

Dear Authors:

This current manuscript is an improved representation of the idealized nature of the exercise and has better addressed the previous comments. However, I think that the manuscript would benefit from some additional revisions and I would like you to please the comments listed below.

General Comments:

The fact that the quantum yield and concentration of photolabile NO₃⁻ are likely related needs to be treated in more detail. In particular, one could make the case that the base case may be a towards the lower end of the expectations due to the use one of the lower quantum yields (determined for a case where the nitrate was present throughout the solution and not just on the surface) applied to only a fraction of the nitrate. There are obviously many unknowns and as well as subtleties that a global model cannot resolve in this system; however, given the range of values and sensitivities the model predicts, a more thorough discussion about this topic are in order.

I think that it would be beneficial to reconsider some of the word choices, particularly the choices in the conclusions section, regarding comparisons between spatial distributions of the various influencing factors. In numerous locations spatial similarities are referred to as “mainly determined by” or “determined most strongly by” a specific factor. These types of word choices can be interpreted as implying some type of quantitative analysis regarding the relative influence of factors. Many of the actual comparisons are qualitative (often requiring the reader to make spatial comparisons between the figures) and often times many of the factors are heavily interdependent. Furthermore, I think one of the strengths of this manuscript is how it illustrates the complexity and the interdependency of the many influencing factors and that it might therefore be beneficial to put more attention on the fact that many of these spatial patterns are the result of several influencing factors.

Technical Corrections:

Abstract: “Despite the similarity in snow-sourced NO_x fluxes, these fluxes lead to smaller increases in mean austral summer boundary layer mixing...” Please reword to clarify that these are smaller *percentage* increases. The current wording could be interpreted as absolute differences which are not presented in this work.

Line 42: This should read “...produced in E1 can evaporate...”

Line 67: Please fix E4 – charge is not conserved.

Line 234: Is it truly pH dependent or is a constant pH assumed? Additionally, the pH dependence is not discussed in the introduction where the quantum yield is discussed in detail. Please add a brief discussion of the pH dependence there.

Line 515: Should this equation be $(\delta^{15}\text{N}(\text{NO}_3^-)_{\text{air}} + 1)$?

Line 601: Dominant is a bit strong of a word since there are many areas where this number is less than 0.5.

Table 3: Please consider also including how large the increase in F_{NO_x} is relative to the base/standard case in the last column.

Fig. 3a: I find the various shades of blue very difficult to distinguish in many of the figures, but this one is particularly difficult. Given the importance of this figure to the discussion, please consider a different color bar or even separate color bars for Figs. 3a and 3b.

Figs. 11a and 11b: This color bar needs to be altered such that the regions where the fraction of NO_3^- increases are visible. Currently the light blue, white, and light red (the maximum achieved) are indistinguishable and one cannot judge where NO_3^- has increased.