An analysis of the correlation between dust storms in Korea and ^{137}Cs nuclide concentration

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1. Introduction

Dust storms occur in Korea during spring time when fine dust is blown in from the far western regions of western China and Mongolia. A fine powdery dust is blown up into the sky and enters the upper reaches of the atmosphere where it is carried easterly across China then slowly falls to the ground on the Korean peninsula and Japan. The dust originates mostly in the Gobi dessert of China, as well as the yellow earth regions in the middle and upper streams of the Yellow river in China. Previous studies on dust storms have been limited to following or estimating their courses, distribution and frequency, or distribution of the heavy metals they transmit. However, since radionuclides exist in the dust, they must also exist in the dust storms. In this study, we analyzed the correlation of ^{137}Cs nuclide concentration based on a count of annual dust storm occurrence in the city of Suwon, South Korea and assessed seasonal differences of ^{137}Cs nuclide concentration.

2. Methods and Results

We made a comparison against the results of an analysis done on air-floating dust containing a high-capacity gamma-ray isotope conducted by the Suwon Environmental Radiation and Radioactivity Measuring Center on the basis of sandy dust concentration and frequency of dust storms that occurred within the Suwon region of Korea over a 5-year period from 2003 to 2007. For the ^{137}Cs nuclide, we installed a high-volume dust collector 1m above ground and collected air-floating dust through 15 paper filters for one month. The collected dust was ashed for 6 hours at 420 ℃ to prevent damage to the ^{137}Cs. A measurement was taken using an HPGe (model Gc3019).

2.1 Annual Average Frequency and Intensity of Dust Storms

Fig. 1 shows the frequency of dust storms per year in the Suwon region over a 5-years from 2003 to 2007.

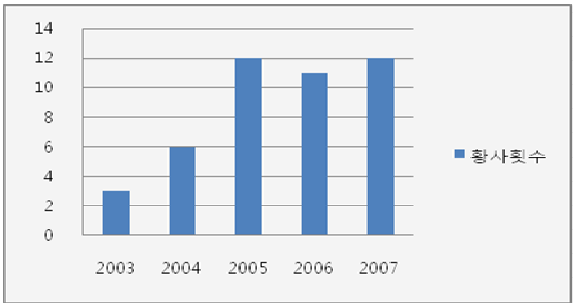

Fig.1. Frequency of Dust Storms per Year in the Suwon Region

The annual average frequency of dust storms from 2003 to 2007 was 8.8 occurrences/year. However, considering the high frequency of dust storms over the previous three years, we expect that the annual average frequency of dust storms will increase in the future. In Korea, dust storms mainly occur during spring time. This is presumed to be due to the influence of seasonal winds. In Korea, the frequency of dust storm occurrence is low during winter because of the cold and dry northwesterly wind caused by the high atmospheric pressure from Siberia. During spring, the migratory wind flows originating in the Yantze river region of China passes through Korea and results in frequent dust storms.

2.2 Relationship between Season and ^{137}Cs Nuclide Concentration

Table Ⅰ shows the average ^{137}Cs nuclide concentration and sandy dust concentration over the 5-year period of 2003 ~ 2007.

Table I: ^{137}Cs Nuclide Concentration and Sandy Dust Concentration

	Average	Standard

		Deviation
^{137}Cs(μBq/m^3)	0.786	0.367
Sandy Dust Concentration (㎍/㎥)	180.22	172.73

The average ^{137}Cs nuclide concentration over the 5-year period was 0.786 μBq/m^3. Maximum and minimum values were analyzed to be 2.92 μBq/m^3 and 0.454 μBq/m^3 respectively. Also, average sandy dust concentration during the 5 years was 180.22 ㎍/㎥ and maximum concentration was found to be 1025.71 ㎍/㎥.

Among the meteorological factors, such as dust storms, temperature, humidity and atmospheric pressure, etc. that impact ^{137}Cs concentration, we analyzed the correlation between the frequency of dust storm occurrence and ^{137}Cs concentration. The result is as shown in Table Ⅱ.

Table Ⅱ: Correlation between the Frequency of Dust Storm Occurrence and ^{137}Cs Concentration

	Frequency of Dust Storm Occurrence
^{137}Cs	.499 ***

* p<.05, ** p<.01, ***p<.001

As shown in Table Ⅱ, a positive (+) correlation of .499 was found, which is a statistically significant correlation with a significance level of .001. Therefore, it is deduced that ^{137}Cs concentration increases as the frequency of dust storms in Korea increases.

Table Ⅲ shows the differences in ^{137}Cs nuclide concentration per season.

Table Ⅲ: ^{137}Cs Nuclide Concentration per Season

[Unit: μBq/m^3]

Season	Average ^{137}Cs Concentration	Standard Deviation	F Value (p value)
Spring	0.939	0.676	1.491(0.227)
Summer	0.694	0.095	
Fall	0.703	0.072	
Winter	0.807	0.235	

In terms of average ^{137}Cs nuclide concentration per season, it was the highest at 0.939mBq/m^3 during spring, followed by winter, fall and summer. However, no statistical difference in ^{137}Cs nuclide concentration per season was found. Therefore, it is concluded that there is no difference in ^{137}Cs nuclide concentration per season.

3. Conclusions

In this study, we investigated the annual frequency of dust storm occurrence in the Suwon region of Korea to calculate its correlation with ^{137}Cs nuclide concentration and analyzed seasonal differences of ^{137}Cs nuclide concentration. As a result, first, we found a positive (+) correlation of .449 between ^{137}Cs nuclide concentration and frequency of dust storm occurrence.

Second, it was analyzed that there was no change in ^{137}Cs concentration per season. Even if the expression of dust storms, a highly relevant seasonal factor, is connected to a change in ^{137}Cs concentration, a change in ^{137}Cs concentration is also influenced by various other factors such as rainfall, wind velocity and atmospheric pressure, etc. Therefore, it is difficult to predict a seasonal change in ^{137}Cs nuclide concentration only by looking at dust storms. As the frequency of dust storms in Korea has been increasing recently, it will be necessary to study continuously the impact exerted by ^{137}Cs carried by dust storms upon the Korean people.

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