

## ***Interactive comment on “Isotopic effects of nitrate photochemistry in snow: a field study at Dome C, Antarctica” by T. A. Berhanu et al.***

### **Anonymous Referee #3**

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Berhanu et al. conduct a field experiment to examine the relative impacts of physical and photochemical loss of snow nitrate at Dome C on nitrate concentrations and isotopic composition. The experimental design is innovative as it is the first to attempt to study this issue by replicating actual field conditions, but at the same time this limits their ability to uniquely distinguish between different processes. The authors need to adequately discuss these limitations. Although they do, the paper is so poorly organized, and contains many confusing and ambiguous statements, that it is difficult to follow their discussion and even rationale. Therefore it is difficult for me to effectively evaluate the scientific integrity of this manuscript.

The term “shape of the incoming light flux” and “shape of the solar actinic flux” is ambiguous, especially in the abstract. Perhaps use “spectral distribution” instead.

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The manuscript says that the Python code for correcting for blank effects and isotopic exchange is in the supplement, but I don't see it there.

Page 33056 Lines 10-13: Here you say that the loss of nitrate is comparable for both snowpits, and also say that the loss was larger for the UV pit. Are they the same or is one pit different from the other in terms of nitrate fractional loss? This is important. If they have the same amount of loss than this warrants discussion, as one would expect the UV pit to experience much more loss of nitrate if indeed UV photolysis is the dominant loss process as you claim.

Page 33058 Lines 1-7: You refer to figure 9 to discuss results from both pits, but figure 9 only shows results from one pit.

Page 33058 Lines 12-20: Again, the discussion here refers to figure 10 to discuss results from both pits, but figure 10 only shows results from the UV pit.

Page 33060 Line 8: Convergence between what? Between the two pits? Between samples at different depths in one or more pits?

Page 33060 Line 13: Where do these  $\delta^{15}\text{N}$  values come from?

Page 33060 Lines 20-23: Could this be important in both pits? Even if there is no photolytic loss of nitrate in the control pit, could nearby snow-sourced  $\text{NO}_x$ /nitrate could be transported and deposited to the surface of the control pit?

Page 33060 Line 29: These  $\delta^{15}\text{N}$  values are measured at what depth?

Page 33061 Lines 20-28: I don't get how certain samples were excluded based on their  $\delta^{15}\text{N}$  values. This needs to be described and shown in a figure. This analysis involves one of the main conclusions of the paper and I don't know what you did.

Page 33063 Lines 5-11: Or perhaps it's because the field results are a combination of both processes? You do mention this later, but here is an example of how the paper is disorganized. A discussion of the mismatch between the laboratory and field results

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should be placed all together, not scattered throughout sections 4 and 5.

Page 33064 Lines 28-30: I don't see how you can exclude physical processes such as evaporation from either pit. Therefore you have not minimized (or even reduced) physical loss in the UV pit.

Page 33064 Lines 17-19: "clearly pointing the radiations" is not grammatically correct.

Page 33064 Lines 21-24: I'm confused. Did this study conclude -59.9 or -67.9? If both, what's the difference? If only one, where does the other one come from?

Page 33066 Lines 10-15: I don't understand why you would say that -67.9 is representative only of photolytic processes when you were not able to remove physical loss.

Page 33066 Line 21: Replace "short" with "shallow".

Figures: Symbols and colors should be consistent from figure to figure throughout for each (e.g., "control#0" should be the same in each figure. It's also helpful to have the line and the symbol the same color.

Figure 5: It's not top and bottom but right and left. The profiles suggest re-deposition to the surface. Is this discussed in the manuscript?

Figure 7: Use consistent labeling. Is there a difference between control-0 and control#0?

Figure 10 caption: Which sampling events specifically? Even the first one? Where does the -50 to -70 permil range come from? Provide references in the caption.

Figure 12: Define the triangle symbols in caption. Why is one a line while the others are discrete symbols?

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 33045, 2014.

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