On the Impact of Climate Change on Extreme Extratropical Cyclones in the Northeastern U.S.

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Extratropical Cyclones (ETC) can produce high-impact weather in mid-latitudes that create extreme precipitation, wind, or storm surge. For instance, on January 10th and January 13, 2024, Maine experienced two severe back-to-back ETCs resulting in unprecedented damages to public and private infrastructure across the state's entire coastline. Besides the societal impacts of ETCs, little is known about climate change's impact on these storms and their related hazards. Here, we investigate how wind extremes in rare – once in a hundred year – ETCs are changing under future climate conditions. We are leveraging the 100-member CESM2 second large ensemble dataset to identify ETCs that transect the Northeastern U.S. and find that the annual number of ETCs is projected to decrease but that the storms with the highest near-surface wind speeds and lowest pressure anomalies are intensifying under warmer conditions. Additionally, we see that extreme future ETCs in the Northeast more frequently have southeastern trajectories (moving through the Southeastern U.S.) and less zonal movements. We leverage the variable resolution capabilities of MPAS to downscale hundreds of intense ETC events from LENS2 to 3 km grid spacing over the Northeast. We demonstrate that there is little sensitivity to the size of the high-resolution region and decided to use the 60 km to 3 km global mesh, which allows for high-quality and computationally highly efficient simulations of current and future climate ETCs. We will present analyses of climate change impacts on ETC wind extremes and discuss potential future applications of the created dataset and the experimental design in general.