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The continuing story of the telemac hydro-informatics system

Hydrolink

FROM COMMERCIAL DISTRIBUTION TO AN OPEN SO
THE CONTINUING STORY OF THE TELEMAC HYDRO-

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Foreword

The beginning of this century saw the increasing development of software under the Open Source License. It was a real change of paradigm for sharing knowledge, radically different from the usual commercial approach. Why is the Open Source model attractive for a large company such as EDF?

First, it was a real opportunity for sharing feed-back on our codes and improving their validation. By encouraging use at the limit of the validation domain, it is also a way for extending the validation domain. The Open Source Community developing around our codes is also a good way for sharing development of new functionalities, attracting new ideas or coupling with other codes. Of course, the Open Source license is especially interesting for collaborations with academics but it is also attractive for industries wanting to master the development of specific models.

But Open Source is also relevant because we think that the solver by itself has and creates no value. It is the ecosystem around the solver which creates the value. Moreover Open Source codes welcome wide international collaboration and are especially attractive for young researchers. All these elements explain why the Open Source model is now the basis for developing and sharing scientific software at EDF R&D.

For downloading EDF Simulation software go to: http://research.edf.com/research-and-the-scientific-community/software/software-44329.html

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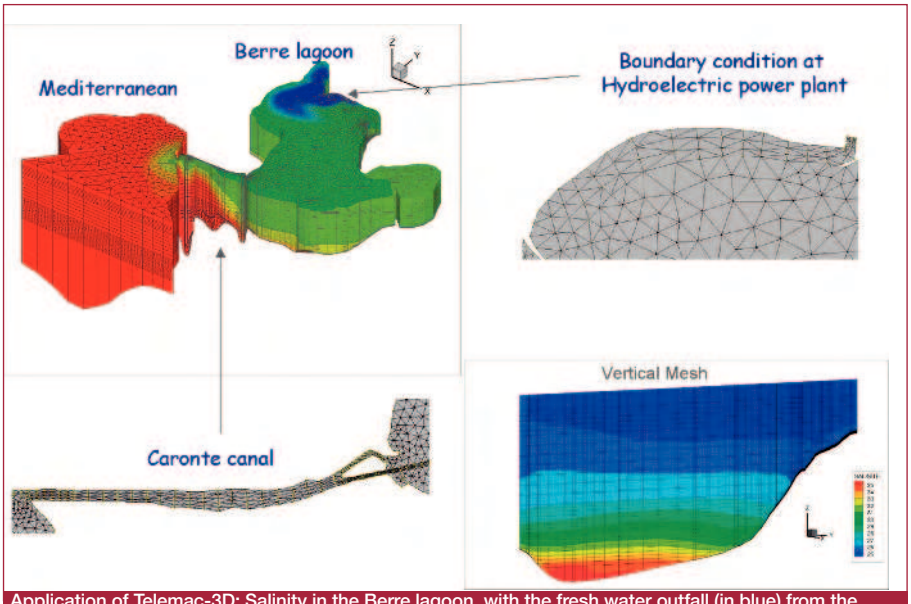
In the beginning, let's say in the seventies, an amazingly large number of computer programmes for hydraulics coexisted, generally used by an amazingly small number of people. The Electricité de France (EDF) R&D division of that time could boast 6 different programmes, and as many authors, just to solve the shallow water equations. Such programmes were rapidly built by a trainee, a PhD student or an engineer, they had a limited range of application and a limited lifespan. At the same time a famous folk artist began to sing: "The times they are a changin'", and things gradually became more complicated. Computational Fluid Dynamics and Computer Engineering emerged as new disciplines. Team work and collaborations imposed new schemes of organisation. New architectures, such as vector processors and parallelism, required new ways of programming. New and strange words like "GUI" or even "validation" popped up. It became obvious that what were soon to be called hydro-informatics or hydro-science systems could only be the product of long-term collaborative work. It then appeared that building such complicated tools not only required money and a panel of specialists in various disciplines, but also what they were designed for: users.

Thanks to a continous funding by EDF, the Laboratoire National d'Hydraulique et Environnement (LNHE) was able to sustain across many years a project that was the framework of the Telemac hydro-informatics system. It started in 1987 with a shallow water equations solver that was called Telemac-2D, mostly because it was inspired from a Navier-Stokes solver called Ulysses and an Euler equations solver called Mach-1. Initially based on curvilinear coordinates, it rapidly evolved to finite elements and unstructured grids, and was complemented with Telemac-3D for free surface Navier-Stokes equations, while waves and sediments were also being tackled. In 1993 the commercial distribution started, first ensured by Sogreah, soon to be joined by Hydraulic Research Wallingford (HR Wallingford) and the Canadian Hydraulic Centre (CHC-NRC). Specific conditions were allowed for research purposes. The benefits then clearly appeared to be not only an extra funding, but also an extra manpower, as new developments stemming from PhDs brought important pioneer works. This is how parallelism with domain decomposition and non-hydrostatic Navier-Stokes equations came to life. However, making money with software is not the main concern at LNHE.



Application of Telemac-3D: Salinity in the Berre lagoon, with the fresh water outfall (in blue) from the Saint-Chamas power plant.

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Environmental studies, and design related to security of dams and power plants are the core work, it requires using the best and most fully validated available software, a broad recognition and the confidence of the security authorities. Hence the nagging question: how to get international recognition if your software is hidden and protected against copying, and if your algorithms are kept secret? This is where the concept of commercial distribution vacillated, when the profit of hundreds of paying customers was opposed to the benefit of thousands of free users. Eventually, to improve access to Telemac for the whole community of consultants and researchers, the decision was made in 2009, after 16 years of the fee-paying era, to move to freeware and open-source. A core group of European partners readily embarked with us on this new adventure, with a commitment to provide manpower and a right to participate in decisions. This new consortium is today composed of:

- Artelia group (formerly Sogreah, France),
- BundesAnstalt für Wasserbau (BAW, Germany),
- Centre d'Etudes Techniques Maritimes et Fluviales (CETMEF, France),
- Daresbury Laboratory (United Kingdom),

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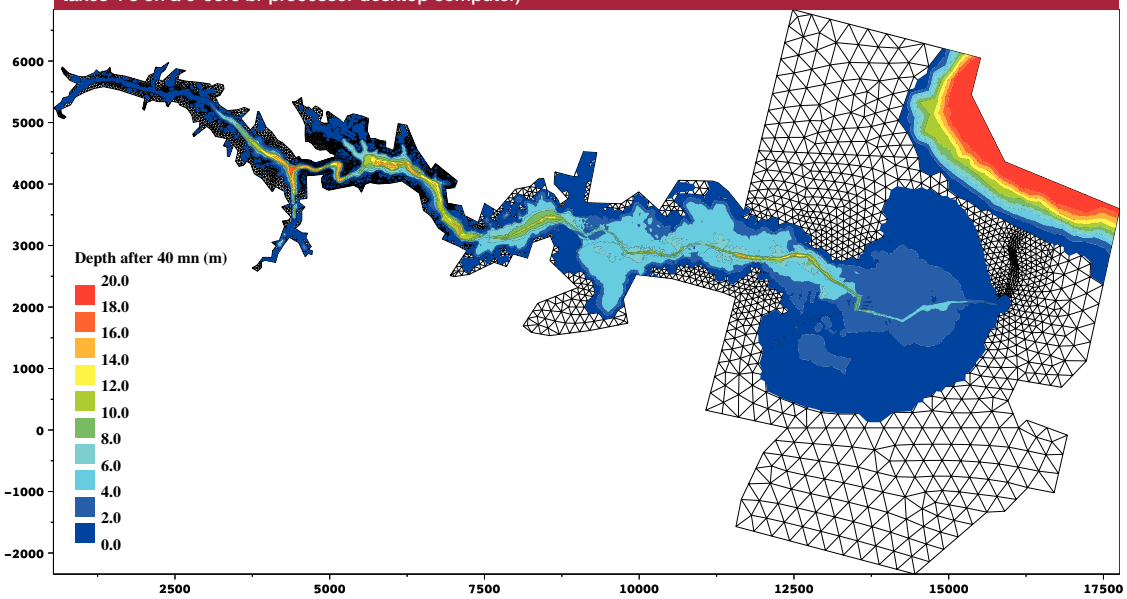
Simulation of the Malpasset dam break flood wave in 1959, with a 26,000 elements mesh (the run, 1,000 time steps of 4 s, takes 4 s on a 6-core bi-processor desktop computer)



- Electricité de France (EDF, France) ,
- HR Wallingford (United Kingdom).

Anyone can thus now download Telemac on our Website (www.opentelemac.org) and assess its performance.

The software suite is currently composed of:
- Telemac-2D (Shallow Water or Saint-Venant equations, Boussinesq equations)
- Telemac-3D (non hydrostatic Navier-Stokes equations)
- Sisyphe (sediment transport)
- Tomawac (wave climate)
- Artemis (agitation in harbours)

Soon there will be also: Mascaret (1D Saint-Venant equations). Groundwater flows are also dealt with but are not yet distributed.

User interfaces are provided by partners, such as Fudaa-Prepro (CETMEF) and Blue-Kenue (CHC-NRC).

Paradoxically, providing freeware appeared to be more difficult and demanding than selling. The software may be installed on every kind of system, be it Unix, Linux or Windows, the Fortran 90 sources may be compiled on any compiler. This is not quite like downloading a mere executable file on a PC. Installation is no longer done by trained professionals but by the users themselves, possibly absolute beginners, and there Murphy's law begins to rage. If any detail can go wrong, it will, as there is always one user to see it, and it helps! This is how we realised that the evolution to freeware was a full success, by observing with mixed awe and pride the growing number of questions on the assistance forum. After two years, more than 2,500 users joined, and the forum is crammed with 4,000 messages. The hundreds of customers have duly turned into thousands of users. Small consultants have access to software they could not afford before, Engineer schools and Universities can equip their class-rooms, isolated students are able to start PhDs, and a flood of remarks helps improve the product. Fortunately former distributors, now members of the newly-created consortium, play the game and provide substantial help on the forum, regardless of the fact that they still propose fee-paying assistance contracts. The minimum input to maintain the project is indeed high, but progress is still eagerly wanted and it is boosted by freeware. From the first steam-powered cars to our sophisticated modern vehicles, there was a tremendous progress and yet everybody is fully convinced that more research is needed to improve them. So is the case with hydro-informatics, and we should honestly admit that we are not so advanced as the car industry. The progress of numerical modelling was however dramatic. The simulation of the Malpasset dam break flood wave, a run that lasted 24 hours in 1993, takes today 4 s: thanks to the progress of machines, algorithms and parallelism. Who could think 30 years ago that we would now compute in a few hours the 10-year evolution of morphology in a 100 km long tidal estuary, with full coupling with hydrodynamics and time-steps of a few seconds, or that we would run 13 years of water quality in a lagoon? Users push forward and immediately take advantage of improve-ments to venture into even longer, more refined and more complex applications, that will require new efforts, and we do not see the end of this ongoing process. We are always very proud of every new version, but every new breakthrough finds us less proud of the previous version. New challenges appear, such as interoperability. New architectures constantly change the deal, like GPUs recently. This rising complexity becomes itself a problem: who can encompass and manage such big and intricate constructions? Simple and partly unanswered questions like "what is the accuracy of our results?" show us that we still have a long way ahead. Yet the pioneer time has not vanished. Besides a handful of hydro-informatics systems, there is still a large diversity of computer programmes based on an amazing number of different techniques, though they are mostly used for education or publication. The "not in my backyard" syndrome is still thriving, but new rules are here to stay: it is a desperate approach to start from scratch like in the 70s, and hydro-informatics will now only progress with well-established long-term projects, with large teams and collaboration of big organisations, and with large numbers of supporting users. We are convinced that in the future such collaborative work will be closely linked to freeware and open source. We are also convinced that Europe will play an outstanding role in this domain. Don't think twice…

For more information on Telemac Open Source visit www.opentelemac.org