COMPARISON OF SEASONAL CHARACTERISTICS OF CLOUD CONDENSATION NUCLEI MEASURED AT POLAR REGIONS

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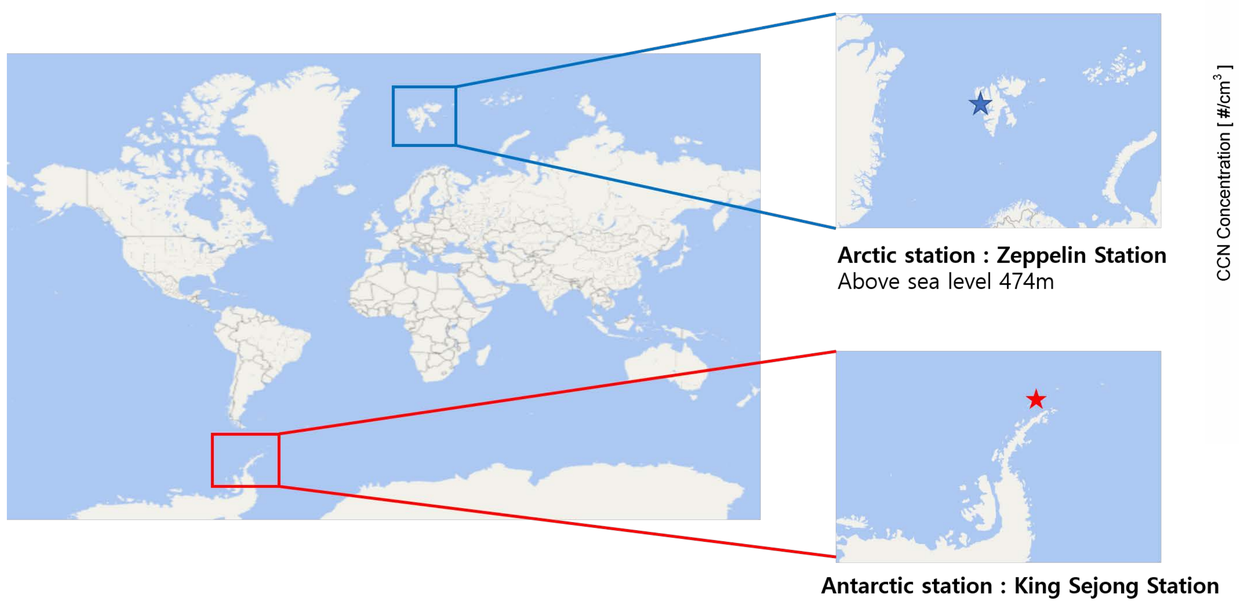
1. INTRODUCTION

In atmospheres with only water droplet, cloud is not formed because water droplet do begin to condensed to water vapor when the supersaturation is at least hundreds percent. (Yau et al, 1996) However, in actual atmospheres, cloud is formed at less supersaturation because of the presence of particles, called cloud condensation nuclei, that is required for cloud formation and grows through the surrounding water vapor.

Cloud play a role on Earth radiative budget that emit long wave radiation and reflect solar radiation. Therefore, Earth albedo effect on climate. It is necessary to understand the cloud condensation nuclei concentration forming cloud.

In addition, comparative study on cloud condensation nuclei condensation at two polar regions are not be enough. Therefore, in this study, comparison of seasonal characteristics of cloud condensation nuclei in the Antarctic and arctic is analyzed seasonally.

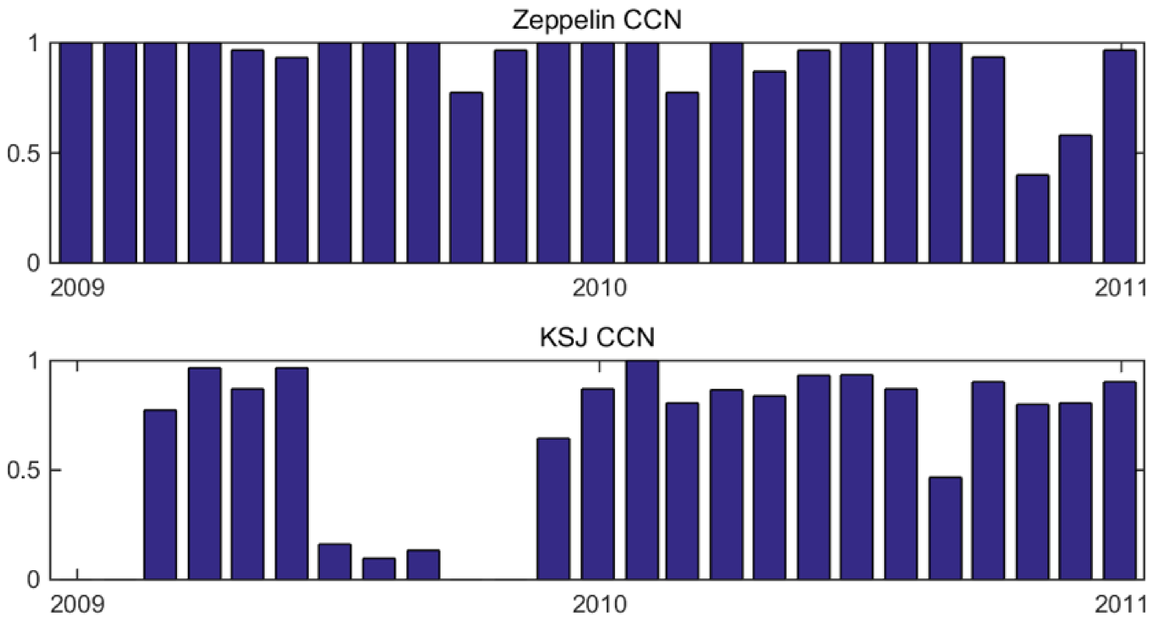
2. METHOD



(i) King Sejong station

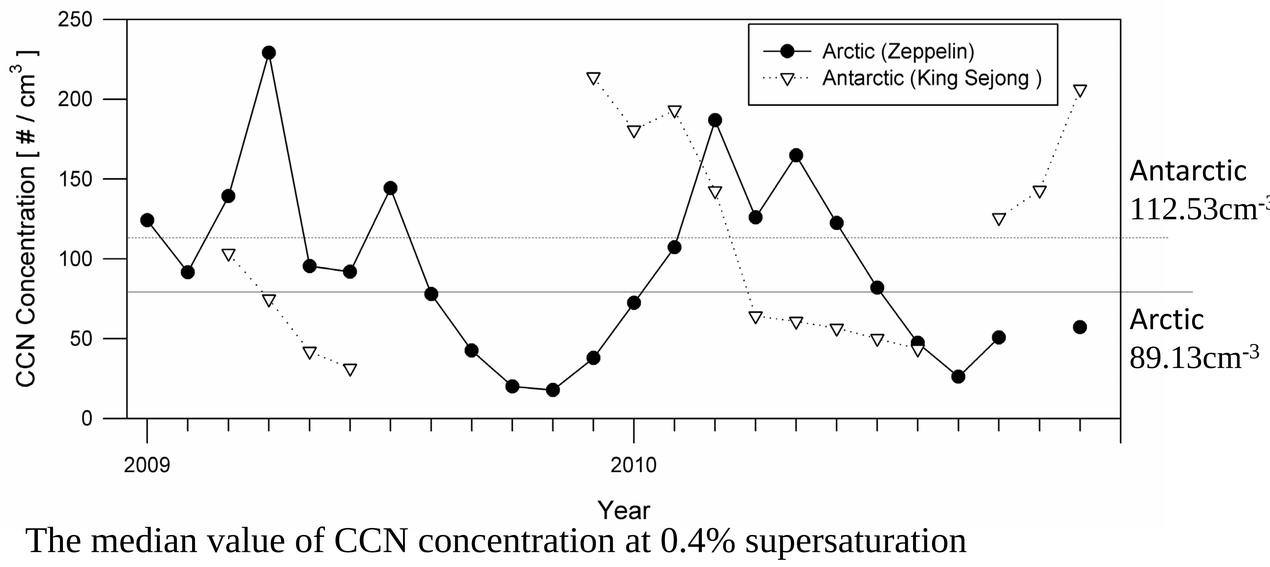
(ii) Zeppelin station

Cloud Condensation Nuclei (CCN) concentrations have been measured at polar stations, (i) King Sejong station (62.22°S, 58.78°W) of Antarctic Peninsula and (ii) Zeppelin station (78.91°N, 11.89°E, Above sea level 474m) of Arctic region.



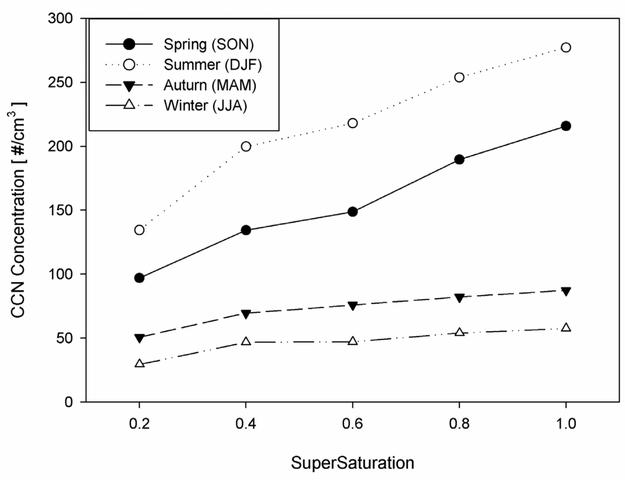
Analysis of the CCN date were conducted for the periods from January 2009 to December 2010, for the cases when instruments of the both stations were operational. Commercially available CCN Counters (DMT-100) were deployed at both sites. Time resolution of measurements have been set as 1 second. The cycle of supersaturation was gradual increasing 5 steps, from 0.2% to 1.0%. CCN data was obtained at raw to hourly median value, hourly to daily median value, daily to monthly median value in sequence.

3. RESULT AND DISCUSSION



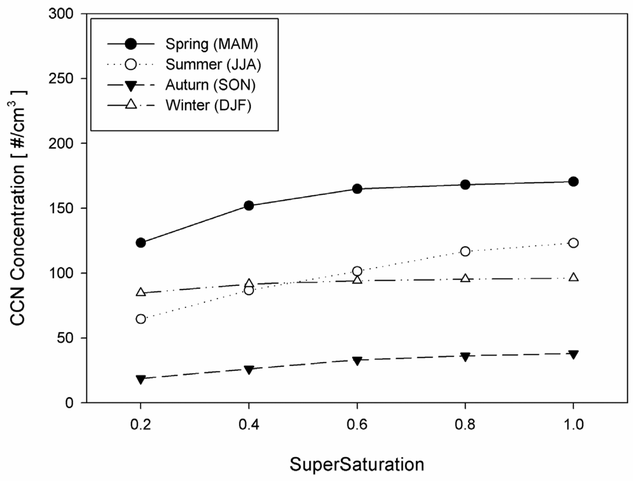
The median value of CCN concentration at 0.4% supersaturation at Arctic and Antarctic stations were 89.13cm^{-3} and 112.53cm^{-3}, respectively.

Antarctic(King Sejong)



Summer>Spring>Autumn>Winter

Arctic(Zeppelin)



Spring>Summer>Winter>Autumn

The seasonal variations of CCN show different patterns for both polar regions, showing the highest value of 151.96cm^{-3} in spring and the lowest value of 26.16cm^{-3} in autumn, for Arctic region at supersaturation of 0.4%. On the other hand, for Antarctic atmosphere, seasonal median CCN concentration was highest at 199.65cm^{-3} in austral summer and the lowest at 46.73cm^{-3} in austral winter.

	Antarctic (King Sejong)			Arctic (Zeppelin)		
	C [cm^{-3}]	k	Slope	C [cm^{-3}]	k	Slope
Spring	146.1	0.47	96.96	173.73	0.25	68.39
Summer	271.95	0.48	174.7	124.36	0.52	88.24
Autumn	103.87	0.37	57.02	36.66	0.29	16.33
Winter	43.96	0.26	16.49	73.21	0.07	10.31
median	124.99	0.4	76.99	98.785	0.27	42.36

CCN spectra was used to calculate the experimental parameters of C and k adapted from Seinfeld and Pandis (2016). During analysis period, for Arctic and Antarctic, entire median value of C were 98.78cm^{-3} and 124.99cm^{-3} and k values were estimated as 0.27 and 0.42, respectively.

As a result, the CCN median number concentration during the observation period was higher in the Antarctic than in the Arctic. By season, the highest concentration of CCN was found in the summer of Antarctica and the highest concentration of CCN in the Arctic was in the spring. The reason of high CCN number concentration is considered the influence of biological organic compounds to marine aerosol in summer season at Antarctic (Kim et al. 2017) and due to Arctic Haze in the Arctic spring (Shaw. 1995). The C and k values obtained by the empirical equation are similar to those of Hegg and Hobbs (1992), the North Pole is similar to Maritime (Australia) and the South Pole is similar to Cape Grim (Australia). The correlation observation between cloud condensation nuclei and actual cloud should be studied in the future.

4. REFERENCE

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5. ACKNOWLEGEMENTS

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ABSTRACT

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