

Dominant Role of Atlantic Multi-decadal Oscillation in the Recent Decadal Changes in Western North Pacific Tropical Cyclone Activity

Wei Zhang^{1,*}, Gabriel A. Vecchi², Hiroyuki Murakami^{3,4}, Gabriele Villarini¹, Thomas L.
Delworth^{3,4}, Xiaosong Yang³, Liwei Jia⁵

¹IIHR-Hydroscience & Engineering, The University of Iowa, Iowa City, Iowa

²Department of Geosciences, Princeton University, Princeton, NJ, USA

³National Oceanic and Atmospheric Administration/Geophysical Fluid Dynamics Laboratory,
Princeton, NJ, USA

⁴Atmospheric and Oceanic Sciences Program, Princeton University, Princeton, NJ, USA

⁵Climate Prediction Center, NOAA/NWS/NCEP, College Park, and Innovim, LLC, Greenbelt,
Maryland

*email: wei-zhang-3@uiowa.edu

Supplementary Information

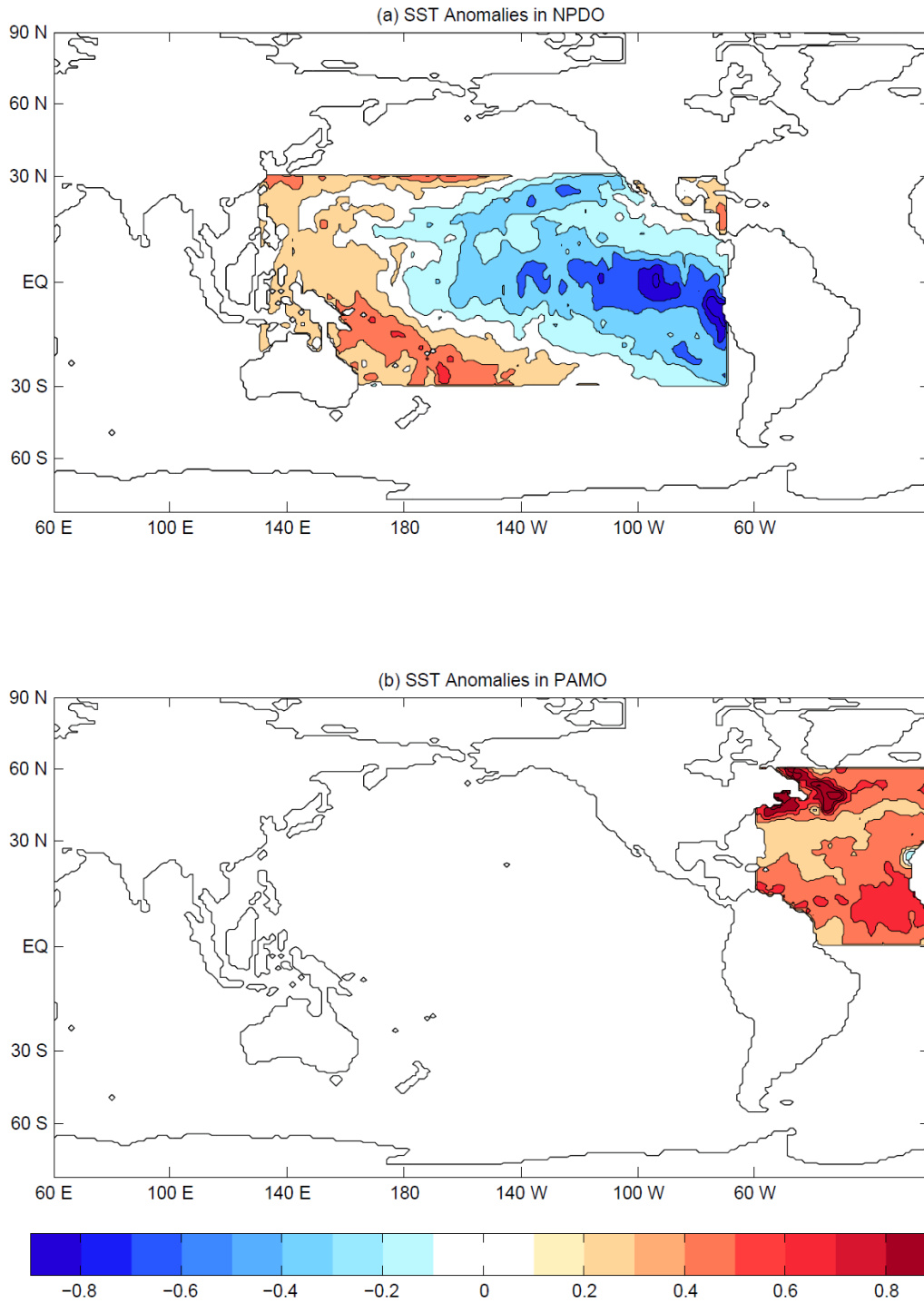


Figure S1. The SST anomalies (shading, unit: $^{\circ}\text{C}$) added in the (a) NPDO and (b) PAMO perturbation experiments for September. The annual cycle of SST anomalies for PAMO and NPDO are defined as the anomalies of SST averaged over the years with positive AMO and negative PDO, respectively. The spatial patterns of SST anomalies associated with NPDO and PAMO are similar to the regression of SST onto the PDO and AMO indices.

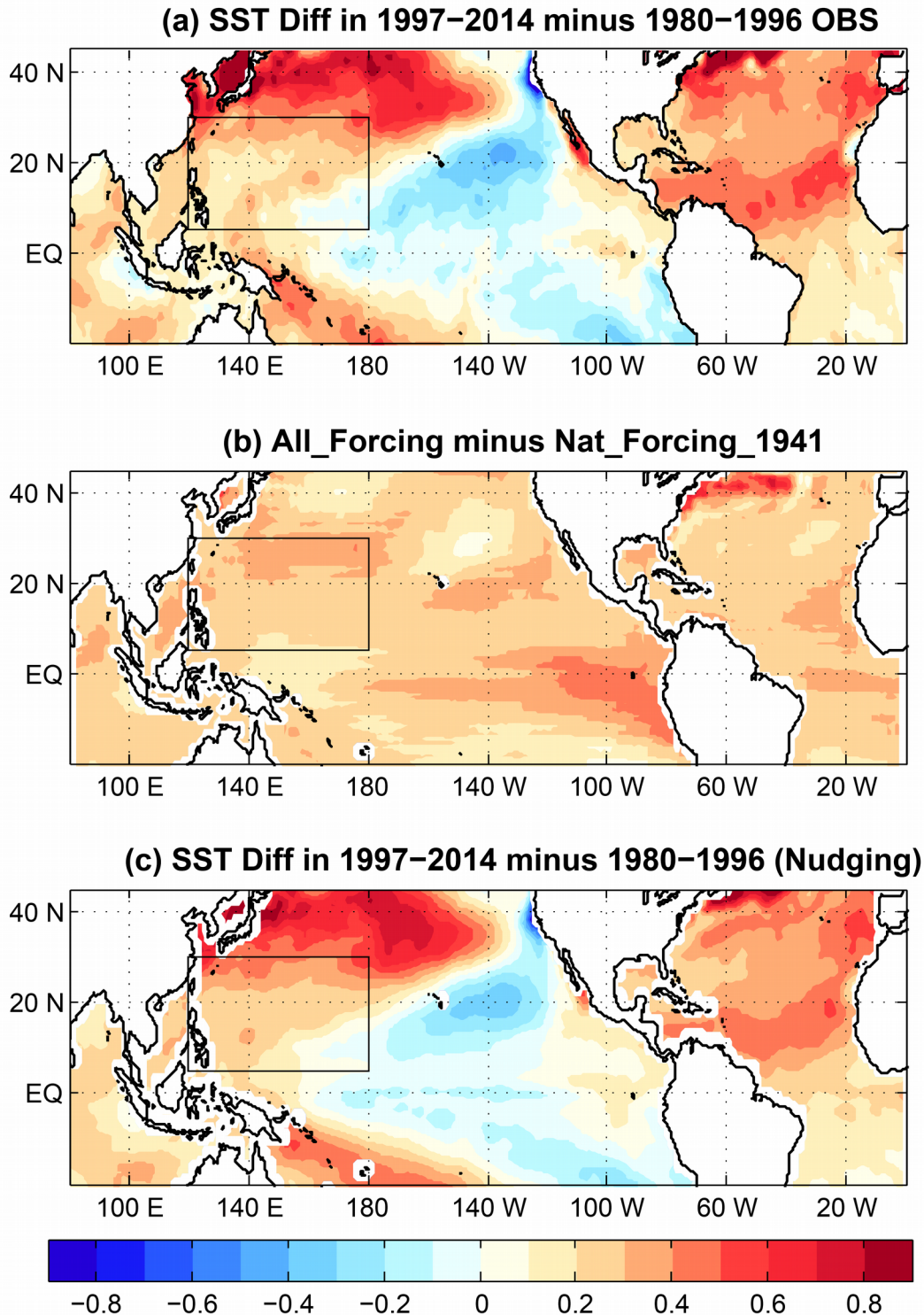


Figure S2. The SST (shading, unit: °C) differences in 1997-2014 minus 1980-1996 in (a) the observations, (b) large-ensemble multi-decadal all_forcing minus natural_forcing (1941 forcing) experiments with FLOR and (c) the SST-nudging experiments with FLOR. The black rectangle represents the main develop region in the WNP.

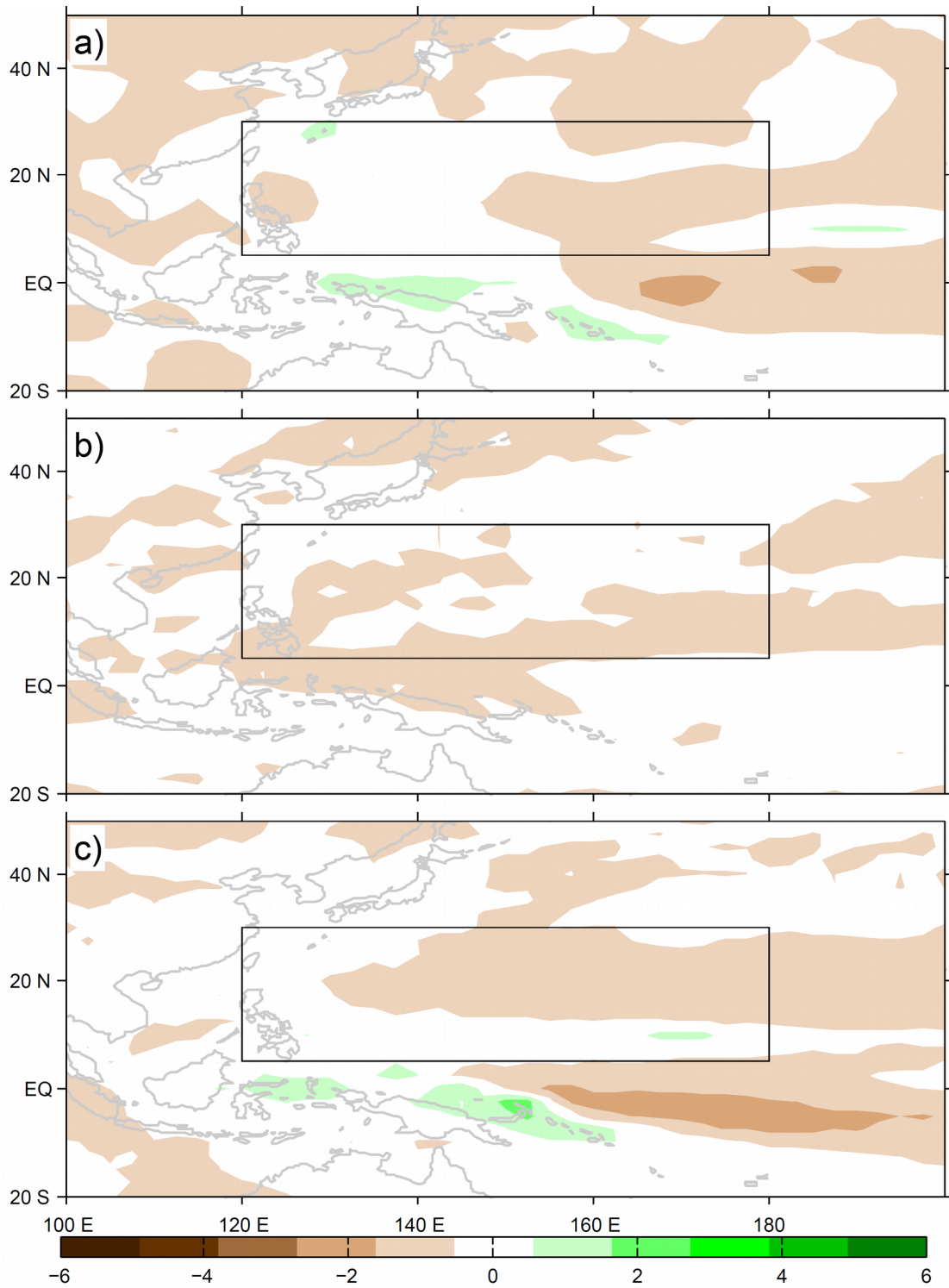


Figure S3. Precipitation (shading, unit: mm/day) differences in (a) the observations, (b) large-ensemble multi-decadal all_forcing minus natural_forcing (Allforc minus Natforc) experiments with FLOR, and (c) the SST-nudging experiments with FLOR. The rectangle shows the MDR in the WNP.

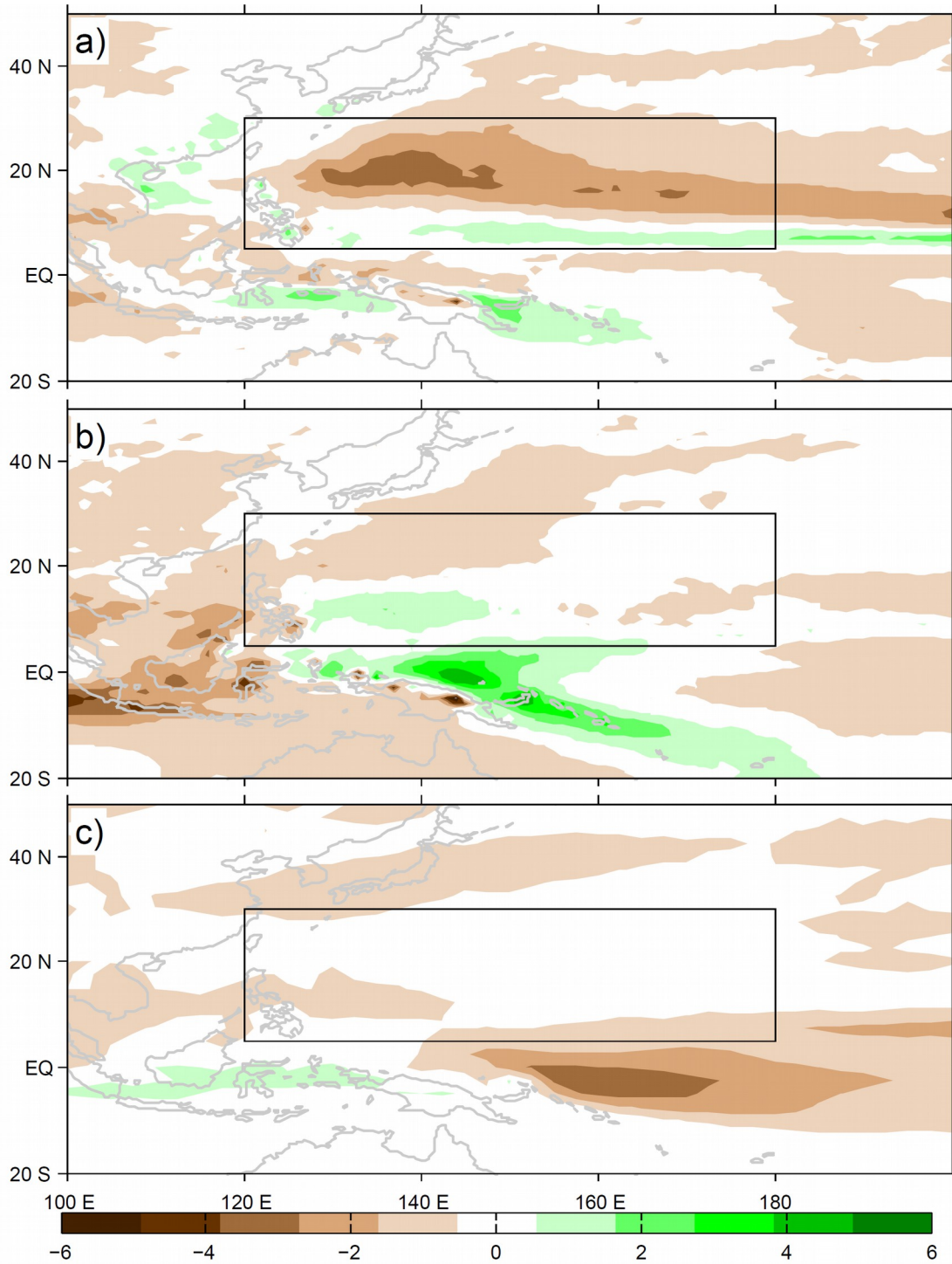


Figure S4. Precipitation (shading, unit: mm/day) differences in (a) PAMO minus CLIMO, (b) NPDO minus CLIMO and (c) all_forcing_stress minus all_forcing experiments (1997-2014) with FLOR. The all_forcing_stress minus all_forcing experiments indicate the responses to the strengthened wind stress in the tropics since 1997. The rectangle shows the MDR in the WNP.

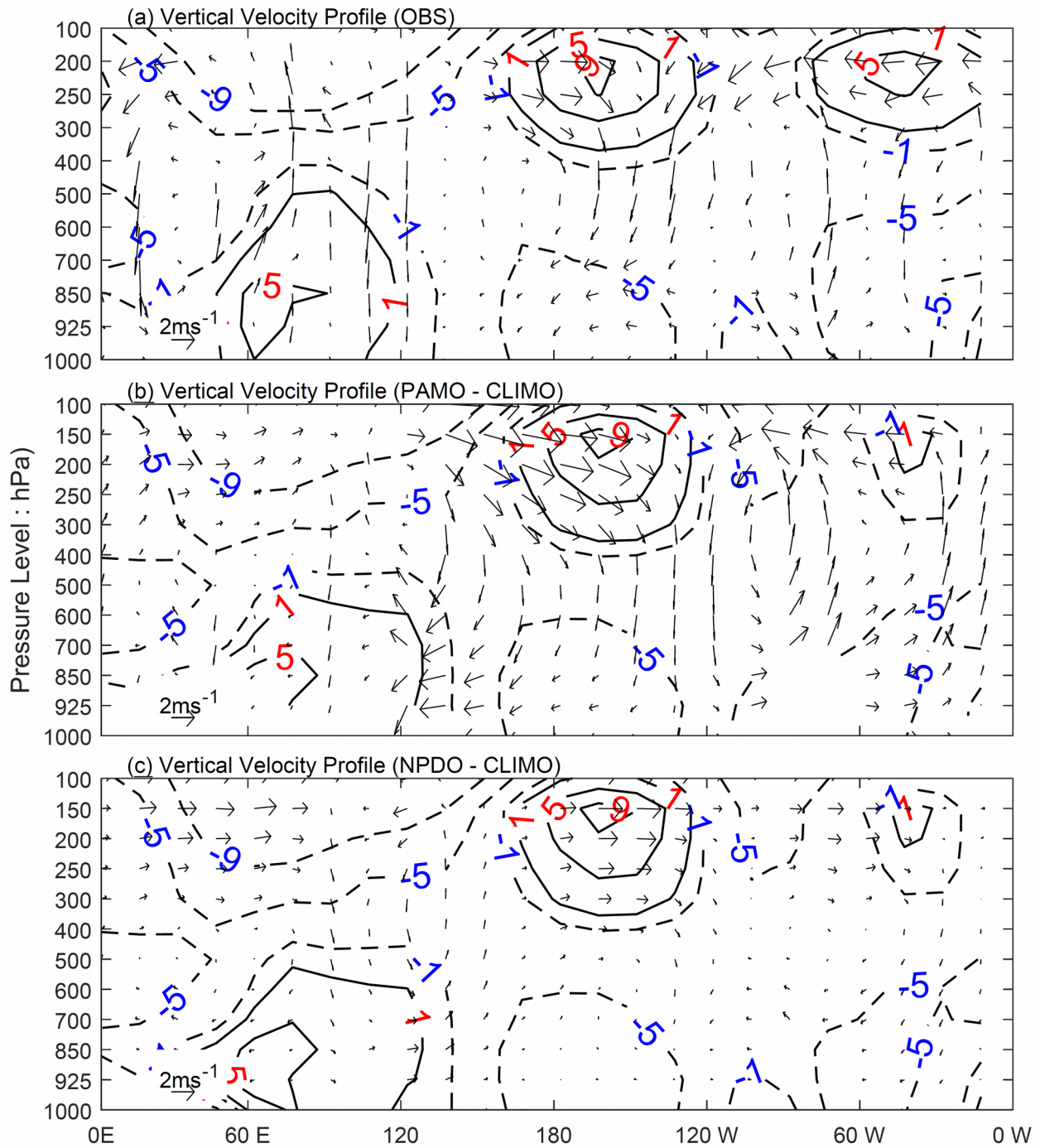


Figure S5 Vertical profile of vertical and zonal wind vector (ms^{-1}) averaged along the latitudes 5°N - 30°N in (a) observations (1997-2014 minus 1980-1996), (b) PAMO – CLIMO experiments, and (c) NPDO – CLIMO experiments. The contours represent the climatology of zonal winds averaged over the latitudes 5°N - 30°N .

Table S1. WNP TC frequency differences in PAMO minus CLIMO and in NPDO minus CLIMO experiments. The '*' symbol represents the difference is significant at the 0.05 level based on Student's *t* test.

TCF (unit: occurrences)	PAMO	NPDO
Perturbation	19.4	22.9
CLIMO	23.6	23.6
Diff	-4.2*	-0.7

Table S2 Correlation between WNP TC frequency from JTWC, JMA and STI and the PDO index and between WNP TC frequency and the AMO index during June-November (JJASON) of 1980-2014. The '*' symbol represents the difference is significant at the 0.05 level.

Correlation	JTWC	JMA	STI	Average
PDO	0.14	0.13	0.19	0.16
AMO	-0.56*	-0.54*	-0.35*	-0.50*