

***Interactive comment on* “External and Internal CCN Mixtures: Controlled Laboratory Studies of Varying Mixing States” by Diep Vu et al.**

Anonymous Referee #3

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The manuscript represents a method of CCN data analysis for different mixtures of organic and inorganic components of varying mixing states with regards to the observed activation and hygroscopicity. By conducting controlled laboratory experiments of mixing, the transition from external to internal mixtures are effectively mimicked. For mixtures of known hygroscopicity CCN behavior agrees well with traditional Köhler theory. Finally, aerosol water is shown to play a significant role in promoting mixing and can be used to modify mixing states.

The paper is well written and easy to follow, though there are some issues and more thorough discussion should be made in specific sections. A very interesting point of the study is the deconvolution of the activation curves to different sigmoidal curves consistent with those of the different components, as well as the study of the impact of

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mixing fresh combustion emissions with inorganic and organic aerosols.

Specific comments:

1) More thorough discussion should be made in the study of mixing fresh combustion aerosol with inorganic and organic aerosols. Why is combustion aerosol considered and referred to solely as Black Carbon? Also, the activation curve presented in Fig.07 does not reach an obvious plateau, how can we speak about a “homogeneous mixture of black and brown carbon”? Also I would expect that as a homogenous mixture, the activation curve would be a lot steeper, especially in the larger particle size range. Can you please clarify/comment on this?

2) A more thorough review of the current literature should be made, as there are relevant studies that are not mentioned. E.g. L69-70 Moore et al., 2012 provide an in-depth analysis of ambient CCN measurements during the 2010 Deepwater Horizon Oil Spill, both studying hygroscopicity vs mixing state and type of size distributions and droplet activation kinetics.

3) CCN activity also depends on the atmospheric processing as well. L50-51 it is stated that CCN activity is complicated when inorganic salts are internally mixed with a complex organic. It has been shown in field studies that even within a few hours of processing, hygroscopicity (thus activity as well) becomes more or less constant, e.g. Lathem et al., 2013; Bougiatioti et al., 2009. This, to my opinion, should be mentioned.

Technical corrections:

L109 What type of SMPS, sizing range and of CCNc? It is mentioned in Section 2.3. but it seems to me as missing information to me at that early stage.

L293 What do the authors mean by “does not account for non-spherical fractal particles”?

Fig.05 Some points exhibit huge variation

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