Coastal wetlands, such as salt marshes and mangrove forests, are vital carbon sinks, highly efficient at absorbing and storing carbon from the atmosphere. And with global emissions of carbon dioxide topping 35 billion tons in 2016, understanding and preserving these habitats that act as carbon sinks has become more important than ever.

The carbon sequestered in these coastal ecosystems—and in the ocean—is called blue carbon. All across the world, we are losing these blue-carbon ecosystems; for example, more than 2% of mangrove forests are destroyed every year. The loss of these carbon sinks not only compromises their ability to sequester carbon, but it can also lead to increased carbon emissions.

Researchers need more precise data to understand better how the loss of these ecosystems may affect the global carbon cycle and to develop strategies to preserve these threatened habitats.

“Being able to measure soil carbon levels accurately and economically in mangrove forests would help address the real impact of deforestation on these ecosystems,” says Gabriel Nóbrega, a researcher at the University of São Paulo in Brazil.

In a recent study published in the *Soil Science Society of America Journal* (http://bit.ly/2AfuhfV), Nóbrega and his colleagues highlight a technique that could be used to accurately measure levels of soil carbon in coastal wetland carbon sinks, such as mangrove forests. The technique, diffuse reflectance spectroscopy, or DRS, is not new. In the past, researchers have used it to measure levels of carbon in dry soils. However, few studies have tested whether the technique would also be effective on coastal wetland or mangrove soils.

Nóbrega and his colleagues tested DRS on soil samples from three mangrove forests in northeastern Brazil, each facing a different level of impact from human activities. One mangrove was relatively free from human impacts, but the other two have been affected by either domestic sewage outflow or effluents from shrimp farming.

From the data gathered, the researchers found that DRS may be a more accurate and efficient method compared with more conventional approaches to determine carbon levels in mangrove soils.

In the past, researchers have found it challenging to measure exact levels of soil carbon in coastal wetlands using conventional methods. According to Nóbrega, one factor that makes coastal wetlands efficient carbon sinks also makes it difficult to accurately measure levels of carbon in their soils.

Coastal wetlands are frequently saturated with water, which lowers oxygen availability for microbes and slows down rates of decomposition of organic matter. This allows large amounts of carbon to persist in the soils.

At the same time, the water-saturated, low-oxygen environment also leads to microbes using elements other than oxygen for respiration. That yields compounds that interfere with traditional methods that require chemical analyses of samples to measure levels of different elements in soils.

Researchers using DRS do not have to rely on chemical analyses to assess soil carbon levels because the technology works in a similar way to
how we see things around us. Light from a source, like the sun, hits an object, say a flower. Some part of the light is absorbed, and some part reflected. The light that is reflected is captured by our eyes. They act like sensors, and voila, we see a blossom.

When using DRS, researchers target a soil sample with light of known wavelengths, usually 350 to 2,500 nm. The light interacts with organic carbon, and other elements, in the soil sample. Sensors capture the reflected light, which researchers can use to create “reflectance fingerprints.” Using these fingerprints, they can study soil properties, including levels of carbon, without having to do chemical analyses. That can lead to more accurate results.

Increased accuracy is not the only benefit of using DRS to measure soil carbon levels. Conventional methods can be expensive, time-consuming, or toxic, whereas “DRS is fast, economical, and non-toxic,” according to Nóbrega. “That makes it possible to take more measurements and to be more precise than when using traditional chemical methods.”

While initial results using DRS have been encouraging, Nóbrega says there is still much work to be done. For example, mangrove forests across the world are highly variable. Their soils may differ in various characteristics, such as grain size and salt or mineral content. Researchers will have to account for these differences when using DRS to measure levels of carbon.

Nóbrega is aiming to build a database of soil reflectance fingerprints for mangrove soils from across the world. He doesn’t want to stop with mangrove soils, though. “Ultimately, we want to expand to other coastal environments, such as saltmarshes, seagrasses, and tidal flats,” he says.

He also wants to take to the air to analyze the ground. Eventually, it might be possible to equip a drone with the DRS sensors. “Then we could obtain vital information without disturbing sensitive ecosystems. We could even monitor carbon levels in large, inaccessible areas.”

Dig Deeper

doi:10.2134/csa2018.63.0101

Source: Gabriel N. Nóbrega