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North Atlantic storm driving of extreme wave heights in the North Sea

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The relationship between storms and extreme ocean waves in the North Sea is assessed using a long-period wave data set and storms identified in the Interim ECMWF Re-Analysis (ERA-Interim). An ensemble sensitivity analysis is used to provide information on the spatial and temporal forcing from mean sea-level pressure and surface wind associated with extreme ocean wave height responses. Extreme ocean waves in the central North Sea arise due to intense extratropical cyclone winds from either the cold conveyor belt (northerly-wind events) or the warm conveyor belt (southerly-wind events). The largest wave heights are associated with northerly-wind events which tend to have stronger wind speeds and occur as the cold conveyor belt wraps rearward round the cyclone to the cold side of the warm front. The northerly-wind events provide a larger fetch to the central North Sea to aid wave growth. Southerly-wind events are associated with the warm conveyor belts of intense extratropical cyclones that develop in the left upper tropospheric jet exit region. Ensemble sensitivity analysis can provide early warning of extreme wave events by demonstrating a relationship between wave height and high pressure to the west of the British Isles for northerly-wind events 48 h prior. Southerly-wind extreme events demonstrate sensitivity to low pressure to the west of the British Isles 36 h prior.