Stochastically-perturbed bred vectors

Georg Gottwald and Brent Giggins

University of Sydney, School of Mathematics & Statistics, Sydney, Australia (georg.gottwald@sydney.edu.au)

Bred vectors are a computational method to generate ensembles exploring growth in multi-scale systems for short- and medium weather forecasts. Bred vectors suffer from a small ensemble spread as they tend to align with the maximal Lyapunov vector for reasonable perturbation sizes. We introduce a modification, the stochastically-perturbed bred vectors, to diversify an under-dispersive BV ensemble in multi-scale systems. It is shown that stochastically-perturbed bred vectors constitute an effective sampling of the conditional invariant measure of the fast dynamics in regions of phase space which are likely to grow. This generates a reliable ensemble with good spread-error relationship. Further we show that the bred vectors align with the unstable sub-space as characterized by the covariant Lyapunov vectors and thereby retain original local dynamical information about the system.