Referee report on the paper “A method to predict the uncompleted climate transition process” by Pengcheng Yan, Guolin Feng, and Wei Hou.

General comment:

The authors developed a method to predict the uncompleted transition process based on the dynamic characteristics of the continuous function instead of a piecewise one, applying it to three ideal time sequences and the Pacific Decadal Oscillation (PDO). The manuscript is of potential interest for the broad community of NPG, however in its present form is difficult to read, some concepts and findings are unclear and also some previous methods should be used as a comparison. Thus, I recommend to revise the manuscript based on the suggestions given below.

Major comments:

1. According to the Thom's theory (1972) there are at least 4 different types of dynamics which describe different physical systems. In page 5, line 2 the authors state "It means that Eq. (2) describes a system with tipping-point abrupt change". This is not correct since the tipping-point picture proposed by Thom (1972) is associated with a thirth-order polynomial function, generally known as "fold catastrophe". The authors refer to a quartic polynomial function which is related to the so-called "cusp catastrophe", that can be related to different kinds of bifurcation (e.g., the pitchfork). The bistable function the authors found is indeed very common for the climate system (as for simple energy-balance models, see a lot of papers by Ghil and co-authors, or the famous stochastic resonance mechanism, see Benzi et al. papers) but the equation governing the dynamics of the system should be characterized by a third-order polynomial in the righthand term. Indeed, given a forcing F(x) the dynamics of the system can be described by $dx = F(x)\,dt$ and assuming that F(x) is conservative then there exists a potential function V(x) such that $F(x) = -dV(x)/dx$. This means that if F(x) is a polynomial function of order n, then V(x) is a polynomial function of order n+1. By looking at Eqs. (1) and (2) of the present paper there is a discrepancy between the quadratic forcing term of Eq. (1) and the quartic potential function of Eq. (2). The authors need to carefully consider this point.

2. Fig. 6: in my opinion the authors should revise this figure, also concering comments raised by previous reviewers. There is still a discrepancy between the different form of k, it is not simply readable, and it seems to me that there is something wrong in plotting the green dots. Please revise.

3. Fig. 7: as for Fig. 6 in my opinion the authors should revise this figure. Where is the gray region in the upper-right corner stated in the caption? Moreover, the authors should also insert

4. I'm not sure I completely understood the main purposes of the manuscript as written in the present form. Indeed, it seems to me that the authors state that "By using a piece-wise function, the transition process is stated approximately" (lines 14-15 in the Abstract) and that "Thus, we had proposed a method (Yan et al, 2015, 2016) to study the transition process by using a continuous function" (lines 17-18 in the Abstract) but they are using a piecewise prediction method which is based on a linearization of the logistic equation. So, what would be the main benefit? Why not to directly use the logistic fit for investigating the transition? Moreover, the authors use the term "tipping point" but they are not considering/discussing implications of tipping points as well as comparing their results with established methods for tipping point evaluation (variance, autocorrelation, ..., see papers by Ditlevsen, Lenton, and colleagues). I urge the authors re-organize both the introduction and the conclusion sections to take into account these aspects.

Minor comments:

- Page 2, line 6: the term "attractors" is too wide in this context, probably it is better to use "fixed points" or "equilibrium states".
- Page 4, line 9: the term "discontinuous" seems not to be appropriate, should be better "discrete".
- Page 4, line 19: "k as 0.4" should be "k as 0.5". Indeed, in Fig. 1 being u and v fixed then k values are chosen as 0.3 and 0.5, when k=-0.4 is chosen different values for u and v are considered.
- Fig. 5: are the authors showing xt' and not xt? Please confirm.
- Check some English forms through the text.