Supporting Information for "Projected Changes to Cool-Season Storm Tides in the 21st Century along the Northeastern United States Coast"

William J. Pringle[1], Jiali Wang[1], Keith J. Roberts[2], Veerabhadra R.

Kotamarthi[1]

[1]Environmental Science Division, Argonne National Laboratory, Lemont, IL, USA

[2]School of Marine and Atmospheric Science, Stony Brook University, NY, USA

Contents of this file

Introduction This supplementary contains figures that summarizes the accuracy of low-level winds and extratropical cyclone (ETC) characteristics of the 12-km horizontal resolution downscaled regional climate models (RCMs; computational domain shown in Fig. S1) in the northeastern United States coast (NEC) region during the historical cool-season (November-March) decade (1995-2004).

RCM-simulated near-surface wind velocities (10-m above ground) are compared with National Buoy Data Center (NBDC) offshore buoy observations in Figs. S2-S5. Observed winds at the NBDC anemometers are adjusted to 10-m above ground height through the Power-law method (Hsu et al., 1994). Since the WRF-based RCM simulations are not a reanalysis (i.e., the date of occurrence is meaningless), the root-mean-square-error

─────────

December 14, 2020, 5:21am

(RMSE) of wind speeds shown in Fig. S2 is computed on the quantile-quantile plot distribution.

Figures S6-S7 show the density and intensity distributions, respectively, of ETCs represented by the RCMs as compared to 0.25° ERA5 reanalysis data (European Centre for Medium-Range Weather Forecasts, 2019). Individual cyclones are extracted from the meteorological data by tracking the local minimums of sea level pressure (SLP) using Version 2 of CyloneTrack (Flaounas et al., 2014), a cyclone tracking algorithm. To filter out small scales in SLP a 2-D Gaussian smoothing kernel with a standard deviation of 10 is used. The ERA5 reanalysis data was sampled at 3-hourly intervals to match the RCM model outputs.

References

European Centre for Medium-Range Weather Forecasts. (2019). *ERA5 Reanalysis (0.25 Degree Latitude-Longitude Grid).* Boulder, CO: Research Data Archive at the National Center for Atmospheric Research, Computational and Information Systems Laboratory. Retrieved from `https://doi.org/10.5065/BH6N-5N20` doi: 10.5065/BH6N-5N20

Flaounas, E., Kotroni, V., Lagouvardos, K., & Flaounas, I. (2014). CycloTRACK (v1.0)-tracking winter extratropical cyclones based on relative vorticity: Sensitivity to data filtering and other relevant parameters. *Geoscientific Model Development*, *7*(4), 1841–1853. doi: 10.5194/gmd-7-1841-2014

Hsu, S. A., Meindl, E. A., & Gilhousen, D. B. (1994). Determining the Power-Law Wind-Profile Exponent under Near-Neutral Stability Conditions at Sea. *Journal of Applied Meteorology and Climatology*, *33*(6), 757–765. doi: 10.1175/1520-0450(1994)
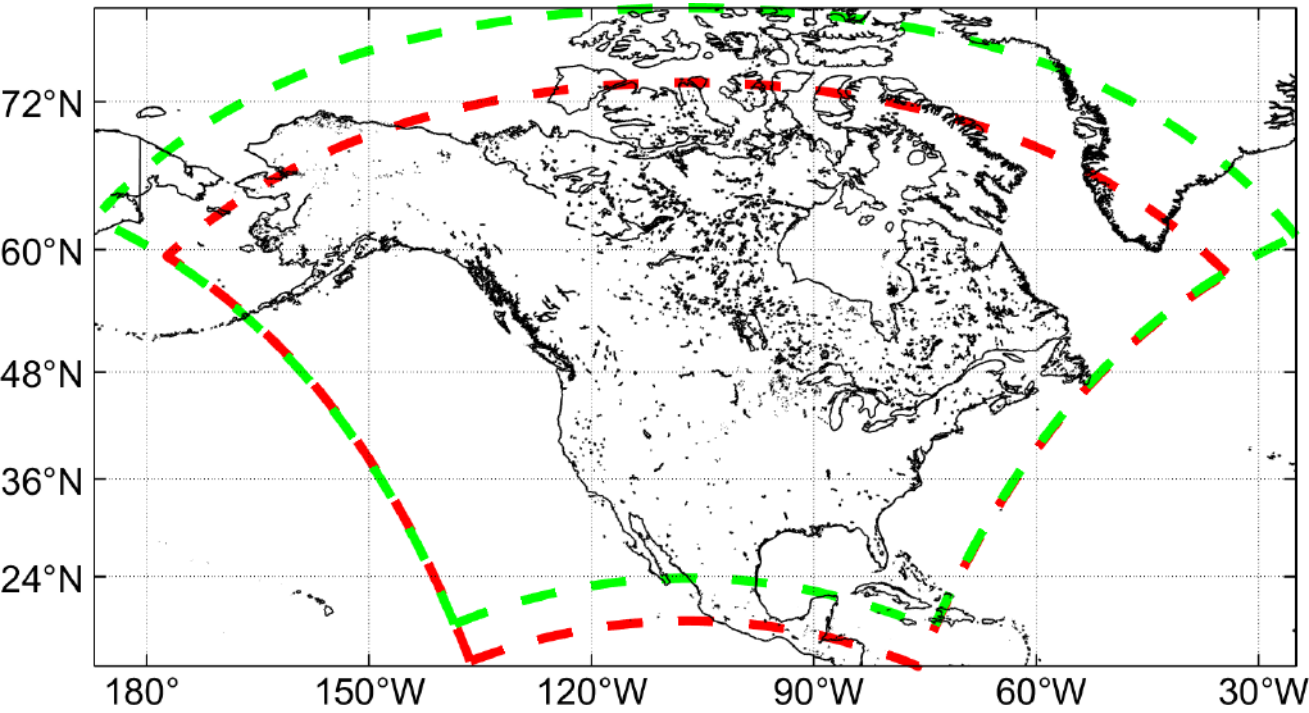
033⟨0757:DTPLWP⟩2.0.CO;2

Figure S1. Computational domain (dashed regions) of the three WRF-based RCMs (WRF-CCSM4: green, WRF-GFDL/HadGEM: red).
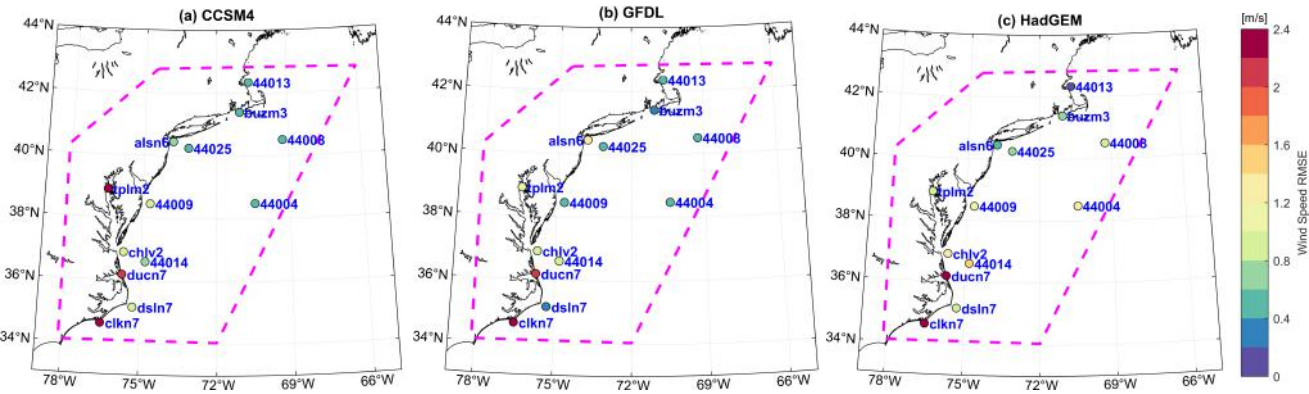

Figure S2. Accuracy (RMSE) of simulated 10-m wind speeds during the cool-season at NDBC buoys in the NEC region for the historical decade (1995-2004) by the three WRF-based RCMs; (a) WRF-CCSM4, (b) WRF-GFDL, (c) WRF-HadGEM.
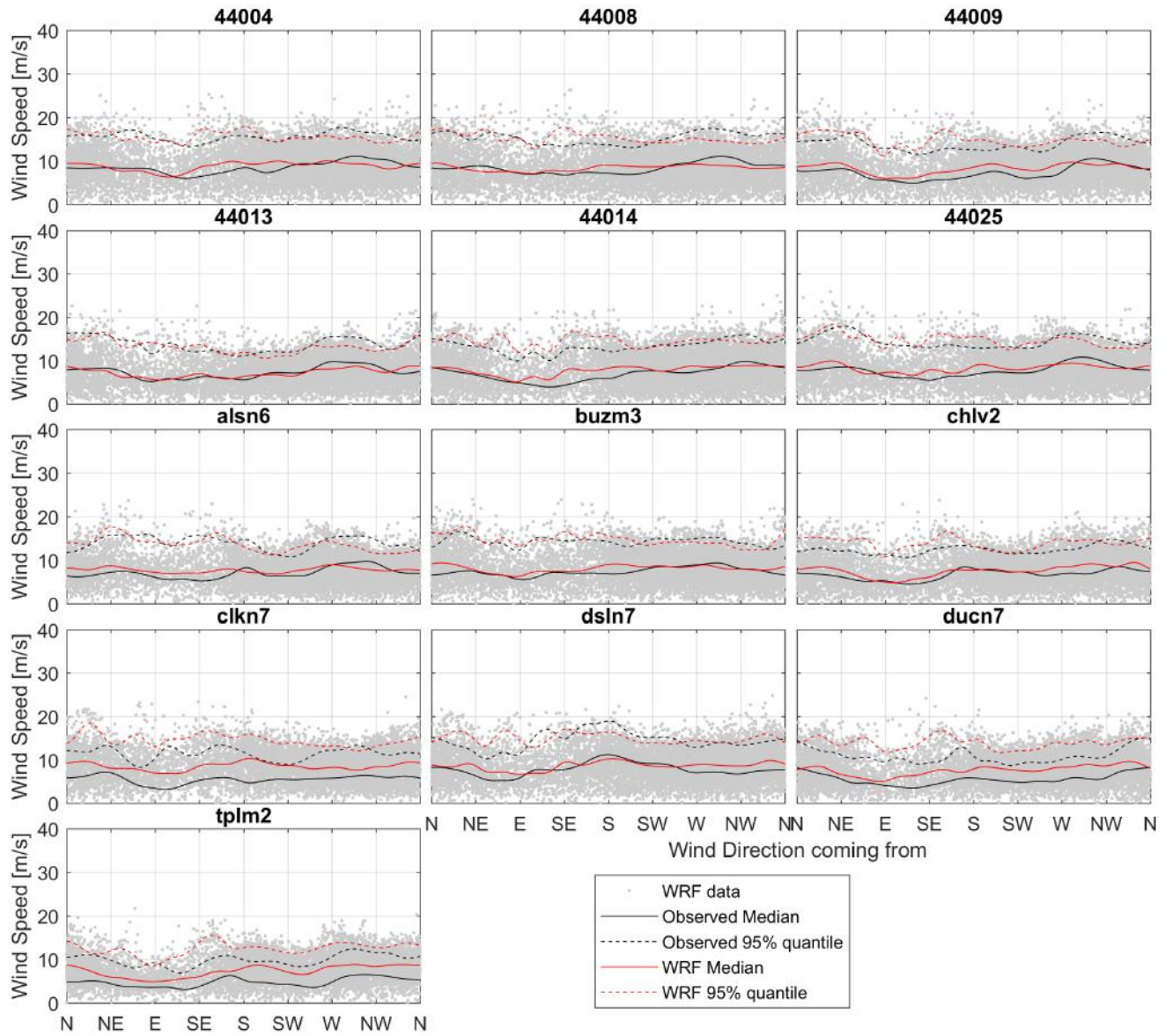
Figure S3. Distribution of WRF-CCSM4 simulated wind speeds and directions at NDBC buoys in the NEC region for the historical decade (1995-2004). Comparisons are shown against the median and 95% quantile of measured wind speeds at the NDBC buoys whose locations are shown in Fig. S2.
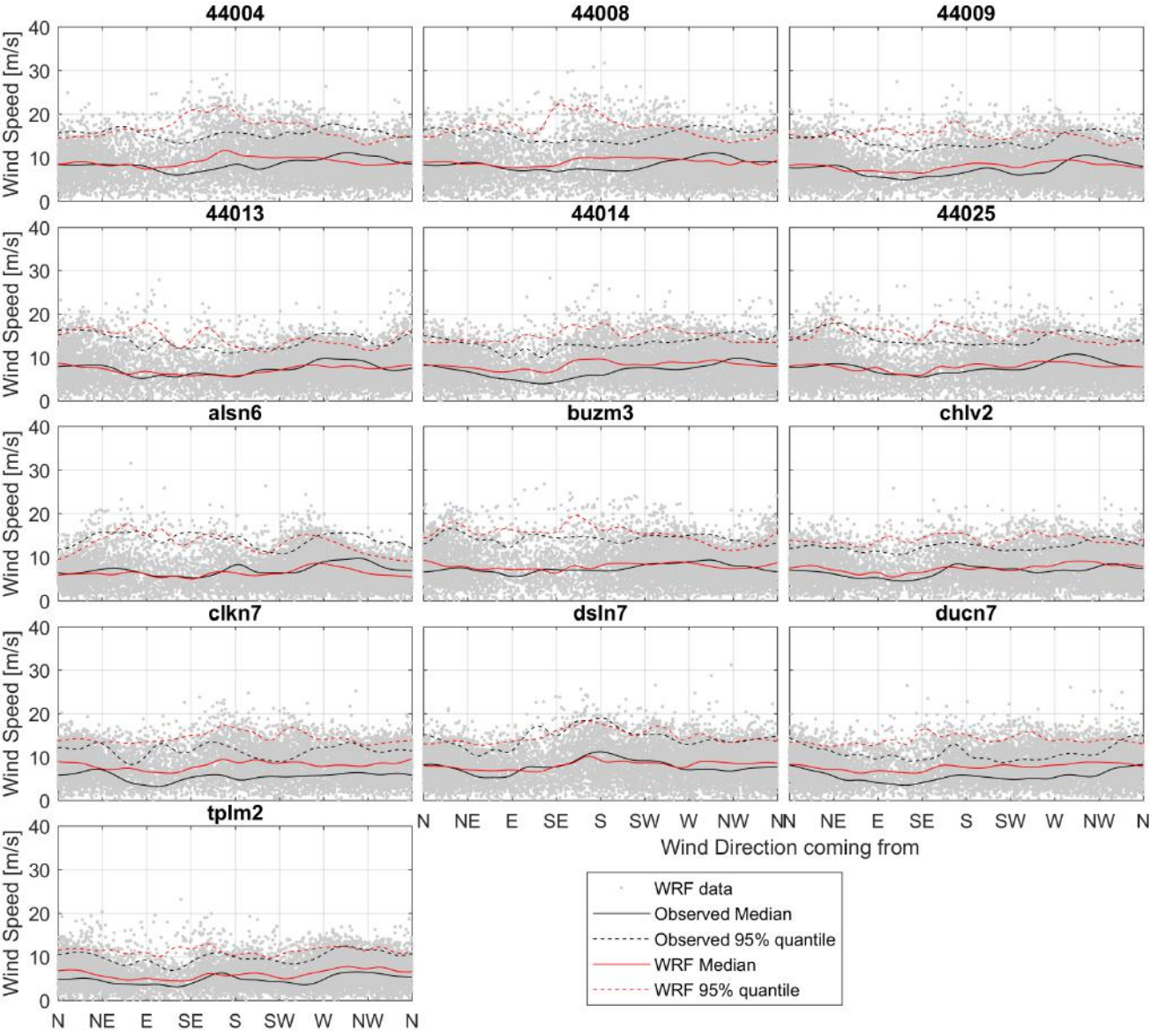
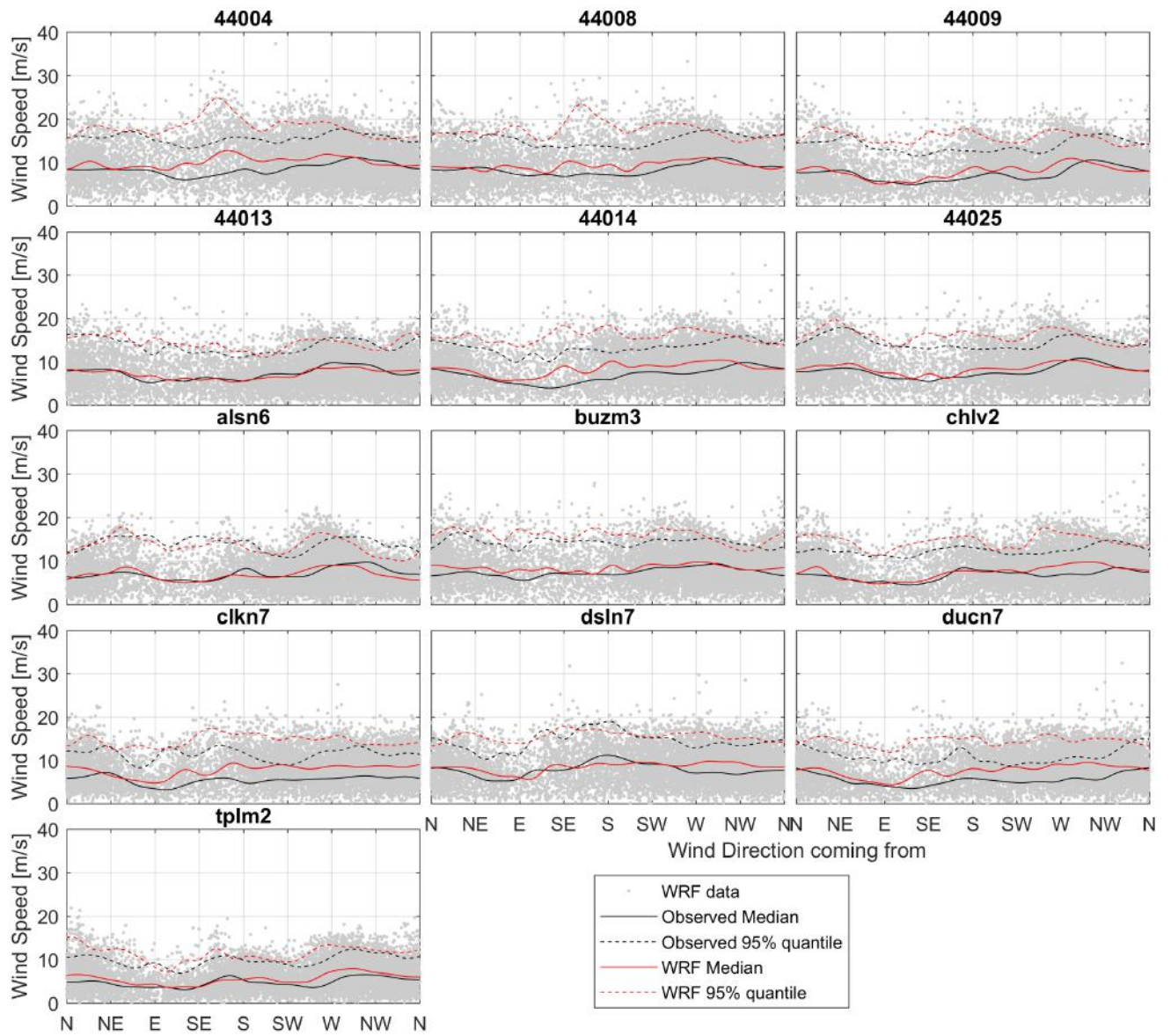**Figure S4.** Same as Fig. S3 but for WRF-GFDL.

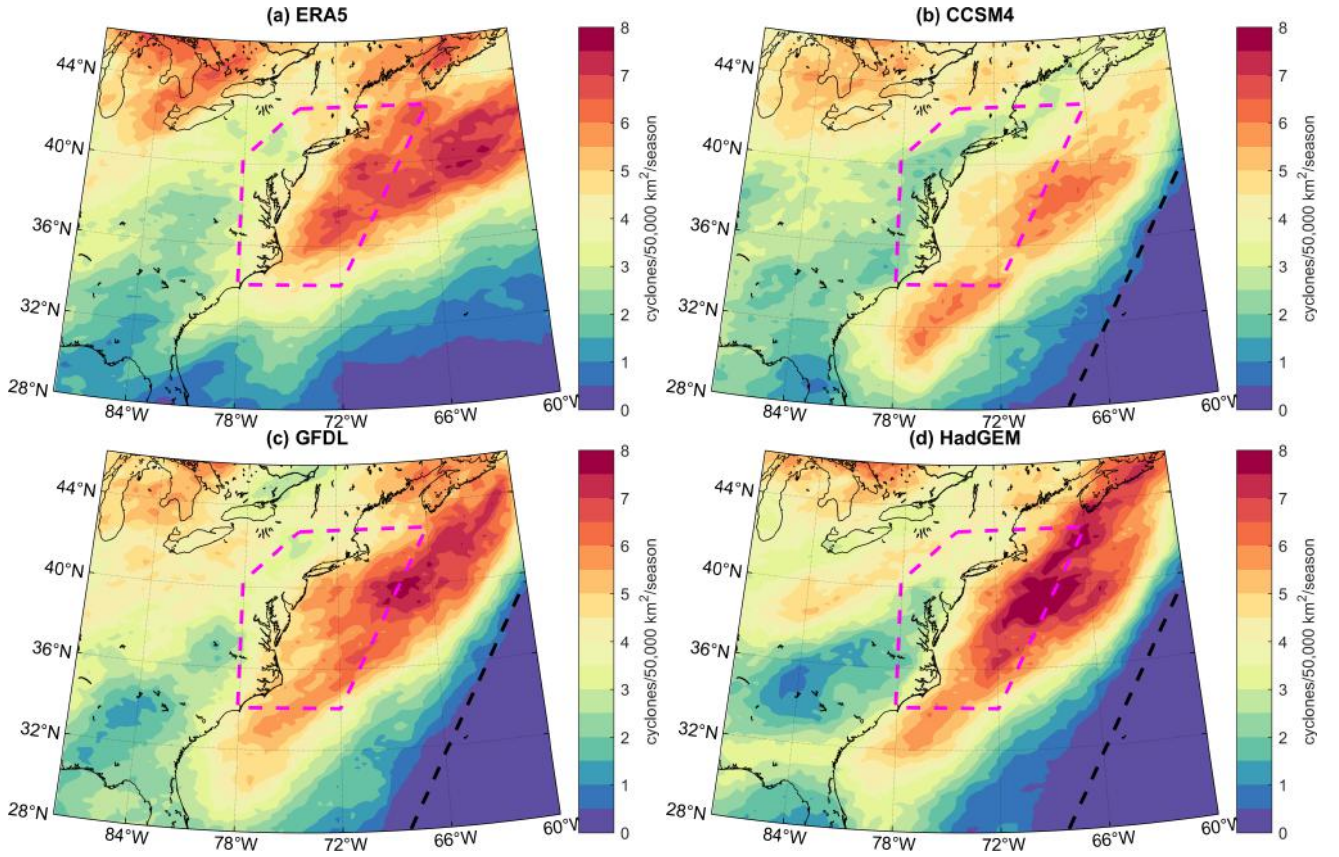**Figure S5.** Same as Fig. S3 but for WRF-HadGEM.

:

Figure S6. Spatial distribution of cool-season ETC density (number of cyclones per 50,000 km^2 per season) in the western North Atlantic Ocean during the historical decade (1995-2004) for: (a) ERA5 reanalysis data, and the WRF-based RCMs; (b) WRF-CCSM4, (c) WRF-GFDL, (d) WRF-HadGEM. Black dashed line indicates the edge of the WRF computational domains, explaining the zero density further offshore. Dashed magenta region indicates the NEC zone in which the distribution of ETC intensity is shown in Fig. S7.
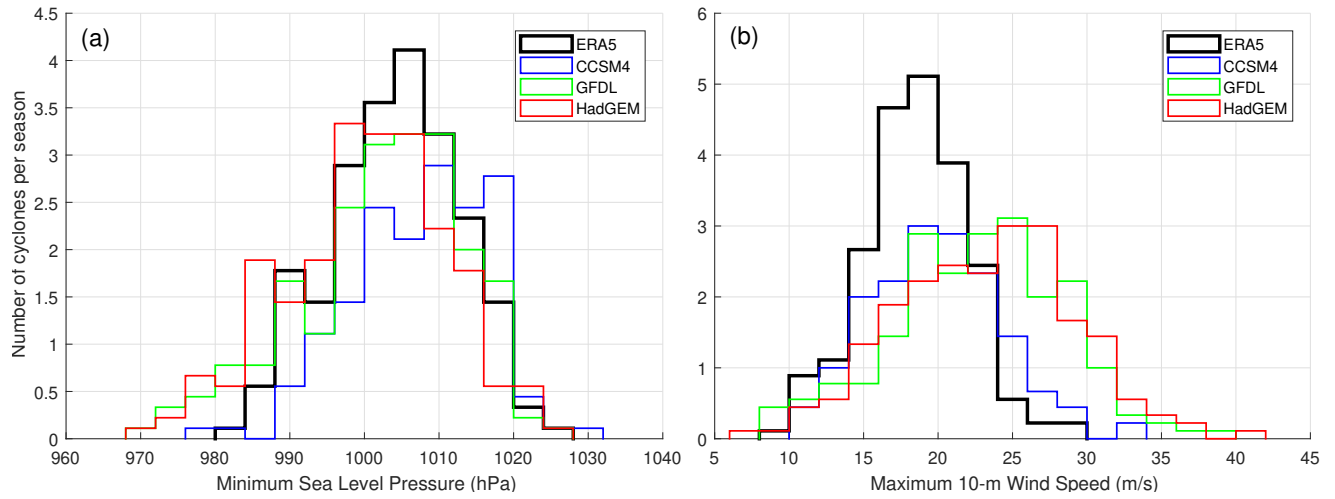
Figure S7.   Distribution of the maximum lifecycle intensity of cool-season ETCs along the NEC (cyclones that fall within the magenta box region plotted in Fig. S6) during the historical decade (1995-2004) for ERA5 reanalysis data and the three RCMs (WRF-CCSM4, WRF-GFDL, WRF-HadGEM). (a) Minimum sea level pressure, (b) Maximum 10-m wind speed.