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Interactive Comment

Interactive comment on "Enhancements of the refractory submicron aerosol fraction in the Arctic polar vortex: feature or exception?" *by* R. Weigel et al.

R. Weigel et al.

weigelr@uni-mainz.de

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Authors Comment: We first want to acknowledge the efforts spent by all referees and the editor, and also all provided helpful comments and constructive suggestions. Doubtlessly the advices crucially contributed to comprehensively improve this article.

We tried to meet all requests mentioned in the referee comments. Detailed descriptions of the modifications related to each of the specified points are provided by individual replies to the respective referee as a supplement pdf. However, three major points seemed to be of particular importance, as they are touched by almost all reviews:

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Interactive Discussion

Discussion Paper

1) Phrasing: Following the suggestions the manuscript is completely restructured and rephrased to avoid ‘awkward English’, to eliminate incorrect grammar and to minimize ‘complicated language’ by involving a native English speaker for proof-reading and improving the text.

2) Size distribution: Another major concern relates to the estimate of the total mass of refractory aerosol within the entire Arctic vortex. Concretely, it appeared doubtful to base these estimates on the parameterized size distributions of the stratospheric background aerosol based on observations. Additionally, the question arose if the incorporation of more than one refractory core per droplet was accounted for with our assumptions.

We agree with the argument that these sizes distributions of the stratospheric background aerosol can only serve as an uppermost limit for an estimate. Thus, we recalculated the estimate in the revised manuscript version. The size distributions used in the previous paper version now serves for estimating an uppermost limit of the aerosol mass. As a lowermost limit the numerically modelled size distribution of meteoritic smoke particles (MSPs) is considered, provided by Bardeen et al. (2008). The recalculation of course yields new results and the discussion has changed. The revised paper version now aims at an approximation of the so far unknown size distribution of refractory aerosol within the vortex.

Concerning the point that more than one nucleus could be incorporated in one H2SO4 droplet: we assume that after contraction due to the surface tension of each evaporating H2SO4 droplet, the van-der-Waals forces will keep the remaining refractory residuals in shape of a single particle. We address further discussion on this with the revised article and the reply to the respective referee.

3) In the revised paper we took also care of clarifying the conclusions from the tracer-tracer correlation of N10nv and N2O that was found to be in good agreement with earlier findings (works of Plump et al.). This appears to be important enough to be

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outlined in the context of this paper as we found that the mixing ratio N10nv may be understood as a passive tracer in the probed vortex region. The conclusion out of these correlations are essential A) for interpreting the enhancement of refractory aerosol in the lower vortex regime of $\Theta < 500K$ over the course of a winter season with respect to the early winter conditions. B) as an evidence that the possible entry of refractory particles into the vortex interior due to isentropic in-mixing is excluded. C) for getting new insight into dynamic processes, particularly at the lower vortex regime of $\Theta < 500K$, where the mean large-scale subsidence is apparently not the major driver for the downward transport. Instead, another process must be more efficient such as the suggested diabatic dispersion.

However, we are confident that rephrasing large parts of the paper improved its readability. We want to thank for the referee's contribution to uncover deficits of the previous article version.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 9849, 2014.