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Midlatitude cyclone features associated with extreme winds and gusts in the seas surrounding the UK

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Located near the end of the North Atlantic storm track, the UK's surrounding seas are characterised by a highly variable wind climate, making prediction of wind speeds challenging at all time scales. While wind speed trends over the UK's land and seas have been the focus of several studies of the literature in the past 20 years, the question of what is the current systematic link between observed extreme wind speeds (and gusts) over these seas and distinct sub-synoptic features of midlatitude cyclones is, to date, unanswered. To address this question, we have performed a 10-year climatological analysis of the observed extreme wind speeds and gusts, presenting the distribution of extremes and the prevailing wind direction, along with an analysis of their inter- and intra-annual variability. We find that between the 70 and 85% of the observed top 1% extreme wind and gust events recorded at each network site are within 1000 km of the centre of a cyclone (tracked in the ERA5 reanalysis), and that an even higher proportion of the top 0.1% of the wind and gust events is associated with a cyclone centre (between 80 and 100% depending on the site). We then determine at each site whether the warm or cold conveyor belt flows are more likely to lead to extreme wind or gust events. Combining the observed extreme winds and gusts data with reanalysis significant wave heights, we further discuss the relationship between extreme winds and extreme ocean wave heights, and consider the relevance of the results to the safety and the smooth running of the operations of the wind energy and oil and gas industries in the UK's surrounding seas.