We thank the reviewer for the review and constructive comments. Below we address each comment point by point. Reviewer comments are marked as black and our response as blue.

Leinonen et al. have developed a first-of-its-kind semi-empirical model to simulate the gas- and particle-phase evolution of organic species while aging emissions from wood combustion. They comment on model performance and discuss the advantages and disadvantages of using such a model to assess causality between the predictors and outcomes.

There are several key deficiencies in this manuscript and I do not recommend publication of this manuscript to GMD. The primary deficiency of this manuscript is that the methods and application for the MECHA model are very poorly described and are hard to follow (assuming I represent the average researcher within the atmospheric modeling community). I suspect if the methods need to be described and published in a more appropriate journal and that this manuscript should focus primarily on the application to aging of wood combustion emissions. For instance, sections 2.2 to 2.5.4 were quite abstract. A lot of technical terms were introduced (e.g., causal discovery algorithm, causal graph) but there wasn't a detailed explanation of how its use applies to the application explored in this work. Another deficiency is that the technical communication is grammatically incorrect in a lot of places, which it makes it hard to follow the authors' train of thought. Overall, it was very hard to assess the scientific merit of this work.

It is also quite likely that I am not well versed with this type of modeling (to me, the model appears to be one where one solves a set of differential equations on aggregated variables, which are factors from the gas and particle instrument data, to fit coefficients that can reproduce the observed data; a related question then is how was the model was trained and tested?). If that is true, I might not be well-suited to review this manuscript.

Regardless, I feel confident that the average reader of this journal is going to be hard pressed to understand the model and the key findings from this work.

The reviewer is correct, the model is based on solving multiple differential equations on aggregated variables. To clarify the methods section, we decided to remove chapters 2.2-2.4 and focused more on connecting causal discovery algorithms and differential equations. Due these changes, the terminology is now somewhat simplified and thus it should be easier to understand for readers applying these types of models.

Model performance was tested on simulated datasets, where the connections between variables were known. Because we had only few chamber

experiments, we decided to use those entirely to form the structure. Obtained structures for dark and UV ageing experiments could be tested in future studies.