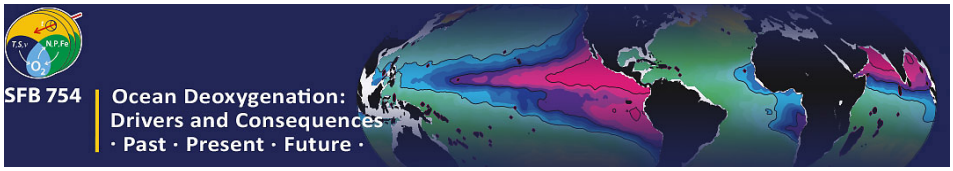

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Constraints on ocean de-oxygenation and warming from atmospheric oxygen observations

Monday, 3 September 2018 09:35 (35)

O2 inventories in the ocean and the atmosphere are linked. As the ocean warms, it loses O2 to the atmosphere. The amount of O2 lost by the ocean could be quantified with the complementary change observed in the atmosphere, using precise atmospheric O2 measurements spanning nearly three decades. This method is not limited by data sparseness, as fast mixing in the atmosphere efficiently integrates the global ocean signal, and could provide an independent constraint on the global ocean O2 loss obtained from hydrographic data. Here, we use atmospheric O2 and C O2 measurements combined into the tracer "atmospheric potential oxygen" (APO) to remove land biosphere influences in atmospheric O2. The signature of ocean changes (solubility, ocean circulation and biological photosynthesis and respiration) in APO is further isolated from the impacts of industrial processes, anthropogenic aerosol deposition etc. We show that a clear positive signal in APO emerges, i.e. the global ocean response to climate change has unambiguously led to a net ocean outgassing of O2 and CO2. We use this observed ocean-driven change in APO to evaluate ocean de-oxygenation and discuss the uncertainties related to this method that implicitly assumes a carbon-to-heat ratio in the ocean. Hydrographic observations and Earth system models indicate, however, that this ocean-driven APO signal is largely dominated by solubility changes, and is therefore a good proxy of the global change in ocean heat content. Using this tight link between APO and heat, we provide a much-needed independent constraint on the ocean heat uptake, at the high end of previous in-situ temperature based estimates (1.41 ± 0.36 x 1022 J /y since 1991).

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