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Supplementary Materials for

The internal origin of the west-east asymmetry of Antarctic climate change

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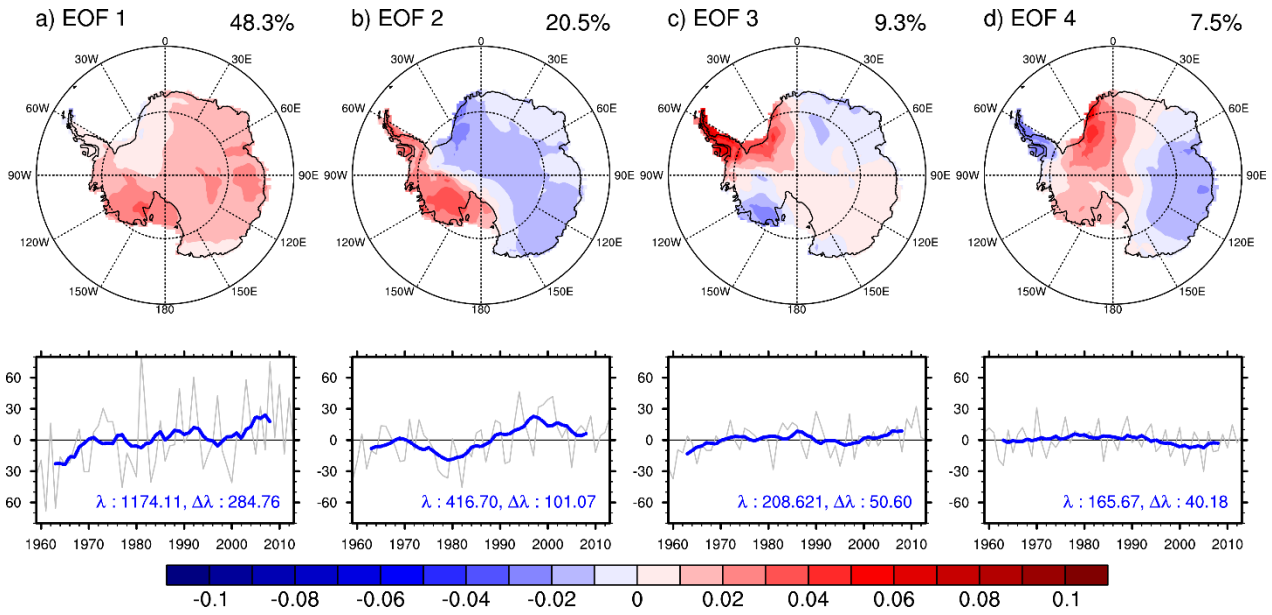
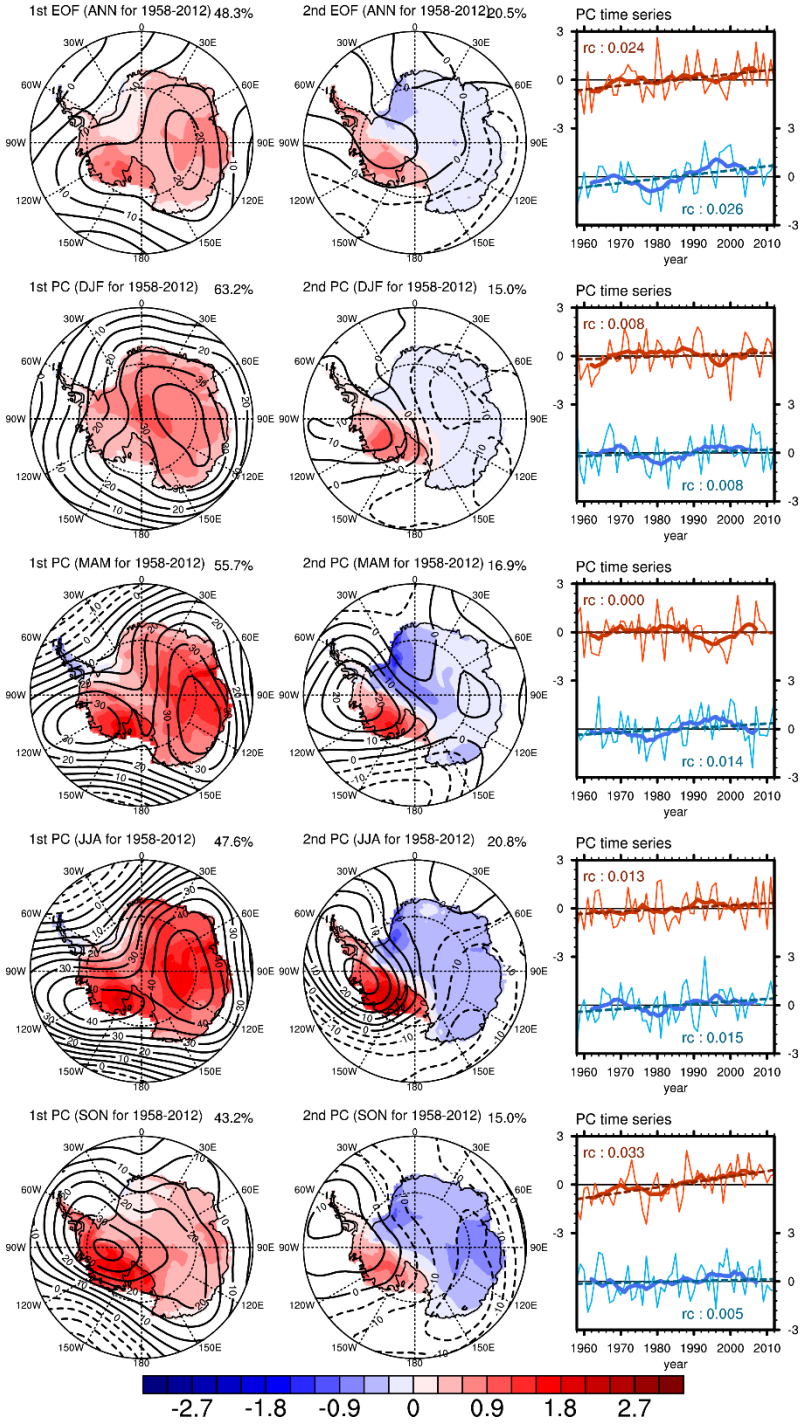
This PDF file includes:

Figs. S1 to S9



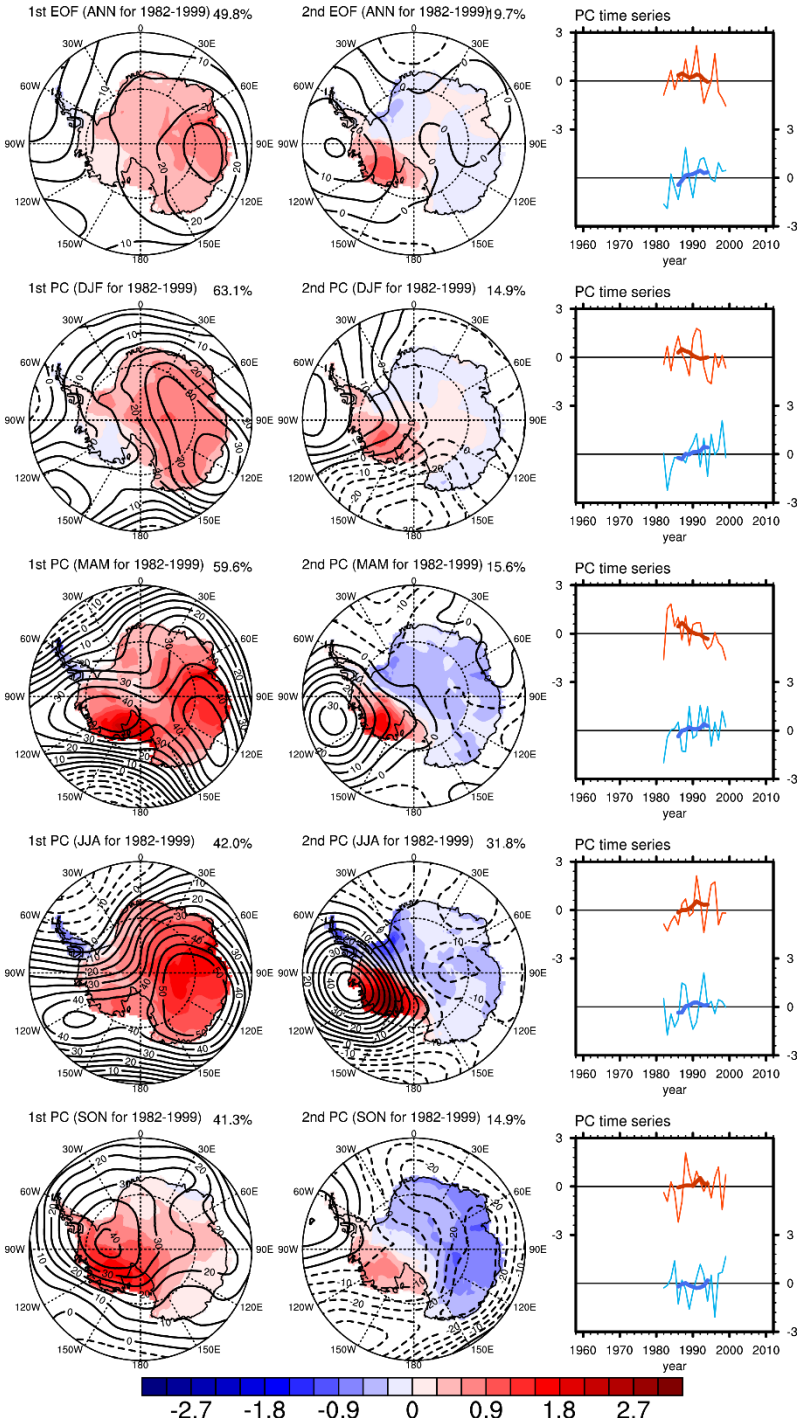
Supplementary Fig. S1. Four leading modes of the annual mean surface temperatures for the period of 1958–2012

The first four EOFs (unitless) with explained variances (%) and their corresponding PC time series (K; thin line) of annual mean surface temperature from NB2014. The thick blue lines in the PC time series indicate 10-year running means. Eigenvalue (λ) and *Shift* ($\Delta\lambda$) of EOFs are shown in the time series plot.



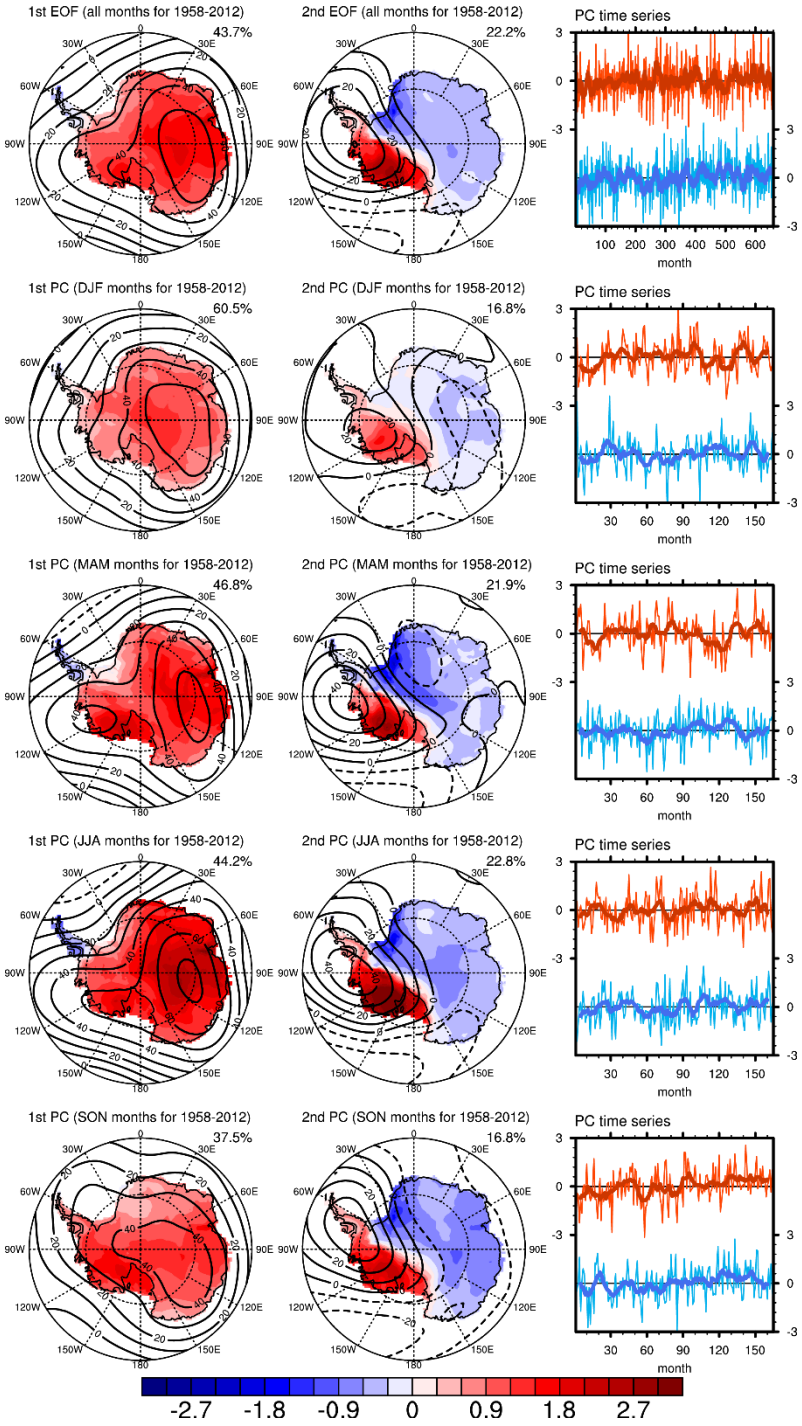
Supplementary Fig. S2. Two leading modes of the annual and seasonal mean surface temperatures for the period of 1958–2012

Regression patterns of surface temperature (in K) and 300 hPa geopotential height (in metres) on the **(left)** first and **(mid)** second EOFs of the annual-mean and seasonal-mean surface temperature for the period of 1958–2012 for the NB2014 dataset and **(right)** their normalized corresponding principal components (PCs; thin solid line), 10-year running means (thick solid line), and linear trends (thin dashed line). The red and blue colors indicate the first and second EOF PCs, respectively. The explained variance in the EOF mode is written in the upper-right corner of each EOF mode. The linear trend of normalized PC is written in the upper-left and lower-right corner of each line with the same color.



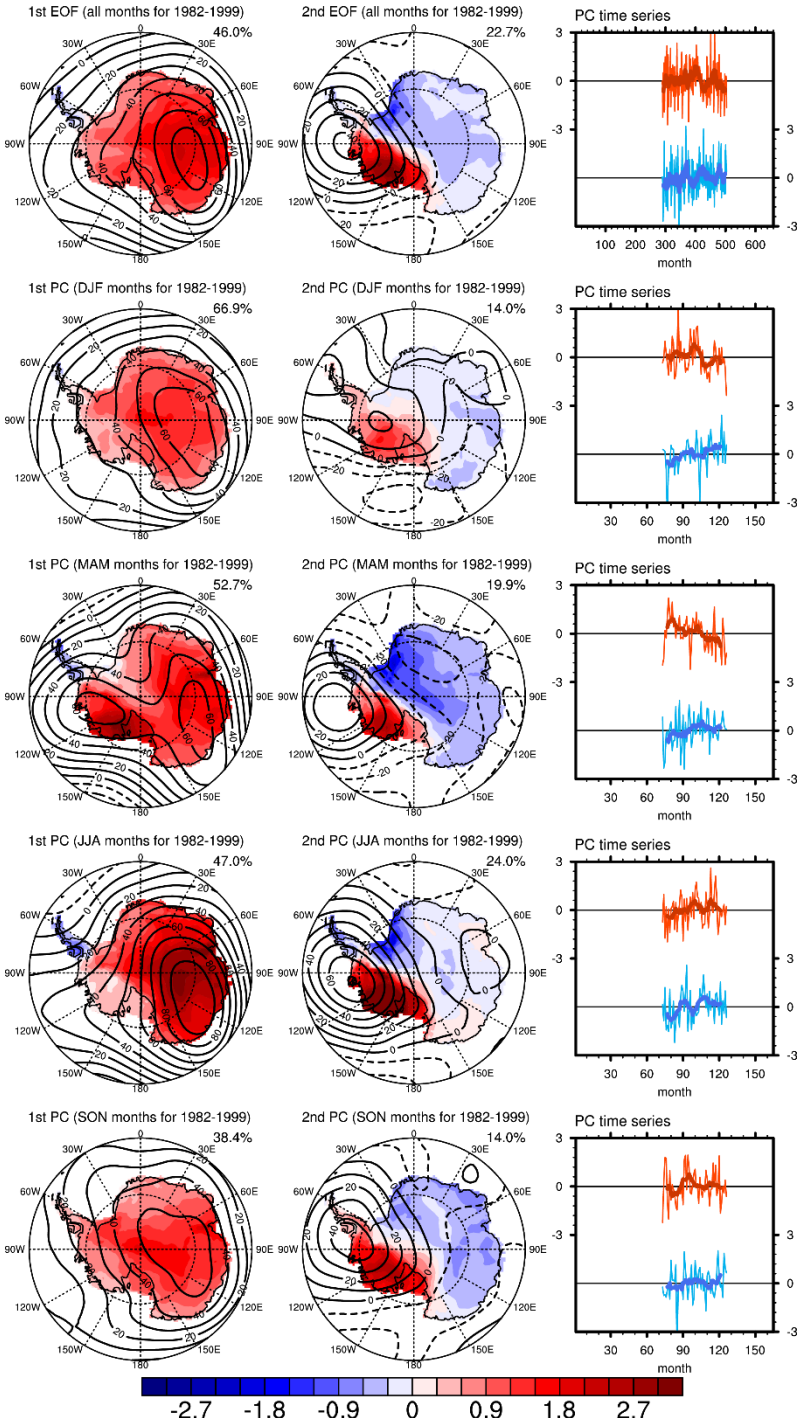
Supplementary Fig. S3. Two leading modes of the annual and seasonal mean surface temperatures for the period of 1982–1999

Regression patterns of surface temperature (in K) and 300 hPa geopotential height (in metres) on the **(left)** first and **(mid)** second EOFs of the annual-mean and seasonal-mean surface temperature for the period of 1982–1999 for the NB2014 dataset and **(right)** their normalized corresponding principal components (PCs; thin solid line), and 10-year running means (thick solid line). The red and blue colors indicate the first and second EOF PCs, respectively. The explained variance in the EOF mode is in the upper-right corner of each EOF mode.



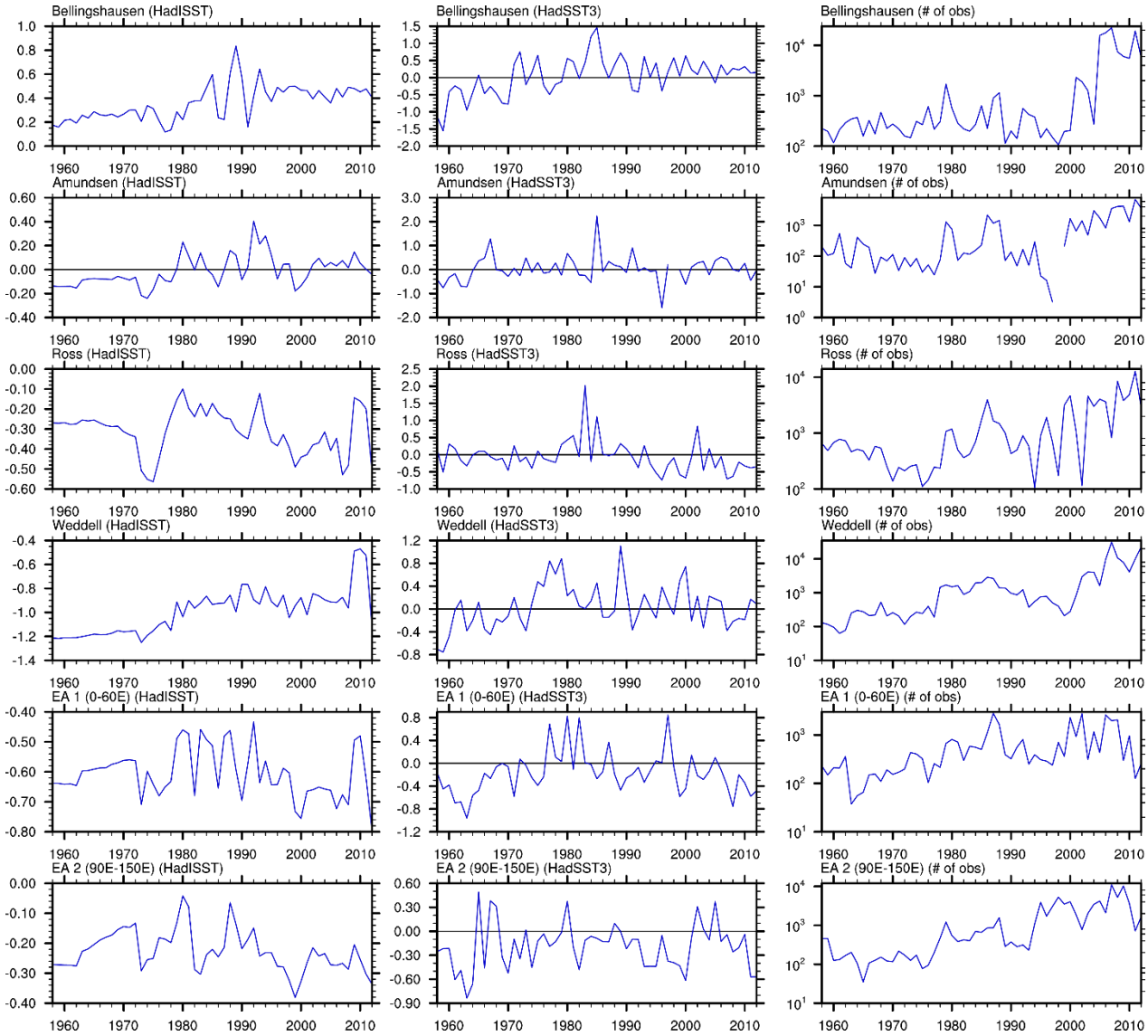
Supplementary Fig. S4. Two leading modes of the monthly surface temperature for the period of 1958–2012

Regression patterns of surface temperature (in K) and 300 hPa geopotential height (in metres) for the **(left)** first and **(mid)** second EOFs of monthly surface temperature during the entire year and each season for the period of 1958–2012 by the NB2014 dataset and **(right)** their normalized corresponding principal components (PCs; thin solid line), and 10-months running means (thick solid line). The red and blue colors indicate the first and second EOF PCs, respectively. The explained variance in the EOF mode is written in the upper-right corner of each EOF mode.



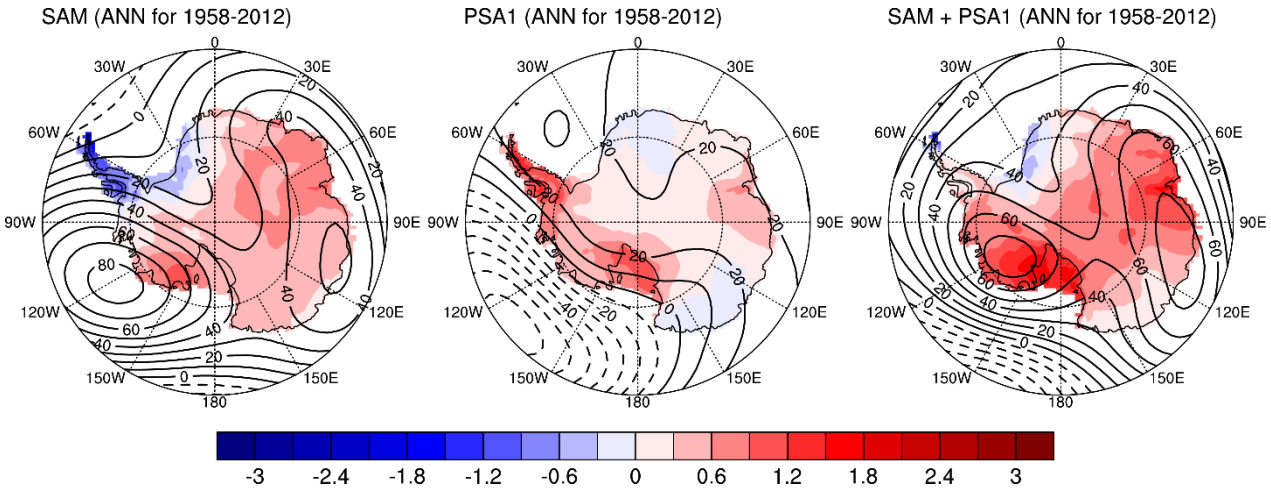
Supplementary Fig. S5. Two leading modes of monthly surface temperature for the period of 1982–1999

Same as in supplementary Fig. S4 but for the period of 1982–1999.



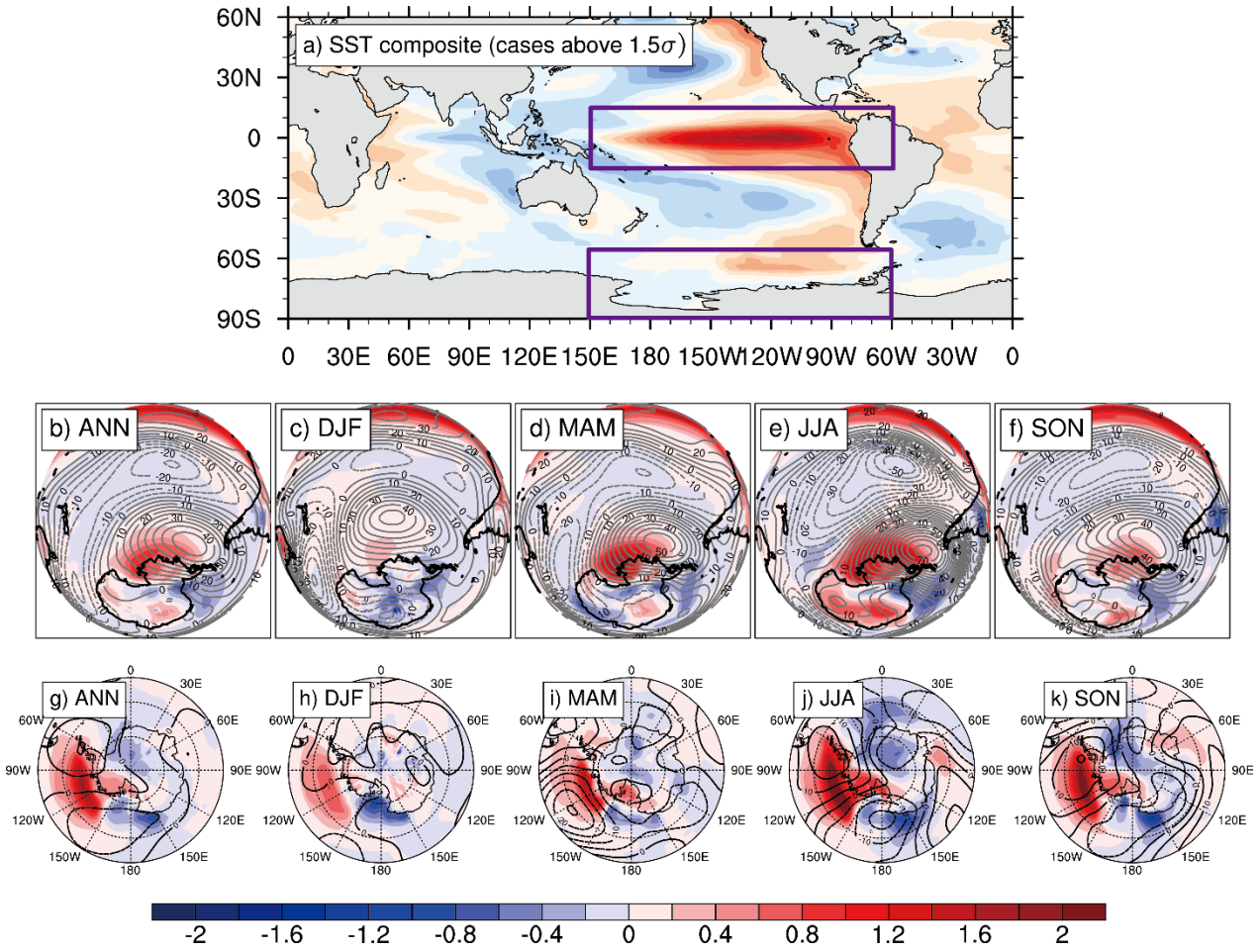
Supplementary Fig. S6. Year-to-year variations in SSTs and number of observations over the individual oceans around Antarctica

Annual-mean sea surface temperature (in K) from the HadISST1 dataset and annual-mean median (in K) and number of annually accumulated observations from the HadSST3 dataset for the period of 1958–2012 over the Bellingshausen Sea (60°S–85°S, 60°W–90°W), Amundsen Sea (60°S–85°S, 90°W–150°W), Ross Sea (60°S–85°S, 150°E–150°W), Weddell Sea (60°S–85°S, 30°W–60°W), East Antarctic region 1 (60°S–85°S, 0°–60°E), and East Antarctic region 2 (60°S–85°S, 90°E–150°E).

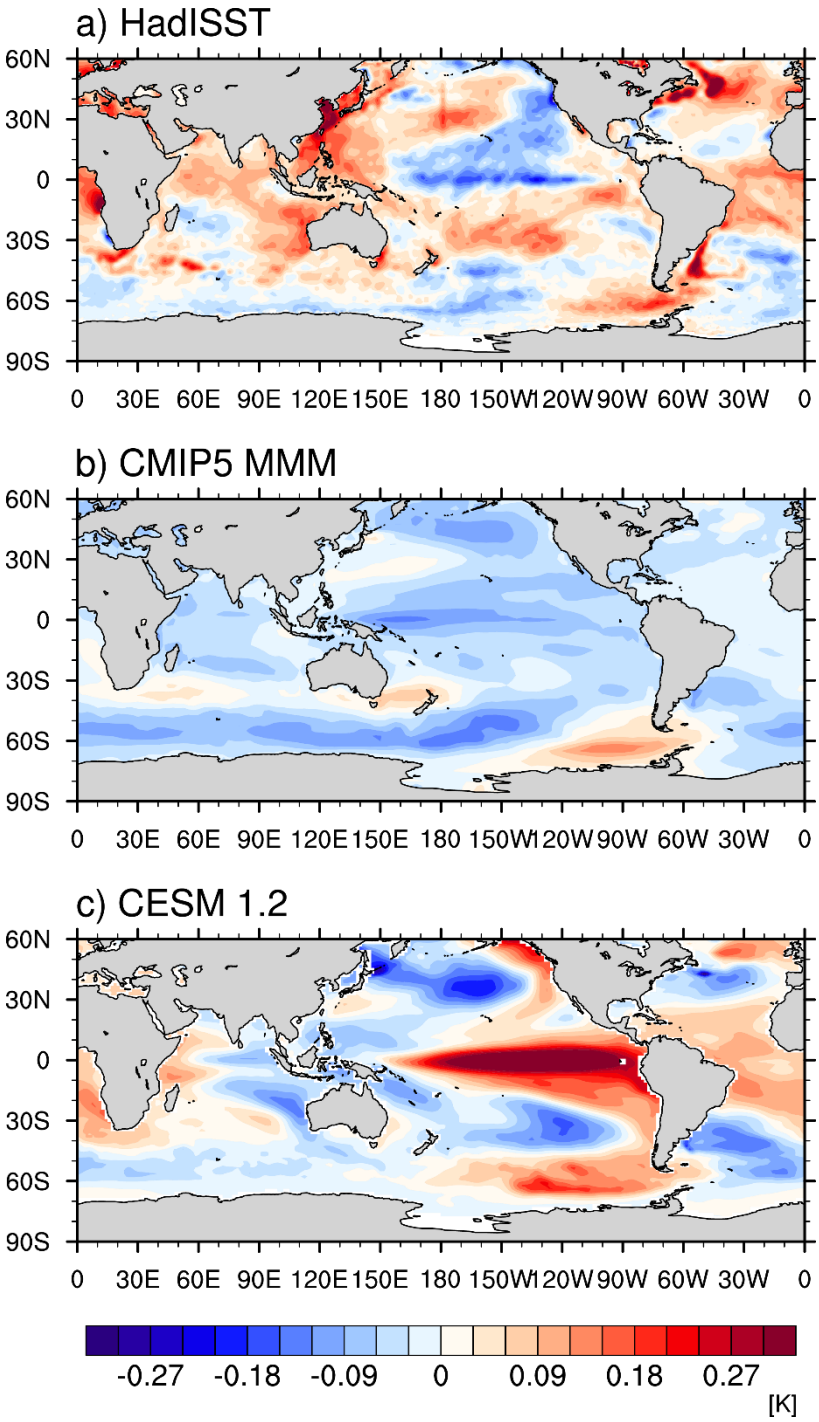


Supplementary Fig. S7. Signature of the SAM and PSA-1 indices in Antarctic surface temperature and atmospheric circulation

Regressed surface temperature (in K) and 300-hPa geopotential height (in metres) for the annual-mean Southern Annular Mode (SAM) and Pacific South America (PSA)-1 indices and their combined patterns. The sign of the pattern is reversed for convenience.



Supplementary Fig. S8. Responses of height and SAT to isolated ocean surface anomalies for the high phase (i.e., warmer west) of the West Antarctic asymmetric mode
(a) Composite annual mean SST anomalies for the case of above 1.5σ of the normalized EOF2 PC from the coupled GCM experiment. (b-k) The atmospheric responses of SAT (shading, in K) and 300-hPa geopotential height (contour, in metres) of the AGCM experiments with different west Antarctic ocean surface conditions: anomalous SST and sea ice condition over (b-f) the tropical Pacific (15°S–15°N, 150°E–60°W, purple box in tropics) and (g-k) the West Antarctic sector (55°S–90°S, 150°E–60°W, purple box around Antarctica) compared to baseline experiment with climatological condition.



Supplementary Fig. S9. Spatial SST patterns related to the Antarctic surface asymmetry
Regressed SST (in K) of (a) HadISST1 dataset with the normalized EOF2 PC of the annual mean SAT for the period of 1958–2012, (b) CMIP5 multi-model mean for their normalized CBF2 PCs for same period with the HadISST1, and (c) the coupled GCM experiment with current topography in Fig. 5.