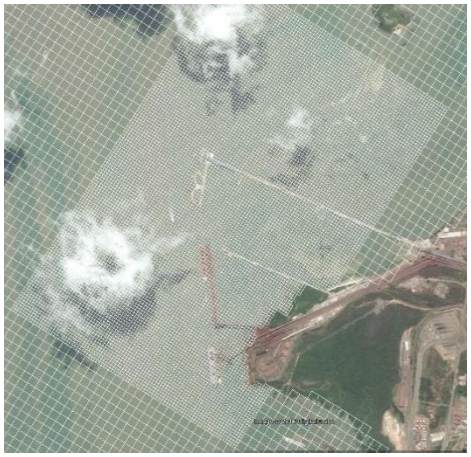
GRACE Science School

Hydrodynamic modeling with Delft3D

Date & Time:	July 6-8 and July 11, 2022 (Wed-Fri and Mon) 13:00 – 19:00 CEST
Place:	Building 50.31, Room 322, Gotthard-Franz-Str. 3
Online:	Participants from UFPR and ABRHidro can join this hybrid course via MS Teams
Lecturer:	Prof. Dr. Tobias Bleninger (UFPR, Curitiba)
Credits:	3



This course is offered as joint international course, hosted by GRACE in cooperation with PPGERHA (Graduate Program on Water Resources and Environmental Engineering), PPGEA (Graduate Program of Environmental Engineering) from the Federal University of Paraná (UFPR), Curitiba, Brazil, and also promoted by the Brazilian Association for Water Resources (ABRHidro).

Context and Background

Hydrodynamic modeling is an essential method to study scenarios for hydro-environmental problems, such as pollutant or cooling water discharges, sediment transport, lake eutrophication, river training, etc. Delft3D is a world leading 3D modeling suite to investigate hydrodynamics, sediment transport and morphology and water quality for fluvial, estuarine and coastal environments. Since 2011, the Delft3D flow (FLOW), morphology (MOR) and waves (WAVE) modules are available in open source. The hydrodynamic module Delft3D-FLOW is a multidimensional hydrodynamic simulation program that calculates non-steady flow and transport phenomena resulting from tidal and meteorological forcing. The primary purpose of the computational model Delft3D-FLOW is to solve various two- and three-dimensional, time-dependent, non-linear partial differential equations related to hydrostatic free-surface flow problems. The equations are formulated in orthogonal curvilinear coordinates on a plane or in spherical coordinates on the globe. The hydrodynamic module is based on the shallow water equations. The equations are solved with a robust and highly accurate solution procedure.

Some supported features are:

- Propagation of long waves (barotropic flow)
- Density gradients due to a non-uniform temperature and salinity concentration distribution (density driven flows)
- Transport of dissolved material and pollutants
- Transport of sediments, including erosion, sedimentation and bed load transport
- Many options for boundary conditions, such as water level, velocity and discharge boundaries
- Simulation of drying and flooding of inter-tidal flats
- Turbulence modeling to account for the vertical turbulent viscosity and diffusivity

Topics

Review of governing equations of fluid mechanics for environmental systems. Revision of numerical methods and stability, as well as data

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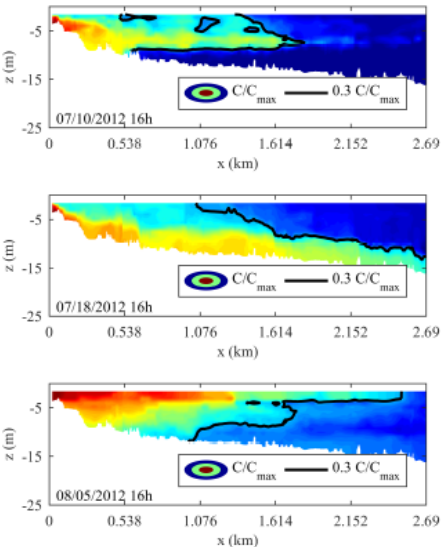

handling. Introduction into grid generation. Introduction on bathymetry interpolation. Modeling hydrodynamics and density effects. Postprocessing. Revision of governing processes of sediment transport and water quality modeling. Introduction to Wave Modeling. Applications for coastal waters, rivers and lakes.

Objectives

Create the ability to plan, setup and execute 2D and 3D hydrodynamic simulations with Delft3D, and using post-processing features.

Course format

The course will be offered as hybrid course. Participants from Karlsruhe are highly encouraged to attend in presence. Participants from UFPR and ABRHidro can join remotely as online course. Technical requirements are thus listed as follows:

- Internet connection
- Up to date PC or notebook with Windows Operational System (the course only provides compiled software executables for Windows)
- Webcam and headphone for videoconferencing (for online participants)

The course will be offered within the platform Microsoft Teams, where files will be provided and shared and chats, conferencing and scheduling will be handled. For details on the schedule and further preparation for this course, please follow the link to the course website.

Recommended pre-requisites

Participants should have a background on fluid mechanics, hydraulics and mathematics.

Certificate

Full-time participation to obtain *certificate of participation* (usually for GRACE students)

or

Full-time participation and one graded group work (mixed international group) to obtain *certificate with grades* (usually required for UFPR students). Group work will be for a specific flow simulation project (data provided by course or own data can be used too). The work should be summarized as report, including the following items:

- Site description and context
- Available data and boundary conditions
- Model description and setup
- Model simulations for at least 2 scenarios (e.g. high and low resolution grid with different boundary conditions or forcings)
- Post-processing (figures, graphs, animations, comparison of scenarios)
- Being summarized in a project report

About the lecturer

Tobias Bleninger is Professor (2011) for Environmental Fluid Mechanics and Applied Mathematics at the Department of Environmental Engineering of the Federal University of Paraná (UFPR) in Curitiba, Brazil. He is a Civil Engineer (2000) from the Karlsruhe Institute of Technology (KIT), Germany, where he did his

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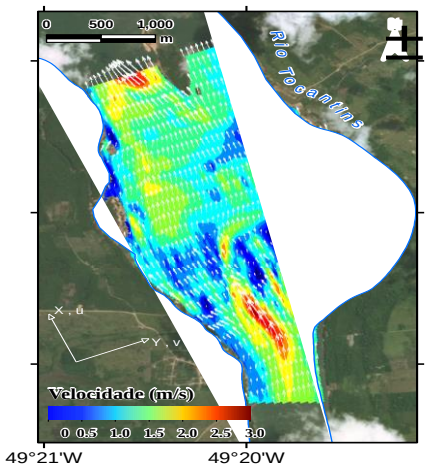

Doctor in Environmental Fluid Mechanics (2006) and lead the research group of Environmental Fluid Mechanics of the Institute for Hydromechanics (2007-2011). Tobias Bleninger has experience in Hydraulics and Fluid Mechanics with focus on physical and numerical modeling of Mixing and Transport Processes of Environmental Fluid Systems. A special topic are mixing studies for submarine outfalls using and coupling the models CORMIX and Delft3D, as well as considering transport phenomena in hydropower reservoirs, waterway fluvial hydraulics, and coastal sediment transport projects.

Contact and further information: Tobias Bleninger at UFPR

References

More information on Delft3D: http://oss.deltares.nl/web/delft3d/home
For more references and additional information check the course website.

Registration

1. All: Please register for this course via the online form.
2. UFPR students: Please register within the SIGA system in addition.
3. ABRHidro: The course is offered only for post-graduate students who are active in ABRHidro commissions or affiliated student members. Limited number of participants. Please pre-register sending an e-mail with your CV and post-graduate matricula to bleninger@ufpr.br.
4. Please register also for the free Open-Source License at: https://oss.deltares.nl/web/delft3d/source-code before the course (further instructions on installation will be provided throughout the course).

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