

Reviewer #2

General comments

This study presents a novel and well-executed parameterization method for estimating the photolysis rate constants of oxygenated volatile organic compounds (OVOCs) based on molecular structure. By constructing a photolysis module that complements the MCM v3.3.1 mechanism, the authors successfully establish a structure–reactivity relationship that overcomes the longstanding limitation of insufficient quantum yield data. This allows for the estimation of photolysis rate constants for a wide range of compounds lacking experimental measurements. Furthermore, by integrating the updated photolysis mechanism, the study highlights the significant contribution of non-formaldehyde OVOCs to the daily average concentration of ROx radicals. Overall, this work introduces a creative and highly valuable approach for addressing a critical gap in atmospheric chemistry modeling. Some technical suggestions for improving the manuscript are provided below.

Reply: We sincerely thank the reviewer for the positive feedback and careful review. The reviewer's detailed suggestions and corrections were very helpful in improving the clarity and accuracy of our manuscript. Please find the response to individual comments below.

Specific comments

(1) Line 28, Please note that 'photolysis rate' is different from 'photolysis rate constant.' It would be more appropriate to use 'photolysis rate constant' here and in other relevant parts of the manuscript.

Reply: Thank you for pointing out this important terminology distinction. We have reviewed the manuscript and replaced “photolysis rate” with “photolysis rate constant” where appropriate, including in Line 28 and other relevant sections, to ensure scientific accuracy and consistency.

(2) Line 155, there is a Chinese-style period that needs to be replaced.

Reply: The Chinese-style period at line 155 (now at line 159) has been corrected and replaced with a standard English full stop. In addition, the manuscript has been carefully proofread to eliminate any remaining typographical errors.

(3) The Supplementary Information includes numerous tables and figures; however, several figures are not referenced in the main text. It is recommended that the authors incorporate appropriate citations and briefly discuss the relevance of these figures to enhance clarity and coherence.

Reply: We have carefully reviewed the Supplementary Information and updated the main text to include explicit references to all relevant figures and tables. Brief descriptions of their significance have been added at appropriate locations in the manuscript or supplementary text to improve coherence and ensure that readers can better understand their context and relevance to the main discussion.