Supporting Information for "Past the precipice? Projected coral habitability under global heating"

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Introduction

This Supporting Information contains additional supporting methodological text, additional supporting figures, and an additional supporting table for our paper.

Text S1.

We determined the sensitivity of departure year to the DHW threshold and to the climatological baseline on which it is referenced for SSP245, SSP370, and SSP585. Each climatological reference period in was a 15 year contiguous period centered around the marked year. Since we required more than two decades of time span in which to perform this experiment, and the MUR SST dataset only goes back to 2002, we needed to use the coarse model projections and HadISST observational dataset. The analysis was performed

using a weighted-mean model ensemble at the 100 km spatial resolution, and climatologies were calculated from the HadISST observational dataset at each coarse grid point. We did not extend the sensitivity analysis to SSP126 due to the many reef locations which depart only after 2100.

For these three scenarios, we used least squares linear fits to determine the DHW threshold for our MUR SST climatology (with a center year of 2008.5) that would be biologically equivalent to a threshold of 8 DHW which was determined relative to the traditional Coral Reef Watch climatological period (with a center year of 1988.29). This is necessary because the mean global SST is increasing each year due to anthropological global heating. While the mean departure years from each of the three SSPs have different linear relationships to climatological baseline and DHW threshold, we find that the climatologically adjusted DHW threshold is 4.8 in each case, and that the largest difference between the three pairs of numbers (0.05 DHW) corresponds to mean departure year errors of 0.11 years, 0.14 years, and 0.20 years for SSP585, SSP370, and SSP245 respectively. These errors are negligible compared to uncertainties arising from the downscaling procedure.

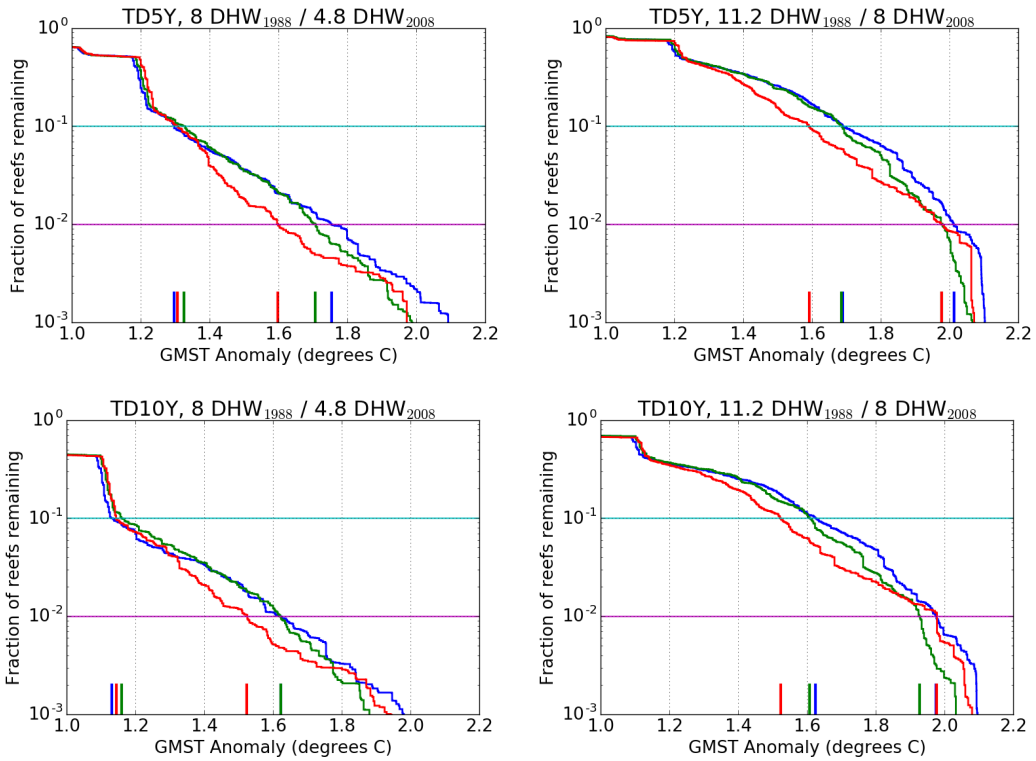


Figure S1. Cumulative histograms of thermal departure as a function of GMSTA, for SSP126 (black), SSP245 (blue), SSP370 (green), SSP585 (red), for a five year heat event return timescale (TD5Y, top row) and a ten year heat event return timescale (TD10Y, bottom row). Both DHW thresholds are shown. Cyan and magenta horizontal lines show the 10% and 1% fractional levels respectively; colored vertical ticks on the y-axis indicate crossings of these levels. Shading indicates the propagated MUR SST uncertainty.

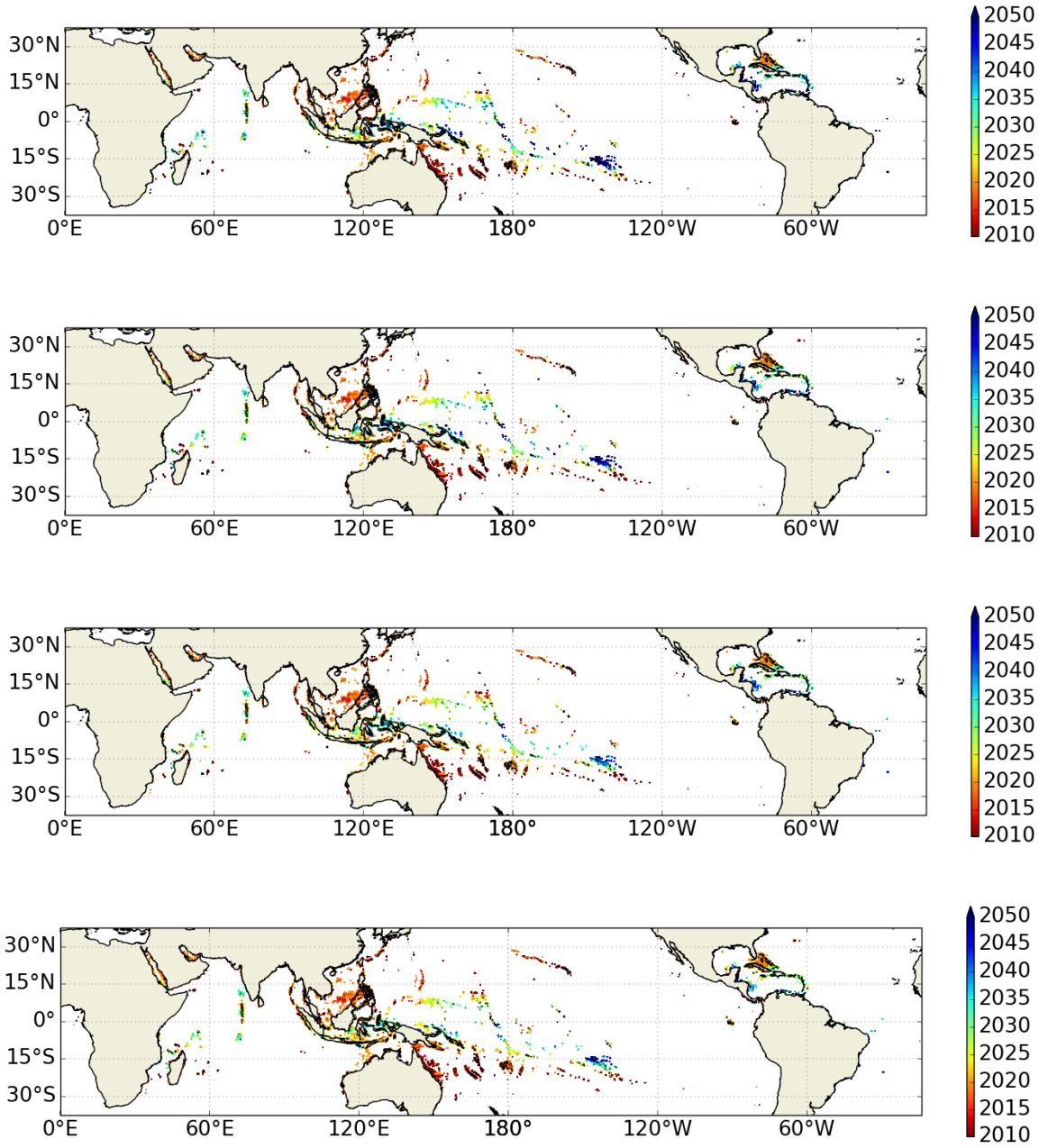


Figure S2. Global maps of thermal departure under the four emissions scenarios (from top: SSP126, SSP245, SSP370, SSP585) for TD5Y and the 11.2 DHW_{1988} / 8 DHW_{2008} threshold.

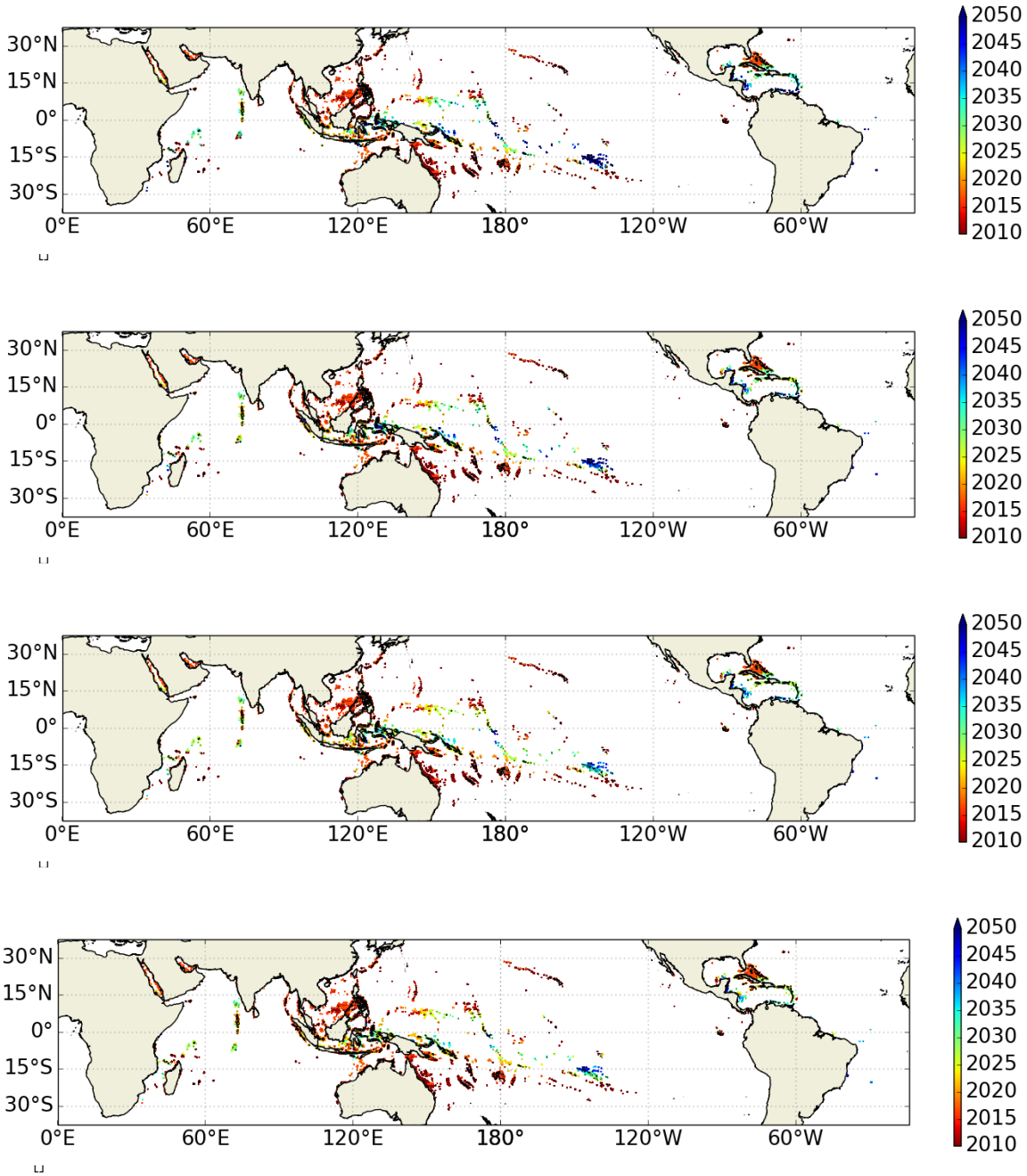


Figure S3. Global maps of thermal departure under the four emissions scenarios (from top: SSP126, SSP245, SSP370, SSP585) for TD10Y and the 11.2 DHW_{1988} / 8 DHW_{2008} threshold.

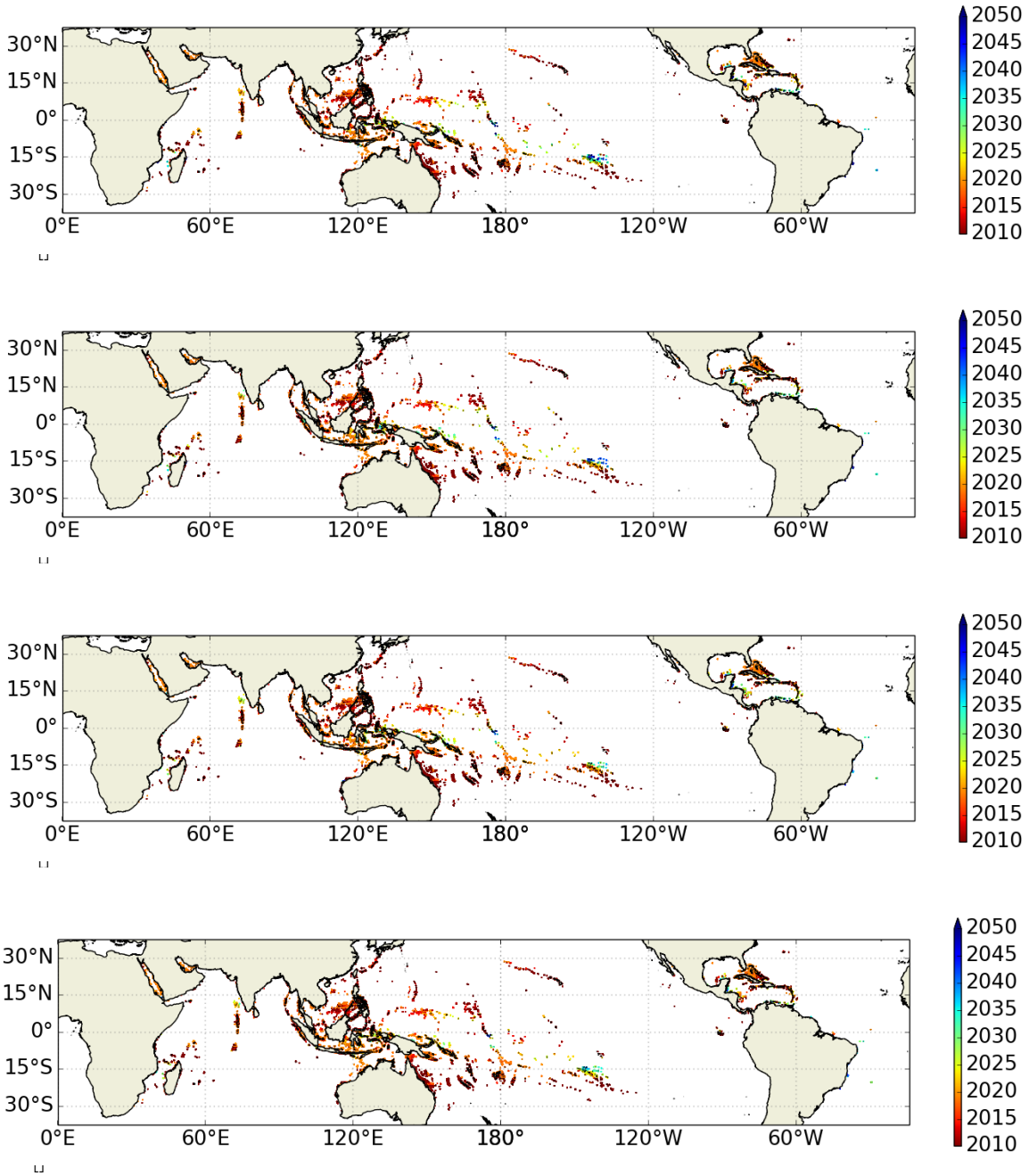


Figure S4. Global maps of thermal departure under the four emissions scenarios (from top: SSP126, SSP245, SSP370, SSP585) for TD5Y and the 8 DHW_{1988} / 4.8 DHW_{2008} threshold.

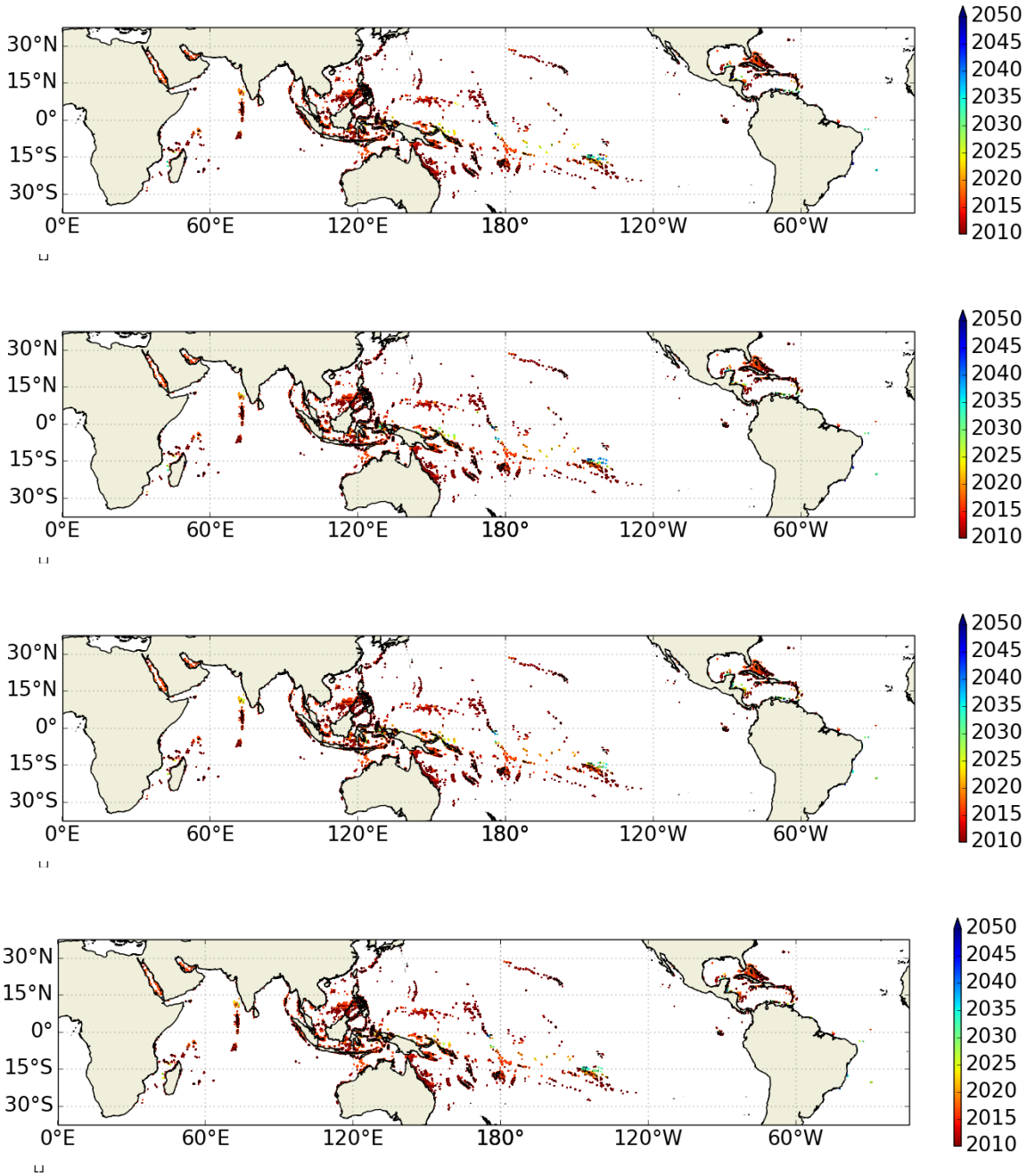
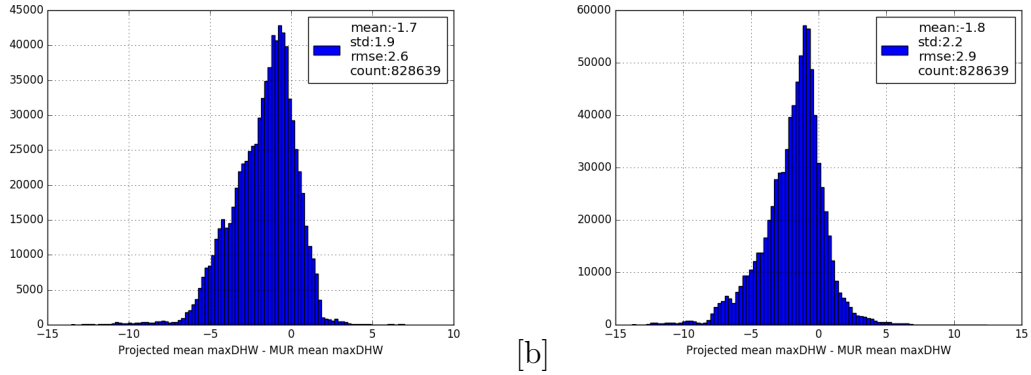


Figure S5. Global maps of thermal departure under the four emissions scenarios (from top: SSP126, SSP245, SSP370, SSP585) for TD10Y and the 8 DHW_{1988} / 4.8 DHW_{2008} threshold.



[a] [b]

Figure S6. Error distributions of the mean of the three annual maximum DHW values calculated between 2018 and 2020 from MUR subtracted from the corresponded value from the downscaled model ensemble, for SSP245 and using (a) BGL downscaling; and (b) trend-only downscaling.