Towards a direct data-driven identification of reduced models in climate research and fluid mechanics

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Abstract:

The applicability of many computational approaches in atmosphere/ocean sciences is dwelling on identification of reduced dynamical models defined on a small set of collective variables (colvars). The popular approaches to Bayesian and Markovian model reduction rely on the knowledge of the full matrix of relations between the systems components. In many application areas these matrices are not directly available and must first be estimated from the data, resulting in the uncertainty of the obtained models and colvars. A simple-to-implement but still rigorous clustering methodology for probability-preserving identification of reduced dynamical models and colvars directly from the data is presented - not relying on the availability of the full relation matrices or models at any stage of the resulting algorithm. The methodology is demonstrated on an application to analysis and modeling of interactions between global teleconnections in the atmosphere and on a computational fluid mechanics application.