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Extreme Value Statistics of the Total Energy in a Mid-latitude Atmospheric Model of Intermediate Complexity

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An intermediate complexity baroclinic model for the atmospheric circulation at mid-latitudes is used as a stochastic generator to produce time series of the total energy of the system. Statistical inference of extreme values is applied to yearly maxima sequences of the time series, in the rigorous setting provided by extreme value theory. In particular, the Generalized Extreme Value (GEV) family of distributions is used here as a fundamental model for its simplicity and generality. Several physically realistic values of the parameter TE, descriptive of the forced equator-to-pole temperature gradient and responsible for setting the average baroclinicity in the atmospheric model, are examined. Stationary time series of the total energy are generated and the estimates of the three GEV parameters - location, scale and shape - are inferred by maximum likelihood methods. The location and scale GEV parameters are found to have a piecewise smooth, monotonically increasing dependence on TE. This is in agreement with the piecewise smooth dependence on TE observed in the same system when other dynamically and physically relevant observables are considered. The shape parameter also increases with TE but is always negative, as a priori required by the boundedness of the total energy of the system. The sensitivity of the statistical inference process is studied with respect to the selection procedure of the maxima: the roles of both the length of maxima sequences and of the length of data blocks over which the maxima are computed are critically analyzed. The extraction of few maxima from data increases the uncertainty in the estimates of the GEV parameters, while the consideration of short data blocks introduces a bias in the estimates. Issues related to model sensitivity are also explored by varying the resolution of the system.