

Fukushima Dai-ichi and the Ocean: 10 years of study and insight Abstract Submission Form : Entry # 28

Name

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Title

Transport of surface seawater in the global ocean labeled by chemical tracer ¹³⁷Cs from 1957 to 2018

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Session

Consequences for the ocean

Abstract Title (English, limited to 300 characters)

Transport of surface seawater in the global ocean labeled by chemical tracer ¹³⁷Cs from 1957 to 2018

Abstract (English)

The spatial and temporal variations in ¹³⁷Cs concentrations in the surface seawater in the global ocean from 1957 to 2018 were analyzed by using the "HAM database - global 2018" and the database constructed by the IAEA Marine Radioactivity Information System in order to understand the behaviors of ¹³⁷Cs originated atmospheric weapons tests, nuclear fuel reprocessing plants, and nuclear power plant accidents at Chernobyl and Fukushima. The global ocean was divided into 37 boxes. The 0.5yr average value of ¹³⁷Cs, apparent half residence times (T_{ap}), and ¹³⁷Cs inventory in each box was estimated. Except for the regions affected by the ¹³⁷Cs discharge from the nuclear fuel reprocessing plants, the 0.5yr average value of ¹³⁷Cs decreased exponentially due to advection and diffusion from 1970 to 2010, and the expected reduction of the 0.5yr average value of ¹³⁷Cs in 2010 was 44-99% against to those in 1970. Relatively higher ¹³⁷Cs originated from the atmospheric weapons tests existed in the region between 25°N and 5°S in the Pacific Ocean. These ¹³⁷Cs were transported westward from mid of the eastern North Pacific Ocean and intruded into the Indian Ocean. The ¹³⁷Cs discharged from the nuclear fuel reprocessing plant in the later 1970s and earlier 1980s resulted extremely high ¹³⁷Cs activity concentration in the North Atlantic Ocean. These ¹³⁷Cs were transported in the Arctic Sea and the Baltic Sea. Result with the FNPP1 accident, it appeared that ¹³⁷Cs is transported in the Sea of Japan (SOJ), the East China Sea (ECS), and subtropical western North Pacific Ocean due to the formation of Sub Tropical Mode Water (STMW) following internal westward movement to bottom of the East China Sea. The integrated amount of FNPP1- ¹³⁷Cs that entered the SOJ until 2017 was estimated to be 0.27 ± 0.02 PBq, which consist 6.4 % of the estimated total amount of FNPP1-derived ¹³⁷Cs in the STMW. The ¹³⁷Cs inventory in 2011 in the surface seawater in the global ocean were 69 ± 15 PBq. In these, the ¹³⁷Cs originated from the global fallout was 28 ± 8 PBq (54 ± 16 PBq decay corrected to 1970). The ¹³⁷Cs inventory derived from the FNPP1 accident increased 16.5 ± 4.8 PBq

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and this value is in good agreement with previous studies.