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Northeast Atlantic storminess in centennial reanalyses

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Global atmospheric reanalyses are commonly applied for the validation of climate models, diagnostic studies, and driving higher resolution numerical models with the emphasis on assessing climate variability and long-term trends. Over recent years, longer reanalyses spanning a period of more than hundred years have become available. In this study, the variability and long-term trends of storm activity is assessed over the northeast Atlantic in modern centennial reanalysis datasets, namely ERA-20cm, ERA-20c, CERA-20c, and the 20CR-reanalysis suite with 20CRv3 being the most recent one. All reanalyses, except from ERA-20cm, assimilate surface pressure observations, whereby ERA-20c and CERA-20c additionally assimilate surface winds. For the assessment, the well-established storm index of higher annual percentiles of geostrophic wind speeds derived from pressure observations at sea level over a relatively densely monitored marine area is used.

The results indicate that the examined centennial reanalyses are not able to represent long-term trends of storm activity over the northeast Atlantic, particularly in the earlier years of the period examined when compared with the geostrophic wind index based on pressure observations. Moreover, the reanalyses show inconsistent long-term behaviour when compared with each other. Only in the latter half of the 20th century, the variability of reanalysed and observed storminess time series starts to agree with each other. Additionally, 20CRv3, the most recent centennial reanalysis examined, shows markedly improved results with increased uncertainty, albeit multidecadal storminess variability does not match observed values in earlier times before about 1920.

The behaviour shown by the centennial reanalyses are likely caused by the increasing number of assimilated observations, changes in the observational databases used, and the different underlying numerical model systems. Furthermore, the results derived from the ERA-20cm reanalysis that does not assimilate any pressure or wind observations suggests that the variability and uncertainty of storminess over the northeast Atlantic is high making it difficult to determine storm activity when numerical models are not bound by observations. The results of this study imply and reconfirm previous findings that the assessment of long-term storminess trends and variability in centennial reanalyses remains a rather delicate matter, at least for the northeast Atlantic region.

