Supplementary Materials for

Southern Ocean dominance and basin asymmetry in centennial-scale bottom-water return

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This PDF file includes:

Figs. S1 to S5

Supplementary Figures

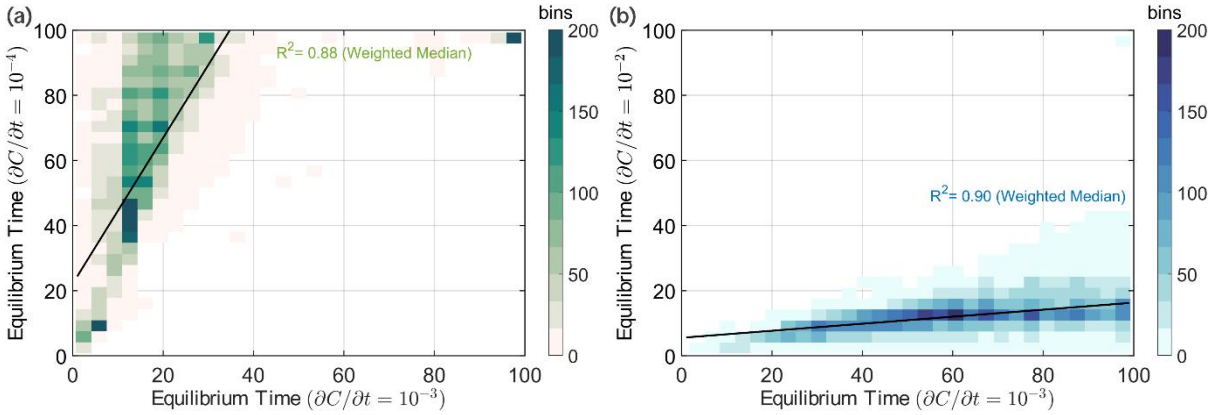

Figure S1 Sensitivity of the diagnosed bottom-water equilibrium time to the concentration-tendency threshold ($\partial C/\partial t$). Each panel shows a two-dimensional binned scatter comparison between equilibrium times diagnosed with the baseline threshold of 10^{-3} on the x-axis and those diagnosed with an alternative threshold on the y-axis: (a) the more stringent threshold of 10^{-4}, and (b) the less stringent threshold of 10^{-2}. Color shading indicates the number of grid cells in each bin. The solid black line denotes the weighted-median fit to the binned data, and the corresponding R^2 values summarize the consistency of the equilibrium-time structure across different threshold choices.

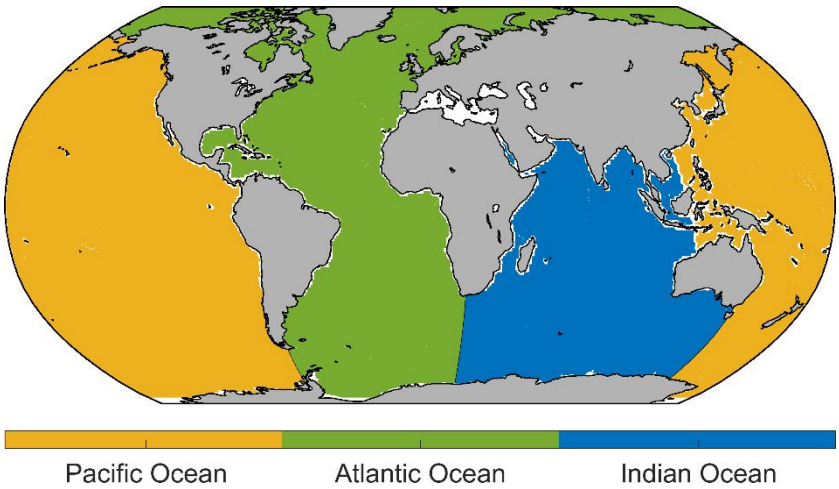

Figure S2 Ocean-basin masks used to partition the global ocean into the Atlantic Ocean (green), Pacific Ocean (yellow), and Indian Ocean (blue). The masks are used throughout the study for basin-scale diagnostics, including zonal-mean diapycnal velocity, bottom-water concentration, concentration-weighted diapycnal fluxes, and water age analyses.

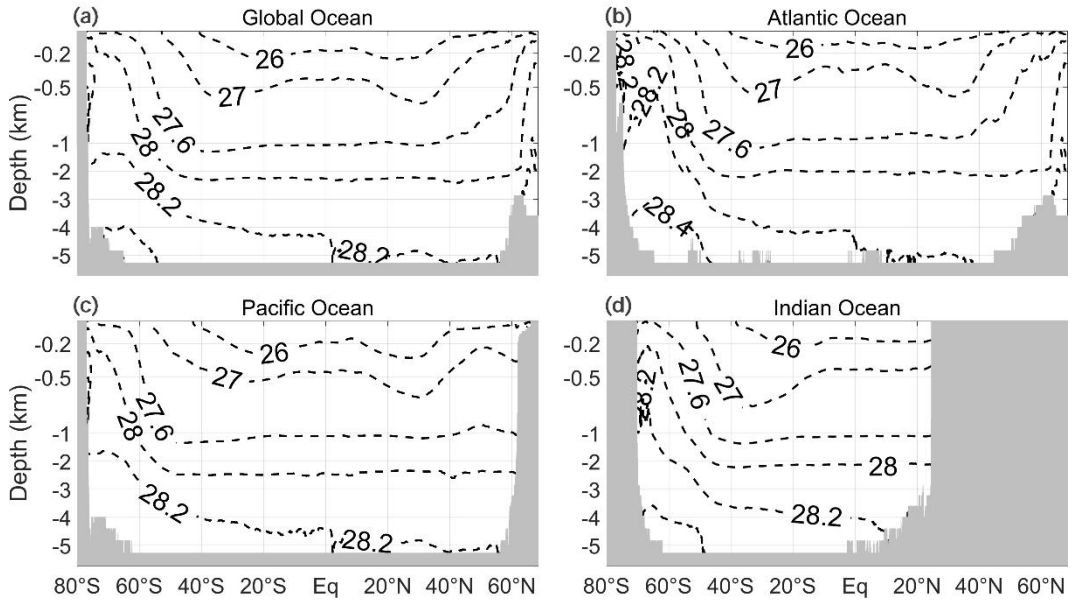

Figure S3 Zonal-mean neutral density (γ^n, kg m^{-3}) from GLORYS12 in depth–latitude coordinates for the (a) global ocean, (b) Atlantic Ocean, (c) Pacific Ocean, and (d) Indian Ocean. This structure provides the isopycnal framework used throughout the study for diagnosing diapycnal motion and bottom-water return pathways.

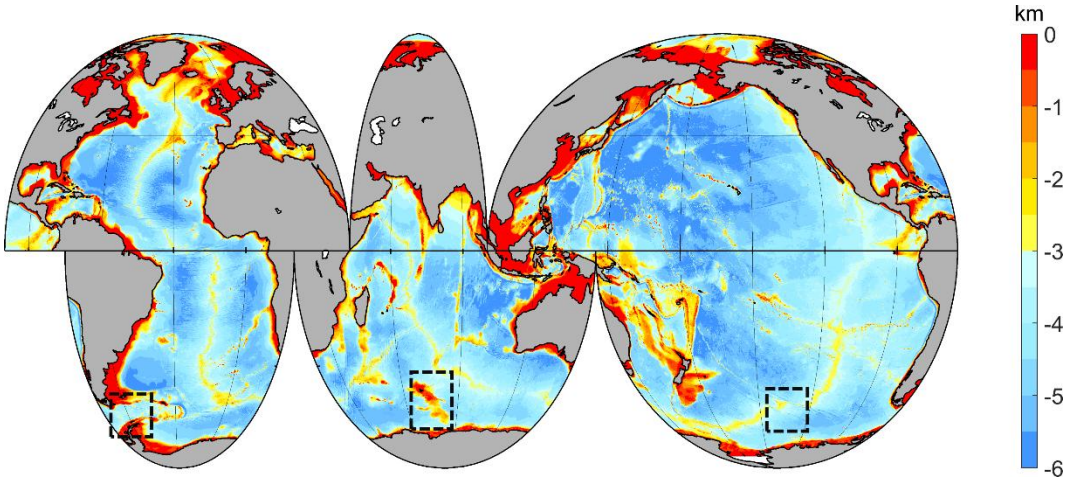

Figure S4 Global bathymetry (km) of the ocean floor. Black dashed boxes indicate the three representative Southern Ocean regions highlighted in Fig. 2a, corresponding to areas near Drake Passage, the Kerguelen Plateau, and the Campbell Plateau where intensified diapycnal exchange signals are identified in this study.

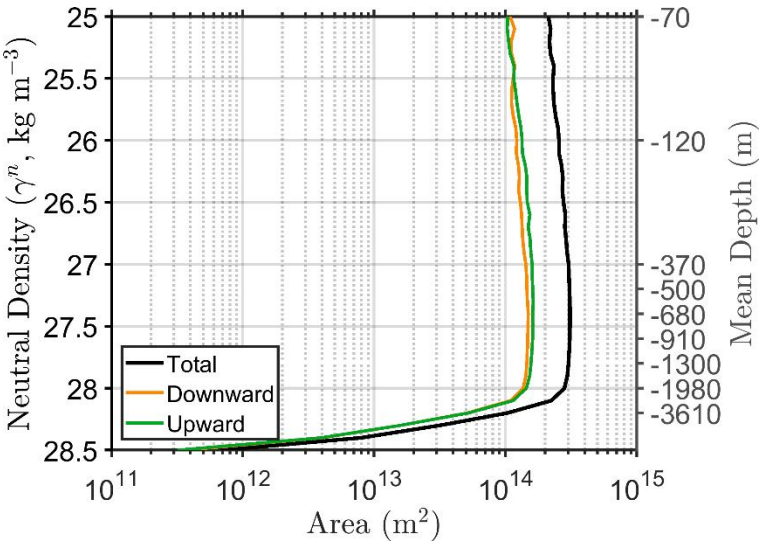

Figure S5 Total area (m^2) of each neutral-density surface (black), together with the areas associated with upwelling fluxes (green) and downwelling fluxes (yellow). The right y-axis indicates the mean depth of the corresponding density surfaces.