

Wind-buoyancy dichotomy of the Southern Ocean carbon storage

ITO, Takamitsu^{1*} ; TAKANO, Yohei¹ ; DEUTSCH, Curtis²

¹School of Earth and Atmospheric Sciences, Georgia Institute of Technology, ²School of Oceanography, University of Washington

We use a hierarchy of ocean climate-carbon models to investigate the future scenarios of the Southern Ocean carbon storage. Intensified and poleward-shifted westerly wind is hypothesized to enhance the upwelling of deep water and thermocline ventilation, which may be counteracted by the warming and freshening of the surface waters. We analyze the solubility and biological carbon pumps in the Southern Ocean as simulated by the Climate Model Inter-comparison Project phase 5 (CMIP-5) models. Model-model differences in the regional carbon storage are significant, $O(100\text{PgC})$, reflecting the organized changes in the two carbon pumps. To investigate the underlying mechanisms, we perform a suite of numerical sensitivity experiments using an ocean biogeochemistry model, where we purposefully impose (1) a global warming of sea surface temperature, (2) an intensification of freshwater forcing and (3) an increase in the Southern Ocean wind. Comparing the simulated patterns of carbon and oxygen changes, we find that the future increase in the biological carbon storage is likely due to the warming and freshening of the surface water dominating over the increasing wind.