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DISPERSION OF RADIONUCLIDES POTENTIALLY RELEASED FROM THE ATOLLS OF MURUROA AND FANGATAUFA TO NEIGHBORING ARCHIPELAGOS

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In the framework of IAEA's Study of the Radiological Situation at the Atolls of Mururoa and Fangataufa [1], a special interest was devoted to the assessment of present and potential radiological doses to human populations in the South Pacific, particularly those inhabiting the nearest islands. Since seafood constitutes an important fraction of the islanders diet [2], the marine dispersion from the atolls and the transfer of radionuclides through the marine food-chain to man has been the object of a number of studies and publications [2, 3, 4].

This paper presents a compartmental model developed to simulate dispersion of radionuclides released to the ocean from the atolls of Mururoa and Fangataufa on a scale of 3000 x 1700 km (15° to 30° S latitude, 130° to 160° W longitude), including the Tuamotu, Cook, Society, Gambier and Austral archipelagos. The horizontal resolution of the model is finer (0.5° x 0.5°) in the region of the atolls and to the nearest inhabited island (Tureia) and coarser (5° x 5°) beyond a range of 200 km from the atolls. The vertical structure is based on the analysis of flow-fields generated by the numerical model of the Pacific and Indian Oceans of Masumoto and Yamagata [5], and includes 3 water layers. Monthly values of the exchanges of water between the compartments are evaluated by spatially integrating flows obtained on the basis of monthly snap-shots of velocity fields predicted by the Masumoto and Yamagata model. The model also includes sediment-water interaction. The finer short-range model resolution permits to better simulate dispersion in the vicinity of the atolls, where steeper concentration gradients can be expected, and also to differentiate between the two atolls as sources. In the intermediate range, seasonality has been shown to have important effects, therefore

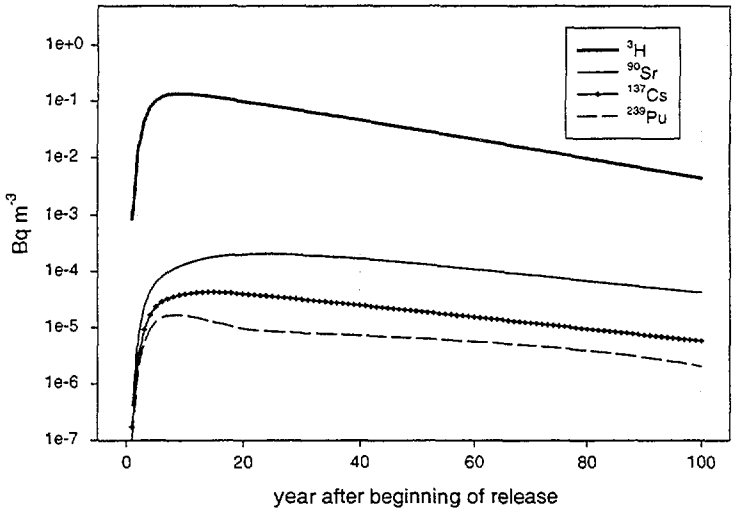

FIG 1. Annual mean concentrations of radionuclides averaged over the top 450 m layer of water at Tahiti. The release of radionuclides from the Atolls of Mururoa and Fangataufa takes place according to the normal release scenario given in [1] for a 100 y time-scale.

the model has been designed to reproduce monthly flow patterns by sequentially employing 12 sets of exchange coefficients, each of them characterizing circulation patterns and volume flows for a given month.

Simulations were performed for dispersion of ^{3}H, ^{90}Sr and ^{137}Cs on a time-scale of 100 years and for ^{239}Pu over 10,000 years. The release-rate functions considered were those corresponding to the source terms calculated by the Working Group 4 of the IAEA Study [1] for various scenarios. Predictions of time-dependent radionuclide concentrations were obtained for a number of 88 water compartments and 20 sediment compartments. Model predictions for concentrations of ^{3}H, ^{90}Sr, ^{137}Cs and ^{239}Pu in seawater at Tahiti are illustrated in Fig.1 for the normal release scenario in [1], which assumes the release to start in 1980. For the same scenario, the evolution of predicted ^{239}Pu concentrations over the longer time-scale at several locations in the South Pacific is shown in Fig.2. Maximum concentrations predicted are below present–day background levels measured in the region [1, 2]. Resulting individual dose-rates from consumption of seafood, calculated on the basis of generic values of the concentration factors [6] are negligibly small as compared to those from natural ^{210}Po.

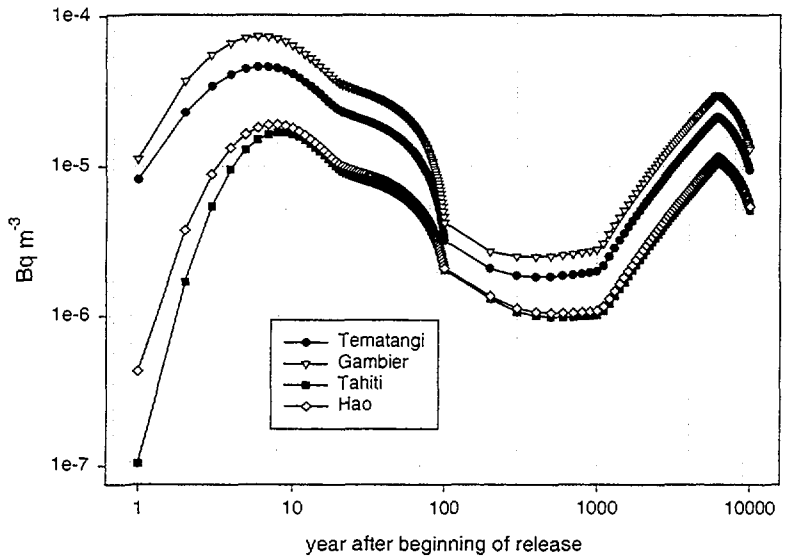

FIG 2. Annual mean concentrations of ^{239}Pu averaged over the top 450 m layer of water at various inhabited locations in the South Pacific for the long-term normal release scenario given in [1].

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