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90Sr dispersion and fate in the Northwestern Pacific and adjacent seas: global fallout and the Fukushima Dai-ichi accident

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The 3D compartment model POSEIDON-R (Maderich et al., 2013) was applied to the Northwestern Pacific and adjacent seas to simulate the transport and fate of 90Sr in the period 1945-2010 and to perform a radiological assessment on the releases of 90Sr after the Fukushima Dai-ichi (FDNPP) accident (2011-2040). The model predicts the dispersion of radioactivity in the water column and in marine sediments, and the transfer of radionuclides throughout the marine food web, and the subsequent doses to the population due to the consumption of marine products. The contamination due to runoff of 90Sr from terrestrial surfaces was taken in account using generic predictive model (Smith et al., 2004). A dynamical food-chain model is used instead of the biological concentration factor (BCF) approach. The radionuclide uptake model for fish has as a central feature the accumulation of radionuclides in the target tissue (bones for 90Sr). The model was compared with observation data on 90Sr for the period 1955-2010 and the budget of its activity was estimated. It was found that in the East China Sea and Yellow Sea the riverine influx was 1.5% of ocean influx only with local importance. Calculated concentrations of 90Sr in water, bottom sediments and marine organisms in the coastal box around the FDNPP before and after the accident are in agreement with measurements from the Japanese databases (TEPCO, MEXT) and publications (Casacuberta et al., 2013; Oikawa et al., 2013). The dynamical food web model predicts that due to the delay of the transfer throughout the food web and specific accumulation of 90Sr, the concentration for piscivorous fishes return to background level only in 2015. For the year 2011, the calculated individual dose rate for Fukushima Prefecture (except FDNPP vicinity) due to consumption of fishery products is an order less than the maximal dose rate caused by nuclear weapon testing in 1960.