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Influence of hypoxia on benthic oxygen consumption in the Lower St. Lawrence Estuary, Canada

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Time-series measurements of dissolved oxygen in the Lower St. Lawrence Estuary (LSLE), a deep coastal environment, have highlighted the development of a persistent hypoxic zone ([O_2] < 62.5 μmol L-1) since the mid-1980s. In parallel, the composition and activity of benthic macrofauna (bioturbation, bioirrigation) changed. As oxygen is the thermodynamically most favorable electron acceptor used by marine microorganisms for the mineralization of sedimentary organic matter and the oxidation of chemical species resulting from anaerobic respiration (Mn(II), Fe(II), NH4+, HS-), a change in bottom water oxygen concentrations could deeply affect benthic oxygen uptake rates. In order to elucidate the consequences of hypoxia on benthic oxygen uptake and in order to identify factors that control benthic oxygen uptake rates, a large dataset (n=99), containing diffusive and total oxygen uptake rates measured over more than 30 years, was analyzed using different statistical tools. Despite varying bottom-water oxygen concentration, organic matter reactivity, and significant change in organic carbon accumulation rate along the Laurentian Trough, oxygen uptake rates display more intra-station variability (1 to 100 m) than inter-station (ten to hundred km) variability. Nevertheless, individual oxygen uptake rates can clearly be assigned to each station by cluster analysis. The oxygen uptake rates do not vary in a clear function of bottom-water oxygen concentrations in the observed range of (140 to 50 μmol L-1), but are a complex function of temperature, oxygen concentration, organic carbon accumulation rate and reactivity. It would appear that the benthic communities have either adapted to the low oxygen concentrations or the concentrations are still above a critical threshold that would result in important changes.