

Dear editors,

This manuscript investigates how organic matter (OM) sources and human-induced perturbations influence OM degradation in the highly dynamic and heavily dredged estuarine system of the Port of Rotterdam. The authors address an important and timely question about shifts in OM provenance and oxygen exposure, especially through dredging and subaerial sediment handling, and consequences on carbon mineralization and potential CO<sub>2</sub>/CH<sub>4</sub> emissions. The study is well motivated given the disproportionate role of estuaries in the global carbon cycle and the current uncertainty associated with their response to anthropogenic disturbance.

The authors present a comprehensive dataset. The multi-proxy approach is a strong asset and clearly demonstrates spatial variability in OM sources along the salinity gradient, as well as consistent differences in reactivity between marine (more labile) and riverine/terrestrial (more refractory) OM. A key contribution of the manuscript is the demonstration that perturbation and associated oxygen exposure substantially enhance OM degradation rates, by a factor of two to three, highlighting a carbon-cycle impact of dredging that is often overlooked.

The manuscript is clearly written, the methods are rigorous, and the results support the conclusions. Some aspects could be clarified further, such as the limitations of using freeze-dried sediments for subaerial incubations or the quantitative implications for carbon budgets at system scale.

Overall, this is a valuable and well-constructed study that provides meaningful insights into OM dynamics in disturbed estuarine environments. I therefore support publication in its current form.