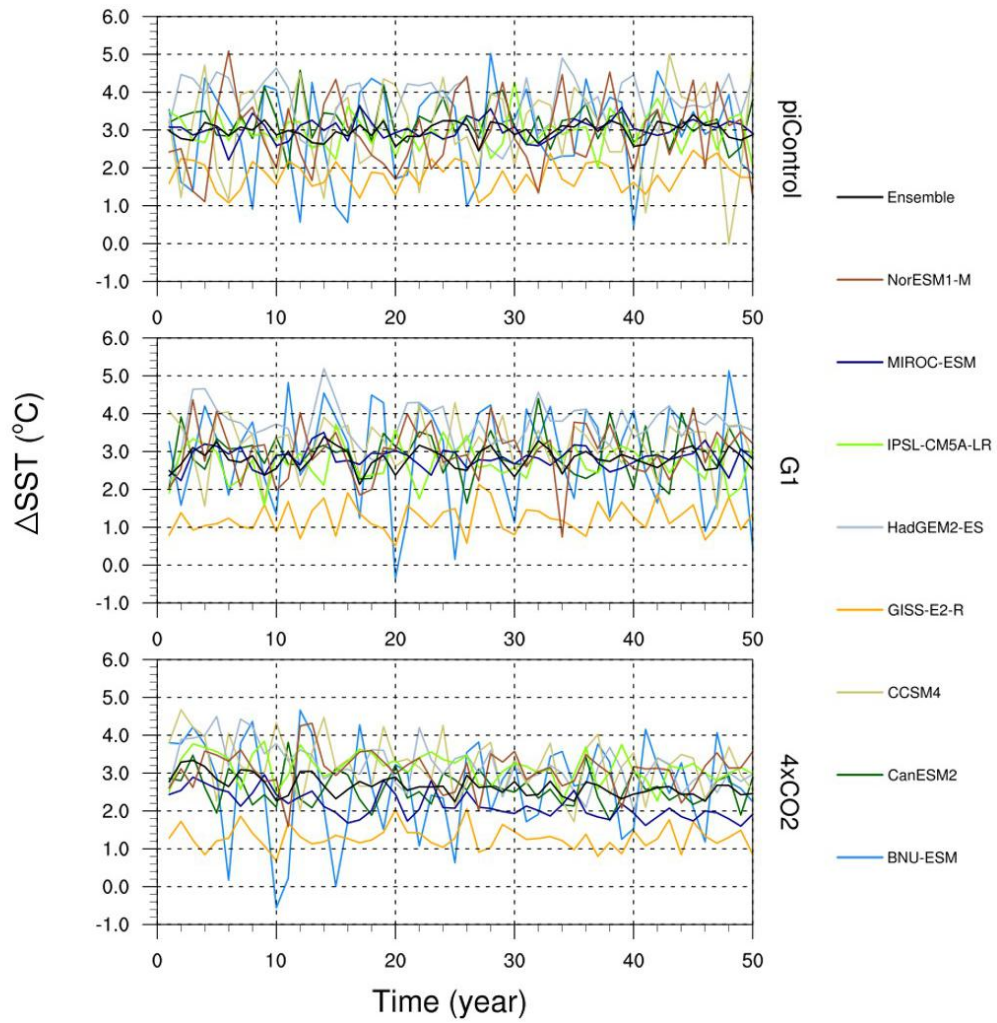


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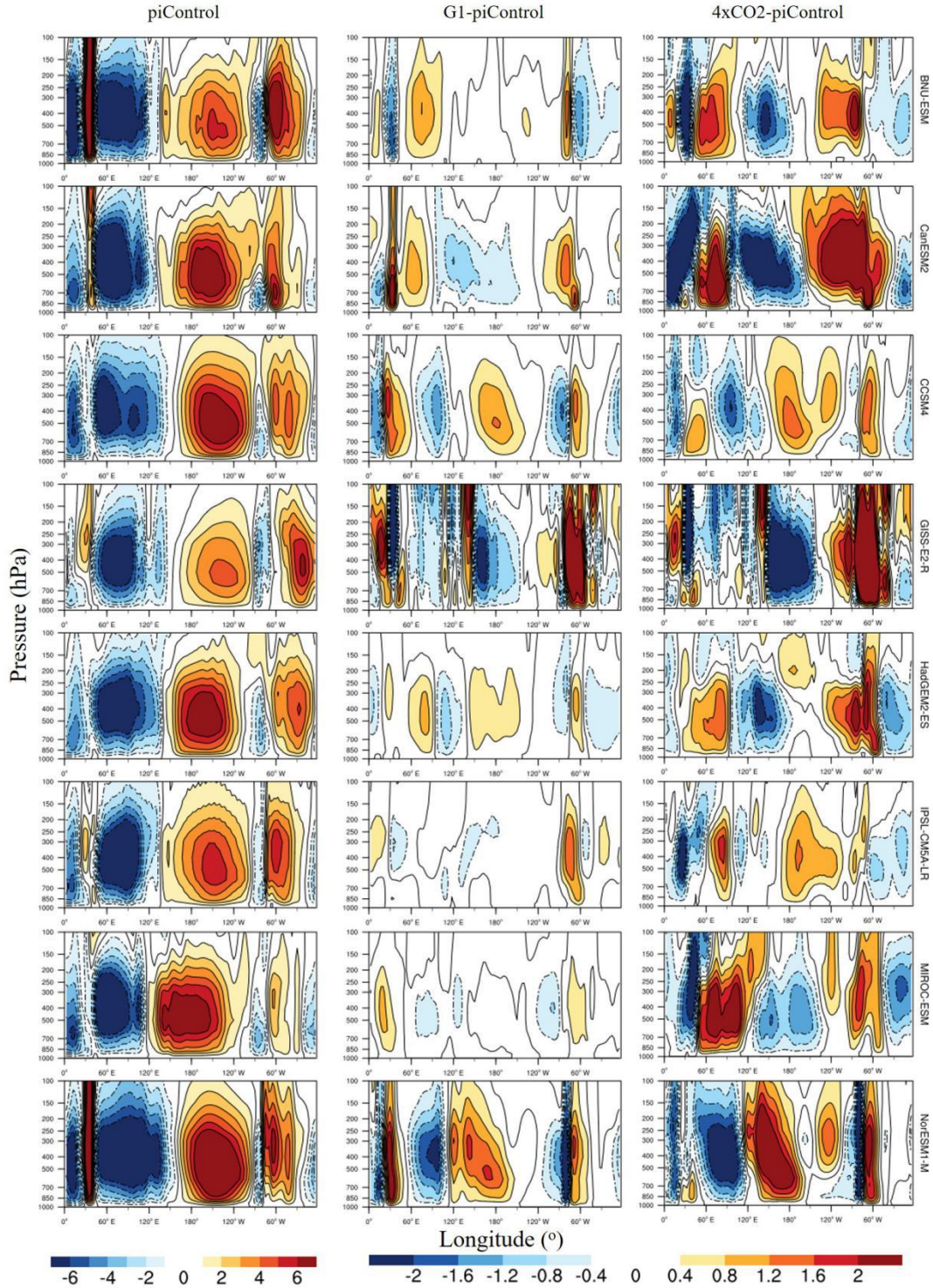
2 **Figure S1.** Time series of the monthly Walker circulation intensity based on the STRF
 3 index, that is the vertically averaged value of the stream function ψ_z over the western
 4 and central Pacific ($150^\circ\text{E} - 150^\circ\text{W}$), and between 1000 – 100 hPa ($10^{10} \text{ kg s}^{-1}$).
 5 Different colored lines represent different models. Note the lack of obvious transients
 6 at the start of the simulations. Some models (BNU-ESM, CanESM2, GISS-E2-R,
 7 MIROC-ESM, HadGEM2-ES) have strong annual variability in STRF, while others
 8 show weak seasonality (CCSM4, NorESM1-M, IPSL-CM5A-LR).

9



10

11 **Figure S2.** Time series of the annual Walker circulation intensity indices based on the
 12 Δ SST index. Different colored lines represent different models.



13

14 **Figure S3.** The mean state of Walker circulation during 50 years in three experiments

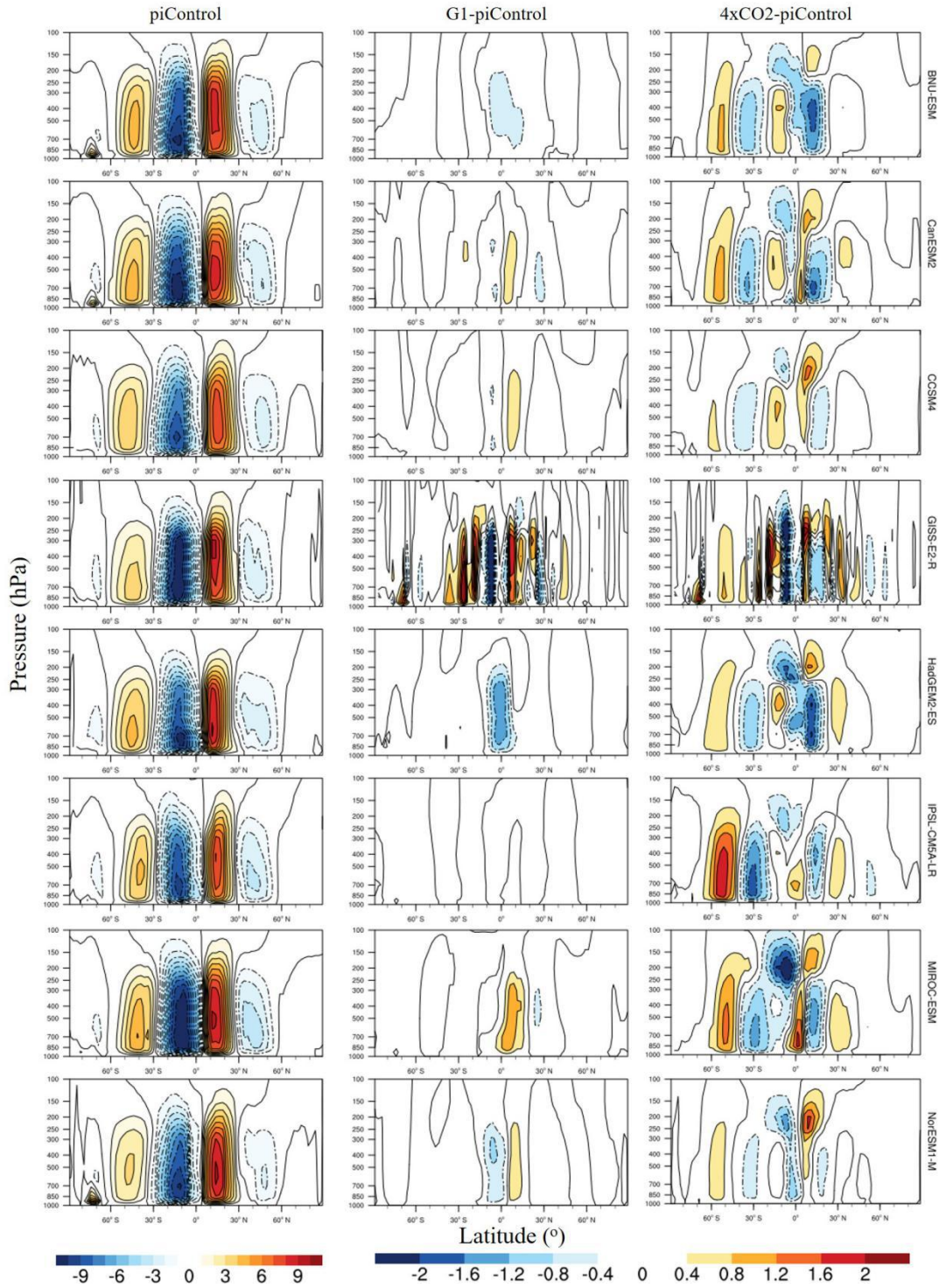
15 for the 8 models. Color bar indicates the value of averaged zonal mass

16 stream-function ($10^{10} \text{ kg s}^{-1}$). Left shows *piControl*, while center and right column

17 respectively indicate the anomalies relative to *piControl* for *G1* and *abrupt4xCO₂*

18 experiments. Warm color (positive values) indicate a clockwise rotation and cold
 19 color (negative values) indicate an anticlockwise rotation.

20

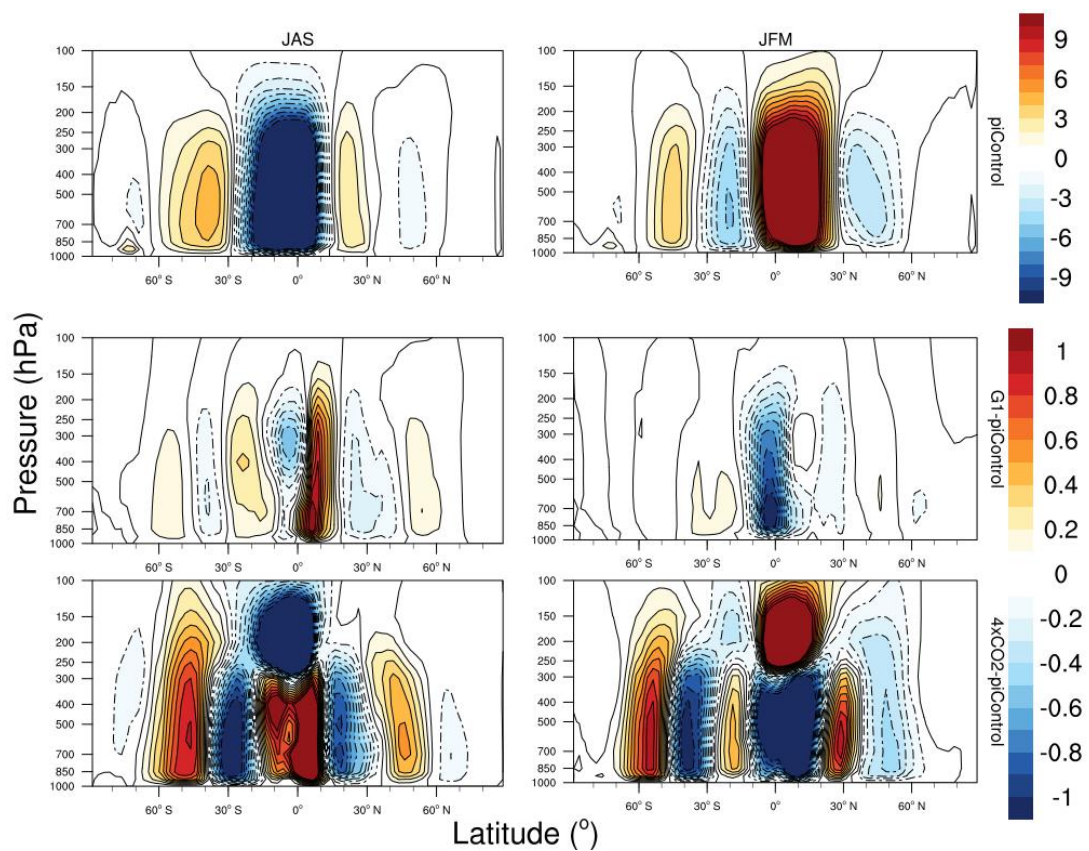


21

22 **Figure S4.** The mean state of Hadley circulation during 50 years in three experiments

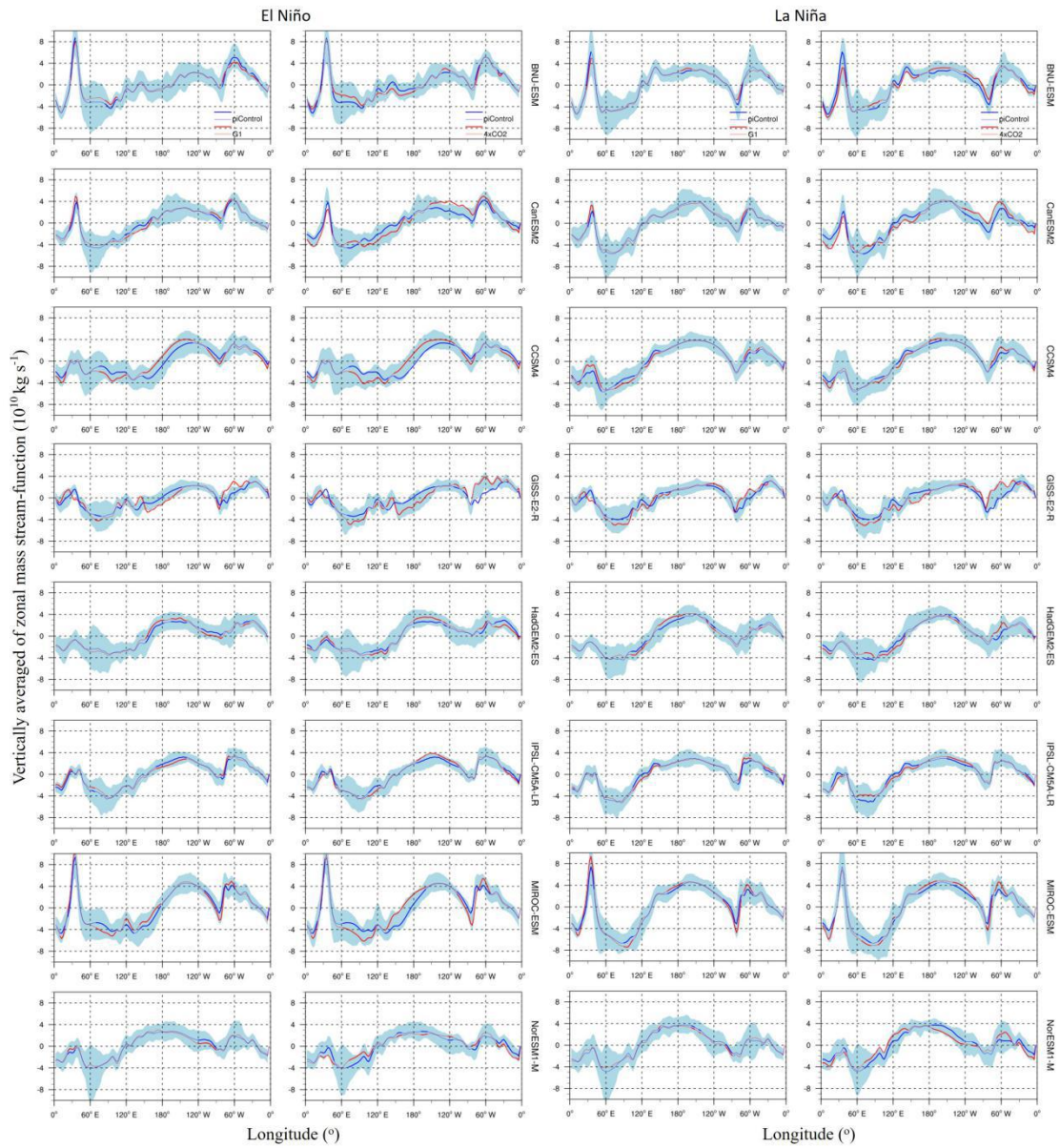
23 for the 8 models. Color bar indicates the value of averaged meridional mass
 24 stream-function ($10^{10} \text{ kg s}^{-1}$). Left shows *piControl*, while center and right column
 25 respectively indicate the anomalies relative to *piControl* for *G1* and *abrupt4* \times *CO*₂
 26 experiments. Warm color (positive values) indicate a clockwise rotation and cold
 27 color (negative values) indicate an anticlockwise rotation.

28



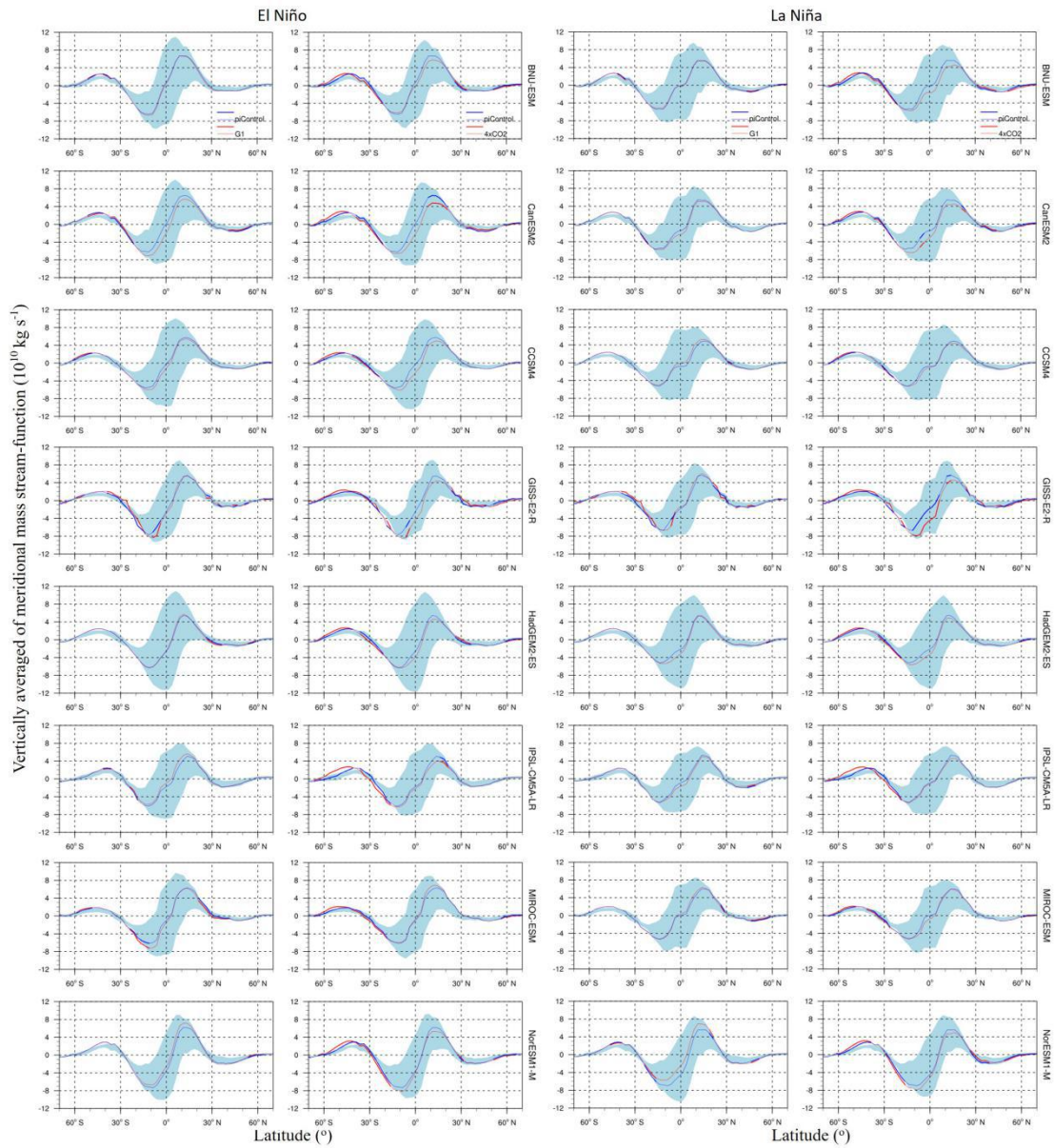
29

30 **Figure S5.** Model ensemble mean meridional stream-function without GISS-E2-R in
 31 JAS (left) and JFM (right). Top shows *piControl*, while center and bottom row
 32 respectively indicate the anomalies relative to *piControl* for *G1* and *abrupt4* \times *CO*₂
 33 experiments. Color bar indicates the value of averaged meridional mass
 34 stream-function ($10^{10} \text{ kg s}^{-1}$). Warm colors (positive values) indicate a clockwise
 35 rotation and cold colors (negative values) indicate an anticlockwise rotation.



37

38 **Figure S6.** The vertically averaged of zonal mass stream-function under ENSO. For
 39 El Niño or La Niña conditions, blue line in each panel represent the vertically
 40 averaged of zonal mass stream-function ($10^{10} \text{ kg s}^{-1}$) under *piControl*. Red line in left
 41 two column is *G1* and right two column *abrupt4xCO2*. Thick lines denote locations
 42 where circulation changes are significant at the 95% confidence level. The 16%-84%
 43 range across the 8 individual models are show by light blue shading.



45

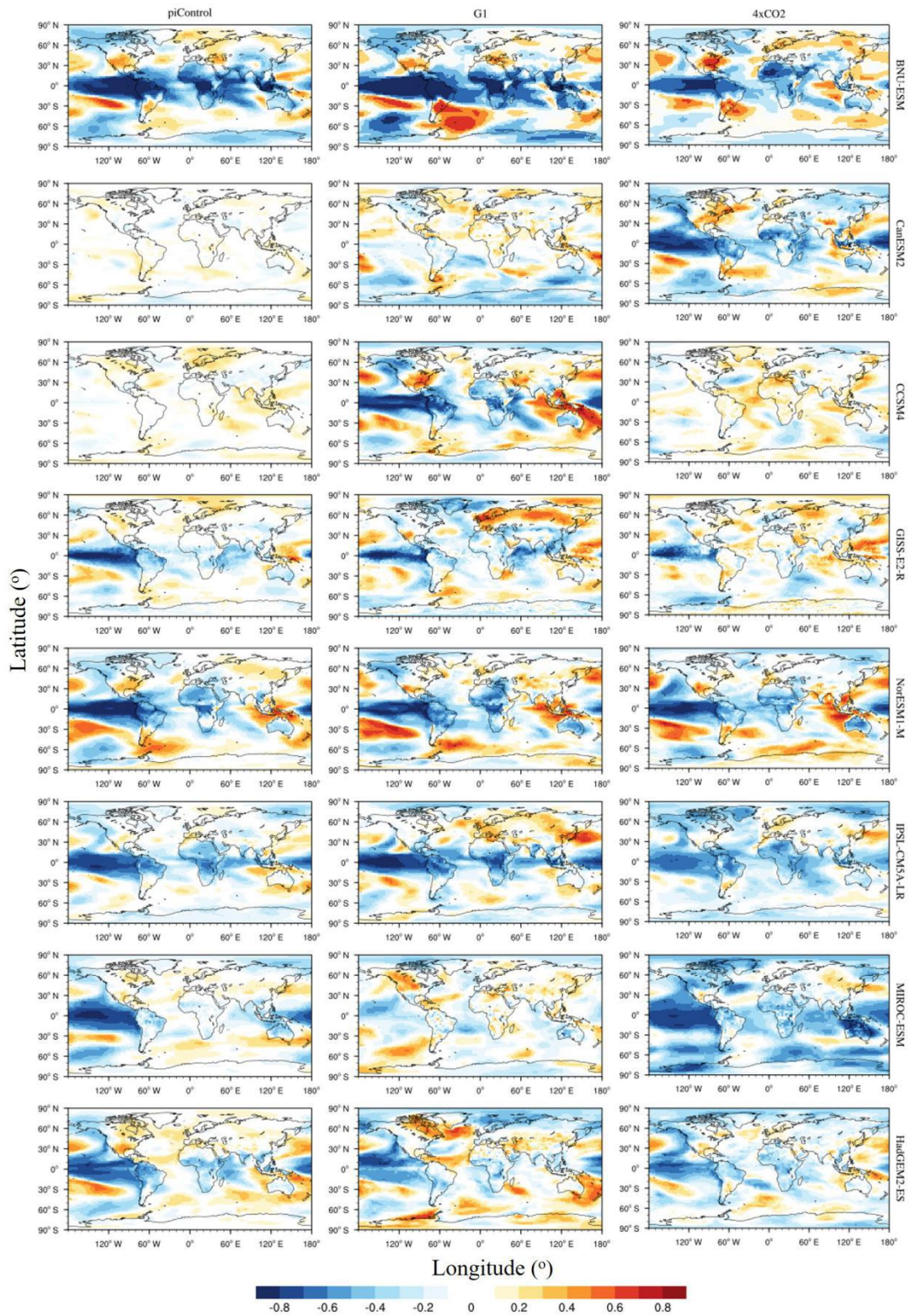
46 **Figure S7.** The vertically averaged of meridional mass stream-function under ENSO.

47 For El Niño or La Niña conditions, blue line in each panel represent the vertically

48 averaged of zonal mass stream-function ($10^{10} \text{ kg s}^{-1}$) under *piControl*. Red line in left49 two column is *G1* and right two column *abrupt4xCO₂*. Thick lines denote locations

50 where circulation changes are significant at the 95% confidence level. The 16%-84%

51 range across the 8 individual models are show by light blue shading.

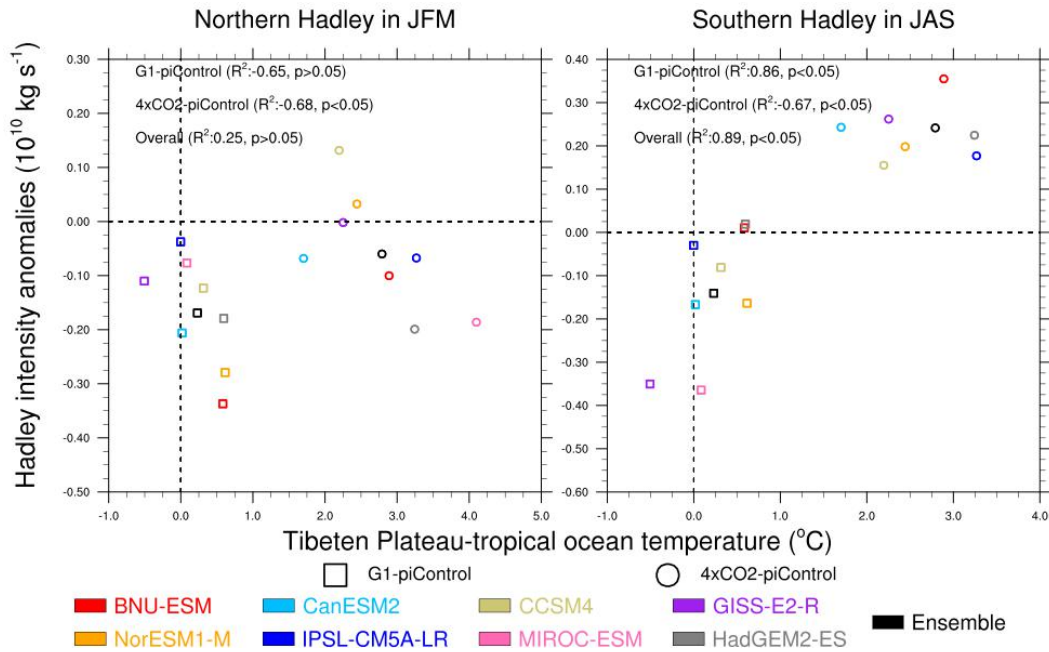


53

54 **Figure S8.** Mean correlation between yearly STRF and global gridded 2 m
 55 temperatures for 100 years of piControl (left column), and 30 years of G1 (middle

56 column) and abrupt4×CO₂ (right column) experiments for 8 models.

57



58

59 **Figure S9.** Hadley intensity mean model anomalies versus the Tibetan Plateau
60 (26°N-39°N, 73°E-104°E) minus tropical ocean (5°S-5°N, 180°W-180°E)
61 temperature for the northern Hadley cell (left) in JFM and the southern Hadley cell in
62 JAS (right). Positive value of Hadley intensity indicate Hadley circulation
63 strengthening regardless of the direction.