

FINAL REPORT PROGRAM LEFE

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| Program LEFE/CYBER | Project Title Microphytobenthos dynamics: a coupled approach 3D numerical modeling/satellite data (MIMOSA) | Years 2016 – 2017 |
| PI name, email and lab: LE FOUEST Vincent, vincent.le_fouest@univ-lr.fr , Littoral ENvironnement et Sociétés (LIENSs) - UMR 7266 Participating Laboratories : MMS (Nantes University), IFREMER | | Other funding sources : CNRS/EC2CO, CNES, CPER/FEDER, MNESR PhD fellowship |

Context

The low frequency of in-situ measurements in intertidal mudflats precludes any assessment of the effects of environmental changes on the microphytobenthic (MPB) primary production (PP). Storms, winds and temperature variations induce a variability, whose consequences on benthic primary production and export of organic matter to the pelagic system are not known.

Objectives / scientific questions

The objective is to quantify the activity and fate of the MPB PP by combining physical/biological coupled modeling and high resolution satellite data.

Main results

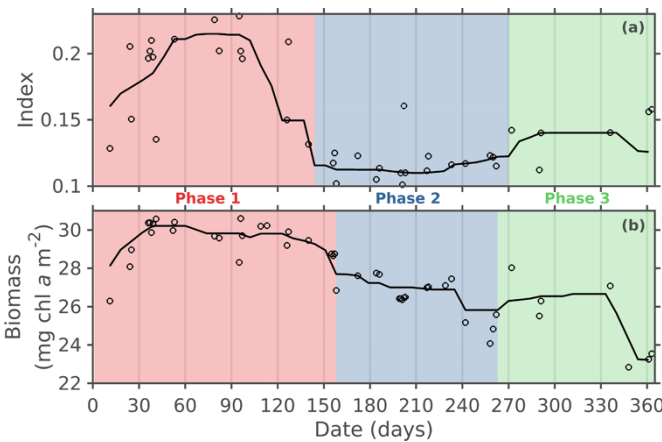


Fig. 1. Seasonal cycle of the 2008 (a) normalised difference vegetation index (NDVI) and (b) simulated daily maximum of the MPB biomass (mg Chl a m^{-2}) in the biofilm. Original extracted data (black circles) are overlaid. The black full lines represent the original extracted data regularised and filtered with running medians (window size = 7). The NDVI was calculated at the pixel corresponding to the study site. Phases were determined according to the amplitude of the sign change of the second-order derivative (Savelli et al., 2018).

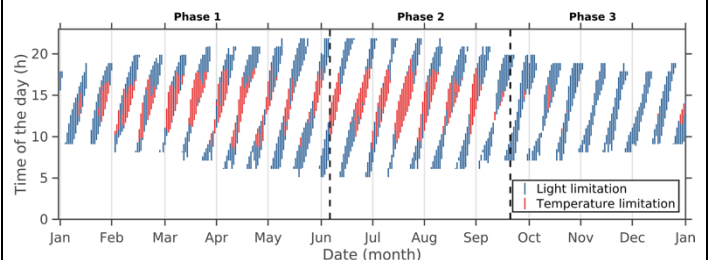


Fig. 2. Simulated time occurrence of the light or temperature limitation of the MPB growth rate over daytime emersion periods in 2008 (Savelli et al., 2018).

Our main results suggest a simulated MPB annual cycle characterised by a main spring bloom, a biomass depression in summer, and a moderate fall bloom, in line with the satellite-based observations (Fig. 1) (Savelli et al., 2018). In early spring, simulated photosynthetic rates are high due to mud surface temperature (MST) values close to the MPB temperature optimum for photosynthesis and because increasing solar irradiance triggers the onset of the MPB spring bloom. Simulated peaks of high *P. ulvae* grazing mostly contribute to the decline of the MPB bloom along with the temperature limitation for MPB growth (Fig. 2). In late spring–summer, the MPB biomass depression is due to the combined effect of thermo-inhibition and a moderate but sustained grazing

pressure. The model ability to infer biotic and abiotic mechanisms driving the seasonal MPB dynamics could open the door to a new assessment of the export flux of biogenic matter from the coast to the open ocean and, more generally, of the contribution of productive intertidal biofilms to the coastal carbon cycle. Other research articles focusing on the simulated export of MPB PP toward the water column and on the 3D behavior of the MPB activity are in preparation.

Future of the project : We initiated a new project to link the mechanistic processes behind the simulated and remotely sensed MPB PP estimates (CNES funding). We investigate the possibility to couple the MPB model to a carbon cycle model in order to simulate MPB-driven CO₂ fluxes on intertidal mudflats.

Nombre de publications, de communications et de thèses

1. Revue à Comité de lecture

Savelli, R., Dupuy, C., Barillé, L., Lerouxel, A., Guizien, K., Philippe, A., Bocher, P., Polsenaere, P., and Le Fouest, V. (2018) On biotic and abiotic drivers of the microphytobenthos seasonal cycle in a temperate intertidal mudflat: a modelling study, *Biogeosciences*, 15:7243-7271, doi.org/10.5194/bg-15-7243-2018

2. Communications

Savelli, R., Cugier, P., Polsenaere, P., Méléder, V., Lavaud, J., Barnett, A., Dupuy, C., and Le Fouest, V. (2019) Physical-biological coupled modelling for mapping microphytobenthos primary production on a temperate intertidal mudflat, ASLO 2019 Aquatic Sciences Meeting, 23 February - 2 March 2019, San Juan, Puerto Rico. Poster

Savelli, R., Bertin, X., Orvain, F., Gernez, P., Dalle, A., Coulombier, T., Pineau, P., Lachaussée, N., Polsenaere, P., Dupuy, C., and Le Fouest, V. (2019) From chronic to massive resuspension mechanisms of microphytobenthos on a temperate intertidal mudflat, A modelling study ASLO 2019 Aquatic Sciences Meeting, 23 February - 2 March 2019, San Juan, Puerto Rico. Talk

Savelli, R., Dupuy, C., Barillé, L., Lerouxel, A., Orvain, F., Guizien, K., Bocher, P., Philippe, A., Cugier, P., Polsenaere, P., Le Moine, O., and Le Fouest, V. (2018) Drivers of microphytobenthos (MPB) seasonal cycle on a temperate intertidal mudflat: A modelling approach, British Phycological Society 66th Annual Meeting, Essex (UK), January 8-11, 2018. Talk.

Savelli, R., Dupuy, C., Barillé, L., Lerouxel, A., Orvain, F., Guizien, K., Bocher, P., Philippe, A., Cugier, P., Polsenaere, P., Le Moine, O., and Le Fouest, V. (2017) Drivers of microphytobenthos (MPB) seasonal cycle on a temperate intertidal mudflat, Congrès international AMEMR (Advances in Marine Ecosystem Modelling Research), Plymouth, July 3-6, 2017. Talk.

Savelli, R., Dupuy, C., Polsenaere, P., Le Moine, O., Barillé, L., Méléder, V., Gernez, P., Lerouxel, A., Brenon, I., Cugier, P., Orvain, F., Guizien, K., Bocher, P., Philippe, A., and Le Fouest, V. (2017) Dynamique spatio-temporelle du microphytobenthos des vasières intertidales : une approche couplée modélisation/images satellitaires, Journée thématique du PNTS, CNES, Paris, 16 mars 2017. Poster.

Savelli, R., Dupuy, C., Polsenaere, P., Le Moine, O., Guizien, K., and Le Fouest, V. (2017) Modélisation de la dynamique spatiale et temporelle du microphytobenthos sur les vasières intertidales: rôle de la température du sédiment, Journées des Marsiens, Ifremer, Brest, 21-22 mars 2017. Talk.

Savelli, R., Dupuy, C., Polsenaere, P., Le Moine, O., Barillé, L., Méléder, V., Gernez, P., Lerouxel, A., Cugier, P., Orvain, F., Guizien, K., Bocher, P., Philippe, A., and V. Le Fouest, V. (2017) Cycle saisonnier du microphytobenthos (MPB) sur une vasière intertidale de région tempérée, Journées scientifiques de l'Université de Nantes, Nantes, 2 juin 2017. Talk.

Savelli, R., Dupuy, C., Barillé, L., Lerouxel, A., Orvain, F., Guizien, K., Bocher, P., Philippe, A., Cugier, P., Polsenaere, P., Le Moine, O., and Le Fouest, V. (2017) Modélisation de la dynamique spatiale et temporelle du microphytobenthos sur les vasières intertidales des Pertuis Charentais, Journées des doctorants de l'Ifremer, Nantes, 17 octobre 2017. Talk