Supporting Information for "Recent multi-decadal Southern Ocean surface cooling unlikely caused by Southern Annular Mode trends"

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Table S1. Model large-ensemble simulations used in this study

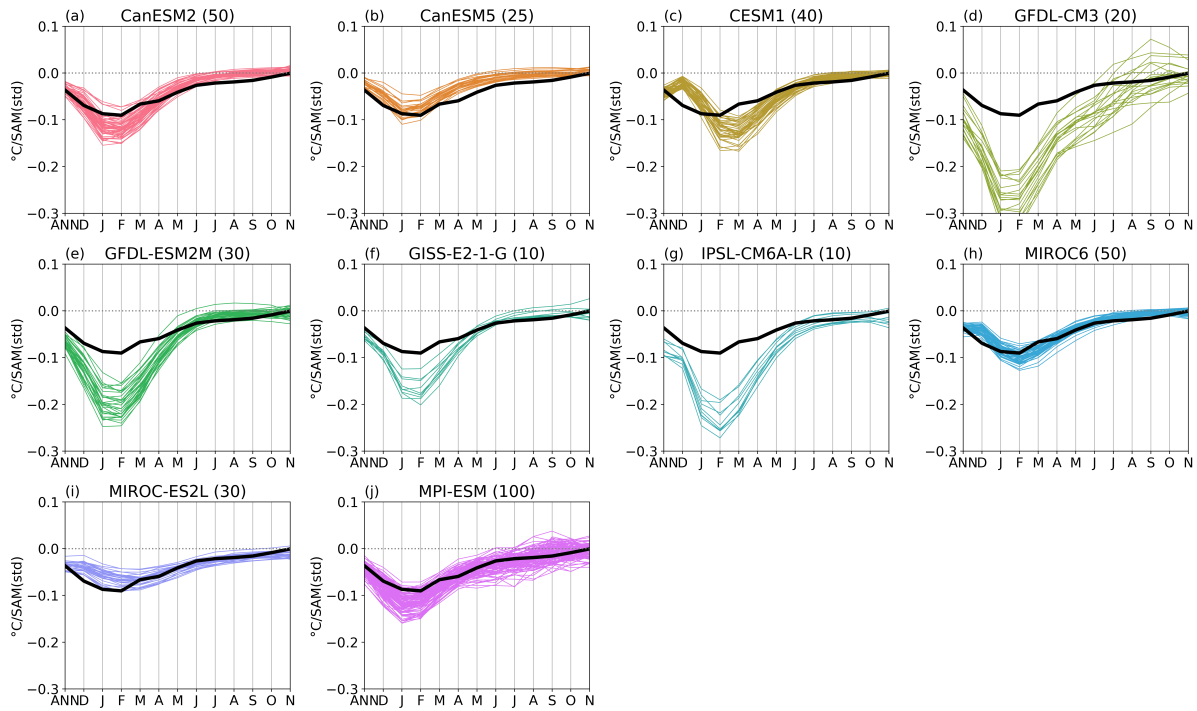| model	simulation	ensemble number
CanESM2	Historical, rcp8.5	50
CESM1	Historical, rcp8.5	40
GFDL-CM3	Historical, rcp8.5	20
GFDL-ESM2M	Historical, rcp8.5	30
MPI-ESM	Historical, rcp8.5	100
CanESM5	Historical, ssp245	25
GISS-E2-1-G	Historical, ssp370	10
IPSL-CM6A-LR	Historical, ssp370	10
MIROC6	Historical, ssp245	50
MIROC-ES2L	Historical, ssp245	30

Figure S1. (a) Coefficients of monthly SST regressions onto DJF SAM for each individual model large-ensemble. Numbers in the title for each panel denotes the total number of ensemble members of the model.
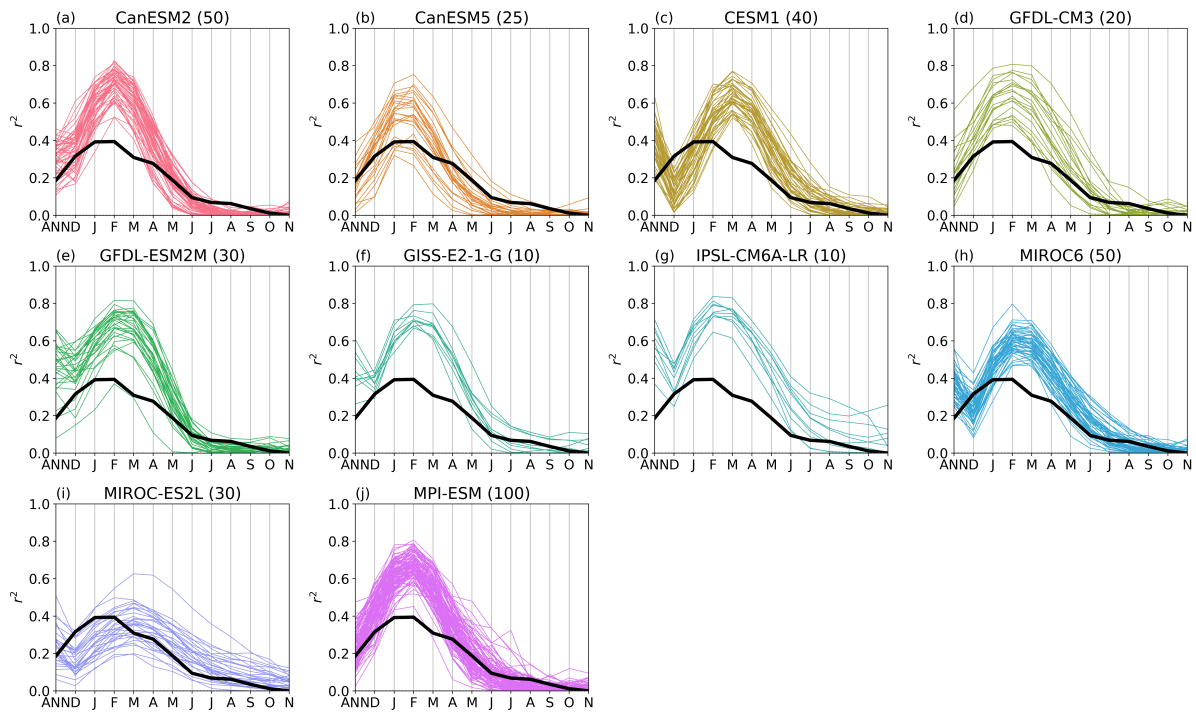
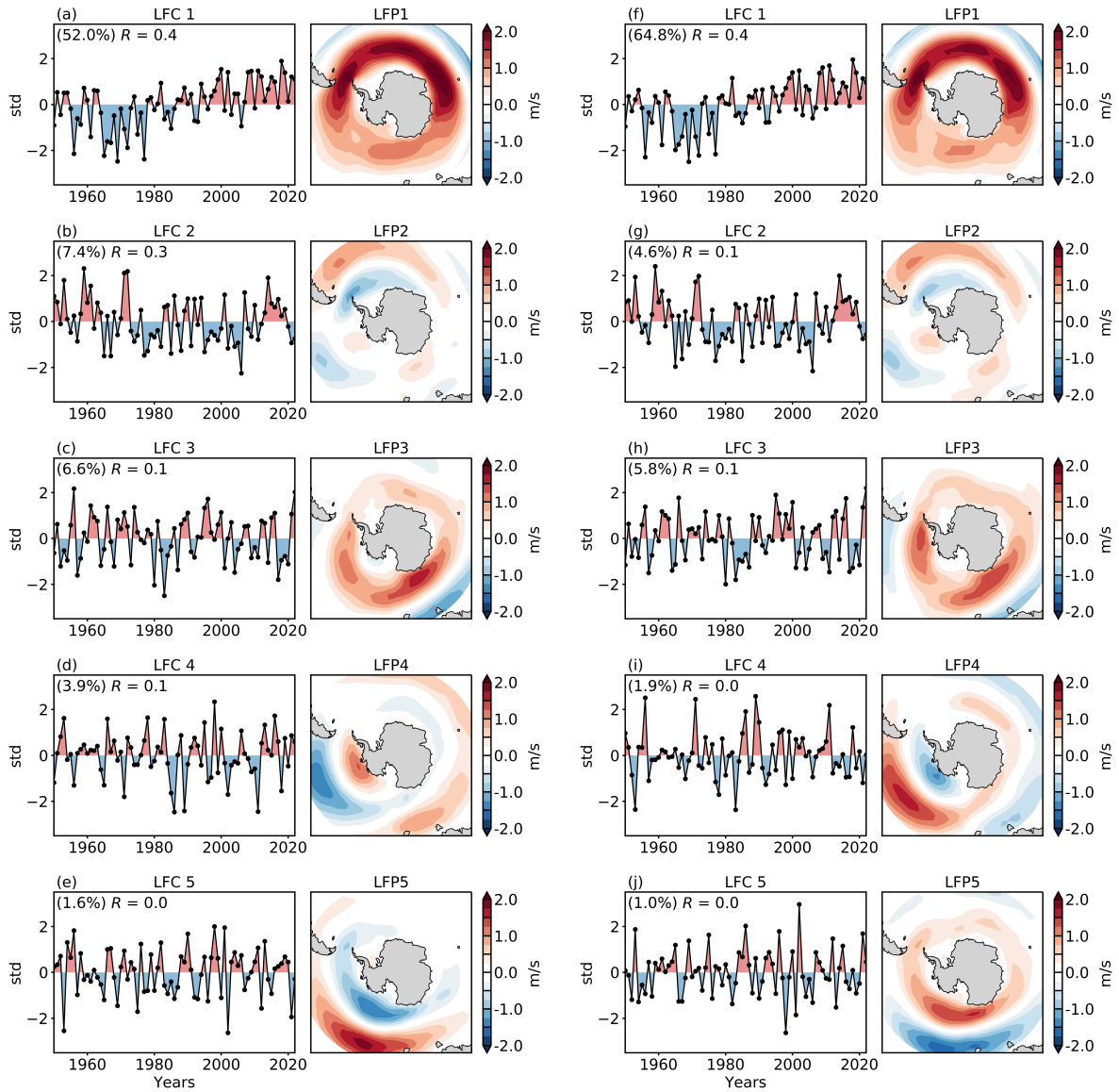**Figure S2.** Same as Fig. S1, except for regression r^2.

Figure S3. LFP and LFC results obtained using a cutoff of 10-year (left, a-e) or 20 year (right, f-j)
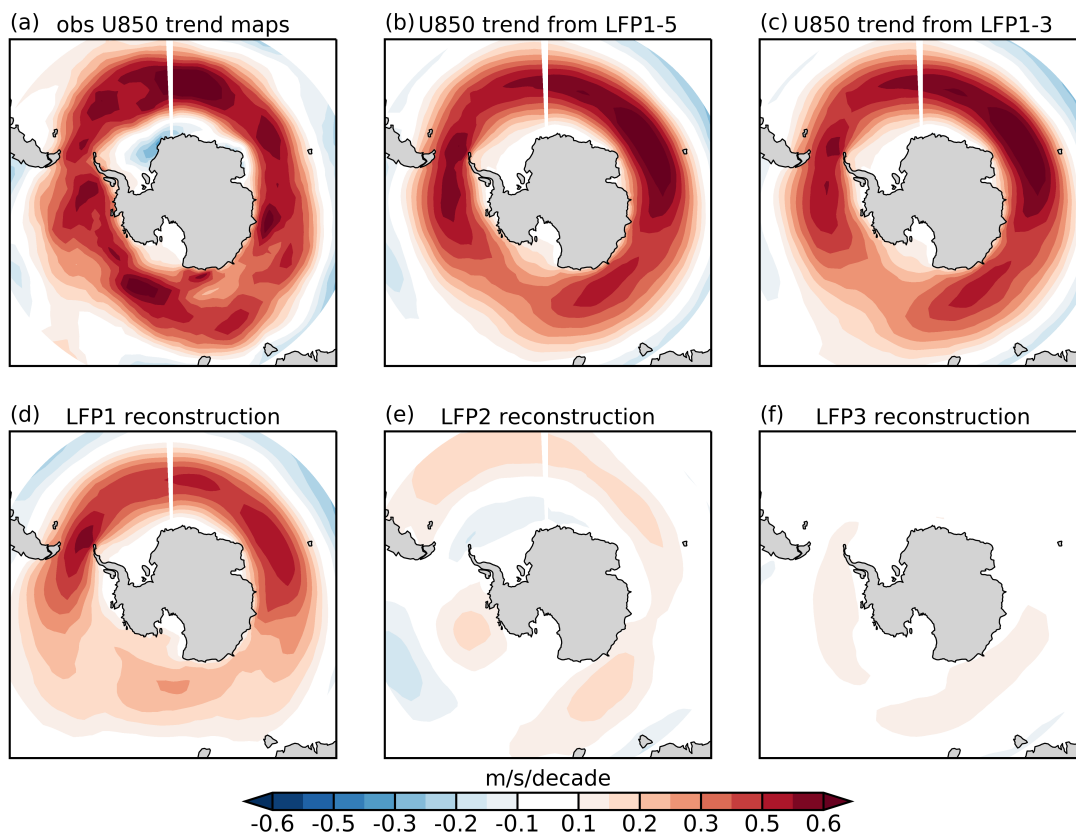
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Figure S4. DJF U850 trend patterns over 1979-2022 (m/s/decade) from (a) ERA5 Reanalysis, (b, c) the reconstruction using all five LFPs or the leading three LFPs, and (d-f) the reconstructions using LFP 1-3, respectively.
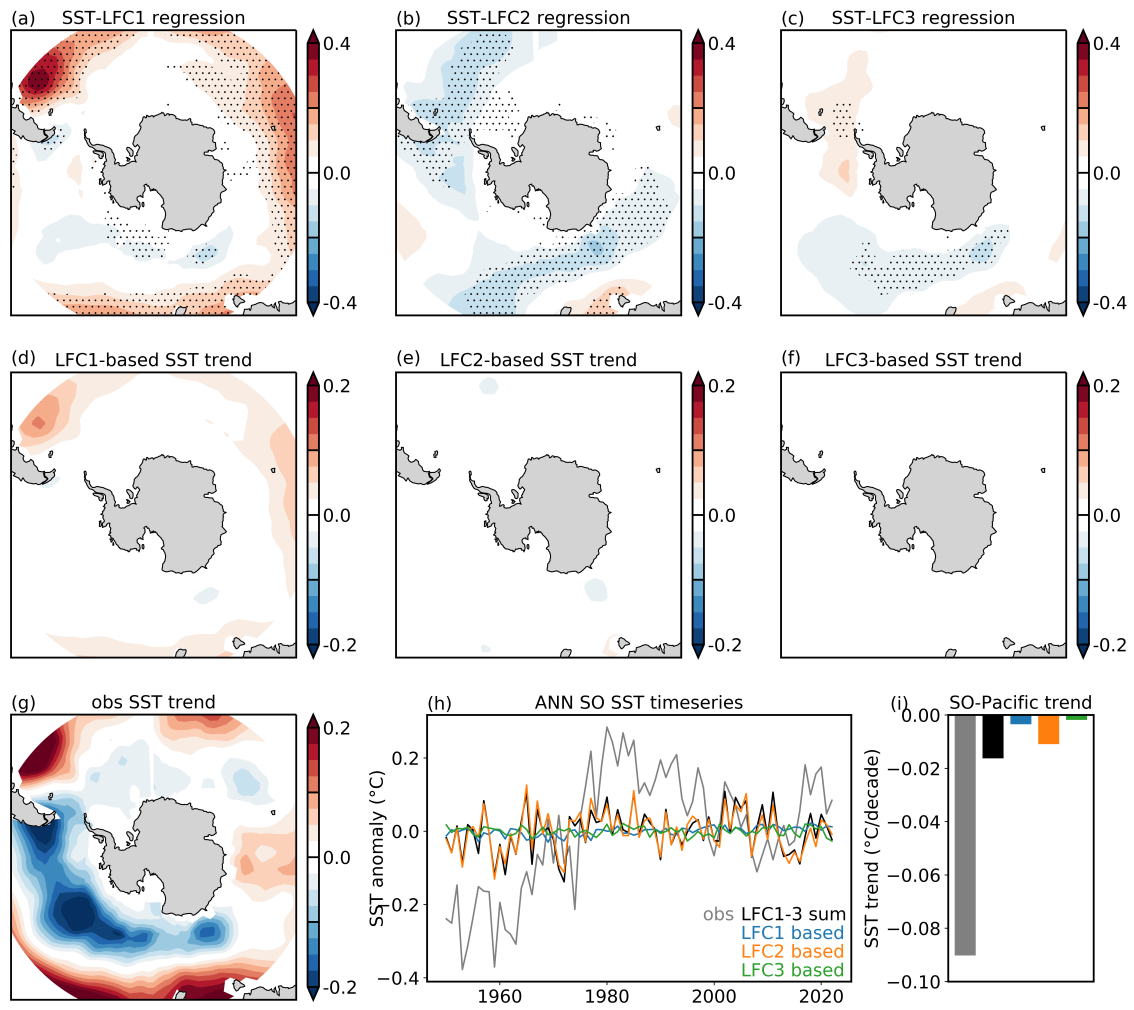
Figure S5. Same as Fig. 4, except for annual-mean SST regressions and trends.