



**AMS**  
American Meteorological Society

## Supplemental Material

© Copyright 2022 American Meteorological Society (AMS)

For permission to reuse any portion of this work, please contact [permissions@ametsoc.org](mailto:permissions@ametsoc.org). Any use of material in this work that is determined to be “fair use” under Section 107 of the U.S. Copyright Act (17 USC §107) or that satisfies the conditions specified in Section 108 of the U.S. Copyright Act (17 USC §108) does not require AMS’s permission. Republication, systematic reproduction, posting in electronic form, such as on a website or in a searchable database, or other uses of this material, except as exempted by the above statement, requires written permission or a license from AMS. All AMS journals and monograph publications are registered with the Copyright Clearance Center (<https://www.copyright.com>). Additional details are provided in the AMS Copyright Policy statement, available on the AMS website (<https://www.ametsoc.org/PUBSCopyrightPolicy>).

1 **LIST OF TABLES**

2 **Table S1.** The SW modeling experiments for isolating the contribution from different  
3 tropical ocean basins in forming the springtime North Pacific ENSO telecon-  
4 nection bias during La Niña events. Basic state is the FM climatology of winds  
5 and temperature during 1958 to 2010. Diabatic heating anomalies is compos-  
6 ited during FM of the La Niña years. . . . . 2

7 Table S1. The SW modeling experiments for isolating the contribution from different tropical ocean basins in  
8 forming the springtime North Pacific ENSO teleconnection bias during La Niña events. Basic state is the FM  
9 climatology of winds and temperature during 1958 to 2010. Diabatic heating anomalies is composited during

10 FM of the La Niña years.

Experiment Name	Heating
LN_trop	TOGA–JRA (15°S-15°N)
LN_IO	TOGA–JRA (15°S-15°N, 40°E-110°E)
LN_WP	TOGA–JRA (15°S-15°N, 110°E-180°)
LN_CP	TOGA–JRA (15°S-15°N, 180°-110°W)

11

12 **LIST OF FIGURES**

13 **Fig. S1.** Stationary wave components of the 1000 hPa (left) and 300 hPa (right) stream  
 14 function anomalies simulated by (a) (d) “TOGA\_H+JRA\_T+JRA\_B”, (b) (e)  
 15 “JRA\_H+TOGA\_T+JRA\_B”, (c) (f) “JRA\_H+JRA\_T+TOGA\_B” experiments in Ta-  
 16 ble 1. . . . . 4

17 **Fig. S2.** Stationary wave components of the 300 hPa stream function anomalies simulated  
 18 by (a) “TOGA\_H+TOGA\_T+JRA\_B” experiment, and (b) the difference between  
 19 “TOGA\_H+TOGA\_T+JRA\_B” and “JRA\_all” experiments. . . . . 5

20 **Fig. S3.** Stationary wave components of the 1000 hPa (left) and 300 hPa (right) stream function  
 21 anomalies simulated by (a) (d) “JRA\_trop”, (b) (e) “TOGA\_trop” experiments in Table 2;  
 22 (c) (f) their difference. . . . . 6

23 **Fig. S4.** Stationary wave components of the 1000 hPa (left) and 300 hPa (right) stream function  
 24 anomalies simulated by (a) (d) “JRA\_xtrop”, (b) (e) “TOGA\_xtrop” experiments in Table 2;  
 25 (c) (f) their difference. . . . . 7

26 **Fig. S5.** Tropical diabatic heating during El Niño events for (a) JRA55’s DJ average, (b) JRA55’s  
 27 FM average, (c) CESM1 TOGA simulations’ DJ average, (d) CESM1 TOGA simulation’s  
 28 FM average. The top panels are for the vertical cross section averaged over 15°S-15°N. The  
 29 bottom panels are for the horizontal distribution at 500 hPa. . . . . 8

30 **Fig. S6.** Tropical diabatic heating bias in CESM1 TOGA simulations when compared to (a) JRA55,  
 31 (b) NCEP-NCAR (R1), (c) ERA20C, (d) ERAI, (e) ERA5, and (f) CFSR datasets during  
 32 FM of the El Niño events in 1980–2009. . . . . 9

33 **Fig. S7.** Similar to Fig.6 but by imposing the CP diabatic heating biases (a)-(b) north (0°-15°N,  
 34 180°-110°W) and (c)-(d) south (15°S-0°, 180°-110°W) of the equator separately. . . . . 10

35 **Fig. S8.** Evolution of the tropical diabatic heating bias by applying the iterative bias-correction tech-  
 36 nique. . . . . 11

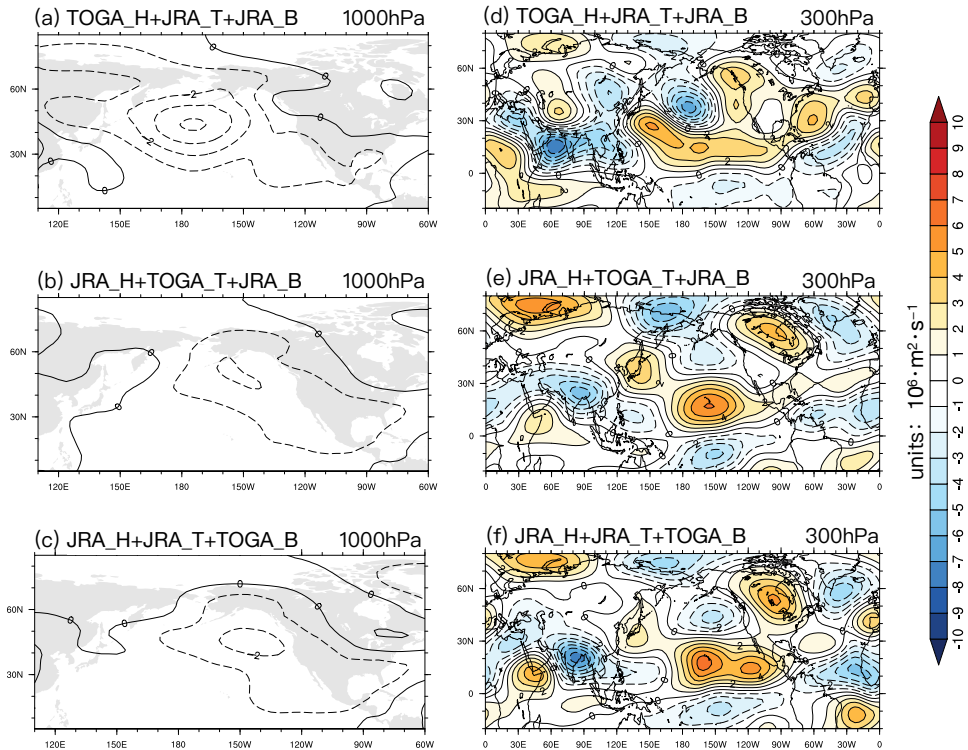
37 **Fig. S9.** Stationary wave components of the 300 hPa stream function anomalies simulated by the SW  
 38 model for understanding the residual North Pacific cyclonic circulation bias seen in “*iter 9*”  
 39 (Fig. 11). Only the diabatic heating bias over the CP in “*iter 9*” (Fig. 9(j)) is used to force  
 40 the SW model. . . . . 12

41 **Fig. S10.** Extratropical diabatic heating bias in (a) NINO and (b) “*iter 9*” experiment. the area that  
 42 exceeds 95% confidence level is stippled. . . . . 13

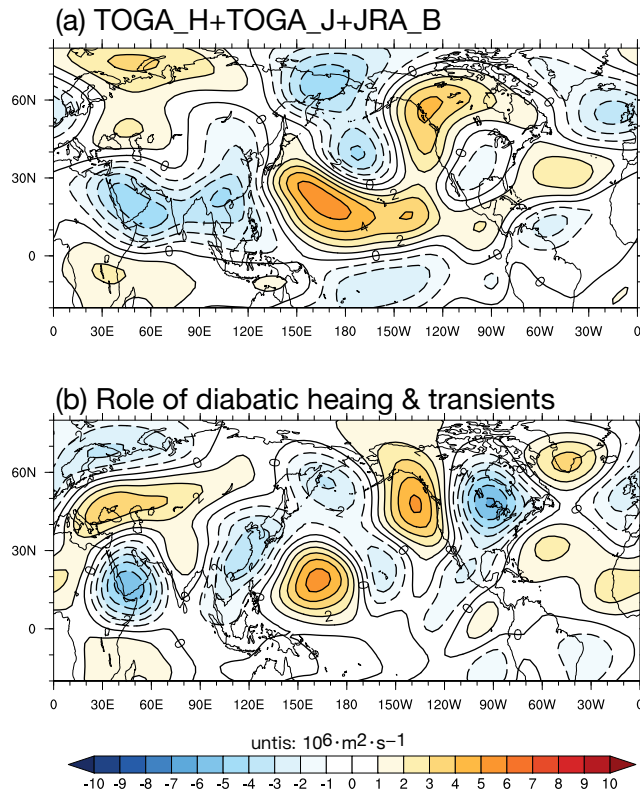
43 **Fig. S11.** (a) DJ and (b) FM-averaged tropical diabatic heating bias in CESM1 TOGA simulations  
 44 during La Niña events from 1958 to 2010. The top panels are for the vertical cross section  
 45 averaged over 15°S-15°N. The bottom panels are for the horizontal distribution at 500 hPa.  
 46 The area that exceeds 95% confidence level is stippled. . . . . 14

47 **Fig. S12.** Stationary wave components of the 300 hPa stream function anomalies simulated by (a)  
 48 “LN\_trop”, (b) “LN\_IO”, (c) “LN\_WP”, and (d) “LN\_CP” experiments in Table S1. . . . . 15

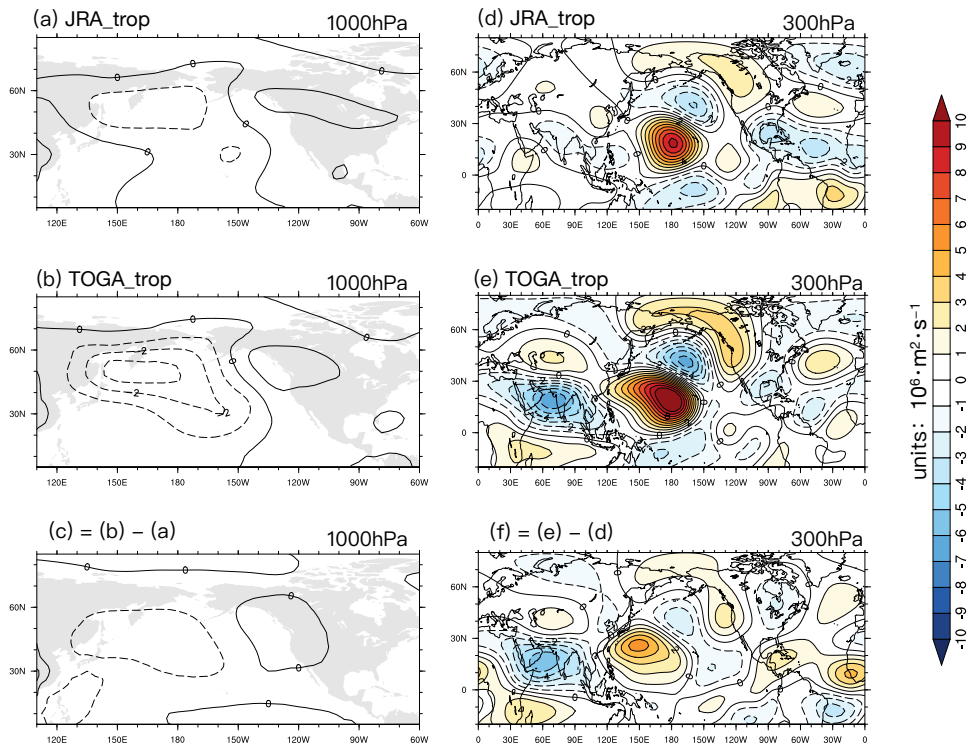




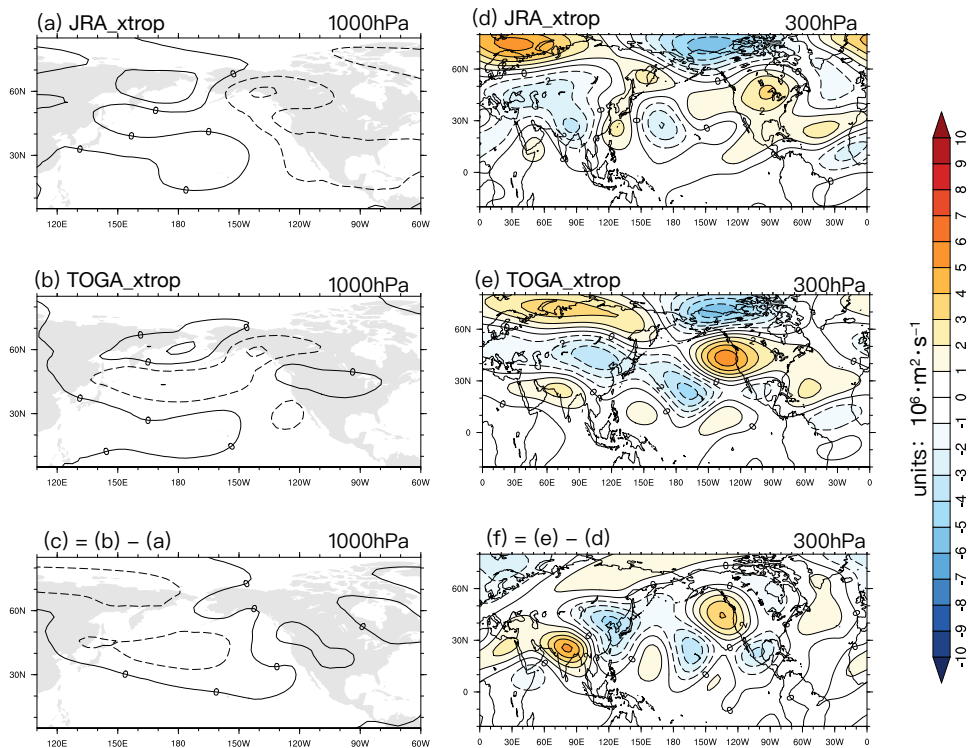
49 Fig. S1. Stationary wave components of the 1000hPa (left) and 300hPa (right) stream function  
 50 anomalies simulated by (a) (d) “TOGA\_H+JRA\_T+JRA\_B”, (b) (e) “JRA\_H+TOGA\_T+JRA\_B”, (c) (f)  
 51 “JRA\_H+JRA\_T+TOGA\_B” experiments in Table 1.



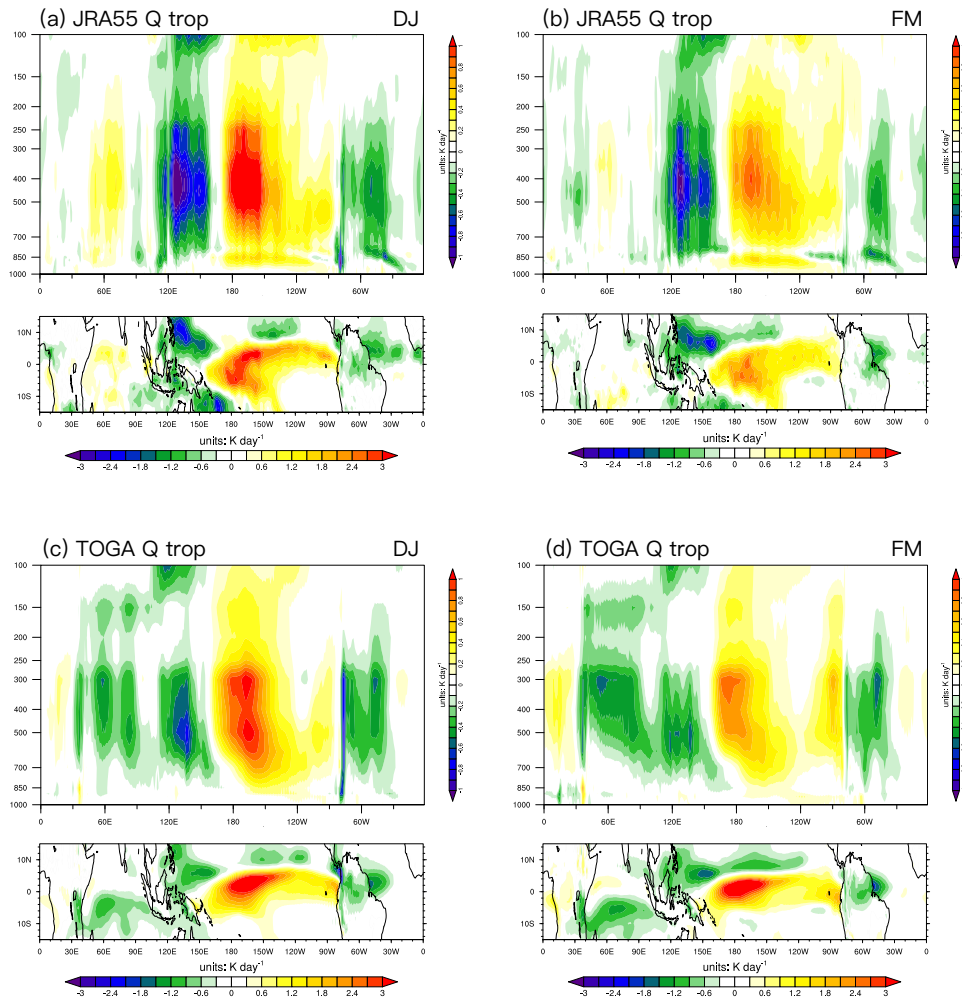
52 Fig. S2. Stationary wave components of the 300 hPa stream function anomalies simulated by (a)  
 53 “TOGA\_H+TOGA\_T+JRA\_B” experiment, and (b) the difference between “TOGA\_H+TOGA\_T+JRA\_B” and  
 54 “JRA\_all” experiments.



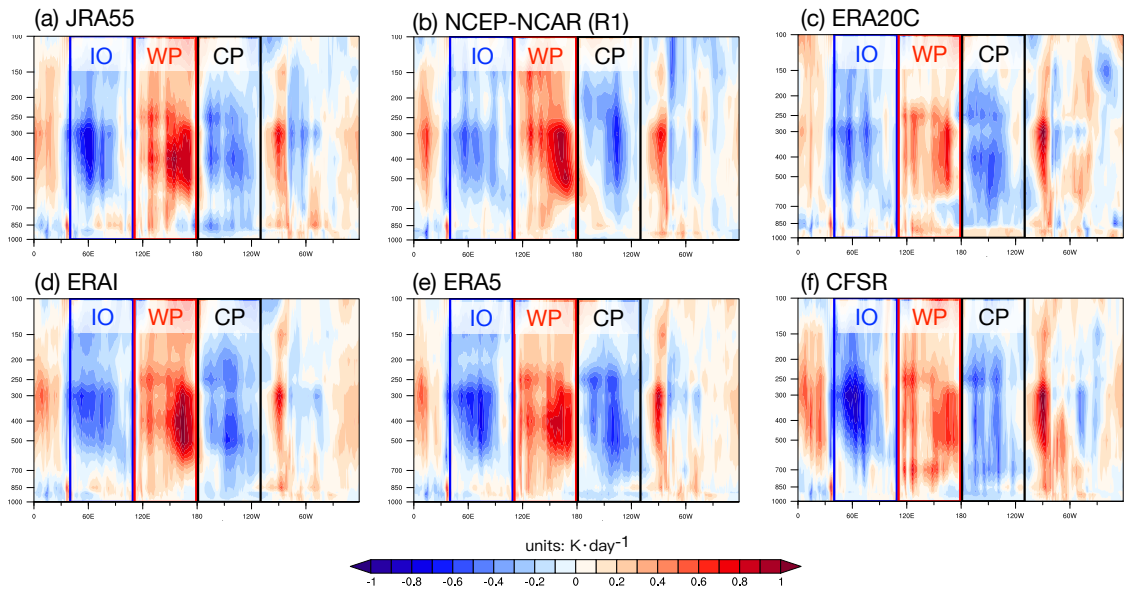
55 Fig. S3. Stationary wave components of the 1000 hPa (left) and 300 hPa (right) stream function anomalies  
 56 simulated by (a) (d) “JRA\_trop”, (b) (e) “TOGA\_trop” experiments in Table 2; (c) (f) their difference.



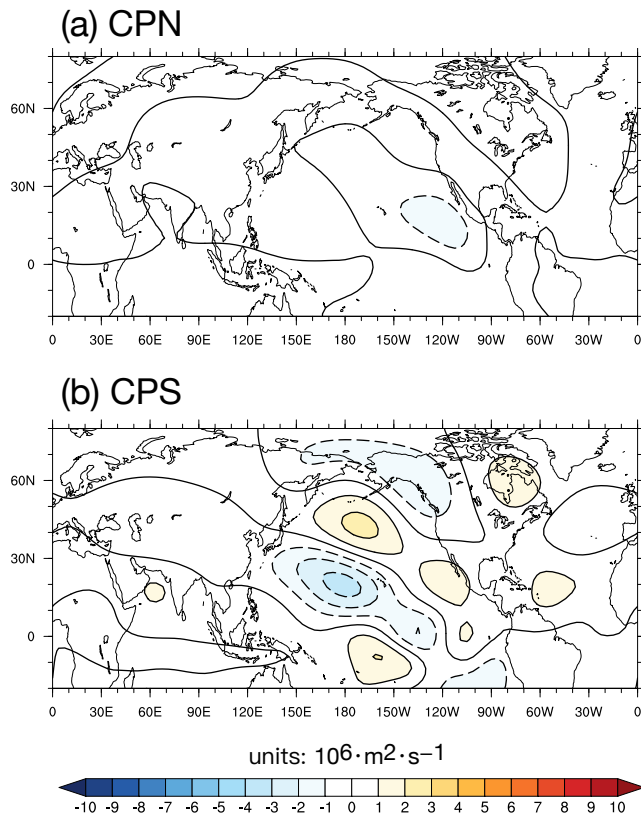
57 Fig. S4. Stationary wave components of the 1000 hPa (left) and 300 hPa (right) stream function anomalies  
 58 simulated by (a) (d) “JRA\_xtrop”, (b) (e) “TOGA\_xtrop” experiments in Table 2; (c) (f) their difference.



59 Fig. S5. Tropical diabatic heating during El Niño events for (a) JRA55's DJ average, (b) JRA55's FM  
 60 average, (c) CESM1 TOGA simulations' DJ average, (d) CESM1 TOGA simulation's FM average. The top  
 61 panels are for the vertical cross section averaged over 15°S-15°N. The bottom panels are for the horizontal  
 62 distribution at 500 hPa.



63 Fig. S6. Tropical diabatic heating bias in CESM1 TOGA simulations when compared to (a) JRA55, (b)  
 64 NCEP-NCAR (R1), (c) ERA20C, (d) ERAI, (e) ERA5, and (f) CFSR datasets during FM of the El Niño events  
 65 in 1980–2009.



66 Fig. S7. Similar to Fig.6 but by imposing the CP diabatic heating biases (a)-(b) north ( $0^\circ$ - $15^\circ\text{N}$ ,  $180^\circ$ - $110^\circ\text{W}$ )  
 67 and (c)-(d) south ( $15^\circ\text{S}$ - $0^\circ$ ,  $180^\circ$ - $110^\circ\text{W}$ ) of the equator separately.

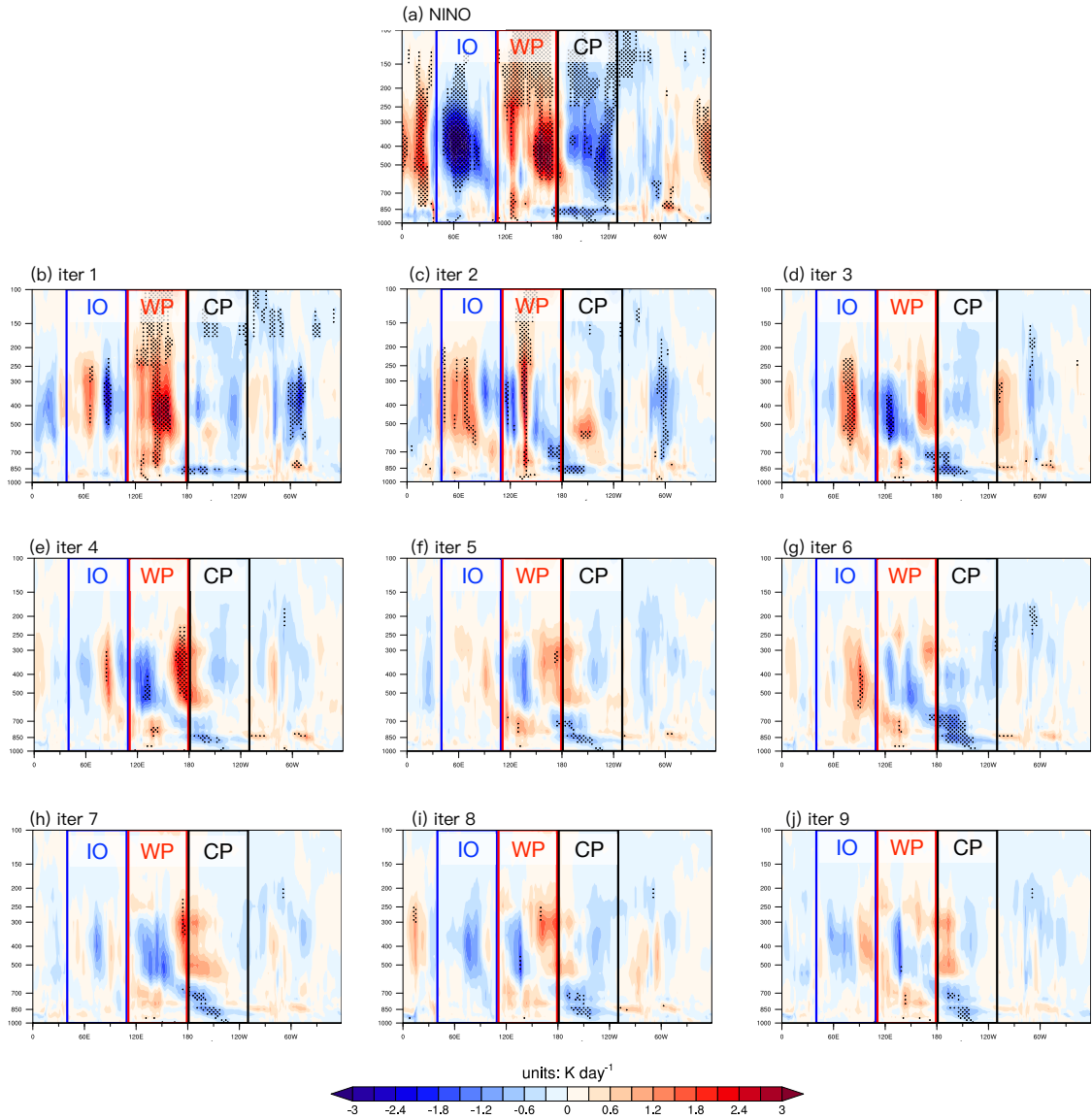
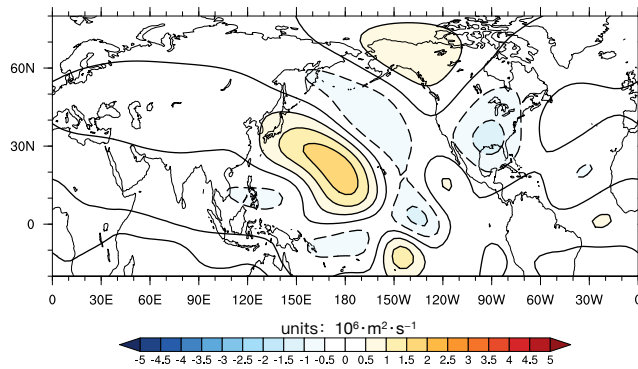
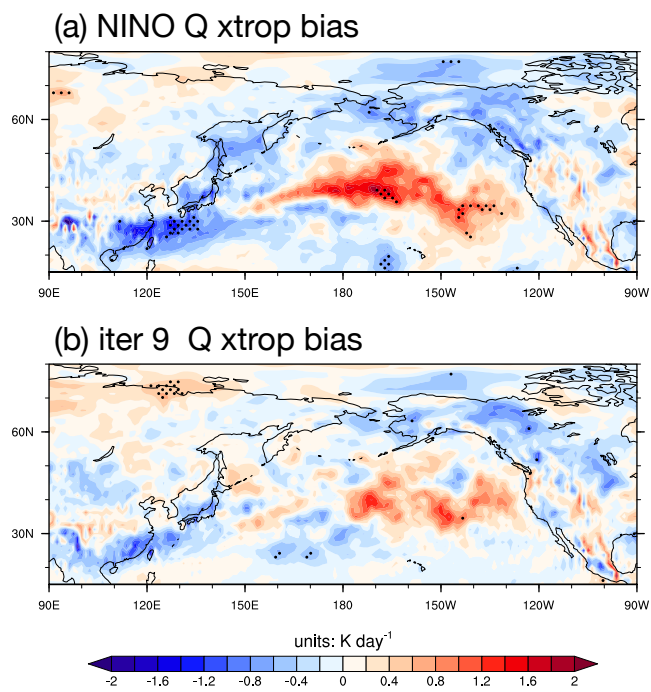


Fig. S8. Evolution of the tropical diabatic heating bias by applying the iterative bias-correction technique.

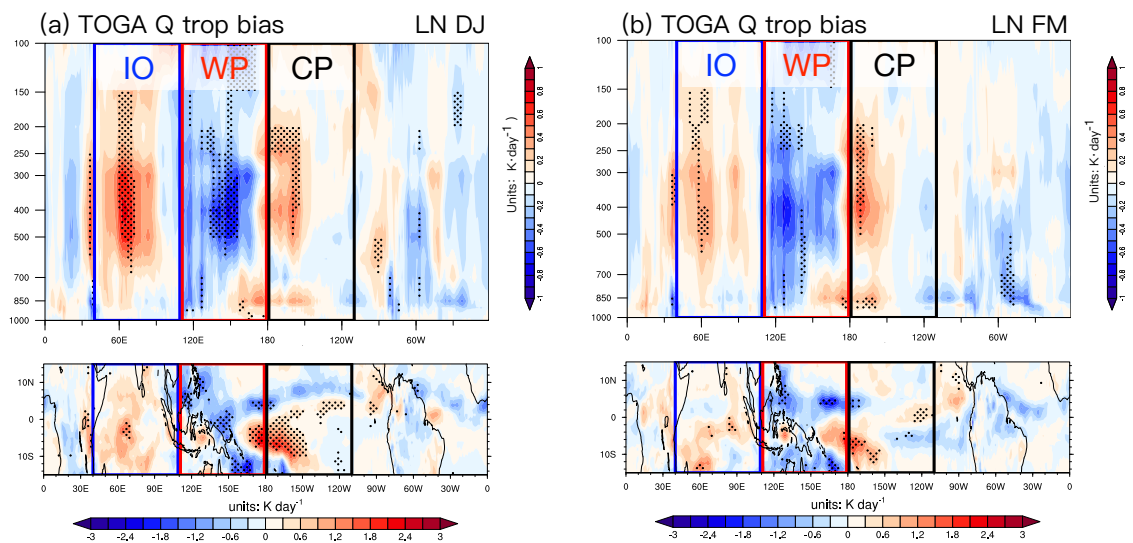




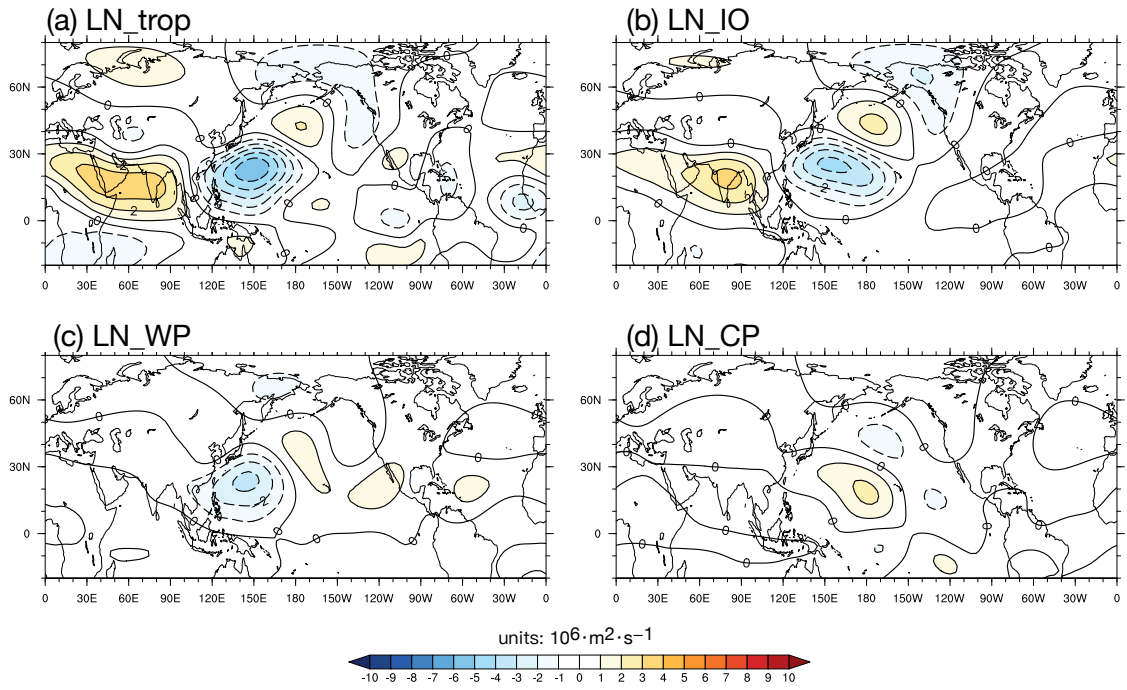
68 Fig. S9. Stationary wave components of the 300 hPa stream function anomalies simulated by the SW model  
 69 for understanding the residual North Pacific cyclonic circulation bias seen in “*iter 9*” (Fig. 11). Only the diabatic  
 70 heating bias over the CP in “*iter 9*” (Fig. 9(j)) is used to force the SW model.



71 Fig. S10. Extratropical diabatic heating bias in (a) NINO and (b) “*iter 9*” experiment. the area that exceeds  
 72 95% confidence level is stippled.



73 Fig. S11. (a) DJ and (b) FM-averaged tropical diabatic heating bias in CESM1 TOGA simulations during  
 74 La Niña events from 1958 to 2010. The top panels are for the vertical cross section averaged over 15°S-15°N.  
 75 The bottom panels are for the horizontal distribution at 500 hPa. The area that exceeds 95% confidence level is  
 76 stippled.



77 Fig. S12. Stationary wave components of the 300 hPa stream function anomalies simulated by (a) “LN\_trop”,  
 78 (b) “LN\_IO”, (c) “LN\_WP”, and (d) “LN\_CP” experiments in Table S1.