

Mass balance and long term behavior of fluxes of ^{137}Cs derived from the TEPCO FNPP1 accident among atmosphere, land and ocean

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The consensus values of total atmospheric release of ^{137}Cs from FNPP1 accident is 15-21 PBq, it for atmospheric deposition of ^{137}Cs on land is 3-6 PBq, it for atmospheric deposition of ^{137}Cs on the North Pacific is 12-15 PBq, it for direct discharge of ^{137}Cs to ocean is 3-6 PBq and it for total inventory of ^{137}Cs in the North Pacific is 15-18 PBq (Aoyama et al., 2019). Regarding with fluxes from domain to domain for several years after the accident, the amount of ^{137}Cs transported by the rivers in the south of Pacific coast of Tohoku region to the ocean might be 40 TBq (Aoyama et al., in revise) which is corresponding to less than 1.3 % of deposited ^{137}Cs on land. In terms of annual flux of ^{137}Cs , it was estimated to be 10–12 TBq year⁻¹ in 2011-2012 by 14 rivers around FNPP1 including particulate form and dissolved form (Kitamura et al., 2014) and ca. 0.9 TBq year⁻¹ for particulate form and dissolved form and 0.04 TBq for dissolved form only in Dec. 2016 (Tsumune et al., 2020). In October and November 2019, ^{137}Cs activity concentrations in surface water off Tohoku region were reported to be 10-20 Bq m⁻³ by governmental monitoring after floods by the Typhoon Hagibis in October 2019. Preliminary results of integration of ^{137}Cs for coastal region off Miyagi, Fukushima and Ibaraki prefectures, of which size was 200 km x 20 km, showed that flux from land to ocean in this region by floods might be ca. 0.1 TBq per this typhoon event. This might one tenth of annual flux by the rivers. For resuspension, the annual deposition of ^{137}Cs at Okuma during the period from 2014 to 2018 means that 4 TBq year⁻¹ to 10 TBq year⁻¹ should be amount of resuspension from land to atmosphere and this amount correspond to 0.1 % to 0.3 % of total deposition of ^{137}Cs on land in Japan. The ^{137}Cs activity concentration at 56N canal in 2016-2018 correspond to ^{137}Cs discharge of 0.73 TBq year⁻¹ to 1.0 TBq year⁻¹ from FNPP1 site to open water. As a result of decontamination works, 134 TBq of ^{137}Cs was removed from surface soil until February 2019 which correspond to 4 % of deposited ^{137}Cs on land in Japan (Aoyama et al., in revise). The integrated amount of FNPP1 derived ^{137}Cs that entered the Sea of Japan, SOJ, until 2017 was 0.27 ± 0.02 PBq, which is 6.4 % of the estimated total amount of FNPP1-derived ^{137}Cs in the STMW in the North Pacific. The integrated amount of FNPP1-derived ^{137}Cs that returned to the North Pacific Ocean through the Tsugaru Strait from SOJ was 0.11 ± 0.01 PBq, 42 % of the total amount of FNPP1-derived ^{137}Cs transported to the SOJ (Inomata et al., 2020)

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