EGU24-17518, updated on 28 Mar 2024
https://doi.org/10.5194/egusphere-egu24-17518
EGU General Assembly 2024

Carbon footprint (uptake/sequestration) of freshwater marshes according to agricultural water management practices

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Recent scientific investigations have classified blue carbon ecosystems as coastal vegetated areas characterized by rooted vegetation and marine sediments, spanning coastal, continental shelf, and offshore regions. While vegetated coastal salt marshes are recognized as highly effective carbon storage ecosystems, there is a limited understanding of the blue carbon potential when these ecosystems are transformed into embanked freshwater agricultural marshes. In regions like Charente-Maritime (France), where marshes cover 15 to 20%, comprising 95,000 hectares of freshwater marshes and 15,000 hectares of saltwater marshes, human activities through farming and water control, play a pivotal role in shaping and managing these areas. This results in a blend of water and land habitats, namely ditches and meadows, crucial for biodiversity maintenance and carbon storage. Despite the well-documented green carbon storage potential of meadows, able to store up to 1200 Kg C/ha/yr, the blue carbon footprint (uptake/sequestration) of associated freshwater ditches or wet meadows under various water management practices remains inadequately understood.

The present PhD work is closely aligned with two prominent regional blue carbon initiatives in France, namely TETRAE MAVI (Living Marshes) and LRTZC (La Rochelle Zero Carbon Territory). It focuses on the impact of water management practices in Charente's marshes on biodiversity and carbon dynamics in aquatic and terrestrial ecosystems. The study targets three different habitats - ditches, ditch edges, and wet meadows- and their corresponding compartments. Efforts will be made to understand the functional diversity of aquatic organisms (pelagic and benthic) and carbon dynamics in the water column, along with associated fluxes at exchange interfaces (water-air, sediment-air) using various methods such as sensors, chambers, samplings, and laboratory analyses.

A significant innovation of our work lies in the simultaneous consideration and measurement of blue carbon (aquatic) and green/brown carbon (terrestrial), leading to an integrative and comprehensive assessment. For example, one management approach, i.e. the dredging of a marsh (ditch), will enable a coupled analysis of blue carbon and green/brown carbon capture and sequestration, addressing the dual challenge of biodiversity and carbon balance on the terrestrial part too, considering all ecosystem components, and associated human activities.

The aim of this presentation is to present my PhD work in the framework of MAVI and LRTZC projects and to discuss the measurements and methodologies employed in our approach. Anticipated results will revolve around evaluating functional diversity and carbon capture/sequestration in the three studied habitat systems, considering human activities. To achieve this, a two-year on-site monitoring, coupled with laboratory measurements, will be conducted within an experimental unit in Charente-Maritime, encompassing diverse freshwater marsh habitats and ensuring logistical instrumentation and reliable data acquisition. Standardizing carbon footprint analysis methodologies is crucial for a consistent and reliable assessment of the carbon balance as intended here in this work presentation that would benefit from discussions to optimize the associated efficiency and overall benefit to the blue carbon community.