
The climate regulation service is determined by a microbe-driven trade-off between C sequestration and greenhouse gas emissions in costal environments

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Résumé

Coastal environments can act as net sinks of carbon (C). Their restoration is thus viewed as crucial to increase the climate regulation service, which is often quantified by a gain in 'blue' C sequestration in sediments. However, the restoration of coastal environments could also lead to increased emissions of greenhouse gases (GHG), in particular methane (CH₄) and nitrous oxides (N₂O), hence diminishing the benefits of coastal restoration for climate regulation. In the European project REST-COAST, we tested the existence of a trade-off between C sequestration and GHG emissions by comparing different restoration treatments for intertidal habitats in Western and Southern France, and Northern Italy, evaluating how the ecology of key microbial functional groups determines this trade-off. We quantified (i) sediment accretion and C sequestration rates through fine-scale measurements of ²¹⁰Pb isotopic signal and C content, (ii) the emissions of CO₂, CH₄ and N₂O *in situ* with smart chambers, (iii) abiotic parameters, and (iv) the activities, abundances and diversity of total bacteria, fungi, N₂O producers, N₂O reducers, methanogens and methanotrophs, through lab incubations, qPCR, and a targeted metagenomic method. We assume that coastal restoration increases C sequestration but increases GHG emissions. Our results reveal the existence of a trade-off between C sequestration and GHG emissions, showing that blue C sequestration is not a good proxy of the climate regulation service in these coastal systems. We also unfold the abiotic and microbial determinants of this trade-off. These results can guide restoration practices maximizing the benefits of restoration for the climate regulation service.

Mots-Clés: Greenhouse Gas Emissions, Carbon Sequestration, Coastal Restoration, Climate Regulation service, Microbial functional groups.

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