

Modelled benthic biogeochemical recovery following physical sediment disturbances in the Loire estuary (France)

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Estuaries are highly dynamic environments subjected to natural or anthropogenic disturbances affecting benthic compartment. Specifically, periodic high-energy flood events can erode sediments previously settled, but they can also generate deposits characterized by large sediment input from terrestrial source. These disturbances have major effects on benthic biogeochemical stability. Previous works in the Loire estuary (France, East Atlantic coast) demonstrated that the steady state of the early diagenetic sequence is frequently interrupted or modified in response to such disturbances. In addition to pore water chemical analyses, transient state modelling allows high temporal resolution description of gradients recovery and brings new insights on scenarios for physical disturbances not registered through sampling efforts. In 2021, three sampling campaigns were performed during different hydrological conditions including a decennial flood and low discharge conditions allowing hypoxia in the Loire Estuary. Analysis of the data collected showed clear transient states in early diagenetic processes in response to an erosional event that occurs during the winter flood and a 30 cm deposition event when the flow diminished. As the recovery of all geochemical gradients was not observed, the modelling approach can fill the gaps between the sampling times by computing porewater gradients and fluxes across the sediment-water interface over the entire hydrological cycle allowing better estimates of the benthic compartment to oxygen uptake and pelagic nutrient bioavailability. The FESDIA v1.0 diagenetic model was therefore applied to simulate the observed transient conditions caused by these disturbance events. The results of dynamic modelling of transient states of benthic biogeochemical processes with respect to environmental parameters (T°C, salinity, dissolved oxygen concentration) will be presented, and the modelling outputs will be compared with high-frequency bottom water measurements collected at a relevant monitoring station. The response of the sediment to the shift in quality and quantity of organic matter triggered by these events will be highlighted, and the distributions of dissolved oxygen, ammonium, nitrate, manganese, iron and phosphorus will all be considered. Our work, as part of the “LIFE 2019 IPE/FR/000007 REVERS’EAU” project, will allow to better