Analyzing Satellite Scaling Bias Using Drone Data, Application to Microphytobenthos Studies

# Introduction

## MPB

The present study focuses on microphytobenthos (MPB) colonizing estuarine intertidal zones. MPB refers to photosynthetic unicellular microalgae forming biofilms at the sediment surface during low tides. This group includes diatoms, euglenids, cyanobacteria, and chlorophyta (Underwood 2001). They can be associated to mud and sand, i.e. inorganic particles with size between 4 and 63µm, and 63 and 2000µm, respectively (Wentworth 1922). In these soft-bottom sediments, MPB can be the main primary producer, notably in turbid estuaries.

## Ecological services

MPB provides several ecosystem services (Hope, Paterson, and Thrush 2020). In addition to its contribution to carbon fluxes, estimated between 30 and 230 g C/m²/year (Heip et al. 1995 ; Park et al. 2024), it stabilizes the sediment through the secretion of extracellular polymeric substances (EPS) (Gibbs 1983 ; Riethmüller et al. 2000 ; Stal 2010 ; Huiming, Hongwei, and Minghong 2011 ; Fang et al. 2012 ; Gerbersdorf et al. 2020), and therefore reduces coastal erosion (Hope, Paterson, and Thrush 2020). It is a key element of food webs (Deppe 1999 ; Aberle-Malzahn 2004 ; Dauvin and Desroy 2005), and it plays an important role in nutrient cycling, increasing water quality. It can also be used as a bioindicator of water quality (Oiry and Barillé 2021).

## Spatial structure

## MPB & RS

## The use of a proxy

#Bias

## Present study

# Material and methods

## Simulating a satellite dataset from a drone dataset

# Results

# Discussion

# References

Aberle-Malzahn, Nicole. 2004. “The Microphytobenthos and Its Role in Aquatic Food Webs.” PhD thesis, Christian-Albrechts-Universität Kiel. <https://pure.mpg.de/pubman/faces/ViewItemOverviewPage.jsp?itemId=item_1507232>.

Dauvin, Jean-Claude, and Nicolas Desroy. 2005. “The Food Web in the Lower Part of the Seine Estuary: A Synthesis of Existing Knowledge.” *Hydrobiologia* 540 (1): 13–27. <https://doi.org/10.1007/s10750-004-7101-3>.

Deppe, Frauke. 1999. “Intertidal Mudflats Worldwide.”

Fang, Hongwei, Huiming Zhao, Qianqian Shang, and Minghong Chen. 2012. “Effect of Biofilm on the Rheological Properties of Cohesive Sediment.” *Hydrobiologia* 694 (1): 171–81. <https://doi.org/10.1007/s10750-012-1140-y>.

Gerbersdorf, Sabine Ulrike, Kaan Koca, Dirk de Beer, Arjun Chennu, Christian Noss, Ute Risse-Buhl, Markus Weitere, et al. 2020. “Exploring Flow-Biofilm-Sediment Interactions: Assessment of Current Status and Future Challenges.” *Water Research* 185 (October): 116182. <https://doi.org/10.1016/j.watres.2020.116182>.

Gibbs, Ronald J. 1983. “Effect of Natural Organic Coatings on the Coagulation of Particles.” *Environmental Science & Technology* 17 (4): 237–40. <https://doi.org/10.1021/es00110a011>.

Heip, C. H. R., N. K. Goosen, P. M. J. Herman, J. Kromkamp, J. J. Middelburg, and K. Soetaert. 1995. “Production and Consumption of Biological Particles in Temperate Tidal Estuaries.” *Oceanography and Marine Biology: An Annual Review*. <https://www.lifewatch.be/en/imis?module=ref&refid=8311&printversion=1&dropIMIStitle=1>.

Hope, Julie A., David M. Paterson, and Simon F. Thrush. 2020. “The Role of Microphytobenthos in Soft-Sediment Ecological Networks and Their Contribution to the Delivery of Multiple Ecosystem Services.” *Journal of Ecology* 108 (3): 815–30. <https://doi.org/10.1111/1365-2745.13322>.

Huiming, Zhao, Fang Hongwei, and Chen Minghong. 2011. “Floc Architecture of Bioflocculation Sediment by ESEM and CLSM.” *Scanning* 33 (6): 437–45. <https://doi.org/10.1002/sca.20247>.

Oiry, Simon, and Laurent Barillé. 2021. “Using Sentinel-2 Satellite Imagery to Develop Microphytobenthos-Based Water Quality Indices in Estuaries.” *Ecological Indicators* 121 (February): 107184. <https://doi.org/10.1016/j.ecolind.2020.107184>.

Park, Jihae, Hojun Lee, Jana Asselman, Colin Janssen, Stephen Depuydt, Jonas De Saeger, Thomas Friedl, et al. 2024. “Harnessing the Power of Tidal Flat Diatoms to Combat Climate Change.” *Critical Reviews in Environmental Science and Technology* 0 (0): 1–22. <https://doi.org/10.1080/10643389.2024.2315004>.

Riethmüller, R., M. Heineke, H. Kühl, and R. Keuker-Rüdiger. 2000. “Chlorophyll a Concentration as an Index of Sediment Surface Stabilisation by Microphytobenthos?” *Continental Shelf Research* 20 (10-11): 1351–72. <https://doi.org/10.1016/S0278-4343(00)00027-3>.

Stal, Lucas J. 2010. “Microphytobenthos as a Biogeomorphological Force in Intertidal Sediment Stabilization.” *Ecological Engineering*, Special Issue: BioGeoCivil Engineering, 36 (2): 236–45. <https://doi.org/10.1016/j.ecoleng.2008.12.032>.

Underwood, G. J. C. 2001. “Microphytobenthos.” In *Encyclopedia of Ocean Sciences*, edited by John H. Steele, 1770–77. Oxford: Academic Press. <https://doi.org/10.1006/rwos.2001.0213>.

Wentworth, Chester K. 1922. “A Scale of Grade and Class Terms for Clastic Sediments.” *The Journal of Geology* 30 (5): 377–92. <https://doi.org/10.1086/622910>.