Interactive comment on "On the CCN [de]activation nonlinearities" *by* S. Arabas and S. Shima

Anonymous Referee #1

Received and published: 13 December 2016

A review of the manuscript npg-2016-50 "On the CCN [de]activation nonlinearities" authored by Sylwester Arabas and Shin-ichiro Shima.

The paper is dedicated to stability and bifurcation analysis of diffusion growth equation in its complete form, which includes curvature term and chemical composition term. Authors show that critical point on the Kohler curve is the point of saddle-node bifurcation. The time scale associated with this point which can be interpreted as time scale of aerosol activation is estimated analytically. Also the analysis of the more complicated case when the aerosol growth is accompanied by decrease of surrounding humidity has been done. The second saddle-node point was found in this analysis. At last the numerical calculation of hysteresis profiles of supersaturation and aerosol wet radius in adiabatic vertically-oscillating air parcel has been done. The article is interesting and I recommend it for publication in NPG after two additions. Firstly I recommend

adding some elementary mathematical explanation what saddle-node bifurcation and cusp catastrophe are. May be authors will write a separate Appendix on this topic. This will help the reader to better understand the article. Secondly I recommend to compare the results obtained in Sections 6, 7 and Fig.4 with results of study by Pinsky et al., (2013: J. Atmos. Sci., 70, 2778-2793). In this study some analytical investigation of monodisperse droplet spectra evolution as well as parcel model investigation are carried out. Possibly the matching of equations from this study and the ones in the reviewed one can bring some new results.