

The [ECOSPHERE research group](#) aims to study aquatic and valley ecosystems that are continuously challenged by natural and anthropogenic stressors. The research focuses on acquiring fundamental and applied knowledge at different levels of structural and functional organisation in order to underpin environmental management decisions.

MASTER THESIS SUBJECT 2026-2027

Effects of salinity and inundation on microbial communities and greenhouse gas fluxes in tidal wetlands: a mesocosm study

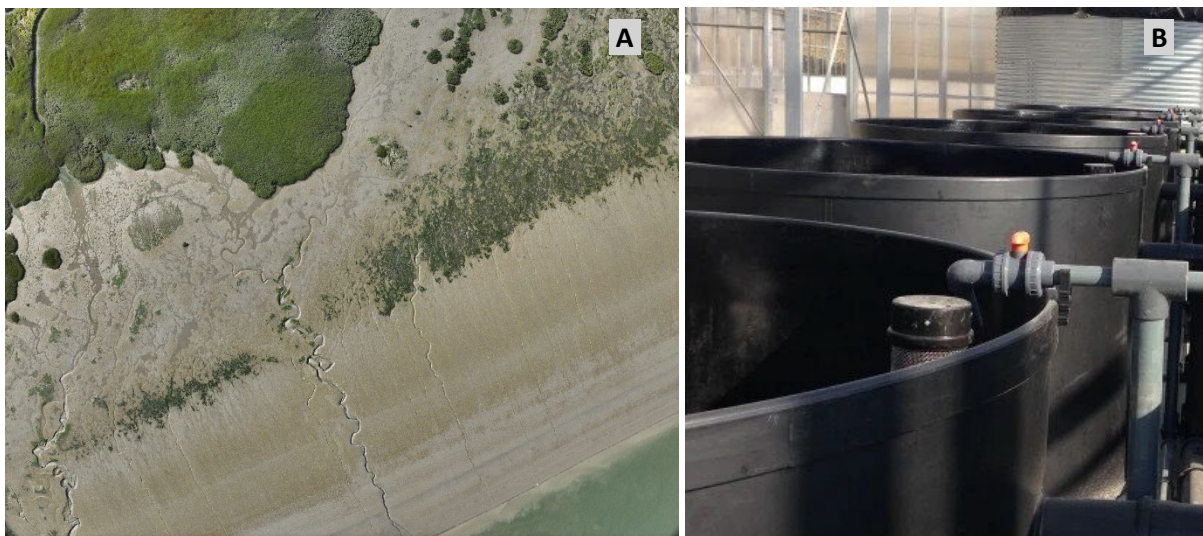
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(A) Drone image of the Paulina salt marsh along the Scheldt estuary, (B) mesocosm experimental setup in the Mesodrome facility of the University of Antwerp.

- This topic mostly contains ☒ literature study, ☒ lab work, ☐ field work, ☒ experimental work, ☐ GIS, ☐ numerical modelling, ☐ other:
- Possession of driver's license B is ☐ needed, ☐ recommended, ☒ not needed
- Possession of certificates needed: ☐ FELASA C, ☐ other:

Summary

Tidal marshes are coastal wetlands at the boundary between land and sea, typically found along estuaries. They provide important ecosystem services, including flood protection, water quality regulation and habitat for biodiversity. They are also recognized as *blue carbon* ecosystems because their soils are regularly flooded and poor in oxygen, organic matter decomposes slowly and large amounts of carbon can accumulate over centuries. This makes them valuable for climate change mitigation.

Whether a marsh actually helps the climate, however, depends not only on how much carbon it stores, but also on how much CO₂ and methane (CH₄) it releases. Microbes are central to these processes, regulating carbon turnover and stabilization in wetland soils. Two environmental factors strongly shape which microbial pathways dominate:

- **Inundation:** longer and more frequent flooding lowers soil oxygen, which slows decomposition and favors methane-producing microbes (methanogens).
- **Salinity:** seawater supplies sulfate, which lets sulfate-reducing bacteria outcompete methanogens, so salt marshes usually emit much less CH₄ than freshwater marshes.

Climate change is expected to alter both factors: sea-level rise will cause many marshes to be flooded more often and for longer, and saltwater will move further up estuaries. How microbial communities respond to these combined changes, and what this means for greenhouse gas emissions, is still poorly understood. In the field, salinity and flooding always change together with vegetation and soil properties, which makes their effects hard to separate. This thesis therefore uses a controlled mesocosm experiment with different salinity and inundation treatments to investigate how both factors affect microbial communities and their role in the carbon cycle.

Specifically, it will address the following questions:

1. How do salinity and inundation, alone and combined, affect CO₂ and CH₄ fluxes?
2. How do methanogens, methanotrophs and sulfate reducers respond?
3. Can changes in these microbial groups explain the changes in fluxes?

These objectives will be addressed through an integrated experimental and laboratory approach, combining sampling in a mesocosm experiment with advanced molecular and analytical techniques. You will set up and maintain the mesocosm experiment, monitor CO₂ and CH₄ fluxes regularly with closed chamber measurements, and take soil cores for chemical and microbial analyses. In the lab, you will extract DNA, amplify and sequence the 16S rRNA gene, and process the sequencing data with bioinformatic tools. Finally, you will use multivariate statistics to link environmental conditions, microbial community composition and greenhouse gas fluxes.

To conclude, this study will clarify how microbial communities are influenced by different environmental conditions and how this may affect carbon cycling in tidal wetlands. For you, it offers the perfect preparation for graduating as a versatile biologist, combining field, lab and computational work.

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