Flushing Time for Multiple Segments in an Estuary

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To examine the effects of tide and river discharge on estuarine flushing twenty-four longitudinal salinity transects were obtained during spring and neap tides in the Sumjin River Estuary, Korea from August 2004 to April 2007. The freshwater fraction method was used to calculate the flushing time in multiple estuarine segments. The integrated transport time scale of the freshwater fraction method showed only the effects of freshwater input on estuarine flushing, but did not show the influence of tide. However, the spatially varying time scale identified the effects of tide, river discharge and stratification on estuarine flushing. Flushing time was close to the semidiurnal (M_2) tidal period during spring tide, but twice of that during neap tide near the mouth. A negative linear function related estuarine flushing to tide near the mouth, whereas a power law function related estuarine flushing to freshwater inflow near the head. Comparison between linear and power regression analyses implied that the freshwater fraction method does include flushing not only by freshwater input but also by tide. Strong stratification induced by freshwater input and small tidal amplitude had a dominant control on reducing estuarine flushing in the central and upper regime of the estuary during neap tide.

These results suggested the use of spatially varying local time scales, instead of the integrated transport time scale, to investigate the effects of tide, river discharge and stratification on spatially varying estuarine flushing. The spatially varying local time scale sheds light in the understanding of hydrodynamic processes that transport water and its constituents such as living biomass, suspended particles, masses of nutrients and contaminants.