Three-dimensional, finite-element, baroclinic model of the Congo River plume

V. Vallaeys[1], Y. Le Bars[1], E. Deleersnijder[1,2,3], E. Hanert [3]

[1]Université catholique de Louvain, Institute of Mechanics, Materials, and Civil Engineering (IMMC), Belgium

[2]Delft University of Technology, Delft Institute of Applied Mathematics (DIAM), The Netherlands

[3]Université catholique de Louvain, Earth and Life Institute (ELI), Belgium

The Congo River is the second largest river in the world in terms of mean discharge. The main feature of this river is the presence of a deep canyon starting in the estuary and cutting through the shelf to directly connect the river with the deep ocean. The hydrodynamics in this region are strongly affected by the river, and its plume spreads far into the Atlantic Ocean.

Preliminary work has been carried out to set up the 2D external mode and validate it with satellite measurements. This was done by using SLIM2D, a depth-averaged shallow water model. We are now in a position to go further in the modelling by adding the 3D component of SLIM. SLIM3D is a baroclinic discontinuous Galerkin finite element model. It has so far only been used to model very shallow areas, such as an idealised domain or subregions of the Great Barrier Reef. Applying it to the Congo River plume is challenging, as the bathymetry alternates between very shallow and very deep regions, and the domain includes a large oceanic area and the estuary, in which the tides have a crucial influence on the hydrodynamics.

This talk will focus on the latest developments in SLIM3D and its application to the Congo River ROFI. The z vertical coordinates system has been improved and the staircase created by the mismatch of vertical levels at adjacent nodes has been eliminated with a shaved-cell approach using the concept of degenerate prisms. Global model outputs are used to generate suitable open boundary conditions in order to create a large-scale circulation through the domain. The key features of the simulated plume will be discussed.