LEGRAND REVIEW

In this revised version, the authors have made very significant efforts to improve their manuscript. That makes it an acceptable paper for publication in the ACP journal. Nevertheless I still have a few comments that the authors may consider when producing the final version of the manuscript.

Section 3, end of page 7 (discussion on ammonium records): The wording of the sentence "the 300 year records of nitrate and ammonium from Holtedahlfonna are in **reasonable good agreement** with the Lomo09 data" is diplomatically correct, but I recommend a different wording since the agreement is quite (very) good for nitrate but is far less good for ammonium: the wave around 1760 seen in the Holte05 ice core (Beaudon et al., 2013) is not seen in the Lomoo9 ice core.

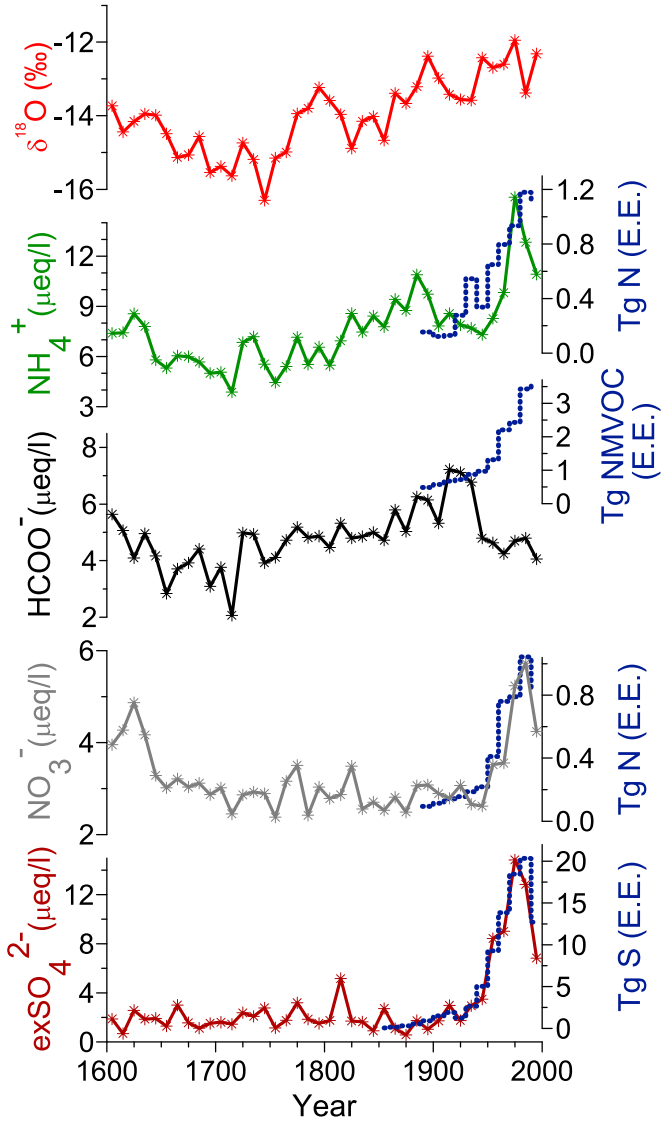
Also your argument (in response to one of the other reviewers) that the preindustrial ammonium levels are close to detection limit is not true: the preindustrial level (new Figure 4) is above 0.5 microEq. L^{-1} (i.e. more than 9 ppb) whereas referring to your table 1 your detection limit is 0.02 (0.4 ppb).

Notation IB (ionic balance): may be better for the reader to use the wording « acidity».

Overall comment based on your figure S2:

I think that your figure S2 in which you now report (as recommended) sulfate data is for me the key figure of the paper. Looking at it through a magnifying glass, I realize that over the recent (1950-2010) you have an excellent co-variation of MSA with nitrate but the same is true for sulphate (????, a short comment on that would be welcome). Of course that cannot be seen in your Table 3 since there you considered only the pre-industrial period.

When discussing the post 1950 period and having in mind your S2 Figure I would have discuss the data in another way (I guess that it is too late at this stage of the review but may in a future paper more focused on the recent decades?). I would have used this period for which historical Eastern European emission estimates of NH_3 [Van Aardenne et al., 2001]), NO_x [Van Aardenne et al., 2001], and SO_2 [Stern, 2005, 2006] are known, to test the assumption that, in spite of melt, such ice core are still useful to examine decadal atmospheric changes. Indeed, the decadal trends of ammonium, nitrate and sulfate extracted from the ice records may differ (as corresponding emissions did: the post 1970-80 decrease is far more pronounced for SO_2 than for NO_x for instance). Note that this difference was already detectable in the sulphate and nitrate ice core records reported in Figure 3 of the Eichler's GRL paper. If no difference in the trends of sulphate and nitrate appears in the Svalbard ice core, I will tend to conclude that everything is driven by melting, handicapping the use of such records to extract atmospheric information even at the decadal scale.



End of the Legrand's review.