Link between land-ocean warming contrast and surface relative humidities in simulations with coupled climate models

Supporting information

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S1 CMIP5 models

The models used are ACCESS1-0, ACCESS1-3, BCC-CSM1-1, BCC-CSM1-1-M, CanESM2, CCSM4, CESM1-BGC, CESM1-CAM5, CNRM-CM5, CSIRO-Mk3-6-0, FGOALS-s2, GFDL-CM3, GFDL-ESM2M, GISS-E2-H, GISS-E2-R, HadGEM2-AO, HadGEM2-CC, HadGEM2-ES, INMCM4, IPSL-CM5A-LR, IPSL-CM5A-MR, IPSL-CM5B-LR, MIROC5, MIROC-ESM, MRI-CGCM3, NorESM1-ME, and NorESM1-M.

The subset of models used for the analysis of daily-maximum temperatures and daily-minimum relative humidities are CanESM2, CNRM-CM5, CSIRO-Mk3-6-0, HadGEM2-CC, INMCM4, IPSL-CM5A-LR, IPSL-CM5A-MR, IPSL-CM5B-LR, MIROC5, MIROC-ESM, and MRI-CGCM3.

Other models were excluded because of lack of available data at the time when the analysis was conducted.

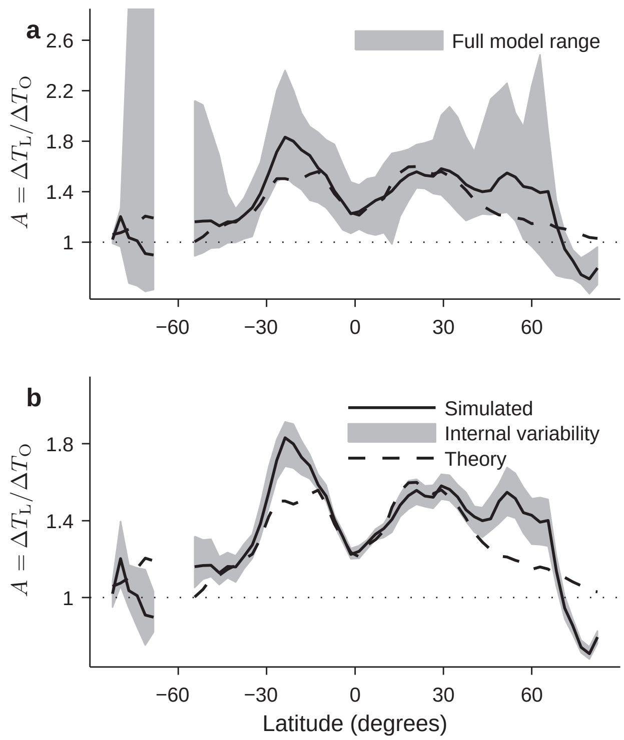

Figure S1: As in Fig. 2 but the gray shading shows different quantities instead of the interquartile range of the models. In (a), the gray shading shows the full model range. In (b), the gray shading shows a measure of the effect of internal variability on the multimodel median at each latitude. The internal variability in the simulated amplification factor is estimated by first dividing the 30-year averaging periods in the historical and RCP8.5 simulations into three decades each, i.e. for the historical simulation the averaging periods are 1975-84, 1985-94, and 1995-2004 (similarly for RCP8.5). The land and ocean temperature changes between the historical and RCP8.5 simulations for every combination of decades (nine combinations in total) are then used to recalculate the amplification factor. The upper bound of the gray shading denotes the multimodel median of the maximum amplification factor obtained from this analysis at each latitude, and the lower bound is the multimodel median of the minimum values.

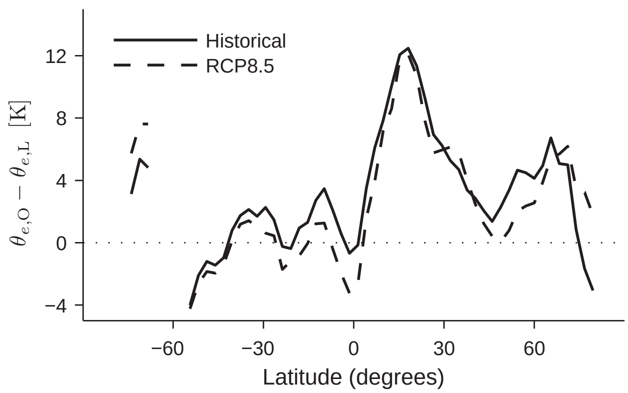

Figure S2: The multimodel-median difference between surface air equivalent potential temperatures over land and ocean vs latitude for the historical (1975-2004) and RCP8.5 (2070-2099) simulations. The equivalent potential temperatures are evaluated based on zonal- and time-mean temperatures and relative humidities to be consistent with how the theory is evaluated.

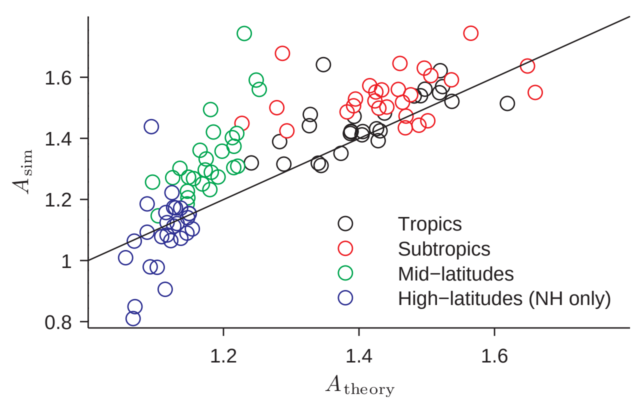

Figure S3: As in Fig. 3a but averaged over different latitude bands. The tropics (black symbols) are 20°S to 20°N. The subtropics (red symbols) are 20° to 40° in both hemispheres. The mid-latitudes (green symbols) are 40° to 60° in both hemispheres. The high-latitudes (blue symbols) are 60° to 90° in the Northern Hemisphere only because the amplification factors are noisy at these latitudes in the Southern Hemisphere for some of the models.

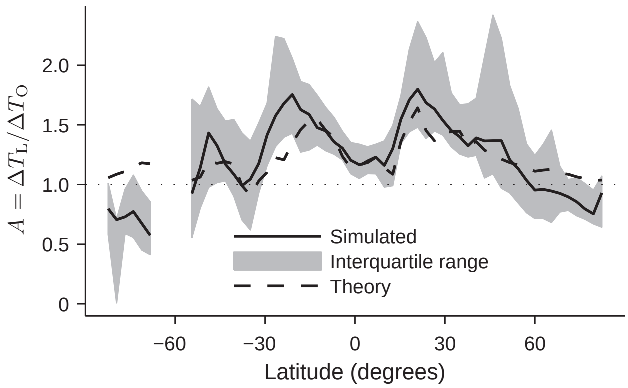

Figure S4: As in Fig. 2 but for trends (1950-2004) in the historical simulations rather than changes under RCP8.5.

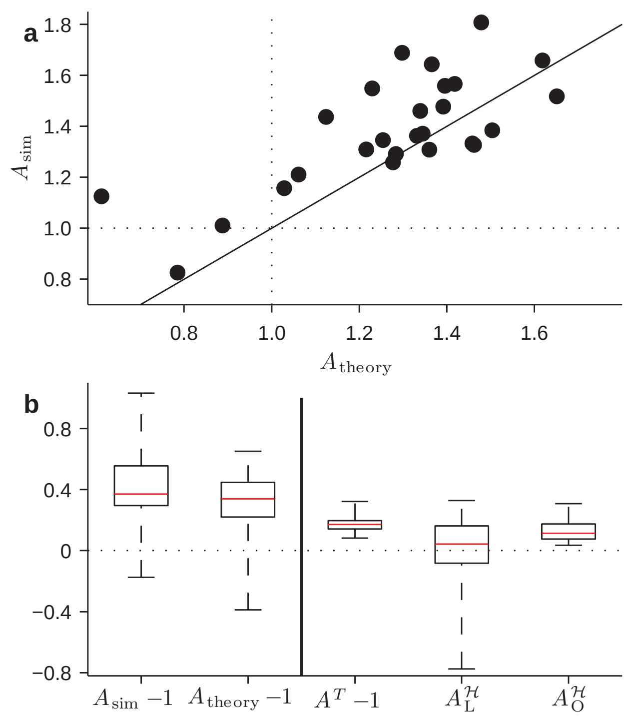

Figure S5: As in Fig. 3 but for trends (1950-2004) in the historical simulations rather than for changes under RCP8.5.

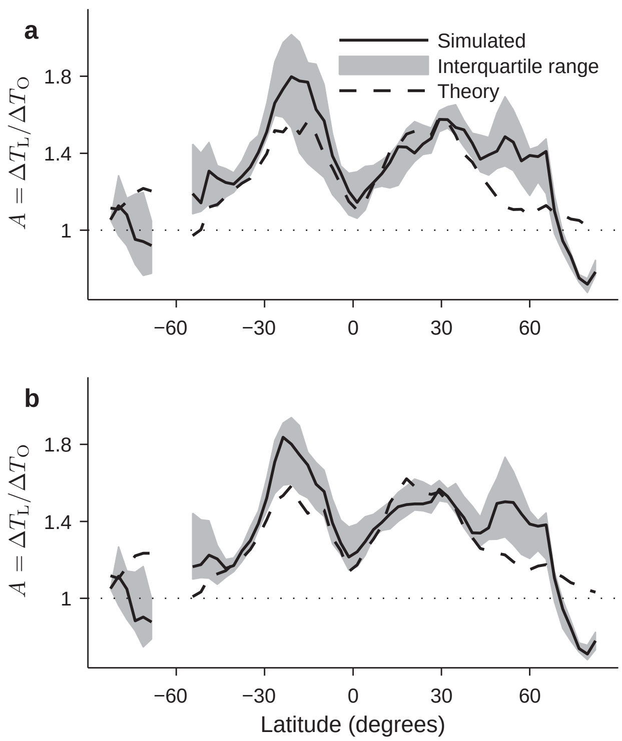

Figure S6: As in Fig. 2 but using (a) daily-maximum surface air temperatures and daily-minimum surface relative humidities in the subset of models for which the data were available and (b) daily-mean temperatures and relative humidities for the same subset of models as in (a). The subset of models used in this figure is listed in Section S1.

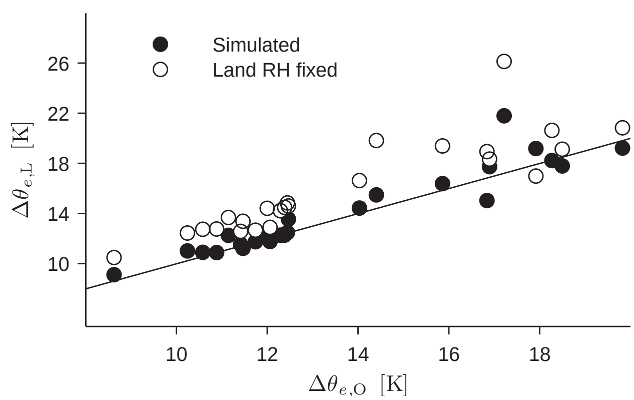

Figure S7: Changes in tropical-mean (20°S to 20°N) surface air equivalent potential temperature over land vs ocean (filled circles). The equivalent potential temperatures are calculated using the time-mean temperatures and relative humidites at each grid point prior to averaging over the tropics. The unfilled circles show the same quantities but with land relative humidity held fixed under climate change. The solid line corresponds to equal changes over land and ocean.