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Interactive Comment

Interactive comment on "Atmospheric nitrogen oxides (NO and NO_2) at Dome C, East Antarctica, during the OPALE campaign" *by* M. M. Frey et al.

Anonymous Referee #1

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General: I enjoyed the paper and appreciate the challenges in linking NOX chemistry, the diurnal cycle, and boundary layer effects. The discussion of limitations in the evaluation of the effects of interferences was quite complete. It is clear that much has been accomplished but more remains to be done. A peeve of mine that the various papers in this collection do not appear to have been coordinated in the time periods highlighted (particularly in the figures): For example, Gallee et al provides details on model versus observed boundary layer depth for 26-28 December but the really interesting chemistry is earlier in Periods II and III in Frey. Similarly earlier published work (Argentini et al.) looked carefully at 10 January boundary layer behavior but Frey et al. did detailed profile measurements a day earlier. It would useful in collections such as these to identify specific periods of common interest prior to extensive analysis.

Specific: Abstract: Should be more specific about the difference between the South Pole and Concordia: It is not just the diurnal cycle but the sudden collapse of the boundary layer in the evening that is unique to Concordia (when the surface flux of NOX is suddenly confined to a shallow layer).

31284, Lines 15-19: You list four factors leading to high NOX at the South Pole (Davis et al. 2008) in the introduction. Your conclusion should come back and summarize which of these are relevant to Concordia. In particular, the statement “low temperatures leading to low primary production rates of HOx Radicals” should be addressed insofar as Davis et al argue that this is what contributes to the non-linear increase in the lifetime of NOX and high accumulation levels at the South Pole – is there any relevance to the chemistry at Concordia.

31284, Line 28: A more current reference using sodar data is: B. Van Dam, D. Helmig, W. Neff, and L. Kramer, 2013: Evaluation of Boundary Layer Depth Estimates at Summit Station, Greenland. J. Appl. Meteor. Climatol., 52, 2356–2362. doi: http://dx.doi.org/10.1175/JAMC-D-13-055.1

31290, Lines 11-12: Can you argue that the NOX flux is constant with time through the collapse of the boundary layer. Eliminating 22% of the data when the boundary layer depth is <10m may be problematic if this 22% occurs during the evening transition when NOX levels get large.

31293, Lines 10-19: This description of changes in NOX levels could use a bit more work. The intraseasonal “trend” should be characterized as intraseasonal variability. Also, there is a gap in wind data Dec 3-7. I looked at the AWS data (ftp://amrc.ssec.wisc.edu/pub/aws/10min/rdr/2011/089891211.r) for this period and it looks like the wind speed was greater in Period II compared to Period III. The AWS anemometer data shows frequent stalling in Period III. However, a simple average yields Period II: 2.4 m/s whereas Period III: 1.3 m/s. This suggests a closer look at the depth of mixing between the two periods. With respect to the correlation between

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wind speed and NOX levels, another factor to look at is the response of NOX concentrations to the sudden collapse of the boundary layer in the "evening." Ideally, one should compare average winds during just the period of collapse and higher NOX: the correlation might come out differently. There were also significant changes in the behavior of the wind direction: Early Period III shows a 180 degree rotation of the wind whereas Period II shows a most consistent wind direction centered from the SE. In period III, when the wind was rotating from SW to SE to N, could there have been contamination from the station? (Frey et al 2013, Figure 1; also see Gallee this issue, their Figure 3)

Figure 2: The discussion of this figure might want to include a reference to Argentini et al. 2013 (Annals of Geophysics 56, 5, 2013; 10.4401/ag-6347) which shows the negative heat flux at sunset as well as the decrease in downward longwave radiation for 9 January 2012 (rapid cooling of the surface resulting in a strong shallow surface inversion. That paper also shows fairly graphically, using sodar data, the evolution of the boundary layer on 10 January 2012 – it would be nice to have a similar figure for the 9th together with Gallee's simulation (note that the Gallee paper in this special issue compares modeled versus sodar observed BLD for 26-28 December 2011) – It would be nice if these comparisons could be coordinated and cross referenced between the papers (e.g. the high NOX period 12-16 December). Also, Gallee's Figure 6 shows a later falloff in BLD in his model than does the sodar – does the same result hold for the 9th.

Section 3.5.2: This section should probably reference/compare other NOX flux "measurements." See Davis et al 2008 and references therein (Ockley et al, Wolff eta al., Wang et al. and Neff et al) that discuss the magnitudes, estimates, and boundary depth effects relevant to the NOX flux (esp. Wang et al).

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 31281, 2014.