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Nonlinear Processes in Geophysics
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# *Interactive comment on* "Conditional nonlinear optimal perturbations based on the particle swarm optimization and their applications to the predictability problems" *by* Qin Zheng et al.

**Anonymous Referee #2**

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For a given dynamical system the conditional nonlinear optimal perturbations (CNOP), which cause the largest prediction error at the prediction time, is one of the keys to estimate the lower bound of maximum predictable time in the predictability problem. This paper introduces the particle swarm optimization (PSO), an intelligence algorithm, to compute the CNOP. A simple two dimensional Ikeda model is employed and its CNOPs are calculated using both the traditional adjoint approach, and the PSO algorithm. Numerical results show that both approaches can the global CNOPs in the presence of small initial perturbation with short prediction period, and the adjoint approach may also get some local CNOPs. However, when the initial perturbation become large or the prediction period extended, the strong nonlinearity of the dynamical model may



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Discussion paper

lead to the failure of the adjoint method to get the global CNOP. The PSO approach still work effectively to get the global CNOPs with high probability if the population is large. These results indicate that the PSO maybe also be an advanced and effective tool to compute the CNOP for a more complex dynamical system like the weather forecast system in the future. The paper is well organized and all the tables and figures are of good quality and well used. Therefore, it is recommended to publish the paper with minor modification.

Following are some suggestion for modification of the paper 1. In the numerical experiments, the filtering method are taken as the benchmark. It is better to describe what the filtering method is and its concrete steps.Âă 2. There are several parameters to tune when the PSO approach is used. The authors should better indicate if the results are sensitive to these parameters, like the initial velocity, and the inertial weight. 3. The authors also mentioned the generic algorithm GA). If possible, a simple comparison of this approach to the PSO would help the reader a lot to know the advantage of the PSO approach.

Following are some minor corrections of the paper 1. P1 Ln10: the CNOP method has been . . . should be the CNOP has been. . . 2. P2 Ln13: Kalnay, 2003 should be Kalnay 2003. 3. P5 Ln 3: T also depends on u0, , . 4. P7 Ln7-8: The Ikeda model is better to rewrite in (x1, x2) instead of (x,y) to make it compatible with note on P8 Ln7. 5. P10L3: are completely same . . . should be are completely the same . . .

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