Supporting Information for "TC-GEN: Data-driven Tropical Cyclone Downscaling using Machine Learning-Based High-resolution Weather Model"

Renzhi Jing [1,2], Jianxiong Gao [3], Yunuo Cai [4], Dazhi Xi [5], Yinda Zhang [6],

Yanwei Fu [4], Kerry Emanuel [7], Noah S. Diffenbaugh [1,8,9], Eran Bendavid [2,10]

[1]Woods Institute for the Environment, Stanford University, Stanford, CA, USA

[2]School of Medicine, Stanford University, Stanford, CA, USA

[3]Institute of Science and Technology for Brain-inspired Intelligence, Fudan University, Shanghai, China

[4]School of Data Science and MOE Frontiers Center for Brain Science, Fudan University, Shanghai, China

[5]Department of Civil and Environmental Engineering, Princeton University, Princeton, NJ, USA

[6]Google LLC, 1600 Amphitheatre Pkwy, Mountain View, CA, USA

[7]Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, NA, USA

[8]Department of Earth System Science, Stanford University, Stanford, CA, USA

[9]Doerr School of Sustainability, Stanford University, Stanford, CA, USA

[10]Department of Health Policy, Stanford University, Stanford, CA, USA

Contents of this file

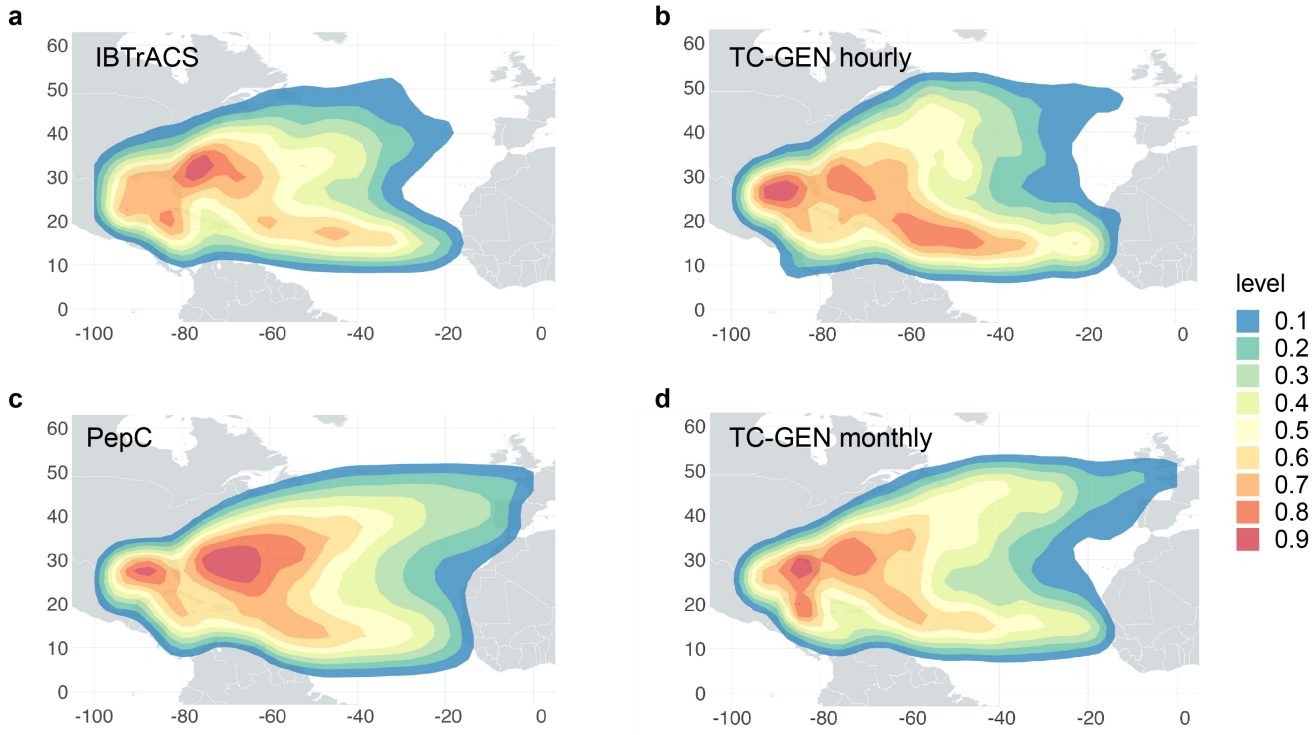

Figure S1. Sensitivity test of track density Similar to Figure 7, track density is computed as the accumulated number of tropical cyclone passes into each 0.75 × 0.75 grid box, normalized by the maximum grid value of the basin, and smoothed using a Gaussian low-pass filter. The four panels show track density from (a) observations, (b) TC-GEN initiated with hourly data, (c) storms simulated by PepC, and (d) TC-GEN initiated with monthly data. In comparison with Figure 7, we resample the genesis locations based on the spatial distribution of historical genesis to ensure a fair comparison between TC-GEN simulated storms and observations. We demonstrate that, following the resampling, the simulated tracks effectively capture the hotspots in the main development region, the southeast US coast, and the Gulf of Mexico.

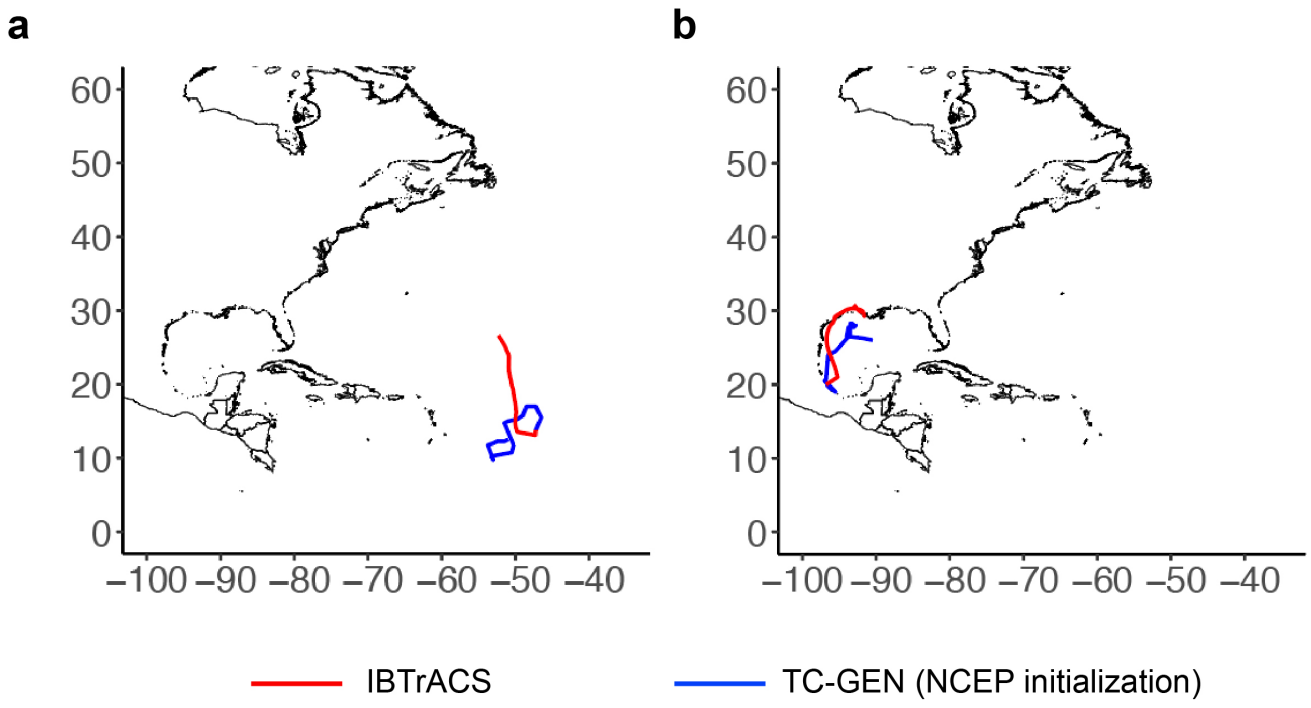

Figure S2. Robustness with alternative reanalysis data We assess the suitability of TC-GEN by initiating it with an alternative reanalysis dataset, the NCEP GFS. Through the simulation of two historical tropical cyclones (a) 2021240N13313 and (b) 2021256N21265, representing storms originating in the Gulf of Mexico and the main development region, respectively, we observe unsatisfactory performance. This is likely due to the well-known domain gap problem in deep learning.