Review of "An Adjoint-Free Algorithm for CNOPs via Sampling"

The three main problems in calculating CNOP are: long computation times, large data storage and adjoint model development. This study tries to use the sample-based method to compute CNOP. A notable feature of the sample-based approach is that it is an adjoint-free algorithm and requires less storage. Theoretically, this method may be useful for obtaining CNOP. However, this study is too preliminary to present enough information about the practical application of sample-based method. So the current version of the manuscript may not be accepted unless more valid information is given.

Major Comments:

1. The sample-based algorithm is very similar to the ensemble-based method (Wang and Tan, MWR, 2010). It is necessary to compare these two approaches. I also find that the ensemble-based result (Fig. 2 in Wang and Tan, 2010) seems to have less error than the sample-based algorithm.
2. Line 105, this equation is satisfied if the gradient exists. As mentioned in section 1, the gradient may not exist in some cases, such as the on-off process. In this situation, whether the sample-based method can be used to calculate the CNOP. If not, it will be a great challenge to use this method in practical models.
3. What are the similarities between the CNOPs obtained by the sample-based methods with gradient-definition or adjoint approaches? In the Burgers model, to what extent the value of n affects the accuracy of the CNOPs? Could it be possible to provide the results with larger n values?
4. Are the results sensitive to the choice of the samples? How to choose the samples, especially for the realistic applications?
5. The Burgers equations is too simple. To show the valid of the method, I strongly recommend using a GCM realistic model to test this method. In fact, in the GCM model, the sample number may be very important. Larger sample number may be required in realistic model. But too large sample number will limit the potential use of this method, because too many nonlinear model runs need to be performed. How to obtain the accurate CNOP with suitable sample number?
6. Fig. 3. Why are the errors remarkable larger when t=11?

Minor Comments:

1. Line 60: "faults" is inappropriate.
2. Line 62: "an optimal solution" can also hardly be guaranteed in other approaches, such as ensemble or even adjoint approaches in GCM model.
3. Line 145 $\epsilon = 10^{-8}$ is selected for calculating the CNOPs. Does the value of this

parameter affect the obtained CNOPs?

4. Line 150 Further clarify the parameter $\alpha = 10^{-8}$. Is it the same with $\epsilon = 10^{-8}$
5. Line 189: “We implement…” →”We will implement…”

Wang, B. and Tan, X. 2010: Conditional nonlinear optimal perturbations: Adjoint-free calculation method and preliminary test, Monthly Weather Review, 138, 1043–1049