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Risk of extreme events under non-stationary conditions related to climate change

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Large, abrupt and widespread climate changes with major impacts have occurred repeatedly in the past decades. Although they can occur for many reasons, it is conceivable that human forcingof climate change is now increasing the probability of extreme events, such as floods or heat waves. Using results from the statistics of extremes, a study of the risk of extreme events under those non-stationary conditions is presented. The probability of an extreme event under non-stationary conditions depends on the rate of change of the parameters of the distribution as well as on the rate of change of the frequency of their occurrence. In this study, we used the NCEP reanalysis data (1948-2004) of temperature and precipitation over the extended region of the North Atlantic. The data being highly dependent, a pre-processing by declusterisation (elimination of data aggregates) is needed. We then investigate the distribution of extremes over a given threshold chosen carefully, so that the resulting dates of events follow a non-stationary Poisson process and the resulting peaks fit a Generalized Pareto Distribution under the non-stationarity of the scale parameter (sigma). These conditions are checked with likelihood tests. Under these conditions, the concept of the return period or return level is altered, since the value is highly dependent on the extrapolated period of consideration. Moreover, non-stationarity conditions can be taken with respect to different covariates, such as time, or the North atlantic Oscillation (NAO) or the Greenhouse gas content.

Obviously, this research brings us a step further in the estimation of climate change impacts on abrupt climate events, evaluating changing amplitudes and frequencies in different locations of extended periods of extremely high/low temperatures and heavy precipitations.