstream Old	-2.236209624	-79.83263863
Intermediate Young	-2.51660197	-79.73883701
Intermediate Old	-2.522481037	-79.73375003
Downstream Young	-2.635219982	-79.75186097
Downstream Old	-2.635031976	-79.73747000
Marine	-2.428225027	-79.92496597

Table S2. Average values (\pm SD) of sediment dry bulk density, OC and nitrogen (N) content, C:N ratio (weight/weight), and $\delta^{13}\text{C}$ values from the sampling sites.

Site		Bulk Density (g cm ⁻³)	OC (%)	N (%)	C:N	$\delta^{13}\text{C}$ (‰)
Upstream	Young	0.53 \pm 0.13	1.57 \pm 0.34	0.11 \pm 0.02	13.67 \pm 1.70	-26.5 \pm 0.29
	Old	0.45 \pm 0.10	2.03 \pm 0.19	0.15 \pm 0.02	12.72 \pm 0.63	-26.1 \pm 0.67
Intermediate	Young	0.32 \pm 0.09	2.10 \pm 0.30	0.16 \pm 0.03	13.21 \pm 0.72	-26.6 \pm 0.36
	Old	0.31 \pm 0.11	3.75 \pm 0.56	0.17 \pm 0.02	21.91 \pm 1.83	-27.0 \pm 0.27
Downstream	Young	0.37 \pm 0.11	1.77 \pm 0.36	0.13 \pm 0.03	13.55 \pm 1.13	-26.5 \pm 0.44
	Old	0.31 \pm 0.07	4.38 \pm 0.96	0.18 \pm 0.03	24.68 \pm 3.92	-27.5 \pm 0.28
Marine	Young	0.36 \pm 0.15	4.16 \pm 1.01	0.19 \pm 0.01	16.07 \pm 1.56	-26.6 \pm 0.55
	Old	0.26 \pm 0.09	5.24 \pm 0.92	0.22 \pm 0.04	23.56 \pm 2.75	-27.5 \pm 0.30

Table S3 Total sediment organic carbon (SOC) stocks (Mg C ha⁻¹) for the upper 0.64 m of the vertical sampling profiles. Standard deviation was calculated based on the SOC stocks of three replicate cores per site.

	OC Stocks (Mg C ha ⁻¹)	
	Young Mangrove	Old Mangrove
Upstream	55.78 \pm 0.78	56.92 \pm 0.65
Intermediate	48.66 \pm 1.14	78.43 \pm 1.07
Downstream	46.63 \pm 0.29	98.26 \pm 1.98
Marine	97.74 \pm 1.52	92.68 \pm 0.93

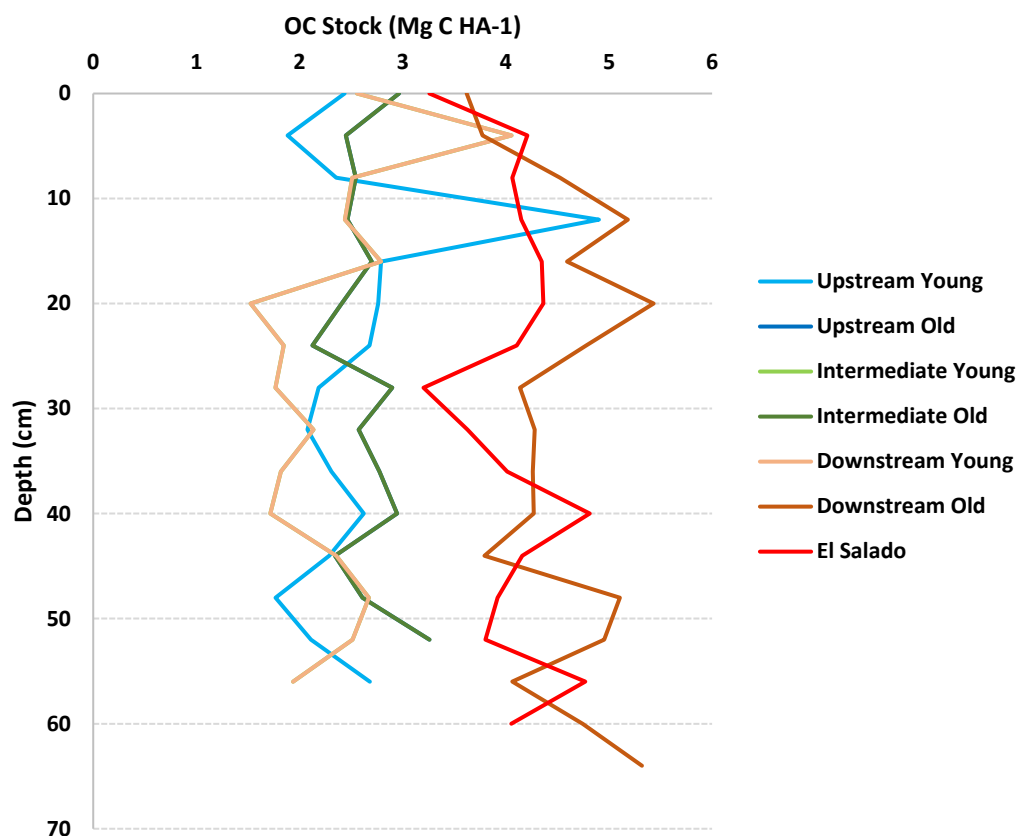


Figure S1. Downcore profile of organic carbon stock (Mg C ha^{-1}) for all sites. Values are averages of calculated stocks for the three replicate cores per site. El Salado correspond to Marine zone.

Table S4. Average elemental and isotopic values of the above- and belowground vegetation samples (roots, leaves, branches, live, senescent, and surface litter) collected in all sites.

VEGETATION			
	d13C	C/N	%C
Upstream Young	-29.66359793	38.02908119	35.37297317
Upstream Old	-30.44364274	38.81577096	41.50683274
Intermediate Young	-29.85944234	29.78286022	34.09707074
Intermediate Old	-29.15367319	59.09320523	39.85188803
Downstream Young	-29.01597733	36.24931493	35.60161094
Downstream Old	-29.72282494	65.17726349	43.44982479
Marine Young	-29.26842541	27.05625971	26.53586235
Marine Old	-29.22627625	47.19742232	36.79645821
Max	-29.01597733	65.17726349	43.44982479
Min	-30.44364274	27.05625971	26.53586235
Average	-29.58965484	42.02910796	36.65156512

Table S5. Elemental and isotopic values of the POC of the suspended particulate matter collected in the estuarine zone of the delta. Values are averages of data collected in dry and wet seasons.

POC (average dry and wet season)			
Stations	d13C	C/N	%OC
LT20	-25.5916	9.132098	1.451785
LT30	-25.5545	9.484568	1.672867
LT40	-25.4961	9.128386	1.625243
LT50	-25.1786	8.918236	1.695907
LT60	-25.8451	8.998877	1.919865
LT15	-25.4016	9.540545	1.578292
LT25	-25.2214	8.867861	1.620175
LT35	-25.4724	9.291912	1.632906
LT45	-25.5664	8.256801	1.71873
LT55	-25.8887	8.391194	1.780894
HT20	-25.4585	7.777592	1.724006
HT30	-25.7888	8.127518	1.746856
HT40	-25.7143	7.785988	1.844373
HT50	-25.7999	7.849447	1.982116
HT60	-25.6782	7.411576	2.070946
HT15	-26.6138	7.3732	3.240154
HT25	-26.4203	7.377663	2.283054
HT35	-26.4572	7.771362	1.932142
HT45	-25.9157	8.470695	1.850968
HT55	-25.8792	7.769142	2.201139
LT SITE 3	-26.1131	8.681934	2.578353
LT SITE 4	-25.6704	7.493975	1.464966
HT SITE 3	-26.8522	8.058445	2.380307
HT SITE 4	-27.1516	8.029017	1.66768
Min	-27.1516	7.3732	1.451785
Max	-25.1786	9.540545	3.240154
Average	-25.8637	8.332835	1.902655

Table S6. Detailed grain texture data of the mangrove sediments collected at all sites. Values per site are averages of three replicate cores.

UPSTREAM YOUNG				UPSTREAM OLD			
Depth (cm)	%clay (<2 μm)	%silt (2μm - 63 μm)	%sand (>63 μm)	Depth (cm)	%clay (<2 μm)	%silt (2μm - 63 μm)	%sand (>63 μm)
0-3	23.04	72.57	4.36	0-3	23.44	72.81	3.80
8-9	11.21	54.00	34.82	8-9	21.99	72.07	5.96
16-17	16.41	76.71	6.87	16-17	25.62	71.13	3.25
24-25	17.59	78.97	3.44	24-25	26.42	70.61	2.98
32-33	22.44	73.81	3.71	32-33	22.92	73.82	3.28
40-41	27.59	69.98	2.45	40-41	25.67	69.50	4.84
48-49	22.59	74.42	2.97	48-49	26.75	70.04	3.24
56-57	27.80	72.05	0.16	56-57	20.53	70.78	8.73
64-65	16.93	77.53	5.53	64-65	28.43	69.29	2.28
AVERAGE	20.62	72.23	7.15	AVERAGE	24.64	71.12	4.26

INTERMEDIATE YOUNG				INTERMEDIATE OLD			
Depth (cm)	%clay (<2 μm)	%silt (2μm - 63 μm)	%sand (>63 μm)	Depth (cm)	%clay (<2 μm)	%silt (2μm - 63 μm)	%sand (>63 μm)
0-3	9.8	71.5	18.7	0-3	17.52	79.61	2.87
8-9	21.3	75.8	2.8	8-9	18.40	78.74	2.86
16-17	7.9	58.8	33.2	16-17	18.95	78.99	2.08
24-25	17.6	77.2	5.1	24-25	22.03	75.66	2.30
32-33	16.3	79.6	4.2	32-33	21.23	76.53	2.23
40-41	15.1	77.1	7.8	40-41	19.20	78.97	1.86
48-49	20.5	74.4	5.0	48-49	16.28	80.90	2.91
56-57	13.6	82.5	3.9	56-57	21.75	75.24	3.03
64-65	18.2	76.3	5.5	64-65	17.08	80.54	2.37
72-73	15.7	82.0	2.3	72-73	17.94	79.66	2.44
80-81	15.9	79.2	5.0	80-81	18.34	79.00	2.66
AVERAGE	15.6	75.9	8.5	AVERAGE	18.97	78.53	2.51

DOWNSTREAM YOUNG			
Depth (cm)	%clay (<2 μm)	%silt (2μm - 63 μm)	%sand (>63 μm)
0-3	12.01	81.94	6.04
8-9	14.87	81.48	3.66
16-17	12.23	81.56	6.20
24-25	13.77	82.38	3.84
32-33	14.92	80.81	4.28
40-41	9.60	81.59	8.81
48-49	14.14	79.61	6.28
56-57	14.20	81.64	4.19
64-65	17.67	79.35	3.00
72-73	18.86	78.22	2.87
AVERAGE	14.23	80.86	4.92

DOWNSTREAM OLD			
Depth (cm)	%clay (<2 μm)	%silt (2μm - 63 μm)	%sand (>63 μm)
0-3	19.44	79.05	1.49
8-9	16.85	79.25	3.93
16-17	14.15	83.23	2.66
24-25	19.42	78.12	2.49
32-33	21.71	78.30	0.00
40-41	13.83	83.02	3.20
48-49	19.06	78.94	2.01
56-57	17.15	80.10	2.74
64-65	15.48	81.22	3.27
72-73	6.17	43.57	50.26
AVERAGE	16.33	76.48	7.20

MARINE OLD			
Depth (cm)	%clay (<2 μm)	%silt (2μm - 63 μm)	%sand (>63 μm)
0-3	14.89	81.57	3.57
8-9	17.98	79.30	2.75
16-17	13.78	82.06	4.17
24-25	14.87	79.46	5.67
32-33	13.51	64.08	22.43
40-41	14.47	81.88	3.68
48-49	16.71	81.95	1.37
56-57	12.57	82.32	5.05
64-65	19.82	76.19	4.01
72-73	15.54	78.06	6.39
AVERAGE	15.41	78.69	5.91

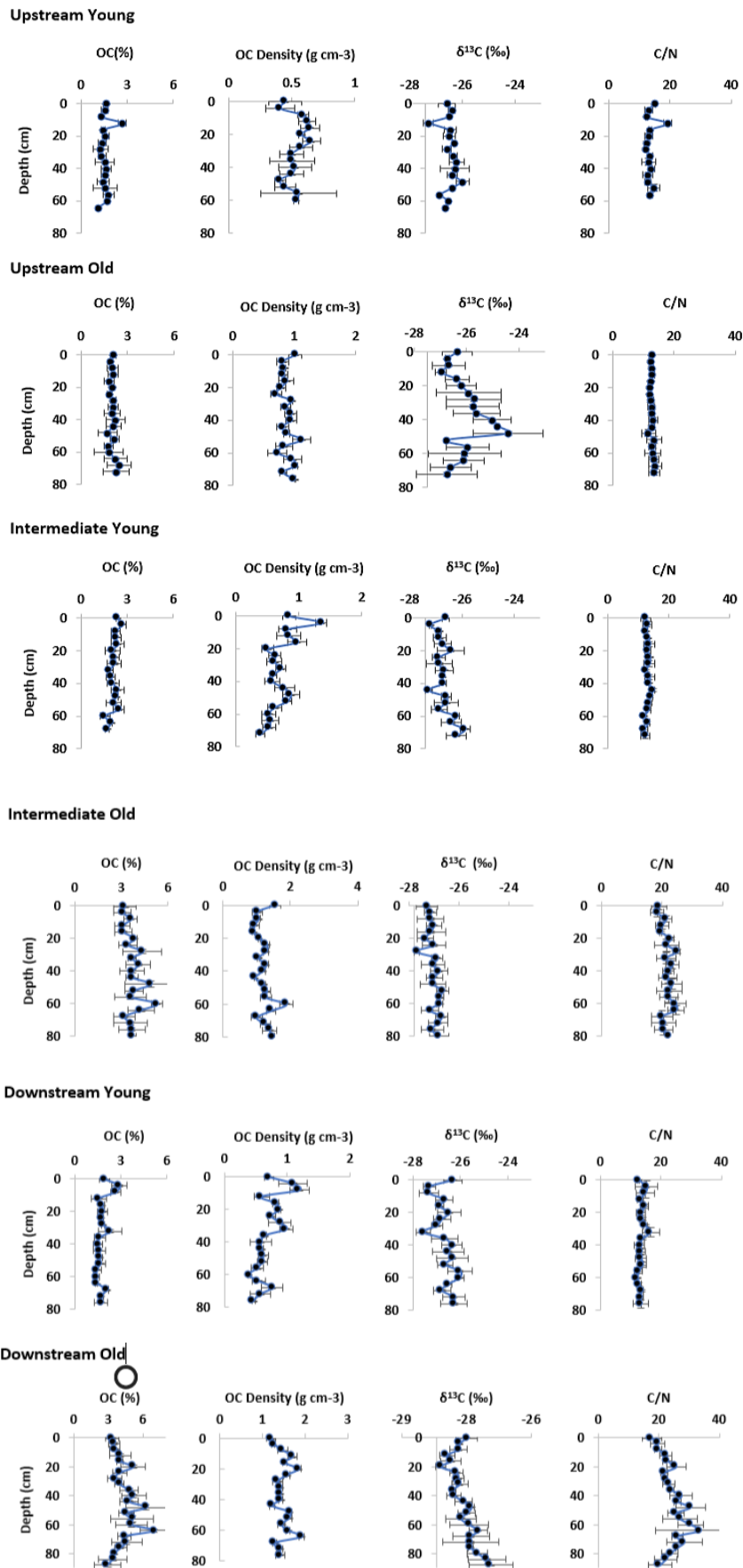


Figure S2. Downcore variation of sediment properties of the sites. Error bars represent standard deviation.

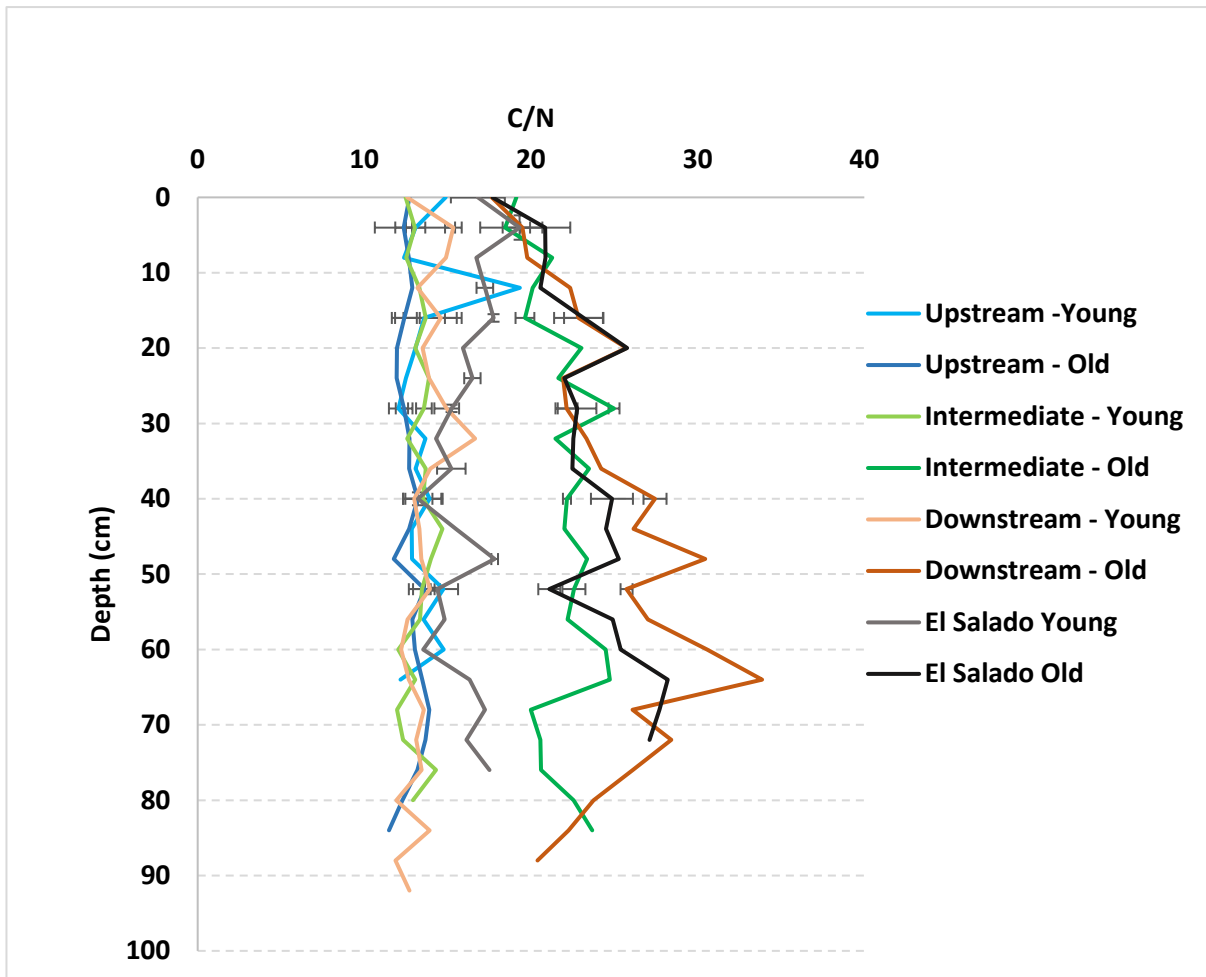


Figure S3. Depth profiles of C:N ratio for all sites. Error bars represent the standard deviation of subsamples taken at 0.04m depth increment for the three replicate cores at each site. El Salado sites correspond to Marine zone

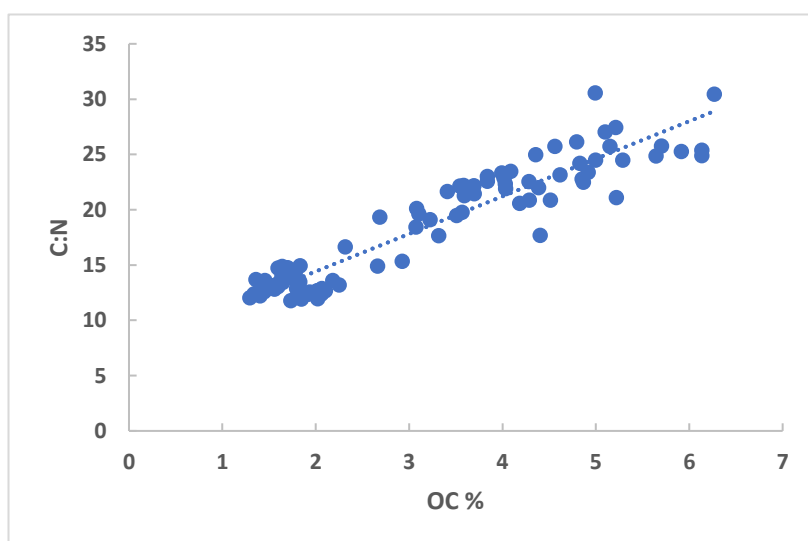


Figure S4. Sediment organic carbon content (% dry weight) versus carbon nitrogen ratios of all study sites. Data points represent average values of subsamples taken every 0.04m of three replicate cores per sites.

Table S8. Elemental and isotopic values of the above- and belowground vegetation samples (averaged per type: roots, leaves, branches, live, senescent, and surface litter) collected in all sites. ID corresponds to (1) sun-exposed leaves; (2) sun-shaded leaves; (3) sun-exposed branches; (4) sun-shaded branches; (5) living leaves; (6) senescent leaves; (7) surface litter and (8) roots.

SITE	ID	%C	%N	C/N	d13C	d15N
Upstream Young	1	41.2	1.3	31.9	-30.1	7.7
	2	42.8	1.7	25.6	-34.0	5.0
	3	42.4	0.8	55.0	-29.6	6.3
	4	44.0	0.7	59.4	-31.4	5.0
	5	43.7	1.4	30.3	-29.4	6.0
	6	43.5	1.2	37.6	-29.8	5.7
	7	38.2	0.9	40.3	-29.6	4.2
	8	39.3	0.6	33.4	-27.6	4.4
Upstream Old	1	43.6	1.5	29.9	-31.7	6.3
	2	40.2	1.6	25.9	-31.9	7.1
	3	42.2	0.7	56.8	-32.1	4.8
	4	44.0	0.7	62.0	-30.9	5.4
	5	45.1	1.7	26.5	-30.9	-1.1
	6	43.6	1.8	24.9	-31.0	-1.4
	7	41.3	1.0	41.1	-29.9	6.3
	8	38.3	0.9	40.4	-28.6	5.1
Intermediate Young	3	43.8	1.4	31.1	-28.5	8.5
	4	40.1	1.6	24.5	-31.5	5.7
	5	42.8	1.7	25.7	-30.5	5.4
	6	44.2	1.8	24.9	-33.5	4.5
	7	42.2	1.0	42.4	-30.4	6.1
	8	37.9	0.7	29.9	-28.2	3.6
Intermediate Old	1	47.0	1.0	48.8	-33.3	4.6
	2	47.2	1.8	26.0	-33.4	4.8
	3	46.8	0.9	54.9	-34.6	3.9
	4	48.2	0.6	86.7	-33.7	4.7
	5	41.7	0.9	47.4	-30.5	5.9
	6	42.4	0.8	52.8	-29.3	3.8
	7	46.1	0.5	85.5	-29.6	4.3
	8	36.3	0.6	47.1	-27.0	2.5
Downstream Young	5	43.1	1.9	22.3	-28.4	6.3
	6	43.0	1.8	24.1	-28.6	6.5
	7	40.5	0.8	52.4	-30.0	3.4
	8	39.0	0.8	39.6	-29.0	3.8
Downstream Old	1	44.9	1.1	42.2	-34.4	3.5
	2	48.4	1.3	38.1	-30.8	6.2
	3	49.1	0.4	117.8	-32.4	2.3
	4	48.1	0.5	96.6	-32.4	-0.5

	5	40.9	1.2	33.1	-28.5	5.9
	6	36.4	1.0	34.9	-28.2	5.5
	7	41.4	0.7	62.0	-29.8	3.2
	8	41.8	0.6	75.7	-26.9	0.9
Marine Young	8	36.5	1.0	27.1	-29.3	1.6
Marine Old	1	43.5	1.1	40.0	-28.6	7.0
	3	45.3	0.8	58.3	-27.4	5.3
	4	36.2	1.2	29.5	-32.8	5.2
	5	41.8	1.5	27.9	-30.1	2.0
	6	43.7	1.7	25.5	-29.4	0.4
	7	42.8	0.6	75.0	-29.7	2.9
	8	35.9	0.5	56.2	-28.3	2.4

Table S9. Year of establishment of mangrove study sites based on analysis of historical LANDSAT satellite images.

Site	Year of Establishment	
	Minimum	Maximum
Upstream Young	1993	2003
Upstream Old	1982	1984
Intermediate Young	2006	2009
Intermediate Old	1980	1982
Downstream Young	2004	2007
Downstream Old	1981	1984
Marine Young	2005	2008
Marine Old	1982	1983

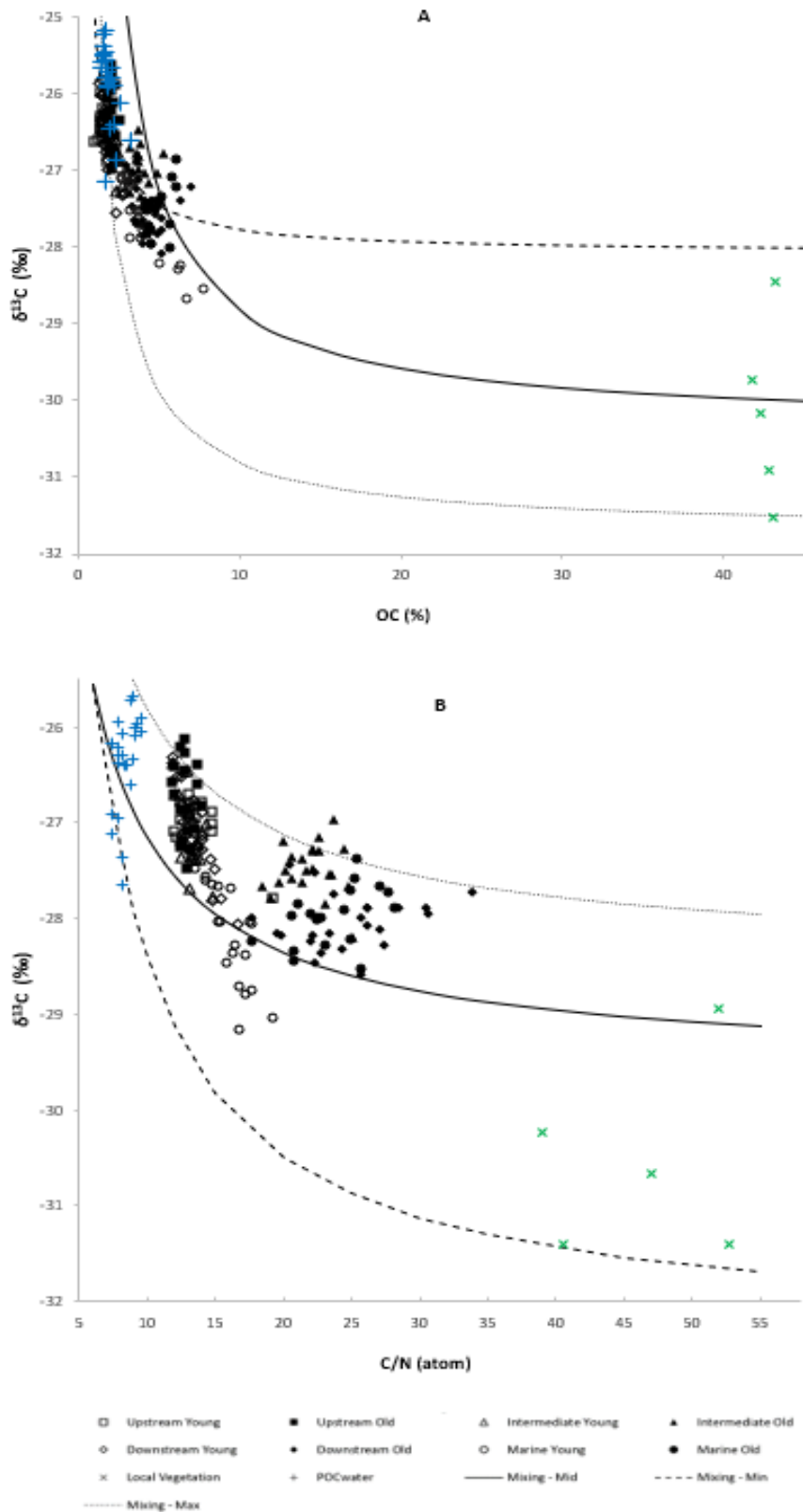


Figure S5 (A) Stable carbon isotope ratios $\delta^{13}\text{C}$ (‰) versus SOC content (%) ($r=-0.77$) and (B) $\delta^{13}\text{C}$ (‰) values versus C/N (atom) ratios ($r=0.77$) of all sampled sites. Different curves correspond to different end-member values for the sources (see main text for details). Local vegetation data represent **live aboveground** vegetation.

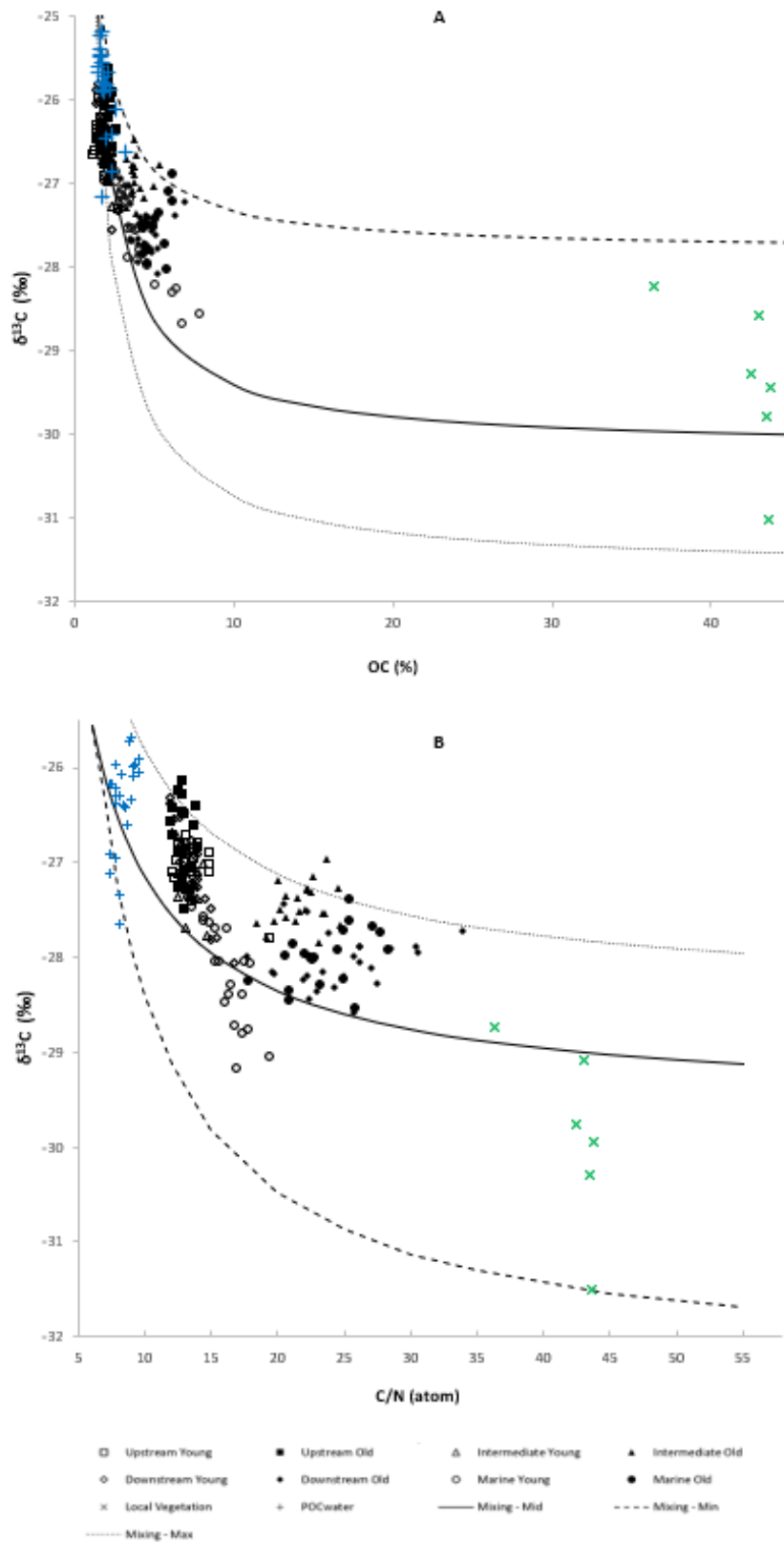


Figure S6 (A) Stable carbon isotope ratios $\delta^{13}\text{C}$ (‰) versus SOC content (%) ($r=-0.85$) and (B) $\delta^{13}\text{C}$ (‰) values versus C/N (atom) ratios ($r=74$) of all sampled sites. Different curves correspond to different end-member values for the sources (see main text for details). Local vegetation data represent **senescent aboveground** vegetation.

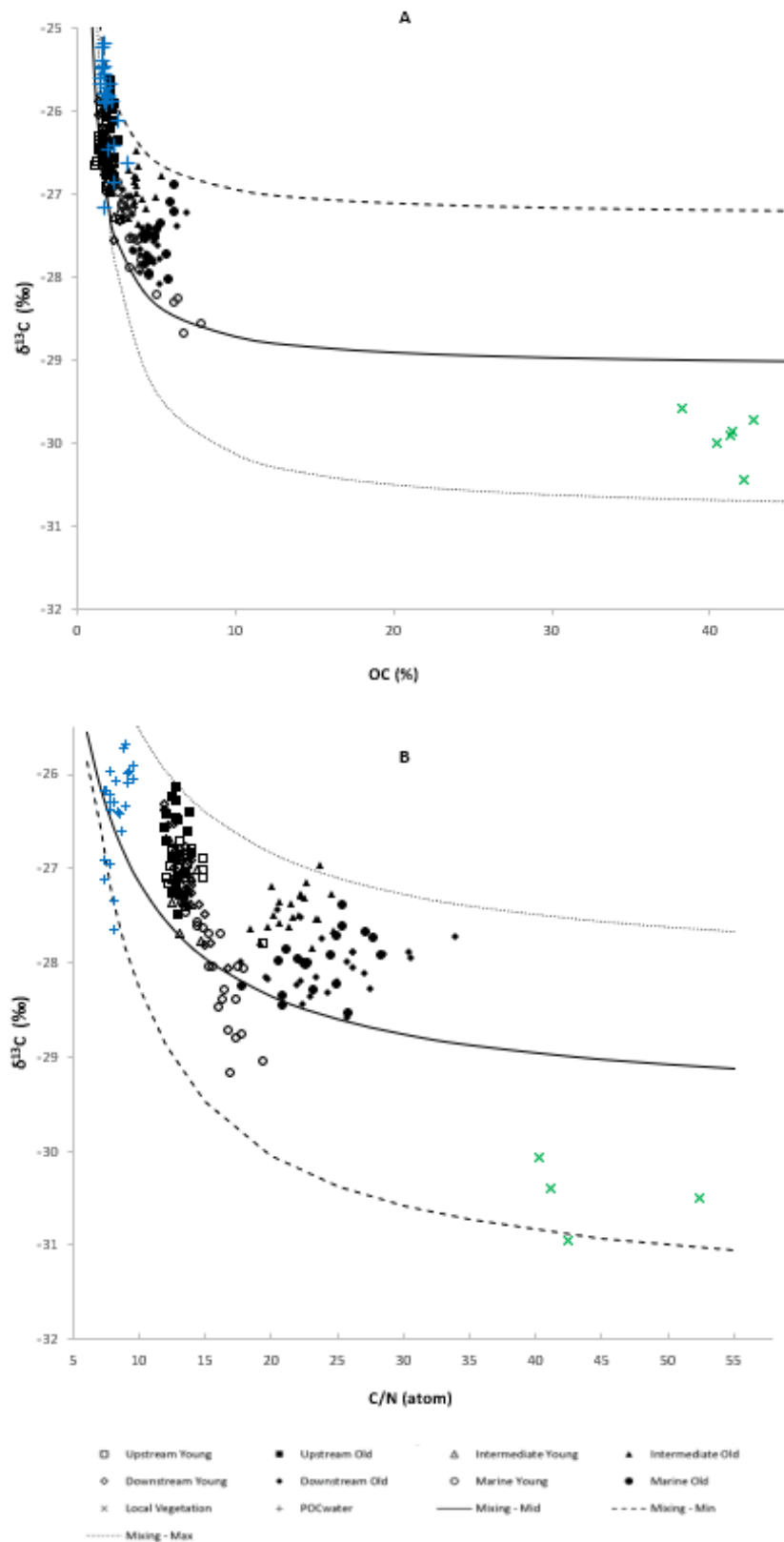


Figure S7 (A) Stable carbon isotope ratios $\delta^{13}\text{C}$ (‰) versus SOC content (%) ($r=87$) and (B) $\delta^{13}\text{C}$ (‰) values versus C/N (atom) ratios ($r=76$) of all sampled sites. Different curves correspond to different end-member values for the sources (see main text for details). Local vegetation data represent **surface litter**.

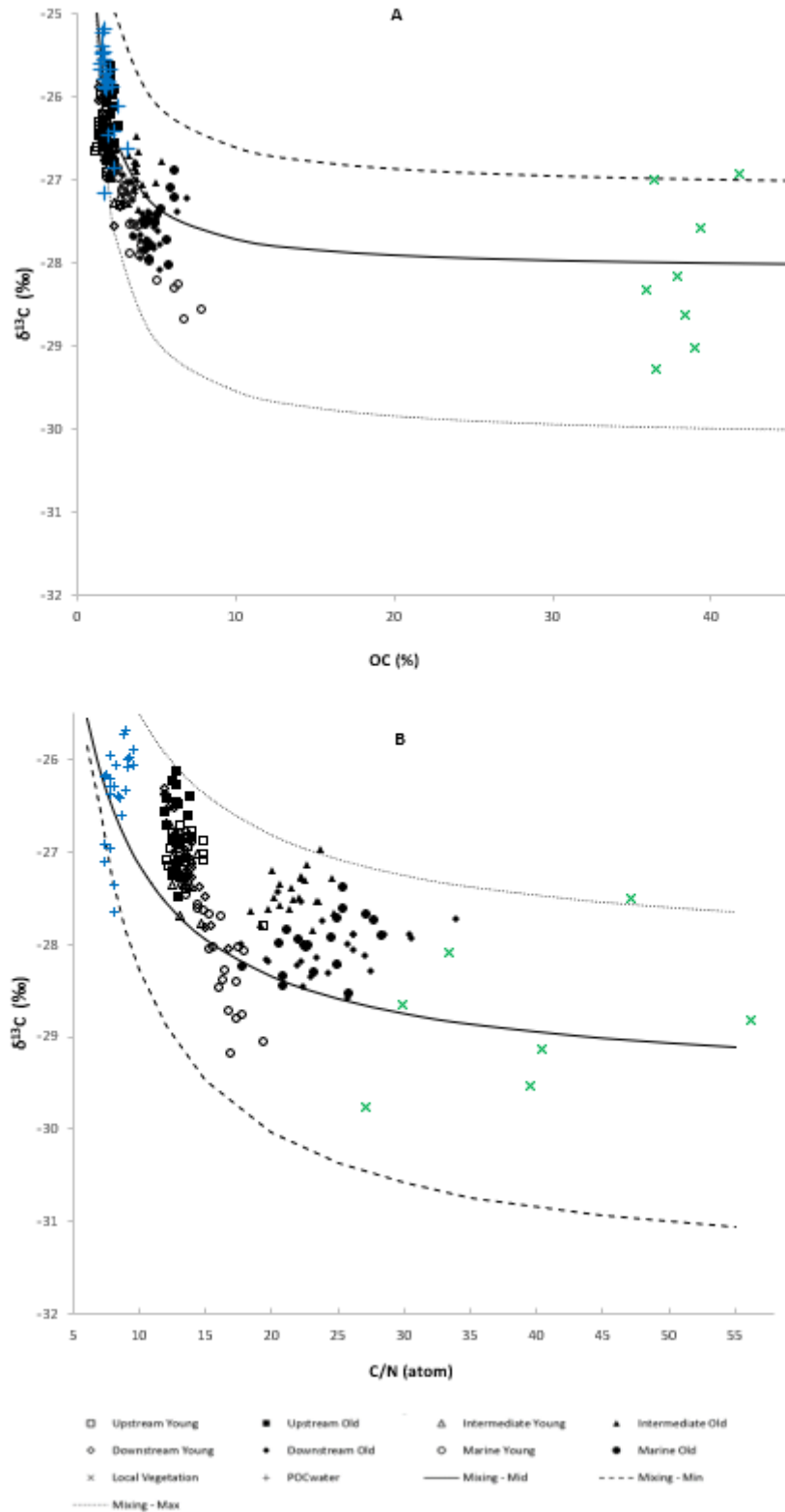


Figure S8 (A) Stable carbon isotope ratios $\delta^{13}\text{C}$ (‰) versus SOC content (%) ($r=84$) and (B) $\delta^{13}\text{C}$ (‰) values versus C/N (atom) ratios ($r=80$) of all sampled sites. Different curves correspond to different end-member values for the sources (see main text for details). Local vegetation data represent **belowground root tissues**.

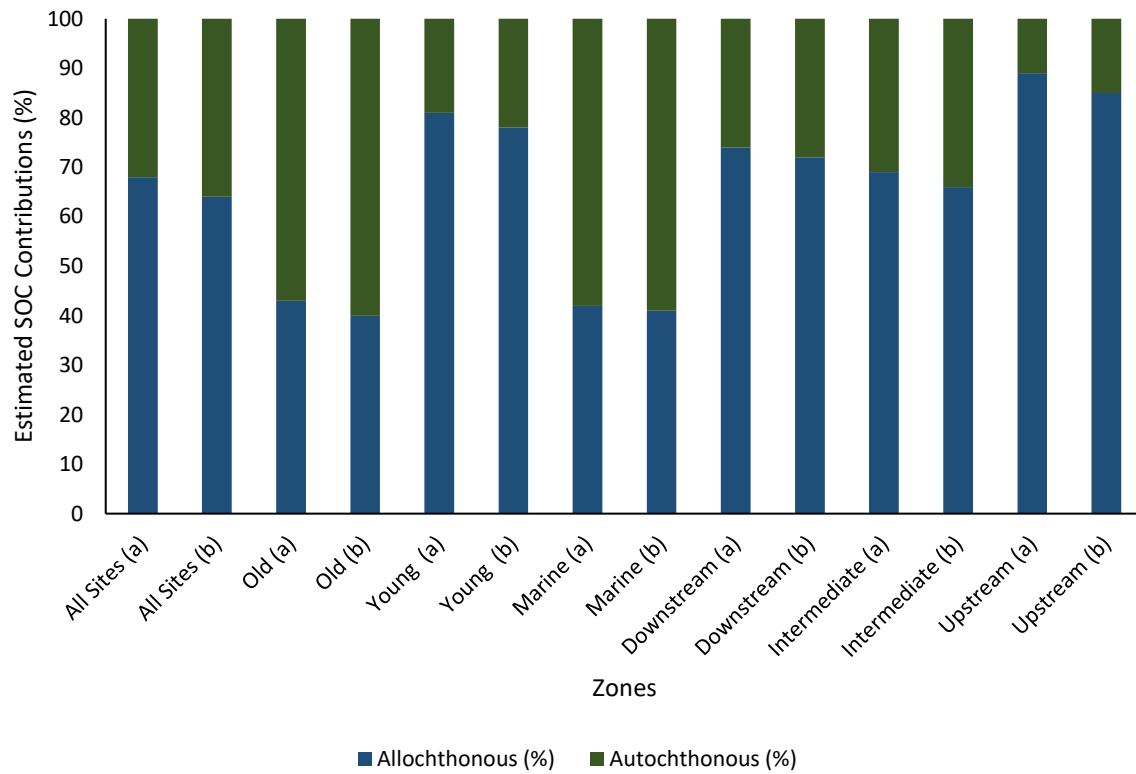


Figure S9. Estimated contribution (%) of allochthonous (POCwater) and autochthonous (vegetation) origins to the SOC of the study sites. **(a) 'Aboveground'** utilized leaves, branches, senescent and surface litter vegetation data while **(b) 'belowground'** utilized root samples data in the calculation of relative contributions of the main sources to SOC.