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Detecting future changes in ocean circulation from atmospheric oxygen

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Climate models suggest that the climate changes projected for this century will impact the circulation of the world's oceans. The models project that the ocean surface will warm and stratify, and the Meridional Overturning Circulation will be reduced. These changes will be maximum at high latitudes. Here we analyze modelled oceanic fluxes of O_2, CO_2, and heat to describe how these fluxes behave with respect to other oceanic parameters such as Sea Surface Temperature, Heat Content, and Mixed Layer Depth in a climate change perspective. In particular, we test the potential for oxygen fluxes to detect changes in the ocean circulation and its implication on the carbon cycle. Oxygen fluxes and carbon dioxide fluxes have been combined in a new tracer called Atmospheric Potential Oxygen (APO). APO is defined as APO = O_2 + 1.1*CO_2 and is not affected by exchanges of the terrestrial biosphere. We analyze long time series of oceanic fluxes from a coupled climate model and atmospheric concentration using a tracer transport model. We look at the differences between present conditions and future scenarios of concentration of atmospheric tracers in order to quantify the natural variability in seasonal and interannual APO variations and extract potential trends caused by climate change. We show that the modelled atmospheric signal is able to detect changes in ocean physics, in particular changes in surface stratification. The model results show oxygen outgassing from the ocean in future climate change scenario.