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Increased wind risk from sting-jet mid-latitude cyclones in a warmer climate

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One of the mechanisms whereby a mid-latitude cyclone can produce strong damaging surface winds is through the generation of sting jets: highly-localised transient jets, descending from the tip of the hooked cloud head towards the top of the boundary layer within the dry slot. Recent research, based on ERA-Interim data from 1979-2012, has shown that around 30% of November-March North Atlantic mid-latitude cyclones had the potential to produce sting jets, with this percentage rising to around 40% for those cyclones classified as meteorological bombs.

To investigate the changes to these statistics under a warming climate, 13-year global climate simulations under both present-climate and the IPCC RCP8.5 scenario conditions have been analysed and compared, focusing again on the North Atlantic region during September - May. As for the ERA-Interim data, a sting-jet precursor diagnostic is applied to tracked cyclones. This diagnostic, designed for climate-resolution datasets, requires the presence of conditional symmetric instability and the necessary environmental conditions for it to be released. We show that the present-day simulation shares the statistical features of sting jet storms found in ERA-Interim. In contrast, the proportion of extratropical cyclones with the potential to generate sting jets increases to around 45% in the RCP8.5-scenario simulation. Furthermore, while the proportion of meteorological bombs is similar in the two climate simulations, the proportion of these storms with the potential to generate sting jets increases to nearly 70% in the RCP8.5 simulation.

The resolved-wind risk over Europe associated with meteorological bombs containing a sting-jet precursor increases substantially in the future climate; in reality this wind risk is likely to be further enhanced by the release of localised moist instability, unresolved by typical climate models.