Universität Stuttgart

WAREM
Water Resources Engineering and Management

akkreditiert durch ASIIN
im Auftrag des Akkreditierungsrats (KMK / HRK)

Universität Stuttgart · WAREM · Pfaffenwaldring 7a · 70569 Stuttgart

Pfaffenwaldring 7
70569 Stuttgart
Telefon: (0711) 685 - 66615 / 66616
Telefax: (0711) 685 – 66600
warem@iws.uni-stuttgart.de
http://www.warem.uni-stuttgart.de/

Anne Weiss M.A., M.Sc.
(Durchwahl: - 66616)

Master Thesis Abstract

of Nerea Karmele Portillo De Arbeloa

Assessing the transferability of a 2D hydraulic model into a 3D hydraulic model on the example of the "Kleine Kinzig" reservoir

The first step in making any hydraulic model is constructing the appropriate discretization of the study area that allows the solving of the model equations. This discretization is called the meshing process, and it is done using bathymetry data of the area. This mesh building process is a time-consuming task that more often than not requires a re-adaptation and edition. Programs like Hydro_As-2D allows 2D simulation of both structured and unstructured grids, and because it is easily coupled with SMS Aquaveo V 11.1, allows an easy re-adaption of the grid cells, however, the model is not designed to perform 3D simulations. Therefore, available software like SSIIM 1 and SSIIM 2 become an option; they solve 3D models using the Computer Fluid Dynamics (CFD) approach. The problems arise in the mesh editing and adaption. SSIIM counts with a user interface that allows the creation of a grid, but it has limitations regarding its edition compared to other programs. The question of whether a transfer between the 2D grid created for Hydro_As-2D into SSIIM 2 is possible arises.

The primary objective of this Master's Thesis was to assess the transferability of a two-dimensional hydraulic model into a three-dimensional hydraulic model of the example of the Kleine Kinzig Reservoir, by the use of SMS Aquaveo V 11.1 as a pre-processor, Hydro_As-2D for the 2D model simulation and SSIIM for 3D model simulation. Additionally, a plausibility check of the models by simulating under different scenarios for the 2D and 3D cases where the proper boundary conditions for the simulation were chosen. Then, a step-by-step guide to the method for transfer was elaborated and can be used for any given model, and finally, a comparison between the 2D and 3D model results was made.

The results of this study indicate that the transfer between the 2D and 3D model is possible. The method is recommended once the structured grid is already built, nevertheless, the construction of a structured grid itself is an arduous task for complex geometries like the example here presented. Regarding the model results, the velocities magnitude ranges were low as expected for reservoirs and the differences observed between the 2D and the 3D model are a consequence of the approach used to obtain the solution of the Navier-Stokes equations.