

# WATER

Developing tools and strategies for numerical and physical modelling continues to be one of Artelia's key research objectives. Designing hydraulic structures and optimising their performance and safety have also led to major advances.

Our work in **3D hydrodynamic modelling** focused on the nearfield around sea outfalls in order to simulate the dilution of high or low discharges and their complex dynamics. As far as offshore areas were concerned, research concentrated on better spatial and temporal integration of general oceanic circulation patterns with a view to forcing local models accurately.

Major advances were made in the area of **hydrosedimentary forecasting** (erosion, sediment transport and deposition) in river systems and reservoirs. These included improvements in the simulation of sediment deposition and consolidation mechanisms in particular. Poor feedback and uncertain objectives in terms of the hydromorphological restoration of rivers make this a difficult subject. Numerical modelling (using Mascaret and Telemac software) and physical modelling, sometimes carried out jointly, are the basic tools of this line of research.

In the field of **hydrological modelling**, progress was made in terms of limiting uncertainties by taking better account of spatial variations in rainfall over a catchment area as well as of rainfall categories with much higher extremes than those obtained by conventional methods. Artelia's teams also worked at improving estimates of inflows to reservoirs.

In the area of **groundwater**, we are constantly striving to build new modelling strategies in order to handle a wide range of complex issues: evaluate or manage water resources, optimise aquifer recharge (ACTISOL project), estimate the risk of buildings being flooded due to rising

water tables or the impact of open-cast mining, optimise pollution confinement systems, or exploit a cold spring on a sustainable basis.

With its long-standing experience of the subject, Artelia is continuing to develop methods and tools for improved forecasting and management of **extreme events** (floods and draughts), their effects and the associated crisis situations (e.g. the European projects SAFER and CRISMA). Predictive modelling of flood dynamics in urban areas was once again an area of concern in 2011, with particular attention being paid to the operation of multi-scale urban models and the consequences of dam breaks.

In the field of complex **hydraulic structures**, Artelia is innovating in coupling numerical models and ensuring the complementarity of numerical and physical modelling techniques (hybrid models). In addition, Artelia's subsidiary SPRETEC has developed methods for sizing hydro-mechanical equipment and a number of technological innovative solutions, such as large flexible metal joints.

To improve the **design and safety of dams**, Artelia is taking part in a collaborative research group organised by the French Dams and Reservoirs Committee (CFBR) that is working on earthquakes. To improve the operation of flood spillways in exceptional conditions, Artelia is optimising their ability to dissipate rapid flows through a study in its laboratory. Artelia has also developed a 3D thermo-mechanical procedure



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The experience of Artelia's teams in the field of hydraulic numerical modelling has been recognised since the 1960s. Beginning in 1993, they contributed to the development of the Telemac 2D/3D finite-element modelling system in cooperation with Electricité de France. They then coordinated its international distribution and have made it their reference modelling system. This daily involvement in the development and use of the Telemac system in a wide range of engineering studies and research projects has given them considerable knowledge of its potential and the ability to apply it to solve a wide range of complex problems in the areas of hydrodynamics, morphodynamics, water quality and natural hazards in river, maritime and industrial contexts. This twofold expertise, at the interface between research and engineering, is an enormous asset for our studies and enables us to propose reliable and innovative solutions for our clients.

for designing up to 200 m high roller-compacted concrete (RCC) dams that are sensitive to temperature effects.

In response to changes in French legislation concerning the safety of **river levees**, innovative methodologies have been developed using a semi-quantitative approach to rank more accurately the occurrence of possible scenarios (failures, accidents, etc.).

Lastly, to ensure better management of **large canals**, research has concentrated on three areas: the design and optimisation of exceptionally large locks (over 30 m high), the development of a comprehensive vision at regional level, and the standardisation of regulating structures in order to rationalise construction site methods.

