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North Atlantic cyclones, geometry, life cycles and extremes

A. Schneidereit, F. Sienz, R. Blender, F. Lunkeit, and K. Fraedrich

Meteorologisches Institut, Universität Hamburg, Hamburg, Germany (andrea.schneidereit@zmaw.de)

Mid-latitude cyclones are analysed in re-analysis data, present-day, and global warming simulations during winter and summer. Cyclone centres are identified by the minima of the 1000 hPa geopotential height. Fitting a radially symmetric Gaussian function to the surrounding height field provides cyclone depth (difference between the cyclone centre and the synoptic environment) and radius (standard deviation). The present-day simulation is validated by the ECMWF ERA-40 re-analysis data, and the impact of global warming is determined by the comparison of the A1B scenario with the present-day (20C) simulation.

Extreme value statistics is applied to the radius, the depth, relative vorticity, central pressure, and the mean horizontal pressure gradient. Generalized extreme value distributions are fitted and the changes of the parameters are determined. Due to a shift of parameters, the return time distributions of extreme central pressure, vorticity, and pressure gradients are altered in the warmer climate. The distributions of the depths changes qualitatively. The radii show no direct relationship with the intensity and are largest at the cyclolysis stage.