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Universal properties of extremes in a two-layer quasi-geostrophic atmospheric model

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Universal properties of extreme events, are theoretically predicted for Axiom A flows. We search for the signature of these universal properties in a chaotic and high dimensional dynamical system by studying the convergence of GEV (Generalized Extreme Value) and GP (Generalized Pareto) shape parameter estimates to a theoretical value, expressed in terms of partial dimensions on the attractor. We perform simulations with a two layer quasi-geostrophic (QG) atmospheric model using two forcing levels, and analyse extremes of different types of physical observables (local energy, zonally averaged energy, and globally averaged energy). We find good agreement in the shape parameter estimates with the theoretical value only in the case of strong forcing, corresponding to a strongly chaotic behaviour of the system, for some observables. In the case of weak forcing, inducing a less pronounced chaotic flow with regime behaviour, we encounter, unsurprisingly, worse agreement with the theory developed for Axiom A flows.