Review of the paper "A compilation of tropospheric measurements of gas-phase and aerosol chemistry in polar regions" by Sander and Bottenheim (essd-2012-24)

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Summary

In this paper by Sander and Bottenheim, as the title of the paper dictates, the authors have compiled the measured concentrations (or mole fractions) of gas-phase and aerosol compounds obtained in the polar troposphere of both hemispheres and presented in the literature during the past several decades. The data compiled are taken not only from papers reporting the acquisition of observational data themselves but also from those in which the observational data were used for the purpose of model evaluation.

The present paper is intended to update the previous version of compilation published as a supplement to the Simpson et al. (2007) review paper. Therefore the majority of pre-2007 datasets compiled into the present work is simply the repetition of what was already there in the Simpson et al. (2007). Nevertheless, I think the publication of the present work as a part of the AICI special issue makes sense because the amount of gaseous and aerosol chemistry datasets from the polar troposphere has grown and also quite a few new instruments have emerged since 2007 (this aspect is not stressed in the present paper though). Otherwise we may not have been able to see the update of this compilation for another several years.

Overall, this paper will help readers spot previous measurements of their interest by easy-to-look-up tables and (for most compounds listed) make a quick guess on the typical range of concentrations that have been measured in the field. So I would recommend its publication in ESSD with mostly minor revision.

I have some reservation, however, in that this surely useful material (to the community of polar tropospheric chemistry research – more than several times I did look up in the previous version from Simpson et al.) does not necessarily appear to satisfy the conventional standard of scientific publication or the tentative publication criteria for the Earth System Science Data journal, as this work (categorized as a review paper in conventional sense) neither provides the critical evaluation of previous measurements, nor does it archive the datasets in digitized forms (but I know it is impossible or at least unreasonably demanding). One possible way to overcome this issue is adding some section(s) that describes new types of measurements/instruments having emerged since 2007 and/or not mentioned in Simpson et al. (2007).

Finally, selection criteria for data/works compiled are not always obvious or perhaps as the authors admit (Page 586, Line 19) some of the published works have simply missed the authors' attention. I will try to complement some of the gap with what I have gathered in the literature (please see my specific comments below).

Specific comments

1. How each of "measurements" was conducted is not indicated/explained in Tables 4 and 5 (e.g., Cl-atom concentrations were actually not measured but inferred from hydrocarbon concentration ratios, BrO concentrations and/or column densities were measured either remotely by MAX-DOAS and LP-DOAS or in-situ by CIMS at the ground/sea level or from aircrafts). Also, some of the datasets include profile information in the near-surface

atmosphere and/or into the free troposphere but not mentioned here explicitly. Simpson et al. (2007), in which the previous version of data compilation tables was included, described these aspects in detail, so it would be useful if the authors could refer to relevant sections in the Simpson et al. paper from Table 4 and 5 or from the main text. As noted above in the summary, I would prefer to see some description about new types of measurements and/or instruments that have emerged since 2007.

2. For ozone data, it may also be useful to add information (in Table 4) as to how the data were acquired, e.g., ozonesonde, surface and aircraft in-situ measurements, to each entry. That will indicate if the data contain profile information.

3. The World Ozone and Ultraviolet Radiation Data Centre (WOUDC) is particularly relevant to the present work for its comprehensive archive of ozonesonde data from across the world including the polar regions (http://www.woudc.org/index_e.html). This data center should be referred to in Section 3.

4. The "filterable Br" from Skov et al. (2004) is entered as aerosol data in Table 5 (Page 683), but this data probably represented a mixture of gaseous and aerosol Br as discussed (based on some evidence) in their Experimental Procedure section. In addition, throughout Tables 4 & 5, the entry of "filterable Br" occurs only once by the Skov et al. (2004) data. I wonder if some of the bromine data entered with different names (such as "Br") in Tables 4 & 5 are actually equivalent to "filterable Br" and therefore represent the mixture of gaseous and aerosol Br (e.g., Barrie and Barrie, 1990). By the way, shouldn't you include "filterable Br" from the Barrie et al. (1988) Nature paper in Tables 4 and/or 5?

5. Tables 4 & 5 will become (slightly) more complete if you add the following datasets.

O_3

- Kelly (1973)

Surface ozone measurements at Barrow from January 1965 to September 1967 by electrochemical (KI) method. What we call ODEs today seem to have been observed during the spring, but summertime ozone measurements may appear a bit erroneous to those who know "contemporary" surface ozone data from Barrow (but I cannot make a judgement right away).

- Yurganov (1990)

ODEs encountered during shipboard surface ozone measurements in Weddell Sea (September 1989). Some relation to the synoptic system was described for the first time.

- Bottenheim and Chan (2006)

Statistical analyses of surface ozone data (April data during 1992-2000 from Alert, Zeppelin and Barrow) in combination with backward trajectories. Is this type of observational data use/presentation beyond the scope of data compilation in the present work?

- Hirdman et al. (2009)

This study is similar to Bottenheim and Chan (2006). They used surface ozone (2000-2007) and Hg (GEM, 2000-2008) data obtained at Zeppelin for winter (December to February), spring (April-May) and summer (July-August).

BrO

- McElroy et al. (1999)

McElroy et al. optically retrieved quite high BrO levels in the Arctic free troposphere (April-May 1997, from the ER-2 aircraft in nadir viewing geometry), which is along the same line as recent in-situ BrO measurements (e.g., Salawitch et al., 2010, Choi et al., 2012) and can be contrasted to low values retrieved by Prados-Roman et al. (2011) from aircraft DOAS limb observations.

- Wagner et al. (2001)

One of the most comprehensive data analyses for GOME BrO VCDs in both hemispheres (for the year 2007).

- Wagner et al. (2007)

A unique dataset for BrO dSCDs obtained by shipboard MAX-DOAS over Antarctic sea ice (June to August 2006).

Halocarbons

- Yokouchi et al. (1996)

Seasonal variations in the mixing ratios of $CHBr_3$, $CHBr_2Cl$, CH_2BrCl, CH_2ClI, C_2HCl_3, C_2Cl_4 and $C_2H_2Cl_2$ obtained from measurements from January 1992 to June 1994 at Alert.

Inorganic Br gas, aerosol bromide and other ions

- Staebler et al. (1999)

Inorganic gaseous bromine (denuder) and aerosol Br^-, Cl^-, NO_3^-, $SO_4^=$ and NH_4^+ (as well as ozone) measured during the ARCTOC'96 campaign (March-May 1996) at Zeppelin.

Aerosol metals

- Virkkula et al. (1999)

Aerosol samples were obtained in Kola Peninsula, Russia (December 1992-July 1994). The data include halogens (Cl, Br, I) as well.

Other specific comments

P586, L20-22: In the present paper, have you simply expanded data compilation by including those published after 2007? It looks like you have added some datasets published before 2007 but missing in the previous version of data compilation from Simpson et al. (2007). Please adjust your statement if this is the case.

P589, L2-3: "... several web sites providing large data sets." This statement perhaps needs to be adjusted because, among the websites listed, the AMAP does not provide/archive observational datasets within itself, does it?

P589, L14: As far as I can look up by using their search tool, the WDCA does seem to archive some aerosol chemistry datasets as it claims, although at the moment only from outside the polar region. Is this data center mainly archiving physical and optical kind of datasets?

P589, L22: Can you be a bit more specific about what type of information or chemicals (mercury, black carbon, etc?) we may find from AMAP's scientific reports?

P589, L24: Is this website at Grenoble still active? I tried to browse it on a few different occasions and failed all the time. And again, can you expand on what type of chemical measurements we may find from this website?

P590, L6-8: The EMEP website also provides aerosol chemistry data (SO_4 etc) from Zeppelin. I found these aerosol data very useful for my own model evaluation.

P636, Table 4: Anlauf et al. (1994) reported surface ozone measurements at Alert Baseline Observatory (what is now GAW site perhaps, at 210 m a.s.l.) and at the Special Studies Laboratory nearby (at 200 m a.s.l.) and ozone profiles obtained by ozonesonde launches from the Alert (Canadian Air Force?) base (perhaps at 60 m a.s.l.).

P638 & P665, Table 4: In addition to in-situ O_3 measurements from the Special Studies Trailer (SST) at ca. 190 m a.s.l. near the Alert GAW observatory (at ca. 210 m a.s.l.), the Morin et al. (2005) GRL paper presented in-situ O_3 and MAX-DOAS BrO measurements from the "Out On The Ice" (OOTI) site on the Arctic Ocean sea ice, ca. 5 km off the coast of Canadian Forces Station at Alert. The OOTI site (ca. 0 m a.s.l.) should be distinguished from the Alert GAW site, as is done already for SWAN ice floe camp (SW) and Narwhal ice floe camp (NW).

Possible typos (suggested changes)

P587, L4: Hemisphere -> Hemispheres

P632, Table 1: gaseous elemental mercury

P683, footnote: 83 and 740 pg m^{-3}(STP), respectively (check also footnotes in P692 & P701)

P695, Table 5: Add a horizontal line between Fe and Ga.

P702, Table 5: Add a horizontal line between Sr and Ti.

References (excluding those cited in the Sander and Bottenheim paper)

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