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# Regional Efficacy of Ocean Heat Storage under a $CO_2$ Quadrupling

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By storing and transporting heat, the ocean plays an important role on climate change and variation. When Earth's surficial environment warms as a result of increasing atmospheric concentrations of greenhouse gases, the ocean absorbs heat from the atmosphere and stores it deep in the ocean leading to a reduced atmospheric warming. This study aims to investigate basin-wide regional efficacy of ocean heat storage induced by a quadrupling of atmospheric carbon dioxide concentration and estimate basin-scale contributions to world ocean heat storage. We used multi-model climate simulation datasets submitted to the Coupled Model Intercomparison Project-phase 5 for the idealized abrupt4x$CO_2$ experiment. For the multi-model median at years 110 to 140, the Pacific Ocean stored about 35% of total ocean excess heat, more than any other basin. Redistributing the heat energy to depth, the Pacific Ocean contributed approximately 40% of the world ocean's heat storage up to 700 m, about 30% for 700 to 2000 m, and 20% for the depth below 2000 m. Heat storage efficacy, defined as heat storage per unit surface area of each basin was , the greatest in the Atlantic Ocean and the lowest in the Arctic Ocean. From the surface to 2000 m depth, the Atlantic Ocean showed the greatest heat storage efficacy while in the depth below 2000 m, the Southern Ocean showed the greatest efficacy. A considerable inter-model spread in heat storage efficacy was revealed in the Arctic Ocean, indicating a major uncertainty relevant to projections of future Arctic sea ice change. These heat storage efficacies at basin scales may in part be a consequence of ocean stratification associated with ocean warming and freshening in the Pacific and Southern Oceans and the weakening of Atlantic meridional overturning circulation.