Characterization of ^{210}Pb deposition distribution in Asia-Japan based on numerical simulation.

*Yu Cai[1], Takeshi Iimoto[1] and Hiromi Yamazawa[2]

[1]The University of Tokyo, [2] Nagoya University

Abstract

This study examined ^{210}Pb deposition in the Asian region in 2012-2015. Results show that air masses from southern China most significantly impact summer deposition along the Sea of Japan, while air masses from Siberia and northern China mainly affect winter deposition.

Keywords: ^{222}Rn, ^{210}Pb deposition, atmospheric transport model, long range transport, tracer

1. Introduction ^{222}Rn decay products, ^{210}Pb and ^{210}Po, are considered as the primary factors contributing to Japan's natural radiation exposure due to their abundant occurrence in seafood. ^{210}Pb has a relatively long atmospheric lifetime and can be transported over long distances. The influence of monsoonal transport and heavy precipitation on the Japan Sea side has been identified as crucial for the winter wet deposition of ^{210}Pb. However, the scarcity of measurement sites for ^{210}Pb deposition necessitates calculations using atmospheric transport and deposition models. The present study aims to identify the primary sources of ^{210}Pb impacting Japan and elucidate its behavior in the Northern Hemisphere. The decay products of ^{222}Rn, ^{210}Pb and ^{210}Po, are considered major contributors to natural radiation exposure in Japan, as they are abundantly present in seafood. ^{210}Pb has a relatively long atmospheric lifetime, allowing it to migrate over long distances. Monsoonal transport and heavy precipitation along the Sea of Japan are believed to be key factors in the wet deposition of ^{210}Pb. However, due to the scarcity of ^{210}Pb deposition measurement sites, atmospheric transport and deposition models must be used for calculations. This study aims to identify the specific sources influencing ^{210}Pb deposition in Japan across different seasons.

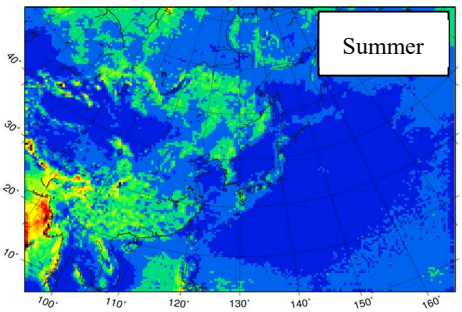

Figure 1 ^{210}Pb deposition distribution in summer

2. Experiment The atmospheric transport and deposition model HIRAT [1], using meteorological data from the meteorological model WRF and ^{222}Rn exhalation rate, was employed to simulate long-distance atmospheric transport and deposition. This analysis covers the Asian region for the period from 2012 to 2015, using a horizontal grid spacing of 48 km.

3.Results Figure 1 depicts average summer deposition fluxes, while Figure 2 illustrates winter averages. In winter, the highest fluxes occur in the northern Sea of Japan, eastern Vietnam, and Siberia, ranging between 20-120 Bq m^{-2} month^{-1}. Conversely, during summer, increased fluxes are observed in the Bay of Bengal and western Philippines, also ranging from 20-120 Bqm^{-2} month^{-1}. Notably, summer deposition in Kyushu along the Sea of Japan (20-60 Bq m^{-2} month^{-1}) exceeds that in other Japanese regions. To ascertain deposition sources, we analyzed high deposition events (>0.2 Bq m^{-2} s^{-1}). In summer, 80% of these events were associated with air masses from southern mainland China, while the remaining 20% originated from the Xinjiang-Kazakhstan border and Siberia, driven by westerlies and subtropical south winds. In winter, 47% of high deposition events originated from Xinjiang and 53% from eastern Siberia, influenced by the dynamics of the Siberian High -pressure systems.

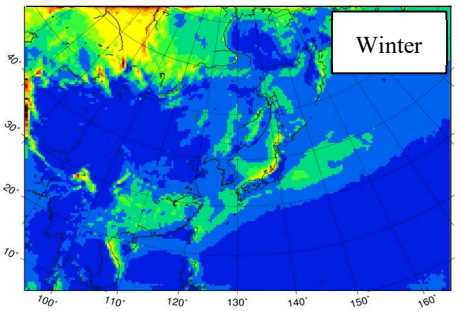

Figure 2 ^{210}Pb deposition distribution in winter

References

[1] S. HIRAO et al. (2008) J. Nucl. Sci. Technol. Suppl., 166-172. This study was supported by KAKENHI 20H04321.