Investigation of spatial and temporal salinity distribution in river deltas through idealized numerical modelling

Constantinos Matsoukis1, Laurent Amoudry2, Lucy Bricheno2, and Nicoletta Leonardi1

1University of Liverpool, Geography and Planning, United Kingdom of Great Britain and Northern Ireland (c.matsoukis@liv.ac.uk)
2National Oceanography Centre, Joseph Proudman Building, 6 Brownlow Street, Liverpool, Merseyside, L3 5DA, UK

The world’s river deltas are increasingly vulnerable due to pressures from human activities and environmental change. In deltaic regions, the distribution of salinity controls the resourcing of freshwater for agriculture, aquaculture and human consumption; it also regulates the functioning of critical natural habitats. Despite numerous insightful studies, there are still significant uncertainties on the spatio-temporal patterns of salinity across deltaic systems. In particular, there is a need for a better understanding of the salinity distribution across deltas’ channels and for simple predictive relationship linking salinity to deltas’ characteristics and environmental conditions. We address this gap through idealized three-dimensional modelling of typical delta configurations (river, tide dominated etc.) and by investigating the relationship between salinity, river discharge and channels’ bifurcation order. Model results are then compared with data from real delta cases. Results demonstrate the existence of simple one-dimensional and analytical relationships describing the salinity field in a delta. Salinity and river discharge are exponentially and negatively correlated. There is a correlation between salinity and channels bifurcation order and salinity increases linearly with decreasing stream order. These useful parametrizations of salinity distribution following deltas’ features and geometry might be applied to real case scenarios to support the investigation of deltas vulnerability to environmental change and the management of deltaic ecosystems.

Keywords: salinity, salt intrusion, river deltas, numerical modelling, idealized river delta models