



SGS



Assessing Coastal Blue Carbon Residence Times using Radiocarbon Techniques

Elizabeth Brizuela
Dr. Amy M. Scott
Sean P. Ahearn
Rolando D. Alvarez



lab@radiocarbon.com | www.radiocarbon.com

Research and Development



Dr. Amy M. Scott
Ph.D., R&D Director



Sean P. Ahearn, M.Sc., P.G



Flare system sampling in a South
Florida landfill – Hydrocarbon Gas
/ Fuel Gas service testing



Rolando D. Alvarez, B.Sc.



Elizabeth Brizuela, B.Sc.

Session Objectives

- Coastal Blue Carbon
- Radiocarbon Dating overview
- Stable Carbon Isotope Ratio ($\delta^{13}\text{C}$)
- Emissions
 - $[\text{CH}_4]$, $^{14}\text{C}_{\text{CH}_4}$, $\delta^{13}\text{C}_{\text{CH}_4}$
 - $[\text{CO}_2]$, $^{14}\text{C}_{\text{CO}_2}$, $\delta^{13}\text{C}_{\text{CO}_2}$
- Dissolved Organic Carbon
- Case Studies
- Carbon Offsetting
- Residence Time Accounting Summary

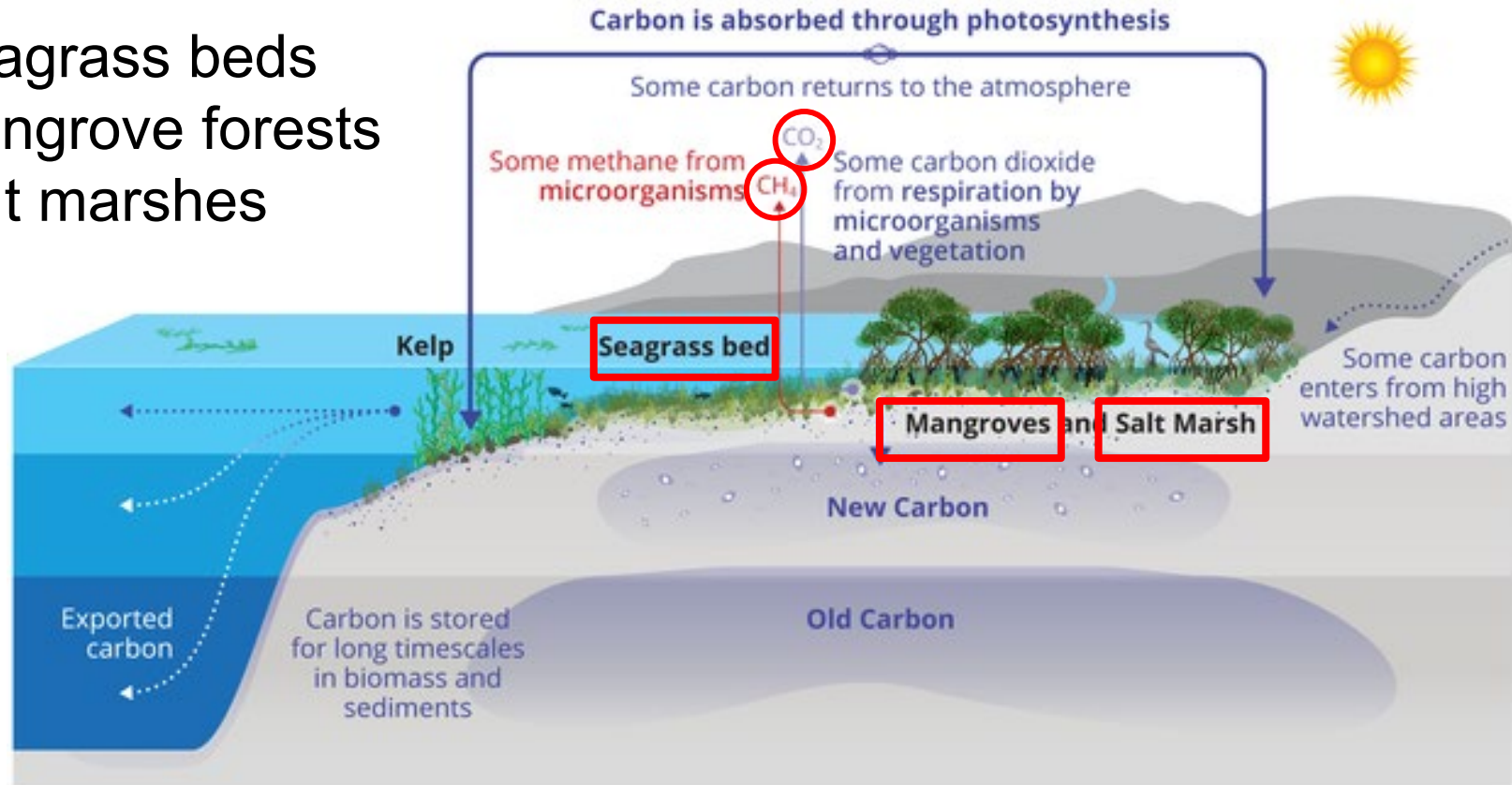
Radiocarbon



It's not just for bones...

Coastal Blue Carbon (CBC) Ecosystems

- Seagrass beds
- Mangrove forests
- Salt marshes



<https://www.climate.gov/news-features/understanding-climate/understanding-blue-carbon#:~:text=Blue%20carbon%20is%20any%20carbon,surge%20protection%2C%20and%20local%20economies.>

DISCLAIMER: This presentation is the property of Beta Analytic, Inc. and may not be distributed, reproduced, or modified without the prior written consent of Beta Analytic, Inc.

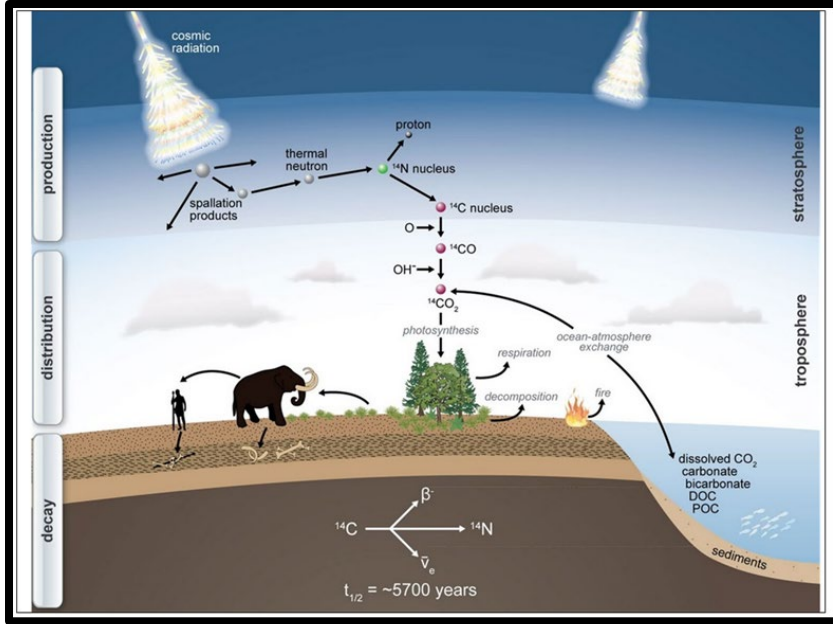
Copyright © 2023. Beta Analytic. All Rights Reserved

SGS

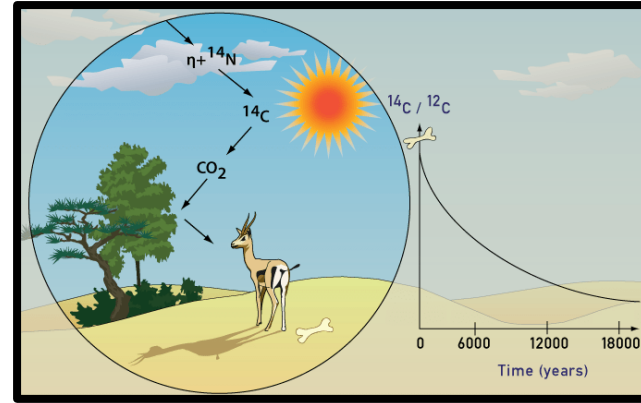


Radiocarbon Decay and Dating

<https://sites.ps.uci.edu/kccams/education/>

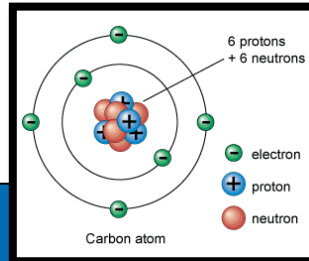


Radiocarbon, ^{14}C , is continuously formed in the upper atmosphere by the neutron bombardment of nitrogen and incorporates into the atmosphere as $^{14}\text{CO}_2$



<https://www.radiocarbon.com/accelerator-mass-spectrometry.htm#Advantages>

As ^{14}C forms it decays back to nitrogen by beta emission with a half life of 5,730 years. This decay is measured and provides objective age estimates for carbon containing materials using specialized instruments such as an accelerator mass spectrometer (AMS).



Stable
Stable
Radioactive

^{12}C (98.8%)
 ^{13}C (1.11%)
 ^{14}C (1×10^{-10} %)

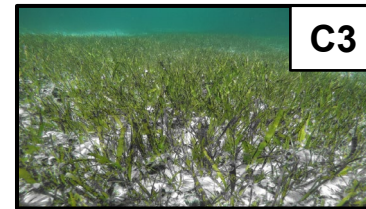
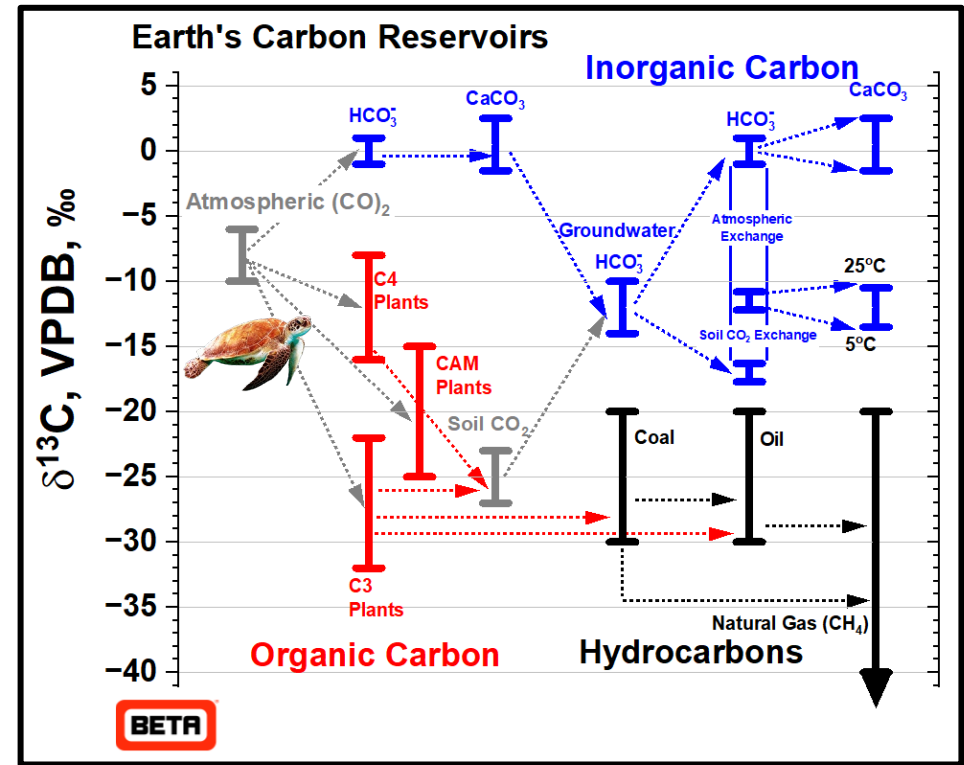
6 protons, 6 neutrons
6 protons, 7 neutrons
6 protons, 8 neutrons

$\delta^{13}\text{C}$: Why it Matters

The stable isotopic ratio of carbon, $\delta^{13}\text{C}$, is analyzed on Isotope Ratio Mass Spectrometers (IRMS) and can be used to differentiate the source of carbon in a sample.

$$\delta^{13}\text{C} = \left(\frac{\left(\frac{^{13}\text{C}}{^{12}\text{C}} \right)_{\text{sample}}}{\left(\frac{^{13}\text{C}}{^{12}\text{C}} \right)_{\text{standard}}} - 1 \right) \times 1000$$

Ideally, $\delta^{13}\text{C}$ is used in conjunction with other stable isotopes or radiocarbon to determine changes in the trophic system and impacts from shifts in the hydrologic system.

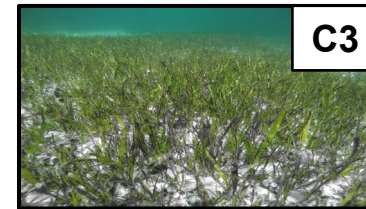
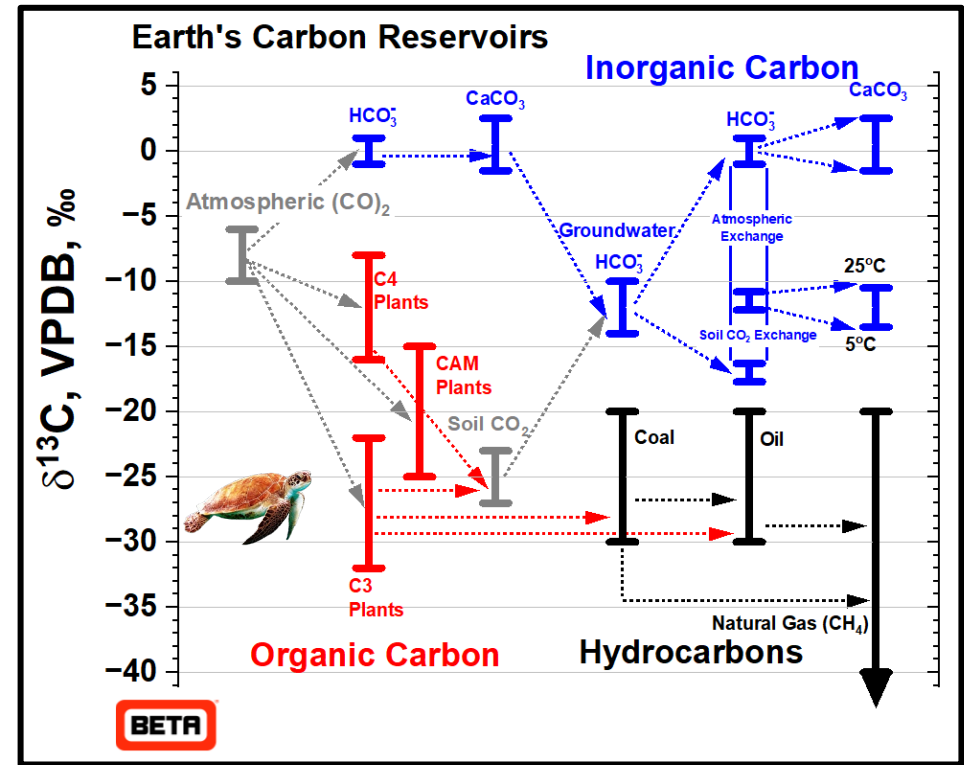


$\delta^{13}\text{C}$: Why it Matters

The stable isotopic ratio of carbon, $\delta^{13}\text{C}$, is analyzed on Isotope Ratio Mass Spectrometers (IRMS) and can be used to differentiate the source of carbon in a sample.

$$\delta^{13}\text{C} = \left(\frac{\left(\frac{^{13}\text{C}}{^{12}\text{C}} \right)_{\text{sample}}}{\left(\frac{^{13}\text{C}}{^{12}\text{C}} \right)_{\text{standard}}} - 1 \right) \times 1000$$

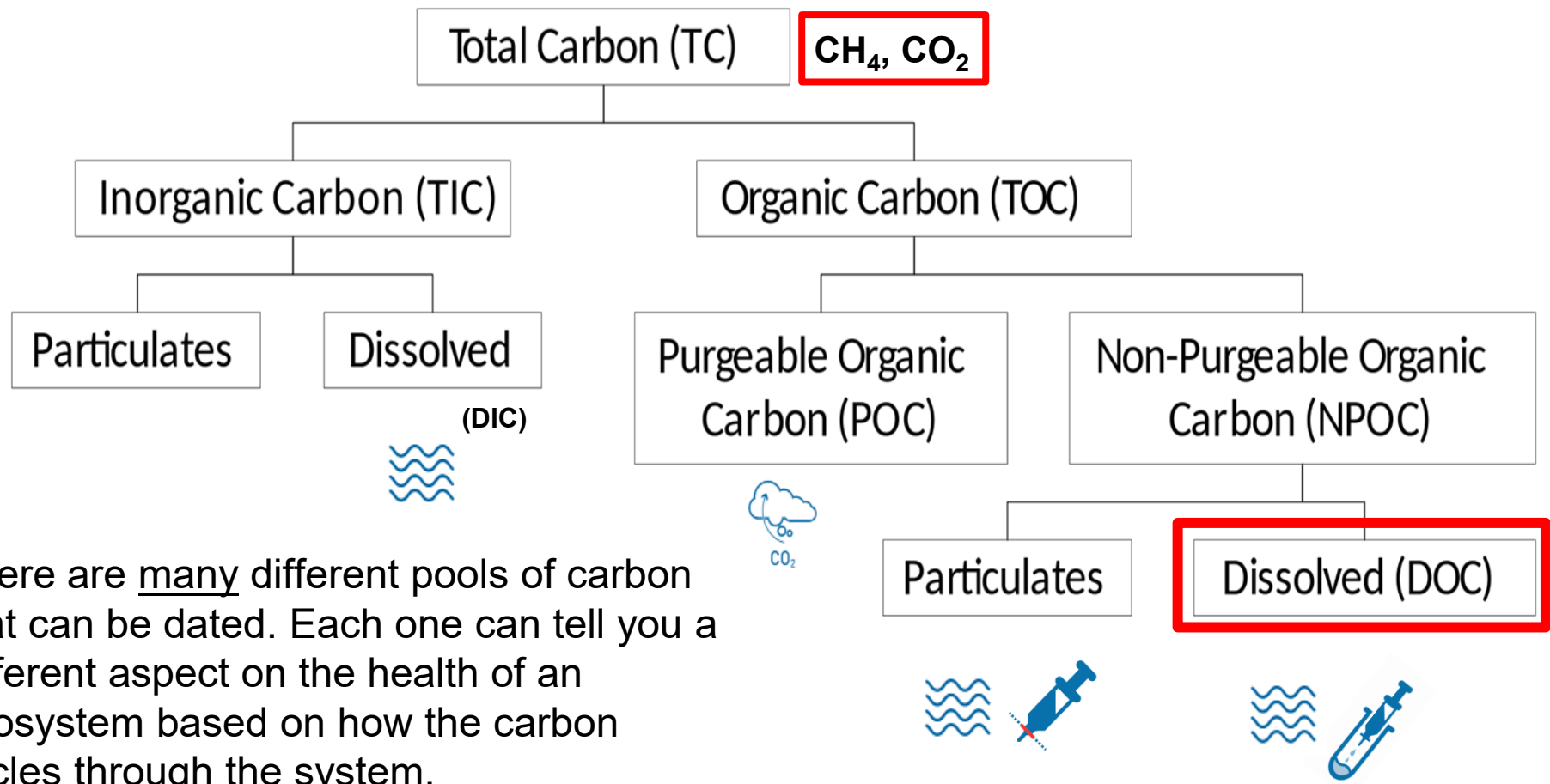
Ideally, $\delta^{13}\text{C}$ is used in conjunction with other stable isotopes or radiocarbon to determine changes in the trophic system and impacts from shifts in the hydrologic system.



C3

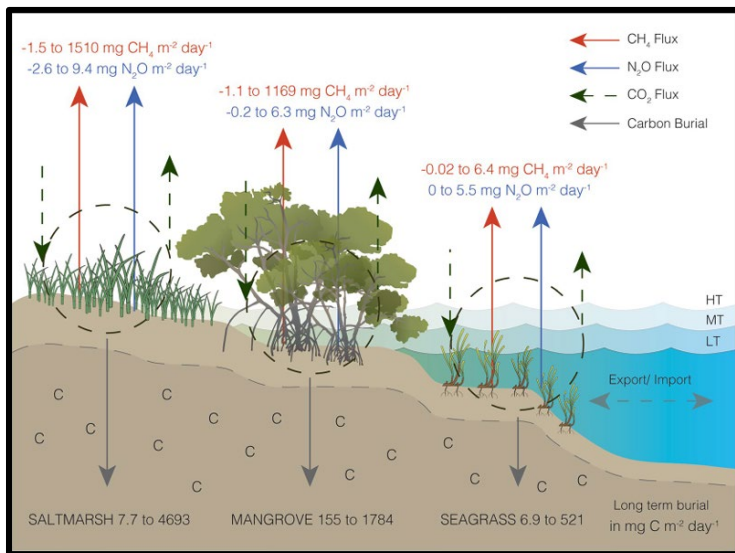


C4

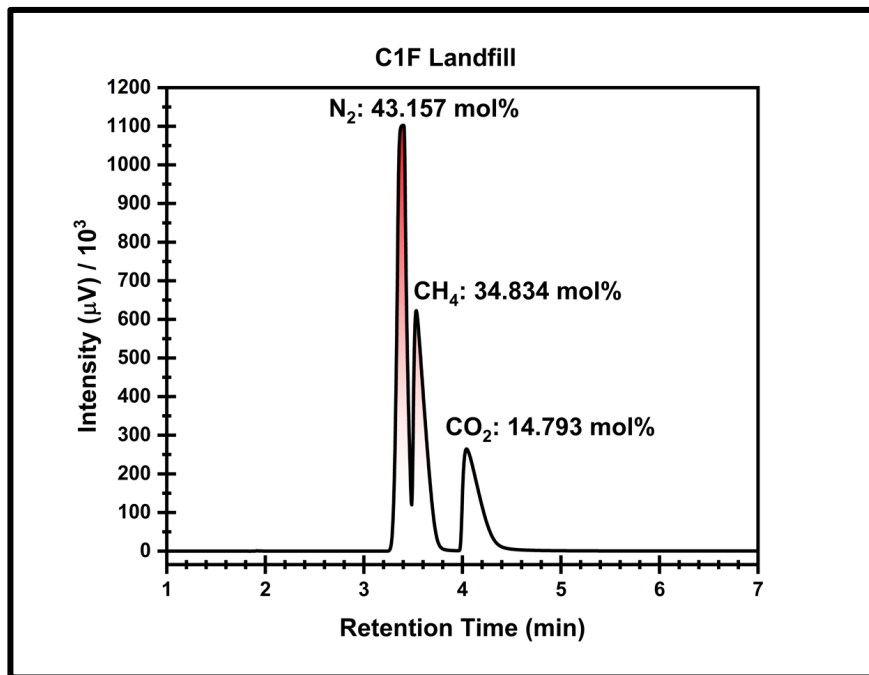


There are many different pools of carbon that can be dated. Each one can tell you a different aspect on the health of an ecosystem based on how the carbon cycles through the system.

CBC Emissions: Carbon Dioxide and Methane



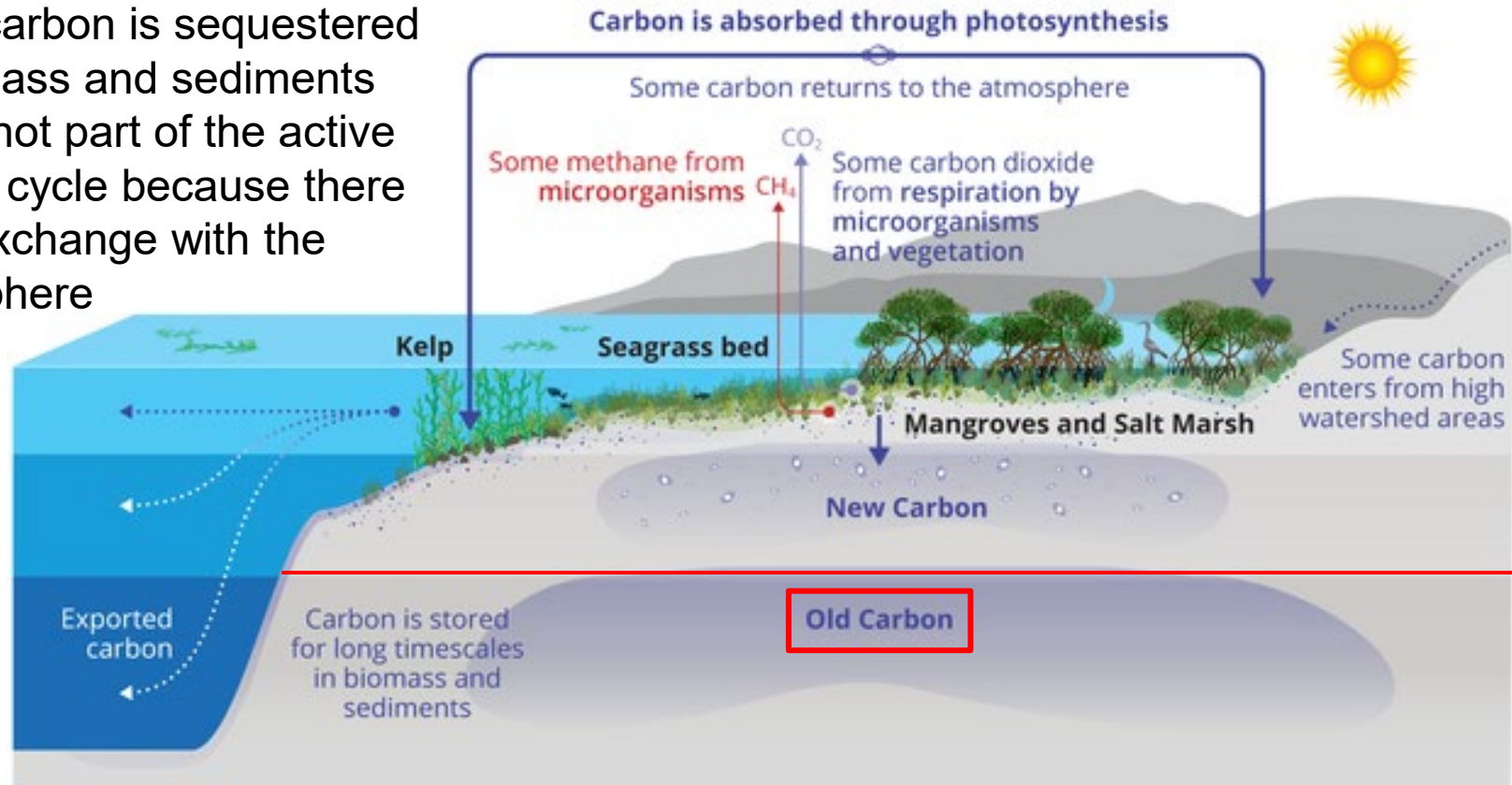
- Methane (CH₄) is 28 times more potent at trapping heat in the atmosphere.
- The effects of methane fluxes on carbon storage are still not well studied in coastal blue carbon sites.



- Gas compositions are determined on a gas chromatography instrument prior to analysis.

Coastal Blue Carbon (CBC) Ecosystems

Older carbon is sequestered in biomass and sediments and is not part of the active carbon cycle because there is no exchange with the atmosphere



<https://www.climate.gov/news-features/understanding-climate/understanding-blue-carbon#:~:text=Blue%20carbon%20is%20any%20carbon,surge%20protection%2C%20and%20local%20economies.>

DISCLAIMER: This presentation is the property of Beta Analytic, Inc. and may not be distributed, reproduced, or modified without the prior written consent of Beta Analytic, Inc.

Copyright © 2023. Beta Analytic. All Rights Reserved

SGS

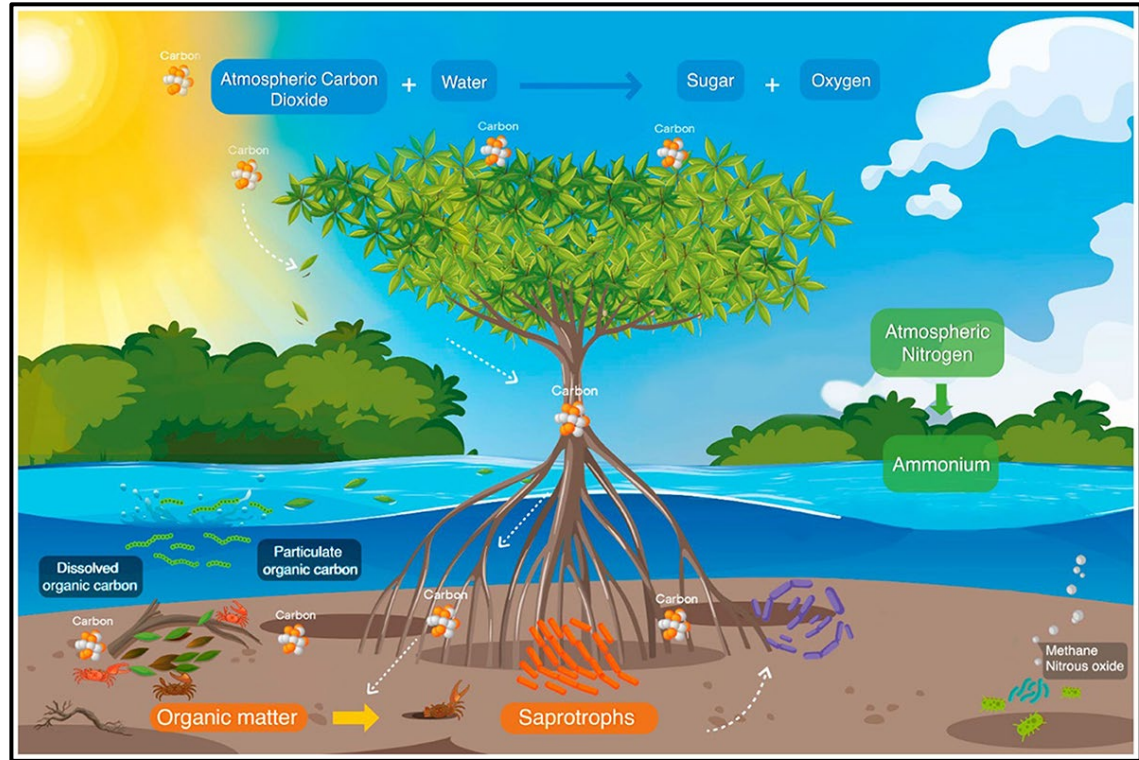


Dissolved Organic Carbon

The largest pool of organic matter in aquatic ecosystems, **dissolved organic carbon (DOC)** originates from the incomplete breakdown of organic material (terrestrial origin).



https://www.researchgate.net/figure/Seawall-constructed-behind-mangroves-Hainan-Island-China-both-eutrophication-and_fig4_327731777



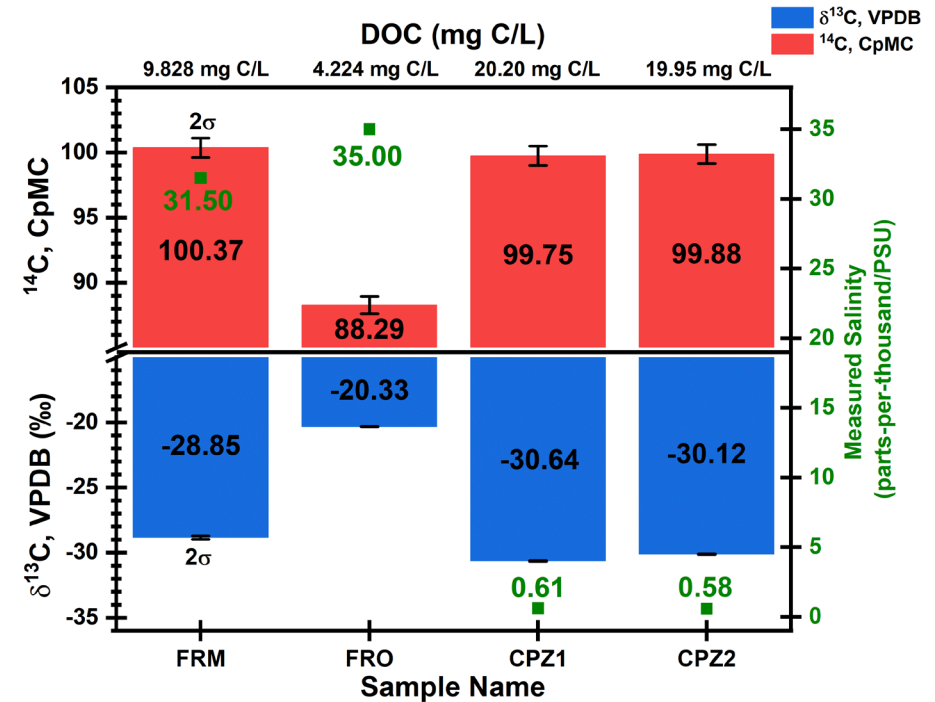
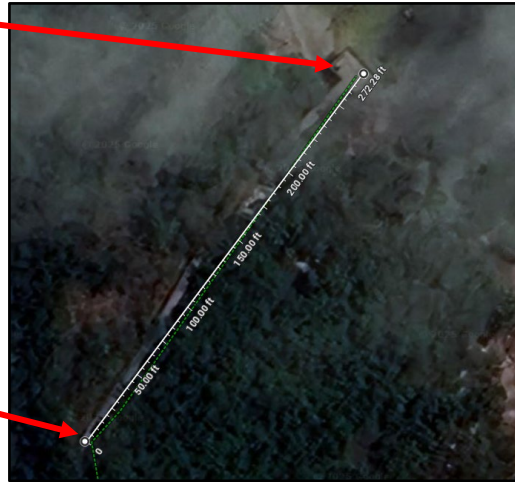
https://www.frontiersin.org/files/Articles/812948/trym-10-812948-H1 ML/image_m/figure-3.jpg

South Florida DOC Case Studies

FRO – Overlook site
directly on coastline
88.29 pMC = 920 years BP
(before present)

~ 273 ft

FRM – Mangrove Forest
100.37 pMC = Modern





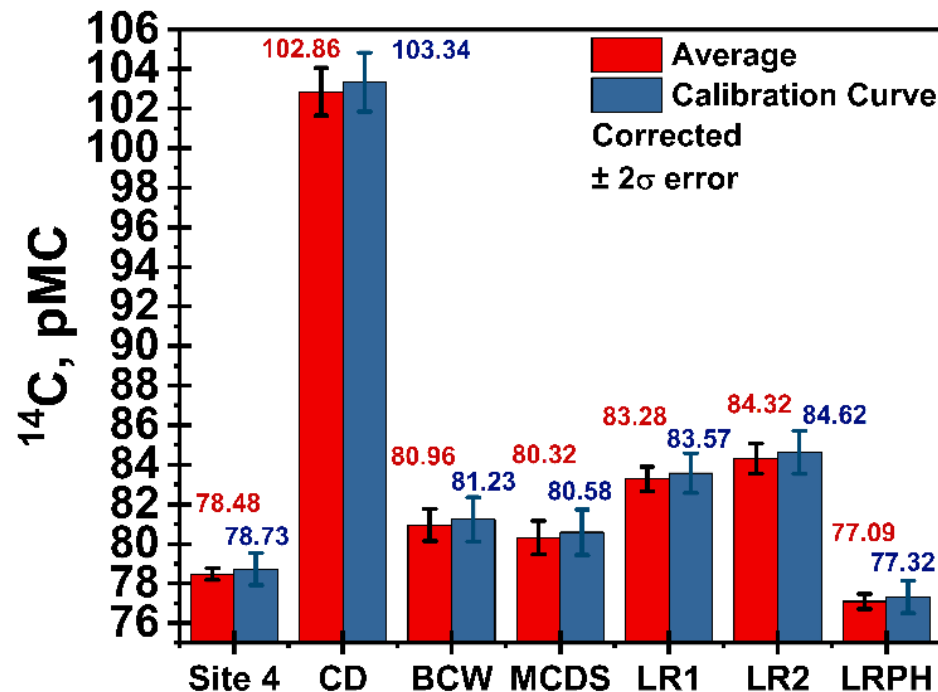
South Florida DOC Case Studies

CD – Cypress Dome

While they are not considered coastal blue carbon sites, cypress domes can sequester a lot of carbon in their deep, water-logged roots.

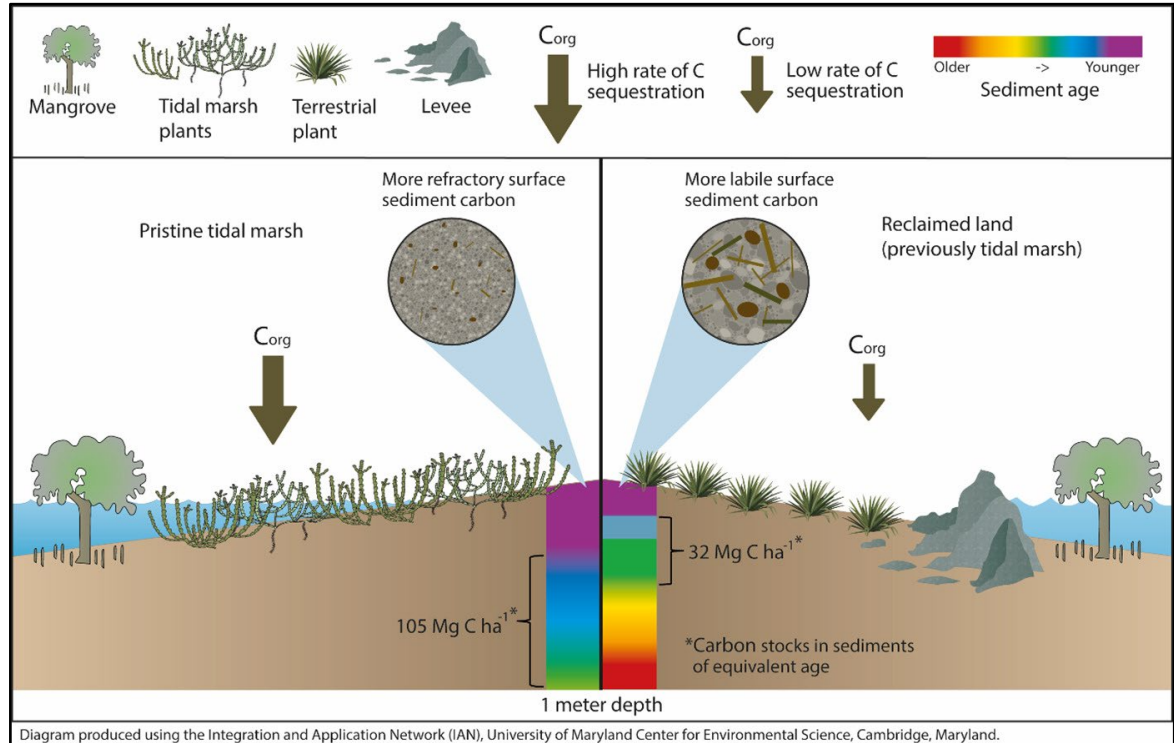
Site 4 – Stormwater Treatment Area

Human activity and agricultural runoff are more present in treatment areas and disturbance is evident in this study based on the radiocarbon age depicting a mixing of old and new carbon.



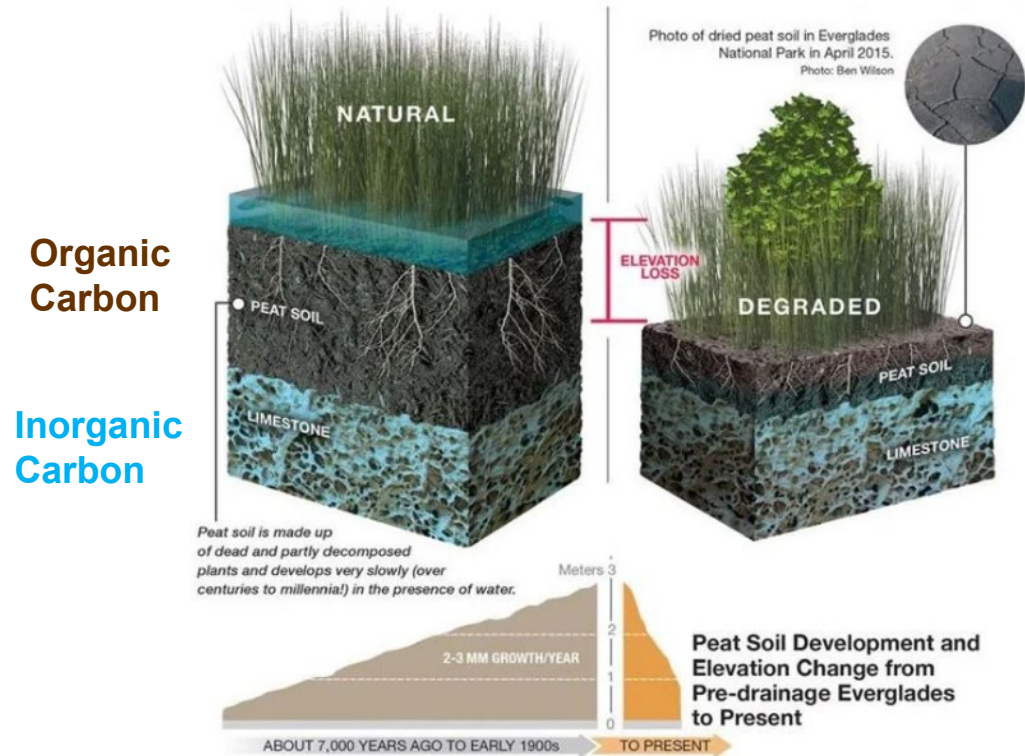
Sediment Depth Profiling using Radiocarbon

- Reclamation of tidal marshes resulted in a 70% loss of sediment carbon stocks.
- Carbon stock losses caused by reclamation may go undetected without in-depth analysis.
- “New” carbon in reclaimed sites was more degradable than in pristine tidal marshes.



Other Considerations: Disturbance Impacts

- Coastal blue carbon environments can accumulate sediments over long periods of time. These sediments are low in oxygen and can store carbon for much longer than other environments (carbon sink).
- If the peat soil is degraded or dried, not only is it more vulnerable to fire, but it also results in habitat loss and disrupts the ecosystem's trophic system.



Source: The Everglades Foundation

<https://www.evergladesfoundation.org/post/everglades-restoration-water-and-cimate-change>

DISCLAIMER: This presentation is the property of Beta Analytic, Inc. and may not be distributed, reproduced, or modified without the prior written consent of Beta Analytic, Inc.

Copyright © 2023. Beta Analytic. All Rights Reserved

SGS

BETA



Carbon Offsetting

Carbon offsetting is the process of reducing or removing GHG emissions in an area as compensation for a companies' own emissions.

Carbon credits provide incentive for reducing carbon emissions by assigning a monetary value per credit. Carbon markets are available internationally and regionally.

Sustainable Rubber Tree Reforestation, Guatemala

Type: Nature-based Solutions | Afforestation and Reforestation

Region: South America

Standard: VCS (Verified Carbon Standard)

"This project removes carbon from the atmosphere by reforesting degraded farmlands in Guatemala. All rubber trees planted are kept for an average of 40 years and at the end of their sap-producing life will be used for Forest Stewardship Council (FSC) certified furniture production and the site will be replanted".

<https://www.climateimpact.com/global-projects/sustainable-rubber-tree-reforestation-guatemala/>

<https://www.climateimpact.com/services-projects/carbon-credits-explained-what-they-are-and-how-they-work/>

DISCLAIMER: This presentation is the property of Beta Analytic, Inc. and may not be distributed, reproduced, or modified without the prior written consent of Beta Analytic, Inc.

Copyright © 2023. Beta Analytic. All Rights Reserved

SGS





Coastal Blue Carbon Accounting Summary

By accounting for the carbon residence time in a coastal blue carbon ecosystem, one can:

- Track bioavailability and rehabilitate natural coastal ecosystems
- Confirm a sites' carbon capturing capabilities to preserve the area from manmade disturbances
- Promote carbon offsetting and overall GHG reduction
- Determine carbon cycling efficiency between ecosystems



SGS



THANK YOU FOR
LISTENING

Questions?

info@betalabservices.com |
www.radiocarbon.com

ebrizuela@radiocarbon.com

