Stability Matters: A New Perspective on Wetland Soil Carbon

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Wetland and coastal ecosystems store a disproportionately large amount of global carbon (C) relative to their aerial extent, particularly in the soil. Over the past few decades, new empirical data on the spatial and temporal patterns of soil C across diverse wetland and aquatic ecosystems has improved management, conservation, and restoration efforts aimed at C sequestration for climate mitigation. However, most of these studies focus only on total C (or organic C) quantification, a property governed by soil organic matter (SOM) content. This metric fails to capture the diverse and dynamic nature of SOM, which is continuously processed, modified, and mineralized.

Our lab seeks a deeper understanding of SOM dynamics, asking: what controls which C compounds remain stored in the soil long-term, and which are lost? Within the conceptual framework of redox serving a central role in wetlands, we are critically evaluating the long-held assumption that the inherent biochemical properties of SOM lead to 'selective preservation' of more complex organic molecules. Rather, we have found broad evidence that organo-mineral complexes (termed mineral-associated organic matter, or MAOM) vary greatly in wetland soils and may be a key indicator of the vulnerability of SOM to mineralization. This presentation will introduce the concept and history of MAOM research in wetland soils, as well as present cutting-edge data on MAOM content and controlling factors across diverse wetland ecosystems. Our work highlights the importance of considering soil C fraction and form, rather than total C alone, when evaluating the climate mitigation potential of wetland soils.