# A study of ocean circulation using a tracer in a high resolution model

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Oceanic uptake of anthropogenic carbon dioxide ($CO_2$) is important because $CO_2$ is considered the major greenhouse gas. Physical processes such as advection and diffusion in the ocean are key to determining the magnitude of this uptake. Because past studies used coarse resolution models to estimate this uptake, the role of western boundary currents and eddies in the oceanic carbon cycle has not been elucidated.

In this tracer study, we use a high-resolution ocean general circulation model (OGCM) to investigate the role of middle-scale phenomena, especially eddy processes, on the distribution of tracers. The ocean circulation model is the JAMSTEC high-resolution OGCM with a fine grid of 1/4 degree in the horizontal and 55 levels in the vertical. We apply atmospheric forcing from the monthly mean Hellerman and Rosenstein [1982] wind stress and relaxation of surface temperature and salinity to Levitus [1982]. The quasi-equilibrium state of the model ocean circulation after 30 years time integration is used as an initial state for this tracer study. The tracer is initialized as an idealized tracer uniformly stratified from one at the sea surface to zero at the bottom (6000 m). We apply this simple distribution to investigate tracer movement, especially vertical displacement by general circulation and eddies. The tracer's concentration is damped to its initial value at the sea surface with a timescale of 30 days. We have completed the tracer study for 20 years. The computed distribution of the tracer reflects the large scale ocean circulation from the model. It clearly shows the upwelling in the subpolar and equatorial regions and in the Southern Ocean as well as the downwelling in subtropical regions. It also suggests that the tracer is strongly influenced by the western boundary currents (the Kuroshio and the Gulf Stream) and by the eddies south of Africa.