Supporting Information for "Response of the Southern Ocean overturning circulation to extreme Southern Annular Mode conditions"

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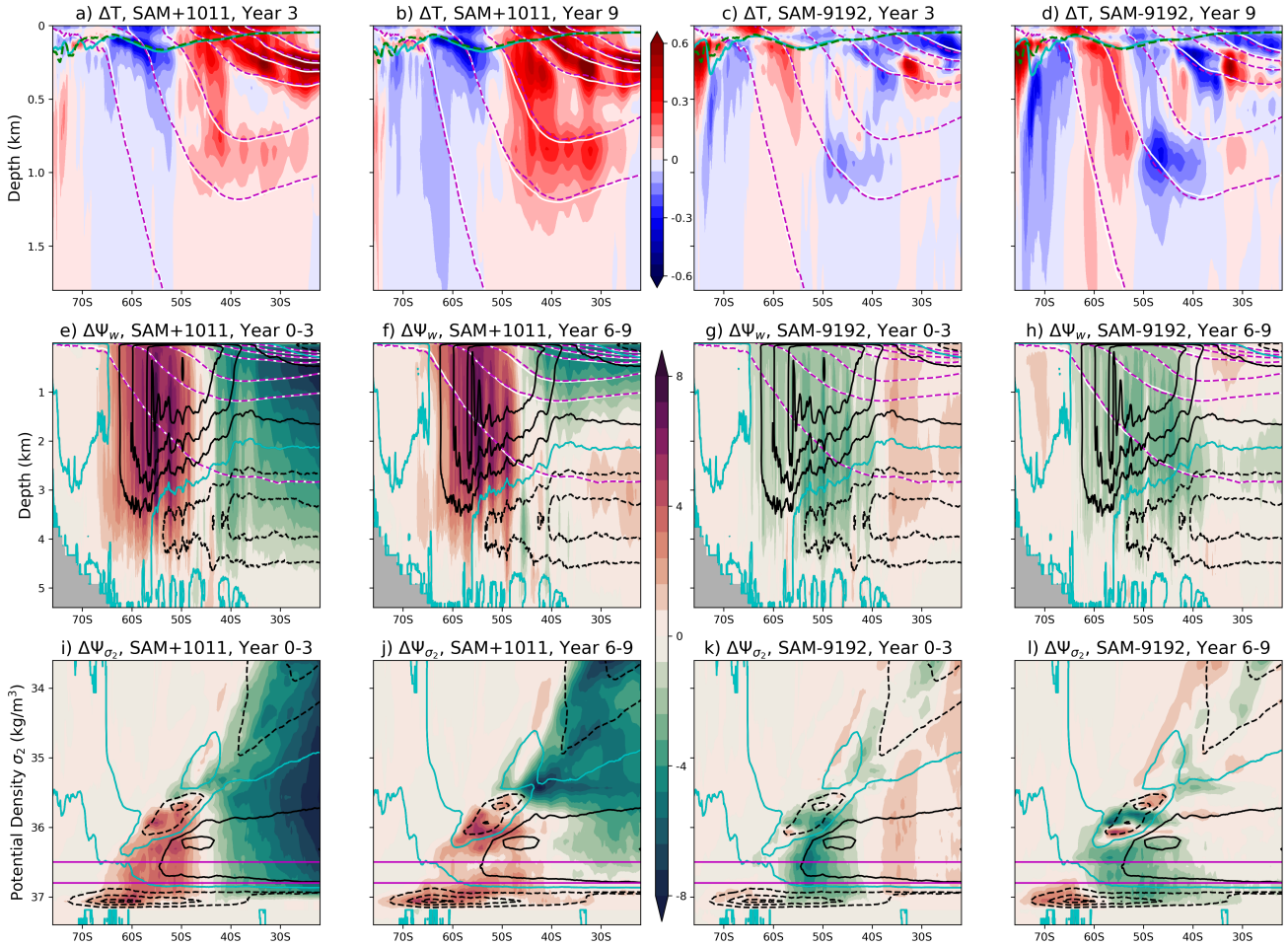

Figure S1. SUPPLEMENTARY FIGURE 1: Equivalent to Figure 2. a-d) Distributions of the Year 3 (a,c) & 9 (b,d) temperature anomalies from the 0.1° ACCESS-OM2-01 for (a,b) SAM+1011 and (c,d) SAM-9192 simulations. The white and dashed magenta contours represent the SAMx and RYF9091 isopycnals at $\sigma_2 = 0.5\,\mathrm{kg/m^3}$ intervals, respectively, spanning $\sigma_2 = 34$–$37\,\mathrm{kg/m^3}$ inclusive, with the cyan and dashed green contours representing the respective mixed-layer depths. e-h) The w-streamfunction anomalies of the ACCESS-OM2-01 simulations with SAM+1011 (e,f) and SAM-9192 (g,h) averaged for the years 0-3 (e,g) and 6-9 (f,h). Contoured in black is the Ψ_w for the RYF9091 case at $\pm 7.5\,\mathrm{Sv}$ intervals with the $0\,\mathrm{Sv}$ contour in cyan. The white and dashed magenta contours represent the same isopycnals as in (a-d). Panels (i-l) depict a similar analysis to panels (e-h) but for the σ_2-streamfunction anomalies. The magenta lines in (i-l) at 36.5 and $36.8\,\mathrm{kg/m^3}$ indicate the regions of interest for Figure 3.

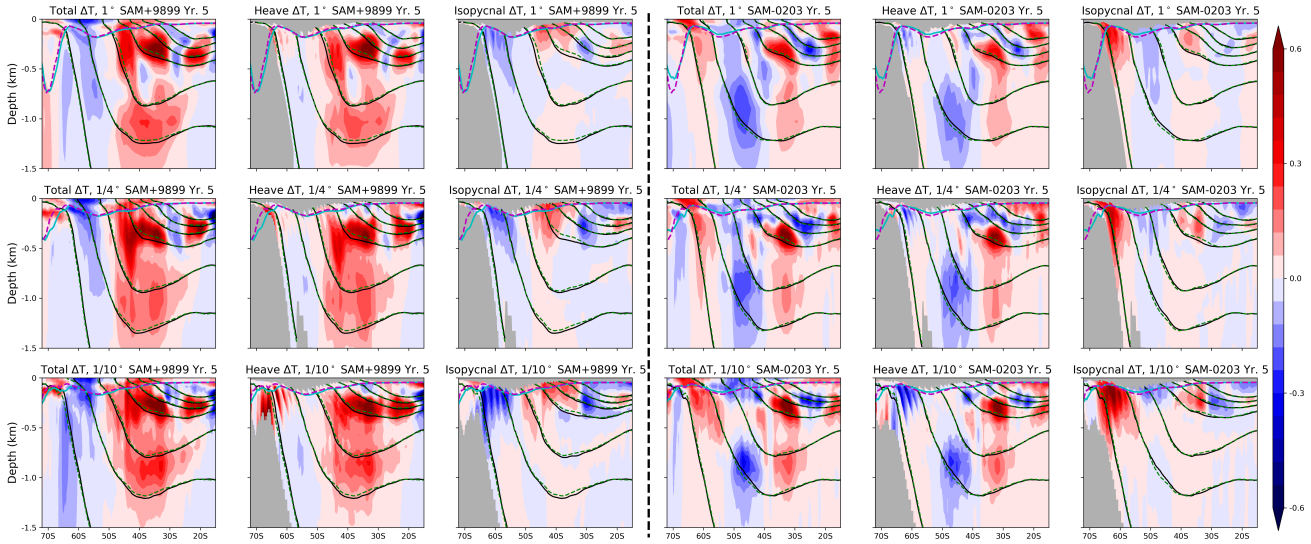

Figure S2. SUPPLEMENTARY FIGURE 2. Distributions of the Year 5 temperature anomalies for the SAM+9899 (cols. 1-3) and SAM-0203 (cols. 4-6) cases at 1°, 0.25° and 0.1° resolutions (rows 1-3, respectively). Columns 1 & 4 show the total temperature anomalies; columns 2 & 5 show the temperature anomaly associated with heave; and columns 3 & 6 show the temperature anomaly due temperature changes on isopycnals. The black and dashed green contours represent the SAMx and RYF9091 isopycnals at $\sigma_2 = 0.5\,\mathrm{kg/m^3}$ intervals, respectively, spanning $\sigma_2 = 34$–$37\,\mathrm{kg/m^3}$ inclusive, with the cyan and dashed magenta contours representing the respective mixed-layer depths. The temperature anomaly due to heave is calculated by remapping the zonally-averaged temperature in latitude-σ_2 space of the RYF9091 case back into latitude-depth space using the σ_2-depth relationship of a given SAMx case. The temperature anomaly due to the change of temperature on isopycnals is calculated by remapping the zonally-averaged temperature differences between the SAMx and RYF9091 in latitude-σ_2 space back into latitude-depth space using the σ_2-depth relationship of RYF9091. The greyed regions here are an artefact of transformation between depth and σ_2 spaces.

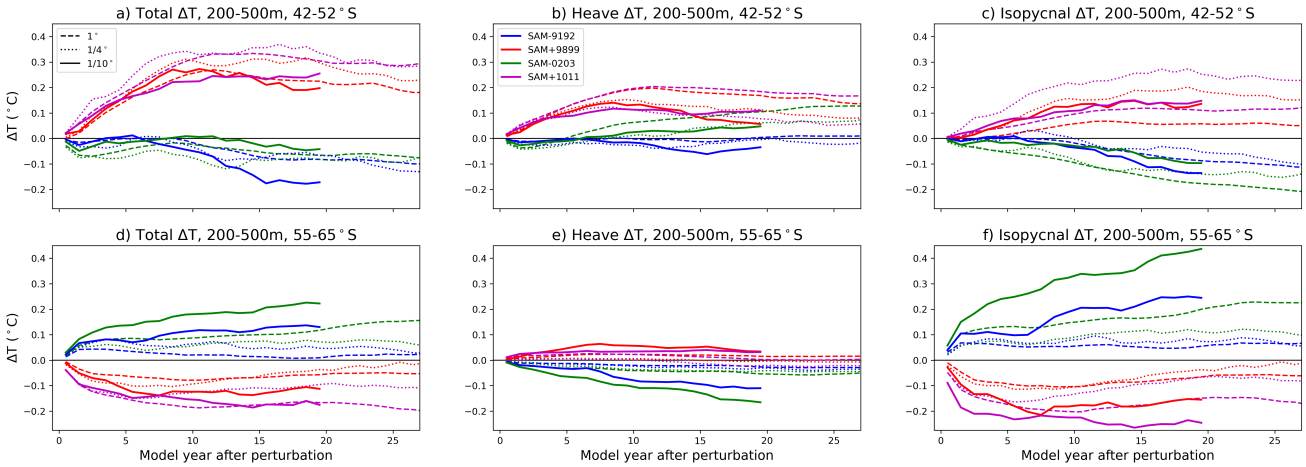

Figure S3. SUPPLEMENTARY FIGURE 3. Timeseries of the extended responses in regions north (a-c) and south (d-f) of the wind speed maximum for the total (a,d), heave (b,e) and isopycnal (c,f) temperature anomalies.