Review of “On the CCN [de]activation nonlinearities” by Sylwester Arabas and Shin-ichiro Shima

The study investigates the activation and deactivation of aerosols, a fundamental process in cloud physics, using the mathematical framework of nonlinear dynamics. In doing so, the authors also introduce this methodology to the cloud physics community. Considering myself a member of the latter group, I found the references to classical textbooks an essential prerequisite for approaching this study. Of course, this journal is dedicated to nonlinear processes in geophysics but this study’s subject is of interest for a broader audience. Therefore, some more physical explanations accompanying the mathematical framework of nonlinear dynamics might be necessary to make this study more approachable, especially in Section 7. Moreover, there are some more minor points and technical flaws which should be fixed easily.

All in all, the study is interesting, offers a new point of view, and is, therefore, worth publication after some very minor revisions.

Very minor comments:

- Physical interpretations: Reducing the discussion of Fig. 5 to terms like hysteresis, cusp bifurcation, and catastrophe makes anyone who is less familiar with nonlinear dynamics feel uncomfortable. It should be easily possible to associate the observed behavior with physical timescales as the activation timescale (see Fig. 3 of the manuscript), the phase relaxation timescale (e.g., Eq. (17) of Korolev and Mazin, 2003, JAS) or the evaporation timescale (e.g., Eq. (2) of Lehmann et al., 2009, JAS).
- Description of numerical model: Is system (17) complete? There should be a prognostic equation for the ambient vapor density ρ_v. If not, how is the supersaturation calculated? Are all equations of (17) solved with the same time step?
- Implications for modeling: Although I think the advices regarding the numerical solution of the activation/deactivation process are of major importance, I feel that there should be some more text on it in the introduction of the manuscript. Otherwise, the switch to the discussion of the model timestep in Section 7, line 348 – 359, feels too abrupt. Similarly, the term “stiffness” is mentioned first in line 365, but could be mentioned earlier (e.g., Section 2) to introduce the reader earlier to the numerical problems in the modeling of activation/deactivation.

Technical comments:

- Mathematical equations are a part of a sentence. Therefore, punctuation should also be considered in equations.
- There is a wide variety of notations used for derivations. Newtonian (Eq. 1, 2, 5, 7, 8, 9, 11), Leibnizian (Eq. 13), and Lagrangian (Eq. 12). Please stick to one.