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Anoxic metabolism after the 21st century in oxygen minimum zones

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Global models project a decrease of marine oxygen over the course of the 21th century. The future of marine oxygen becomes increasingly uncertain further into the future after yr 2100 , partly because ocean models differ in the way organic matter remineralisation continues under oxygen- and nitrate-free conditions. Using an Earth system model of intermediate complexity we found that under a business-as-usual CO2-emission scenario ocean deoxygenation further intensifies for several centuries until eventually ocean circulation re-establishes and marine oxygen increases again. (Oschlies et al. 2019, DOI 10.1038/s41467-019-10813-w).

In the Pacific Ocean the deoxygenation after yr 2100 goes along with the large scale loss of nitrate from oxygen minimum zones. Here we explore the impact on simulated ocean biogeochemistry of three different process formulation of anoxic metabolism, which have been used in other ocean models: (1) implicit sulphate reduction (organic matter degradation continues without oxidant), (2) no sulphidic metabolism (organic matter is not degraded under anoxic conditions), and (3) explicit sulphate reduction (with H2S as explicit model tracer). The model with explicit sulfphate reduction supports larger regional organic matter fluxed into the deep ocean and an increase in respired carbon storage, compared with the model applying implicit sulphate. We discuss the impact of anoxic metabolism on the coupling between export production and respired carbon stored in the ocean interior.