

1 **Supplementary Information for**

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3 Ocean eddy compensation regulates feedbacks amplifying ozone-
4 induced Southern Ocean cooling

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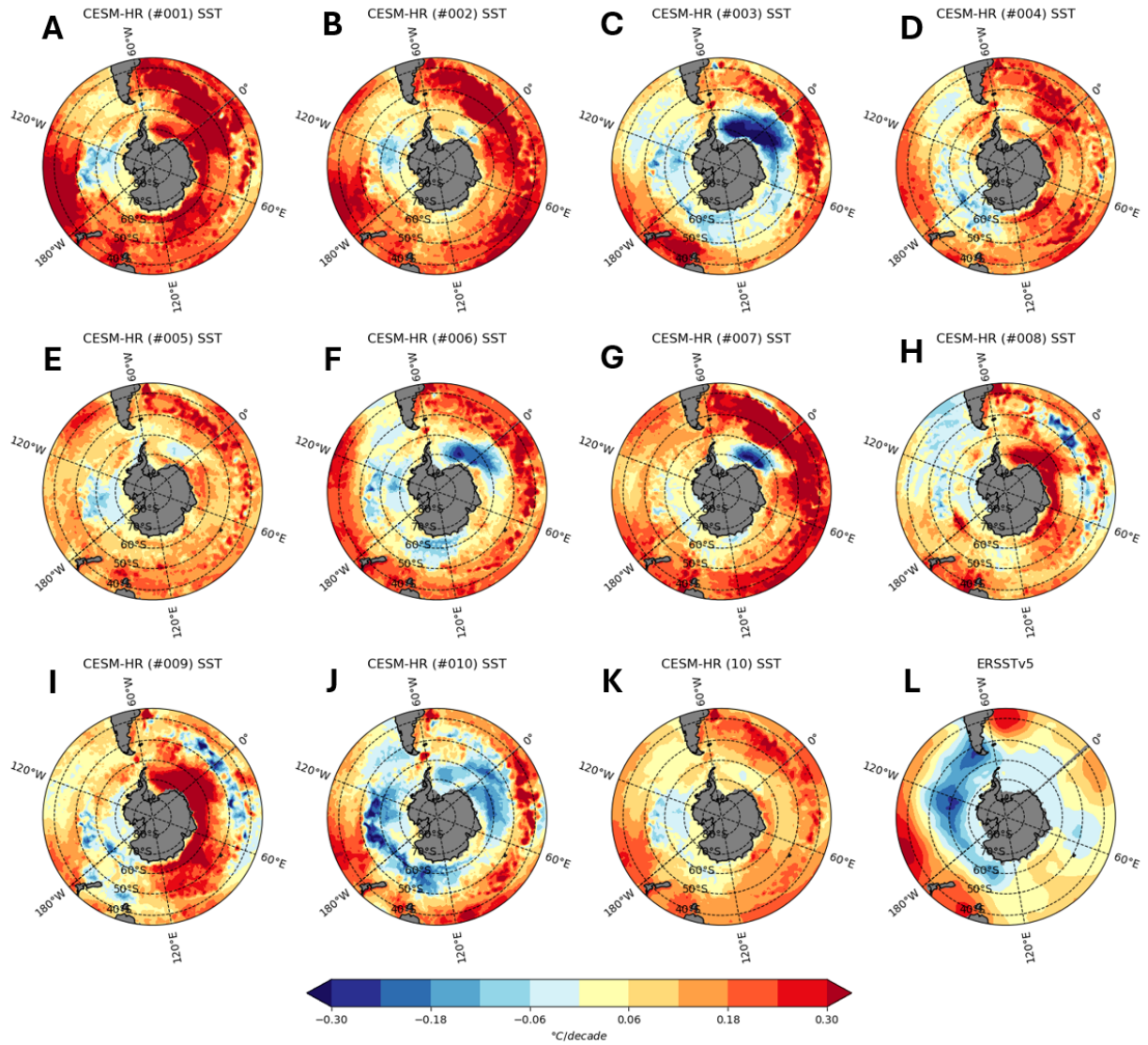
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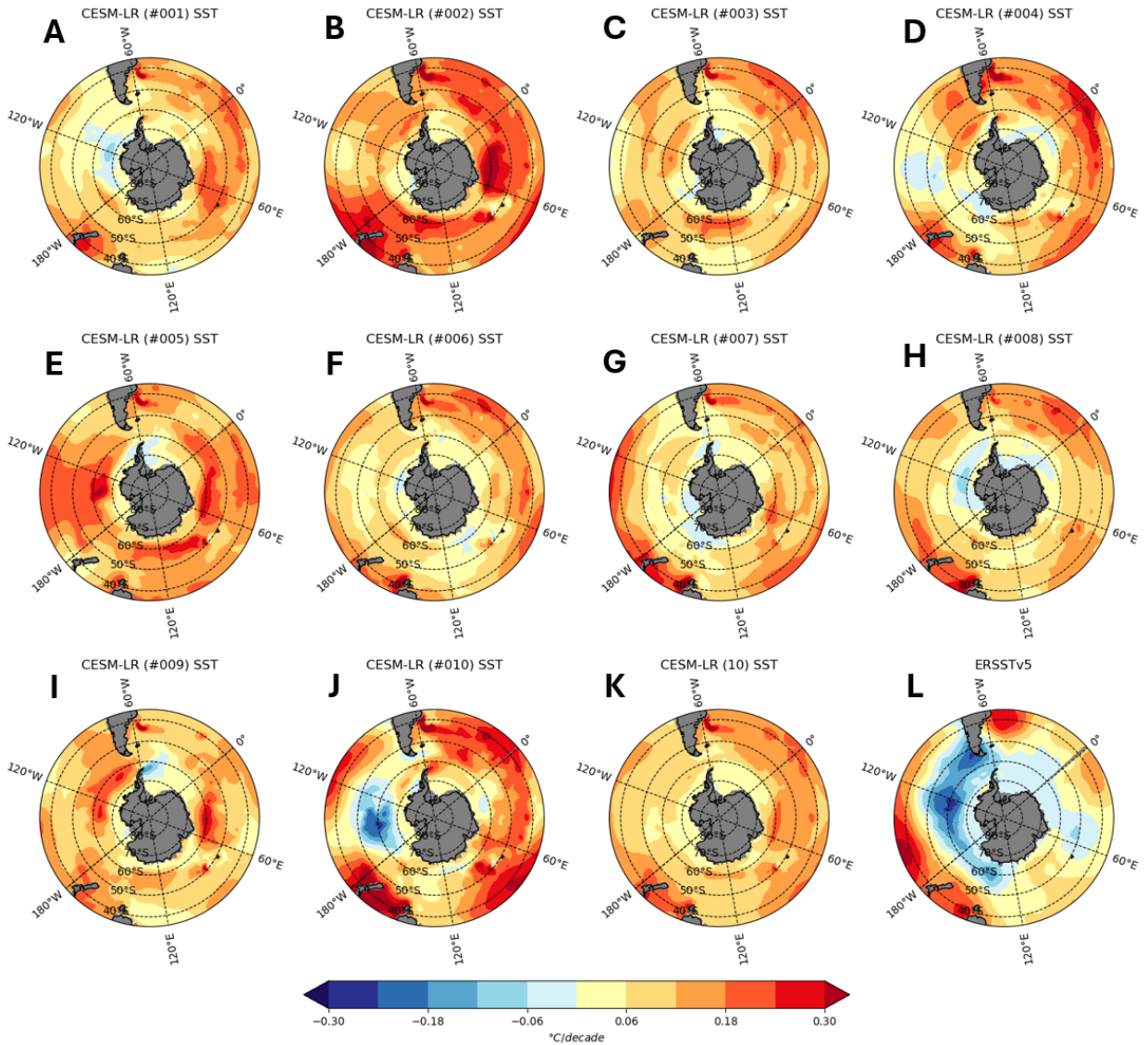
14 Figures S1 to S8



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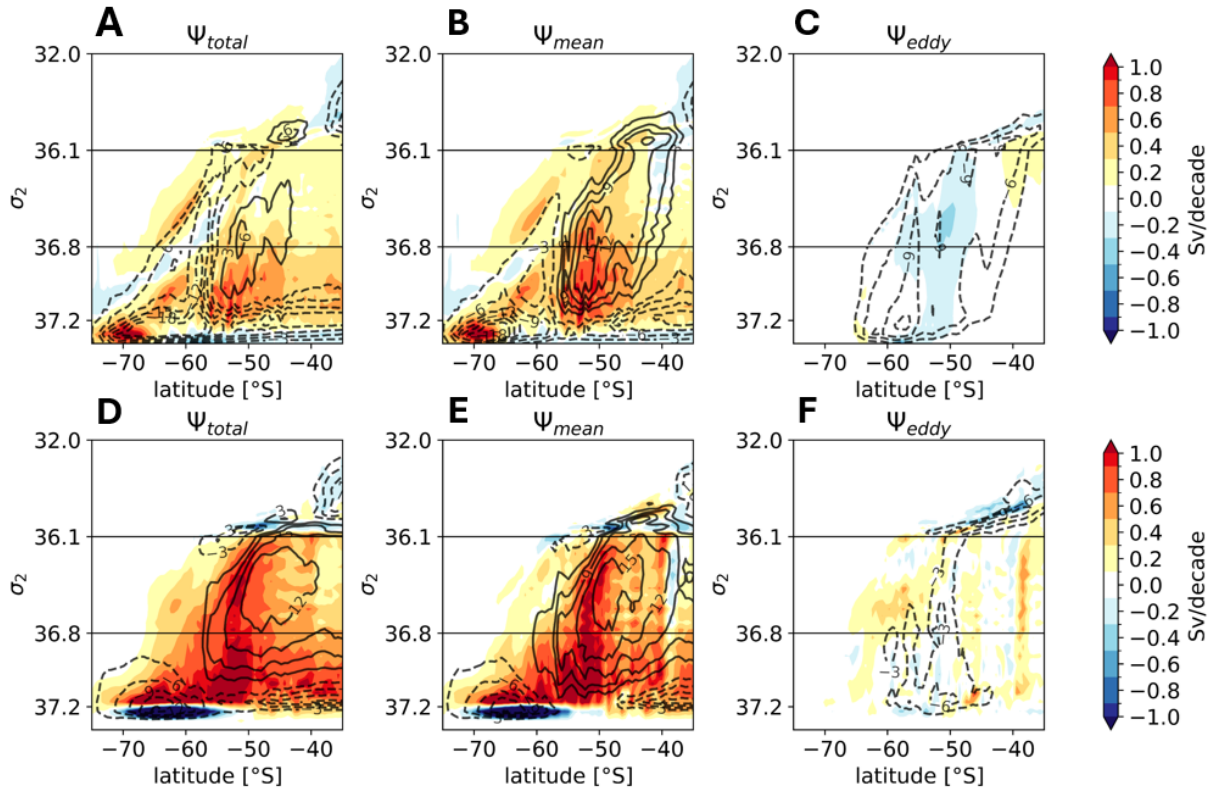
16 **Fig. S1:** Linear SST trend in each ensemble member of CESM-HR over 1980-2022, compared to
 17 ERSST. (A-J) CESM-HR ensemble members #001-#010. (K) CESM-HR ensemble mean. (L)
 18 ERSSTv5.

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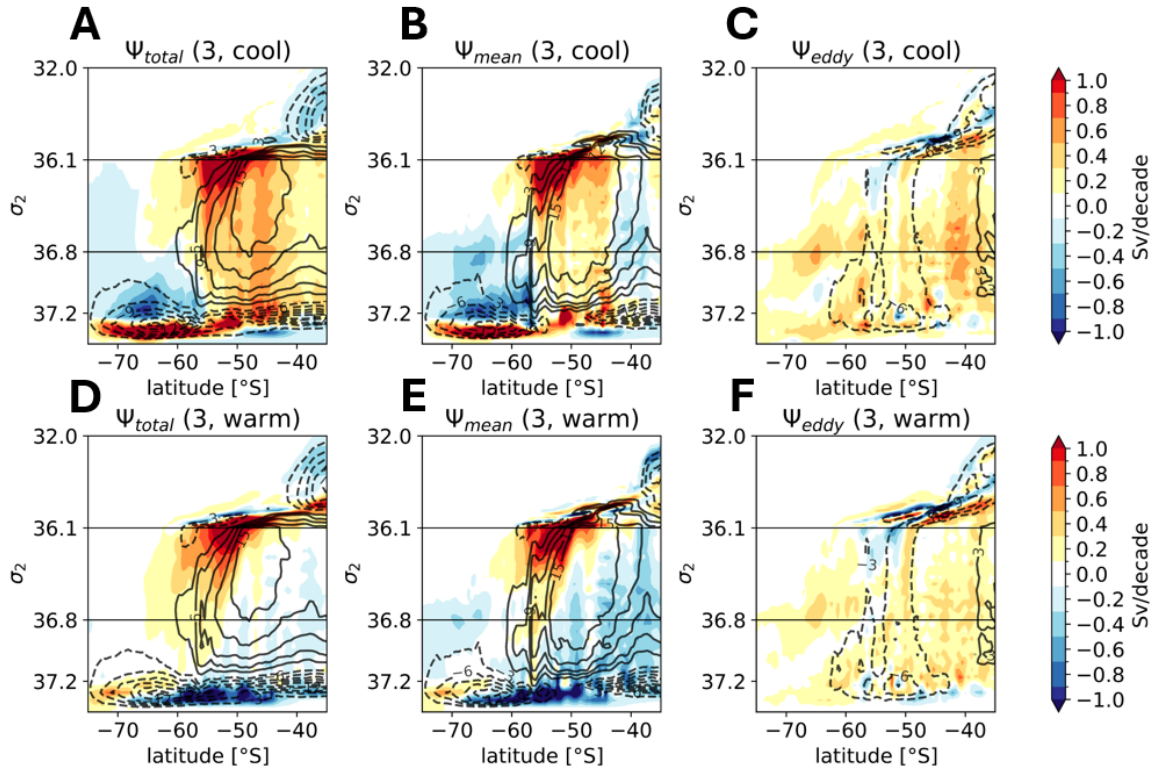
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Fig. S2: Linear SST trend in each ensemble member of CESM-LR over 1980-2022, compared to ERSSTv5. (A-J) CESM-LR ensemble members #001-#010. (K) CESM-LR ensemble mean. (L) ERSSTv5.

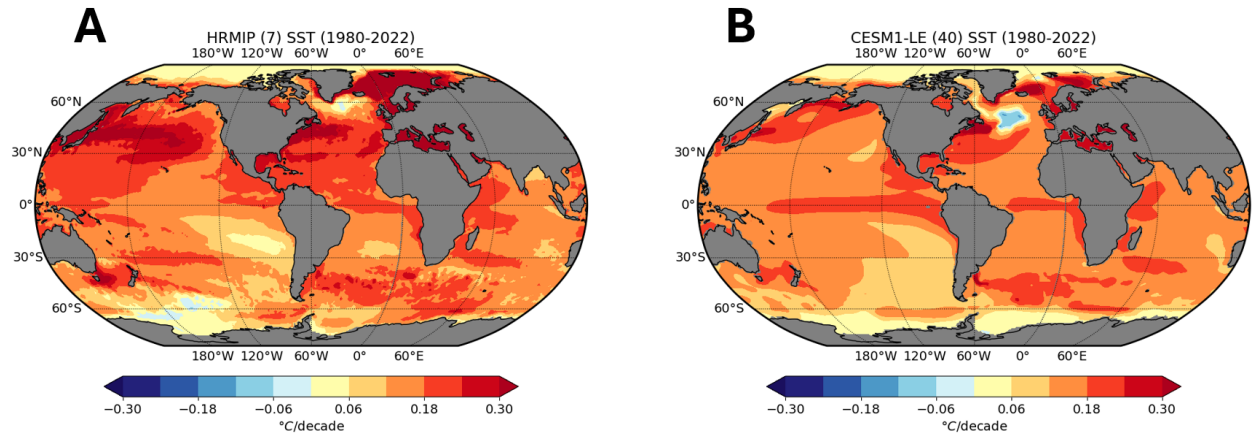


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Fig S3: Ocean meridional overturning streamfunction in density space: time-average (black contours, 3 Sv intervals) and linear trend (shading) in the Southern Ocean in FOSI-HR and FOSI-LR over the 1979-2017 period. (A and D) total (residual) streamfunction Ψ_{total} , (B and E) time-mean streamfunction Ψ_{mean} , and (C and F) transient eddy streamfunction Ψ_{eddy} .



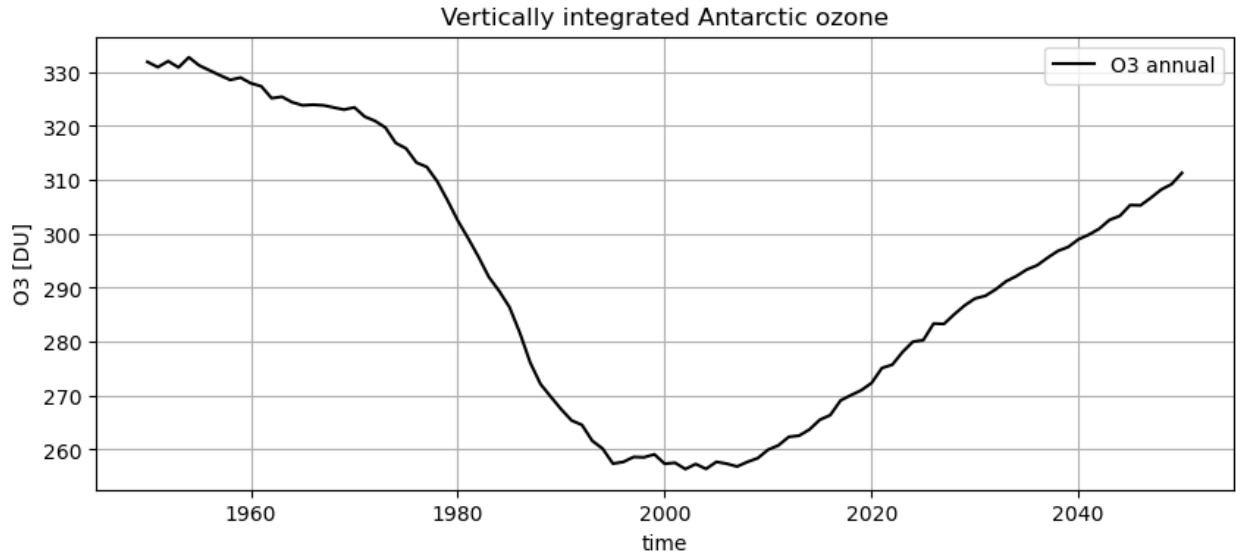
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 32 **Fig. S4:** Ocean meridional overturning streamfunction time-average (black contours, 3 Sv intervals)
 33 and linear trend (shading) in the Southern Ocean in CESM-HR over the 1980-2022 period. For the
 34 three cool members, (A) residual streamfunction $\Psi_{total}(3,cool)$, (B) time-mean streamfunction
 35 $\Psi_{mean}(3,cool)$, and (C) transient eddy streamfunction $\Psi_{eddy}(3,cool)$. For the warm members, (D)
 36 residual streamfunction $\Psi_{total}(3,warm)$, (E) time-mean streamfunction $\Psi_{mean}(3,warm)$, and (F)
 37 transient eddy streamfunction $\Psi_{eddy}(3,warm)$.
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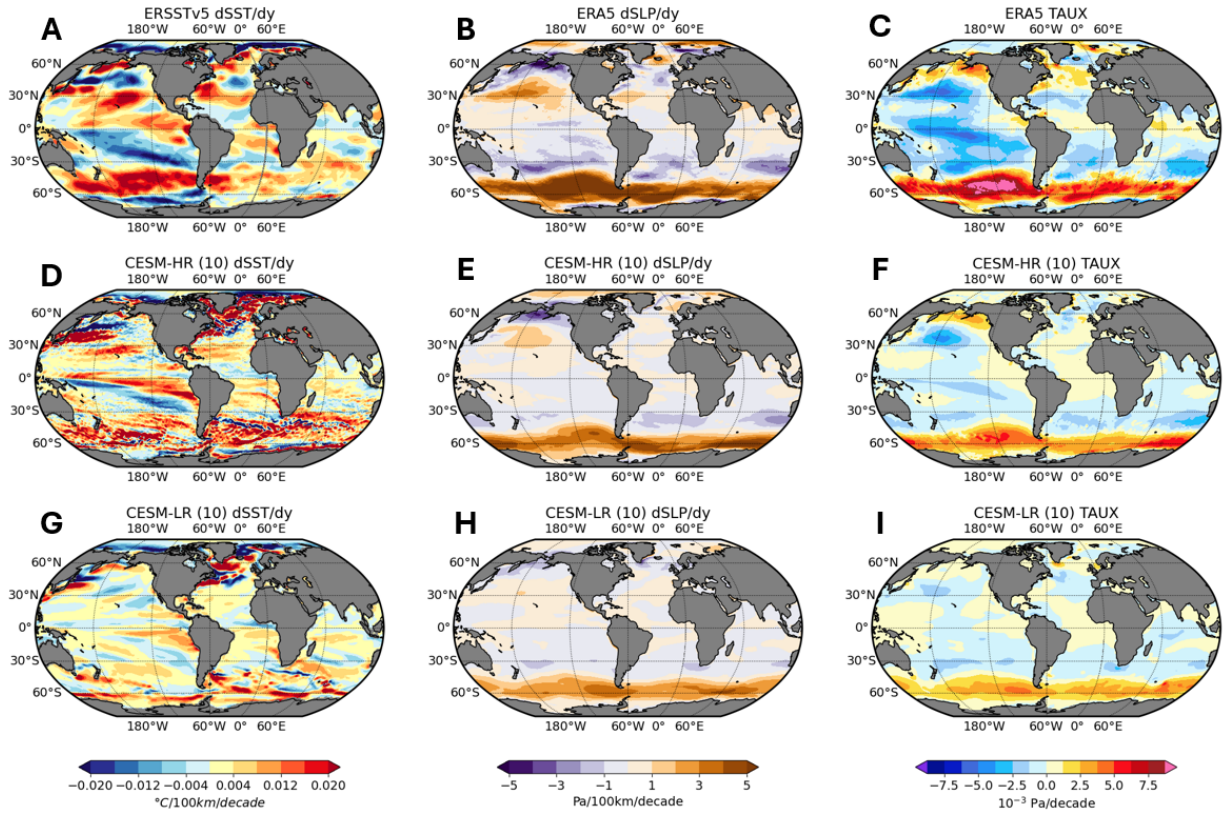
40 **Fig. S5:** Linear trends in SST over 1980-2022 for (A) HighResMIP, multi-model-mean and (B)
 41 CESM1-LE, 40-member ensemble mean.

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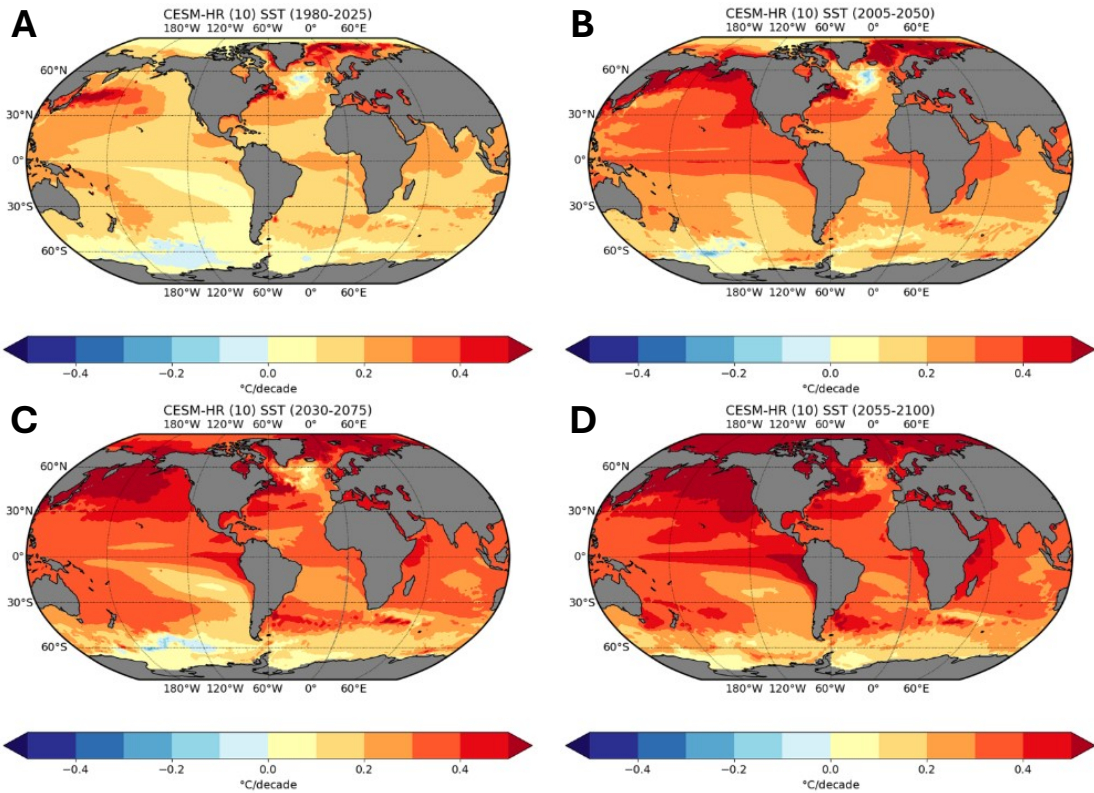
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Fig. S6: Vertically-integrated annual ozone (O3) averaged over the Antarctic region (63°S-90°S) for 1950-2050 as prescribed in CESM-HR, CESM-LR, AMIP-HR, and AMIP-LR. The Antarctic region is defined from 90°S to the climatological extent of the polar jet, at about 63°S.



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48 **Fig. S7:** Observation-based and simulated linear trends of meridional gradients of sea surface
 49 temperature (dSST/dy) and sea level pressure (dSLP/dy), along with zonal surface wind stress
 50 (TAUX) over the 1980-2022 period. (A) Linear trends of dSST/dy in ERSSTv5. Linear trends in
 51 ERA5 of (B) dSLP/dy and (C) τ^x . Ensemble mean linear trends simulated in CESM-HR of (D)
 52 dSST/dy, (E) dSLP/dy, and (F) τ^x . Ensemble mean linear trends simulated in CESM-LR of (G)
 53 dSST/dy, (H) dSLP/dy, and (I) τ^x .



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 55 **Figure S8.** Linear trends of simulated SST over the period of (A) 1980-2025, (B) 2005-2050, (C)
 56 2030-2075, and (D) 2055-2100 in CESM-HR future climate simulations under the RCP8.5 emission
 57 scenario, averaged over all 10 ensemble members.
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