EGU21-12795, updated on 18 Jan 2022
https://doi.org/10.5194/egusphere-egu21-12795
EGU General Assembly 2021

Midlatitude cyclones in convection permitting climate simulations: the added value offered for extreme wind speeds and sting-jets

Colin Manning[1,2], Elizabeth Kendon[2], Hayley Fowler[1], Nigel Roberts[3], Segolene Berthou[2], Dan Suri[3], and Malcom Roberts[2]

[1]Newcastle University, School of Engineering, United Kingdom of Great Britain – England, Scotland, Wales (colin.manning@ncl.ac.uk)

[2]Met Office Hadley Centre, Exeter, United Kingdom

[3]UK Met Office, Exeter, United Kingdom

Extra-tropical windstorms are one of the costliest natural hazards affecting Europe, and windstorms that develop a phenomenon known as a sting-jet account for some of the most damaging storms. A sting-jet (SJ) is a mesoscale core of high wind speeds that occurs in particular types of cyclones, specifically Shapiro-Keyser (SK) cyclones, and can produce extremely damaging surface wind gusts. High-resolution climate models are required to adequately model SJs and so it is difficult to gauge their contribution to current and future wind risk. In this study, we develop a low-cost methodology to automate the detection of sting jets, using the characteristic warm seclusion of SK cyclones and the slantwise descent of high wind speeds, within pan-European 2.2km convection-permitting climate model (CPM) simulations. Following this, we quantify the contribution of such storms to wind risk in Northern Europe in current and future climate simulations, and secondly assess the added value offered by the CPM compared to a traditional coarse-resolution climate model. This presentation will give an overview of the developed methods and the results of our analysis.

Comparing with observations, we find that the representation of wind gusts is improved in the CPM compared to ERA-Interim reanalysis data. Storm severity metrics indicate that SK cyclones account for the majority of the most damaging windstorms. The future simulation produces a large increase (>100%) in the number of storms exceeding high thresholds of the storm metric, with a large contribution to this change (40%) coming from windstorms in which a sting-jet is detected. Finally, we see a systematic underestimation in the GCM compared to the CPM in the frequency of extreme wind speeds at 850hPa in the cold sector of cyclones, likely related to better representation of sting-jets and the cold conveyor belt in the CPM. This underestimation is between 20-40% and increases with increasing wind speed above 35m/s. We conclude that the CPM adds value in the representation of severe surface wind gusts, providing more reliable future projections and improved input for impact models.