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# Data Assimilation and upstream open boundary Bias Correction in a regional model for the East Sea

Jae-Sung Choi[1], Kyungman Kwon[2], Byoung-Ju Choi[1]
[1]Department of Oceanography, Chonnam National University, Gwangju, Republic of Korea
[2]Tropical & Subtropical Research Center, Korea Institute of Ocean Science and Technology, Jeju, Republic of Korea
(e-mail: bchoi@jnu.ac.kr)

Boundary conditions are important constraints on the interior solution when solving partial differential equations. Global ocean prediction models, such as Hybrid Coordinate Ocean Model (HYCOM) and Mercator International Ocean Model, have been used to provide boundary conditions for regional ocean models. However, in the Korea Strait, the simulated salinity by HYCOM was lower than the in-situ observation data in winter and higher in summer. The simulated temperature from HYCOM also has biases compared to the observation. These boundary biases can create critical bias in the interior of nested regional models, particularly in the downstream region where the biased information is propagating. To reduce prediction errors in the interior of the nested regional model domain, the boundary bias correction and the data assimilation were applied for the East Sea circulation model using temperature and salinity profile data observed in 2019. The effects of boundary bias correction and data assimilation were quantified from four numerical experiments: free run without BC and DA (Exp.FR) and simulations with BC (Exp.BC), with DA (Exp.DA), and with both BC and DA (Exp.BCDA). The root mean square errors (RMSEs) of temperature from Exp. FR, Exp.BC, Exp.DA, and Exp.BCDA were 1.59, 1.55, 0.88, and 0.92°C at a depth of 10 m in 2019, respectively. The RMSEs of salinity from the four experiments were 0.36, 0.30, 0.33, and 0.27, respectively. Exp.DA and Exp.BCDA reduced temperature errors by 44% and 42%, respectively. Meanwhile, Exp.BC and Exp.BCDA reduced salinity errors by 17% and 26%, respectively. Data assimilation improved the temperature distribution in the northwestern Ulleung Basin during winter, while boundary bias correction lowered the salinity in the Korea Strait and Ulleung Basin during the summer of 2019. Therefore, data assimilation and boundary bias correction have potential to improve the interior solution of temperature and salinity in other regional ocean models.