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Editorial

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Advances often go in waves and this is a dominant theme of this issue. In a literal sense, two of the papers are about developments in wave modelling techniques. However, I use the word in the more general context of the working paradigm that most of us follow, whether knowingly or not, at any point in time. Ilya Prigogine, was a chemist and Nobel Laureate who advanced our understanding of time, complexity and the importance of open, non-linear systems. Such systems give rise to self-organisation and dissipative structures, which can be observed as the basis of life in the natural world we see around us. As such, Prigogine was instrumental in opening up a new paradigm but he was also acutely aware that our scientific (and engineering) horizon is itself conditioned by the cultural outlook of our times (Prigogine and Stengers, 1985). This is not just a matter of the state of current knowledge and technology. It runs much deeper and depends on the constraints imposed by our respective languages, cultural heritage and our metaphysical mind sets (to see this, simply compare some of the fundamental differences in outlook between Eastern and Western cultures).

Within this broader context of the governing paradigm, advances occasionally come about by major changes in direction (think of Copernicus, Darwin and Einstein) but most of our advances are incremental in character. However, this is not a linear process and tends to see surges at intervals, as new capabilities become available. In my lifetime this has been and continues to be hugely influenced by our technological capability. Before the advent of the computer, the analytical solution was dominant and even today remains a powerful means of developing a basic understanding of a problem. However, the power of the computer has opened up new horizons, initially by allowing larger problems to be solved but progressively through the introduction of new techniques that take advantage of such computational power. We have seen not only traditional differential/integral formulations (that could not be solved analytically) now being solved with ever greater sophistication but also the use of simple rules applied recursively in the form of cellular automata, genetic algorithms and neural networks.

The development of a range of models to represent processes in our oceans, seas, coast and estuaries means we now have a panoply of models available to us. One of the current initiatives being pushed forward by a number of groups is to make better use of what we already have. This entails sharing existing developments (see for example: http://csdms.colorado.edu/wiki/Main_Page) and linking models rather than simply building

bigger and bigger models which become increasingly difficult to maintain (see for example: <http://www.openmi.org/reloaded/>). In parallel, our ability to observe and measure the properties of the world around us has also moved on apace. Not only do we have much more detailed data (e.g. from remote sensing) but also the access to large integrated data sets is changing rapidly (see for example: <http://www.channelcoast.org/> in the UK and <http://www.cuahsi.org/> in the USA).

Thus the paradigm is changing from one of data-sparse and computationally limited approaches, to one where the modeller has access to large and diverse databases and model libraries. At the recent OpenMI-Life conference (January 2010) to discuss the future of integrated modelling, Andrea Rizzoli suggested that we were moving towards a data-rich world, where there would be increasingly less distinction between models and data and the way in which we develop models was likely to change as a result. For this to happen there is much work to be done, mainly related to communications. Thus both models and data need to conform to standards, so that as we begin to automate the exchange of information we can be sure that we are exchanging apples with apples and not pears.

This issue contains papers that all make very different contributions to this endeavour. The paper by Villarroel-Lamb (2010) builds on existing empirical relationships to develop a computationally efficient means of predicting non-linear wave properties. This has the potential to be used in morphological modelling, where there is a need to examine long simulation periods, and the availability of an efficient solver avoids the need to oversimplify the solution. The paper by Palha *et al.* (2010) also considers the modelling of waves. In this paper the focus is on using an existing well-established model but applying the model to a very large model domain. This makes use of the scriptable language, Python, giving a model-specific solution to the problem of linking several instances of the same model (an alternative to the more generic approach adopted in the OpenMI Standard – see the link given above). Finally, the paper by Guo *et al.* (2010) again makes use of a commercial computational fluid dynamics code to develop a better understanding of the three-dimensional eddy flow in the wake of structures made up of overlapping cylinders. This is of relevance to the design of scour protection around offshore structures and links closely with some of the applications in the recent themed issue on marine renewable sources of energy (Prandle, 2009) and the work on scour described by Harris *et al.* (2010).

For some, the focus on such detailed modelling applications may seem remote from the day-to-day practicalities of getting things built. Certainly, getting to grips with some of the technical detail reported here requires a degree of application and effort. Whilst this may only be essential for those working on these specific problems, for others just gaining an overview, and so knowing the art-of-the-possible, remains important, so that all involved in the task of improving our built environment can provide leadership based on the best available evidence. This was a driving force in the contribution of Sir Alan Muir-Wood, who pushed the boundaries in the fields of both coastal and tunnelling engineering. Sir Alan died in February 2009 and the obituary by one of his close colleagues, Chris Fleming, concludes this issue.

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