Dear Editor,

We sincerely thank you and the reviewers for taking the time to evaluate our manuscript and for providing valuable recommendations. We have carefully considered all the points raised and have implemented the corresponding changes in the revised manuscript.

Below, we address the comments point by point and detail the specific modifications made to the text.

For clarity, we use the following color-coding scheme: the reviewers' comments are in red, our responses are in black, and the revised text added to the manuscript is in blue (enclosed in quotation marks).

1. l. 197: “exited” -> “excited”

Corrected, see line 197 in the revised manuscript.

2. After describing plots for individual years (Figures 6 and 7), the paper turns to a discussion of a few anomalous years (l. 322-365). Only after that does it address what, to this reader, is the notable result from the paper, viz. the sharp and persistent changes in zeq that results from elevated stratopause events (l. 366-403). Wouldn’t it make sense to rearrange the text in order to highlight the stronger, more notable results first?

We have addressed this comment by moving the text originally on lines 366–403 to precede the text originally on lines 322–365. This reorganized section can now be found on lines 322–403 of the revised manuscript.

3. l. 453: I think “и” should be “and”

Corrected, see line 453 in the revised manuscript.

4. Eq. (7) and (8): These are confusing because of difficulty distinguishing O (oxygen) and 0 (zero, indicating the initial time). Please consider different nomenclature. Also, just below this, it is confusing to see T used as a temporal duration when it was earlier used as temperature.

In the revised manuscript, we have updated the notation in Equations (7) and (8), as well as the subsequent text (see lines 456–465):

«$\tau_O \equiv \frac{O}{|dO/dt|} = \frac{1}{2 \cdot k_4 \cdot M \cdot O_2} \cdot \left(\frac{O}{H}\right)_{lt=lt_n} - \left(1 - \frac{k_5+k_6}{k_3}\right) \cdot (lt - lt_n),$ (7)

$\tau_H \equiv \frac{H}{|dH/dt|} = \frac{1}{2 \cdot k_4 \cdot M \cdot O_2} \cdot \frac{k_3}{k_5+k_6} \cdot \left(\frac{O}{H}\right)_{lt=lt_n} - \left(\frac{k_3}{k_5+k_6} - 1\right) \cdot (lt - lt_n),$ (8)

where lt is the local time, lt_n is the onset of night, $\left(\frac{O}{H}\right)_{lt=lt_n}$ is the O/H ratio at the onset of night. Note that $k_3 \gg k_5 + k_6$ (see Table 1). Above the NOCE boundary: $O_3 \approx {O_3}^{eq} = \frac{k_1 \cdot O \cdot O_2 \cdot M}{k_2 \cdot H}$, then $\left(\frac{O}{H}\right)_{lt=lt_n} = \frac{(O_3)_{lt=lt_n}}{M^2}$. Moreover, in the transition zone, relative concentration of ozone (O_3/M) begins to increase,

forming a secondary maximum at 90-95 km. This means that the first terms in equations (7-8) increase with altitude faster than M^{-3}, leading to approximately the same altitude dependence for τ_O and τ_H. Thus, the lower regime of O and H evolution, characterized by strong diurnal oscillations, corresponds to the condition $\tau_{O,H} \ll D_n$, where D_n is duration of the night, whereas the weak diurnal oscillations of O and H at higher altitudes correspond to the opposite condition: $\tau_{O,H} \gg D_n$.»

5. l. 463: "regim" -> "regime"

Corrected, see line 463 in the revised manuscript.

6. l. 472: "… imposes strong constraints on the O concentration…" Do you mean to say it imposes constraints on the derivation of the O concentration? The criterion is used for evaluation and does not, of course, control the O itself.

In response to this comment, we have revised the sentence to read as follows (see lines 470–473):

« It can be seen that the Cr=0.1 contour corresponds to the following expression:

$$k_2 \cdot O = 20 \cdot (k_4 \cdot M \cdot O_2 \cdot \left(1 - \frac{k_5 + k_6}{k_3}\right) + k_2 \cdot O_3), \quad (10)$$

which implies that the position of the NOCE boundary is closely tied to a particular value of the atomic oxygen concentration.»

7. l. 489: For the benefit of readers who did not see the earlier draft of the paper, please be explicit about what the "previous" rate constants are.

In response to this comment, we have revised the sentence to read as follows (see lines 488–490):

« In addition, we compared the z_{eq} values determined using the new rate constants for function A with those derived using the previous rate constants (Mlynczak et al., 2013a, 2018). »

Furthermore, we have addressed two technical corrections noted in Referee 1's report.

Sincerely,

Mikhail Kulikov

On behalf of all co-authors