

Development of the compartment model POSEIDON-G for seamless cross-scale transport and food-chain transfer of radioactivity in the global ocean

Environmental Modeling & Assessment

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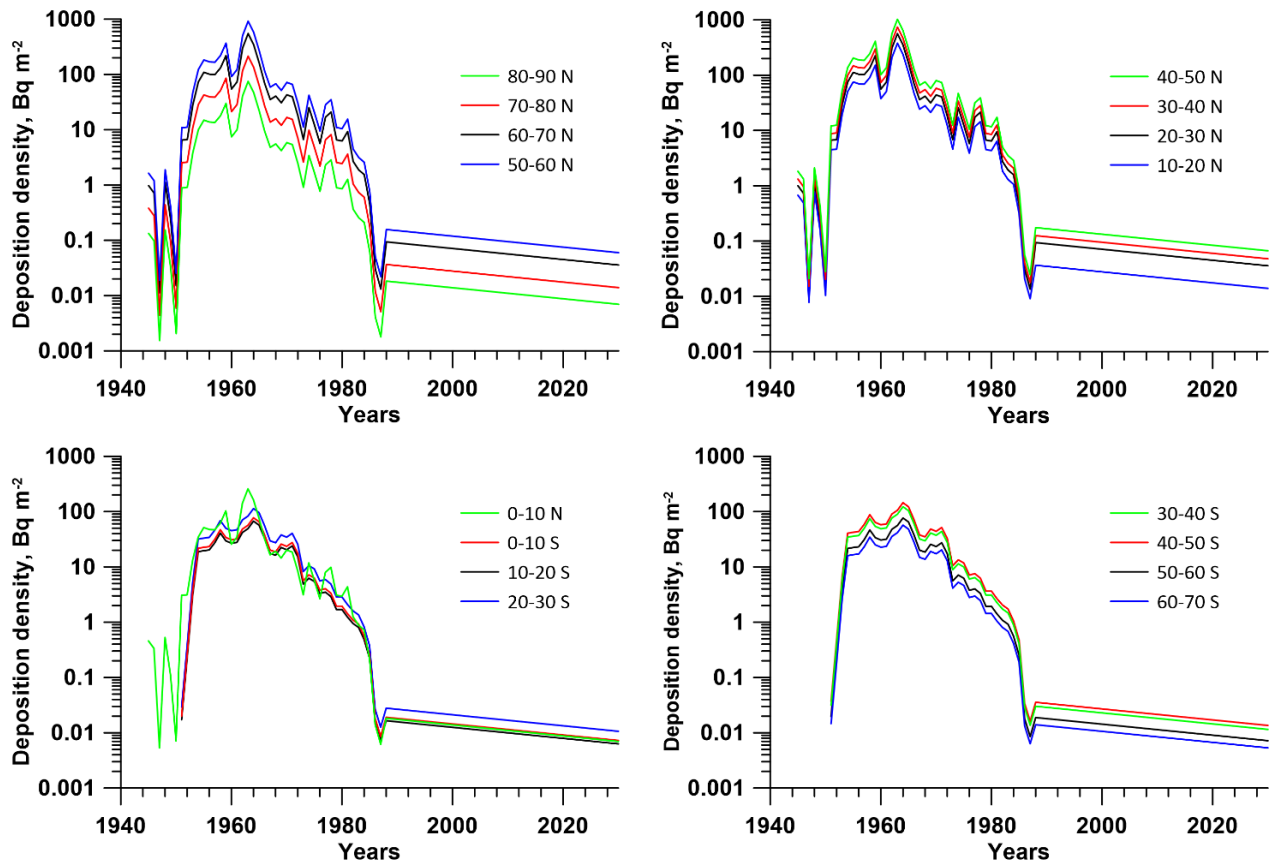


Fig. S2. Time variations of ^{137}Cs zonal deposition density of ^{137}Cs on the ocean surface due to global fallout (UNSCEAR, 2000).

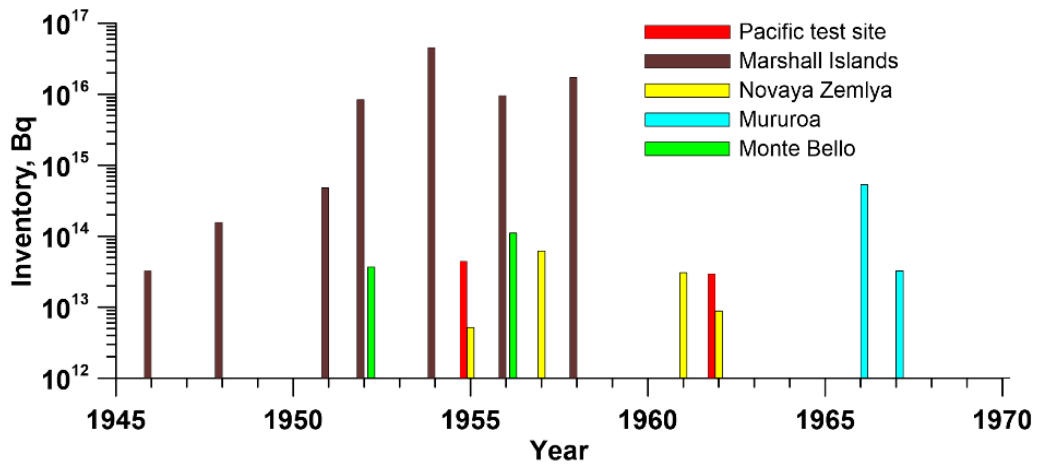


Fig. S3 Inventory of released ^{137}Cs from local sources due to the nuclear weapon tests (UNSCEAR, 2000).

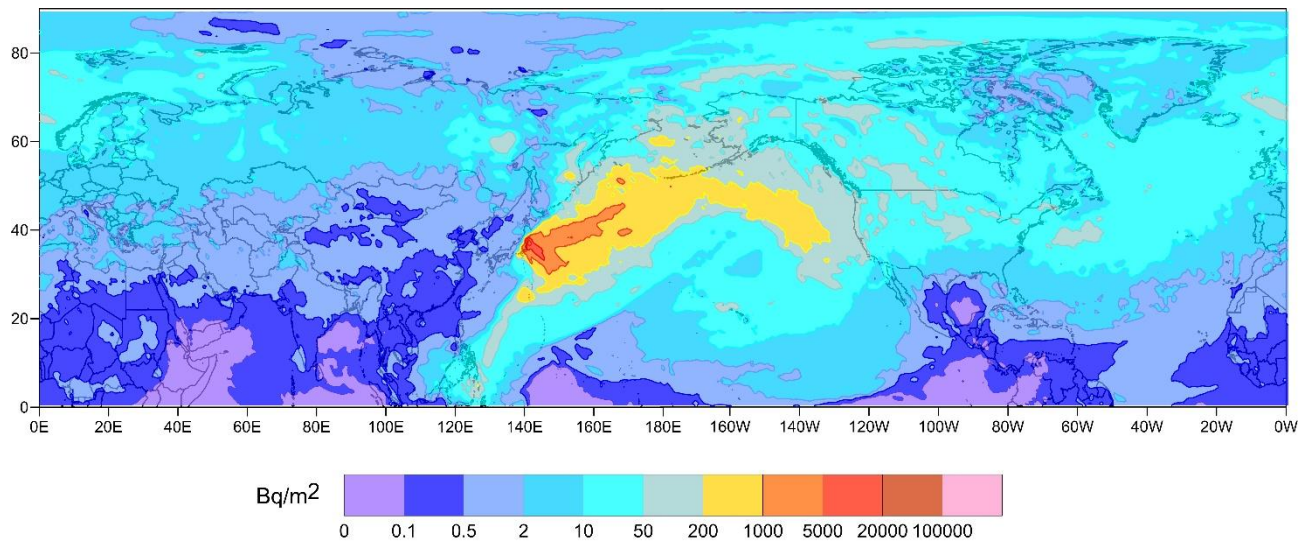


Fig. S4 Distribution of accumulated atmospheric deposition of ^{137}Cs as a result of the FDNPP accident according to the FLEXPART simulations.

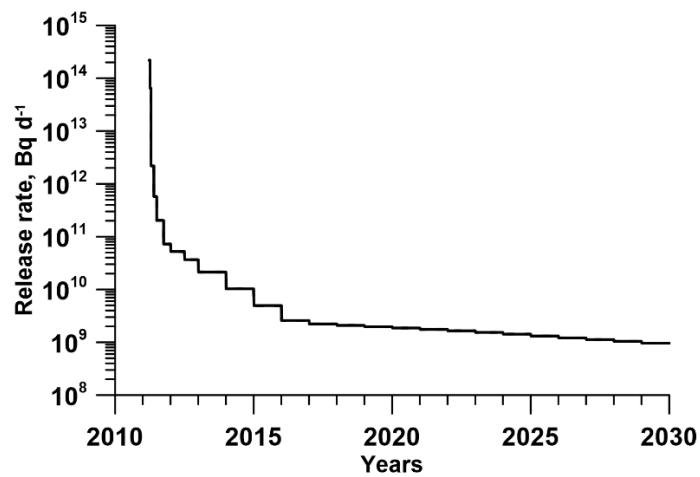


Fig. S5 Direct release rate ^{137}Cs from FDNPP as a result of the Fukushima accident (Tsumune et al., 2023)

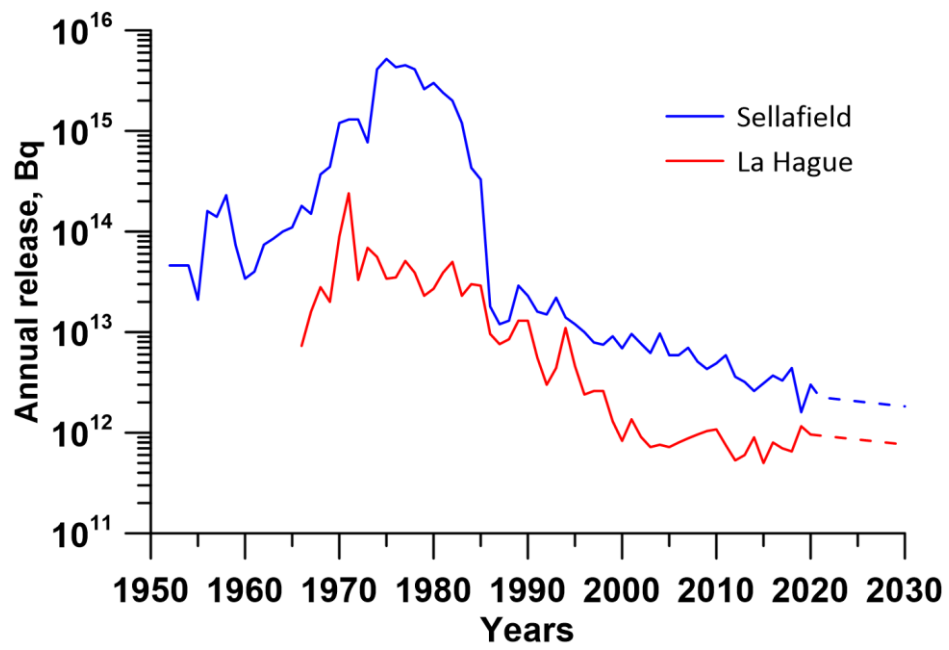


Fig. S6 Annual release rate of ^{137}Cs from Sellafield and La Hague reprocessing plants (OSPAR, 2020).

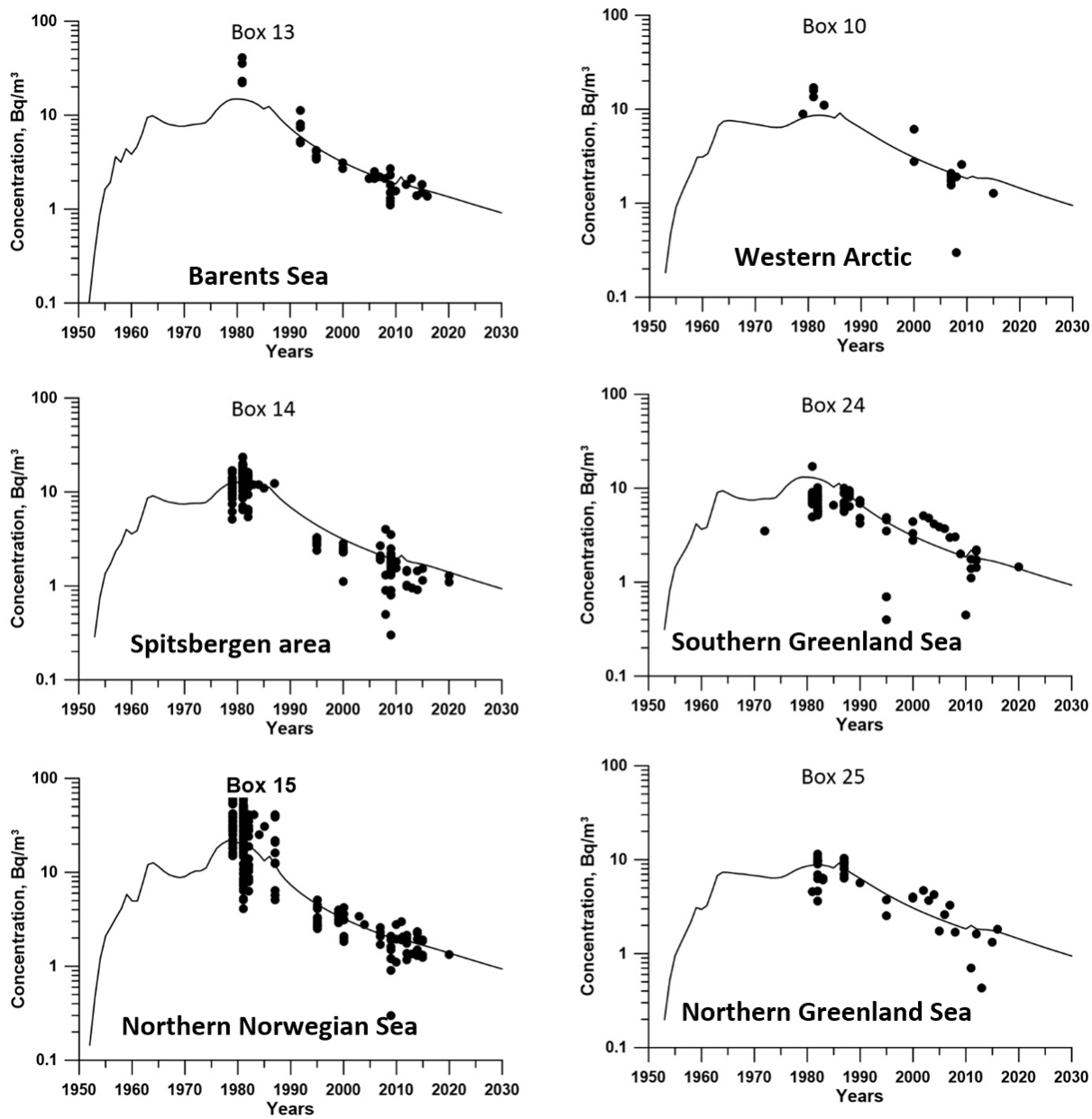


Fig. S7 Temporal change of dissolved concentration of ^{137}Cs across several global boxes in the Arctic Ocean.

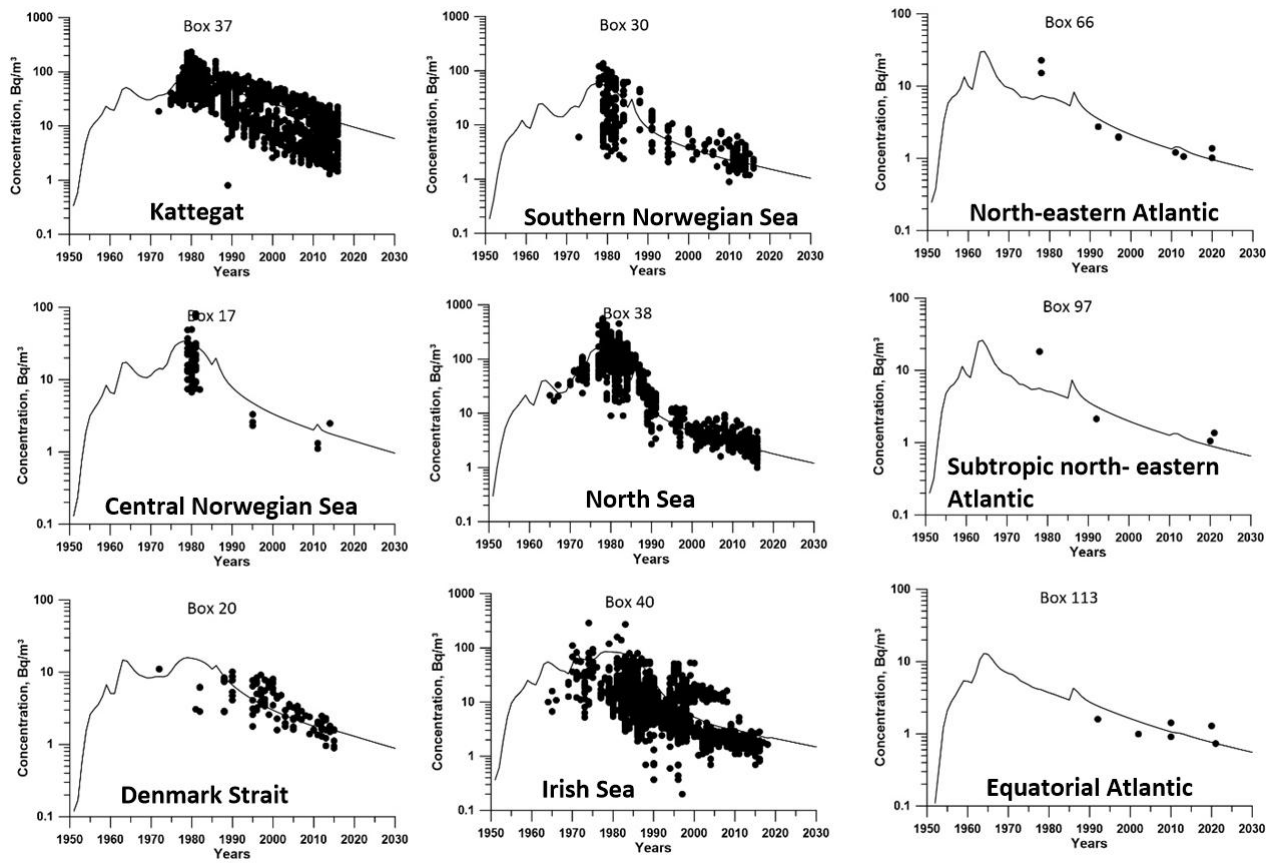


Fig. S8 Temporal change of dissolved concentration ^{137}Cs across several global boxes in the Atlantic Ocean

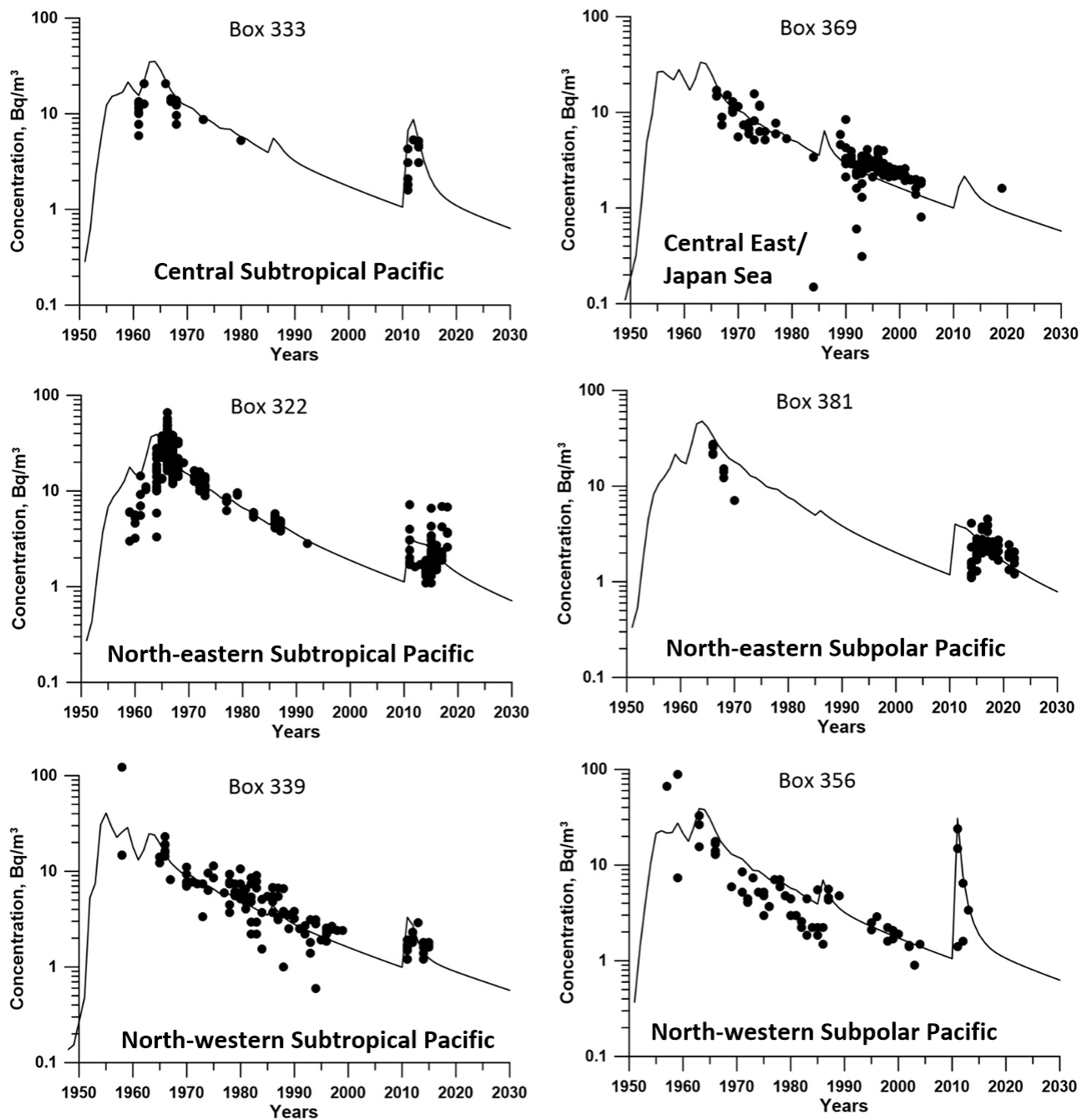


Fig. S9 Temporal change of dissolved concentration of ^{137}Cs across several global boxes in the Pacific Ocean

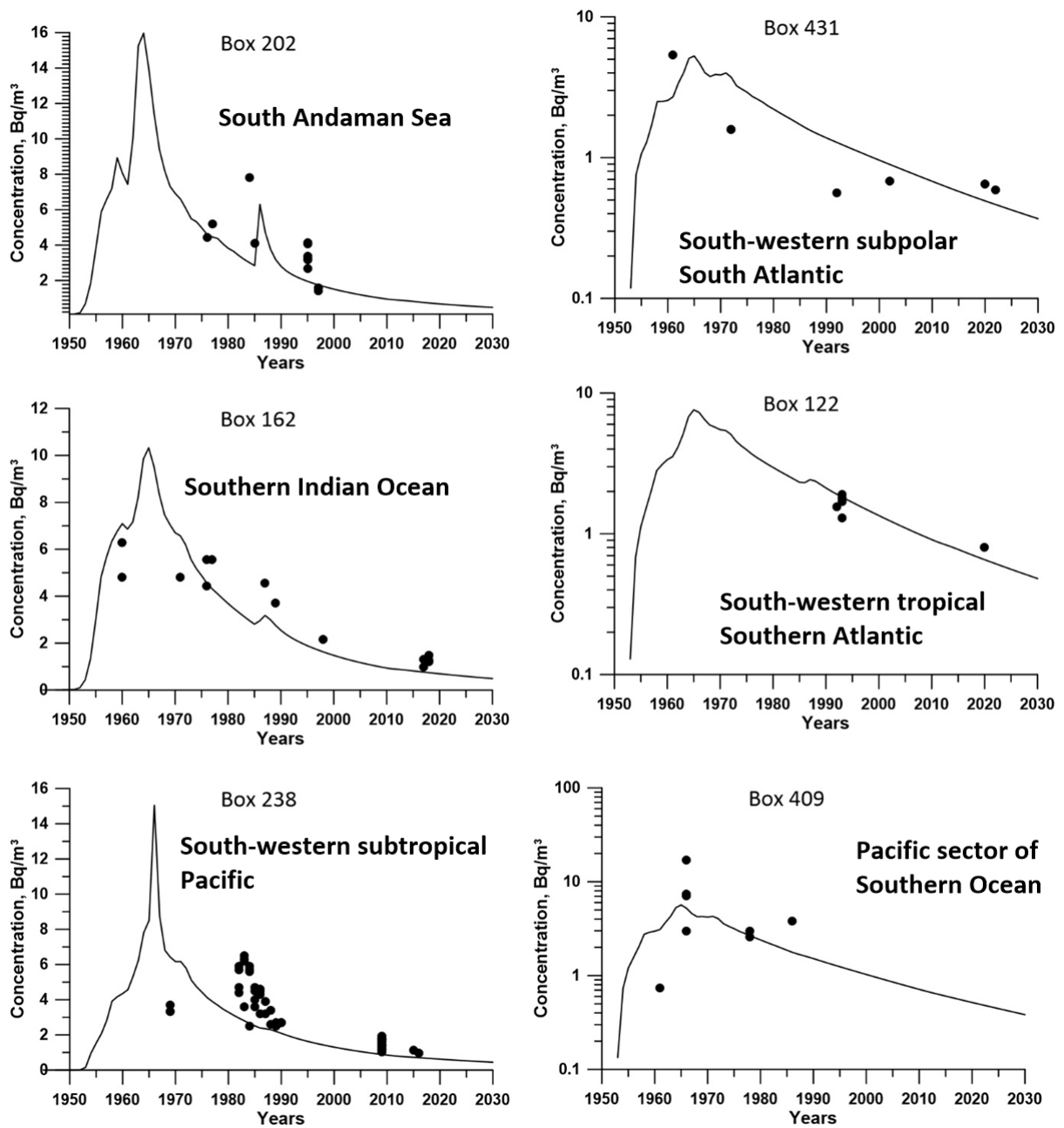


Fig. S10 Temporal change in dissolved concentration of ^{137}Cs across several global boxes in the Indian and Southern Oceans.

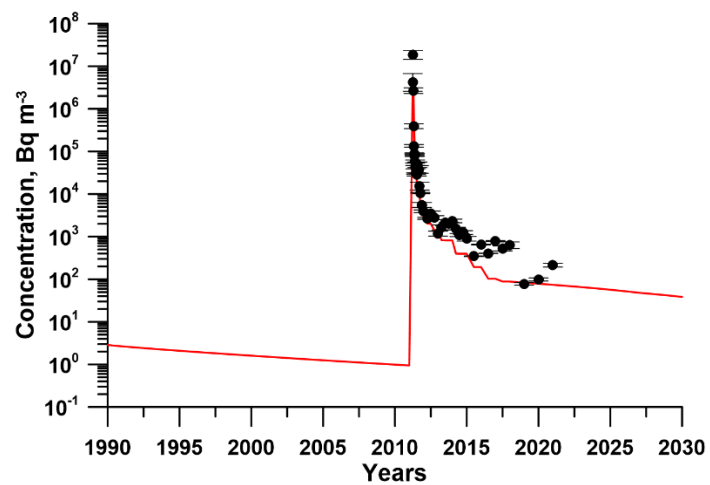


Fig. S11 Temporal change in dissolved concentration of ^{137}Cs in the coastal box.

Table S1. Computation times of the POSEIDON models for the Baltic Sea scenarios.

Type of the model	Rank of the complete/water-sediment matrix	POSEIDON-R	POSEIDON-G	Acceleration
Pelagic with the single-organ model	896/305	14 min	33 sec	26
Pelagic and benthic with the single-organ model	1288/305	46 min	34 sec	83
Pelagic with the multi-organ model	1288/305	39 min	35 sec	68
Pelagic and benthic with the multi-organ model *	2268/305	8 h 48 min	25 sec	1268

Table S2. Computation times of the POSEIDON models for the North-Western Pacific scenarios.

Type of the model	Rank of the complete/water-sediment matrix	POSEIDON-R	POSEIDON-G	Acceleration
Pelagic with the single-organ model	1680/621	6 h 14 min	10 min	37
Pelagic and benthic with the single-organ model	2384/621	32 h	10 min	192
Pelagic with the multi-organ model	2384/621	36 h	11 min	196
Pelagic and benthic with the multi-organ model *	4144/621	85.5 h	4.5 min	1140

* scenario with fewer time steps

Table S3. Regional sources of ^{137}Cs due to nuclear weapon tests (50% of the fission yield) considered in the POSEIDON-G model.

Box	Year	Yield, Mt	^{137}Cs , PBq	Site	Country
Box 238	1966	0.0625	0.1844	Fangataufa	France
	1966	0.1165	0.3437	Mururoa	France
	1967	0.011	0.03245	Mururoa	France
Box 159-160	1952	0.0125	0.0369	Monte Bello Islands, Australia	UK
	1956	0.0375	0.1106		
Box 309	1946	0.011	0.03245	Bikini	USA
	1948	0.053	0.15635	Enewetak	USA
	1951	0.1628	0.48026	Enewetak	USA
	1952	2.85	8.4075	Enewetak	USA
	1954	0.423	1.248	Enewetak	USA
	1954	14.987	44.212	Bikini	USA
	1956	0.37544	1.1075	Enewetak	USA
	1956	2.892	8.5314	Bikini	USA
	1958	3.4324	10.1256	Enewetak	USA
	1958	2.4271	7.1599	Bikini	USA
Box 323	1955	0.015	0.04425	North-eastern Pacific	USA
	1962	0.01	0.0295		USA
Box 13	1955	0.00175	0.00516	Novaya Zemlya	USSR
	1957	0.021	0.06195		USSR
	1961	0.0104	0.03068		USSR
	1962	0.003	0.00885		USSR

Table S4. Geometric mean (GM), geometric standard deviation (GSD) of simulated-to-observed ratios and the number of comparison pairs (*n*) of surface concentration of ¹³⁷Cs for different scenarios.

Scenario	GM	GSD	<i>n</i>
A 1957-2010	1.31	1.78	2014
B 1957-2010	1.14	1.86	2014
A 2011-2024	1.1	1.73	509
B 2011-2024	1.23	1.94	509

Table S5. Geometric mean (GM), geometric standard deviation (GSD) of simulated-to-observed ratios and the number of comparison pairs (*n*) of surface concentration of ¹³⁷Cs for the regional system of boxes around the FDNPP in 1990-2024.

Marine environment	GM	GSD	<i>n</i>
Water	1.174753	3.090287	649
Sediment	0.98505	2.011466	210
NPF	1.032618	4.988935	134
BPF	0.873897	2.228983	193

Measurement data used in the comparison with modelling

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