

Interactive comment on “” by

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We thank the reviewer for his/her comments. The reviewer correctly states that this paper is not a measurement paper, and that the papers describing the methods and/or the original results should be published first. This was a very fair point, and we have waited for the papers to be published. Papers describing the high resolution results and the measurement techniques are now available for PAN, NO and NO₂, HNO₃, p-NO₃⁻ and surface snow nitrate and appropriate references are included. For HONO, although the method and some data are published (and now referred to in this manuscript) subsequent work has strongly suggested that they contain an artefact and are an overestimate of ambient HONO. We therefore do not present the HONO results in this paper. Flask samples for analysis of alkyl nitrates were taken throughout the CHABLIS campaign; as these have not been published in a separate paper, they are now included, with full technical description, in this manuscript. With regards the suggestion that the paper does not warrant publication as there is little new science in this work – well, obviously we disagree. This is the longest-duration NO_y budget study in Antarctica (indeed in either polar region) with the widest coverage of NO_y species measured.

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Further, an assessment of the relative NO_x sources from snowpack nitrate compared with gas-phase reservoirs has not previously been done. As some considerable time has elapsed since this manuscript was originally submitted to ACPD, references have been revised and updated.

Specific comments:

Results 3.1.1/3.1.2

The reviewer does not think that the data show anything new and merely confirms previous work in the Arctic and Antarctica. It's hard to see how this paper confirms previous work in Antarctica, when budget studies there have only been carried out during the summertime. This is the first study to consider the NO_y budget during other seasons. Equally, in the Arctic, studies of the NO_y budget have been limited to the summer. Studies of individual NO_y components have included measurements in other seasons, but the wider context has not been addressed. As stated above, our study is the longest duration and widest coverage of any NO_y budget study conducted either in the Arctic or Antarctic. As directed by the reviewer, we now include additional discussion regarding sources and lifetime of PAN by referring to the primary data paper (Mills et al., 2007). We also discuss the alkyl nitrates in the new section 3.1.

The Solberg et al reference is removed.

Results 3.1.3

The second paragraph from this section, as well as the original Figure 3, have now been removed.

Results 3.2.1

Additional references to field measurements addressing the source of NO₃⁻ in snow are now included.

The snow sampling protocol is described in a companion paper for which a reference

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is now given in section 2 which deals with the methods used in this work.

Sources of NO_x 4.

The following references are now included in section 4, that introduces the question of NO_x emissions: Ridley et al., 2000; Davis et al., 2001; Jones et al., 2001; Beine et al., 2002; Honrath et al., 2002; Wolff et al., 2002. Further, we have added the following text to section 4.2: “Field observations of NO_x fluxes have been made predominantly during summer months (e.g. Jones et al., 2001; Honrath et al., 2002; Oncley et al., 2004; Bauguitte et al., 2009) in both the Antarctic and Arctic. Measurements of daily-averaged NO_x emissions range from 1.7×10^8 molec. cm⁻² s⁻¹ (Bauguitte et al., 2009) to 3.9×10^8 molec. cm⁻² s⁻¹ (Oncley et al., 2004). The values derived for the Antarctic summer in this study therefore concur with the field measurements. No published field data exist with which to compare the springtime values derived in this study.”

Section 4.1.3

Although we can see the Reviewer's point here, we feel that the discussion of Uncertainties sits better where it is, given that the uncertainties are presented tightly within the context of the results. For example, the relevance of the discussion regarding the role of PAN makes more sense once the results have been presented; this is also true for the robustness of the conclusion even within the uncertainties of, for example, boundary layer height. The fact that there are important assumptions and uncertainties within the approach of the analysis is, however, highlighted at the end of the Methodology section where we have added the following text: “Uncertainties in this approach are discussed in some detail in Section 4.3 below.”

Outcome 4.2

This way of discussing NO_x and HONO is now removed as we no longer present the HONO data.

Regarding the Oncley et al flux measurements, actually theirs are higher than those

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calculated here: they derived fluxes of 3.9×10^8 molec. $\text{cm}^{-2} \text{s}^{-1}$ over their measurement period, whereas we calculate a daily-averaged flux for January of 2.42×10^8 molec. $\text{cm}^{-2} \text{s}^{-1}$

The previous sections “Discussion” and “Summary and conclusions” are now combined and shortened into a new section “Discussion and conclusions”

Specific comments:

Page 4138: ppbv changed to pptv

Page 4142 line 1 – text corrected within updated calculation

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 4127, 2007.

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