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The Maximum Likelihood Ensemble Filter performances in chaotic systems

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The performances of the Maximum Likelihood Ensemble Filter, which has been so far successfully applied to several contexts from idealized (stable) spatially distributed systems up to numerical weather prediction models, is investigated in the context of generic systems featuring the essential ingredients of unstable dynamics and on a spatially extended system displaying chaos. The main objective is to clarify the response of the filter to different regimes of motion and highlighting features which may help its optimization in more realistic applications. It is found that, in view of the minimization procedure involved in the filter analysis update, the algorithm provides accurate estimates even in the presence of prominent nonlinearities. Most importantly, the filter ensemble size can be designed in connection to the properties of the system attractor (Kaplan-Yorke dimension), thus facilitating the filter setup and limiting the computational cost by evolving only an optimal ensemble. As a corollary, this latter finding indicates that the ensemble perturbations in the MLEF reflect the intrinsic system error dynamics rather than a sampling of realizations of an unknown error covariance.