Electronic Supplementary Material

Radionuclide Transport and Uptake in Coastal Aquatic Ecosystems – a Comparison of a 3D Dynamic Model and a Compartment Model

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BOX S1: PARTITION COEFFICIENTS (K_d)

In safety assessment of nuclear facilities, solid/liquid partition coefficients (K_d) have been widely used to describe the sorption and retention of radionuclides (Sibley and Myttenere, 1986). In this paper, the K-model uses a single K_d value for total suspended particulate matter (PM), whereas the D-model uses separate K_d values for organic carbon ($K_{d\ C}$) and inorganic matter such as clay ($K_{d\ in}$).

In the **K-model,** K_d is defined as the ratio between the element concentration in suspended particulate matter C_p and the concentration in water C_w, i.e.,

$$K_d = C_p / C_w$$

and is expressed as (Bq kg dw^{-1}) per (Bq m^{-3}), i.e., m^3 kg dw^{-1} where dw is dry weight. The partition coefficient for particulate organic carbon (POC), $K_{d\ POC}$ ((Bq g_C^{-1}) per (Bq m^{-3})) is the product of the K_d (m^3 kg dw^{-1}) and a conversion factor which is the ratio of the mass (kg dw) of suspended particulate matter to its carbon content (g): 0.006 (kg dw g_C^{-1}). The K_ds used in the K-model are site-specific (Nordén et al. 2010) as shown in Table S1.

The **D-model** uses separate coefficients for organic carbon ($K_{d\ C}$) and inorganic material ($K_{d\ in}$). $K_{d\ C}$ and $K_{d\ in}$ were estimated from literature values of relations between element concentrations in 'muddy' sediments and their organic carbon content, where the intercept (zero organic carbon) is used to estimate $K_{d\ in}$ and the slope is used to estimate $K_{d\ C}$. Being dynamic, the D-model resolves adsorption-desorption processes explicitly in each model cell, taking account of summed surface areas for inorganic and organic matter and imports and exports of radionuclides across grid cell boundaries, and uses K_d as an equilibrium representation of the ratio between adsorption rate and desorption rate. Modeled rates of adsorption and desorption of radionuclides are controlled at low concentrations using a Michaelis-Menten relation to fulfill Courant–Friedrichs–Lewy conditions (Erichsen et al. 2010).

Table S1 Model constants for partition coefficients (K_d) in model D and K. Note that units differ between the two models. The K-model follows the carbon cycle estimated as dry weight, whereas the D-model follows the carbon cycle estimated as both C and inorganic concentrations

Radionuclide	**D-model**		**K-model**
	$K_{d\ C}$ m^3 kg C^{-1}	**$K_{d\ in}$** m^3 kg dw^{-1}	**K_d** m^3 kg dw^{-1}
Cs-135	20	0.13	19
Ni-59	2.1	0.015	14
Th-230	417	1.67	740

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