PF14) Chemical Characteristic of Precipitation and PM_{10} for Detecting the Asian Dust

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1. Introduction

KMA stresses the importance of the distinction on Asian dust by the instrument monitoring in order to improve the accuracy to predict Asian dust. Asian dust is monitored on 28 sites in South Korea and on 15 sites of Asian dust source regions and inflow routes in China with β-ray type PM_{10} analyzers in five-minute interval. Real time monitoring like this offers the useful information for Asian dust prediction.

The standard of Asian dust warning is divided three steps, information, advisory, and warning. Yet, the dust phenomenon actually often occurs when the dust concentration is within 300㎍/㎥. Also, although the dust concentration exceeds 300㎍/㎥, the dust phenomenon can rise not due to the effect of Asian dust but due to other factors such as air pollution and sea fog.

In this study, we inspect the chemical characteristics of precipitation and PM_{10} on Asian dust events using chemical analysis data in KGAWC and suggest the quantitative standard for the distinction on Asian dust.

2. Sampling and Method

Chemical analysis data in 2005～2007 was used for understanding the chemical characteristic of precipitation. One day total precipitation is collected from 9 A.M. to 9 A.M. next day. Nine major ion concentrations(F^-, Cl^-, NO_3^-, SO_4^{2-}, Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}) are analyzed by ion chromatography manufactured by Dionex corporation after measuring the pH and electrical conductivity on precipitation. Quality assurance and quality control on precipitation chemical data is performed with the standard methods such as ion balance and conductivity balance suggested by WMO GAW World Data Centre for Precipitation Chemistry(WMO/GAW, 2004). Finally, the number of the data which passed QA/QC is 182.

Chemical analysis data in 2005～2007 was used for understanding the chemical characteristic of PM_{10} on Asian dust. PM_{10} is sampled on the filter from 10 A.M. to 10 A.M. next day. It weighs before and after sampling and the mass concentration is calculated. The process of ion concentration analysis is the same as that of precipitation. Finally, the number of the data that passed QA/QC is 142.

3. Results and Discussions

Fig. 1 shows the pH variation and the percentile analysis results on the 182 precipitation samples in 2005～2007. The precipitation samples were classified in the range of the top 10%(pH>5.68, 18 ea), the bottom 10%(pH<4.01, 18 ea), and 30～70%(4.47<pH<5.02, 72 ea) by the percentile analysis. We consider that the precipitation samples in the range of the top 10% have high possibility that they might have been influenced by Asian dust.

Fig. 2 shows the monthly frequency distribution of precipitation samples which are classified based upon the pH ranges. The samples in middle range have the general characteristics of precipitation in the peninsula and the highest frequency appears in July and August in the Summer. The samples in the top 10% range have high possibility that they might have been affected by Asian dust and their highest frequency appears in April and May in the spring. The strong acid rain with the bottom range doesn't have any seasonal variation and occurs on the special events.

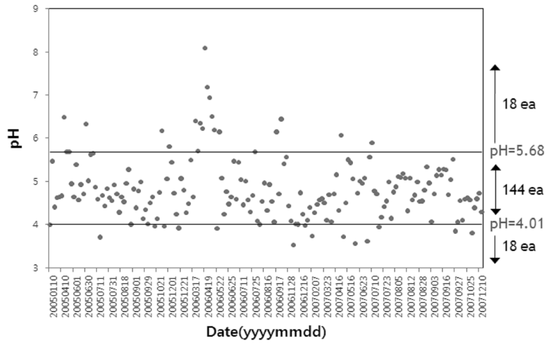

Fig. 1. pH variation for precipitation in Anmyeondo during 2005～2007.

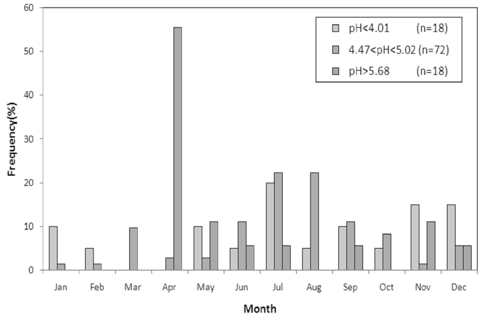

Fig. 2. Monthly frequency distribution of precipitation samples which are classified based upon the pH range.

Fig. 3 compares the neutralizing factor(NF) of NH_4^+ and that of nss-Ca^{2+}. Here NF is calculated as the concentration ratio of each ion to acid source ions. As a result, NFs of NH_4^+ and nss-Ca^{2+} are 0.5 and 0.4 or less respectively. This values are relatively small. When pH exceeds 5.68, NF of NH_4^+ is similar to the data with pH 4.01 or less except for some parts. Yet NF of nss-Ca^{2+} is much higher. Therefore, the chemical characteristic of precipitation on Asian dust is that NF of nss-Ca^{2+} is 0.6 or more.

Fig. 4 shows the increase rate of mass concentration and ion components on occurring high mass concentration, 38 cases. Yellow shadow represents a day of Asian dust observed in Seosan weather station which is located near Anmyeondo. As the result, on April 8th in 2006, the strongest Asian Dust event, the mass concentration increases 2,014% and the concentration of Ca^{2+} increases 1,239% compared with the background concentration. On the contrary, on the cases of March 9th, and June 12th in 2006, February 7th, March 26th, and December 20th in 2007, the concentration increase of pollutant ions like NO_3^-, SO_4^{2-} is much higher than that of Ca^{2+}. In conclusion, the chemical characteristic of PM_{10} on Asian Dust is that the concentration of Ca^{2+} increases 200% or more on the base of the background concentration.

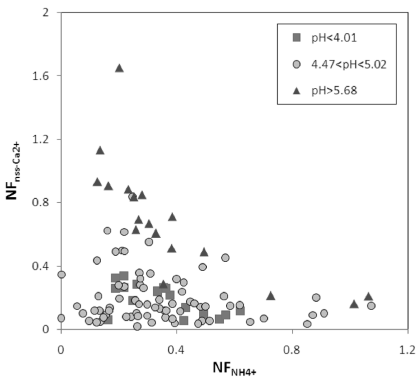

Fig. 3. Comparison NF_{NH4+} of $NF_{nss\text{-}Ca2+}$.

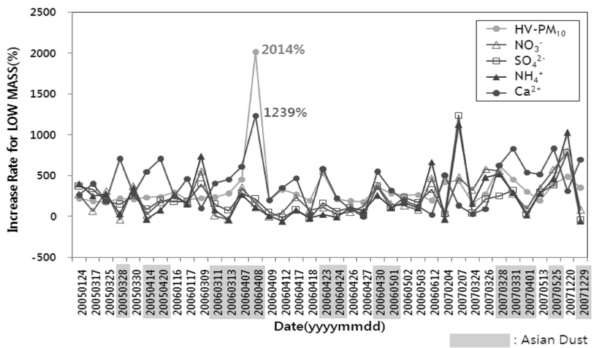

Fig. 4. Increase rate of mass concentration and ion components on occurring high mass concentration.