

Hydro-biogeochemical modelling of the tributaries of the Bay of Brest to better understand coastal eutrophication

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Coastal socio-ecosystems depend on terrestrial riverine inputs, which act as vectors for anthropogenic pressures and uses occurring in contributing watersheds. Understanding the dynamics of these inputs at a local scale is essential to develop sustainable management strategies with local stakeholders and to prevent coastal water quality deterioration for guiding coastal socio-ecosystems toward sustainability.

The Bay of Brest (Brittany, France) is an interesting pilot site that experiences increasing eutrophication events despite decreasing nutrient loads associated with agricultural and urban pressures [1], impacting local ecosystems and economic activities. A methodology coupling observations and modelling is proposed to capture the spatial and temporal variability of biogeochemical processes and investigate their role in nutrient transfers to the bay.

We analyze watershed hydro-biogeochemistry using the pyNuts-Riverstrahler model for the recent period (2010–2023). This model simulates water fluxes (discharges, water withdrawals, dams) and the associated concentrations of carbon and nutrients (N, P, and Si) throughout the entire river network, with a kilometer-scale spatial resolution. Simulations are conducted on the three river systems discharging into the bay, providing insights into nutrient dynamics for watersheds with distinct characteristics (Fig.1). Budgets of these inputs are established to estimate eutrophication potential, quantify seasonal variations, and identify spatialized key nutrient sources.

The results enhance our understanding of land-to-sea transfers, supporting sustainable watershed and coastal management. Further research will couple river models to physical-biogeochemical and ecological models of the Bay of Brest to achieve a complete land-sea modelling chain.

[1] Ragueneau, O., Raimonet, M., Mazé, C., Coston-Guarini, J., Chauvaud, L., Danto, A., Grall, J., Jean, F., Paulet, Y.-M., & Thouzeau, G. (2018). The Impossible Sustainability of the Bay of Brest? Fifty Years of Ecosystem Changes, Interdisciplinary Knowledge Construction and Key Questions at the Science-Policy-Community Interface. *Frontiers in Marine Science*, 5, 124. <https://doi.org/10.3389/fmars.2018.00124>

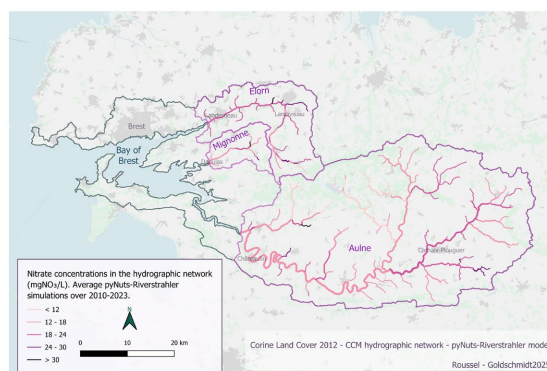


Figure 1 - Map of the Aulne, Elorn, and Mignonne watersheds. Average NO₃ concentrations simulated by the pyNuts-Riverstrahler model for each kilometer point of the hydrographic network over the period 2010-2023.