ScaldisCoast: An unstructured next generation integrated model for the Belgian Coastal Zone

De Maerschalck Bart[1], Kolokythas Gerasimos[1], Wang Li[1,2], Fonias Efstratos[1,2] and Breugem Alexander[2]

[1] Vlaamse overheid, Waterbouwkundig Laboratorium (MOW-WL), Berchemlei 115, 2140 Antwerpen (Borgerhout), Belgium
E-mail: bart.demaerschalck@mow.vlaanderen.be
[2] International Marine & Dredging Consultants, Van Immerseelstraat 66, 2018 Antwerpen, Belgium

Historically, coastal modelling tools often relied on finite difference and finite volume based numerical methods on structured grids, e.g. Delft3D, XBeach, SWAN, etc. From a numerical point of view, these methods are robust, reliable and relatively fast. However, they lack the flexibility of applying locally high resolution in the area of interest, or to model complex geometries in an efficient way. In general, building the grid is time consuming and once a schematization is build, any adaptation of the grid requires serious effort, which makes it more difficult to implement complex shaped scenario analyses.

The last decades more advanced numerical schemes find their way into the world of environmental modelling in general and hydrodynamic modelling in particular. These schemes allow for unstructured triangular and quadrilateral based schematizations. TELEMAC-MASCARET is such an open source finite element based model suit. In the present study, we use the TELEMAC2D module to develop an unstructured hydrodynamic coastal model for the Belgian Coast and Western Scheldt, referred as the ScaldisCoast (ScaldisKust) model.

For the construction of the grid an advanced grid generator, GMSH, developed by the Université Catholic de Louvain-La-Neuve has been used (Geuzaine & Remacle, 2009). GMSH allows for automatic refinement near complex geometrical structures like ports and breakwaters, but also based on the bathymetry gradients, leading to higher resolution near steep slopes of the bottom. It also allows for an efficient accurate representation of sand banks and gullies. The resulting grid consists of a broad range of element sizes going from kilometres offshore to a few meters nearshore. GMSH automatically optimizes the grid for orthogonality and aspect ratios. For complex shaped scenarios, GMSH is capable of automatically adapting the model to the new local geometry or bathymetry.

On the same model domain and grid, a TOMAWAC model for wave propagation is developed. Recently the two models have been coupled. However, since the wave model and the hydrodynamic model require different grid properties, it is under investigation if the models can be coupled without sharing identical grids, allow for more efficient computing.

Finally, the TELEMAC2D – TOMAWAC models are coupled to the sediment transport model SISYPHE in order to model sediment transport and bottom evolution along the Belgian Coast. Since the TELEMAC-MASCARET model suit is open source, this allows us to implement new transport models, e.g. those derived by the CREST research program, into the software.

Keywords: Coastal Modelling; Unstructured grids; Belgian Coast