University of Antwerp
Faculty of Science

ECOSPHERE

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 2024

Title: Investigating Suspended Particulate Matter dynamics along the Scheldt–North Sea continuum

Research group: ECOSPHERE, ECODAM

Hosting laboratory: Campus Drie Eiken, Antwerp; Royal Belgian Institute of Natural Sciences, Brussels

Promotor(s): Jean-Philippe Belliard, jean-philippe.belliard@uantwerpen.be ; Michael Fettweis, mfettweis@naturalsciences.be

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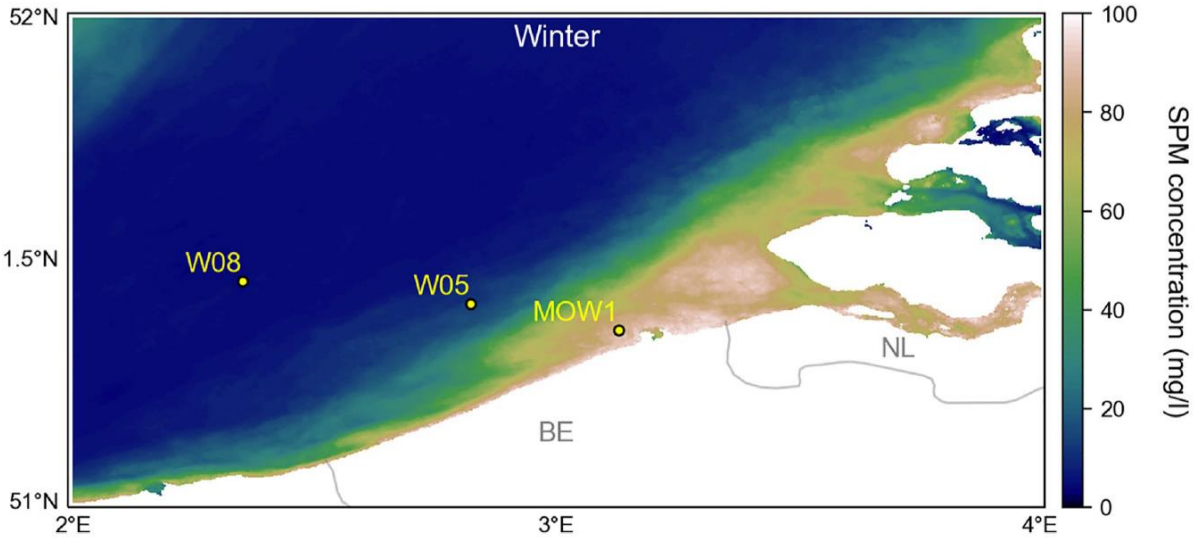
Suspended sediments and the associated organic matter and biota (or SPM) play a crucial role in the functioning of estuarine and coastal ecosystems. For instance, the steady supply of SPM is needed for intertidal marshes to follow sea level rise and to maintain their spatial extent, while also determining the rate of carbon sequestration through burial. Additionally, SPM significantly affects benthic and pelagic ecosystems and bio-geochemical cycles. In particular, it alters turbidity, impacting light availability in the water column, which in turn affects biological processes including phytoplankton primary production. Over recent decades, SPM dynamics has been altered by both increasing human activity (dredging, dumping, mining, eutrophication, etc.) and climate change impacts like sea level rise and warming. These changes, as observed along the Scheldt estuary and the North Sea region, have led to environmental shifts with potential negative effects on the marine food web, phytoplankton productivity, and water quality. Given these challenges, a thorough understanding of SPM dynamics is essential for predicting future ecosystem states and managing these environments effectively.

SPM dynamics is primarily controlled by hydrodynamic forcing such as tides, waves, river discharge and the physical and chemical properties of the particles themselves, which all depict spatial gradients in their magnitudes from land to ocean. In addition, SPM dynamics is also mediated by biological processes, notably the secretion of sticky substances by phytoplankton that influence sediment flocculation (where particles aggregate into flocs or break-up), which in turn affect particle size and their sinking speeds. Previous studies have identified a nearshore-offshore gradient in SPM concentration in marine regions, such as the Belgian continental shelf (Figure 1), which correlates with SPM composition and shows an increase in organic matter content of the SPM offshore. Yet, it remains unclear whether such a gradient extends over more inland areas, such as estuaries. Preliminary observations suggest a more complex pattern of SPM concentration and composition across the Scheldt–North Sea system. Such complexity may be attributed to differences in the magnitude and variability of driving forces, as well as the relative importance of physical and biological processes between estuarine and coastal zones.

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



Winter average SPM concentration in the southern North Sea with indications of the sampling stations positioned along a nearshore–offshore transect.

This thesis aims to explore the interactions between physical and biological processes that govern SPM dynamics along the land-ocean continuum, focusing on the Scheldt–North Sea region. The thesis will emphasize on: (i) improving the characterization of the SPM dynamics over time and across different locations along this continuum; and (ii) advancing the understanding of the interactions between biology, bio-geochemistry and sediment dynamics in estuarine and coastal areas. To do so, the candidate will utilize a unique, extensive dataset on SPM concentration, composition and associated controlling factors covering the Scheldt–North Sea region over multiple years. This work will involve data mining, statistical analysis, and potentially empirical modelling. Depending on funding availability (but this is uncertain), the candidate may also participate in an oceanographic campaign to monitor in-situ water quality in the North Sea.

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