Evaluating hypoxia risk in the Gironde estuary (SW France) based on high-frequency monitoring

SABINE SCHMIDT[1], HERVÉ DERRIENNIC[1] AND PASCAL LEBLEU[1]

[1]UMR5805 EPOC, Université de Bordeaux, OASU, 33615 Pessac. sabine.schmidt@u-bordeaux.fr

Hypoxia is at present among the main economic and environmental issues in coastal and transitional waters. The worldwide increase of hypoxia is usually ascribed to eutrophication due to anthropogenic activities. Here we present spatio-temporal changes in dissolved oxygen (DO) in the Gironde estuary, one of the largest European estuaries. This macrotidal system is characterized by a well-developed turbidity maximum, with particle load typically of several grams per litre, preventing light penetration and primary production. However, borderline DO concentrations have been already measured in the upper Gironde estuary. Assessing the future risk of hypoxia on such a large estuarine system is complex and requires reliable observations in order to understand the multi-scale drivers of temporal DO variations. Here we show the interest of a high-frequency, multi-year and multi-site monitoring (MAGEST), which records every 10 min, since 2005, temperature, salinity, turbidity and dissolved oxygen (DO) in surface waters. The lowest measured DO concentration is 1.2 mg L^{-1} on 17 July 2006. Anyway, hypoxic DO levels (< 2 mg L^{-1}) were rarely measured over the period 2005-2016. The 12-year record covers contrasted range of hydrological and meteorological conditions, which have induced large differences in discharge, temperature, and not surprisingly in DO. On annual time scale, temperature is the main controlling factor of the largest DO changes in the Gironde estuary, followed by discharge and turbidity. On seasonal timescale, DO concentration appears as the result of a complex interaction between different environmental drivers (temperature, fluvial discharge, turbidity, tidal cycles, urban input). Regarding the risk of hypoxia, summer is the most critical period due to the combination of warm water, low fluvial discharge and high particle load. Ongoing regional changes (increase in temperature and population, decrease in river discharge) suggest the establishment of summer chronic oxygen deficiency in the next decades.