Title: **Numerical Modelling of Pollutant Transport in Stratified Coastal Water using Finite Volume Method and Unstructured Mesh.**

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Abstract

In this master thesis the prediction of pollutant transport phenomena in coastal water bodies with stratification presence is analysed. The numerical model is focused in the use of Unstructured Mesh for the domain discretization and Finite Volume Method (FVM) for the numerical approach in the transport equations. So, the main purpose is the evaluation of the suitability of theses numerical tools to implement models for the transport phenomena prediction. The structure of the work is six chapters:

The first one the physical problem is explained. First the characteristics of the coastal water bodies and concepts related as stratification and baroclinic circulations are defined. Then the different salinity structures are described. As well a dimensionless numbers and estuarine or lagoon parameters are set up. Finally the pollutant dispersion is described introducing different kind of pollutants.

In the second chapter the equations of the phenomena are introduced. First of all the transport equation is formulated starting from the Transport theorem of Reynolds. The advection and diffusion is introduced in turbulent conditions and some simple cases are displayed and solved when is possible to find analytical solution for the phenomena. In this part of the chapter is concluded assuming the necessity to solve the hydrodynamic problem as a previous step to solve the transport problem. So in the second part are defined the hydrodynamic equations taking in account the tidal period, the wind, Coriolis, bed resistance and the turbulence model suitable to consider baroclinic effects. Finally a several utilities of the transport problem are described such as mud transport or water quality models.

In the third chapter is described and analysed the numerical solution used. Is emphasized the use of unstructured mesh and finite volume method. About the unstructured mesh their proprieties and advantages are described. In the finite volume method the scheme for the explicit method is formulated in 3D. In this scheme the stability analysed is done in function of the Curant number. Then a basic comparison between the Finite Element Method and Finite Volume Method is done according the stability and the computational time. After the characteristics of the numerical model of the hydrodynamic model is described. Finally the validation, calibration and verification process are defined.

The numerical model used, MIKE 3FM, is explained in the fourth chapter. This model is developed by DHI (Denmark Hydraulic Institute) and it will be commercial software to solve the hydrodynamic equations taking in account the density gradients and using Unstructured Mesh and Finite Volume.

The fifth chapter the software is applied in a real case. This case is a lagoon in Morocco. For the study, first of all a basis scenarios are defined to evaluate the sensitivity of the forces in the system comparing the salinity structures. After that, study scenarios are found obtaining the conclusions about the hydrodynamic behaviour. Once solved the hydrodynamic model, is set up the transport model using a generic pollutant discharge evaluating its propagation in time.

In the sixth chapter the conclusions are explained focussed in the suitability of Unstructured Mesh and Finite Volume Method for the prediction of these kinds of problems. Finally a discussion and lines of investigation are propounded in improve the applicability, accuracy a computational time of the method.