

**Auxiliary Material for Paper 2013GL055741**

**Changes to Environmental Parameters that Control Tropical Cyclone Genesis under Global Warming**

**Hiroyuki Murakami, Tim Li** (*International Pacific Research Center, University of Hawaii at Manoa, Honolulu, USA*)

**Melinda Peng** (*Naval Research Laboratory, Monterey, CA, USA*)

Geophysical Research Letters

Introduction

Details in a detection method for developing and non-developing disturbances are described in “text01.pdf”. “fs01.pdf” shows simulated/projected displacement vector of developing (starting at days  $-3$ ,  $-2$ , and  $-1$ ) and non-developing disturbances (starting at each day of its lifespan). “fs02.pdf” shows composite mean and variance of 20-day filtered variables in a  $20^\circ \times 10^\circ$  grid box centered on each disturbance during the summer season obtained by the future experiment.

1. text01.pdf

Auxiliary Text. Detection method for developing and non-developing disturbances.

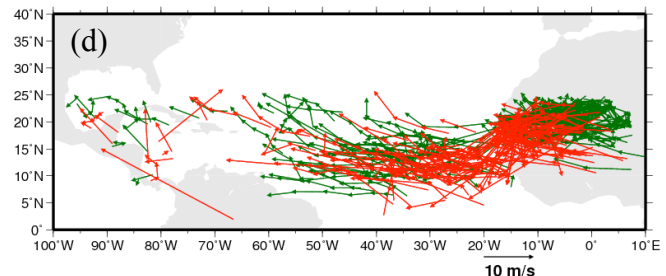
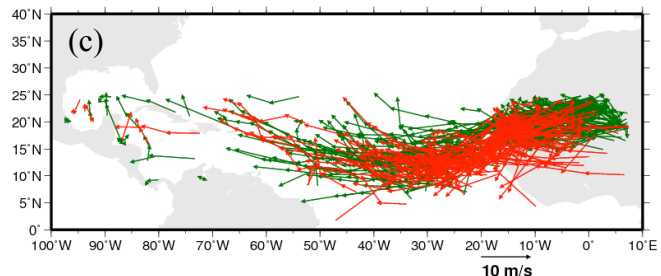
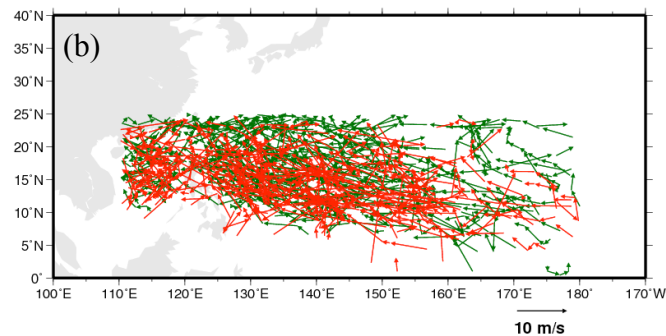
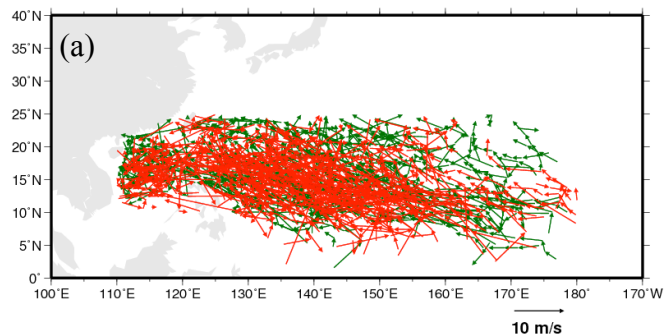
2. fs01.pdf

Auxiliary Fig. S1. Daily displacement vectors of developing disturbances (red arrows) and non-developing disturbances (green arrows) in the western North Pacific by (a) the present-day simulation and (b) the future projection. (c) and (d) as in (a) and (b), but for the North Atlantic.

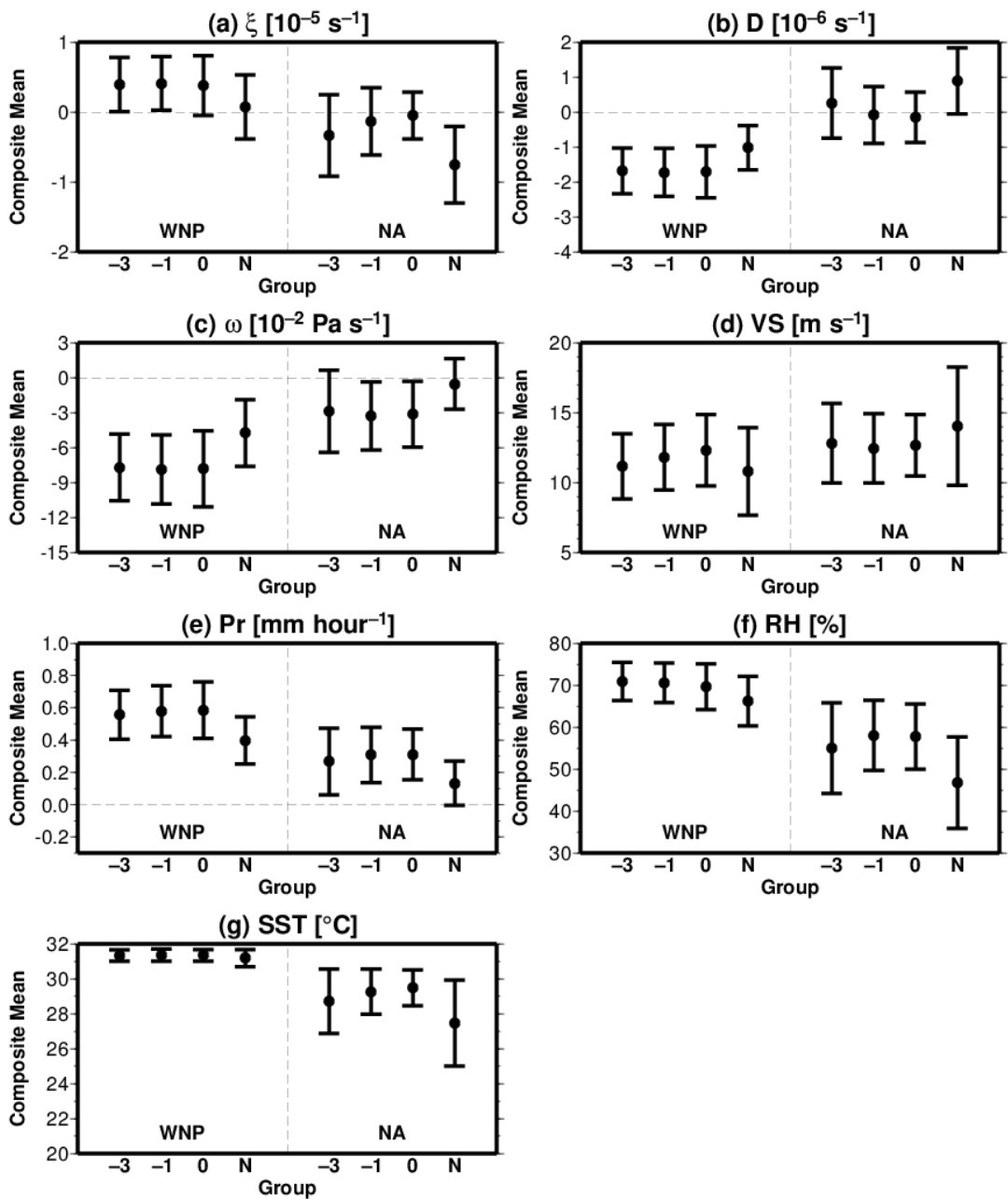
3. fs02.pdf

Auxiliary Fig. S2. Composite area mean of 20-day filtered variables in a grid box of  $20^\circ \times 10^\circ$  during the summer season computed by the future (GW) projection for (a) relative vorticity at 500 hPa [ $10^{-5} \text{ s}^{-1}$ ], (b) low-level divergence at 850 hPa for the WNP and 700 hPa for the NA, (c) vertical pressure-velocity at 250 hPa [ $10^{-2} \text{ Pa s}^{-1}$ ], (d) vertical wind shear [ $\text{m s}^{-1}$ ], (e)

precipitation [ $\text{mm hour}^{-1}$ ], (f) relative humidity at 700 hPa [%], and (g) sea surface temperature [ $^{\circ}\text{C}$ ]. The error bars indicate one standard deviation. Each panel shows composites at days  $-3$ ,  $-1$ ,  $0$  prior to cyclogenesis for developing disturbances, and every day for non-developing disturbances (N) in the WNP and NA.



**Auxiliary Figure S1.** Daily displacement vectors of developing disturbances (red arrows) and non-developing disturbances (green arrows) in the western North Pacific by (a) the present-day simulation and (b) the future projection. (c) and (d) as in (a) and (b), but for the North Atlantic.



**Auxiliary Figure S2.** Composite area mean of 20-day filtered variables in a grid box of  $20^{\circ} \times 10^{\circ}$  during the summer season computed by the future (GW) projection for (a) relative vorticity at 500 hPa [ $10^{-5} \text{ s}^{-1}$ ], (b) low-level divergence at 850 hPa for the WNP and 700 hPa for the NA, (c) vertical pressure-velocity at 250 hPa [ $10^{-2} \text{ Pa s}^{-1}$ ], (d) vertical wind shear [ $\text{m s}^{-1}$ ], (e) precipitation [ $\text{mm hour}^{-1}$ ], (f) relative humidity at 700 hPa [%], and (g) sea surface temperature [ $^{\circ}\text{C}$ ]. The error bars indicate one standard deviation. Each panel shows composites at days  $-3$ ,  $-1$ ,  $0$  prior to cyclogenesis for developing disturbances, and every day for non-developing disturbances (N) in the WNP and NA.

## Auxiliary Text

### **Detection method for developing and non-developing disturbances**

Developing and non-developing disturbances were detected according to the following criteria using 6-hourly outputs. These criteria are mostly based on those reported in *Murakami and Sugi* [2010]. The values listed in parentheses after each of the following criteria are to detect non-developing disturbances, although some of the conditions were not applied to detect non-developing disturbances.

- (1) The maximum relative vorticity at 850 hPa in  $4^\circ \times 4^\circ$  grid box centered at local minimum of sea level pressure exceeds  $2.0 \times 10^{-4}$  ( $1.0 \times 10^{-5}$ ).
- (2) To detect disturbances with certain size of cyclonic circulation,  $4^\circ \times 4^\circ$  grid box mean relative vorticity at 850 hPa exceeds  $1.0 \times 10^{-5}$  ( $5.0 \times 10^{-6}$ ).
- (3) The sum of the temperature deviations at 300, 500, and 700 hPa exceeds 1.0 K, while this condition is not applied to detect non-developing disturbances. The temperature deviation for each level is computed by subtracting the maximum temperature from the mean temperature over the surrounding  $10^\circ \times 10^\circ$  grid box.
- (4) To exclude extra-tropical cyclones, the maximum wind speed at the 850 hPa vertical level is higher than that at the 300 hPa, while this condition is not applied to detect non-developing disturbances.
- (5) The duration exceeds 36 (72) hours.

After identifying the first detection date of each developing disturbance, we traced its temporal development backwards in time over a period of three days, designated as days  $-1$ ,  $-2$ ,  $-3$ , by identifying local minima of sea level pressure.

## **Reference**

Murakami, H. and M. Sugi, 2010: Effect of model resolution on tropical cyclone climate projections. *SOLA*, **6**, 73–76, doi: 10.2151/sola.2010-019.