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Statistical trend in the extreme values of total energy in a model of the baroclinic jet

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A baroclinic model for the atmospheric jet at middle-latitudes is used as a stochastic generator of non-stationary time series of the total energy of the system. A linear time trend is imposed on the parameter T_E, descriptive of the forced equator-to-pole temperature gradient and responsible for setting the average baroclinicity in the model. The focus lies on establishing a theoretically sound framework for the detection and assessment of trend at extreme values of the generated time series. This problem is dealt with by fitting time-dependent Generalized Extreme Value (GEV) models to sequences of yearly maxima of the total energy. A family of GEV models is used in which the location μ and scale parameters σ depend quadratically and linearly on time, respectively, while the shape parameter ξ is kept constant. From this family, a model is selected by using diagnostic graphical tools, such as probability and quantile plots, and by means of the likelihood ratio test. The inferred location and scale parameters are found to depend in a rather smooth way on time and, therefore, on T_E. In particular, power-law dependences of μ and σ on T_E are obtained, in analogy with the results obtained for the stationary case (fixed values of T_E spanning the same range as in this case). It is emphasized that the present approach is valid under the hypothesis of smooth dependence on T_E of the Sinai-Ruelle-Bowen invariant measure of the strange attractor on which the dynamics takes place.