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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Seasonal features of ultrafine particle volatility in the coastal Antarctic troposphere" *by* K. Hara et al.

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We are grateful for helpful comments and suggestions from Referee #1. We improved our manuscript as suggested based on the comments.

We add some references about aerosol volatility measurements in the Antarctic regions. As far as we know, our study is the longest aerosol volatility measurements in the Antarctica. Since long-term measurement of aerosol volatility had not been made in the Antarctic regions, relative abundance of non-volatile particles and seasonal features of aerosol volatility were not obtained in the previous studies. The description was added into the text.

We used two SMPSs in this study. To check data quality, we compared among CN con-

centrations obtained by CPC-3010, the integrated number concentrations (Dp: 10-168 nm) by SMPS and the integrated number concentrations (Dp: 10-168 nm) by TSMPS during the room temperature scan. Because of remove of aerosol particles by impactor in TSMPS and SMPS, the integrated number concentrations were lower than CN concentration. However, good correlation among CN and the integrated number concentrations was observed. In addition, the integrated number concentration of TSMPS was correlated well to the integrated number concentration of SMPS, although long tubing of thermo denuder lead to slight under-estimation of concentrations in TSMPS. Consequently, abundance of non-volatile particles can be estimated using TSMPS and SMPS data. As pointed by Referee #1, relative abundance of non-volatile particles can be calculated using (1) TSMPS data and SMPS data and (2) TSMPS data in room temperature and 240 C scan. As shown in Fig. 9 in the revised manuscript, however, CN concentration was varied drastically and largely depending on meteorological conditions at Syowa. Since SMPS data was taken simultaneously with TSMPS data, we decided to use TSMPS and SMPS data to obtain the number fraction of non-volatile particles in this study. The number fraction calculated from only TSMPS data was correlated well to the fraction from TSMPS and SMPS data expect the data in the period with drastic change of CN concentration.

Detailed comments were improved as follows; (1) Please add information about how far from the open ocean the station is in summer and winter even if this information is in other papers. This helps in the data interpretation in the later sections. Some additional information on the station: are there nunataks or bare soil nearby? This is important because soil dust is nonvolatile and you are making volatility measurements.

Author's reply: We added the following description into the text;

Syowa station is located on East Ongul Island in Lützow Holm bay. Sea-ice margin was distant, from Syowa, approximately 100 km during the summer and 1000 km during the winter - spring. Although the drought soil surface appeared around the observatory approximately in January – mid February, the surface was covered with snow in mid

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February – December. Seasonal features of sea-ice extent off Syowa shows minimum around February and maximum in September – October (e.g., Kusunoki, 1979).

(2) How about your inlet, what is the D50, in other words, how big sea-salt particles get in?

Author's reply: Based on simultaneous aerosol measurements inside and outside the observatory using handheld optical particle counter (KR12, RION) and condensation particle counter (CPC-3007, TSI Inc.), aerosol passing efficiency in inlet and tubing was examined as follows; 91 % in Dp>0.3 micrometer, 93 % in Dp>0.5 micrometer, 88 % in Dp>1.0 micrometer, and 87 % in Dp>2.0 micrometer. As far as several simultaneous measurements, very little difference was obtained in CN concentration. Although aerosol particles with size of Dp>5.0 micrometer were significantly lost in inlet and tube, the passing efficiency was uncertain because of the lower number density of Dp>5.0 micrometer in the ambient atmosphere and no counts of Dp>5.0 micrometer by OPC inside the observatory during the simultaneous measurements. These descriptions were added in the text.

(3) What were the CPCs of the SMPS and the TSMPS?

Author's reply: CPCs for SMPS and TSMPS were 3025A (TSI Inc.) and 3022A (TSI Inc.), respectively. This was added in the text.

(4) What is the residence time of air in your oven of the TSMPS?

Author's reply: Considering flow rate and inner diameter of tubing, residence time of aerosol particles in the thermodenuder was approximately 1 second. This was added in the text.

(5) Did you ever calibrate your TSMPS by using ammonium sulphate or other volatile particles? Author's reply: Yes, we made laboratory experiments of volatility of (NH4)2SO4 using TSMPS. During the measurement, particle counts in TSMPS suddenly decreased in 170 – 180 C.

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(6) “Therefore, Cl− is identifiable as a sea-salt constituent”. Sure. Where else could it come from, even in theory?

Author’s reply: Plausible major chemical states of particulate Cl- in the troposphere are mainly sea-salts (e.g., NaCl) and NH4Cl. Because of the thermal decomposition, however, NH4Cl can be classified into the volatile fraction in this study. The description was added in the text.

(7) “The CN concentration increased remarkably under the storm conditions with strong winds.” This is interesting. This observation is similar to what we found at Aboa, even though with a different instrument; see Virkkula et al. (2007) Bor.Env. Res. 12, 397-408, Figure 5.

Author’s reply: We would like thank for interesting paper. The paper by Virkkula et al. (2007) was added in the text and references.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 14777, 2011.