

Near-term tropical cyclone risk and coupled Earth system model biases

Objective

Earth system models (ESMs) projecting trends towards El Niño-like conditions in the equatorial Pacific may be inaccurately simulating the response to greenhouse gas-induced warming. Observations indicate a trend towards a La Niña-like state instead. This study explores the implications of this potential erroneous projections for severe weather events, particularly tropical cyclones, and their associated climate risk.

Approach

We analyzed observed and ESM-simulated trends in tropical Pacific sea surface temperatures and global tropical cyclones under historical and future climate conditions with future simulations under rcp8.5/ssp585 warming scenarios. The modeled tropical cyclones include those directly simulated from coupled and SST-forced HiResMIP models, as well as those downscaled from CMIP6 using the Columbia HAZARD model (CHAZ).

Impact

This work aims to raise awareness within the scientific community and advocates for the development of projections that consider a wider range of possible future warming scenarios for the equatorial Pacific. This includes scenarios that reflect recent historical trends, even if current coupled earth system models are unable to generate such projections at present.

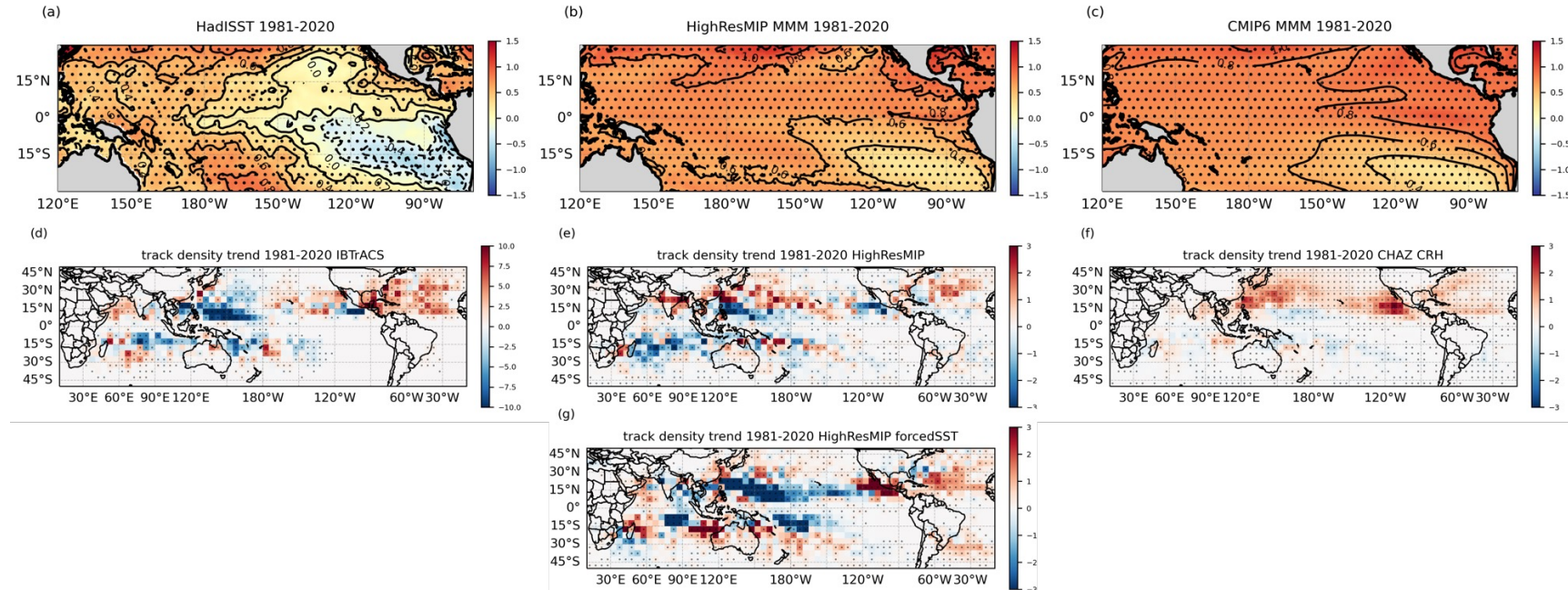


Figure: Historical trends (1981-2020) in sea surface temperature from (a) observations, and (b) HighResMIP and (c) CMIP6 historical simulations; and in tropical cyclone track density from (d) observations, (e) HighResMIP coupled historical simulations, (f) CHAZ, downscaling the same CMIP6 models as in (c), and (g) HighResMIP atmosphere-only simulations using observed sea surface temperature up to 2014 and observed sea surface temperature blended with CMIP5 RCP8.5 SST from 2015 to 2020. The units are similar to Figure 1 but over 40 years.

Sobel, Adam H., Chia-Ying Lee, Steven G. Bowen, Suzana J. Camargo, Mark A. Cane, Amy Clement, Boniface Fosu, et al. "Near-Term Tropical Cyclone Risk and Coupled Earth System Model Biases." *Proceedings of the National Academy of Sciences* 120, no. 33 (August 15, 2023): e2209631120. <https://doi.org/10.1073/pnas.2209631120>.