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The history of Jonsmod 1981–2006

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Abstract This is a history of shallow sea modelling developments as viewed through the Jonsmod modelling conferences over the past 25 years. The conferences are reviewed, and what emerges is a coherent progression to present-day modelling. We also see advances in computing and oceanographic observation, although these are, of course, incidental to the modelling from the point of view of these conferences.

Keywords History · Shallow sea modelling · Jonsmod

Introduction

The Jonsmod acronym dates from the mid 1970s [at a meeting of Joint North Sea Information System (Jonsis) – see later – in 1973, Jonsmod was established with Professor Jacques Nihoul as chairman (Smed 1983)], and this acronym stood for Joint North Sea Modelling Group. The modelling formed part of the initiative centered around the North Sea and included the aforementioned Jonsis, Joint North Sea Data Acquisition Project, and Joint North Sea Wave Project, all of which were active at the same time 30 or more years ago. Therefore, the first Chairman of Jonsmod in this form was Professor Jacques Nihoul from the University of Liège. It is interesting that Jonsis developed into an "informal forum" of interested parties for countries that border the North Sea. This is not quite the network of permanent North Sea ocean data stations envisaged by Smed (1983), but we do have coastal observatories, which is a useful legacy. The notion of an "informal forum" thus has its roots in these early days, and this phrase certainly describes present Jonsmod with accuracy. However, nothing more will be said of this early period. This short article concerns developments from 1981, which is the year of the North Sea Dynamics conference in Hamburg, (West) Germany; see Sündermann and Lenz (1983). Professor Nihoul had previously resigned as Chairman of Jonsmod, and in September of 1981, during the conference, Phil Dyke was asked to take over the vacancy as Chairman. In the 25 years since that time, there have been biennial conferences and significant advances in our knowledge and application of mathematical modelling to shallow sea dynamics. This paper reviews some of these advances as viewed from the perspective of the 13 Jonsmod conferences that have taken place since. No systematic funding has ever existed or been sought for Jonsmod. This has sometimes been irritating, but it has given the Jonsmod research community a freedom to follow research directions unfettered by the demands of funding bodies. This also helps in another respect. Delegates are able to present work that is still in progress rather than a fait accompli, which gives a more dynamic feel to the sessions. Longer than normal time for presentation (25 or 30 min) and lively question-and-answer sessions always conducted in a positive atmosphere have helped maintain Jonsmod.

To give the review some structure, it is divided into the following sections: advances in methods, advances in computing, and advances in oceanographic

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knowledge. All three are intertwined with various other asides that make this contribution clearly a scientific history rather than a research article.

The JONSMOD conferences

Before getting into the scientific advances, it is useful to put these in context through explaining a little about the conferences themselves. Table 1 gives a history of the conferences including venue and publication date and source of the published papers.

Two questions have been asked over the years and they are "how have these Jonsmod conferences lasted so long?" together with "Why have they remained so successful?" The reasons are outlined in the conclusions, but their success is primarily due to the quality of the output of the participants.

Advances in methods

In 1982, finite difference methods for stratified flow were not well developed, and many of the papers showed a great deal of mathematical detail of how the stratification would be represented. The horizontal discretisation was Arakawa B or C (or Richardson) grid, but the jury was out on how to implement vertical structure into a model. The paper by Duwe et al. (1983) describes a layered approach, whilst the paper by Davies (1983) prefers a modal separation. In this method, a Galerkin technique was employed whereby the three-dimensional velocity field is expressed as a series of functions (basis functions) of the scaled vertical (σ) co-ordinate. The Galerkin approach is standard in the application of the finite element method (FEM) to time-dependent problems. However, back in 1982, very few applications of finite elements to fluid mechanics existed, so the use of functional expansions in the vertical with finite differences in the horizontal, which is close to a FEM and was pioneered by Norman Heaps in the 1960s, was not widely known in the oceanographic community. Another different feature of the 1982 conference was the reporting of operational storm surge models, Peeck et al. (1983). This first conference was hosted in Edinburgh by Heriot-Watt University.

In 1984 there were several papers on diffusion modelling; that by Dyke and Robertson (1985) still contains contemporary notions. Another emerging feature was local flavour. Because the meeting was in Bergen (just outside in Fana Folkhogskole but hosted by the University of Bergen), the talks certainly had more ocean scale modelling contributions than Jonsmod would normally contain. One of these, by Johnson (1985), made the final publication.

Table 1 The Jonsmod conferences and publications

Year	Venue	Journal reference
1982	Heriot-Watt University, Edinburgh, UK	Continental Shelf Research (1983), 2, pp 214 - 314
1984	University of Bergen, Norway	Applied Mathematical Modelling (1985), 9, pp 392 - 446
1986	Delft Hydraulics Laboratory, Delft, The Netherlands	Coastal Engineering (1987), 11, pp 392 - 627
1988	Institut für Meereskunde, University of Hamburg, West Germany	Deutsche Hydrographische Zeitschrift (1989) 42, pp 110 - 345
1990	Proudman Oceanographic Laboratory, Liverpool, UK	Continental Shelf Research (1992), 12, pp 1 - 211
1992	Danish Hydraulics Institute, Horshølm, Denmark	Tellus (1994), 46A, pp 97 - 227
1994	Management Unit for Mathematical Modelling, Brussels, Belgium	Journal of Marine Systems (1996), 8, pp 132 - 298
1996	Norwegian Meteorological Institute and University of Oslo, Oslo, Norway	Continental Shelf Research (1998), 18, pp122 - 456
1998	Delft Hydraulics, Delft, The Netherlands	Estuary, Coastal and Shelf Science (2001), 53, pp 397 - 605
2000	Laboratoire de Sontages Electromagnetiques de L'Environment Terrestre, University of Toulon, Toulon, France	Journal of Physical Oceanography (2003), 33 (about 12 papers submitted, 4 papers published)
2002	University of Liège, Liège, Belgium	Ocean Dynamics (2004), 54, pp 108 - 298
2004	Baltic Sea Research Institute, Warnemunde, Germany	Ocean Dynamics (2005), 55, pp 161 - 387
2006	University of Plymouth, Plymouth, U.K.	Ocean Dynamics (forthcoming)
2008	University of Bergen, Bergen, Norway	(to be decided)
2010	Delft Hydraulics, Delft, The Netherlands	(to be decided)

The 1986 conference was held in Delft, and in direct contrast to the previous conference, there were many more contributions about smaller scale models containing a variety of processes, such as wave modelling and morphological modelling, as befitted the venue: Delft Hydraulics Laboratory (now WL/Delft Hydraulics). It was a pleasure to welcome three Australians this time. Theoretical extensions to the classic Ekman model were popular, and Martinsen and Engedahl (1987) presented a flow relaxation scheme of an open boundary condition and used it in an operational model. However, the paper by Coëffé et al. (1987) stands out. It is an outline of how a FEM is used but was written as a paper using proprietary software. Without giving too much away, this received harsh reviews and the guest editor had to fight to get it included in close to its original form. Today, such papers are much more common, one could even say more or less the norm, but this was way before its time. The shallow sea models were still primarily two-dimensional with clever methods of determining vertical structure. The close of the meeting in Delft was followed by the first meeting of the International North Sea Conference 1987 Scientific and Technical Working group: Oceanographic sub-group (Mr. J B Eppel, UK Department of the Environment, secretary). This rather formal meeting contrasted starkly with the informality of Jonsmod. The journeys away from Delft for those that needed to travel by train were enlivened by a hastily called but very successful national rail strike.

Two years on found Jonsmod in Hamburg, (West) Germany, prior to unification. There was no really local flavour this time, although the level of sophistication of some of the modelling reflected the work of the Institut für Meereskunde, University of Hamburg, which hosted the conference. The stratified modelling was more prevalent, but the stand-out paper in the published volume has to be the account of boundary-fitted co-ordinates by Swanson et al. (1989). This was a step change in sophistication and one of the first papers to use the technique. Models of Lagrangian flow and two on the modelling of pollution transport by Gidhagen et al. (1989) and Durance (1989) also featured. It was at this conference that Ian James suggested that the “N” in JONSMOD should change from North to Numerical, so Jonsmod became the Joint Numerical Sea Modelling group. There were other suggestions, for example Jossmod (Joint Shelf Sea Modelling Group), but the preservation of the acronym Jonsmod was the over-riding consideration. Our antipodean friends returned and there was talk of a Domsnoj group that never emerged, unfortunately; perhaps the suggestion had more to do with the local beer/lager.

Although the paper by Swanson et al. (1989) contained authors from “across the pond”, in 1990, the Jonsmod community experienced the first real influx of speakers from the USA and Canada. This brought an emphasis on FEM, with Lynch et al. (1992) and Walters (1992) being prominent. The conference took place in a cold April just outside Liverpool, UK, in the Proudman Oceanographic Laboratory, but proceedings were enlivened not only by Jonsmod but also by a small earthquake centered 80 or so kilometers due south of the venue near Wrexham. Papers on the more statistical side of modelling featured for the first time, but the real first was a paper by Jørgensen (1992) about modelling the distribution of dissolved oxygen, which is primarily of interest to ecosystem modellers. Detailed three-dimensional models, by Zitman (1992) and Davies (1992), were presented probably for the first time, certainly for the first time at Jonsmod. Nevertheless, it was the coming of ecosystems modelling that influenced the next choice of venue. There was a 1-day North Sea Task Force symposium directly following the Jonsmod conference; the emphasis was more on water quality, and hence, this also attracted scientists more interested in ecosystems. This symposium was driven by Georges Pichot of Mathematical Modelling Unit of the North Sea (MUMM), Belgium.

In 1992, Jonsmod went to Denmark. At the conference itself, hosted by the Danish Hydraulics Institute just outside Copenhagen, there were two talks on ecosystems models, but the papers in the published volume that stand out are further papers on FEM and a comparison of very different methods for modelling vertical structure, Davies and Gerritsen (1994). Although the methods were so different, the results for modelling the Irish Sea were similar. This paper was one of only two examples of intercomparison and validation exercises inaugurated 2 years earlier. The other was the Halten Bank study of Hackett and Røed (1994), which looked at what effects were most important to include when sophisticated software was available. The software in question was the Princeton Ocean Model, which is now very well known, based on Mellor–Yamada turbulence closure, Mellor and Yamada (1982), see also Blumberg and Mellor (1987) together with the Norwegian-based model SINMOD, the details of which can be found in SINTEF technical reports referred to in Hackett and Røed (1994). Perhaps there would have been more contributions of this type if finances had been available to tempt the modellers! Other interesting papers featured smaller-scale plume modelling; Ruddick et al. (1994) looked at the Rhine discharge and de Kok (1994) anisotropic dispersion applied to Dutch coastal waters. The

Jonsmod community welcomed several participants from what used to be called the “Eastern Bloc” countries who travelled courtesy of a grant obtained by Jakob Vested, the local organiser. This reflected that this was the first Jonsmod since the raising of the Iron Curtain. Also, this was the Jonsmod that saw the first PC-driven movie displayed by Herman Gerritsen and depicting, in colour, tidal circulation around the UK.

Two more years went by and Jonsmod 1994 was hosted by MUMM in Brussels, Belgium. This time, there were ecosystems models, e.g. Vested et al. (1996), that included hydrodynamics too, and detailed numerical methods on modelling fronts, James (1996), and further work on plumes by de Kok (1996). The real innovation was a paper by Luyten (1996) that gave an extension to the Blumberg–Mellor (Blumberg and Mellor 1987) turbulence closure scheme, raising the level of sophistication of shallow sea modelling.

Next came Oslo in 1996 in a conference hosted jointly by the Norwegian Meteorological Institute and the University of Oslo. Three-dimensional modelling was consolidated, though the FEM papers were absent this time. Two very different approaches to modelling sediment movement were given by Chen and Dyke (1998) and Gerritsen and Berentsen (1998).

The Jonsmod conferences had now been occurring for long enough for venues to be revisited, and the delegates for the 1998 conference were back in Delft at the re-branded WL/Delft Hydraulics. Once more, smaller-scale modelling featured prominently. Most of the three-dimensional models now contained sophisticated bottom boundary formulations of the turbulence closure type, and the paper of Delhez and Carabin (2001) was perhaps the first to give an integrated approach to water system modelling as an aid to overall management.

In the millennium year 2000, Jonsmod went to the south of France and the conference was hosted by the Universite de Toulon et du Var, Laboratoire de Sontages Electromagnetiques de L’Environment Terrestre. There were talks from MEDMOD, which was formed in 1994 and concentrated on models appropriate to the Mediterranean Sea. There were also talks on internal waves and the stability of models, and it was something of a coup to get permission to publish in the *Journal of Physical Oceanography*. One paper, by Bang and Mooers (2003), outlined a model of Prince William Sound and another, by Luyten et al. (2003), the traditional area of the North Sea. This shows that specific-area models only were published in the *Journal of Physical Oceanography*, which was a shame and failed to reflect the breadth of papers presented at the conference itself.

The last three Jonsmod conferences are all published in *Ocean Dynamics*, this started with the 2002 conference, which was hosted in Belgium by the Université de Liège. The emphasis on testing the correctness of the models rather than any new discretisation technique continued. For example, Jones and Davies (2004) looked at the sensitivity of their storm surge models to open-boundary conditions. The use of “age” as a variable, by Delhez et al. (2004), was a novel idea that started here.

In 2004, we went to the Baltic Sea Research Institute in Warnemünde, Germany. There were a lot of papers, most in the tradition of presenting area-specific finite difference models, but they were branching out. Sheng et al. (2005) presented a two-way nesting technique, Jones and Davies (2005) compared a proprietary software (TELEMAC) with an in-house-developed finite difference scheme, and the comparison shows both works well, but accuracy is very dependent upon the accuracy of nearshore water depths. There were also two papers, by LaCasce (2005) and LaCasce and Engedahl (2005), that concentrated on the statistics of model output. This is another indication of the maturity of the models; in 2004, they were considered reliable enough to encourage such questions.

In 2006, the conference came to the UK at the University of Plymouth. The volume emerging is this one, and as this history is being written, it is too early to comment on the content of the papers; however, a striking feature of the papers in the conference was the emergence of adaptive grids. These are grids that can change as the computation proceeds. There were also a series of papers that included data assimilation on different spatial and temporal scales. The overall feeling after 25 years is certainly that of a vibrant modelling research community with many new and interesting problems yet to be solved.

Advances in computing

The transition from cards to terminals (dumb terminals) really took place before the first of these modern conferences in the 1970s. In the 1980s, the personal computer quickly became more and more powerful. In the UK, the BBC Microcomputer was popular, but the 8086 processor was adopted by IBM and IBM clones, and this was succeeded by 286 and then 386 by the beginning of the 1990s. There followed the Pentium processor. The Apple II was manufactured in the late 1970s and developed different but equivalent technology by the end of the 1980s. Mainframes also continued to develop, getting more and more powerful; eventually, the Cray 3 and Cray Y-MP emerged. The power of computers roughly doubles every 18 months [called Moore's Law after Gordon Moore (1929–), who made this prediction in 1965]. Moore's Law is still valid, and the transition from mainframes to UNIX workstations and PCs has been made with the power still increasing. The availability of really powerful computers to shallow sea modellers was, however, patchy and dependent on both country and financial environment of the research group. Universities were sometimes at an advantage and sometimes at a disadvantage compared to government or privately funded research institutes. Unquestionably, though, the availability of computing power increased. The emergence of the mini-computer (usually VAX, SUN or DEC-α) was a boon to many smaller research teams and could be afforded by institutes with only a peripheral interest in modelling.

By the present day, however, computing power is not really a problem and the present PC can perform very creditable numerical computations on one's desk. In the future, we look to grid computing for even more power. Already, climate change models are being designed to be downloaded to work on one's PC overnight and to contribute to making faster (and more accurate?) predictions.

There have been other changes besides that in computer power and availability. Output has changed beyond recognition. The line printer output with masses of numbers first gave way to line graphs. Then we had maps, often output in colour (these remain expensive to mass produce in journals, however, which surely must change). The electronic exchange of information is threatening traditional dissemination through journal publication as it is immediate and seemingly cost-free. However, it can also be free of peer review, which brings the thorny question of how to police the quality. In conferences, and the Jonsmod conferences are no exception, the actual presentation has changed beyond recognition. Jonsmod 2006 papers were all presented via computer projection and featured many movie clips and Java-driven animations often dragged in from remote sites via the Internet. The venue was a modern tiered auditorium with not only these facilities but the capability of projecting an object (three-dimensional or the page of a book) from a table top at the front on to the screen. In 1982, the venue was a flat classroom with one overhead projector (then a reasonably modern innovation for a University classroom) and a chalk board.

Advances in oceanography

It is not the place here to enumerate all the advances made in measurements, but mention must be made of those advances that have influenced modelling as presented in Jonsmod over the past 25 years. The use of current meters and other non-invasive measurement techniques remains very important for modellers. The use of satellites to monitor the ocean is becoming very important to modellers as the resolution gets better. Initially, it was surface temperature, but in the past few years the resolution has been good enough for small particles to act as flow visualisation.

As more and more measurements become available, and as the frequency of updates to present knowledge increases, then data assimilation assumes greater importance. Models are now routinely updated as they run using improved data. This has led to a closer marriage between modellers and observational oceanographers.

Conclusions

In 1982, one could be forgiven for assuming that Jonsmod would last but a few years. Ten years was a good estimate. This turned out to be far from the case. The longevity of the Jonsmod conferences has hinged on three features, two of which were emphasised in 1982 by the host of the first conference. The conference was primarily for young researchers perhaps finishing off a Ph.D. or in the first year or two of a research career. Thus, Jonsmod would provide a foot in the door to their career. Related to this, the papers from the conference would be part of an established international journal, with each contribution passing through the rigorous refereeing procedure, no different from a standard research paper. The publication of "proceedings" as a stand-alone book (termed "junk proceedings" by this author) was to be avoided. The third factor concerns money. Although it is recognised that resources are important, as mentioned in the introduction, the chairman made the decision to relegate money to the role of an enabler and not to treat the Jonsmod conferences as a financial source. Thus, the Jonsmod conferences would aim to break even and costs would be kept to a minimum. Over the years, this has proven to be difficult, and various funding initiatives, notably the EU MAST programmes, have helped considerably.

Longevity was also helped by keeping the conference lively through changing the venues and keeping a 2-year cycle. The Ocean Hydrodynamics conferences held at Liège are both annual and at the same venue every year, so perhaps these last two features are of secondary importance. More important perhaps is consistent leadership, with Jacques Nihoul (followed by Jean-Marie Beckers) at Liège and myself for Jonsmod.

At the time of writing, the next two venues are already settled (see Table 1), so Jonsmod marches (or should that be sails) on.

Acknowledgements I thank everyone who has contributed to the success of Jonsmod over the years, but I must single out Alan M Davies for continuous and continuing help over organisation, processing the papers and making Jonsmod visible in the community. I also thank all the local organisers, Herman Gerritsen (twice, soon to be three times), Gunnar Furnes, Jan Backhaus, Joachim Dippner (twice), Jakob Vested, Jose Ozer, Lars-Petter Røed, Philippe Fraunie and Jean-Marie Beckers.

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