Approximation of long time statistical properties of large dissipative chaotic dynamical systems

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Abstract

It is well-known that physical laws for large chaotic systems are revealed statistically. We consider temporal and spatial approximations of stationary statistical properties of dissipative chaotic dynamical systems. We demonstrate that appropriate temporal/spatial discretization viewed as discrete dynamical system is able to capture asymptotically the stationary statistical properties of the underlying continuous dynamical system provided that two conditions are satisfied:

1. The discrete dynamical system inherits the dissipativity of the original system uniformly (with respect to time step and spatial grid size) in some appropriate sense;
2. The discrete dynamical system converges uniformly on the unit time interval [0; 1] to the original system uniformly for initial data coming from the union of the global attractors.

Application to the infinite Prandtl number model for convection as well as the two-dimensional barotropic quasi-geostrophic equations will be discussed.