Inducing Tropical Cyclones to Undergo Brownian Motion

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Recent work in ensemble forecasting has focused on validating the impact of general forms of stochastic forcing on TC forecasts (e.g. Snyder et al. 2011, Lang et al. 2012) and has shown some beneficial impact. We aim here to specifically address the basic issues of under-dispersiveness and biases in ensemble-based TC track distributions through a stochastic parameterization that induces TCs to undergo Brownian motion. Because a characteristic of Brownian motion is an increasing ensemble position variance with time this allows for the inflation of forecasted distributions by user-defined amounts. The proper application of a stochastic parameterization however requires a choice of stochastic calculus. There exist two standard stochastic calculi that are commonly studied in the theory of stochastic differential equations (Kloeden and Platten 1991). The first is that of Itô (1951) and the second is that of Stratonovich (1966). The most important point about the choice of stochastic calculus is that each one implies a distinctly different algorithm is required to obtain a particular result. The algorithmic differences implied by the choice of stochastic calculus and their impact upon the structure and life cycle of TCs are the subject of this talk. In the course of this talk we will show that the naïve implementation of a stochastic parameterization without properly accounting for the appropriate stochastic calculus will lead to undesirable results. In the cases presented here these undesirable results will manifest as overly intense TCs, which, depending on the strength of the forcing, could lead to problems with numerical stability and physical realism.

References

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