Comments (in *italics*) and responses

General Comments from Anonymous referee # 2

This is an interesting paper that focuses on the integration of several single particle techniques to investigate sea spray aerosol samples collected at King Sejong Korean scientific research station in the austral summer and in the austral winter. Through use of these single particle techniques several conclusions are drawn related to the identification of organic compounds and inorganic salts. Some of the observations reported in the paper have been seen before and confirm earlier studies (e.g. chloride depletion in particles).

Response: We thank the reviewer for the positive evaluation of our work.

Specific comments from Anonymous referee # 2

In many particles, there is nitrate observed in the particles - where does the nitrate come from in these particles?

Response: We provided discussion in the revised manuscript as follows; "Although N X-ray signal was not detected probably due to the small amount of NO_3^- present in the Antarctic SSAs, $Mg(NO_3)_2$ and $NaNO_3$ were frequently observed in samples S1 and S2 using Raman and ATR-FTIR techniques. The nitrate in sea-water can be generated by the photoammonification process, which transforms dissolved organic nitrogen (DON) to labile inorganic nitrogen, mainly ammonium (NH_4^+) (Kitidis et al., 2006; Aarnos et al., 2012; Xie et al., 2012; Rain-Franco et al., 2014; Paulot et al., 2015), followed by the microbial oxidation of ammonium into nitrate (NO_3^-) by nitrifying bacteria (Carlucci et al., 1970; Hovanec and Delong, 1996; Smith et al., 2014; Tolar et al., 2016). As the photoammonification depends on solar radiations, the ammonium and nitrate production would be enhanced in the summer with higher solar radiation level. Indeed, as shown in Table 2, nitrates are more frequently observed in summertime sample S1 than wintertime sample S2." – p. 15, lines 439-449.

Why is alanine such a dominant factor in the SSA? Are there other compounds that can have similar spectral features? It seems too simple to have one compound and one complex Mg-alanine in sea spray particles. The case for fatty acids seems more convincing given several studies that have identified palmitate and stearate in sea spray aerosol.

Response: The reviewer #1 also made the same comment. Please refer to our response to the comment by the reviewer #1.

Some of the figure captions in the supplemental do not match or explain well the figure making it difficult to understand what is being shown. (See for example Figure S3 – what are the three sets of spectra shown?)

Response: Figure captions in the supplement are modified as below.

Figure S3. Raman and ATR-FTIR spectra of the aerosols generated by the nebulization of a mixture solution of 0.2 M alanine and 0.1 M $MgCl_2$ standard chemicals. The first pair of Raman and ATR-FTIR spectra for the aerosols was obtained just after the nebulization and the second and third pairs of Raman and ATR-FTIR spectra were obtained ~1 year later after the storage in a desiccator. The first and third pairs of Raman and ATR-FTIR spectra for organic moiety look similar to those in Figures 4(b) and 4(a), respectively

Figure S4. Raman and ATR-FTIR spectra of some target chemicals for organics in Antarctic SSAs, which do not resemble with those for MgAla-containing SSAs.

Figure S5. Raman and ATR-FTIR spectra of powdery standard Mg palmitate, palmitic acid, Mg stearate, and stearic acid, which are sufficiently different to distinguish the four compounds

Figure S6. ATR-FTIR spectra of Mg palmitate, Mg stearate, a mixture of Mg palmitate and stearate (by 3:1), and MgFAs-containing SSA, showing that MgFAs-containing SSAs are the mixture of mainly Mg palmitate and stearate.

Figure S7. Raman and ATR-FTIR spectra of standard inorganic chemicals, which are observed in Antarctic SSAs.