This Supplementary Information includes the following:

**(1) File ‘Supp Info Figure 1’ is a pdf figure referred to in the main text of the manuscript, showing the annual mean model-data comparison for each model in the ensemble.**

**(2) Directory ‘netcdf\_data\_for\_each\_model’ contains netcdf data for the annual mean, DJF, JJA, and WMM 2m air temperature and SST. The code below provides a key to the filenames.**

filename(x , z(y(x)) ) is model x, orbit z(y(x)), where:

x(0:14)=['HadCM3\_Bris','CCSM3\_Bremen','CCSM3\_LLN','CCSM3\_NCAR','COSMOS\_AWI','COSMOS\_MPI','KCM\_Kiel','LOVECLIM\_Ams','LOVECLIM\_LLN','MIROC\_Tokyo','CLIMBER\_LSCE','IPSL\_LSCE','CSIRO\_UNSW','NORESM\_BCCR','NCEP']

z(1)= 'modern'

z(2) = '125k'

z(3) = '126k'

z(4) = '127k'

z(5) = '128k'

z(6) = '129k'

z(7) = '130k'

y(0)=[2,5,7,1]

y(1)=[2,1]

y(2)=[4,1]

y(3)=[2,7,1]

y(4)=[7,1]

y(5)=[2,1]

y(6)=[3,1]

y(7)=[2,7,1]

y(8)=[4,1]

y(9)=[2,1]

y(10)=[2,5,7,1]

y(11)=[3,1]

y(12)=[2,5,7,1]

y(13)=[2,7,1]

y(14)=[1]

So, for example:

'CCSM4\_NCAR\_137\_sfc\_ann\_um.nc’ is filename (3,0) which is CCSM3\_NCAR, 125k, annual mean, 2m air temperature.

‘ECHAM5\_ZMAW\_lig\_sst\_jja\_um.nc' is filename(5,0) which is COSMOS\_MPI, 125k, JJA, SST.

2m air temperature annual mean (replace ‘sfc’ with ‘sfcdjf, sfcjja’, ‘sfcmax’ for the DJF, JJA, and WMM equivalents). ‘\_um’ indicates that the file has been interpolated onto the resolution of the Met Office Unified Model, i.e. 96×72 gridpoints, 3.75o longitude × 2.5o latitude:

HadCM3\_Bris:

filename(0,0)='HADCM3\_BRIS\_tczjn\_sfc\_ann.nc'

filename(0,1)='HADCM3\_BRIS\_tczjo\_sfc\_ann.nc'

filename(0,2)='HADCM3\_BRIS\_tczjp\_sfc\_ann.nc'

filename(0,3)='HADCM3\_BRIS\_tczjl\_sfc\_ann.nc'

CCSM3\_Bremen:

filename(1,0)='CCSM3\_Bremen\_125\_125\_sfc\_ann\_um.nc'

filename(1,1)='CCSM3\_Bremen\_START\_PRE\_sfc\_ann\_um.nc'

CCSM3\_LLN:

filename(2,0)='CCSM3\_LLN\_127k\_sfc\_ann\_um.nc'

filename(2,1)='CCSM3\_LLN\_0k\_sfc\_ann\_um.nc'

CCSM3\_NCAR:

filename(3,0)='CCSM4\_NCAR\_137\_sfc\_ann\_um.nc'

filename(3,1)='CCSM4\_NCAR\_136\_sfc\_ann\_um.nc'

filename(3,2)='CCSM4\_NCAR\_020\_sfc\_ann\_um.nc'

COSMOS\_AWI:

filename(4,0)='COSMOS\_AWI\_130k\_sfc\_ann\_um.nc'

filename(4,1)='COSMOS\_AWI\_CTL\_0k\_sfc\_ann\_um.nc'

COSMOS\_MPI:

filename(5,0)='ECHAM5\_ZMAW\_lig\_sfc\_ann\_um.nc'

filename(5,1)='ECHAM5\_ZMAW\_piC\_sfc\_ann\_um.nc'

KCM\_Kiel:

filename(6,0)='KCM\_Kiehl\_E26\_sfc\_ann\_um.nc'

filename(6,1)='KCM\_Kiehl\_H0K\_sfc\_ann\_um.nc'

LOVECLIM\_Ams:

filename(7,0)='LOVECLIM\_Amsterdam/LOVECLIM\_Amsterdam\_125ka\_sfc\_ann\_um.nc'

filename(7,1)='LOVECLIM\_Amsterdam/LOVECLIM\_Amsterdam\_130ka\_sfc\_ann\_um.nc'

filename(7,2)='LOVECLIM\_Amsterdam/LOVECLIM\_Amsterdam\_PI\_sfc\_ann\_um.nc'

LOVECLIM\_LLN:

filename(8,0)='LOVECLIM\_LLN/LOVECLIM\_LLN\_127k\_sfc\_ann\_um.nc'

filename(8,1)='LOVECLIM\_LLN/LOVECLIM\_LLN\_0k\_sfc\_ann\_um.nc'

MIROC\_Tokyo:

filename(9,0)=’MIROC\_Tokyo/MIROC\_Tokyo\_125ka-lpj\_sfc\_ann\_um.nc'

filename(9,1)='MIROC\_Tokyo/MIROC\_Tokyo\_ctl\_sfc\_ann\_um.nc'

CLIMBER\_LSCE:

filename(10,0)='CLIMBER\_LSCE\_125K\_AOV\_PSI0\_sfc\_ann\_um.nc'

filename(10,1)='CLIMBER\_LSCE\_128K\_AOV\_PSI0\_sfc\_ann\_um.nc'

filename(10,2)='CLIMBER\_LSCE\_130K\_AOV\_PSI0\_sfc\_ann\_um.nc'

filename(10,3)='CLIMBER\_LSCE\_PI\_AOV\_PSI0\_sfc\_ann\_um.nc'

IPSL\_LSCE:

filename(11,0)='IPSL\_LSCE\_I126K02\_sfc\_ann\_um.nc'

filename(11,1)='IPSL\_LSCE\_2L24\_sfc\_ann\_um.nc'

CSIRO\_UNSW:

filename(12,0)='CSIRO\_UNSW\_125ka\_sfc\_ann\_um.nc'

filename(12,1)='CSIRO\_UNSW\_128ka\_sfc\_ann\_um.nc'

filename(12,2)='CSIRO\_UNSW\_130ka\_sfc\_ann\_um.nc'

filename(12,3)='CSIRO\_UNSW\_0ka\_sfc\_ann\_um.nc'

NORESM\_BCCR:

filename(13,0)='NORESM\_Bergen\_125k\_sfc\_ann\_um.nc'

filename(13,1)='NORESM\_Bergen\_130k\_sfc\_ann\_um.nc'

filename(13,2)='NORESM\_Bergen\_PI\_sfc\_ann\_um.nc'

NCEP:

filename(14,0)='NCEP\_airs\_ann\_um.nc'

SST annual mean (replace ‘sfc’ with ‘sfcdjf, sfcjja’, ‘sfcmax’ for the DJF, JJA, and WMM equivalents). ‘\_um’ indicates that the file has been interpolated onto the resolution of the Met Office Unified Model, i.e. 96×72 gridpoints, 3.75o longitude × 2.5o latitude:

HADCM3\_Bris:

filename(0,0)='HADCM3\_BRIS\_tczjn\_sst\_ann.nc'

filename(0,1)='HADCM3\_BRIS\_tczjo\_sst\_ann.nc'

filename(0,2)='HADCM3\_BRIS\_tczjp\_sst\_ann.nc'

filename(0,3)='HADCM3\_BRIS\_tczjl\_sst\_ann.nc'

CCSM3\_Bremen:

filename(1,0)='CCSM3\_Bremen\_125\_sst\_ann\_um.nc'

filename(1,1)='CCSM3\_Bremen\_PI\_sst\_ann\_um.nc'

CCSM3\_LLN:

filename(2,0)='CCSM3\_LLN\_127k\_sst\_ann\_um.nc'

filename(2,1)='CCSM3\_LLN\_0k\_sst\_ann\_um.nc'

CCSM3\_NCAR:

filename(3,0)='CCSM4\_NCAR\_137\_sst\_ann\_um.nc'

filename(3,1)='CCSM4\_NCAR\_136\_sst\_ann\_um.nc'

filename(3,2)='CCSM4\_NCAR\_020\_sst\_ann\_um.nc'

COSMOS\_AWI:

filename(4,0)='COSMOS\_AWI\_130k\_sst\_ann\_um.nc'

filename(4,1)='COSMOS\_AWI\_CTL\_0k\_sst\_ann\_um.nc'

COSMOS\_MPI:

filename(5,0)='ECHAM5\_ZMAW\_lig\_sst\_ann\_um.nc'

filename(5,1)='ECHAM5\_ZMAW\_piC\_sst\_ann\_um.nc'

KCM\_Kiel:

filename(6,0)='KCM\_Kiehl\_E26\_sst\_ann\_um.nc'

filename(6,1)='KCM\_Kiehl\_H0K\_sst\_ann\_um.nc'

LOVECLIM\_Ams:

filename(7,0)='LOVECLIM\_Amsterdam\_125ka\_sst\_ann\_um.nc'

filename(7,1)='LOVECLIM\_Amsterdam\_130ka\_sst\_ann\_um.nc'

filename(7,2)='LOVECLIM\_Amsterdam\_PI\_sst\_ann\_um.nc'

LOVECLIM\_LLN:

filename(8,0)='LOVECLIM\_LLN\_127k\_sst\_ann\_um.nc'

filename(8,1)='LOVECLIM\_LLN\_0k\_sst\_ann\_um.nc'

MIROC\_Tokyo:

filename(9,0)='MIROC\_Tokyo\_125ka-lpj\_sst\_ann\_um.nc'

filename(9,1)='MIROC\_Tokyo\_ctl\_sst\_ann\_um.nc'

CLIMBER\_LSCE:

filename(10,0)='CLIMBER\_LSCE\_125K\_AOV\_PSI0\_sfc\_ann\_um.nc'

filename(10,1)='CLIMBER\_LSCE\_128K\_AOV\_PSI0\_sfc\_ann\_um.nc'

filename(10,2)='CLIMBER\_LSCE\_130K\_AOV\_PSI0\_sfc\_ann\_um.nc'

filename(10,3)='CLIMBER\_LSCE\_PI\_AOV\_PSI0\_sfc\_ann\_um.nc'

IPSL\_LSCE:

filename(11,0)='IPSL\_LSCE\_I126K02\_sst\_ann\_um.nc'

filename(11,1)=' IPSL\_LSCE\_2L24\_sst\_ann\_um.nc'

CSIRO\_UNSW:

filename(12,0)='CSIRO\_UNSW\_125ka\_sst\_ann\_um.nc'

filename(12,1)='CSIRO\_UNSW\_128ka\_sst\_ann\_um.nc'

filename(12,2)='CSIRO\_UNSW\_130ka\_sst\_ann\_um.nc'

filename(12,3)='CSIRO\_UNSW\_0ka\_sst\_ann\_um.nc'

NORESM\_BCCR:

filename(13,0)='NORESM\_Bergen\_125k\_sst\_ann\_um.nc'

filename(13,1)='NORESM\_Bergen\_130k\_sst\_ann\_um.nc'

filename(13,2)='NORESM\_Bergen\_PI\_sst\_ann\_um.nc'

HadISST:

filename(14,0)='HadISST\_sst\_ann\_um.nc'

**(3) Directory ‘netcdf\_data\_for\_ensemble’ contains netcdf data for the ensemble.**

‘sfc’ is near-surface air temperature. ‘sst’ is SST.

‘’, ‘djf’, ‘jja’, and ‘max’ are annual mean, DJF, JJA, and WMM respectively.

**(4) Directory ‘zonal\_mean\_data\_for\_ensemble’ contains ascii data for the ensemble.**

‘sfc’ is near-surface air temperature. ‘sst’ is SST.

‘’, ‘djf’, ‘jja’, and ‘max’ are annual mean, DJF, JJA, and WMM respectively.

The data are in 3 columns, from left to right: (a) latitude, (b) temperature anomaly relative to preindustrial, (c) one inter-model standard deviation of (b).