MHS NEWS – No. 001 – August 2008
INTERNATIONAL ASSOCIATION of HYDRAULIC ENGINEERING and RESEARCH (IAHR)
Maritime Hydraulics Section (MHS) Newsletter

1: WELCOME

Welcome to this first issue of the Maritime Hydraulics Section Newsletter. A long-standing obligation to our flock, this edition comes alive mainly due to the efforts of the Section's Secretary Francisco Taveira Pinto. Being part of the family of the International Association of Hydraulic Engineering and Research we have to firstly strive to serve the needs of our members. There is, however, a sizable number of our colleagues, who some time ago have requested to be informed of our activities. To these people we also distribute this Newsletter but we will be happy to update our mailing list with new names.

The Maritime Hydraulics Section of IAHR deals with aspects of maritime and coastal environment, primarily in terms of hydraulic research and engineering. It functions under the umbrella of Technical Division III, Geophysical Hydraulics, steered by a committee of eleven IAHR members devoted to the subject of maritime hydraulics.

The scope of the Newsletter is to convey to anybody interested our doings in the Section, to disperse news of relevance to the maritime and coastal community, to provide a forum of free exchange of ideas among our members and beyond.

The plan is that we will be publishing the Newsletter twice a year, but this is quite flexible depending on your response and surely on your input and ideas. These should be addressed to our Secretary (fpinto@fe.up.pt).

Welcome again and happy reading.

Constantine Memos (Chair of MH Section)

2: NEWS

2nd CoastLab Teaching School, June, 2008, Faculty of Engineering of Porto, Portugal.

Following the success of the "First CoastLab Teaching School" held in November 2007 at the Faculty of Engineering of the University of Porto (FEUP) – Portugal, the CoastLab Network – the network for small and medium coastal engineering laboratories has organized the "Second CoastLab Teaching School" again with the support of ENCORA Young Professional Exchange Program (YPEP) and the IAHR-Maritime Section.

Once more the Faculty of Engineering of the University of Porto (FEUP) hosted the 3-day school. An international group of 29 young professionals with a background in coastal sciences was welcomed with participants from Brazil, Turkey, Tunisia and 6 different EU countries.

The aim of this series of teaching schools is to provide a hands-on application-oriented training on coastal physical modelling related issues. In the first CLab course more general topics were addressed (e.g. wave generation, measuring techniques, and wave-structure interactions), on the contrary the second was entirely dedicated to issues related to sediment transport models within a total of 15-hours.

On the first day, after a brief presentation of CoastLab network by its co-ordinator Professor Francisco Taveira Pinto, Professor Leo van Rijn, presently of Deltares and the University of Utrecht, gave two lectures on cross-shore and long-shore sediment transport, presenting very relevant insights on the topics that can be transferred into practical recommendations when developing a movable bed model.

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Edited by: Constantine Memos – CHAIRMAN (memos@hydro.ntua.gr) and Francisco Taveira Pinto – SECRETARY (fpinto@fe.up.pt)

In the afternoon, Professor António Trigo Teixeira, presently of *Instituto Superior Técnico* of Lisbon, introduced the problems addressed, the limitations and the different types of movable bed models followed by a fascinating video on the physical modelling experiment of the Lobito sandspit evolution from the sixties, performed in the National Laboratory of Civil Engineering – Lisbon.

On the following day, students had the chance to visit the Hydraulics Laboratory of FEUP where they got the chance to see some of the ongoing experiments. Afterwards Professor Fernando Veloso Gomes led a field excursion to the Portuguese northwest coast. A number of field stops to some key hotspots illustrating different examples of coastline change to sediment transport disruption were made.

In the morning of the last day, Professor Mutlu Sumer, presently of the Technical University of Denmark, gave two lectures one on the modelling of scour around marine structures and the other one on the effect of turbulence on bedload sediment transport; both presentations were supported by interesting experiments.

Unfortunately, due to medical constraints, Professor Agustín Sánchez-Arcilla, presently of the Technical University of Catalonia, could not give its presentations which were replaced by two presentations: "Improving operational conditions at Leixões oil terminal – Portugal"; and "Simulation of medium term coastal evolution of the Portuguese northwest coast", given by two PhD Researchers of FEUP, Paulo Rosa Santos and Raquel Silva, respectively.

The feedback received was very positive despite the change in programme. Suggestions to be included in forthcomings concern the extension of the school duration to make possible a period of actual work in the laboratory.

CoastLab 2008 – 2nd International Conference on the Application of Physical Modeling to Port and Coastal Protection 2008, July 2nd – 5th, Faculty of Engineering of the Technical University of Bari, Italy.

Following the successful CoastLab06 held in Porto, Portugal, the Second International Conference on the Application of Physical Modeling to Port and Coastal Protection – CoastLab08, took place from July 2nd through 5th, 2008 at the Faculty of Engineering of the Technical University of Bari, Italy, supported by MHS-IAHR.

This conference provided a general forum for enhancing interdisciplinary interactions, dialogue, and cooperation among scientists interested in physical coastal modeling, as well as laboratory equipment suppliers.

Original papers on physical model experiments both on scale and in prototype, practical papers detailing the design, construction, instrumentation and results of model tests, as well as theory, measurement, analysis and modelling of the following topics were presented:

- Waves: generation, theories, prediction;
- Structures: types, interactions and structural responses;
- Measuring Techniques: pressures, velocities, forces;
- Erosion/Scour: assessment, control;
- Scale Effects: control, techniques;
- Natural Hazards Assessment.

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3: UPCOMING EVENTS

(1) Mediterranean Days of Coastal and Port Engineering – 7/9 October 2008, Palermo, Italy **(**http://www.pianc-aipcn.org/docs02/seminars/meddays-2008.doc**);**
(2) LITTORAL 2008 – 25/28 November, 2008, Venice, Italy (www.littoral2008.corila.it);
(3) ICS 2009 – 13/18 April, 2009, Lisbon, Portugal (www.e-geo.fcsh.unl.pt/ics2009);
(4) Coasts, Marine Structures and Breakwaters 2009 (www.ice-breakwaters.com)
(5) 33rd IAHR Congress, 10/14 August 2009, Vancouver, Canada (www.iahr2009.org);
(6) COASTLAB2010, Spain (to be announced);

Events´ Databases:

(1) IAHR: http://www.iahr.net/site/index.html
(2) EUCC: http://www.coastalguide.org/meetings/index.html
(3) COPRI: http://content.coprinstitute.org/events/calendar.html
(4) ASCE: http://www.asce.org/conferences/
(5) ICE: http://www.ice.org.uk/conferences_events/newsevents_events.asp
(6) PIANC: http://www.pianc-aipcn.org/congresses.php

4: NEW MEMBERS

Members of the Maritime Hydraulics Section (http://www.iahr.net/site/index.html**)**

CHAIRMAN: **Constatine Memos**, Professor
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5: ARTICLES

Numerical Particle Modeling in Maritime and Coastal Hydrodynamics

Dr. Songdong Shao, Lecturer in Environmental Fluid Mechanics,
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Maritime and coastal hydrodynamics, such as the wave breaking, wave overtopping and wave interactions with the coastal structure, are of significant theoretical and practical importance. However, these flows are difficult to simulate because of a free moving surface of large deformation with the surface breakup and reconnection. The traditional grid modeling techniques have been used but additional algorithms have to be implemented to track the free surfaces and moving boundaries, which lead to a complicated code design. On the other hand, the particle modeling is an emerging and promising approach that has played an important role in the numerical computations of maritime and coastal hydrodynamics.

In a particle modeling approach, the fluid is regarded as an assembly of individual particles and each particle is moved by following the fundamental hydrodynamic equations. The interactions between all pairs of the particles are considered using some forms of mathematical formulations. In this regard, the particle method is a completely mesh free approach that does not use a grid at all. Thus it can describe the large deformation of free surfaces and the complicated flow interactions with fixed or moving solid boundaries in a natural way. The two most popular particle methods are the Smoothed Particle Hydrodynamics (SPH) developed by Monaghan (1992) at Monash University and the Moving Particle Semi-implicit (MPS) developed by Koshizuka et al. (1995) at the University of Tokyo.

The SPH method was originally developed for the astrophysics applications and later modified to model a wide range of fluid flows, including the wave propagation (Monaghan and Kos 1999) and wave breaking and overtopping (Dalrymple and Roger 2006). In an SPH approach, the analytical kernel functions are used to relate the interactions between all pairs of the particles and the computational accuracy can be improved by using the higher order kernels. In the early formulations of SPH for the incompressible flows, the fluid was regarded as slightly compressible and an equation of state was used to solve the fluid pressures. The numerical scheme is completely explicit and straightforward, but the computational time step is very limited especially for the flows with moderate and large Reynolds numbers. This SPH modeling technique is termed as the Weakly Compressible SPH Approach (WCSPH).

The MPS method is another robust particle modeling technique in which the individual particles are used to solve the Navier-Stokes equations. Different from the SPH philosophy, the MPS method uses the particle interaction models to relate the interactions between all pairs of the particles and thus the numerical algorithm has a clearer physical implication. The MPS method was developed based on a two-step prediction and correction solution procedure. It is semi-implicit due to that the fluid pressure is solved by a pressure Poisson equation derived from a combination of the continuity and momentum equations.

One distinctive advantage of the semi-implicit MPS numerical scheme is that a much larger time step can be used in the computations, which makes the MPS approach an effective tool to model a variety of maritime and coastal hydrodynamic problems. Using the MPS modeling technique, Koshizuka *et al.* (1998) and Gotoh and Sakai (2006) computed the wave interactions with fixed and moving structures.

By combining the merits of the standard SPH kernel formulations and MPS semi-implicit solution algorithms, an incompressible version of the semi-implicit SPH (Incom-SPH) method was established by Shao and Lo (2003). In the Incom-SPH computations, much larger time steps and more stable pressure fields can be achieved because the numerical algorithms are developed from a strict hydrodynamic formulation. The Incom-SPH modeling approach has shown to be a promising modification of the SPH algorithms and is being further explored by other researchers (Ataie-Ashtiani and Shobeyri 2008). The following two simulations show the latest results obtained by applying the Incom-SPH modeling technique to interesting problems in maritime and coastal engineering.

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(1) Water Entry of a Free Falling Object (Shao 2008)

Figure 1(a) and (b) show the particle snapshots and velocity fields during the water entry of a free falling wedge. The velocity of the wedge is not prescribed but dynamically varied based on the interactions with the water. The Incom-SPH simulations well reproduced the water surface breaking and the wedge motion. This application can be widely found in offshore engineering in which the slamming force is of great interest.

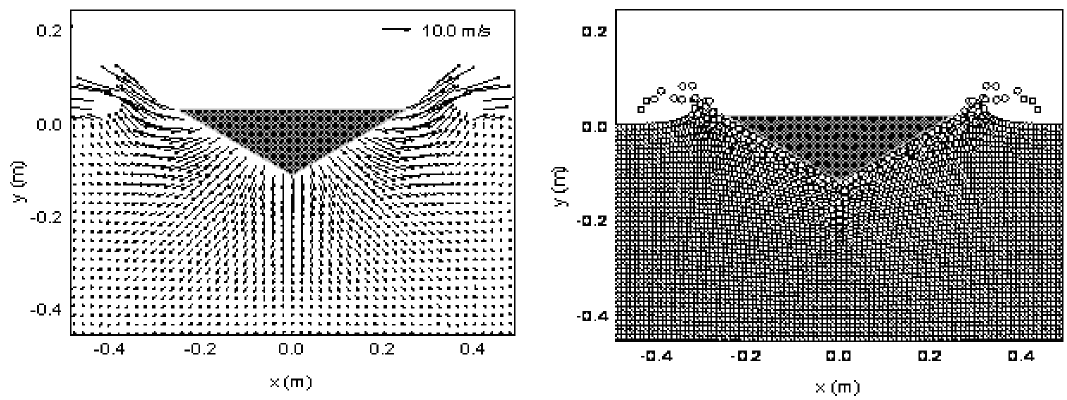

Figure 1. (a) - (b) Particle Snapshots and Velocity Fields during Wedge Entry.

(2) Coastal Wave Breaking (Khayyer, Gotoh and Shao 2008)

The breaking of coastal waves has a significant impact on the coastal process. The following simulations are based on the research collaborations between Dr. Songdong Shao at the University of Bradford and Prof. Hitoshi Gotoh at Kyoto University. The original Incom-SPH model was modified and improved by using a corrected viscosity term which is more suitable for modelling the large deformation of free surface flows in practical fields. Figure 2(a), (b) and (c) show the whole process of the breaking of a plunging wave.

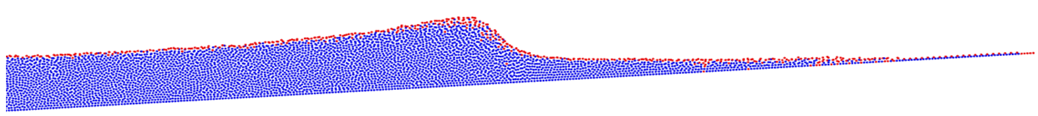

Figure 2. (a) Coastal Wave Pre-breaking.

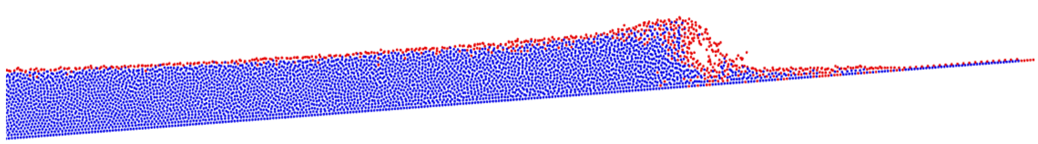

Figure 2. (b) Coastal Wave Breaking.

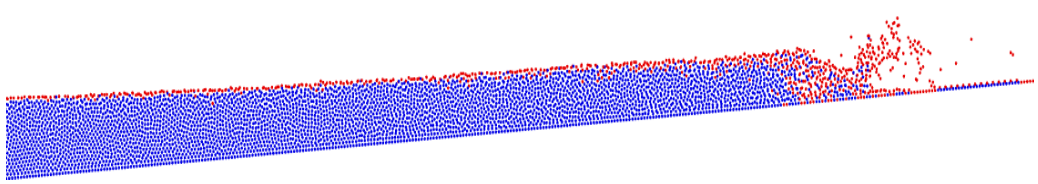

Figure 2. (c) Coastal Wave Second-breaking.

Contents:

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(2) Dalrymple, R. A. and Rogers, B. D. (2006), Numerical modeling of water waves with the SPH method, *Coastal Engineering*, 53, 141–147.

(3) Gotoh, H. and Sakai, T. (2006), Key issues in the particle method for computation of wave breaking, *Coastal Engineering*, 53, 171–179.

(4) Khayyer, A., Gotoh, H. and Shao, S. D. (2008), Corrected Incompressible SPH method for accurate water-surface tracking in breaking waves, *Coastal Engineering*, 55, 236-250.

(5) Koshizuka, S., Tamako, H. and Oka, Y. (1995), A particle method for incompressible viscous flow with fluid fragmentation, *Computational Fluid Dynamics Journal*, 4, 29-46.

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(9) Shao, S. D. and Lo, E. Y. M. (2003), Incompressible SPH method for simulating Newtonian and non-Newtonian flows with a free surface, *Advances in Water Resources*, 26, 787-800.

(10) Shao, S. D. (2008), Incompressible SPH simulation of water entry of a free-falling object, *International Journal for Numerical Methods in Fluids*, DOI: 10.1002/fld.1813

Application of LDA Technique on Regular Wave Flow Patterns over Submerged Breakwaters

Francisco Taveira-Pinto, Faculty of Engineering of the University of Porto, Rua do Dr. Roberto Frias, 4200-465 Porto, Portugal, fpinto@fe.up.pt

Several types of coastal structures are used for coastal protection, to attenuate wave action, such as detached breakwaters, groins, longitudinal block mounds and submerged breakwaters. As experience shows, in many cases, submerged breakwaters afford greater protection of the coastline and also decrease the risk of erosion and help that sand retention could occur. However, it is not entirely understood their hydrodynamics and their influence on local morphology.

In this investigation was possible to verify, measuring reflection and transmission coefficients, as well as flow velocities, how they work and how they modify the wave flow characteristics. As the data show, the interaction is complex but very efficient and it could explain the high efficiency of submerged breakwaters for coastline protection.

The measurements were carried out in the old unidirectional wave tank of the Hydraulics Laboratory of the Faculty of Engineering of the University of Porto.

The wave tank was 4.8 m wide and 24.5 m long with a maximum water depth of 0.60 and 0.40 m near the wave generator and at the test section, respectively. A piston-type wave generator installed on the tank allows the wave generation of the used regular waves. Wave probe modules allow water elevation measurements at different points of the test section. One of these probes was always located at the section where velocity measurements were being carried out. For velocity measurements, the used light source was a Spectra-Physics Stabilité 2017S argon-ion laser operating in single mode with a power of 2 W. The optical system consisted of a 55X modular LDA optics based on a Dantec one-component fibre-optic system, with a 60 mm probe, working in the backscatter configuration. A three-dimensional traversing table located in front of the tank window supported the fibre-optic probe and allowed the control volume to be positioned at each required point on the test section. To improve the alignment of the optics and to reduce the size of the control volume, a 55×12 beam expander (Dantec) was placed before the 600 mm front lens. The scattered light was collected by a photomultiplier (PM). A burst spectrum analyser (BSA) processed the signal from the PM. An AT-MIO-10 card, interfaced the BSA and the wave probe module located at the measuring section. In order to obtain A/D data coincident with LDA samples, the analogue data acquisition was performed at a sampling frequency approximately 2-3 times the mean data rate of LDA samples. Coincidence filtering was used to match both AD and LDA data. An impermeable breakwater model with a smooth surface and trapezoidal section was used and a crest width of 0.10 m.

Horizontal and vertical velocity components, at different locations around the structure, were measured, allowing phase-dependent flow patterns to be defined. Phase averaged rms. values of velocity fluctuations for both the horizontal and vertical velocity components were also evaluated, allowing a detailed picture of the wave interaction with submerged breakwaters.

Measurements were carried out for a water depth of 0.22 m and for regular waves, with height and period of 3.5 cm and 1.25 s, respectively, which when duly scaled correspond to common situations of the sea state on the Portuguese coast. For each of the measured 33 profiles and for each water level value (z), 50 mean velocity values corresponding to 50 intervals of the wave period were evaluated. For each profile the phase-dependent flow field was defined. Water elevation and velocity values were normalized by the still water level (d) and by the wave celerity (C), respectively. The data obtained allowed the definition of the velocity field around the submerged breakwater in 50 different time-steps, corresponding to 50 different wave phase values.

In Figure 1 one of these situations is presented. Velocity fluctuations were also evaluated for both horizontal and vertical velocity components. The calculated rms values (u' and v') of velocities at each profile and each level were normalized by the mean local corresponding velocity value (u and v). As for the mean velocity values, 50 different situations corresponding to 50 different wave phase values were analysed.

Flow motions near the submerged breakwater can be observed during the wave phase, allowing the definition of recirculation regions in front of and behind the structure. Velocity fluctuation flow fields show that the presence of the breakwater leads to an increase in turbulence, the location of the higher turbulence intensity region being dependent on the wave phase value. Further details can be found at the references listed below.

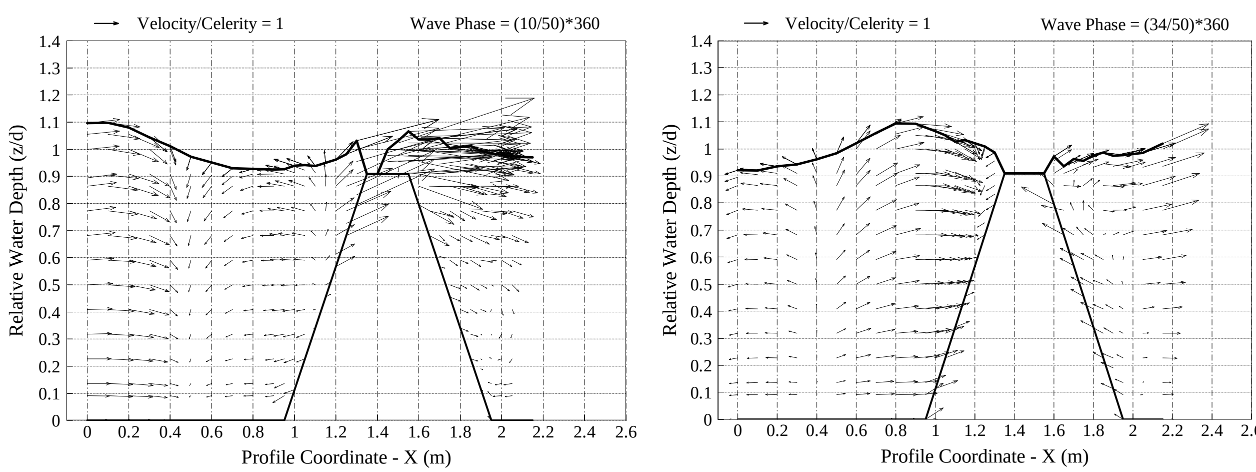

Figure 1. Examples of Velocity Flow Fields.

References

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(2) F. Taveira-Pinto (2004), Pseudo Image Velocimetry of a Regular Wave Flow near a Submerged Breakwater, Advances in Coastal and Ocean Engineering, Volume 9, "PIV and Water Waves", John Grue, Philip L.F. Liu, & Geir K. Pederson Editors, World Scientific, New Jersey, pp. 327-329, ISBN 981-238-949-0;

(3) F. Taveira-Pinto (2005), Regular Water Wave Measurements near Submerged Breakwaters, Special Edition on "Water Wave Measurements", Journal for Measurement Science and Technology, Institute of Physics Publishing, IOP Publishing Ltd, UK, Meas. Sci. Technol. 16, 1883-1888;

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6: FORUM

Send us your comments/ideas on what do you expect from the **Maritime Hydraulics Section** of IAHR?
A survey will be presented in the next issue.

7: CONTACTS

(1) EUCC – The Coastal Union, Leiden, The Netherlands (www.eucc.net);
(2) IHRH – FEUP (Hydraulics and Water Resources Institute), Porto, Portugal (www.fe.up.pt/ihrh);

8: WEBPAGES

PoCoast – Portuguese Network for Coastal Research **(**http://webpages.fe.up.pt/ihrh/pocoast/; contact: fpinto@fe.up.pt);

PoCoast

9: BOOKS/JOURNALS

- 1st International Conference on the Application of Physical Modelling to Port and Coastal Protection (CoastLab06) Proceedings (F. Veloso Gomes, F. Taveira Pinto, Luciana das Neves and Gregorio Iglesias Editors), May, 2006, Porto, PT, International Association of Hydraulics Research (IAHR), Madrid, ISBN-10: 90-78046-04-X **(contact: fpinto@fe.up.pt or IAHR)**;
- 2nd International Conference on the Application of Physical Modelling to Port and Coastal Protection (CoastLab08) Book of Abstracts (Leonardo Damiani and Michele Mossa Editors), July, 2008, Bari, IT, Politecnico Di Bari, IAHR, ISBN 88-6093-046-4 **(contact: l.daminai@poliba.it);**
- Dimensional Analysis and Intelligent Experimentation, Andrew C Palmer, National University of Singapore, Singapore **(contact: World Scientific – www.worldscientific.com);**
- JHR 2008 VOL 46 (Extra Issue 2), with several very interesting articles about Coastal Engineering Issues:
  - **Extreme values for coastal, estuarine, and riverine environments**
    AGUSTIN SANCHEZ-ARCILLA, DANIEL GONZÁLEZ-MARCO, NEELKE DOORN AND ANDREAS KORTENHAUS
  - **Data management of extreme marine and coastal hydro-meteorological events**
    PIETER H.A.J.M VAN GELDER, CONG V. MAI, WEN WANG, GHAHFAROKI SHAMS, MOHAMMAD RAJABALINEJAD AND MADELON BURGMEIJER
  - **Estimation of Extremes: Conventional versus Bayesian techniques**
    PANAGIOTA GALIATSATOU, PANAGIOTIS PRINOS AND AGUSTIN SANCHEZ-ARCILLA
  - **Extremes for scarce data: The role of Bayesian and scaling techniques in reducing uncertainty**
    AGUSTIN SANCHEZ-ARCILLA, JESUS GOMEZ AGUAR, JUAN JOSE EGOZCUE, M.I ORTEGO, PANAGIOTA GALIATSATOU AND PANAGIOTIS PRINOS
  - **Extreme water levels of the Vistula River and Gdansk Harbour**
    DOMINIC E. REEVE, GRZEGORZ ROZYNSKI AND YING LI

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- **Joint probability analysis for estimation extremes**
  PETER J. HAWKS
- **Statistical models for bivariate extremal analysis of a spatial process**
  PANAGIOTA GALIATSATOU AND PANAGIOTIS PRINOS
- **Singular spectrum analysis of storm surges and wave climates**
  RICARDO BRIGANTI AND GIAN MARIA BELTRAMI
- **Distribution functions of extreme sea waves and river discharges**
  PIETER H.A.J.M VAN GELDER AND CONG V. MAI
- **Implications of extreme waves and water levels in the southern Baltic Sea**
  HANS HANSON AND MAGNUS LARSON
- **Implications of nearshore processes on the significant wave height probability distribution**
  DANIEL GONZALEZ-MARCO, RODOLFO BOLAÑOS, JOSE MARIA ALSINA AND AGUSTIN SANCHEZ-ARCILLA
- **Application of statistical methods for the prediction of extreme wave events**
  BARBARA PAPLINSKA-SWERPEL, LUKASZ PASZKE, WOJCIECH SULISZ AND RODOLFO BOLAÑOS
- **Best practice for the estimation of extremes: A review**
  PETER J. HAWKS, DANIEL GONZALEZ-MARCO, AGUSTIN SANCHEZ-ARCILLA AND PANAGIOTIS PRINOS

10: ANNOUNCEMENTS

IAHR Maritime Hydraulics Section Meeting at ICCE, Hamburg

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An IAHR open meeting will be held at ICCE, Hamburg, on 4 Sept. 2008, 6:30 p.m., ICCE Hall, where "maritime" issues of wide interest will be discussed. The agenda will be as follows:

1. Refined Wave Modelling Workshop: review of proposal status and setting of priorities of pending tasks
2. Beach Dewatering: discuss the scope and the directions of a relevant group recently formed within the Maritime Hydraulics Section of IAHR
3. Developing Techniques and Good Practice Guidelines for Composite Modelling in Hydraulics: Presentation of progress of this EU project and discuss possibility in setting up an IAHR Working Group to continue work on a more global level once the project finishes nest year (Hydralab / COMIBBS)
4. New Protocols for Mobile Bed Model Design and Testing: As above #3. (Hydralab / SANDS)
5. Any other relevant issue to be raised during the meeting.

All interested are welcome.

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