Reply to second review

General

Many of the comments in the review are by Alan Robock and these comments are addressed in the reply to Alan Robock. There are however some new comments in the review (red comments) which are repeated here (in red). We are very grateful for these comments. The reply and the associated changes in the text of the manuscript are given below (in black).

Reply in detail

Comment 1

(abstract) First versus one of the first. e.g., Hal Johnston and NOx catalyzed strat ozone loss.

We have emphasised the contribution by Hal Johnston now in the following text in the paper:

"The recognition of the strong effect of NO_x on stratospheric ozone had a major impact, since emissions of NO_x caused by a possible fleet of supersonic planes was the first stratospheric ozone depletion issue that was studied (Johnston, 1971; Crutzen, 1972)."

We know that Paul Crutzen (in conversations) made the point that his 1970 contribution should not be forgotten (Crutzen, 1970, although he felt that sometimes it is), so we decided to not change the wording here.

Comment 2

(geological institutions): what does this mean?

We agree and have removed the comment on geological institutions.

Comment 3

(football) for American audience- Soccer.

We agree and have added a footnote stating "Football is the game referred to in American English as soccer".

Comment 4

(tropospheric ozone): This was also done by Chameides and Walker in 1973. The work of Crutzen and C&W were the key studies that led to the realization that tropospheric ozone is mostly produced in the troposphere.

We agree that the work of Chameides and Walker (1973) needs to be mentioned when talking about tropospheric chemistry. In response to the comment we have now expanded and clarified the discussion; the relevant text reads now in the manuscript:

"Tropospheric chemistry, and in particular the chemical production of of ozone in the troposphere were topics of great importance to Paul (Crutzen, 1996; Fishman et al., 2023). The radical OH (Levy, 1971; Crutzen and Zimmermann, 1991; Crutzen, 1996) is responsible for the oxidation of CH_4 (and many other compounds emitted into the atmosphere). It was found that in environments containing sufficient NO, the methane oxidation chain could produce ozone in large quantities – large compared to the downward flux of ozone from the stratosphere to the troposphere – (Crutzen, 1973; Chameides and Walker, 1973; Crutzen, 1974). Paul's work and the work of Chameides and Walker (1973) were the key studies that led to the realisation that tropospheric ozone is mostly chemically produced in the troposphere. In the early seventies, very little was known about homogeneous and heterogeneous reactions affecting the methane oxidation chain in the troposphere, so that initial conclusions remained uncertain (Crutzen, 1974). However some years later, together with Jack Fishman and Susan Solomon, Paul presented observational evidence for a strong in situ tropospheric ozone production (Fishman and Crutzen, 1978; Fishman et al., 1979). Later, Paul's work on tropospheric ozone led him to realise the importance of biomass-burning for the chemistry of the atmosphere (Crutzen et al., 1979; Crutzen and Andreae, 1990)."

Comment 5

(NOx cycle): this had a major impact since NOx emissions from SSTs was the first strat ozone depletion issue that was studied.

We agree and have extended the text on the SST issue. It reads now:

"The recognition of the strong effect of NO_x on stratospheric ozone had a major impact, since emissions of NO_x caused by a possible fleet of supersonic planes was the first stratospheric ozone depletion issue that was studied (Johnston, 1971; Crutzen, 1972)."

Comment 6

(Open review and open access): You may want to qualify this. Faraday Transactions and the Proceedings of the Combustion Institute did this long time ago, but in a Q&A format.

We agree with this comment and in response we have added the following text to the manuscript: 'Scientific discussions have been documented before the invention of ACP; for example in the "Electronic Transactions in Artificial Intelligence" (ETAI) and the "Journal of Interactive Media in Education" (JIME) (Pöschl, 2012, section "Comparison to earlier initiatives with two- or multi-stage open peer review"). Further, the review process in "Faraday Transactions" and in the "Proceedings of the Combustion Institute" is "open", in the sense that these journals have a long history of meetings and their subsequent publication of the discussion. Faraday Discussions collects questions and answers through delegate discussion during meetings (rather than online or through a text forum); a discussion which is then edited and published alongside the articles in each volume. A similar procedure is followed by the Combustion Institute (see Nicovich and Ravishankara, 1982, for an example). The interactive open access process (as we call it today) with a multi-stage public peer review as practised in ACP, however, had not been introduced in scientific publishing prior to the launch of ACP (Pöschl, 2012).'

References

Chameides, W. and Walker, J.: A photochemical theory of tropospheric ozone, J. Geophys. Res., 78, 8751–8760, URL https://doi.org/10.1029/JC078i036p08751, 1973.

Crutzen, P. J.: The influence of nitrogen oxides on the atmospheric ozone content, Q. J. R. Meteorol. Soc., 96, 320–325, 1970.

Crutzen, P. J.: SSTs–a threat to the earth's ozone shield, Ambio, 1, 41–51, 1972.

Crutzen, P. J.: A discussion of the chemistry of some minor constituents in the stratosphere and troposphere, Pure Appl. Geophys., 106-108, 1385–1399, 1973.

Crutzen, P. J.: Photochemical reactions initiated by and influencing ozone in unpolluted tropospheric air, Tellus, 26, 48–57, 1974.

Crutzen, P. J.: My Life with O_3, NO_x and other YZO_x compounds, Angew. Chem. Intern. Ed., 35, 1747–1871, 1996.

Crutzen, P. J. and Andreae, M. O.: Biomass burning in the tropics – Impact on atmospheric chemistry and biogeochemical cycles, Science, 250, 1669–1678, 1990.

Crutzen, P. J. and Zimmermann, P. H.: The changing photochemistry of the troposphere, Tellus, 43, 136–151, https://doi.org/10.3402/tellusb.v43i4.15403, 1991.

Crutzen, P. J., Heidt, L. E., Krasnec, J. P., Pollock, W. H., and Seiler, W.: Biomass burning as a source of atmospheric gases CO, H_2, N_2O, NO, CH_3Cl and COS, Nature, 282, 253–256, 1979.

Fishman, J. and Crutzen, P.: The origin of ozone in the troposphere, Nature, 274, 855–858, URL `https://doi.org/10.1038/274855a0`, 1978.

Fishman, J., Solomon, S., and Crutzen, P. J.: Observational and theoretical evidence in support of a significant in situ photochemical source of tropospheric ozone, Tellus, 31, 432–446, 1979.

Fishman, J., Birks, J. W., Graedel, T. E., Steffen, W., Burrows, J. P., Howard, C. J., and Wayne, R. P.: A Tribute to Paul Crutzen (1933–2021): The Pioneering Atmospheric Chemist Who Provided New Insight into the Concept of Climate Change, Bull. Am. Meteorol. Soc., 104, E77 – E95, https://doi.org/10.1175/BAMS-D-21-0311.1, 2023.

Johnston, H.: Reduction of stratospheric ozone by nitrogen oxide catalysts from supersonic transport exhaust, Science, 173, 517–522, 1971.

Levy, H.: Normal atmosphere: Large radical and formaldehyde concentrations predicted, Science, 173, 141–143, https://doi.org/10.1126/science.173.3992.141, 1971.

Nicovich, J. M. and Ravishankara, A. R.: A study of the reaction of $O(^3P)$ with ethylene, Nineteenth Symposium (International) on Combustion/The Combustion Institute, pp. 23–30, 1982.

Pöschl, U.: Multi-Stage Open Peer Review: Scientific Evaluation Integrating the Strengths of Traditional Peer Review with the Virtues of Transparency and Self-Regulation, Frontiers in Computational Neuroscience, 6, https://doi.org/10.3389/fncom.2012.00033, 2012.