Atmos. Chem. Phys. Discuss., 14, C3401–C3404, 2014
www.atmos-chem-phys-discuss.net/14/C3401/2014/

Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #4

Received and published: 10 June 2014

GENERAL REMARKS

The manuscript presents results from a joint analysis of three measurement campaigns in the Artic polar vortex where the authors investigated the abundance of non-volatile (nv) particulate matter. The simultaneously measured abundance of N2O was used to estimate the origin of the related air mass carrying the investigated nv-aerosol. Air mass origin was distinguished between vortex interior, extra-vortex and mid-latitude out-of-vortex. From their observations the authors identified an increasing nv-aerosol fraction of total aerosol with decreasing N2O mixing ratio and thus with increasing contributions of vortex interior air masses. They deduced a potential transport path-

way of meteoritic material and interstellar dust via vortex-interior air masses from the mesosphere to the UT/LS and estimated the total nv-aerosol mass flux into the Earth's atmosphere through the Arctic polar vortex. Their estimates were found in reasonable agreement with other values from the literature.

The presented study is rich in data and has the potential of making an important contribution to this research field. It therefore deserves publication in ACP, whereas the presentation of the material is not acceptable for publication in its current form and requires substantial modifications before re-consideration. Major topics to be addressed before publication are the following:

1/ The style of writing requires major clarification because actually some paragraphs are simply not understandable. This point was raised by all other reviewers and there is no need to repeat their arguments here.

2/ The N2O tracer is used to create an index describing the air mass origin. Index values separating regions of different air mass origins are described and a reference is given where the vortex index is described. Since this index is key in the interpretation of data, it is not acceptable that the only reference to this index is cited as "in preparation". If the companion paper is not yet submitted and thus not accessible to the reader, some key information on the vortex index has to be given here, e.g. information on the justification of the index and its accuracy. How precise in the separation of air mass origin by this index?

3/ The deduction of total nv-aerosol mass is not clear. The authors used size distributions measured for the total stratospheric aerosol, including volatile particles and scaled these size distributions until the related number densities matched the observed values for nv aerosols. This approach assumes similar size distributions for nv and total aerosol which, however, is questionable. Furthermore they used a density of 1400 kg per m3 without further justification of explanation how they derived this value. A critical review of the method of estimating total mass of nv aerosol is strongly recommended.

4/ Section 4 on Observations and Results contains a huge amount of details in running text which makes it almost impossible to identify the key information. It is strongly recommended to rearrange the section and include tables which contain the data. Then the text can focus on the differences and similarities of the different missions and respective atmospheric conditions.

5/ Section 5 is focusing more on implications of the observations than on a discussion of results. Renaming the section title is thus recommended. Furthermore, the entire first subsection 5.1 should be part of the introduction than of the discussion section. Only the every last sentence (page 9870, lines 9-13) of this subsection refers to the presented material. In addition Section 4.2 on particle mixing ratios as function of N2O mixing ratio and Section 5.1 on vertical profiles of nv-aerosol mixing ratios treat almost the same subject and should be combined.

6/ Sub-section 5.3 on Implications for PSC formation requires more in-depth discussion. Although the authors observed almost 75% by number of the total aerosol being non-volatile they hypothesize only a small contribution of nv-aerosol cores to PSC formation. What is the reason for this discrepancy?

MINOR COMMENTS

1/ Abstract, line 10-13: this sentence is not understandable, please rephrase.

2/ Page 9852, line 7: deposited “in” the upper atmosphere.

3/ Reference Murphy 2013: please check the reference in the reference list, obviously there is the wrong paper referenced.

4/ Page 9854, lines 26 – 29: this sentence is not understandable, please rephrase.

5/ Page 9859, line 8: shouldn’t this be a “suit of inert artificial tracers”?

6/ Page 9875, line 13: please rephrase “. . .the temperatures will become too high . . .”

7/ Check references in the text, very often brackets are missing for years of publication.

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