Supplement of Biogeosciences, 23, 4037–4056, 2026
https://doi.org/10.5194/bg-23-4037-2026-supplement

Biogeosciences Open Access EGU

Supplement of

Revealing hidden oxygen variability in the North Pacific: a two-decade analysis using GOBAI-O_2

Miho Ishizu and Tomomichi Ogata

Correspondence to: Miho Ishizu (mishizu@pusan.ac.kr)

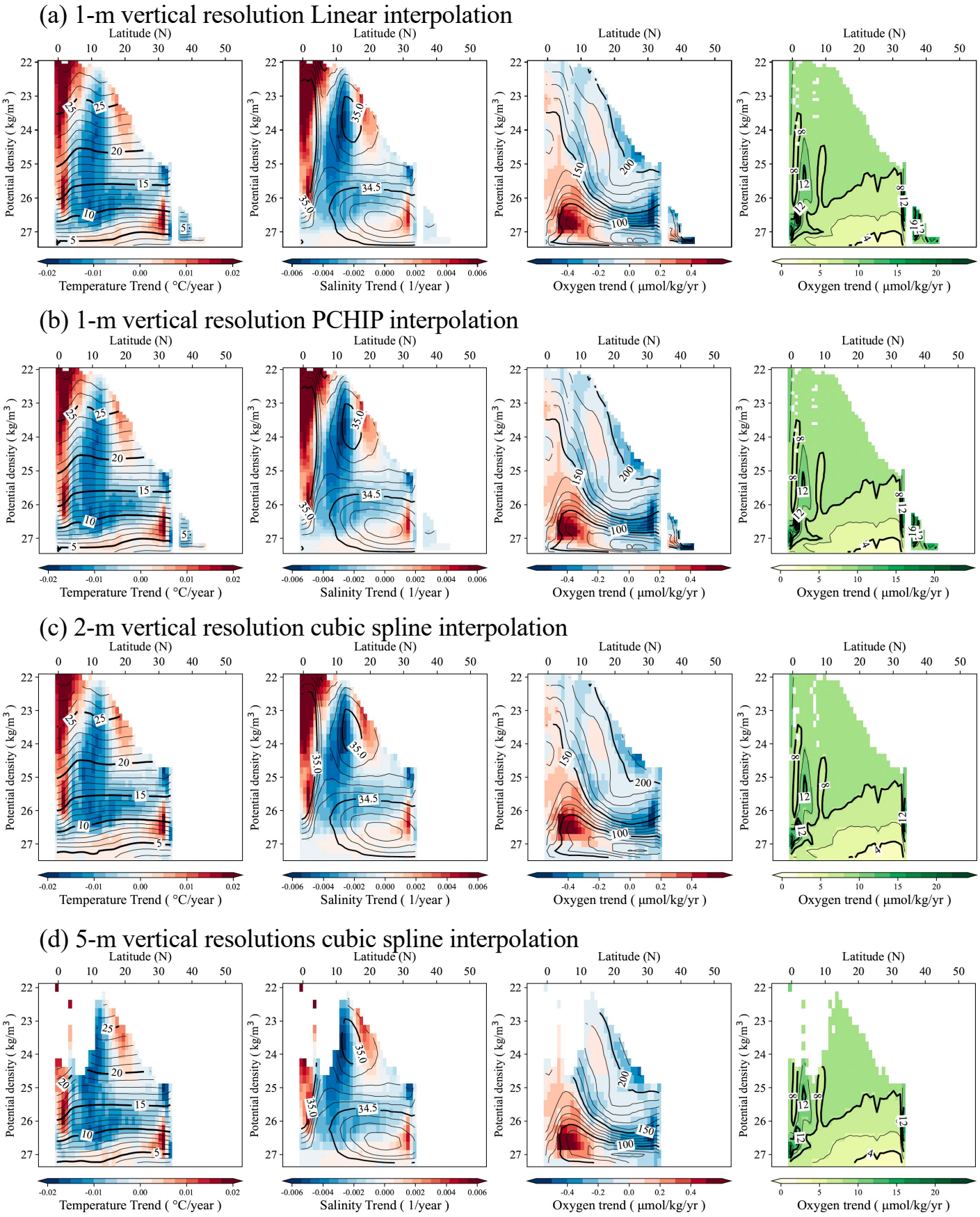

Figure S1. Linear trends in potential temperature, salinity, dissolved O_2 and uncertainty on each isopycnal horizon in 137° E lines. The figures are the same as Figure 4, but using 1° × 1° × 1 m grid data generated data with linear (a) and RCHIP (b) interpolation methods. The 1° × 1° × 2 m and 1° × 1° × 5 m grid data generated data with cubic spline interpolation, respectively. Contour lines represent the mean values during the target observation periods, plotted at density intervals of $0.1\sigma_\theta$ (a, b), $0.25\sigma_\theta$ (c, d) for each 1 deg, respectively.

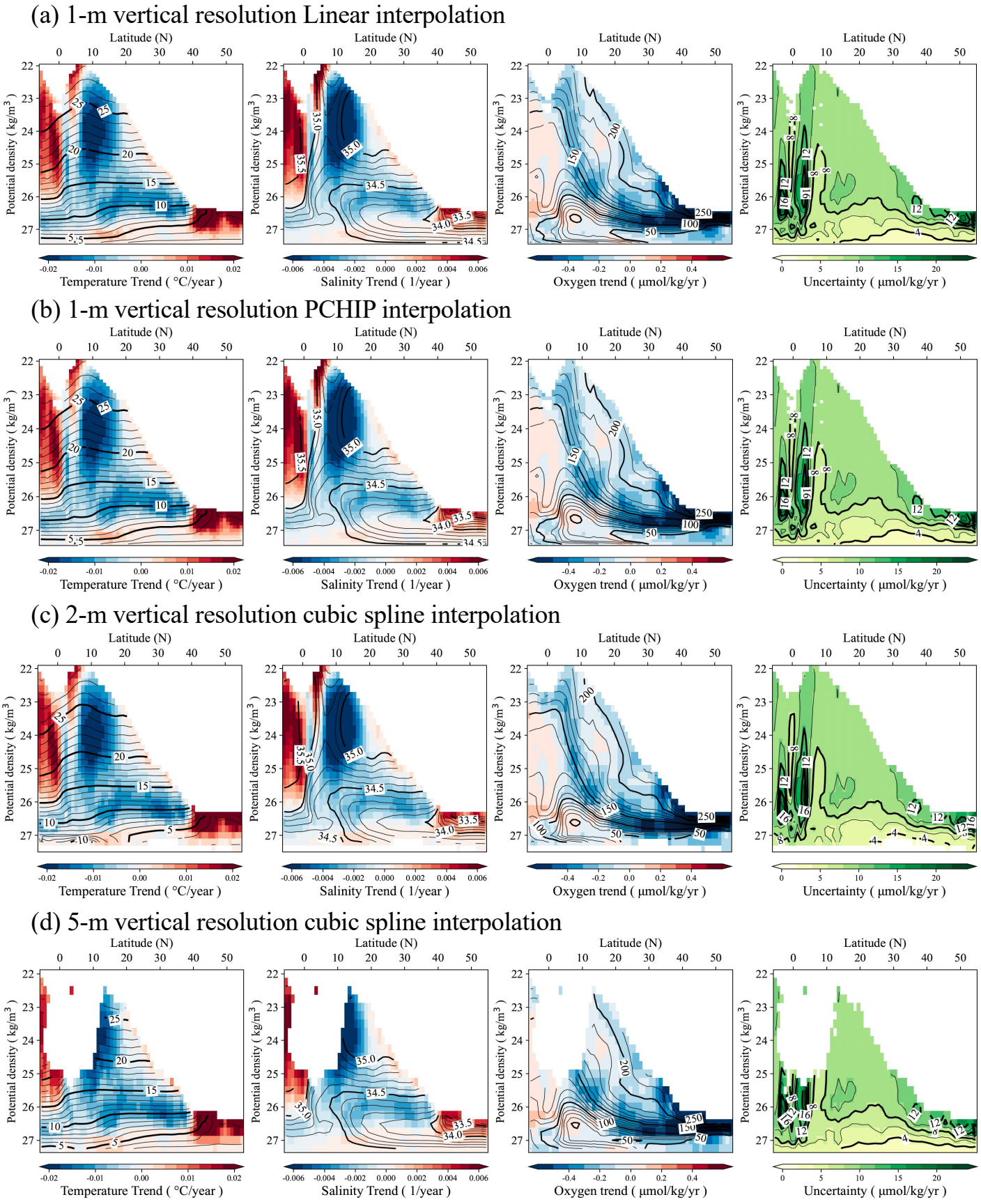

Figure S2. Sams as Fig. S1, but in 165 ° E lines.

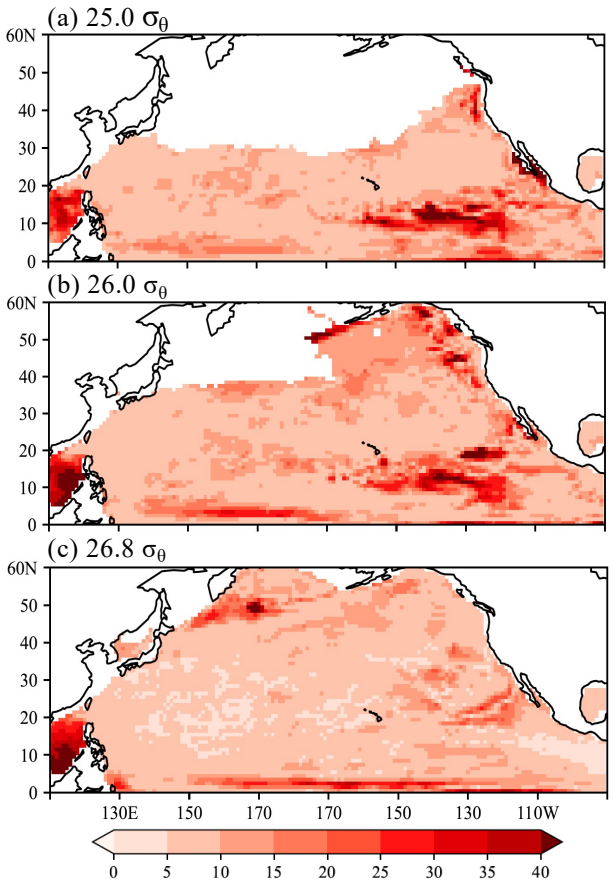

Figure S3. Uncertainty estimates of dissolved oxygen concentration (μmol/kg) along the isopycnal surface of 25.0 (a), 26.0 (b), and 26.8σ_θ (c). The uncertainty data is based on GOBAI-O_2 data [Sharp et al. 2023].

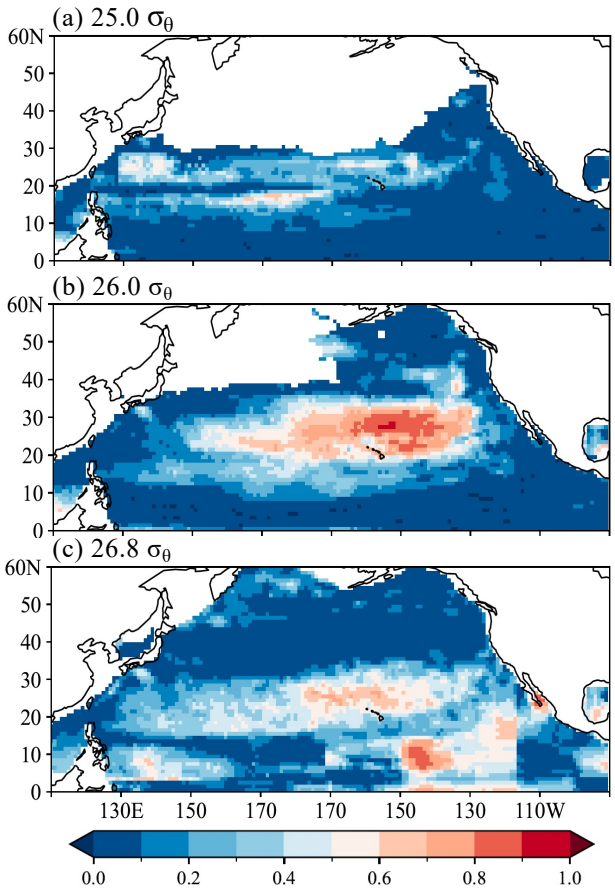

Figure S4. Coefficient of determination for linear regression lines along the isopycnal surface of 25.0 (a), 26.0 (b), and 26.8σ_θ (c).

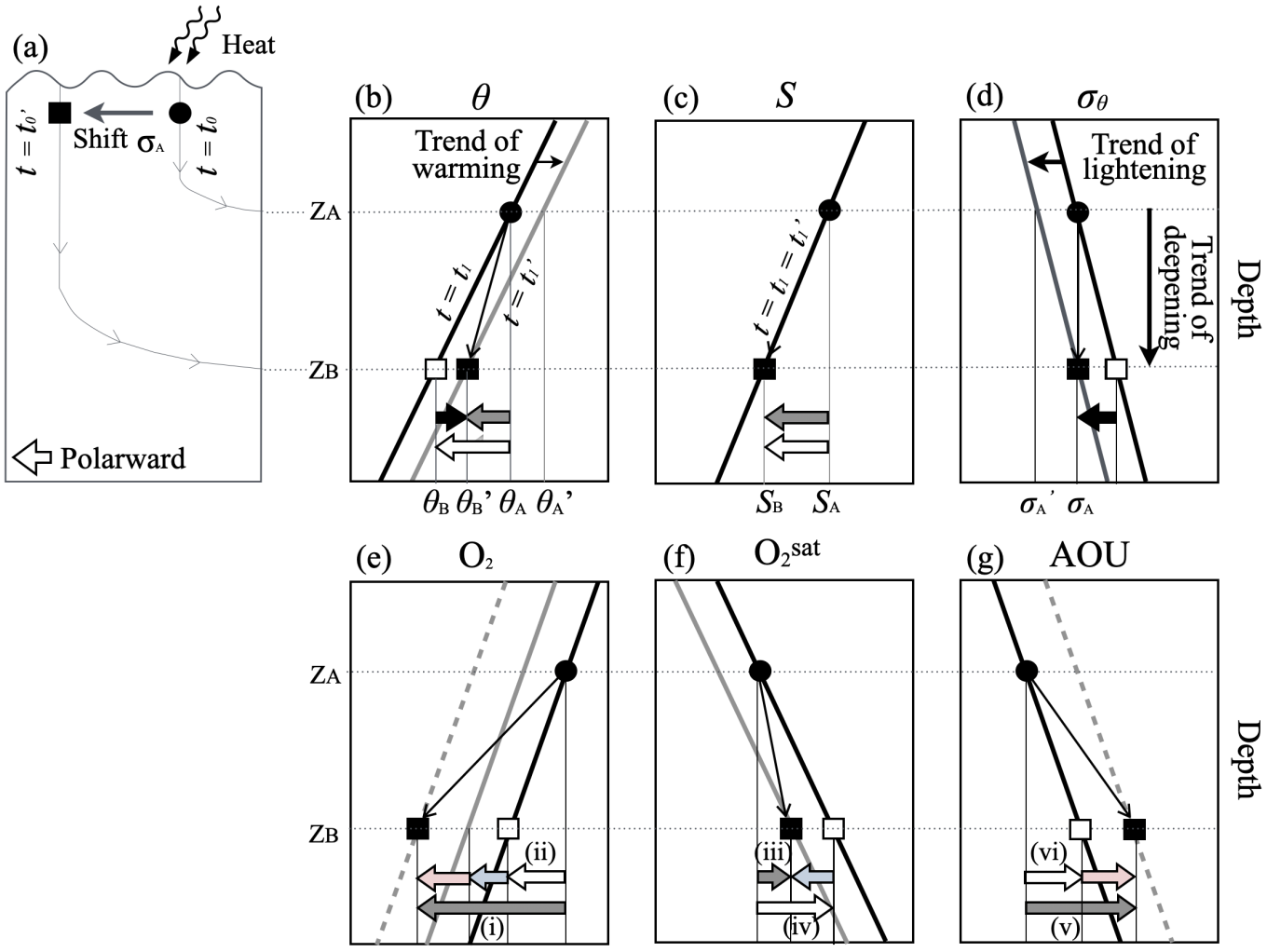

Figure S5. Schematic illustration of the temporal evolution of parameters on a typical (a) isopycnal horizon above a salinity minimum layer: (b) potential temperature (θ), (c) salinity (S), (d) potential density (σ_θ), (e) dissolved oxygen (O_2), (f) oxygen saturation (O_2^{sat}), (g) apparent oxygen utilization (AOU). Thick black (gray) lines indicate the vertical profiles before (after) warming at a time t_1 (t_1'). Dashed gray lines represent profiles after warming, accompanied by a concurrent increase in AOU (e, g). Dotted lines in panel (d) denote the isopycnal horizons considered here. Closed cycles and squares denote water parcels observed at a depth z_A and z_B, respectively, at times between time t_0 and t_1. The time refers to the period between each parcel submergence. Large gray arrows indicate the observed temporal changes along a density horizon ($\partial X/\partial t$), while large white arrows denote apparent changes by the vertical deepening effect ($\partial X/\partial z \cdot \partial z/\partial t$). Large blue and pink arrows in panels (e–g) represent net change (= gray arrow - white arrow). The blue and pink (e–g) arrows with identical patterns indicate identical processes. Arrows labeled with Roman numerals correspond to the respective terms in equation (2). These schematics are after Sasano et al. (2015).

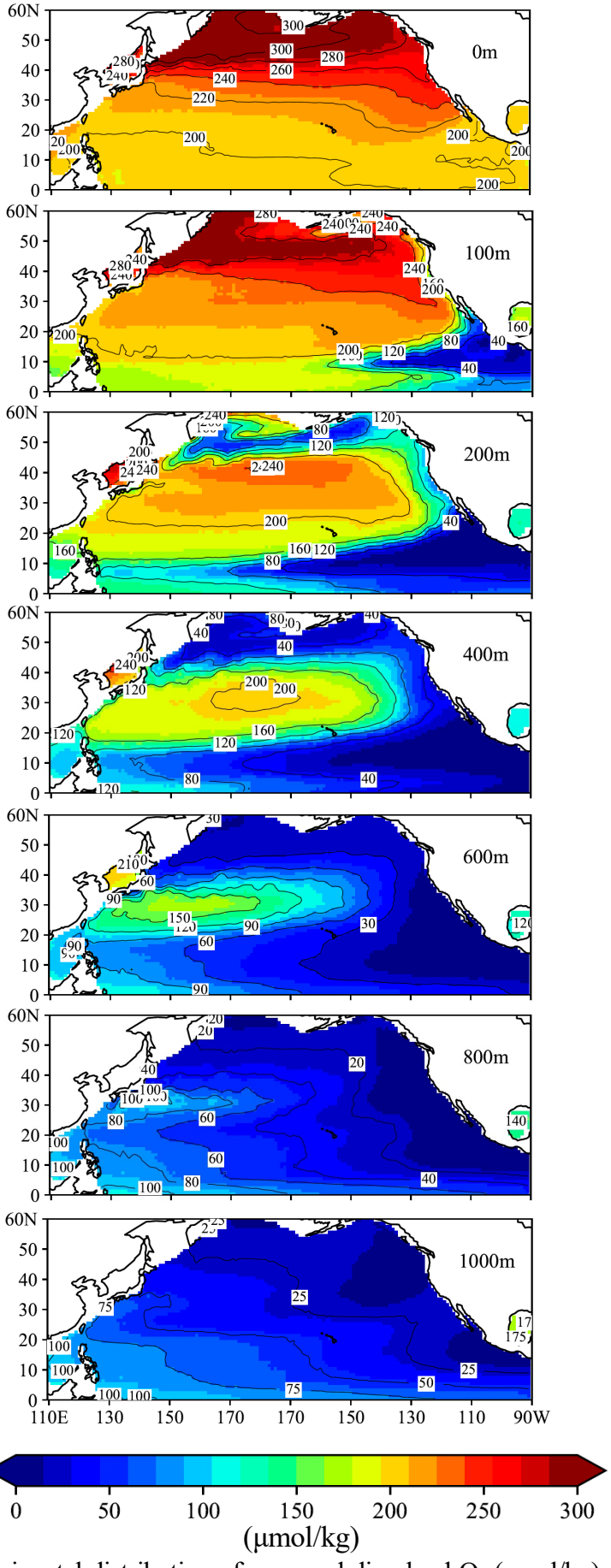

Figure S6. Horizontal distribution of averaged dissolved O_2 (μmol/kg) at depths of 0, 100, 200, 400, 600, 800, and 1000 m, respectively, during 2004–2023.