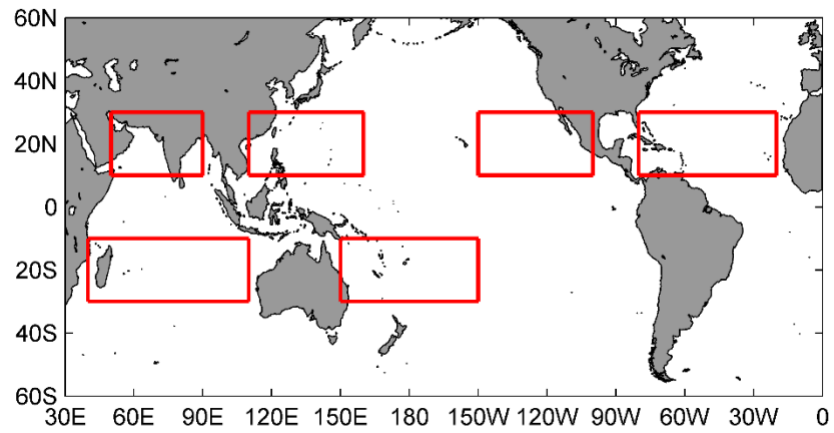


1 **Supplementary Discussion**

2 We use monthly sea surface temperature (SST) over the main development region (80° -
3 20° W, 10° - 30° N) in the North Atlantic to represent the large-scale environmental water vapor
4 and its change. The rainfall associated with a single TC is directly linked to the local water vapor
5 availability, which can be impacted by the warming signal. However, the warming signal may be
6 enhanced or weakened for any single TC. It seems to be more reasonable to use the local SST at
7 the time TCs occur. For the 6-h TC sample, we use daily SST at the closest date to
8 approximately represent its environment due to the unavailability of 6-h SST. The SST within a
9 specified radius (8, 5, 3 and 1 degree) from the storm center is used. We use the North Atlantic
10 as an example. As the radius increases, the local SST gets higher (Supplementary Table 1). And
11 reasonably for all radius used, the local SST is higher than the monthly mean SST over the main
12 development region (Supplementary Table 1). Despite the difference of local and large-scale
13 SST, the two are close in terms of SST increase under anthropogenic warming, suggesting that
14 the enhancing or weakening effect on the climate warming signal, maybe due to cancelling-out
15 effect, is not significant over a long-run period (Supplementary Table 1). It is reasonable to use
16 monthly SST change to explore the moisture change of the TC environment.

17 Supplementary Table 1. Present-day sea surface temperature (SST; degree C) and changes of
 18 SST under anthropogenic warming. The result from using monthly SST over the main
 19 development region (80°-20°W, 10°-30°N) is shown in the second column. Daily SST defined
 20 over a specific distance (i.e., 100, 300, 500 and 800 km, respectively) from the storm center is
 21 also used.

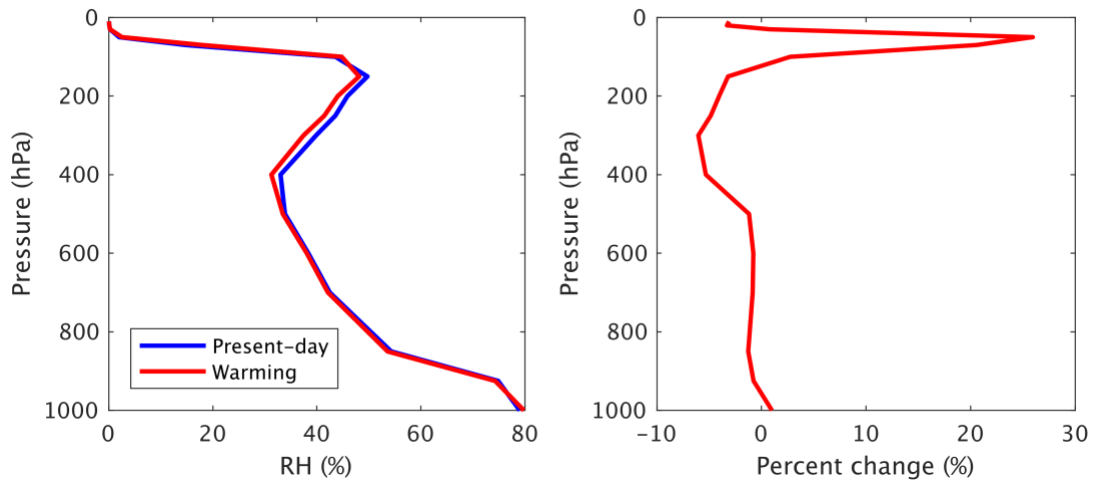
	80°-20°W, 10°-30°N	100 km	300 km	500 km	800 km
Present-day SST	297.45	301.13	301.08	301.04	300.90
SST change under warming	1.66	1.65	1.67	1.67	1.66



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24 Supplementary Figure 1. The main development region in each TC basin as indicated by red
25 boxes.

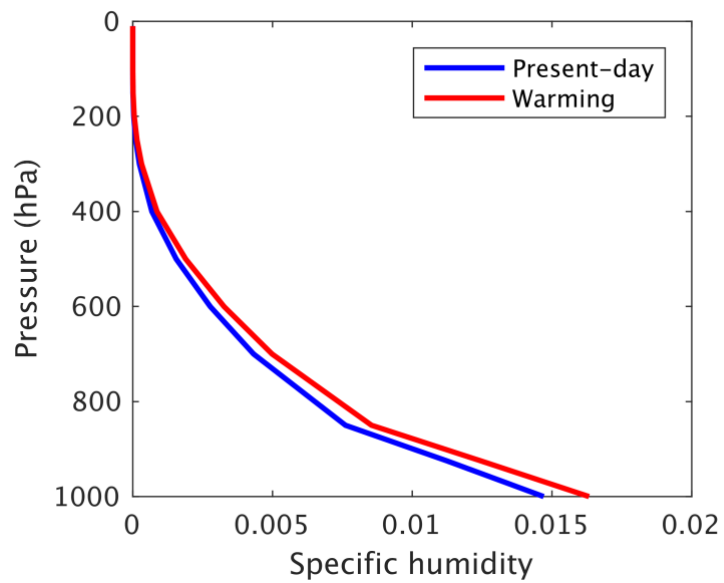
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28 Supplementary Figure 2. The vertical profile of relative humidity (%) for both present-day
 29 simulation (blue) and late twenty-first-century projection (red) averaged over tropical ocean
 30 basins (30°S-30°N) (left column) and the percentage change (%) from present-day simulation to
 31 late twenty-first-century projection (right column).

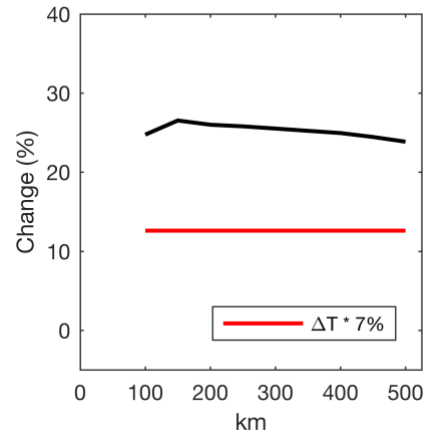
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34 Supplementary Figure 3. The vertical profile of specific humidity (kg kg^{-1}) for both present-day
35 simulation (blue) and late twenty-first-century projection (red) averaged over tropical ocean
36 basins (30°S - 30°N).

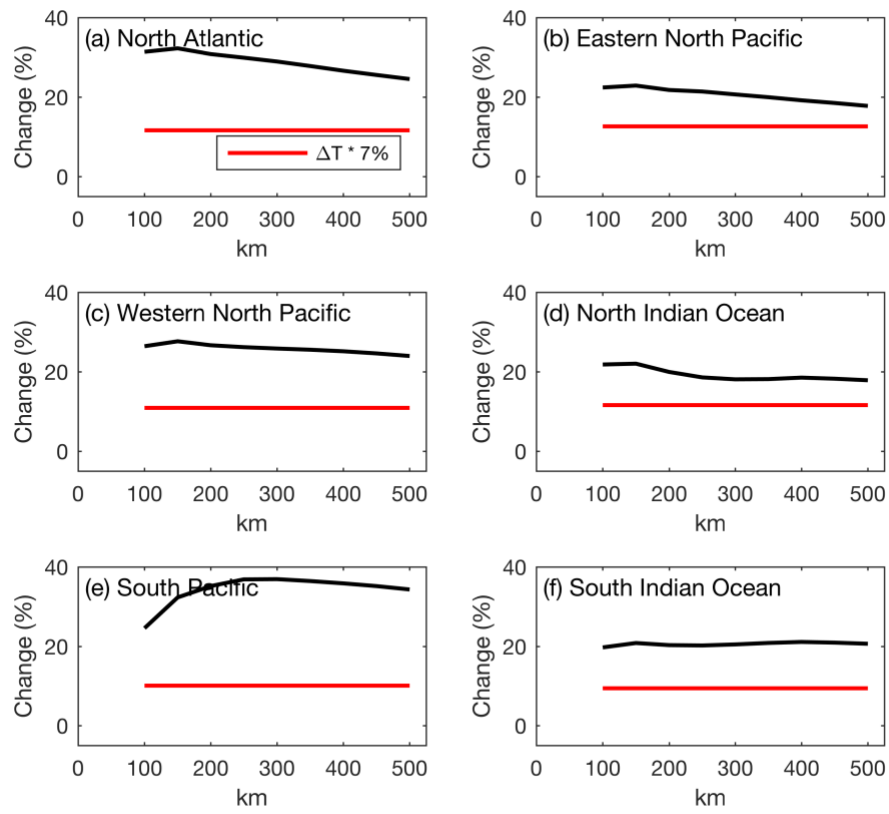
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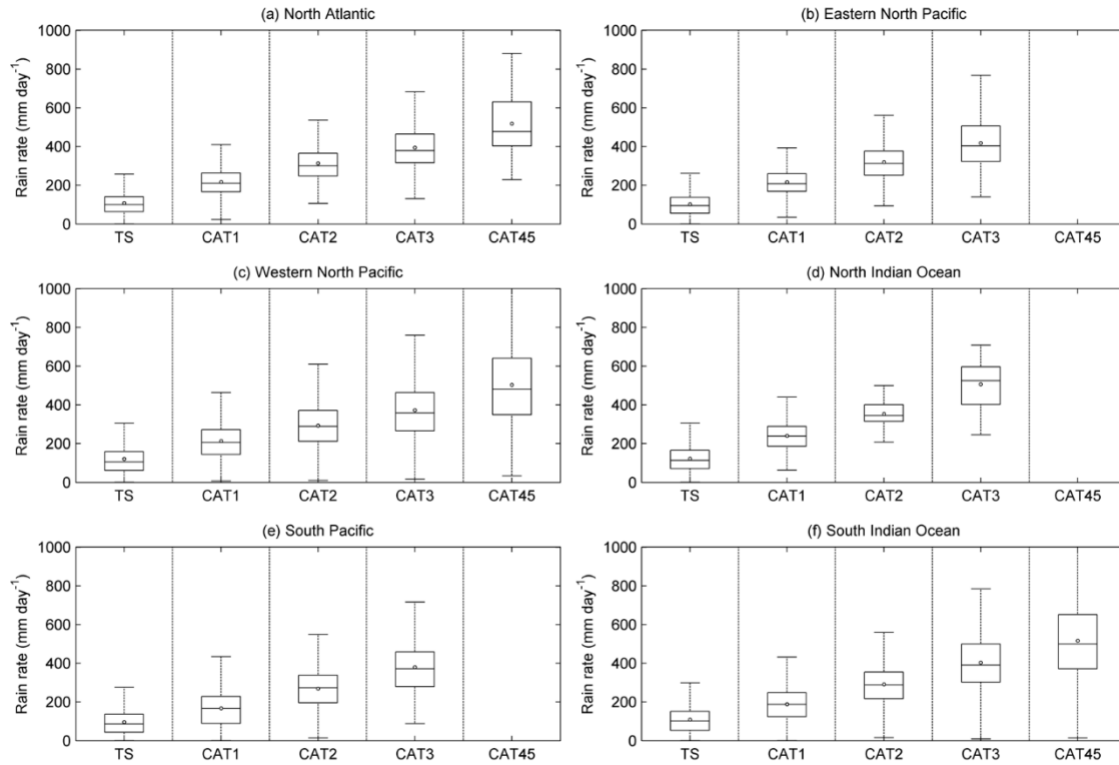
39 Supplementary Figure 4. Projected percentage change of TC rainfall rate with respect to
40 averaging radii at global scale (black line). The percentage change of water vapor content
41 indicated by SST change is shown as reference (red line).

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44 Supplementary Figure 5. Projected percentage change of TC rainfall rate with respect to
 45 averaging radii for each ocean basin (black line). The percentage change of water vapor content
 46 indicated by SST change is shown as reference (red line).



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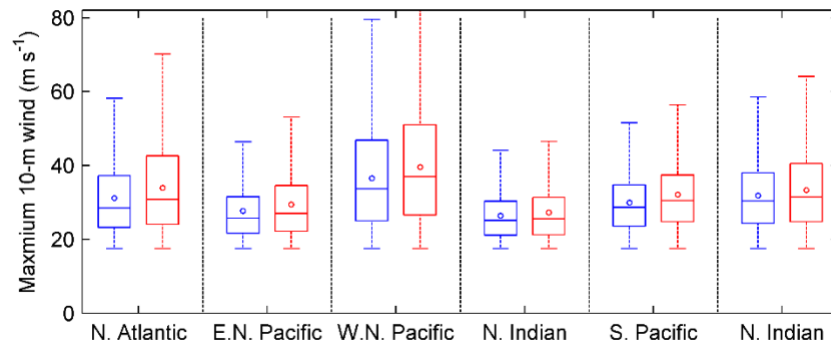
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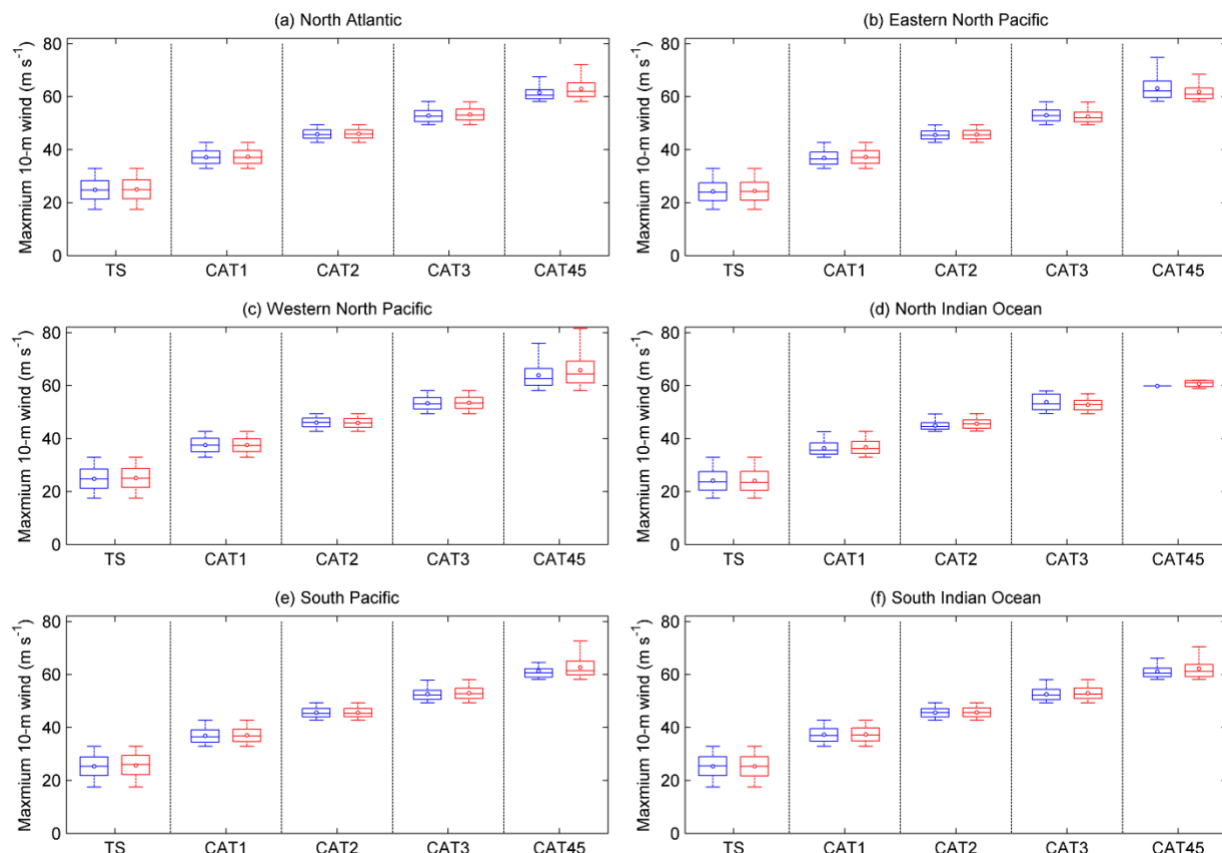
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Supplementary Figure 6. The boxplots of the 100-km TC rainfall for each category of the Saffir-Simpson wind scale in (a) North Atlantic, (b) Eastern North Pacific, (c) Western North Pacific, (d) North Indian, (e) South Pacific and (f) South Indian. The limits of whiskers represent the 10th and 90th percentiles. The limits of boxes represent the 25th and 75th percentiles. The line inside the boxes and the open circle indicate median and mean, respectively. Only composites with sample larger than 100 are plotted. Boxplots in figures after have the same meaning as here.

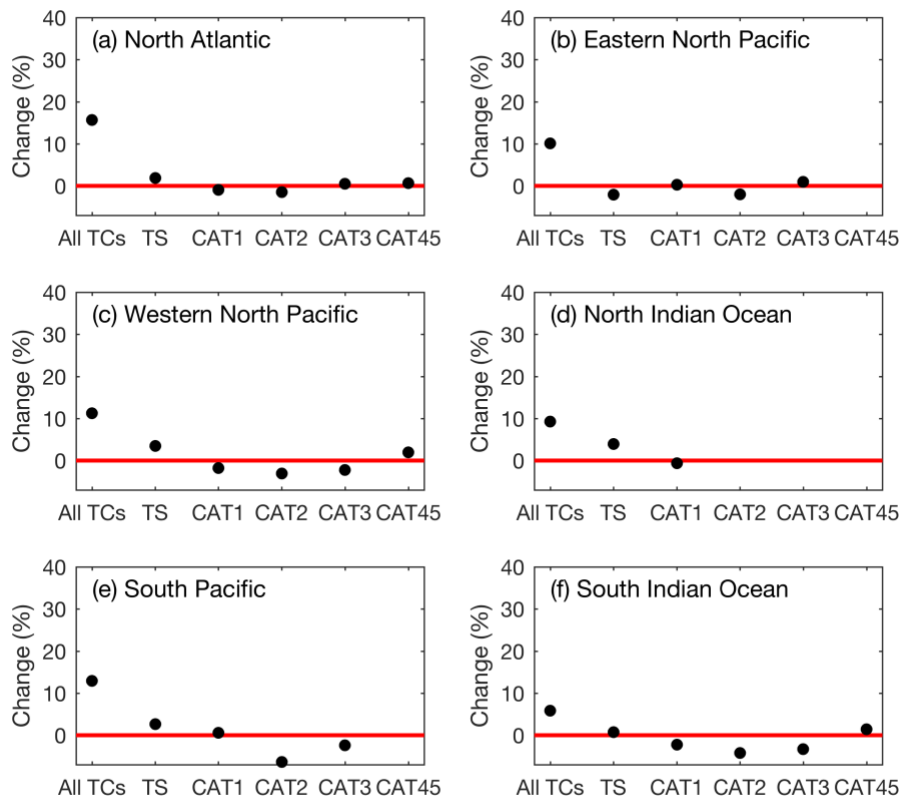


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55 Supplementary Figure 7. The boxplots of maximum 10-m wind (m s^{-1}) from the present-day
 56 simulation (blue) and late twenty-first-century projection (red) for all oceans. For all basins, the
 57 change of maximum 10-m wind between present-day run and warm-climate run is statistically
 58 significant ($p < 0.01$) based on a two-sided Mann–Whitney–Wilcoxon median test.



Supplementary Figure 8. The boxplots of maximum 10-m wind (m s^{-1}) for each intensity category in (a) North Atlantic, (b) Eastern North Pacific, (c) Western North Pacific, (d) North Indian Ocean, (e) South Pacific and (f) South Indian Ocean. The present-day simulation is shown in blue while the late twenty-first-century projection is shown in red.



65

66 Supplementary Figure 9. The change of 10-m radial inflow at 50-100 km from storm center
 67 based on averages over all storms in each category of the Saffir-Simpson TC wind intensity scale
 68 in (a) North Atlantic, (b) Eastern North Pacific, (c) Western North Pacific, (d) North Indian
 69 Ocean, (e) South Pacific and (f) South Indian Ocean. Only storm categories with sample size
 70 larger than 100 are shown.