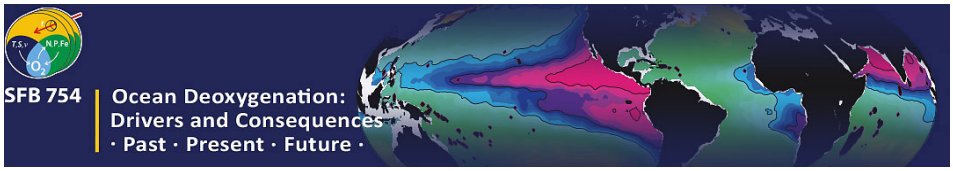

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Elevated marine oxygen inventory by enhanced anaerobic respiration in a warmer future ocean

Tuesday, 4 September 2018 14:45 (15)

A multi-millennial global-warming simulation with an Earth system model of intermediate complexity with fixed phosphorus inventory and driven by business-as-usual CO2 emissions until year 2100 and a linear decline to zero emissions in year 2300 and thereafter, yields a marine oxygen inventory that exceeds the preindustrial oxygen inventory in the simulated warmer future climate, with surface air temperatures about 7°C and mean ocean temperatures about 3°C warmer than pre-industrial. An initial, multi-centennial decline in the oxygen inventory and its subsequent recovery roughly correspond to the rearrangement of the ocean overturning circulation as the ocean warms from the top. The oxygen deficient volume expands threefold on a millennial time scale and shows only a partial recovery to more than twice the pre-industrial volume after a few thousand years. An interior-ocean oxygen source unaccounted for in previous studies stems from enhanced anaerobic remineralisation in expanding oxygen deficient zones: With denitrification replacing some of the current ocean's aerobic remineralization, the resulting net loss of fixed nitrogen is equivalent to a net oxygen gain by the ocean. In our simulation, the ocean's inventory of fixed nitrogen declines by about 17% by the year 8000. The concomitantly avoided aerobic remineralization alone increases oceanic oxygen by 3% over the same time period. Adding physical and biogeochemical effects, the global ocean oxygen inventory simulated by our model in year 8000 is 5% higher than the preindustrial one, despite a more than two-fold expansion of the oxygen deficient volume.

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