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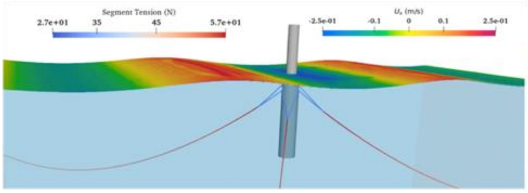

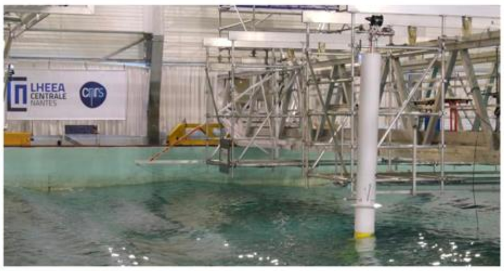

DATA ASSIMILATION TO OPTIMISE COASTAL HYDRODYNAMIC MODEL PARAMETERS

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Abstract

In this first case study of English Channel, model calibration of bottom friction is performed by assimilating time-series of tidal water levels. Data assimilation is used to identify the best bottom friction parameterization, through the study of the error indicator (error between model predictions and measurements). Further, we compare different sediment maps (different classifications of sediment) to find the sediment map that gives the minimum error.

I – Introduction

Hydrodynamic models are often calibrated using bottom friction parameters. The simplest way of calibrating a model using bottom friction is considering constant (single) bottom friction over the entire study domain. However, this method does not take into account the spatial heterogeneity of the sediment types. For instance, the spatial distribution of sediments in the English Channel (EC) is highly heterogeneous. Hence, the bottom friction should vary spatially according to the types of sediment. This increases the number of variables that need to be calibrated. In this study, we test and compare different sediment maps (obtained by grouping sediments in different ways). Each sediment map is tested with the model to find the one which minimizes the error. Data assimilation [1] is used to optimize model calibration for a given sediment map.

II – Methodology

A Telemac2D [2] model (shallow water equations) is calibrated in this study. Bathymetry is from SHOM. The model is forced with water elevation as the boundary condition from Previmer database. The model simulations are for 40 days with a time step of 60 seconds. The cell size of the mesh varies from 1 km to 5 km. We use tidal gauge data for calibrating the model. The tidal gauge data along the French coast are sourced from the SHOM (French navy) and along the English coast from the British Oceanographic Data Centre (BODC).

III – Results

As a first test, we created a synthetic dataset (time-series of water elevations) with a Telemac2D model in which the sediment map was arbitrarily divided into three different zones of roughness. Then, we used the ADAO [3] software to assimilate the synthetic time-series of water elevation and to retrieve the (forgotten) reference values of bottom friction. As shown in Figure 1, after ten iterations of the 3D-var algorithm, the ADAO software permitted to retrieve the three (forgotten) roughness values. This indicates that, in this simple case (sediment map containing three different zones of roughness), this algorithm succeeds in calibrating bottom friction by assimilating time-series of water levels.

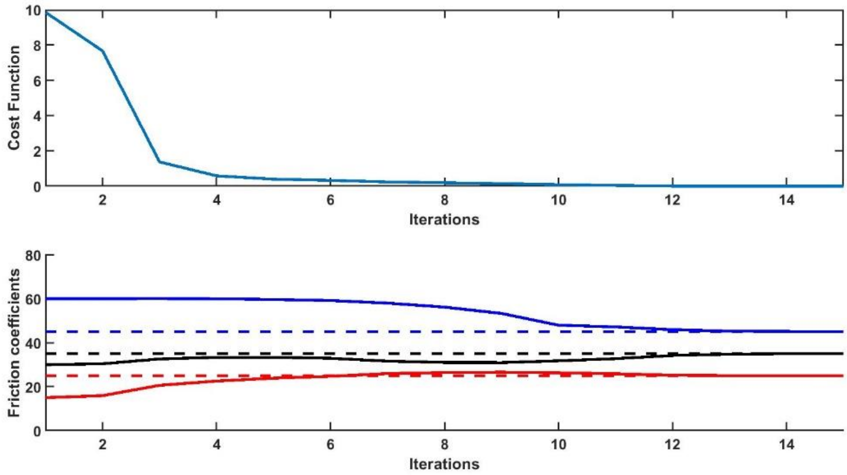

Fig 1. Graph (upper) shows the cost function as a function of the iterations. Graph (lower) shows the convergence of the bottom friction values (continuous lines) to the reference values over the iterations (dashed lines).

IV – Conclusions et perspectives

The ADAO software gives good results when assimilating synthetic dataset created from a model with a simple sediment map. In further works, different (realistic) sediment maps obtained from the SHOM will be given to the model to find which sediment classification gives the model performance. Tidal gauges data will be assimilated to minimize the model error for a given sediment map. This will be achieved with the ADAO software.

Références

[1] Goeury, C., Ponçot, A., Argaud, J. P., Zaoui, F., Ata, R., & Audouin, Y. (2017, October). Optimal calibration of TELEMAC-2D models based on a data assimilation algorithm. In 24th Telemac-Mascaret User Conference, Graz, Austria (pp. 73-80).

[2] Hervouet, J.-M. Hydrodynamics of Free Surface Flows, Modelling with the Finite-Element Method; John Wiley & Sons Ltd.: West Sussex, UK, 2020; 340p.

[3] ADAO, a module for Data Assimilation and Optimization, http://www.salome-platform.org/