We thank the reviewer Mark Lawrence for his helpful comments, especially for pointing out the need for better justification of some of our assumptions. Our responses to his detailed comments are below. The original comments are in black, and our responses are in red.

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1) Several assumptions are made in the algorithm which do not appear to be justified in the manuscript. Examples include: the assumption of maximum overlap of clouds in connected precipitating layers, the retention coefficient of 0.5 for HNO3, the choice of a 25%/km evaporation rate; and the imposed 10% cloud fraction (this is not an exhaustive list; generally the manuscript should be scanned by the authors and justifications added anywhere that a semi-arbitrary choice is made).

We have added the following clarifications to the manuscript:

Page 24423, Line 1: For mixed phase clouds with 258K<T<273K, we use Henry's Law equilibrium with $H_{mixHNO3}=0.5H_{HNO3}$ where H_{HNO3} is the Henry's Law constant for HNO_3 (mol/l/atm). We assume that condensate in this region includes ice and supercooled liquid water, and the value of $0.5H_{HNO3}$ was chosen to represent a mid-point between H_{HNO3} and the value for ice used by von Kuhlman, et al. (2003) of ~$0.005H_{HNO3}$ based on Conklin et al. (1993). Given the high solubility of HNO_3, the uptake is essentially complete.

Page 24441, Line 2: The choice of 25% km^{-1} is arbitrary and reflects the fact that precipitation often falls some distance, but not many kilometers, through clear sky. We test the sensitivity to *evap* as discussed in Section 4.4 and find it to be small in most regions

Page 24441, Line 11: The value of 10% was chosen to provide numerical stability while having minimal impact on the removal.

Page 24419, Line 5: The overlap scheme is described in detail in the Appendix. We assume maximum overlap of clouds in connected precipitating layers, which closely follows JK00 based on their Figure 1.

2) Abstract: it could be a bit confusing to most readership that HNO3 is first indicated to be a "critical" part of the tropospheric O3 budget, but then later in the same sentence it says that HNO3 has "little impact on. . .O3" (here it simply should be added that this implies the NOx and O3 concentrations or mixing ratios, not their budgets); furthermore, in the next sentence it is stated that "the O3 budget is much more sensitive to the lifetime of HNO4", even though HNO3 is already considered "critical" for the O3 budget.

We have changed the wording to: "We find that the process of ice phase scavenging of HNO_3 is a critical component of the tropospheric O_3 budget, but that NO_x and O_3 mixing ratios are relatively insensitive to large differences in the removal rate. O_3 abundances are much more sensitive to the lifetime of HNO_4…." (Page 24414, Lines 13-17)

3) The first paragraph of the introduction should be moved into the end of the abstract (the next paragraph, starting “Recent research. . .” is much more appropriate for an introduction)

This is a style choice and we prefer to leave the paragraph in the Introduction

4) Karcher is spelled with two dots over the “a” (change throughout the manuscript)

Done

5) p. 24419 line 13, “models that have. . .description*s*” (add "s")

Changed to “models that have a more detailed description” instead

6) p. 24421, line 17+: it is unclear what is meant with the reference to Lawrence and Crutzen (1998), which did show that cloud ice sedimentation in and of itself has a large impact on the HNO3 distribution (in addition to precipitation scavenging); please elaborate.

Upon re-reading Lawrence and Crutzen (1998), it is not clear that our statement was justified. We have removed this sentence and changed Page 24416 Lines 22-23 to read “We do not address scavenging by cloud ice sedimentation or convective precipitation here.”

7) p. 24428, line 13: “spanning a similar range” – should this be “smaller range", since it is comparing a 50-70% change with a >200% change?

No, the “spanning a similar range” referred to the uptake rather than the percent change. We have re-written it as “(i.e. the uptake spanned a range similar to our versions UCI-NOICE to GMI)”.