Geophysical Research Abstracts
Vol. 18, EGU2016-2417, 2016
EGU General Assembly 2016

Towards a unified modeling system of predicting the transport of radionuclides in coastal sea regions

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We present in this talk a recent progress in developing a unified modeling system of predicting three-dimensional transport of radionuclides coupled with multiple-scale circulation, wave and suspended sediment modules, keeping in mind the application to coastal sea regions with non-uniform distribution of suspended and bed sediments of both cohesive and non-cohesive types. The model calculates the concentration fields of dissolved and particulate radionuclides in bottom sediment as well as in water column. The transfer of radioactivity between the water column and the pore water in the upper layer of the bottom sediment is governed by diffusion processes. The phase change between dissolved and particulate radionuclides is written in terms of absorption/desorption rates and distribution coefficients. The dependence of distribution coefficients is inversely proportional to the sediment particle size. The hydrodynamic numerical model SELFE that solves equations for the multiple-scale circulation, the wave action and sand transport on the unstructured grids has been used as a base model. We have extended the non-cohesive sediment module of SELFE to the form applicable to mixture of cohesive and non-cohesive sedimentary regimes by implementing an extended form of erosional rate and a flocculation model for the determination of settling velocity of cohesive flocs. Issues related to the calibration of the sediment transport model in the Yellow Sea are described. The radionuclide transport model with one-step transfer kinetics and single bed layer has been initially developed and then applied to Fukushima Daiichi nuclear accident. The model has been in this study verified through the comparison with measurements of 137Cs concentration in bed sediments. Preliminary application to the Yellow and East China Seas with a hypothetical release scenario are described. On-going development of the radionuclide transport model using two-step transfer kinetics and multiple bed layers are briefly described.