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Variations of atmospheric radon-222 at Rishiri Island, Japan and traced fetch regions

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Measurements of atmospheric ^{222}Rn were made on Rishiri Island (45.1^{o}N, 141.2^{o}E) over the period from December 2008 to December 2010, in order to discuss the fetch regions affecting atmospheric ^{222}Rn concentration and some other gases related to climate change. Atmospheric ^{222}Rn data showed variability of a diurnal, synoptic, and seasonal time scales, which will allow us to evaluate transport and mixing schemes of atmospheric and chemical transport models.

Atmospheric ^{222}Rn concentration indicated a clear diurnal variation in summer, which was characterized of a maximum appearing before the dawn and a minimum in the afternoon, with amplitude of 0.64 Bq m^{-3}. This could be caused by the accumulation of ^{222}Rn emitted from the soil (Rishiri Island) in the stable nocturnal boundary layer, and vertical mixing of surface air with upper air due to convection (Zahorowski *et al.*, 2008). The amplitude of diurnal variation is relatively lower than that of the synoptic influence. No clear diurnal variation occurred during the remaining seasons.

Atmospheric ^{222}Rn concentration in daytime, selected to remove effects of local source on ^{222}Rn concentration, showed a broad minimum in winter and a maximum in summer, with an accompanying significant short-term variability. In February monthly mean of atmospheric ^{222}Rn concentration was 3.23 Bq m^{-3}, and in July 0.95 Bq m^{-3}. In Rishiri Island, short-term variations corresponding to the synoptic influence were large in February as compared with those in July. The amplitude of the seasonal variation (2.28 Bq m^{-3}) was somewhat larger than that of Sado Island located in the Sea of Japan. At Sado Island, maximum ^{222}Rn concentration occurred in winter and minimum in summer, which was the pattern attributable to the onshore-offshore pattern of the Asian monsoons (Chambers *et al.*, 2009).

Backward trajectory analysis of air fetch regions was conducted using extremely low and high radon events. In the annual basis, most (76.7%) of high radon events was observed in winter, of which the air masses originated predominately from 40^{o}N to 60^{o}N of Eurasian continent. 41.7% of low radon events were observed in summer, of which air masses usually originated from the relatively lower latitude of the western North Pacific, and 48.3% of low radon events were observed in spring, most in May. In May, back trajectory analysis showed a pattern that the origin of air masses was in the west North Pacific, and air mass moved westward en route the southernmost of Sea of Okhotsk to the RIO.

Keywords: atmospheric tracer, back trajectory analysis, fetch regions, radon