

Atmos. Chem. Phys. Discuss., referee comment RC1  
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## Comment on acp-2021-571

Anonymous Referee #1

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Referee comment on "Effects of oligomerization and decomposition on the nanoparticle growth: a model study" by Arto Heitto et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-571-RC1>, 2021

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The Manuscript provides good insights about the role of oligomerization and decomposition. It is well written and deserves to be published. I have the following comments for clarification of the methodology:

1. Paage 2: Please provide specific examples of decomposition reactions in partcle phase and their expected rates. Currently examples are provided for oligomerization, but decomposition just seems to come from fitting.
2. Please clarify if oligomerization is only considered for molecules in particle phase or does it include both gas and particle phase molecules in a given volatility bin. It seems the authors only consider particle phase oligomerization/decomposition, but some discussions later on make this confusing. See my comments later.
3. Line 240: If oligomerization is just in particle phase, why does reducing gas-phase concentrations from compounds oligomerizing in same bin hinder growth? If particle phase oliomerization reduces why will it reduce gas-phase concentrations? I would think it will be the opposite. Due to decrease in oligomerization, more reacting compounds will be available to establish equilibrium with gas-phase in a given bin, so gas-phase concentrations will be higher. This is confusing and needs explanation.
4. Line 220: Why is there an enhancement in condensation (from gas-phase?) due to oligomerization?
5. Line 260: How does difference in volatility between oligomerizing and product compounds affect growth of sub-5 nm particles?

6. Line 305: What are relative timescales for oligomerization and evaporation of higher volatility compounds?

7. I understand the authors did not consider diffusion limitations. But it would be good to say what particle sizes would diffusion limitations be important? For example, I would think larger particles will have larger diffusion limitations, and there, if diffusion limitations prevent evaporation of higher volatility molecules that oligomerize, would the growth rate be higher?