General comments

In this paper, Li et al. present a new box model that demonstrates high computation efficiency with reasonable accuracy. The model's performance has been thoroughly evaluated through chamber experiments and in-situ observations, showcasing its capability to reproduce pollutant and radical concentrations under varying initial conditions. The results suggest the model could potentially benefit the modeling community. The paper is well-written and adequately referenced. There is only one general comment that I would like to pose. I commend the authors for discussing the implications of their box model in supporting more complex models, as mentioned in the Introduction. I am curious about the potential for easy adoption of the new model in existing CTMs or coupling with climate models. This aspect could significantly enhance the utility of the model if this is the case or it's planned in future developments.

Specific comments

1. Eq.1: It is essential to address why wet deposition is not included as a default item in the function, especially for hydrophilic components like sulfate. Providing an explanation or a discussion on this matter would add clarity to the model's capabilities.
2. Line145: The term "overcome" may not be suitable in describing the model's superiority over existing solvers, as it suggests that the issues present in other solvers have been completely resolved. Instead, consider rephrasing it to highlight that the new model offers an optimized algorithm that strikes a balance between efficiency and accuracy. Maybe also consider to replace the phrase throughout the paper.
3. Line184-185: 'the VSVOR solver has comparable computational efficiency with the EBI solver, and the solution accuracy and stability are better' – any obvious evidence on this than the equations listed above?
4. L232-233: It would be beneficial to offer a general recommendation on the choice of scheme for commonly studied species (e.g., O_3, PAN, SO_2) when utilizing the model. Users might find such a guide helpful when first implementing the model.
5. The model description section employs numerous abbreviations, which may hinder readability. I recommend creating a table containing all abbreviations to enhance the section's clarity and ease of understanding.
6. Figure A1: To improve clarity, consider using more distinct colors for the two models or converting one model to a scatter plot. Which solver is used to obtain the ROMAC results?
7. Line 285: The subtitle may not be suitable: it includes both model evaluation (esp. the chamber study section) than application.
8. Line 318-319: I'm not sure if such a conclusion can be drawn from Fig. 4c, as significant uncertainty exists in k_{other}.