

Coastal Zone Soil Survey

Blue Carbon



Blue Carbon Sampling and Mapping — Why Depth Matters!

What is blue carbon?

Blue carbon is the organic soil material that is captured and stored in soils throughout the world's oceans and coastal ecosystems. Organic soil materials primarily consist of carbon-based compounds that originate from the remains of former living plants and organisms. The capture and storage process of organic soil materials can be defined as carbon sequestration. The soils contained in these coastal habitats can retain large carbon stocks as these soils often remain permanently saturated with water.

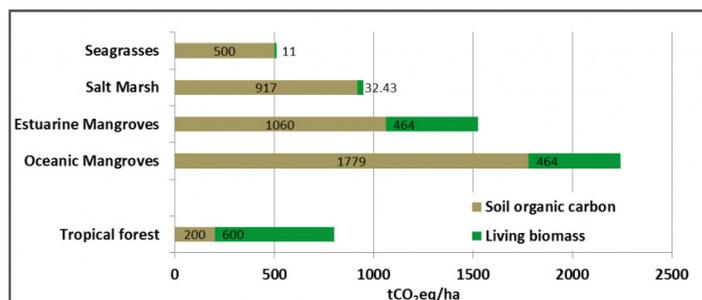
The saturation keeps these systems in a low-oxygen state in which carbon is not readily oxidized and released back to the atmosphere. Instead, carbon stocks in these areas tend to build up or sequester over time and expand the soil volume. Soil organic carbon content is often considered a primary indicator of positive soil health.

Why is blue carbon so important?

As the scientific community continues to study and understand the mechanisms that promote change in the world's climate, one common denominator has arisen — carbon. The scientific community widely accepts carbon as a key driver in climate change, but how much carbon is actually being stored in coastal environments and how best to capture and convey these numbers remains to be answered. USDA's Natural Resources Conservation Service (NRCS) understands that to appreciate the amount of carbon stored in soils, one must first understand the soil.

Soils play a vital part in climate change. It can store carbon from former living plants and organisms. Living plants can absorb atmospheric carbon through the photosynthetic process and store it in below-ground biomass or soils.

Coastal soils store and remove this atmospheric carbon at a much more accelerated and efficient rate than any other ecosystem on the planet. The coastal soils and habitats that sequester blue carbon at beneficial rates can be found in seagrass meadows, mangrove swamps, and tidal salt marsh habitat areas.



Coastal habitats and blue carbon soil sequestration vs. a tropical forest. Source: Murray, B.C. et al. (2011). Green Payments for Blue Carbon.

How does NRCS quantify coastal blue carbon?

NRCS' Coastal Zone Soil Survey (CZSS) program provides seamless soil data encompassing inland soils, tidal marshes, and shallow subaqueous and submerged soils. NRCS' Soil and Plant Science Division (SPSD) administers the CZSS program. NRCS' quality assurance standards require CZSS inventories to quantify and describe soils to a depth of 2 meters, which means the CZSS program will provide coastal blue carbon analysis and carbon stock information to a depth of 2 meters throughout the United States.

The CZSS program also quantifies blue carbon by soil series and soil horizon. This approach will enable the CZSS program to scale up and model blue carbon stock data across entire coastal and estuarine ecosystems using updated soil survey data. It also helps people better understand carbon loss through erosion or ecosystem degradation. Through field observations, one can see how much the soil has eroded and easily quantify the amount of carbon lost. This approach is different from many organizations attempting to quantify coastal blue carbon concentrations based on the vegetation species present. By mapping the soils based on the geomorphology of the coastal habitat, NRCS is adhering to more than 100 years of accepted soil science.

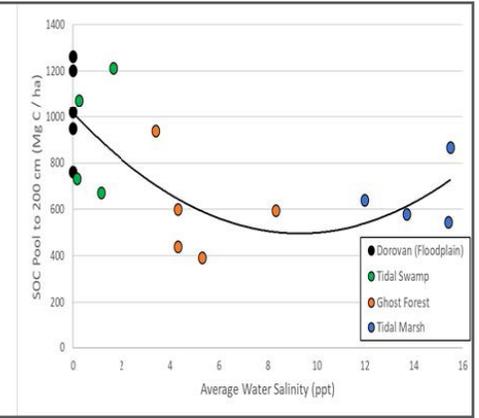
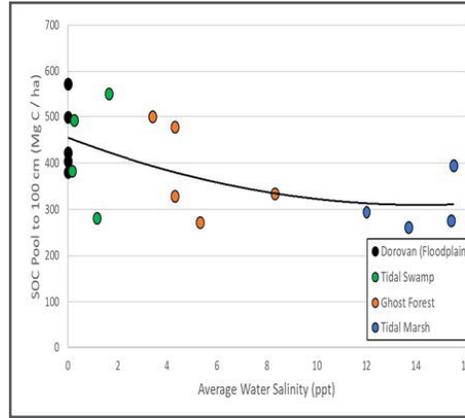


The “brownie” method is one of the best ways to accurately collect bulk density samples. The bulk density data is used to calculate how much carbon is stored in the soil.

It is also important to note that much of the carbon data being used or discussed are often estimated from organic matter. However, unless the organic matter is collected in the field and analyzed, this too is an estimate. NRCS’ CZSS data is based on fieldwork and science-based lab results. SPSP uses specialized equipment and a vast network of partner universities, agencies, and organizations for field collection and lab analysis.

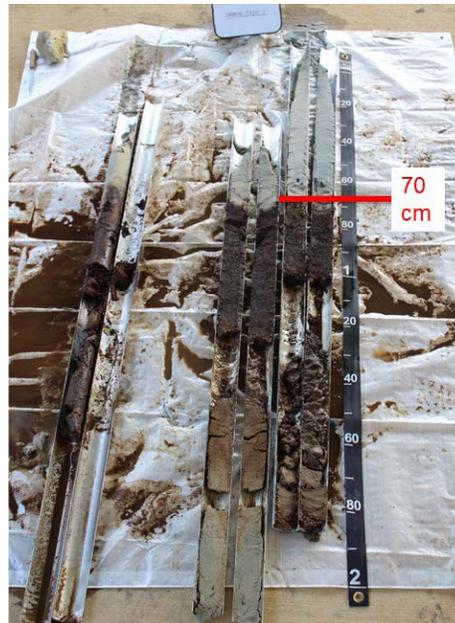
Why 2 meters?

When it comes to soil carbon, depth matters. Collecting carbon data to 2 meters allows for correlating the information to corresponding soil horizons, making the data mappable because it’s now associated with a soil series and map units within a soil survey. This approach allows soil carbon to be mapped by depth and landform, just as properties such as clay content, color, depth to bedrock, and water holding capacity are for traditional soil surveys. Many other organizations only record carbon stock information to a depth of 1 meter or less. Organizations that overlook carbon below 1 meter often homogenize the upper portion of the soil, resulting in inaccurate calculations of blue carbon.



Graph showing lab results by depth. The results illustrate that analyzing the soil to 100 cm (1 meter) would show less carbon being sequestered than if the soil is analyzed to 200 cm (2 meters). Source: Gorczynski, L., and Ricker, M. (2021). Coastal Zone Soil Blue Carbon PowerPoint presentation.

But depth doesn’t just matter because it fits within the parameters of soil science. It matters because field observations and lab analysis show that carbon is often buried in coastal areas’ dynamic systems. By not going deep enough, one often doesn’t see the effects of other factors that can influence carbon storage, nor do they find carbon from past processes such as transitions from a wetland forest to a tidal marsh.



A subaqueous soil core showing buried soil organic matter (carbon) below 70 cm.

How is CZSS data used?

CZSS can help people understand carbon loss, identify prime soils for carbon sequestration, and provide an accurate way to map carbon within bays, estuaries, marshes, and other coastal areas.

CZSS data can also be used to identify and predict the location of numerous salt marsh and mangrove swamp migration corridors. Conservation agencies could then target these migration corridor areas for habitat protection, allowing them to identify these land areas for maximum blue carbon sequestration in the future.

More Information

NRCS’ soil data, including CZSS, can be easily accessed 24 hours a day, 365 days a year through the [Web Soil Survey](#), the largest public-facing natural resource database in the world.

Soil and Plant Science Division

Natural Resources Conservation Service

nrcs.usda.gov/

