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Physically driven Patchy O_2 Changes in the North Atlantic Ocean simulated by the CMIP5 Earth System Models

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Centennial trends of oxygen in the upper 700 m of the North Atlantic Ocean are investigated in Earth System Models (ESMs) included in the Coupled Model Intercomparison Project Phase 5. The focus is on the subpolar region, which is key for the oceanic uptake of oxygen and carbon dioxide. Historical simulations covering the twentieth century and projections for the twenty-first century under the Representative Concentration Pathway 8.5 scenario are investigated. Although the representation of convective activity differs among the models in space and strength, and most models have a cold bias south of Greenland resulting from a poor representation of the pathway of the North Atlantic Current, the observed climatological distribution of dissolved O_2 averaged for the recent past period (1975-2005) is generally well captured. By the end of the 21st century, all models predict an increase in depth-integrated temperature of 2-3^{o}C, a consequent solubility decrease, a weakening of the vertical mass transport, a decrease in nutrient supply into the euphotic layer, and a spatially variable change in apparent oxygen utilization (AOU). Despite an overall tendency of the North Atlantic to lose oxygen by the end of twenty-first century, patchy regions of O_2 increase are observed in a subset of models. This regional resistance to deoxygenation is explained by the weakening of the North Atlantic Current that causes a regional solubility increase exceeding the effect of increasing stratification. Our results imply that potential shifts in the North Atlantic Current play a crucial role in the future projection of the regional oxygen concentration in the warming climate.