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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Air–snow transfer of nitrate on the East Antarctic plateau – Part 2: An isotopic model for the interpretation of deep ice-core records" *by* J. Erbland et al.

**Anonymous Referee #1**

Received and published: 5 May 2015

Review for J. Erbland et al. ACP 2015

Nitrate is massively lost from the snowpack to the atmosphere making an interpretation of nitrate concentrations measured in the ice difficult if not impossible. Isotopes of N and O have been claimed to have the potential to disentangle post depositional processes from the initial nitrate deposition. Both isotopes have their specifics shedding light on different processes. Erbland et al. constructed a conceptual model for air snow interaction for nitrate including its isotopes. The model is not and does not claim to be perfect and include all the processes. However, the relevant processes are claimed to be included by parametrization.

The model and its concepts are well described. The simulations and discussions are hard to follow and naturally depend largely on the assumptions. That part of the manuscript would benefit from a bit of reorganization. State clearly what is working and even more what is not working. There are huge discrepancies between the model and the data. What is the motivation for the "modified Rayleigh plot"? The 21 year response time due to recycling in the model results in a major discrepancy in the concentration in the snow and points, in my view, to a major flaw in the concept of the model.

Still the model is a step forward in our approach to understand nitrate as a climate parameter at low accumulation Antarctic sites and certainly deserves being published.

Minor comments:

Title: the subtitle says "part 2". I had difficulties finding part 1, published in 2013. I suggest to explicitly referring to part 1 in the introduction.

p. 6893, line 16 and 23: f is the remaining fraction. On line 23 it becomes "loss (f)" which is the opposite.

p. 6894: eq 4 is identical to eq 2 written in a different form. The difference in epsilon is that e_app potentially includes more than one process while in eq. 4 epsilon is pure photolytic. I suggest to remove one of the equations and explain the difference properly.

p. 6894: eq 5: eq 5 is the accumulated product not the immediate product as the word emitted suggests. Please reword. Also where is eq 5 relevant? As the processes described later are fast I do not see where the accumulated product comes into play. I did not find any reference to Eq. 5. Therefore I suggest removing it entirely.

p. 6898, line 1: This is the isotopic mass balance. Please call it that.

p. 6898, line 7: "Compartment" should be "box"



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p. 6901, line 28: typo should read “nitrate is kept the same”

section 2.4.2: I do not understand the consequence of f_app. f_app is not used later on as much as I can see. I suggest removing this section and discussing the effect in depth when D17O is discussed.

p 6903: Can you please indicate the “Leighton cycle” in figure 1 and 2.

p6907, line 16, 17: Why is the boundary layer set to 50m not 30m as others have found?

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 6887, 2015.