

Atmos. Chem. Phys. Discuss., referee comment RC1  
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## Comment on acp-2022-196

Anonymous Referee #2

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Referee comment on "Correcting ozone biases in a global chemistry-climate model: implications for future ozone" by Zhenze Liu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-196-RC1>, 2022

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This work addresses the uncertainties in the simulation of surface ozone in chemistry-climate models by offering a novel approach, using machine learning, in identifying the causes of biases originating from the representation of related key processes. As such, it is an excellent feasibility contribution in correcting modelled O<sub>3</sub> biases. The results demonstrate that these biases are mainly due to the UKESM1 model effect of temperature and photolysis rates, and thus provides valuable insight for further model improvement which ultimately should allow improving the assessment of the impacts of changing emissions and climate on future air quality. The paper is very well written and supported with solid analysis, clear presentation and meaningful interpretation and I have no comments of technical nature. I would only like to point out the need for follow-up studies to tackle the questions of the sensitivity of the obtained results on the particular machine learning technique employed here and the enrichment of the technique validation with the consideration of additional, independent derivations of the O<sub>3</sub> biases with alternative observational data. These are included in the following specific comments indicated by the corresponding line numbers.

### SPECIFIC COMMENTS

49-51: This sentence does not clearly introduce the motivation/justification of this study. How is the "gain of greater physical insight" consistent to "loss of interpretability of the results"? Please rephrase.

52-53: Is the current study the first one to apply machine learning for estimations and correcting global model ozone biases? If yes it should be mentioned explicitly.

102-103: Can this statement be elaborated? Is there no value in repeating the process (in a separate study perhaps) including observed station data from locations around the globe as to verify the results from the current gridded data analysis?

151-154: In relation to the previous comment and in conjunction to the method description in the first paragraph of sub-section 2.5, the results of this test are impressive but of course must be viewed in the framework of comparing a test run against a validation run of the same (machine learning) model. Is it possible to compare the resulting O3 biases from this test run (for selected locations) with respective biases obtained from a conventional method and an alternative observational data source?

186-188: Can the results and the conclusions of Fig.5 be compared to those of other studies (based on any other methodology)?

296-298: Also the choice of the particular machine learning model influences the derived O3 biases and conclusions.