We sincerely thank the reviewer for their careful review of our manuscript and for the overall positive feedback. We have addressed all comments from the reviewer with point-by-point responses with corresponding revisions made to the manuscript. Our detailed response and revisions are provided below.

1. Page 6 line 155: Why kGT is assumed to be 2.5 for all organic water mixtures. There are references provided, however a sentence or two justifying this assumption is good.

Response: We thank the reviewer for this insightful comment. The assumption of k_{GT} = 2.5 for all organic–water mixtures is an estimate based on established practices in the literature for secondary organic aerosol components. While the exact k_{GT} value depends on specific solute–water interactions, and can be precisely determined for well-investigated individual systems (e.g., k_{GT} =3.18 for citric acid), obtaining compound-specific parameters for every constituent within highly complex SOA mixtures presents practical challenges. In the absence of explicit experimental data for all constituent compounds, k_{GT} =2.5 is widely utilized as a robust and representative baseline derived from structurally related water-soluble organics. We have explicitly justified this assumption in the revised manuscript and acknowledged the associated uncertainty (typically evaluated as ±1.0) it introduces to our model predictions.

Revision: *...It should be noted that assuming a constant Gordon-Taylor parameter (k_{GT} =2.5) for all organic–water mixtures represents a generalized simplification. The k_{GT} value essentially parameterizes the interaction strength between water and the specific organic solute. Consequently, for organic mixtures with highly complex or varying oxygenated functional groups, the actual k_{GT} value may deviate from this assigned average (typically estimated within a range of 2.5±1.0). This variability introduces a potential, albeit minor, source of uncertainty into the T_g-based model predictions presented in this study...*

2. *What is the pH of these aerosol systems? pH impacts on aerosol properties greatly, and thus authors may want to comment on that.*

Response: We thank the reviewer for raising this important question. We agree that aerosol pH is a critical parameter that can influence aerosol phase transitions. In our

experiments, the aerosol droplet pH ranged from approximately 3.0 to 5.0, which is consistent with the typical pH range observed for tropospheric aerosols. One of our previous studies examined the impact of pH on aerosol efflorescence (Sun et al., 2023); which is one of the few studies that reports the effect of pH on aerosol efflorescence. However, to the best of our knowledge, no consistent trend has been established regarding the direction or magnitude of pH effects on ERH, since the influence of pH is highly dependent on the specific organic composition. In the present study, we consider the influence of pH to be implicitly included within the overall model uncertainty. We have now added a brief discussion in the revised manuscript to acknowledge and contextualize the potential role of pH in modulating ERH.

Revision: *We also note that other parameters, such as aerosol pH, can affect the ERH of organic/inorganic aerosol (Sun et al. 2023); however, to the best of our knowledge, no consistent trend has been established regarding the direction or magnitude of this effect, since the influence of pH is highly dependent on the specific organic composition. Given that the modeled viscosity accounts for organic functional groups, the influence of pH may be implicitly reflected within the overall model uncertainty. Future studies should incorporate more inorganic T_g data and systematically investigate pH effects to provide more accurate $T_g(\omega_{org})$ and pH values and better evaluate the role of both parameters in the viscosity-ERH relationship.*

2. Page 3, 10: some typos found. Please do an additional round of copy-editing.

Response: We sincerely apologize for the spelling and typographical errors that appeared in the initial version of our manuscript and are very grateful to the reviewer for their careful and meticulous examination. We have now corrected all spelling.

4. *Page 4, lines 100-105: Is it possible to add these equations as well to the equation lists for easy following?*

Response: We thank the reviewer for this constructive suggestion. We agree that explicitly formatting these descriptions as numbered equations greatly improves the readability and flow of the manuscript. Accordingly, we have added the requested equations corresponding to the text on Page 4, lines 100-105, and updated the equation

numbering sequentially throughout the revised manuscript.

Revision:

$$O{:}C_{mixture} = \left(\frac{n_{O,org}}{n_{C,org}}\right) \cdot x_{org} \quad (1)$$

$$x_{org} = \frac{n_{org}}{n_{org} + n_{inorg}} \quad (2)$$

5. Please expand the caption 3 to identify all abbreviations in the figure.

Response: We thank the reviewer for the careful check. As suggested, we have expanded the caption of Figure 3 to explicitly define all abbreviations used in the figure, ensuring better clarity for the readers.

Revision:

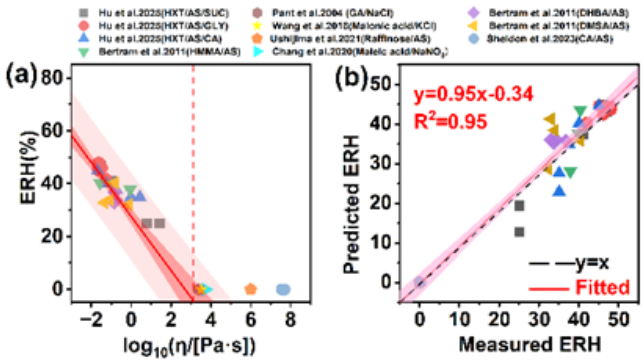

Figure 3. (a) Comparison between the validation set data and viscosity-ERH model prediction (Eq. 4). (b) Comparison of measured ERH values versus model predicted ERH values based on the viscosity-ERH model. The black dashed line denotes the y=x reference line, and the red line representing the linear regression fit to the data, along with the corresponding coefficient of determination (R^2), R^2=0.95. The pale pink shading represents the 95% confidence interval. DEMA represents Diethyl malonic acid, DMSA represents 2,2-Dimethyl succinic acid, DMGA represents 3,3-Dimethyl glutaric acid, HMMA represents DL-4-Hydroxy-3-methoxymandelic acid and DHBA represents 2,5-Dihydroxybenzoic acid, CA represents citric acid, SUC represents sucrose, GA represents glutaric acid, HXT represents 1,2,6-hexanetriol.

6. Is the change in viscosity due to differences in RH (e.g., 20% vs 75%) different between chemical systems studied? If so, do they follow any relationship with the structure/ functional groups present?

Response: We sincerely thank the reviewer for raising this insightful question. The change in viscosity due to differences in relative humidity (RH) varies significantly between the different chemical systems studied. In our quantitative analysis, we calculated the viscosity changes for all organic-inorganic aerosol systems across an RH

range from 20% to 60%, and several representative systems were shown in Table R1. By performing linear regressions of viscosity as a function of RH for these fixed chemical systems, as shown in the table, we found that the slopes of the fitting equations vary considerably, ranging from approximately -13.20 to -45.89. No specific correlation between the fitted slope and functional groups were found.

Table R1 The fitted viscosity-ERH equation for representative organic-inorganic aerosol systems with RH ranged from 20% - 60%.

Compound	OIR	20%	30%	40%	50%	60%	Fitting equation[a]
Glucose/AS	1:4	-0.13	-0.64	-1.00	-1.28	-1.56	y = -28.18x + 14.03
Oxalic acid/AS	1:3	1.64	0.63	-0.19	-0.83	-1.35	y = -13.20x + 39.74
Malonic acid/AS	1:3	-1.50	-1.80	-2.02	-2.21	-2.38	y = -45.89x - 50.99
Glutaric acid/NaCl	1:3	-1.02	-1.46	-1.74	-1.94	-2.15	y = -35.30x - 18.74
Sucrose/$NaNO_3$	1:2	-0.036	-0.74	-1.23	-1.65	-1.98	y = -20.41x + 16.96

[a] y denotes aerosol ERH and x denotes the $\log_{10}\eta$ at corresponding RH values.