

Supplementary Figures

Figure S1. Mean state of various properties at the first ~100 km from the slope. The typical characteristics were obtained by averaging areas of $1^\circ \times 1^\circ$ along the coast between the isopycnal layers S_{upper} and S_{lower} over 9 years (See Methods 2.2). (a) absolute salinity, (b) O_2 , (c) N_2O , (d) NH_4^+ , (e) NO_2^- , (f) NO_3^- .

Figure S2. Distribution of water masses and mean state of biogeochemical characteristics within the S_{core} layer. (a) Average conservative temperature and absolute salinity diagram. The water masses in the study area and their typical values are shown according to Silva et al. (2019) (black squares): Subtropical Water (STW; 20°C , 35.2), Subantarctic Water (SAAW; 11.5°C , 33.8), Equatorial Subsurface Water (ESSW; 12.5°C , 34.9), and Antarctic Intermediate Water (AAIW; 3°C , 34). Black contours represent potential density anomalies (the S_{core} is the red line). Relations between AOU and (b) absolute salinity, (c) ΔNO_3^- , and (d) ΔN_2O . Colors specify the subregions that were defined in Figure 1b.

Figure S3. Relationship between the NH_4^+ and O_2 concentrations at the S_{core} layer for all identified Puddies. Color dots corresponding to the mean property at the core of the Puddy (section 2.5) are contrasted with the corresponding mean state (color squares, section 2.3). The colors used to specify regions are the same as in Figure 1b. Vertical error bars show the y-axis standard deviation, whereas the horizontal error bars represent the standard deviation of O_2 .

Figure S4. Mean vertical variance (σ^2), and skewness (σ^3) associated with the terms involved in the O_2 budget within Puddies at the first ~100 km from the slope. (a) XADV, (b) YADV, (c) VADV, (d) HMIX, (e) VMIX, (f) PHYS. Details of the terms are similar to Figure 5. The variance (red line) and skewness (blue line) were calculated for each profile following the same method as used in Figure 2 and averaging along the coast.

Figure S5. Relative vorticity, NO_3^- , NO_2^- and N_2O related to the suboxic (SP) and hypoxic Puddies (HP). (a-d) SP was located at 75.5°W , 25.18°S with a lifespan of ~11.5 weeks, (e-h) HP was located at 76.5°W , 35.8°S with a lifespan of ~21 weeks. Black contours show the isopycnal layers S_{upper} , S_{core} and S_{lower} . The edge of the Puddies is represented by the dotted line (black) with a radii of 83 km (SP) and 73 km (HP). (a,e) Zonal component velocity (white lines) indicates westward flow (dashed line) and eastward flow (solid line). The core

with low O_2 (magenta lines) encloses hypoxia (solid line), suboxia, and anoxia associated with $O_2 < 1 \mu M$ (dashed line). White contours enclose O_2 concentrations of 90 and 120 μM .

Figure S6. Evolution of the O_2 minimum inside the suboxic and hypoxic Puddies during their lifespan.