Temporal evolution of the oxygen depletion in the bottom water of the Lower St. Lawrence Estuary: from 1930 to 2100

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Historical records reveal that the dissolved oxygen concentration has progressively decreased in the bottom water of the Lower St. Lawrence Estuary (LSLE) during the last century and reached the severe hypoxic threshold in the 1980s where it has hovered ever since. We recently demonstrated that the physics of the system, both benthic and pelagic respirations, as well as the modification of chemical properties of the water mass entering the Laurentian Channel (originating from the North Atlantic Ocean), are the main causes of the oxygen depletion in the LSLE. Climate models forecast a strong deoxygenation of the subsurface water in the North Atlantic Ocean over the next century, that may further decrease the oxygen supply into the Laurentian Channel. We used four climate scenarios (rcp2.6, rcp4.5, rcp6.0 and rcp8.5, labeled according to the additional radiative forcing level in 2100 with atmospheric CO2 concentrations reaching 421, 538, 670 and 936 ppm respectively) to estimate the oxygen concentration in the North Atlantic Ocean and at the entrance of the Laurentian Channel. By applying these estimated oxygen concentrations at the boundary condition of a bidimentional model validated for the 2002-2011 period, we forecast the evolution of hypoxia in the LSLE. We also estimate the contribution of the physics of the system, respirations and chemical properties of the source water to the oxygen depletion.

Coupled cycling of Fe and C_{org} in submarine hydrothermal systems: Modeling approach.

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We investigated the fate of dissolved Fe released from hydrothermal systems to the overlying ocean using an approach that combined modelling and field values. We based our work on a consensus conceptual model developed by members of SCOR-InterRidge Working Group 135. This model was both complex enough to capture the main processes of dissolved Fe release from hydrothermal systems and chemical transformation in the hydrothermal plume, and simple enough to be parameterized with existing field data. It included the following flows: Fe, water and heat in the high-temperature vent fluids, in the fluids diffusing around the vent, and in the entrained seawater; Fe precipitated in sulfides near the vent, and in particles onto the sea bottom away from the vent; and Fe dissolving into deep-sea waters. Through trials and errors, we transformed the conceptual model into equations, which were parameterized with field data. We used the resulting set of equations (model) to explore various scenarios of Fe emissions and transformations. The modelling exercises suggested that hydrothermal systems may play significant roles in the global biogeochemical Fe cycle.