Supporting Information (SI) for "Impact of rainfall on tropical cyclone-induced sea surface cooling "

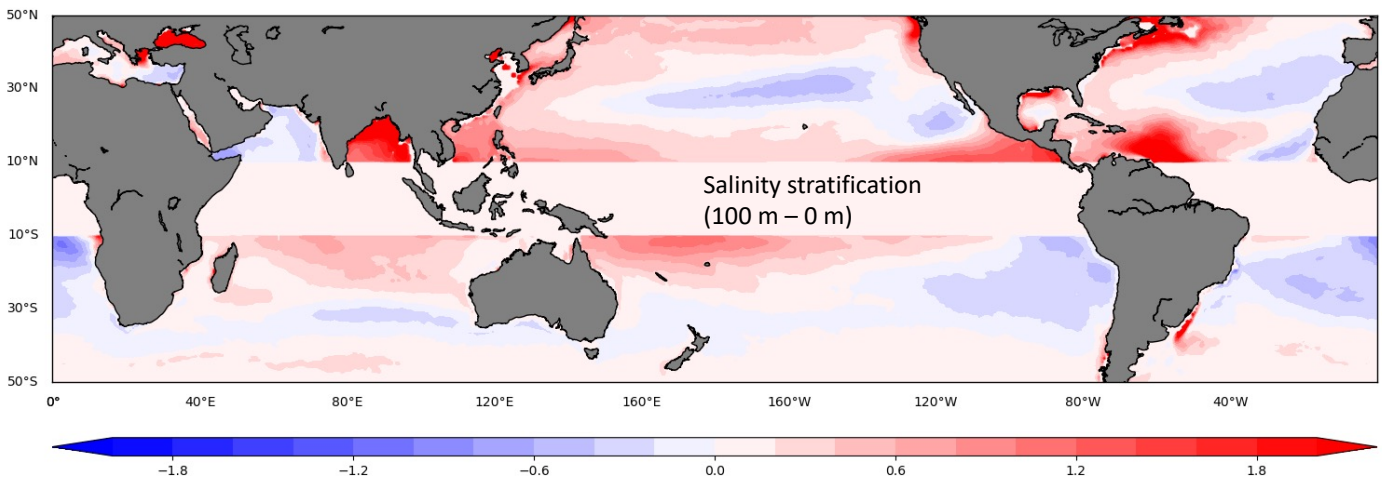
Karthik Balaguru[1], Gregory R. Foltz[2], L. Ruby Leung[1] and Samson M. Hagos[1]

[1]Pacific Northwest National Laboratory, Richland, WA, USA

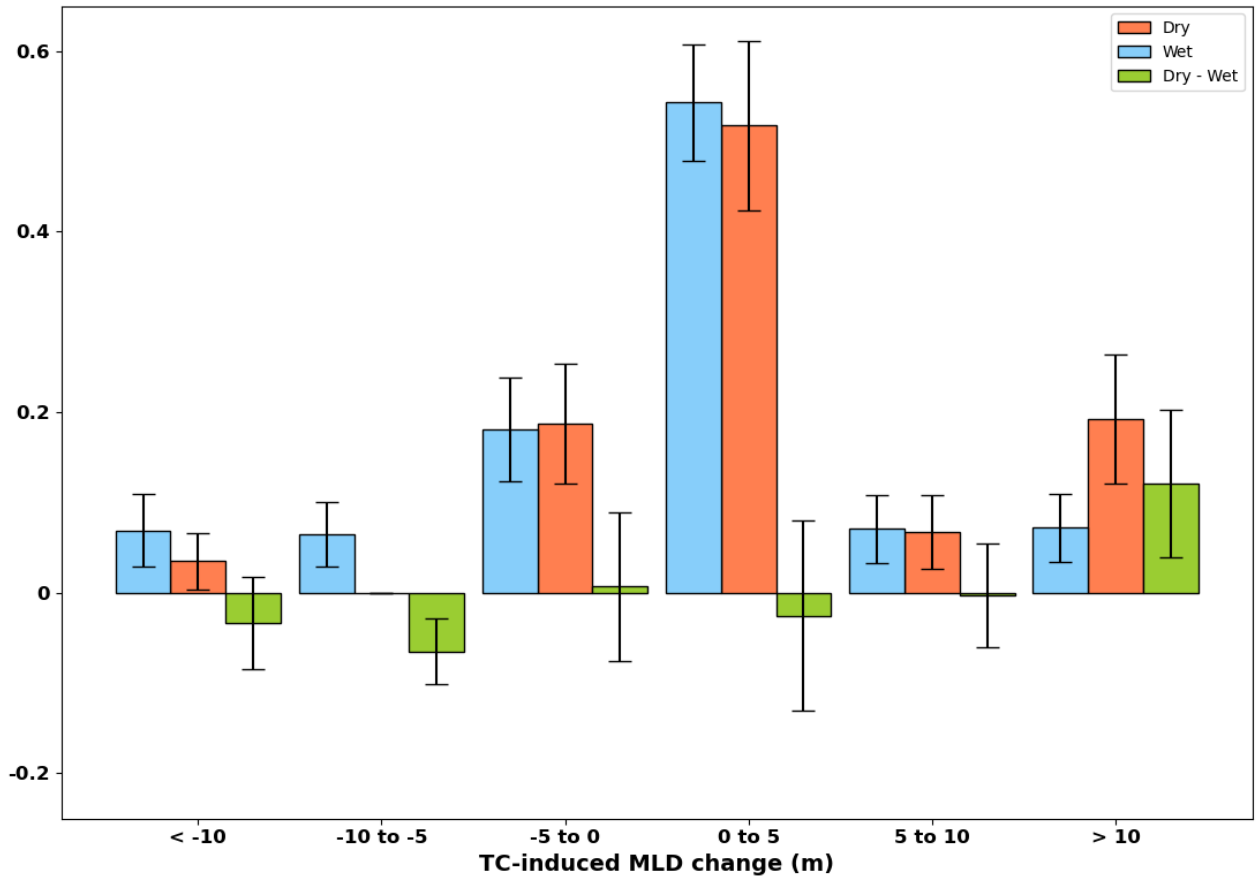
[2]NOAA/Atlantic Oceanographic and Meteorological Laboratory, Miami, FL, USA

Contents of this file

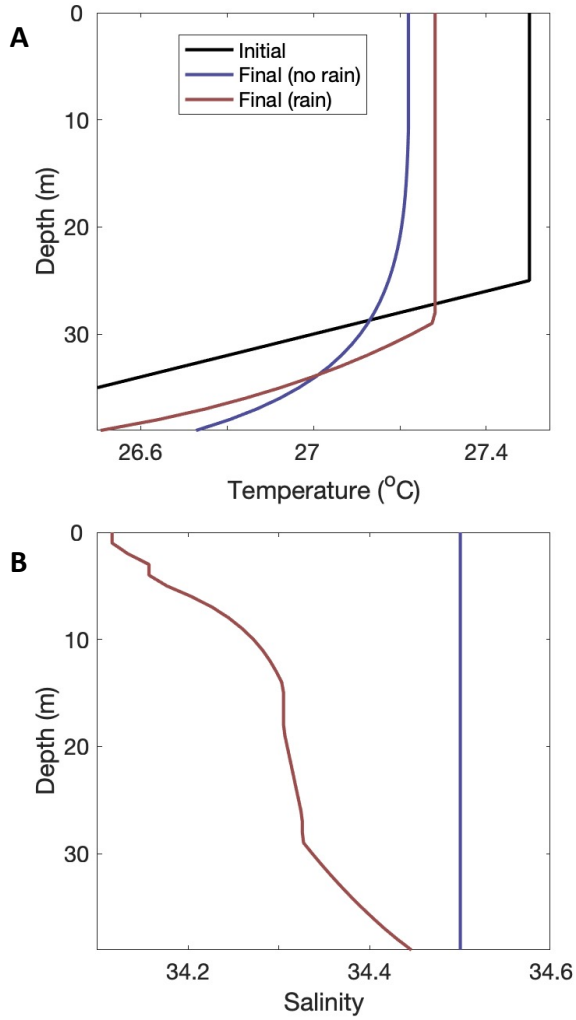
1. SI Fig. 1 to Fig. 5
2. SI Table 1



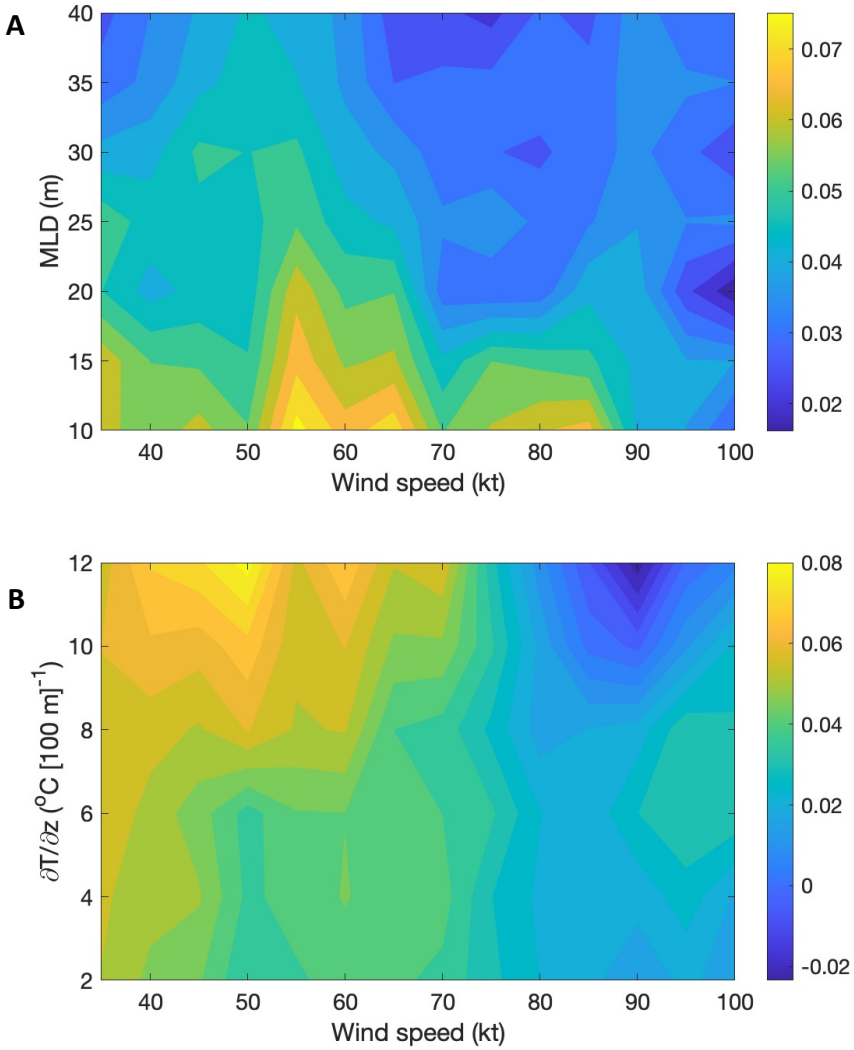
SI Figure 1. Climatological TC-season mean upper-ocean salinity stratification (psu), defined as the difference between salinity at a depth of 100 m and at the surface, based on SODA3 ocean reanalysis (2004-2015). Data is averaged between June-November for the Northern Hemisphere and December-May for the Southern Hemisphere. Values between 10S and 10N, where TCs rarely occur, have been masked.



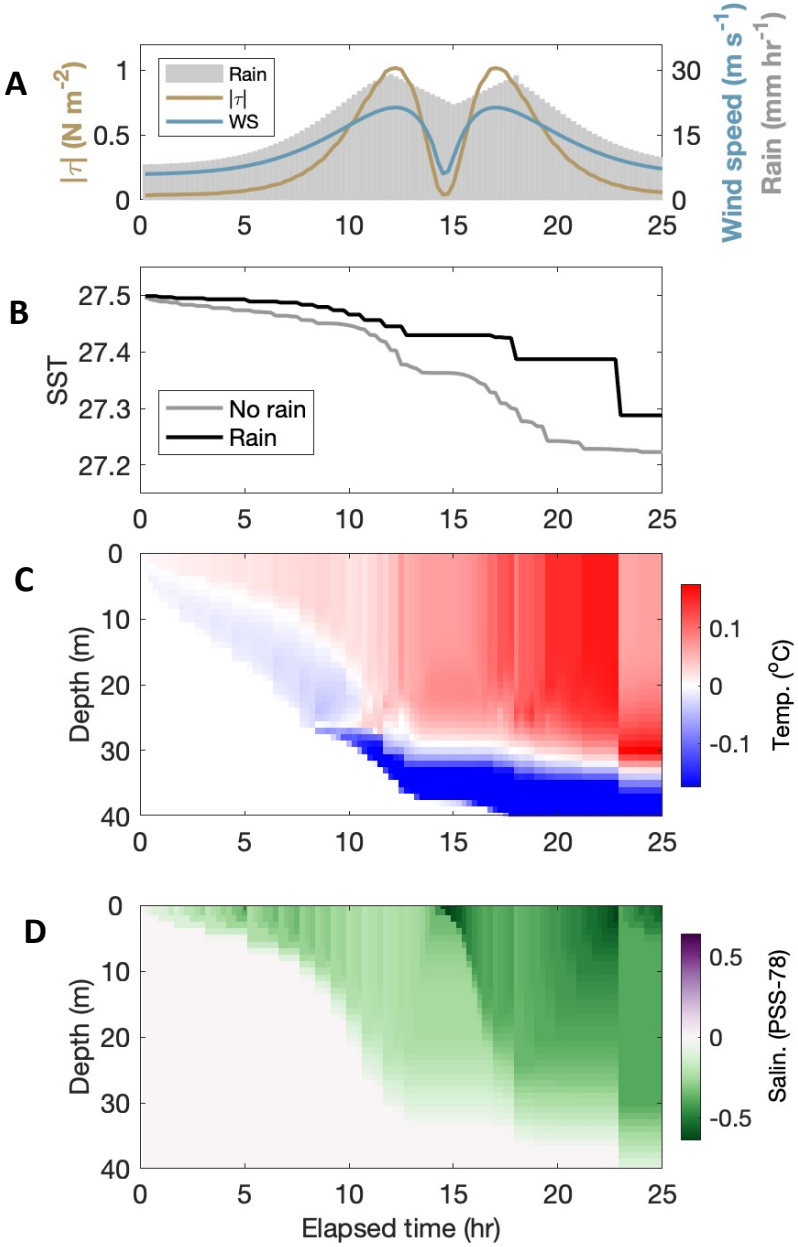
SI Figure 2. PDFs of TC-induced MLD change for the 'Dry' case, 'Wet' case and the difference (Dry − Wet) based on E3SM. While the height of each bar represents the mean value for each range of values, the error bar represents the standard deviation or spread of the values corresponding to that range.



SI Figure 3. Initial and final profiles of upper-ocean A) temperature (°C) and B) salinity (psu) for the 'Rain' and 'No rain' experiments conducted using the PWP ocean mixed layer model. Note that the model was initialized with constant salinity of 34.5 psu. Thus, the initial salinity profile for the two experiments is the same as the final salinity profile in the 'No rain' experiment.



SI Figure 4. Difference in SST change between the 'Rain' and 'No rain' experiments based on the PWP model for varying TC wind speed (kt) and A) MLD (m) and B) ocean temperature stratification (°C 100m^{-1}).



SI Figure 5. A) Profiles of surface wind speed (m s^{-1}), wind stress (N m^{-2}) and rainfall (mm hr^{-1}) used as forcing for the PWP ocean mixed layer model. While the wind forcing is common to both the 'Rain' and 'No rain' experiments, the rainfall profile was only applied to the 'Rain' experiment. Also, the rainfall forcing is twice as large as that used in Fig. 3. B) Time evolution of SST (°C) in the 'Rain' and 'No rain' cases. Difference in time evolution of C) temperature (°C) and D) salinity (psu) between the 'Rain' and 'No rain' cases.

SI Table 1: Lagrangian composite analysis of TC rainfall impacts on TC-induced SST cooling using TC track data, TRMM SST and rainfall data, and SODA3 ocean reanalysis for the period 2004-2014. The 'Wet' column corresponds to those TCs with high rain rates, 'Dry' column corresponds to those TCs with low rain rates, and 'Difference' represents the difference between the 'Wet' and 'Dry' sets. For each parameter, the mean value along with the error, which is represented by the standard deviation, is shown. For the 'Difference' column, the values in bold indicate statistical significance at the 5% level. Data here have been sub-sampled to ensure that the initial storm state and pre-storm ocean conditions are statistically similar for the 'Wet' and 'Dry' sample sets.

Parameter	**Wet**	**Dry**	**Difference**
Maximum wind speed (kt)	35.0 ± 0.0	34.7 ± 1.2	0.3
Translation speed (m s^{-1})	5.3 ± 0.7	6.1 ± 1.4	-0.8
Rain (mm hr^{-1})	5.8 ± 1.1	0.3 ± 0.2	**5.5**
Pre-storm TSTRAT (°C)	-5.1 ± 0.8	-5.4 ± 1.0	0.2
Pre-storm MLD (m)	34.2 ± 6.0	29.1 ± 8.0	5.1
Pre-storm SST (°C)	27.3 ± 0.7	27.2 ± 0.7	0.1
Pre-storm SSS (psu)	34.7 ± 0.2	34.6 ± 0.4	0.1
SSS change (psu)	-0.07 ± 0.04	-0.02 ± 0.05	**-0.05**
SST change (^{o}C)	0.11 ± 0.23	-0.32 ± 0.45	**0.43**