

Review of the manuscript entitled “Seasonal variations in physical characteristics of aerosol particles at the King Sejong Station, Antarctic Peninsula” by J. Kim, Y. J. Yoon, Y. Gim, H. J. Kang, J. H. Choi, and B. Y. Lee, with reference no.: **acp-2016-795**.

This manuscript presents and analyses measurements of aerosol properties (number concentrations, size distributions), cloud condensation nuclei (CCN) and black carbon concentrations for a six-year period (March 2009 to February 2015) at the King Sejong research station in Antarctica.

The Cryosphere and especially Arctic and Antarctica are key components of the Earth’s system, and are inherently sensitive to a changing climate serving as the most stunning indicators of climate change. On the other hand, among climate change drivers, aerosols still contribute the largest uncertainty to the total climate forcing estimate especially through the aerosol – cloud interactions. This is due to the great variety of aerosol types, both natural and anthropogenic, their short atmospheric lifetimes and to the subsequent high spatiotemporal variability of their physical and optical properties. The Antarctic continent being the most remote area on the planet from other continents and thus from anthropogenic activities and emissions, it is an ideal place for studying natural aerosol processes in order to understand them and to correctly distinguish between natural and anthropogenic factors influencing the climate. Apart from some long-range transported pollution aerosols, primary aerosol sources like mineral dust, vegetation, soot or secondary aerosols from gas to particle conversion are virtually absent on this almost completely ice-covered continent. Hence, marine air masses advected from the Southern Ocean surrounding the continent, remains the dominant source to the Antarctic aerosol load. Therefore, any dataset of original and accurate measurements that helps to elucidate physical processes taking place in a such climatically sensitive region is important.

In this framework the submitted manuscript is interesting and relevant to the topics of ACP. Moreover it is well written and organised and thus it could be published in the ACP Journal after taking into account the following comments.

The manuscript presents interesting results on Antarctic aerosols based on continuous relatively long term (six years) observations at King Sejong station. The dataset is unique and the analysis of measurements is quite adequate. Core of the manuscript is data analysis on a seasonal basis and at a next level according to the origin of air masses though timeseries of monthly mean data of some variables are presented (e.g. Fig. 3, Fig. 4, Fig. 7a and Fig. 12). Authors analyse the intra-annual variation of examined parameters and they discuss the main features of their seasonal behavior making an effort to provide possible explanations to interpret their findings. In some cases, they compare their results with that of other research works conducted in Antarctica. However, the whole analysis doesn't go deeper to gain an important insight into the factors determining the aerosol properties seasonality and the factors affecting the CCN activation. For instance, is the new particle formation the only or the main factor that induces seasonal variation in particle concentration (total and CN_{2.5})?

My main concern is about the gain of the new knowledge that this paper brings. Authors cite in the text, especially in the introduction, several works on Antarctic aerosols and their properties. So, what is the contribution of this manuscript to this knowledge? In the introduction authors state "*Although various studies have been performed, the measurements taken at the Antarctic Peninsula and the long-term observations of aerosol particles are still insufficient*" but they do not discuss any inter-annual variability or trend (except for the exceptional year of 2014). They focus on the seasonal variation. In order to support their work, authors should clearly state what are the new approach, analysis and/or findings compared to literature and this should be clearly presented in the concluding section as well. Otherwise, they can discuss their results compared to other works, examining whether they are in agreement strengthening thus the existing knowledge since current results are issued from multi-year observations. Actually they do it sometimes. For instance, authors state that the revealed seasonal pattern of CN_{2.5} and CN₁₀ is in agreement with the results of previous studies (page 8, lines 8-10). I am wondering if the consideration of the seasonal variation of CN_{2.5} and CN₁₀ separately, is additional and further information compared to previous works. On the other hand, throughout the discussion regarding timeseries, seasonal behavior of CCN concentrations, particles size distribution and CCN activation ratios, there are no references to other relative

studies in Antarctica. If this analysis and its findings give new or additional information should be stated by authors adding thus value to their work. The same is valid for the analysis regarding the effects of air masses origin on the aerosols physical properties.

I should however state that the lack of new knowledge doesn't reduce the value of a dataset of original measurements of aerosol properties with a relatively long temporal coverage, in a remote, not easily accessible and very interesting from climate change point of view, area of the planet.

Some minor remarks

- Authors give enough information about instrumentation but they do not discuss any quality control assessment that they apply to their raw records.
- Authors trying to interpret the exceptional CN concentration levels during the period 2013-2014, found that air masses origin was differentiating this period compared to previous years. Air masses from south Atlantic were more frequent than other years. A comparison of CN concentration levels with analogous measurements (if there are published) at stations which are affected mostly by south Atlantic air masses could support this argument.
- Analyzing the CCN concentration, it was found that its seasonal variation follows the seasonal cycle of particles concentration which is logical. I have however point out that the CCN concentrations during the period 2013-2014 seem to be unaffected by the low particles concentration in that period as they remain similar to other years.
- Page 3, lines 8-9. In the sentence “... *the direct and indirect climate effects are still unknown (IPCC, 2013).*”, I think the word “unknown” is not appropriate. Actually, according to IPCC report, aerosol effects contribute the largest uncertainty in the total radiative forcing. Thus you can replace the word ‘*unknown*’ by ‘highly uncertain’.
- Page 3, line 21. In the sentence “*For these reasons, the observation of **the** physical properties in Antarctica, ...*”, replace the word ‘*the*’ by ‘their’

- Page 7, line 14. In the sentence “*Fig. 3 depicts monthly variations of the meteorological parameters measured from **and** automatic weather system (AWS) ...*” replace the word ‘*and*’ by ‘*an*’
- Page 7, line 18. In the sentence “*the observation site was relatively humid and warm **condition** compared to inland Antarctic stations*”, remove the word ‘*condition*’
- Page 15, line 6. In the sentence “*Our results are **similar** those of previous laboratory and field experiments (Sellegri et al., 2006; Yoon et al., 2007).*”, add the word ‘**to**’ after the word ‘*similar*’.