

# ***Interactive comment on “A Parallel Hybrid Intelligence Algorithm for Solving Conditional Nonlinear Optimal Perturbation to Identify Optimal Precursors of North Atlantic Oscillation” by Bin Mu et al.***

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A heuristic optimization procedure is used to identify finite amplitude initial (day 0) perturbations that maximize an NAO related index a few days later (5, 7, and 15). A few comments/suggestions are offered below.

A cursory google search shows that the heuristic optimization procedure that is being proposed here has been previously proposed. Please clarify, discuss and cite related literature.

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## Interactive comment

If individuals in PSO are being mutated/crossed-over in the GA phase of the hybrid algorithm, what is the logic in retaining the original updating rules (Eq. 10) for PSO that depend on the individual's best position?

Please state clearly what is being done for the multiple variables that are being used in the optimization procedure with respect to PCA; are multivariate PCAs being used? if not likely different variables will require different numbers of components to reach the 95% captured variance. How are the different variables weighted?

It would seem that the step corresponding to "compare parents and offspring" requires computing fitness values which in turn requires invoking CESM

Make notation consistent in figure.  $\|V_x\|_2 \leq \xi$

Is the reference flow the same in the three panels of Fig. 5? Seems so. If so, mention it explicitly. How was the initial reference state chosen. Where multiple initial reference states considered. Do the results presented depend on the initial reference state?

Since the anomalies are increasing with simulation time for the simulation times considered, yet longer simulation times should be considered to better characterize this relationship.

Please specify how the amplitudes of the random perturbations were chosen in the context of Fig. 6

How do the serial OPRs compare with the parallel OPRs?

What is the dependence of the OPRs on initial random seeding? This characterization seems important to establish significance of the paper's findings given the heuristic nature of the algorithm.

Practitioners/interested readers may find the inclusion of a brief discussion of CNOP OPRs in the context of more commonly used initial perturbations such as singular vectors and bred vectors useful.

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