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Variability of cyclones over the North Atlantic and Europe since 1871

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The scarce availability of long-term atmospheric data series has so far limited the analysis of low-frequency activity and intensity changes of cyclones over the North Atlantic and Europe. A novel reanalysis product, the Twentieth Century Reanalysis (20CR; Compo et al., 2011), spanning 1871 to present, offers potentially a very valuable resource for the analysis of the decadal-scale variability of cyclones over the North Atlantic sector and Europe.

In the 20CR, only observations of synoptic surface pressure were assimilated. Monthly sea surface temperature and sea ice distributions served as boundary conditions. An Ensemble Kalman Filter assimilation technique was applied. "First guess" fields were obtained from an ensemble (with 56 members) of short-range numerical weather prediction forecasts. We apply the cyclone identification algorithm of Wernli and Schwierz (2006) to this data set, i.e. to each individual ensemble member. This enables us to give an uncertainty estimation of our findings.

We find that 20CR shows a temporally relatively homogeneous representation of cyclone activity over Europe and great parts of the North Atlantic. Pronounced decadal-scale variability is found both in the frequency and intensity of cyclones over the North Atlantic and Europe. The low-frequency variability is consistently represented in all ensemble members. Our analyses indicate that in the past approximately 140 years the variability of cyclone activity and intensity over the North Atlantic and Europe can principally be associated with the North Atlantic Oscillation and secondary with a pattern similar to the East Atlantic pattern. Regionally however, the correlation between cyclone activity and these dominant modes of variability changes over time.

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