^{134}Cs, ^{137}Cs and $^{239+240}$Pu concentrations in surface air at Chiba City, Japan during 2016 to 2023: factors controlling their seasonal and interannual variations

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To elucidate current levels of ^{134}Cs, ^{137}Cs and $^{239+240}$Pu in surface air at Chiba City, we carried out radiometric analysis of their radionuclides during the period from March 2016 to December 2023. Interannual variation revealed that ^{137}Cs and ^{134}Cs activity concentrations in surface air exhibited decrease trends, although the ^{134}Cs have not detected in dust samples after March 2021. On the other hand, Interannual variation of $^{239+240}$Pu in surface air exhibited no clear trend. The ^{137}Cs and $^{239+240}$Pu in surface air indicated seasonal variations; ^{137}Cs occurred maximum in winter and minimum in summer (as shown in Fig. 1), whereas maximum $^{239+240}$Pu appeared in spring (as shown in Fig. 2). The maximum ^{137}Cs in winter is attributable to resuspension of ^{137}Cs-bearing soil particles, contaminated by Fukushima Daiichi Nuclear Power Station (FDNPS) accident, due to low humidity and low rainfall in winter, and transport of air mass including airborne dust dispersed from the area affected by the FDNPS following northerly wind in winter. Spring maximum of $^{239+240}$Pu is due to the arrival of yellow dust (Kosa), where originates in East Asian continental deserts, at Chiba City because of the similar seasonal change between atmospheric dust density (and/or Kosa events) and $^{239+240}$Pu in surface air. Moreover, the relationship between dust density and $^{239+240}$Pu in surface air revealed that massive $^{239+240}$Pu activity concentrations in spring were divided into two groups: high and low concentration groups. This finding suggests that Kosa events occurred different areas with high $^{239+240}$Pu density and low one in the East Asian arid and deserts. We apply ^{137}Cs/$^{239+240}$Pu activity ratio as a new indicator because ^{137}Cs was affected by the local effects of FDNPS accident, whereas most of $^{239+240}$Pu is global fallout origin. The results revealed that the ^{137}Cs/$^{239+240}$Pu ratios showed minimum in spring, which suggests that the enhancement of the global fallout radionuclides due to the arrival of yellow dust occurred in spring, which caused marked increase of the $^{239+240}$Pu, and then the ratios were lower than that in other seasons. This survey is the result of "environmental radioactivity level survey" which is commissioned project by Japan Nuclear Regulation Agency.

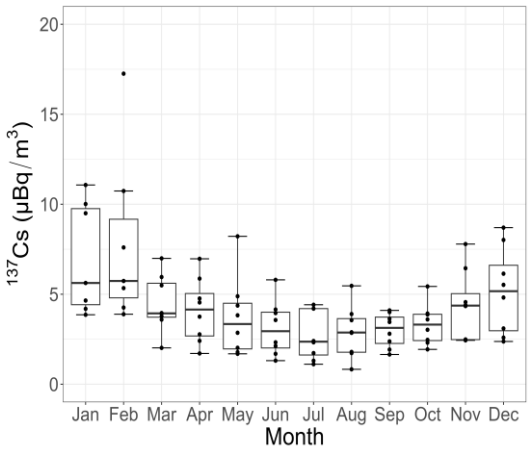

Fig. 1 The seasonal variability of ^{137}Cs activity concentrations in each month during the period from March 2016 to December 2023.

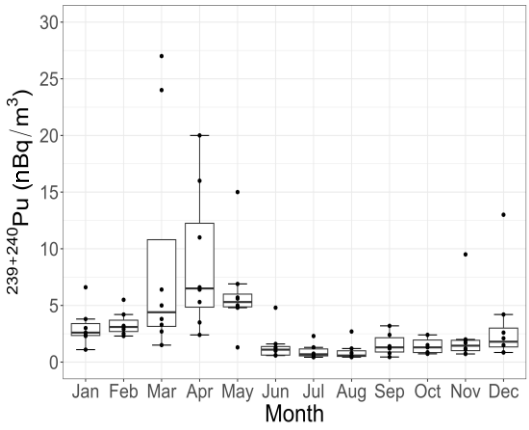

Fig. 2 The seasonal variability of $^{239+240}$Pu activity concentrations in each month from March 2016 to December 2023.