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# Properties of a non-stationary POT model for temperature extremes over the North Atlantic

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The Extreme Value Theory (EVT) is a useful theory for the study of extreme climate events. However, as the statistics of such events can change with the increase of mean global temperature, the usual stationary hypothesis may not be applied. In this presentation, we examine the theoretical foundations and properties of a non-stationary Peak Over Threshold (POT) model. The POT model we consider consists of two complementary non-stationary sub-models: a Generalized Pareto Distribution with a time-varying scale parameter for the values above (or below) the threshold, and a Poisson distribution with a varying parameter to describe the rate of change of the frequency of occurrences of extreme events. Two different mathematical types of covariates for those two parameters are used: polynomials and linear piecewise models. We investigate the theoretical accuracy of each covariate model. In particular, we check for asymptotic properties of the maximum likelihood estimators of polynomials and bring solutions to the computation of confidence intervals, which can be erroneous when computed using the usual information matrix. In this non-stationary context, we revisit and generalize the notion of return levels (RL) and emphasize that their interpretation is different from the stationary case.

We use this methodology to assess the changes in severity and frequency of extreme high temperatures during the last 50 years (from the NCEP reanalysis data) over the North Atlantic. We illustrate how the computation of non-stationary RLs requires care in such data. This approach brings some insight on the connection between average

and extreme changes.