Interactive comment on "Role of nonlinear interaction between water and plant in stability analysis of nonspatial plants" *by* Guodong Sun and Xiaodong Zeng

Anonymous Referee #3

Received and published: 14 November 2018

Review General commentsïijŽ The manuscript, which is submitted to <Nonlin. Processes Geophys> by Sun and Zeng, and titled by <Role of nonlinear interaction between water and plant in stability analysis of nonspatial plants>, has been carefully reviewed, and satisfy the aim and scope of this journal. In this study, the authors applied the CNOP-I method to explore the nonlinear stability of nonspatial plant (grassland or tree). This is a continuation of the work of Sun and Mu (2009, 2011), in which they applied the approach to discuss the nonlinear stability of grassland in China. And, the one of the authors (Dr. Zeng) has explored the model about the grassland variations. However, there are marked differences compared to the previous studies. In this study, a famous model is employed to discuss the nonlinear stability of plant, which could ex-

plain the grassland and tree. The current study is very important, because it is helpful to improve the understanding about the plant, not only for grassland, but for tree. The results are interesting. In particular, the difference between linear character and nonlinear character is revealed. This stresses the importance of the interactions between plant and water. But some descriptions in the manuscript are unclear. I recommend publication after careful revision. . References: Sun, G. D., and M. Mu, 2009: Nonlinear feature of the abrupt transitions between multiple equilibria states of an ecosystem model. Adv. Atmos. Sci., 26(2), 293–304, doi: 10.1007/s00376-009-0293-8.

Sun, G. D., and M. Mu, 2011: Nonlinearly combined impacts of initial perturbation from human activities and parameter perturbation from climate change on the grassland ecosystem. Nonlin. Processes Geophys., 18, 883–893

Specific comments

1. Line 124. What are the physical meanings of the CNOP in this study?

2. Line 165. What are the physical meanings of the parameter value of the constrained condition in this study?

3. Line 160. Why choose T=20, 30?

4. Line 152. Please show the detail of gradient.

5. Line 202: Why not analyze the stability of the tree equilibrium state?

6. It is found that the analysis of the stability of the tree equilibrium state for abrupt and physical mechanism is lacking. Please explain it.

7. Please further explain how to explore the stability of spatial plant. For the stability of spatial plant, I am afraid the spatial grassland or tree is difficult to change the desert equilibrium. How to solve it using the nonlinear and linear approach?

8. The dynamics of three right terms of the equations is suitable. The importance of three terms could be revealed. As far as I know, the studies by Sun and Mu (2009,

2011) is difficult to analyze the dynamics of grassland because there are many right terms for the five-variable model. I believe that the model in this manuscript has an advantage to explore the variations of plant and water.

Technical corrections:

1. In the manuscript, keywords are lacking. Please supplement these.

2. Line 94-96. "If the CNOP could bring to the transition from one linear stable equilibrium state to another, the linear stable equilibrium state was considered as the nonlinear stable." Should be "If the CNOP could bring to the transition from one linear stable equilibrium state to another, the linear stable equilibrium state was considered as the nonlinear unstable."

3. Line 156. "different water input" should be "different water inputs"

4 Line 160 and 164. "T", and "dt" should be italic (type).

5. Line 164. "L2" should be "L2"

6. Line 167-168. "If the eigenvalues are positive (negative), the plant or desert is stable (unstable)." Should be "If the eigenvalues are negative (positive), the plant or desert is stable (unstable)."

7. Line 203-204. "will be transformed into the tree desert equilibrium state" should delete "desert"

8. Line 228-230. "This suggests that the CNOP could cause the nonlinear stability for the nonlinear model, however the LSV fails under the same extent of constrained condition." should be "This suggests that the CNOP could cause the nonlinear unstable for linear stable equilibrium state for the nonlinear model, however the LSV fails under the same extent of constrained condition."

9 Line 268. "For the tree as the reference state (a=0.2)" should be "For the tree as the reference state (a=0.2)"

10 Line 294. "equilibrium states are nonlinear stable" should be "equilibrium states are nonlinear unstable"