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Return periods of losses associated with European windstorm series in a changing climate

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During the last decades, several windstorm series hit Europe leading to large aggregated losses. Such storm series are examples of serial clustering of extreme cyclones, presenting a considerable risk for the insurance industry. Clustering of events and return periods of storm series affecting Europe are quantified based on potential losses using empirical models. Moreover, possible future changes of clustering and return periods of European storm series with high potential losses are quantified. Historical storm series are identified using 40 winters of NCEP reanalysis data (1973/1974 - 2012/2013). Time series of top events (1, 2 or 5 year return levels) are used to assess return periods of storm series both empirically and theoretically. Return periods of historical storm series are estimated based on the Poisson and the negative binomial distributions. Additionally, 800 winters of ECHAM5/MPI-OM1 general circulation model simulations for present (SRES scenario 20C: years 1960– 2000) and future (SRES scenario A1B: years 2060– 2100) climate conditions are investigated. Clustering is identified for most countries in Europe, and estimated return periods are similar for reanalysis and present day simulations. Future changes of return periods are estimated for fixed return levels and fixed loss index thresholds. For the former, shorter return periods are found for Western Europe, but changes are small and spatially heterogeneous. For the latter, which combines the effects of clustering and event ranking shifts, shorter return periods are found everywhere except for Mediterranean countries. These changes are generally not statistically significant between recent and future climate. However, the return periods for the fixed loss index approach are mostly beyond the range of preindustrial natural climate variability. This is not true for fixed return levels. The quantification of losses associated with storm series permits a more adequate windstorm risk assessment in a changing climate.