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Comparison of 3-Dimentional Ocean Circulation Model with Observation Data for Liquid Radioactive Effluent

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1. Introduction

Recently, three-dimensional models have been used for aquatic dispersion of radioactive effluents in relation to nuclear power plant sitting based on the Notice No. 2003-12 “Guideline for investigating and assessing hydrological and aquatic characteristics of nuclear facility site” of the Ministry of Science and Technology (MOST) in Korea. Therefore, KEPRI (Korean Electric Power Research Institute) and KHNP (Korea Hydro & Nuclear Power Co., LTD) have been developed a three-dimensional aquatic dispersion model for radioactive effluents released from nuclear power plants located at east coast of Korea.

In this study, A three dimensional hydrodynamic modeling has been performed for wide circulation of the East Sea of Korea, which is based on the RIAMOM (Research Institute of Applied Mechanics’ Ocean Model, Kyushu University, Japan).

2. Methods and Results

2.1 Model Domain and Grid

The RIAMOM model assumes hydrostatic balance with Boussinesq approximation, and solves the three-dimensional, non-linear, primitive external and internal model equations on Arakawa-B system [1, 2].

The model domain and basic grid configuration taken in this study are identical from those of Kim [3]. The model area covers the sea region from 126.5^{o}E to 142.5^{o}E in longitude and from 33.0^{o}N to 52.0^{o}N in latitude. The inflow regions of the model are Jeju Strait and the west coast of Kyushu and the outflow regions are Tsugaru Strait and Soya Strait. Both of the latitudinal and longitudinal grid intervals are chosen as 1/12^o. The number of vertical layers is a total 20 variable levels and the depth field has been extracted from the ETOPO5 global depth data [4]. The model area is divided to 8 sectors to use parallel computing method.

2.2 Model Condition

In this model, the vertical eddy viscosity and diffusivity coefficients are 1.0 cm^2/sec and 0.1cm^2/sec, respectively. The Horizontal eddy viscosity and diffusivity coefficients are set to values about six orders higher than the vertical counterparts. The eddy viscosity values are same as those used by Kim [3].

At the inflow region, we have specified seasonally varying volume transport of the Tsushima Warm Current(TWC) that has been prepared on the basis of regular(six time a week) monitoring of the flow variation across the Korea/Tsushima Strait from February, 1997 to August, 2002 using an ADCP mounted on a ferry [5]. The average volume transport of the TWC is 2.65 S_v(1 S_v=106 m^3/sec) and 1.54 S_v in east channel , 1.11 S_v in west channel of The TWC with strong seasonal variability. The variation of the observed volume transport shows two maximum in March to June and other maximum in September to November. The minimum of the volume transport occurs around the middle of February, reaching about 1.5 S_v~2.0 S_v.

Along with the volume transports, temperature and salinity are imposed at the inflow boundary based on the monthly mean observations by the Fisheries Research and Development Agency of Korea [5]. The near-surface temperature reaches a maximum in August and a minimum in March showing a variation of about 12.6^{o}C, while the near-bottom temperature reaches a maximum near November and a minimum in March showing a variation of about 4^{o}C to 4.5^{o}C. The near-surface salinity reaches a maximum in March and a minimum in
August showing a variation of about 2.8 psu to 3.0 psu, while the near-bottom salinity reaches a maximum in March and a minimum in October or November

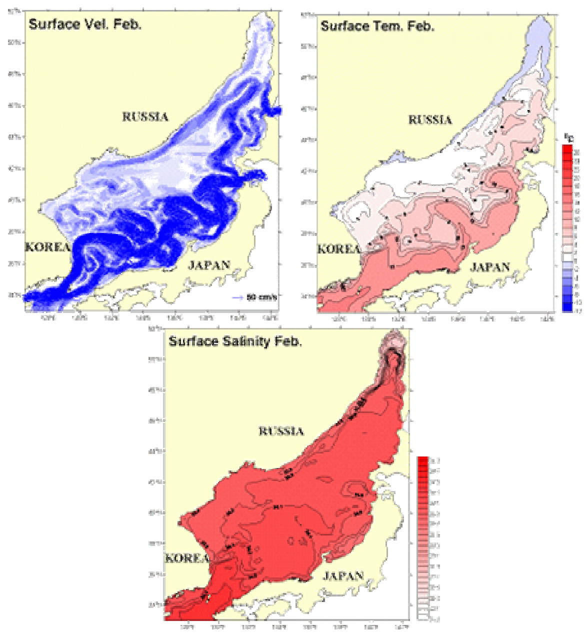

Figure.1. Result of Wide Ocean Circulation Modeling (Winter, February)

showing a variation of about 0.1 psu to 0.25 psu. Based on the observations, monthly mean values over a year are prepared in advance and are repeatedly used for the multi-year integration.

The internal component of velocity consistent with the inflow boundaries is calculated from the prescribed temperature and salinity distribution along the boundaries based on the assumption of the thermal wind relation. No gradient condition has been applied at the outflow boundary. The velocity component tangential to the open boundaries is set at zero. The no-slip, insulating, and impermeable boundary conditions are applied along the lateral land boundaries

2.3 Model Results

The model result was extracted from last 1 year result through the time integration of 6 years in steady state. The distribution of temperature, surface velocity and salinity from this wide ocean numerical model has shown as illustrated in Fig. 1. The Result of this circulation model was similar with former research result. To compare model data and observation data quantitatively, the date from near grid of NPP was compared with yearly cumulative data of the Fisheries Research and Development Agency of Korea as shown in Fig 2. and Fig 3. This model result had shown acceptable data within the range of observation data.

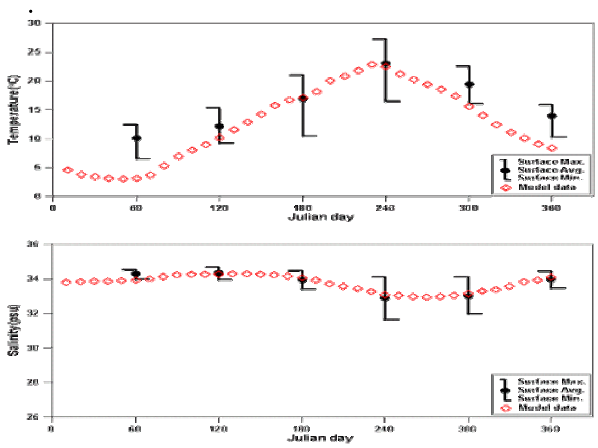

Figure.2. Comparison results of Wide Ocean Circulation Modeling and of the Fisheries Research and Development Agency of Korea (Ulchin Site).

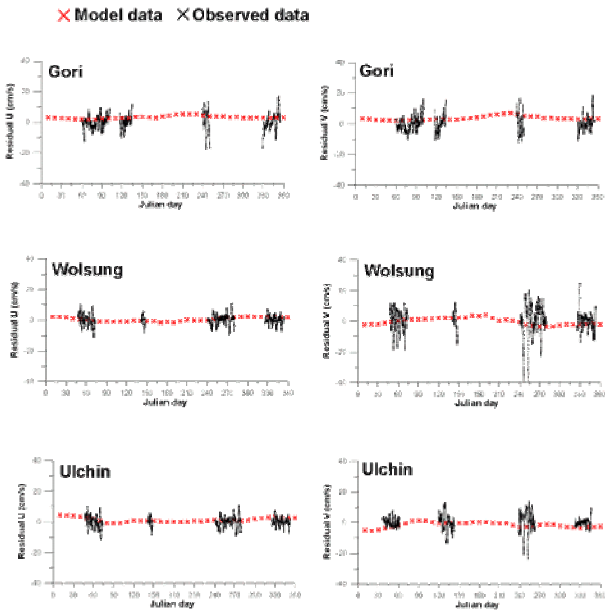

Figure.3. Comparison model results of Wide Ocean Circulation Modeling and observation in surface velocity

3. Conclusion

This Wide Ocean Circulation Model based on the RIAMOM results agrees with ocean observation data from the Fisheries Research and Development Agency of Korea and simulate seasonal variation well. As a result, this research could find this model has secured the site suitability and confidence.

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