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A mechanism to ameliorate ocean deoxygenation by phytoplankton adaptation

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Observations show that dissolved oxygen in the upper ocean has been decreasing over the last decades. While the decline in gas solubility induced by warming is recognized as a main driver of deoxygenation, biological consumption is also a significant driver. Biological consumption of dissolved oxygen depends not only on the amount of organic matter respired but also on how much oxygen is consumed per unit of organic carbon (O_2:C_{rem}). Here, we use two independent methods, one using the gridded nutrient data and another using the satellite derived macromolecular content of phytoplankton to show that global mean O_2:C_{rem} is $\sim$1.4:1 with small spatial variability. This pattern could be explained by the fact that relative abundance of phytoplankton protein universally exceeds those of carbohydrate and lipid. We expect that under a future warming scenario, phytoplankton becomes more carbohydrate rich as the surface oceans become more acidic and nutrient depleted. We suggest there will be a dramatic decrease in O_2:C_{rem} once the carbohydrate content exceeds protein content, which in turn could ameliorate future deoxygenation.