



## **On the validity of linear response theory in high-dimensional deterministic dynamical systems**

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Using statistical limit theorems, we provide analytical results justifying the validity of linear response theory in high-dimensional deterministic systems. In particular, we consider observables of resolved degrees of freedom which are weakly coupled to a large number of unresolved degrees of freedom. We assume that neither the resolved nor the unresolved degrees of freedom are governed by equations which when seen in isolation obey linear response. We consider two cases of the coupling: the case when in the limit of an infinite number of unresolved degrees of freedom there exists a diffusive limit, and the case when there is an averaged deterministic limit system. We show that in the former case linear response is valid for sufficiently large systems whereas in the latter case linear response is valid only for an intermediate system size. We corroborate our results with numerical simulations.