NPGD

**Interactive
comment**

Interactive comment on "Improvements to the use of the Trajectory-Adaptive Multilevel Sampling algorithm for the study of rare events" *by* Pascal Wang et al.

Anonymous Referee #2

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General comments

The authors present useful improvements to the Trajectory-Adaptive Multilevel Sampling (TAMS) technique used to study noise induced rare transitions in multi-stable dynamical systems. In particular, the authors focus on developing a mathematical consistent technique for the algorithm to define target sets using confidence ellipsoids around the stable equilibria. Second, the score functions are modified. The benefits of the improved formulation of the algorithm are tested on an exemplary problem and applied to a box model of the Atlantic Meridional Overturning Circulation (AMOC). The ideas are presented clearly, precise and consistent in a well-structured manner. I can

recommend publishing the article after minor revisions.

Specific comments

My main concern is that one of the proposed improvements, designing a score function based on a typical transition path which is estimated on transition trajectories on a larger noise level, is not applied to the more complex problem of the AMOC. I understand that the computational memory prohibits a direct estimation. However, the authors present in the discussion that this problem can be handled by reducing the dimensionality of the system (ll. 342-343 & ll. 358-360). So, why not try it with the AMOC box model?

The following specific comments refer to specific parts of the algorithm:

How many starting trajectories are needed for the TAMS to give a robust estimate of transition probabilities?
L.143-144: How can you assure that transitions induced due to large noise follow similar transitions paths as transitions induced by smaller noise levels? How robust is it to use estimates on higher noise levels?
L.195: You state that you estimate the typical transition trajectory on 300 different trajectories. How many trajectories do you need in order to obtain a robust estimate of the typical transition trajectory of a dynamical system?

Technical corrections

Figs. 5-8: Panel (b) has only empty parenthesis as label
Figs. 5,7: y-axis has no label
Fig. 8: axes labels are weird in both panels, panel (a) y-tick 10^{-18} is not displayed, panel(a) legend box "Monte Carlo" is not displayed.

L. 165-166: "Here we see, which will be more general, that the level sets of the score function do not have the shape of an ellipsoid." - I don't understand the sentence.

L. 241: "Finally, as a main application of one of the techniques shown in this paper..."
- I would suggest to state directly which "one" technique is applied. I know that it becomes clear later in the section, however, I think there is no harm in directly stating what technique is applied.
L. 249: closing parenthesis after S_s?