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The structure of extra-tropical cyclones in a warmer climate

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Extra-tropical cyclones constitute a large part of the circulation in the mid-latitudes and can lead to high impact weather such as strong winds, heavy rainfall and snow. Therefore, it is vital to understand how the properties of extra-tropical cyclones will change in the future. However, the current generation of climate models do not provide a clear prediction of how the number of extra-tropical cyclones will change in the future nor a clear answer to how the properties of extra-tropical cyclones, for example, their precipitation patterns and associated low-level winds, will change. The overall aim of this study is to determine how the structure of extra-tropical cyclones will change in the future when the climate warms. We address this aim by performing highly idealised "climate change" experiments using a state-of-the-art atmosphere only model in an aqua-planet configuration. Multiple 10-year long simulations are conducted with OpenIFS, a version of ECMWFs Integrated Forecast System (IFS) which is freely available under license to academic institutions. A control experiment and an experiment where the sea surface temperatures are uniformly warmed by 4K are performed. In both experiments, extra-tropical cyclones are tracked using TRACK, an objective tracking algorithm, and then composites of the 200 strongest, and the 200 most typical ("mean") cyclones are created. The mean composite cyclone does not change in structure, however the most intense composite cyclone shows notable changes to the structure of the cyclone: the area of strong winds increases, the location of the heaviest precipitation moves further ahead of the warm front and expands. These results indicate that high impact weather associated with extreme extra-tropical cyclone in the future may affect larger areas than in the current climate.