

Response to reviewer's comments

We numbered the comments as 1) and 2) because they are different issues.

- 1) *The authors have well addressed most of my concerns on the manuscript, though I would still like to ask for clarifications at some points. Firstly, the authors defined that NMINP referred to the net maximum increase in nucleation mode particles number concentration, and FR was calculated according to formula (1) in Text S2 where N_{dp} was the particle number concentration of nucleation mode particles. Please clarify what are the differences between NMINP and the integration of dN_{dp}/dt over the time period of NPF. I am aware that FR is controlled by many factors but absolutely not the calculation formula. However, it can be expected that higher FR leads to larger enhancement of nucleation mode particles, except that the newly formed particles are removed in some pathways as described in the formula (1) in Text S2. In the cases that the FRs exceeded $8 \text{ cm}^{-3} \text{ s}^{-1}$, no correlation existed between NMINP and FRs, could the authors clarify what accounted for the removal of the newly formed particles? The essential influencing factors ($FR = k_{NucOrg}[H_2SO_4]^m[NucOrg]^n$) cannot be used to explain the poor correlation, though which is widely-known to be true, because FR was not calculated according to this formula but based on the observed concentrations of nucleation mode particles.*

Response: In the last-round revision, page 5, lines 23-25, we presented “The net maximum increase in the nucleation mode particle number concentration (NMINP) was defined as $N_{<30 \text{ nm}}$ at the time of reaching the maximal value minus $N_{<30 \text{ nm}}$ at the time immediately before the apparent NPF was initiated (Zhu et al., 2017).” On basis of the definition, it is clear that NMINP is approximately equal to the integration of dN_{dp}/dt over the initial NPF times. We feel no revision is needed here.

The reviewer argued the statistical analysis results, i.e., “In the cases that the FRs exceeded $8 \text{ cm}^{-3} \text{ s}^{-1}$, no correlation existed between NMINP and FRs” could be due to the removal of the newly formed particles. The possibility is probably low because no significant difference between CS under $FR > 8 \text{ cm}^{-3} \text{ s}^{-1}$ and $FR \leq 8 \text{ cm}^{-3} \text{ s}^{-1}$. However, the initial NPF times, defined as the time of $N_{<30 \text{ nm}}$ reaching the maximal value minus the time immediately before the apparent NPF was initiated (Δt), are significantly shorter under $FR > 8 \text{ cm}^{-3} \text{ s}^{-1}$ than $FR \leq 8 \text{ cm}^{-3} \text{ s}^{-1}$. Note that the $dN_{dp}/dt \approx NMINP/\Delta t$ during the initial NPF period.

Thus, in the revision, we add “Moreover, there was no significant difference between CS under $FR > 8 \text{ cm}^{-3} \text{ s}^{-1}$ and $FR \leq 8 \text{ cm}^{-3} \text{ s}^{-1}$. The removal of the newly formed particles cannot explain the presence and absence of correlations obtained above. However, the initial NPF times, defined as the time of $N_{<30 \text{ nm}}$ reaching the maximal value minus the time immediately before the apparent NPF was initiated, are significantly shorter under $FR > 8 \text{ cm}^{-3} \text{ s}^{-1}$ than $FR \leq 8 \text{ cm}^{-3} \text{ s}^{-1}$. The large FRs, i.e., larger than $8 \text{ cm}^{-3} \text{ s}^{-1}$, are most likely due to the organic-enhanced NPF.”

- 2) *It is very interesting that the authors describe sulfuric acid as the fuel and organics as the engine in NPF. However, I cannot agree the statement that NMINP was always determined by the consumed H_2SO_4 vapor for nucleation, unless the authors could provide solid*

evidences to prove that organics are always sufficient and has no/very low possibility to be the limiting factor in NPF. For example, in the cases that the concentrations of the condensable vapors of the organics are much lower than those of the sulfuric acid, could it possible that NMINP is determined by the organic vapors consumed? Overall, these questions are worthy of further discussions before accepting this paper. I look forward to the responses from the authors for clearer clarifications.

Response: We agree “in the cases that the concentrations of the condensable vapors of the organics are much lower than those of the sulfuric acid, NMINP is determined by the organic vapors consumed.” The consumed organic vapors then determine the consumed H₂SO₄ vapor for nucleation. This is what we said in the last round revision. To be more straight forwards and avoid confusion, the revised sentence reads as “However, the NMINP is always determined by the total consumed H₂SO₄ vapor for NPF, although the consumed H₂SO₄ was determined by the consumed organic vapor in Scenario 1.”