

# Quantifying impacts of anthropogenic tritium releases at the Fukushima Daiichi Nuclear Power Plant in tritiated water cycle with numerical modeling

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This study utilizes atmospheric and ocean modeling of anthropogenic tritium ( $^3\text{H}$ ) releases at the Fukushima Daiichi Nuclear Power Plant (FDNPP) to quantify impacts on natural  $^3\text{H}$ , which is generated in the upper atmosphere by cosmic rays and enters water cycle as tritiated water (HTO). In 2011, the FDNPP accident contributed  $^3\text{H}$  radionuclide with a half-life of 12.32 years to the water cycle increasing  $^3\text{H}$  concentrations in coastal springs and wells and complicated  $^3\text{H}$ -tracer interpretation in Fukushima, Japan [1, 2]. From 2023, the Advanced Liquid Processing System (ALPS) treated HTO discharge begun at the FDNPP site focusing international attention on the HTO distribution in the Pacific Ocean under present and future climates. In monitoring activities,  $^3\text{H}$  concentrations have been measured in precipitation, groundwater, and many surface and coastal water sites across Fukushima Prefecture indicating natural  $^3\text{H}$  levels and leading to insignificant annual drinking water doses. Using simulated atmospheric  $^3\text{H}$  releases of the FDNPP accident with  $^3\text{H}$  measurements, we estimate groundwater transit times in terrestrial waters observing limited impact of anthropogenic HTO releases on  $^3\text{H}$ -tracer estimation in Fukushima. For the ALPS treated water, the ocean modeling of anthropogenic HTO releases allows us to quantify HTO concentrations due to the ALPS from present to future demonstrating that environmental  $^3\text{H}$  radioisotope remains a useful water cycle tracer.

[1] Cauquoin, A., et al.: Simulation of tritium releases into the atmosphere during the Fukushima accident and into the ocean due to planned discharge of treated water, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-7089, <https://doi.org/10.5194/egusphere-egu24-7089>, 2024

[2] Gusyev, M., et al.: Anthropogenic and natural tritium radioisotope in terrestrial water cycle of Fukushima, Japan, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-17332, <https://doi.org/10.5194/egusphere-egu24-17332>,