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Quantifying Arctic Storm Risk in a Changing Climate

Alexander Vessey[1], Kevin Hodges[1], Len Shaffrey[1], and Jonathan Day[2]
[1]Department of Meteorology, University of Reading, Earley Gate, Reading RG6 6BB, UK
[2]ECMWF, Shinfeld Park, Reading RG2 9AX, UK

The Arctic has undergone significant change over the past few decades, and there has been great reductions in Arctic sea ice extent. The Arctic ocean has become more accessible, and this has allowed for more human activity in the Arctic. The risk of storms impacting human activities in the Arctic has consequently increased, and as sea ice extent continues to decline in the near-future, the risk of storms impacting human activities in the Arctic is likely to increase further. In this study, the present climatology of Arctic storms is evaluated between modern reanalysis datasets, and the future climatology of Arctic storms is also evaluated in climate model simulations.

There are multiple reanalysis datasets available from different institutions, which each give an approximation of past atmospheric conditions over the last few decades. In addition, there are multiple storm tracking methods, which may impact the climatology of Arctic storms that is identified in a reanalysis datasets. In this study, we aimed to improve the understanding of Arctic storms by assessing their characteristics in multiple global reanalyses, the ECMWF-Interim Reanalysis (ERA-Interim), the 55-Year Japanese Reanalysis (JRA-55), the NASA-Modern Era Retrospective Analysis for Research and Applications Version 2 (MERRA-2), and the NCEP-Climate Forecast System Reanalysis (NCEP-CFSR), using the same storm tracking method based on 850 hPa relative vorticity and mean sea level pressure. In addition, the response of Arctic storms to climate change has been evaluated in the UPSCALE climate simulations, and the affect of horizontal resolution on the representation of future Arctic storminess has been assessed.

The results show that there are no significant trends in Arctic storm characteristics between 1980-2017, even though the Arctic has undergone rapid change. Although some similar Arctic storm characteristics are found between the reanalysis datasets, there are generally higher differences between the reanalyses in winter (DJF) than in summer (JJA). In addition, substantial differences can arise between using the same storm tracking method based on 850 hPa relative vorticity or mean sea level pressure, which adds to the uncertainty associated with current Arctic storm characteristics.

The results also show that Arctic storms will change significantly in a future climate, particularly in their spatial distribution. Differences have been found between the future simulations of Arctic storms between an ensemble of high resolution climate models (25km) and low resolution climate models (130km), which adds uncertainty to how Arctic storms may change in a future climate. The possible reasons for why the representation of future climate Arctic storms may be different in

climate models of differing horizontal resolution has been explored.