



Free Surface Flow Modelling with Open Source Software



3 + 1 Day Intensive User Training

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Karlsruhe, Germany

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Motivation: The numerical modelling of free surface flows undergoes major changes. Almost every university or major company developed their own source code until only few years ago. But since few years, more and more companies join forces and change their software licenses to open source.

One motivation is the fact that it was always necessary to provide source code instead of binaries. Unlike to widespread office software, numerical analysis software almost always deals with non standard cases. Therefore, a universal software package can neither be developed nor could a high number of features be paid by only one developing organisation. As most users extend the code to their own needs anyway, through the Open Source Model everybody can benefit from each others developments. This results in a dramatic increase of features.

A second very important motivation to use Open Source is the need for transparency and acceptance to convince both, clients and critics. Every other engineer can check the correctness of the included formulas.

However, due to the mass of features, it is hard to keep track, and even harder to find the right access point if you start from the scratch with Linux setups, pre- & post processing tools, software versions, mathematical methods or the search for suitable hardware. The theories of hydraulic modelling are taught at universities, but an engineer's work provides many additional hurdles that have to be taken economically.

Therefore the main goal of our courses is to show you the easiest possible access to a full tool chain of market leading applications like **TELEMAC Suite - PARAVIEW - QGIS - Blue Kenue - MPICH - TorquePBS - GNUFortran and CODE::BLOCKS**. Avoid beginner's mistakes, week long trial & error and don't waste too much time configuring Linux. After the 3 day course, you will handle all core disciplines and know the ways to head on auto-didactically.

We learn in 3 steps: [Explanation](#) -> [Demonstration](#) -> [Application, on your own PC!](#)

Day 1: First Steps in the Telemac Universe

Not all beginnings are difficult if you know where to look for. We analyse the program structures and interfaces. Your first own models will be started from scratch, calculated and analysed in detail by the end of this day.

- Features, Possibilities & Limits
 - Flow in 2D and 3D
 - Sediments, wind & waves
- Structure of the Telemac Suite
 - Don't fear the command line!
 - Files & modules
 - Common mistakes
- Demonstration: basic examples
 - Analyse datasets with Paraview and an editor
 - Start and monitor calculations
 - Change your configuration
- Exercise A-I: Hands on the software!
 - Get used to console and scripts
 - Change values and configuration
 - Make mistakes and learn to understand them!

Lunch break

- Configurations
 - Overview on 600+ options! Do I have to understand them all?
 - Which turbulence model, advection scheme, et cetera is the right one? (1 min)
 - Troubleshooting
- Demonstration: Pre & post processing
 - PARAVIEW, BlueKenue, QGIS, BaseMesh, OpenOffice etc.
 - Understand the LOG-files
- Exercise A-II: Build your own model
 - Meshing
 - Configure and calculate
 - Check results with QGIS & Paraview & log-files

Day 2: Speed up with parallel computing

To consolidate your new knowledge, we repeat Day 1 tasks, but in higher complexity. Now you will realize: computer power can't be replaced by anything then more computer power. For most practical applications a state of the art office computer with 4 cores or more is good enough. But on demand you can connect your colleagues' office computers to a cluster within minutes just by booting them up from the live disk. For even more performance you just rent as much as you need from a cloud service provider by hour and control it from your desktop.

- How parallel processing works
 - Domain decomposition of a large project in many small projects
 - Distribution over several computers and connection via MPI
- Demonstration: Understand desktop, workstation und cluster layout
 - The right hardware for your purpose
 - Load balancing
- Exercise B-I: Parallel computing
 - Divide and combine projects: Partel & Gretel
 - Run jobs in different configurations and benchmark it
 - Try fast, efficient, decentralised setups

Lunch break

- Resource efficiency: Queuing with TorquePBS
 - Queuing jobs
 - Priorities jobs overtake the queue
 - Distribute jobs to different computers
- Demonstration: Calculating online in the rented cloud
- Group Exercise B-II: Queues
 - We connect some our computers to a cluster.
 - We find the fastest combination of our computers with standard office network equipment.
 - The cluster MOM server distributes the jobs of a Monte Carlo sensitivity study between all available computers.

Day 3: Modify and extend your software

Special needs for special projects might need special modifications. Time dependent changes of the geometry, new empiric rules or unprecedented boundary conditions can be coded with only few lines. Don't fear to mess with the source code! Understand the architecture of the software and avoid the common errors with this introduction in the development. You don't have to be a programmer to change values. We start at a basic level. But for those who are familiar with FORTRAN we provide advanced exercises.

- The development environment CODE::BLOCKS
 - The preconfigured environment for Telemac.
 - Little helpers of the IDE
- Demonstration: Architecture of TELEMAC
 - Find the right variable
 - Working with the mesh (TIN)
 - Basic input & output
- Exercise C-I: Modify initial and boundary conditions
 - Write your own outputs
 - Roughness and topography modifications
 - Integrate volumes

Lunch break

- Demonstration: Integrate volumes in parallel computations
- Compiling
 - Find errors (Debug)
 - Optimize and find bottlenecks (Profiling)
- Tips, Tricks & Traps
 - Home made accuracy problems (Truncation error)
 - Calculating with mesh arithmetic
- Exercise C-II: Your own routine
 - Write your own plug-in
 - Working with the mesh
 - Working with the time loop

Day 4: Your preferred topics (Optional)

For those who want to practise more under supervision we offer the optional Day 4. The topics are chosen according to participant's wishes. In the past sessions we focused on mesh generation, sensitivities, uncertainties & professional calibration, post processing with Python, SciPy and Matplotlib and we designed action plans for real projects participants already have in mind.

Training Material

We provide a bootable 64GB SSD with a preinstalled and preconfigured [Live Ubuntu/Mint Linux](#). It includes an extensively tuned collection of programmes, with all manuals and examples plus docs. If you work during the training with this disk on your own laptop, we can be sure that all exercises work at home, without configuration marathons and messed up primary discs. Please understand that we do not sell software, as all software is free anyway under LGPL and GNU license.

More Information and Contact

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Dates & Cost

Please visit the website for current costs, as they depend on the detailed final agenda and the number of participants. The next English user training will be in June 2015, 22nd to 25th at the *Fasanenschlösschen in Karlsruhe, Germany*. Other dates and places can be organized on demand, even at your office. We limit the number of participants to 10, to guarantee individual support and teaching in dialogue form.