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Exploration of Anthropogenic Radiotracers in Oceanic Studies of Baltic Sea

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The Baltic Sea is a semi-enclosed marginal sea located in Northern Europe. The strong stratification structure and slow water renewal endow the Baltic Sea with multi-decadal retention of pollutants/nutrients, making it one of the world's most polluted seas. Therefore, understanding the Baltic Sea's hydrodynamics is crucial to mitigate the serious eutrophication, hypoxia expansion, and contamination.

In the present work, we exploited anthropogenic radionuclides (^{129}I, ^{236}U, and ^{99}Tc) released from the European nuclear reprocessing plants as oceanic tracers and pollutant proxies to resolve several scientific questions in terms of the hydrological and environmental processes of the Baltic Sea. A five-decade hindcast simulation (1971-2017) was performed to investigate the historical transport of radiotracers in the North Sea-Baltic Sea [1,2], and in-situ observation datasets (1983-2015) obtained from systematic sampling of seawater and seaweed were used for model validation [1–6].

Based on the spatiotemporal distribution of radiotracers, we: (1) deconstructed the water-mass compositions in the North Sea-Baltic Sea transition zone and Norwegian Coastal Current [7]; (2) depicted the transport pathway and timescale of saline water, as well as the accompanying pollutants/nutrients, in the interior Baltic Sea [8]; and (3) characterized the long-term environmental risks associated with the multi-decadal retention of pollutants/nutrients, i.e. so-called memory effect, in the Baltic Sea [2].

Our findings provided fundamental knowledge of the Baltic Sea's hydrodynamics and the associated impacts on the long-term pollutant/nutrient dynamics, facilitating the future management of the Baltic's ecosystems. Thanks to the point-source releases and accessible discharge histories, the reprocessing-derived radionuclides demonstrated their superior advantages in ocean model validation, and their successful practices in the Baltic Sea will promote a broader application in other ocean systems such as the subpolar North Atlantic and the Arctic.

[1] Lin, et al (2022). Water Res. 210, 117987.
[2] Lin, et al (2023). J. Hazard. Mater. 443, 130144.
[3] Lin, et al (2021). Environ. Sci. Technol. 55, 8918–8927.
[4] Qiao, et al (2021). Nat. Commun. 12, 823.
[5] Qiao, et al (2020). Chemosphere 244, 125595.
[6] Hou, et al (2000). Estuar. Coast. Shelf Sci. 51, 571–584.
[7] Lin, et al (2021). ENVRAD 2021.
[8] Lin, et al (2022). Goldschmidt 2022.