Development of a regional sediment transport model for dispersal of land-derived radionuclides in the ocean

Takafumi YAMANISHI[1#+], Yusuke UCHIYAMA[1], Daisuke TSUMUNE[2], Yasumasa MIYAZAWA[3]

[1]*Kobe University, Japan*, [2]*Central Research Institute of Electric Power Industry, Japan*, [3]*Japan Agency for Marine-Earth Science and Technology, Japan*

[#]*Corresponding author: 37ct57@gmail.com* [+]*Presenter*

Several oceanic dispersal modeling have been conducted by multiple institutions on dissolved radionuclides leaked at the Fukushima Dai-ichi Nuclear Power Plant (FNPP). These models nominally consider scenarios where the direct release of nuclides from FNPP and atmospheric deposition as the secondary source. In the present study, we view freshwater discharge from the rivers as a missing piece for the inventory of the nuclides in the ocean. The land-derived input introduces a time lag behind the direct release through hydrological process because these radionuclides mostly attach to suspended particles (sediments) that are transported quite differently to the dissolved matter in the ocean. Therefore, we develop a sediment transport model consisting of a multi-class non-cohesive sediment transport model, a wave-enhanced bed boundary layer model and a stratigraphy model proposed by Blaas *et al*. (2007) incorporated into ROMS. A 128 x 256 km domain with the grid resolution of dx = 250 m centered at FNPP is configured as a test bed within the existing dx = 1 km domain (Uchiyama *et al*., 2012, 2013). Three classes of sediments, viz., fine sand, silt and clay fractions, are considered here. The bed skin stress is evaluated by a combined wave-current stress model of Soulsby (1995) with the wave field computed with a SWAN spectral wave model at dx = 1 km embedded in the JMA GVP-CWM wave reanalysis.

The model results show that sediment of each size-class is suspended and widespread within approximately 5 km offshore during calm conditions. An episodic strong southward flow occurs throughout the domain during a storm, attributed to increased sediment concentrations in the wide area. We found that in the particular area about 15 – 25 km off FNPP where the clay fraction is predominant over slit and fine sand, bottom stress never develops even with strong near-bed currents.

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