

Impact of Estuarine Dams on the Estuarine Parameter Space and Sediment Flux Decomposition: Idealized Numerical Modeling Study

Steven M. Figueroa*, Guan-hong Lee**, Jongwi Chang***, Kenneth D. Lagamayo****, Nathalie W. Jung*****, Minwoo Son*****

.....

Abstract

Estuarine dams are constructed for securing freshwater resources, flood control, and improving upstream navigability. However, their impact on estuarine currents, stratification, and sediment fluxes is not well understood. To develop a general understanding, an idealized modeling study was carried out. Tide and river forcing were varied to produce strongly stratified, partially mixed, periodically stratified, and well-mixed estuaries. Each model ran for one year. Next, the models were subject to the construction of an estuarine dam and run for another year. Then, the pre- and post-dam conditions were compared. Results showed that estuarine dams can amplify the tidal range and reduce the tidal currents. The post-dam estuaries tended to be a salt wedge during freshwater discharge and a bay during no freshwater discharge. For all estuaries, the estuarine turbidity maximum moved seaward, and the suspended sediment concentrations tended to decrease. In terms of sediment flux mechanisms, the estuarine dam increased the seaward river runoff for cases with strong river, and increased the landward tidal pumping for cases with strong tides.

Keywords : Estuarine processes, Numerical modeling, Human impact, Sediment transport

Acknowledgment

This research was supported by Basic Science Research Program (2017R1D1A1B05033162) and Center for Anthropocene Studies (2018R1A5A7025409) through the National Research Foundation of Korea (NRF). This work was also supported by the Ministry of Oceans and Fisheries, Korea under the project titled “Establishment of the Ocean Research Station in the Jurisdiction Zone and Convergence Research”. Presentation of this research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2021R1I1A3060354).

* Member · Postdoctoral Researcher, Dept. of Civil Eng., Chungnam National University

· E-mail : stevenmiguelfigueroa@gmail.com

** Professor, Dept. of Oceanography, Inha University

*** Graduate Student, Dept. of Oceanography, Inha University

**** Graduate Student, Dept. of Oceanography, Inha University

***** Ph.D., Dept. of Oceanography, Inha University

***** Member · Associate Professor, Dept. of Civil Eng., Chungnam National University