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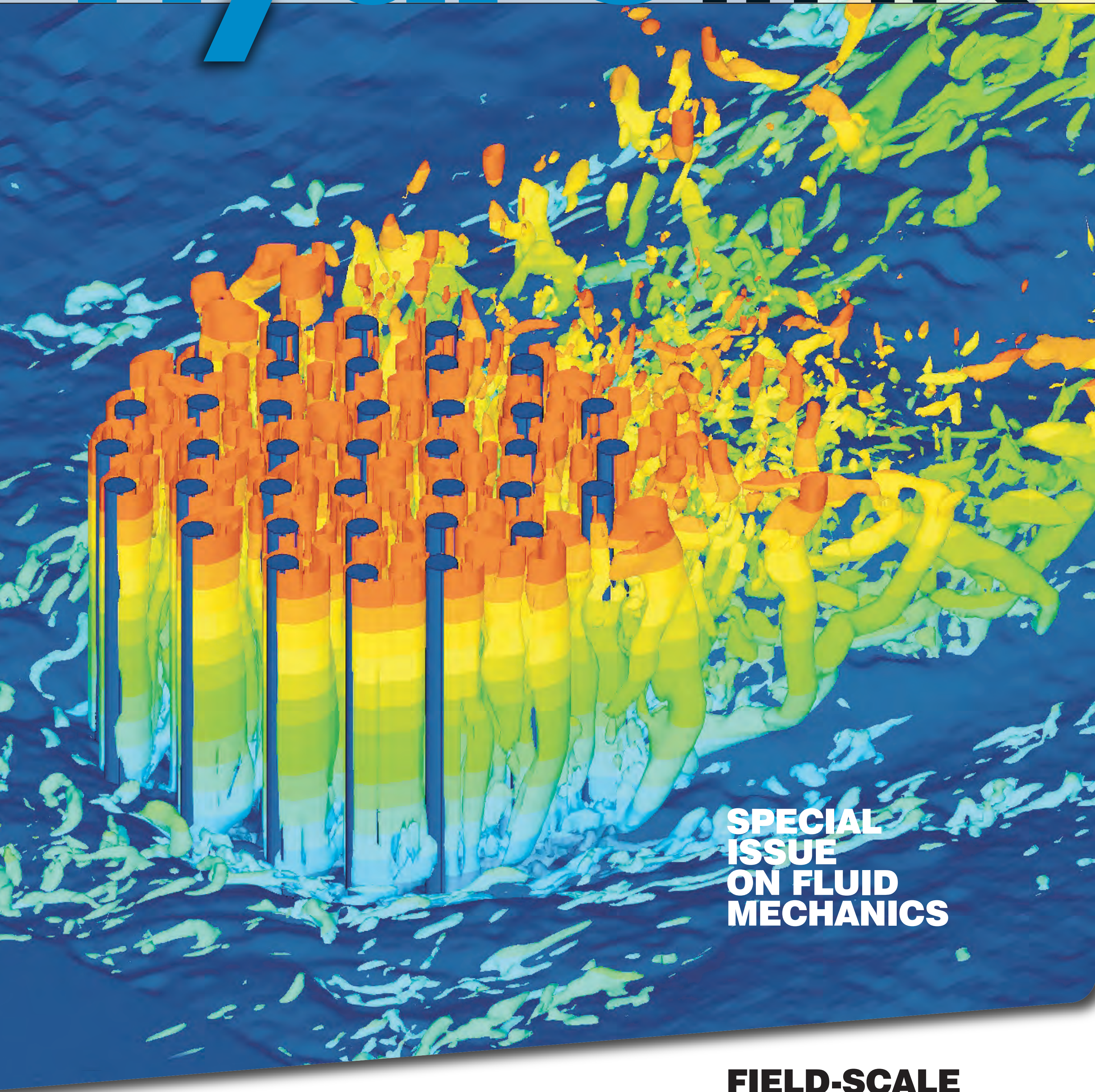

SPECIAL ISSUE ON FLUID MECHANICS

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THE (TURBULENT) FASCINATING HISTORY OF FLUID MECHANICS

EDITORIAL BY PROF. MICHELE MOSSA

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Many centuries, millennia have passed by since Archimedes gave us the fundamental principles of hydrostatics in his work On Floating Bodies (around 250 BC). We can consider that work as the starting point of the fluid mechanics discipline. Archimedes also formulated the first non-destructive method in history to determine the amount of gold contained in the crown of Hiero II, king of Syracuse. There were no calculations even with the great need for water supply and transportation.

Aside from Archimedes Sextus Julius Frontinus (30-104 AD) wrote the oldest treaty on the hydraulic technique, "De aquis urbis Romae". Less well-known, but no less important, is the work of Islamic scientists, particularly Abu Rayhan Biruni (973–1048 AD) and later Al-Khazini (1115-1130 AD) who were the first to apply experimental scientific methods to fluid mechanics, especially in the field of fluid statics, such as for determining specific weights. They applied the mathematical theories of ratios and infinitesimal techniques, and introduced algebraic and fine calculation techniques into the field of fluid statics. In the 9th century, the Banū Mūsā brothers wrote the wonderful "Book of Ingenious Devices" which describes a number of early automatic controls in fluid mechanics.

Further progress in fluid mechanics was made by Leonardo Da Vinci (1452-1519) who built the first chambered canal lock near Milan. He also made several attempts to study flight and developed some concepts on the origin of the forces.

After this initial work, knowledge of fluid mechanics increasingly gained speed thanks to the contributions of Galileo Galilei, who introduced the so-called "scientific method". By the standards of his time, Galileo was often willing to change his views in accordance with observation. In order to perform his experiments, Galileo had to set up standards of length and time, so that measurements made on different days and in different laboratories could be compared in a reproducible fashion. This provided a reliable foundation on which to confirm mathematical laws using inductive reasoning. Galileo observed that two elements are necessary in the scientific method: 1) experience and 2) demonstration.

Other developments in Fluid Mechanics followed Galileo's work, thanks to the contributions of Castelli, Torricelli, Euler, Newton, the Bernoulli family, and D'Alembert. At this stage theory and experiments still showed some discrepancy. This fact was acknowledged by D'Alembert who stated that "The theory of fluids must necessarily be based upon experiment."

Until the end of the eighteenth century the theoretical developments of fluid mechanics had a negligible impact on engineering. This situation began to change with the contributions of Antoine de Chézy (1718-1798), Henri Navier (1785-1835), Gaspard Coriolis (1792-1843), Henry Darcy (1803-1858) and many other researchers and engineers.

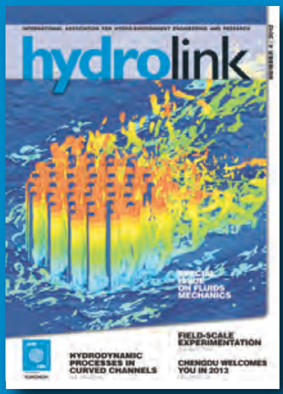
During the mid-1800s important results were obtained thanks to the work of the French doctor Jean Poiseuille (1797-1869), who, studying blood circulation, established the law of viscous laminar flows in circular ducts. The work of Poiseuille can be considered as one of the first attempts to apply fluid mechanics to bio-engineering, a theme of great interest today. Asis well-known, in that same period further advances were made by George Stokes (1819-1903), Osborne Reynolds (1842-1912), William Froude (1810-1879), Giovanni Battista Venturi (1746-1822) and, then, by Lord Kelvin (1824-1907), Lord Rayleigh (1842-1919) and Sir Horace Lamb (1849-1934). Successively, enormous consequences on a practical level were obtained thanks to the work on the boundary layer by Ludwig Prandtl (1875-1953) and his colleagues Theodore von Karman (1881-1963), Paul Blasius (1883-1970) and Johann Nikuradse (1894-1979).

Many questions are still open and unresolved in the (turbulent) fascinating history of Fluid Mechanics, such as the need for a deeper knowledge of the turbulence. On this point, how can we forget Bradshaw's quotation: "Turbulence was probably invented by the Devil on the seventh day of Creation when the Good Lord wasn't looking" (P. Bradshaw, Experiments in Fluids, 16, 203, 1994)?

What will be the development of fluid mechanics in the coming decades? Although it is difficult to make predictions, I think that biomedical engineering is a fascinating research area where co-operation between experts of fluid mechanics and human physiology will have an increasing interest. In addition, fluid mechanics will have more and more impact in the field of environment protection, contributing in various ways to the development and welfare of our society. The recommendation to explore this research field is very strong, considering that now connections to physics, geology, geomorphology, erosion science, ecology, biology, plant physiology, etc. are to be considered obvious. In the future, research teams which will be able to co-operate between disciplines and which bring an open mind to narrow and closes research areas, will surely be successful. It is time to work with the sole fascinating purpose of protecting this small space-craft which is our planet Earth.

This is why this issue of Hydrolink is mainly devoted to Fluid Mechanics, presenting several articles on the subject and an interview with Prof. George Constantinescu, Chair of the Fluid Mechanics Committee of IAHR.

I would like to end this editorial by sending my Season's Greetings to our readers.



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Cover picture: Coherent structures on flow past a surface mounted porous cylinder. George Constantinescu.

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IN THIS ISSUE

IAHR PRESIDENT'S MESSAGE

Prof. Roger A. Falconer
CH2M HILL – Halcrow Professor, Cardiff University, UK
IAHR President

Dear Members,
At the beginning of the New Year I would first like to send you my very best wishes for the coming year and I hope that the year ahead will be a peaceful, prosperous and healthy one for you and your family.
The past year has been my first full year in office and a time to continue to build on some of the previous initiatives, and develop new initiatives, to address some of the challenges our Association faces now and in the future. Some of these key initiatives are summarised below:

New Website
One of our key challenges has been to develop better communication between our members, our Madrid Secretariat, our committees etc. and by the time you receive this issue of Hydrolink our new website will have become live. This is the last major component of our new "Association Management System" which we have been developing behind the scenes over the past two years. The new accounts and back office systems were implemented early last year and have enabled us to improve significantly and streamline our membership management and accounting activities in the Madrid Secretariat.

The new website is the public-facing part of the new system and includes a wealth of new features compared with our old website. We believe our new system will allow us to strengthen our community and facilitate the activities of our vital volunteer groups:
- All members can access and update their own personal records in their our own private and secure on-line library – including adding information on expert fields, photographs and links to personal websites and other documents;
- We are creating a library for the Proceedings of IAHR Congresses and Symposia – accessible to all our members; and
- Committee (and Division and Working Group) leaders will be able to manage their activities within dedicated "Communities" via the website and share information and documents and collaborate on Wiki articles and Blogs.

More information on our new platform will be provided in upcoming issues of Hydrolink.

Connecting with Practitioners
A major objective of my Presidency is to reconnect our current more science-based community with engineers in practice. In my view our current membership level is not sustainable and to increase our membership we need to engage more with practitioners and make our Association more attractive to consultants, government departments and the hydro-environmental industry. In the early years of IAHR, and when I joined in 1980, our members were both university teachers and researchers and at the same time were active in practice. As the world has become more global the two parts of our discipline have tended to

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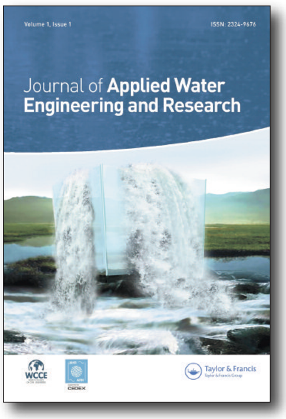
separate to such an extent that very few professional engineers now read our excellent flagship journal, namely the Journal of Hydraulic Research. At the same time I believe that engineers in practice need more help from our academic community so that they can be kept abreast of the rapid innovations taking place, especially in numerical modelling, sensor technology, renewable energy turbine technology, flood risk management etc.

To this end during the coming year I am delighted to welcome several new initiatives which are aimed at making our Association more attractive to practitioners and which, in due course, I hope will benefit all of us by providing the forum for practitioners to engage more with our current community. These include:

- *Launch of our new Journal of Applied Water Engineering and Research (JAWER) in partnership with the World Council of Civil Engineers and Taylor and Francis*

The first issue of our new peer-reviewed Journal will be published in June as an online publication. JAWER will specifically welcome papers on the application of research and practical case studies on all aspects of hydro-environment engineering and research. Practice-oriented papers and case studies are particularly welcome. The Editor is Tobias Bleninger and the Deputy Editor is Ramiro Aurin Lopera. Our new journal JAWER will complement our research-oriented journal JHR and our specialist rivers journal JRBM.



- *Development of our Hydrolink members magazine*

We will continue to strive to make our members magazine into a vibrant forum for presenting innovation in research and practice in the format of short and easily-readable articles. As part of this effort we have established an Advisory Board comprising senior representatives of leading practitioners from IAHR Institute Members, from around the world, to work with the Editor Michele Mossa in developing themes for the coming issues and with a more practice orientated focus. At the same time we will not forget the important value of Hydrolink as a forum for our members and we will further develop the non-themed part of Hydrolink as a place to present our Association's activities and member news and views etc.

Congresses

Over the years the IAHR World Congress, our flagship meeting point every two years, has been steadily growing with a high point being the 1500 delegates attending the IAHR Vancouver Congress in 2009. Of course success is not measured only in numbers – but the attendance at our Congresses does indicate that our domain of interest is important. I was also delighted to note that the organisors of the Brisbane Congress managed to attract so many practitioners to their meeting. I am also highly optimistic that the Chengdu Congress, which will take place this September, will maintain this success. Certainly the location of Chengdu in Szichuan Province with its world-famous Dujiangyan Irrigation system (a UNESCO heritage site) and the famous Panda Sanctuary will add to the attraction of the Congress.

The current IAHR strategy is to increase support for our regional congresses in the even years and I had the honour last year of being the first IAHR President in many years to attend all three of our regional congresses – in Munich, Germany, in June; in Jeju, Korea, in August; and in San Jose, Costa Rica, in September. I was delighted and honoured to deliver keynote addresses at the first two congresses and jointly open the Latin-America Division Congress and sign a national agreement with the Costa Rica Engineers Association.

In addition to our World and Regional Congresses, I also had the privilege of giving keynote addresses at IAHR sponsored conferences, including our own 10th Hydroinformatics conference in Hamburg, Germany, in July; and the International Conference on HydroScience and Engineering in Orlando, USA, in November; I also attended the closing ceremony of our Rivers 2012 conference in San Jose. At these events I was encouraged to see some of the vibrant communities within our Association at work and to realise the opportunities for closer collaboration between our speciality conferences and others and am keen to encourage closer collaboration between our Hydroinformatics community and the ICHE community.

Our Executive Director, Chris George, and myself have also had preliminary discussions with a number of other water associations about how we can work together more closely in the future, including: IWA, IAHS, IWRA, EWRI and CIWEM, and at the Chengdu Congress we are hosting a meeting of the Presidents of a number of water associations to establish a framework as to how we might be able to take forward a joint global initiative on Water Security. We hope this will be just the start of a closer working relationship with other water associations and that we can develop stronger partnerships with other such associations in the future.

These activities and initiatives are just a small part of all the activities which our various technical committees have organised during the year. The world faces ever increasing water related challenges, as I realised when preparing my keynote on extreme flood events for the ICHE conference just a week after Hurricane Sandy. For this disaster I noted that: over 140 people lost their lives, 6.2 million were without power, 1 million residents were ordered to leave their homes, 32 cm of rainfall fell over Maryland, 29 hospitals lost power in New Jersey, 10,000 flights were grounded globally, a 4 m tidal surge sent seawater into large parts of New York's subway, Oyster Creek nuclear power station was offline for maintenance, but officials said Sandy's storm surge was 15 cm off damaging its cooling system. This tragic disaster – like so many in recent years - highlights the crucial need for our Association; that is a global network of high level expertise covering all aspects of hydro-environmental engineering and research. However, it also highlights the need for us to ensure that all our technical committees and working groups etc. are covering the key relevant topics of today. With this in mind I am currently working with the Executive Committee and Secretariat to try and ensure that we are more visible in key areas such as: Water Security, Flood Risk Management, Renewable Energy, and Climate Change. If you have any other thoughts on key high profile topics which we should be addressing then please feel free to advise me through the Secretariat or directly.

Signing an agreement with the Costa Rica Engineers Association.

In the meantime, I would like to conclude this message by again extending to you my very best wishes for 2013 and on behalf of IAHR I would like to express my sincere thanks to all those members who have contributed so much of their time to the committees, workshops, journal editorships, books, monographs etc. and to all the Staff in Madrid who do such an excellent job with limited resources. Finally, I would also like to express our sincere appreciation to CEDEX, who provide us with considerable support in terms of monetary and in-kind resources; without their support our fees would have to rise considerably.


Flooded tunnel in New York City (Photo from Wikipedia).

CAN IAHR BE HELPFUL TO YOUNG RESEARCHERS AND PROFESSIONALS?

BY SANDRA SOARES-FRAZÃO AND IOANA POPESCU

A first meeting of a new group within IAHR, the "Young Professionals" was held during the Brisbane IAHR Congress last summer. This meeting, organized by Ioana Popescu under the auspices of the Education and Professional Development Committee, was chaired by Mrs. Sharon Nunes (Vice President of Strategy & Integration Board IBM Corporation) with the aim of addressing specific issues, on how IAHR can help young scientists and professionals. To feed the discussions, presentations of their personal experience were made by young professionals, e.g. Sandra Soares Frazao (UCL, Belgium), Eva Fenrich (Univ. Stuttgart, Germany), George Constantinescu (Univ. of Iowa, USA), and Francesca de Serio (technical University of Bari, Italy)

The question that was identified was to first know if IAHR is attractive to young researchers and young professionals. If it is not, then why? Several reasons were pointed out to explain the low participation and apparent lack of interest of young researchers in IAHR. First of all the organization itself is not well-known. It appears that the structure including the Council, the technical divisions and the technical committees is not clear to all the researchers. Young researchers and professionals see this organization as a large body of often old experts, and do not see where they could play an active role.

Another reason that arose from the discussions is the rapid turnover of young researchers. Indeed, who can take time for IAHR when the pressure for scientific production and publications is so high? In a world of "publish or perish", where young scientists often do not have a clear vision of their future after the PhD or the PostDoc, giving their time to an association such as IAHR appears as something they cannot afford. What recognition can they obtain from such an involvement? Of course, all the active members certainly will claim that there is certainly a valuable recognition, but this is unfortunately not clear for most young researchers and even more for young professionals.

Finally, the sometimes unclear links with other associations involved in water-related fields was also pointed out as a reason for less involvement of young researchers and professional. What can IAHR bring that another association cannot?

"Young researchers and professionals see this organization as a large body of often old experts, and do not see where they could play an active role."

However, despite this quite negative picture, the discussions showed that opportunities for young researchers and professionals do exist. Many ideas were proposed, showing the interest of the participants who, through their attachment to IAHR, would like the association to improve its image towards younger persons.

The Technical Committees, replacing the former Sections, are in the process of adopting a structure fostering a larger participation of the members. Through the new IAHR website, information will be available in an attractive way to promote the activities of these committees. Initiatives especially devoted to young researchers already exist, such as the Master Classes launched at the first River Flow conference, and now organized during other types of events. These mainly need better advertising to be known and to attract young people. Similarly, the existing media library is a fantastic tool for young researchers and professors in their teaching activities that deserves more visibility.

As was generally recognized by the participants, IAHR has a lot to offer, and really should be better known by the young generation. It is now our task within the division to make all the good ideas come true!

Sandra Soares-Frazão **is an Associate Professor at Université Catholique de Louvain, Belgium and she is currently the Secretary of the IAHR IPD Division**

Ioana Popescu **is a Senior Lecturer in Hydroinformatics at The UNESCO-IHE Institute for Water Education and she is also the Chair of the IAHR Education and Professional Development Committee**

10 QUESTIONS TO... George Constantinescu,

Chair of the IAHR Fluid Mechanics Committee

INTERVIEWED BY MICHELE MOSSA, HYDROLINK EDITOR

Dr. Constantinescu is Associate Professor of Civil and Environmental Engineering at the University of Iowa and is an Associate Editor of the ASCE Journal of Hydraulic Engineering and of the IAHR Journal of Hydraulic Research. He serves as the chair of the IAHR Fluid Mechanics Committee. He has co-authored 55 journal papers in the area of environmental fluid mechanics and hydraulics and more than 100 conference papers.

1. What do you think are the main questions in river engineering where fluid mechanics can provide an answer?

I think Fluid Mechanics can play a major role in answering three main questions related to present research challenges in river engineering:
1) To what extent are the physics of flows dependent on scale effects?
2) How the physics changes between simpler geometries studied in the laboratory in controlled environments and more realistic and complex geometries that are characteristic of natural environments?
3) How does our understanding of river flows and their interaction with natural elements can lead to better predictive models

2. What are the areas where fluid mechanics research can make an important impact as related to hydraulics and water resources in general?

I think that new instrumentation which has become available over the last 10-15 years together with the development of novel experimental and eddy-resolving numerical techniques helped us gain a better understanding and increases the accuracy of our prediction of flows relevant to hydraulics and related transport and dispersion of heat, sediment and contaminants, as well as fluid-driven ecological processes. Most of the flows of relevance to different areas of water resources occur over alluvial beds, and investigations on morphodynamic processes in such flows are a major current thrust of research. In many cases flow stratification, rotation and flow shallowness play an important role in determining the dynamics of such flows. In many aquatic environments, the interactions among flow, turbulence, vegetation, macroinvertebrates and other organisms as well as the transport and retention of particulate matter, have important consequences on the ecological health of rivers, marshes and coastal areas. In all these types of applications fluid mechanics plays a critical role.

3. Sometimes there is a sort of "competition" between researchers who use mainly physical models and those who mainly use numerical models. What is your opinion on this point?

I do not think that this is really the case! I would rather say that both approaches have advantages and disadvantages and that a joint approach is nearly always the best solution and worth pursuing. Much can be learnt from the application of cutting edge experimental (e.g., particle image velocimetry) and numerical (e.g., highly resolved direct numerical simulation, large eddy simulation-LES, large-scale predictive models) techniques to study the physics of flows and transport processes of relevance to river engineering.

4. Fluid Mechanics sweeps from topics that are very theoretical to others that have an immediate technical and engineering application. Sometimes this creates a discrepancy in the possibility to obtain funds for research. What is the situation on this point in your university and, generally speaking, in the USA?

It is true that, especially in US, it is very hard to get funding from the National Science Foundation in what I would call classical hydraulics or river engineering. The key is to link classical problems (e.g., sediment transport in rivers) to 'hot' research areas like river sustainability (e.g., stream restoration, protection of endangered species like fish and freshwater mussels, nutrient transport). The secret is to start by considering a very relevant applied problem and then to try to isolate the parts where fluid mechanics can be used to explain some of the fundamental mechanisms that will help find answers to some of the more applied technical questions.

5. Recent environmental disasters have drawn major public attention to the need to safeguard our seas, rivers, and lakes. What is your opinion on the potential contribution of Fluid Mechanics on the protection of the environment?

I think prediction and monitoring of river- and hurricane-induced floods are maybe the best example. For example, recent natural and anthropogenic disasters such as floods, hurricane damage, oil spills and mudslides, have been critical components of the national discourse in US. The impacts of floods and the effects of failure of hydraulic structures during floods (e.g., levees) is a major engineering problem in which fluid mechanics and, in particular, computational fluid mechanics has a critical role to play. This is because floods are generally simulated using shallow flow models. We are at a point where we can simulate flood scenarios over very large areas. This is possible because of the development of robust and accurate 2D depth-averaged flow solvers and of numerical algorithms and codes that scale well when run on hundreds and even thousands of processors needed to perform these simulations in a relatively short amount of time.

6. What do you think about the future development of Fluid Mechanics?

I think more and more Fluid Mechanics will come into play as we try to address multi-disciplinary problems related to important problems that face our society. A good example is the field of eco-hydraulics that has seen a huge growth over the last decade. For example, vegetation is very important for maintaining the quality of water in rivers because of it's efficiency for nutrient purification through the absorption, sedimentation, and biochemical functions of microbes around plant stems and roots. At a more general level, sustainability of river ecosystems, stream restoration and improvement of water quality are high stake challenges for our society. Our understanding of the interactions among flow, suspended particles, nutrients and river organisms play an important role in the health of the stream and needs to be refined. A multiple scale approach where physical processes and biology are considered at each representative (basin, river, and organisms) scale is the obvious way to proceed. I am a strong advocate of the use of state-of-the-art eddy-resolving experimental and numerical techniques as a main way of investigating the physical mechanisms that underlie the biological and ecological functions of vegetation, macro invertebrates and other river organisms that play an important role for fluvial ecology processes

7. How do you think that IAHR could help this future development of Fluid Mechanics?

I think IAHR is already doing the right thing by organizing a series of high profile educational and scientific activities that try to emphasize the relevance of fluid mechanics beyond what I would call classical hydraulics and river engineering. I am referring here in particular to IAHR events such as the Environmental Summer School, the International Symposia on Environmental Hydraulics, Stratified Flows and Shallow Flows. Providing a common forum for presentations and discussions at a thematic meeting fosters interdisciplinary research and collaboration, rapid dissemination of latest findings, and provide an opportunity for discussing how novel methods and techniques can be used interchangeably in various fields and application areas of engineering and science It is also a way for IAHR to be better known by the scientific community at large.

8. What was your experience with organizing a major IAHR event which has a strong fluid mechanics component? What was the secret for its success?

It was a very interesting and rewarding experience for me to organize the 3rd International Symposium on Shallow Flows. Some 170 papers were presented. The Symposium provided a common forum for discussions among researchers and groups active in shallow flows research using state-of-the-art experimental, field and numerical investigation methods, fostered collaboration and rapid dissemination of latest findings. The symposium provided an opportunity for discussing how novel methods and techniques developed in a certain area of shallow flows can be used interchangeably in various fields and application areas of engineering and science. The 3rd ISSF symposium was the first in the series to introduce ecological aspects and large scale geophysical flows as main topics. I should also mention that a highlight of the symposium was the special session honoring the contributions of the late Prof. G. Jirka who was one of the strongest promoter of fluid mechanics research in IAHR.

9. I cannot avoid a question on the development of the knowledge of turbulence. Sir Horace Lamb said: "I am an old man now, and when I die and go to Heaven there are two matters on which I hope for enlightenment. One is quantum electrodynamics and the other is the turbulent motion of fluids. And about the former I am rather optimistic." Explain briefly to our readers the potential development of this topic.

I think we are much closer to understanding turbulence and its effects. As far as hydraulics is concerned, major advances were reported in understanding flow over rough beds, the coupling between turbulent flows and the evolution of bedforms, 2-D turbulence which is important in shallow environments and how stratification affects turbulence structure. We have a much better qualitative and quantitative idea about the role that large-scale turbulence (macro turbulence) is playing in controlling momentum and mass transport. We also are much more aware that in some cases turbulence is subject not only to quantitative but also to qualitative changes as the Reynolds number increases past a certain threshold. All this was possible because of development of sophisticated experimental and numerical techniques that resolve most of the relevant turbulent structures in turbulent flows

10. As usual, in the last question you are free to direct to our readers to send them a message of yours on a topic that is dear to your heart.

Given my research, I feel very strongly about the role that numerical simulations which resolve the dynamics of the energetically important coherent structures in the flow can play in understanding some 'old problems' in river engineering. With the advent of large-scale parallel computing we can now talk of 'numerical experiments' that produce data similar to that obtained from a real experiment. Of course, this assumes that the boundary conditions are specified in a way consistent with the physical problem one simulates and that the meshes are fine enough to resolve the dynamically important eddies. What is exciting is that this method of investigating turbulent flows is not anymore restricted to very simple geometries and to very low Reynolds numbers. Together with progress in the development of near-wall models and hybrid RANS-LES approaches, we are at the point where we can perform high-resolution eddy-resolving simulations of flow and transport processes in natural streams of a length of several kilometers at field conditions. Given the fact that field experiments are very costly and data available from such experiments are fairly limited, especially in terms of spatial resolution, data from high-resolution eddy resolving simulations can provide a lot of valuable insight into flow and turbulence structures. This should allow us to better understand the fundamental mechanisms that control the momentum and mass transport processes in critical regions of river networks (e.g. at river confluences).

HYDRODYNAMIC PROCESSES
FROM BASIC RESEARCH TO ENGINE

BY KOEN BLANCKAERT

This article summarizes some research performed during the last 15 years on hydrodynamic processes and their implications for river morphology, ecology, engineering and management. The investigated processes include curvature-induced and turbulence-induced secondary flows, flow separation from boundaries, shear layers and turbulence. These processes do occur in natural rivers and channels and play a prominent role in, for example bends, confluences and bifurcations. Three-dimensional flow processes enhance mixing and transport processes, but they also enhance the energy losses and thereby reduce the conveyance capacity. They have an important influence on the sediment transport and lead to the formation of zones of deposition and scour, which may affect navigability or endanger structures like bridge piers, abutments and riverbanks. They also enhance heterogeneity in substrate, flow and morphology that may enrich habitat. On geological timescales, they affect the planform evolution of the river and the development of the floodplain stratigraphy, which is relevant with respect to the exploration of hydrocarbons. The research described in this article, was performed in a collaboration that exploits synergies between expertise in field experiments, laboratory experiments, analytical modelling, numerical modelling and ecological processes available in different groups at Ecole Polytechnique Fédérale de Lausanne (Switzerland), Delft University of Technology (The Netherlands), Leibniz Institute of Freshwater Ecology and Inland Fisheries (Germany), University of Iowa (USA), and Chinese Academy of Sciences (China). All colleagues who contributed to this joint research are acknowledged:
G. Constantinescu, V. Dugué, W. Ottevanger, M. Koken, W. Uijttewaal, W. van Balen, H.J. de Vriend, A. Schleiss, M. Ribeiro, I. Schnauder, F.X. Garcia, M. Pusch, A. Sukhodolov, R. Li, R. Han, Q. Chen.
The main objectives of the research were: to enhance insight in these hydrodynamic processes, to convert the new knowledge into practical tools for application in a wide range of spatial and temporal scales, and to transfer the knowledge to students, scholars and practitioners. The present article highlights some of the results on hydrodynamic processes in open-channel bends, and tries to identify some remaining directions for future research and application.

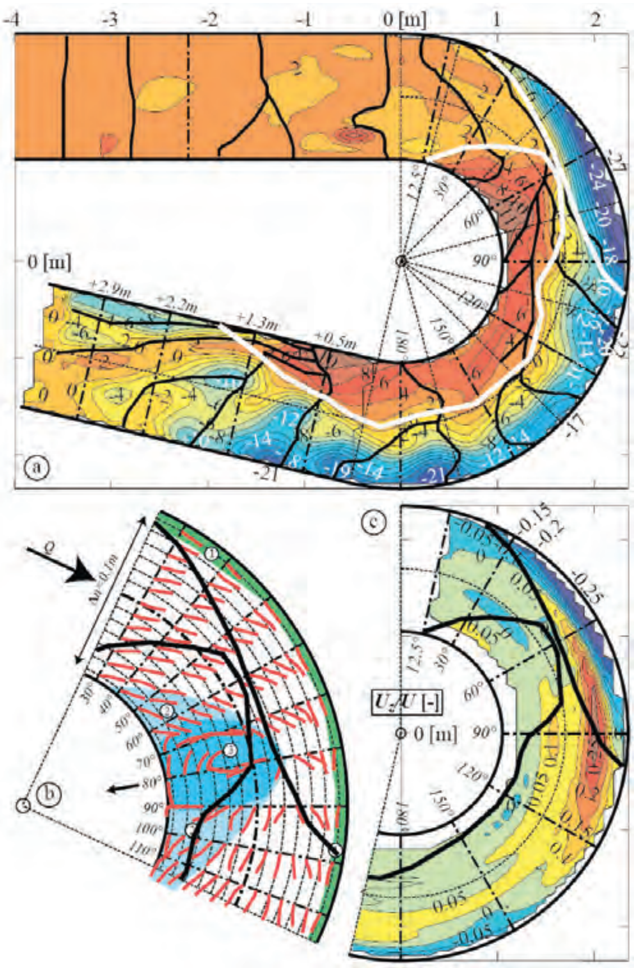


Figure 1. Mobile bed experiments in a curved laboratory flume. (a) Bed level with an interval of 0.02 m. The black lines indicate the position of dunes. The white lines delineate the point bar and pool. (b) Visualization of the flow at the water surface: (1) outer-bank cell of secondary flow; (2) zone of flow separation; (3) zone of flow recirculation. (c) Depth-averaged vertical velocity normalized with the flume-averaged velocity. Figure modified from Blanckaert (2010).

1 Experimental research

Laboratory experiments are being performed since 1998 at Ecole Polytechnique Fédérale de Lausanne in the flume shown in Figure 1, which was designed to be representative of sharply curved natural open-channel bends. This laboratory flume provides a setting with controlled flow and boundary conditions defined with an accuracy exceeding that which could possibly be obtained in a field study. A systematic series of experiments has already been performed that investigates the influence of parameters, such as the degree of curvature defined by the ratio of flow depth to centreline radius of curvature, the configuration of the bathymetry, the roughness of the banks, and the inclination of the banks.
Figure 1 shows some results in a live bed experiment with a typical equilibrium bathymetry that consists of a shallow point bar at the inner side and pronounced bend scour at the outer side of the bend. Figure 1b shows that horizontal flow recirculation occurs over the shallow point bar.

IN CURVED CHANNELS:
EERING APPLICATION

This flow separation captures fine sediments and plays an important role with respect to accretion at the inner bank. Moreover, it reduces the effective width and directs high velocity flow towards the outer bank, thus enhancing the flow attack on the outer bank. In spite of its importance, important knowledge gaps remain, such as the parameters of influence, the conditions of occurrence, the dependence on the geometry and roughness of the bank, and the underlying physical processes.

Figure 1c shows the depth-averaged vertical velocity, based on measurements in the indicated cross-sections. The flow cannot follow the abrupt change in direction at the bend entrance, and collides with the outer bank at an oblique angle near the cross-section at 60°, resulting in abrupt flow reversal and important vertical velocities that impinge on the channel bed and contribute to the formation of the maximum bend scour. The velocities impinging on the bed are deflected inwards near the bottom, and permit the sustaining of a transverse bed shape that is steeper than the angle of repose of the sediment. Zeng et al (2008) have satisfactorily predicted the flow and the macroscopic features of the bed morphology in this experiment with a 3D RANS flow model and Engelund-Hansen's sediment transport formula. The maximum bend scour and the maximum transverse bed slope, however, were underestimated. This indicates that the sediment transport formulae could be improved by including effects of vertical velocities impinging on the channel bed, which are found in a variety of other configurations, such as bridge piers, jets, etc.

2 Numerical research

In the experiment illustrated in Figure 1, about 50 vertical profiles of the three-dimensional velocity vector were measured at high temporal resolution in 12 cross-sections around the flume. In spite of this unprecedented detail, the measurements cannot provide all relevant information on the flow: the spatial resolution in streamwise direction is relatively low, important variables such as the boundary shear stress and pressure fluctuations are not measured, and information on coherent turbulence structures is incomplete. This information can be obtained from numerical simulations, after validation of the numerical model by means of the available experimental data. The hydrodynamics in the illustrated experiment have been numerically investigated by Van Balen et al. (2010) at Delft University of Technology, and by Constantinescu et al. (2011) at the University of Iowa, by means of so-called eddy-resolving techniques, which directly resolve the large scales of the turbulent motion.

Figure 2 illustrates some numerical results obtained by Constantinescu et al. (2011). Figure 2a shows an instantaneous pattern of the vertical vorticity at the free surface, i.e, vortices that rotate around a vertical axis. A shear layer characterized by high vorticity is clearly visible at the edge of the zone of horizontal flow recirculation over the shallow point bar (Figure 1b). Flow animations based on the simulation results show that vortices shedding from the downstream part of this shear layer, at times, impinge on the outer bank near the cross-section at 90° (Figure 2a). This results in large pressure fluctuations on the outer bank (Figure 2b). The effect of such pressure fluctuations on

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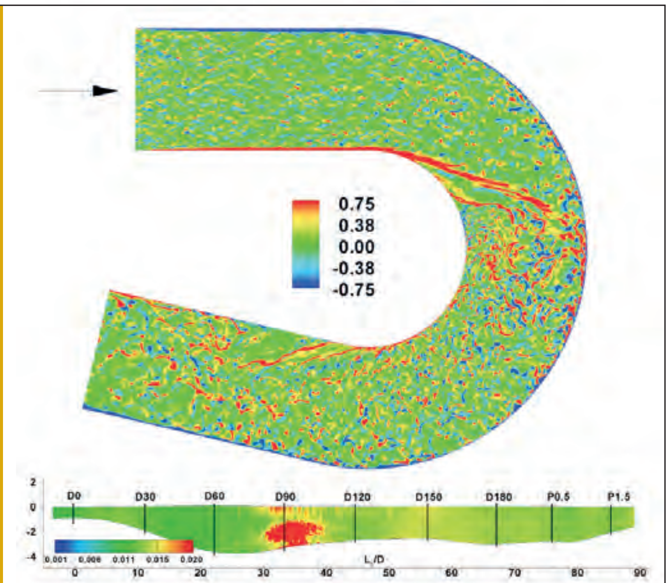
Figure 2. Results of numerical simulations by means of Detached Eddy Simulation. (a) Instantaneous pattern of the vertical vorticity at the water surface, normalized by U/H (U and H are the flume-averaged velocity and flow depth, respectively). (b) Distribution of the pressure RMS fluctuations at the outer bank, normalized by 2U4 where is the water density. Modified from Constantinescu et al. (2011).



the potential for bank erosion, and the inclusion of this effect in sediment transport models and in design methods for bank protection, would be challenging and highly relevant research topics. Numerical models are powerful tools for the broadening of the investigated parameter space and the generalization of the results. Changing the radius of curvature of the bend, for example, is practically not feasible in a laboratory flume, but straightforward in a numerical simulation.

3 Engineering tools and techniques

3.1 Model for flow and morphology in open-channel bends

The computational cost of eddy-resolving flow models is still prohibitive for most practical applications. Therefore, knowledge gained from the experiments and the numerical simulations needs to be converted into practical tools for engineering. Common one-dimensional models predict the average water depth and flow velocity in each cross-section of the river. For the case of meandering rivers, one-dimensional models exist that also predict the transverse gradients of the bed profile and the velocity (Figure 3a). A review of such models is given in Camporeale et al. (2007). Secondary flow, defined as the flow component perpendicular to the channel axis (Figure 3a), plays an important role in the transverse redistribution of the morphology and the velocities.

Most existing models for curved open-channel flow account for the effects of the secondary flow by means of a parameterization that is based on the hypothesis of mild curvature. This parameterization is known to overestimate the effects of the secondary flow in moderately and strongly curved bends. Based on the enhanced insight provided by laboratory experiments and numerical simulations, Blanckaert and de Vriend (2003, 2010) and Ottevanger et al. (submitted) have developed a parameterization for the secondary flow that remains valid for moderately and strongly curved bends. Figure 3b shows the evolution of the transverse bed slope around the flume for the experiment shown in Figure 1: it compares the measured evolution to predictions by mild-curvature models and the newly developed model without curvature restrictions. Mild-curvature models considerably overestimate the maximum transverse bed slope in sharply curved bends, which leads to an overestimation of the maximum bend scour and the flow attack on the outer bank. The newly developed model considerably improves the accuracy of the predictions, at only a marginal increase in computational cost. Obviously, such a one-dimensional model can only predict the macro-scale features of the flow field and the morphology, and is intrinsically unable to resolve features on a spatial scale smaller than the channel width. Such a model is, however, a valuable practical tool. With little input information and at a low computational cost, it allows estimating the morphology and flow field. Based on the river planform, provided for example by aerial images or the design of a re-meandering scheme, it allows identifying the regions with maximum scour depth and maximum velocity that will be most vulnerable to bank erosion. The low computational cost furthermore allows large-scale and long-term simulations. When coupled to a model for bank erosion and planform evolution, the model allows investigating meander dynamics at geological timescales, including processes occurring in sharp meander bends that are close to cut-off.

The combined experimental-numerically research is being pursued, and focuses on the improvement of the parameterization of the flow attack on the banks, by accounting for processes such as flow separation, pressure fluctuations, and turbulence-induced near-bank secondary flow cells.

3.2 Modifying flow in morphology by means of bubble screens

Curvature-induced secondary flow redistributes the flow and contributes to the development of the typical bar-pool morphology. Figure 1 illustrated that vertical velocities impinging on the channel bed contribute to the development of the maximum scour. Based on the insight gained in hydrodynamic and morphodynamic processes by means of the laboratory experiments and numerical simulations, a technique has been developed that consists in counteracting the curvature-induced secondary flow by means of a bubble screen situated near the outer bank. The rising air bubbles counteract the vertical velocities impinging on the bed. Figure 4 compares the flow field and the morphology in the cross-section at 180° in the laboratory flume shown in Figure 1 (Dugué et al. 2013). In the reference situation without bubble screen, a curvature-induced secondary flow cell occurs in the deepest part of the cross-section. Maximum scour depth is found where the vertical velocities associated with this secondary

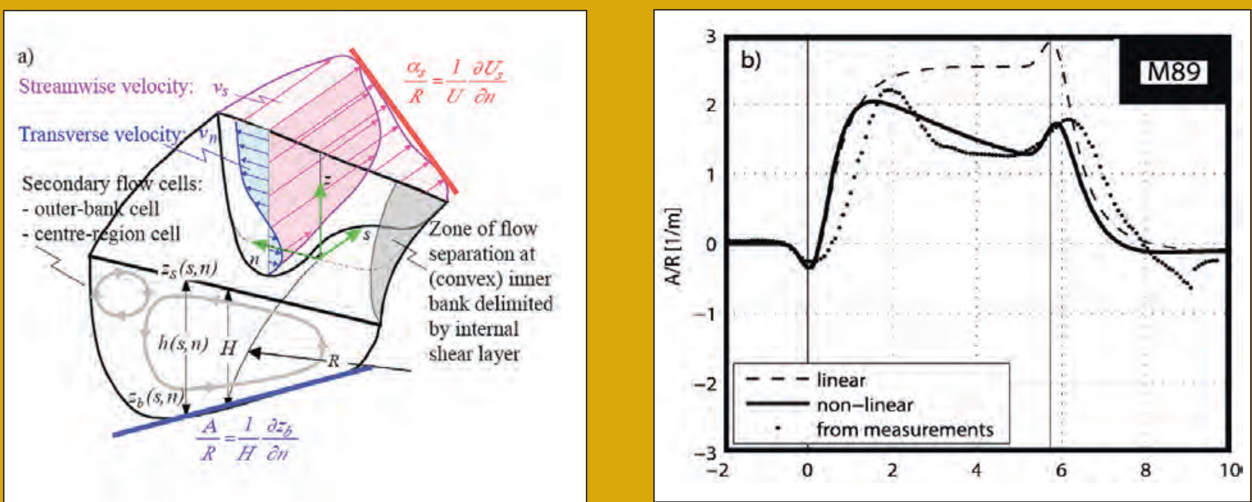


Figure 3. (a) Conceptual representation of flow and morphology in open-channel bends. (b) Evolution around the bend of the transverse bed slope, defined as $A/R = H^{-1}\partial h/\partial n$ in the experiment shown in Figure 1. Comparison of experimental data to simulation results with a weak-curvature model (labeled "linear") and a model without curvature restrictions (labeled "non-linear").

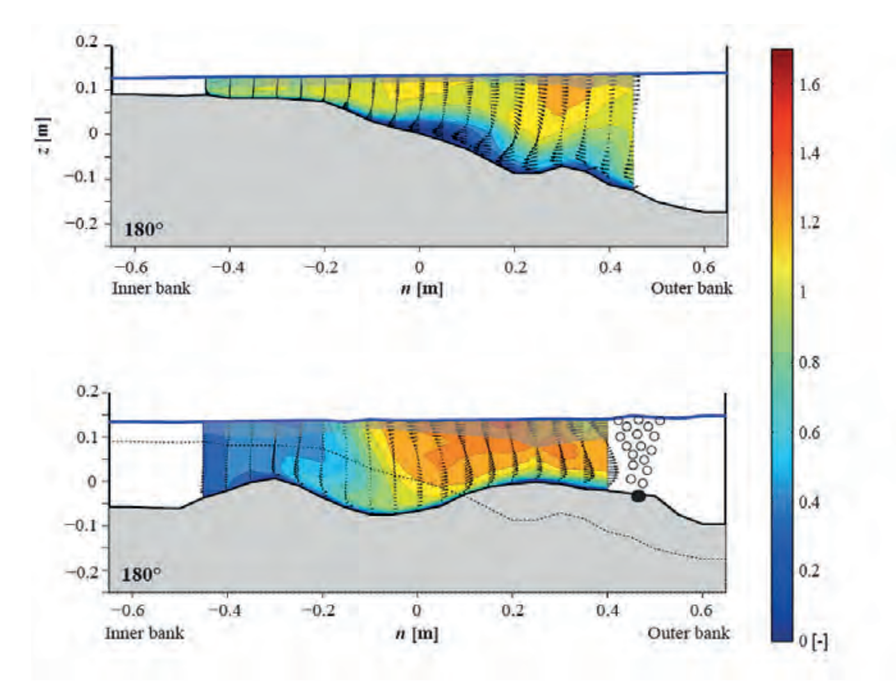


Figure 4. Cross-section at 180° in the bend shown in Figure 1. Bed morphology, streamwise velocity normalized by the cross-sectional averaged velocity (color contours indicate) and secondary flow (vector pattern). (a) Reference experiment without bubble-screen. (b) Experiment with bubble screen.

flow impinge on the bed. In the presence of a bubble screen, the rising air bubbles entrain fluid, and cause a secondary flow cell with a sense of rotation opposite to the curvature-induced secondary flow. This bubble-induced secondary flow redistributes the flow and shifts the core of highest velocities away from the outer bank. The maximum scour, core of vertical velocities impinging on the bed, and core of maximum streamwise velocities are all found near the junction of the curvature-induced and the bubble-screen induced secondary flow cells. Morphological gradients are considerably reduced, as illustrated by the reduced scour near the outer bank and the reduced deposition near the inner bank.

This laboratory experiment demonstrates the capability of the bubble-screen technique to modify the flow field and the morphology in rivers. The potential use of the technique is not limited to open-channel bends, but to configurations where local scour occurs due to vertical velocities impinging on the bed, such as bridge piers, abutments or obstacles in the flow. Further research is required to investigate scale effects, estimate the range of applicability, and develop the bubble-screen technique into a practically applicable tool.

4 Knowledge transfer

A list of publications related to the results described in the present article is available at: https://documents.epfl.ch/users/b/bl/blanckae/www/Blanckaert_Publications

Besides knowledge transfer by means of publications, it is important to promote collaboration between hydrologists, fluid mechanicians, hydraulic engineers, geomorphologists, geologists, ecologists, etc. Two events have been organized in the framework of the reported joint research program. In 2008, the International Summer School "Complex flows, turbulence, morphodynamics and ecology in rivers" was held at Delft University of Technology, The Netherlands. In 2011, the Euromech Colloquium 523 "Ecohydraulics: linkages between hydraulics, morphodynamics and ecological processes in rivers", was held in Clermont-Ferrand, France. A special issue of the Journal "Ecohydrology" will be devoted to it in 2013. These were stimulating events that promoted collaboration, multi-disciplinarity, and knowledge transfer, and provided optimal conditions for the germination of new ideas.

I take the opportunity to thank IAHR for supporting these events.

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MEANDERING RIVER ADJUS
FROM ANCIENT TIMES TO 2013

BY ANA MARIA FERREIRA DA SILVA

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The word meandering is derived from the Menderes River, located in southwestern Turkey, and in ancient times known to the Greeks as Maiandros (see Fig. 1). In Greek mythology, the Maiandros was not just a river, but actually, at the same time, a god. As it happens, the river itself was very active. Its 'restlessness' was explained as the works of a playful, or perhaps temperamental, god Maiandros, who often faced lawsuits for "altering the boundaries of the countries on his banks" (in *Geographica (12.8.19)*, by the Greek geographer, philosopher and historian Strabo (64/63 BC - ca. 24 AD).

We may nowadays consider the explanation for lateral displacements of a meandering river in the previous paragraph rather naïve or simplistic, but the fact remains that a systematic research on meandering was only initiated towards the end of the 19th century. An excellent review of this early research is provided by Serge Leliavsky (1959), in his fascinating book "An Introduction to Fluvial Hydraulics". Since then, and especially over the past 50 or 60 years, a voluminous literature has been produced on various aspects of meandering. The rapid development of computers in the later part of the 20th century has greatly contributed to developments in the field, with difficulties in making the computer models to reproduce reality prompting the related scientific community to substantially deepen our understanding of the underlying physical processes and improve their mathematical expressions. Towards the end of the 20th century, it had become possible to quite accurately simulate the process of bed deformation of a meandering stream with rigid banks. This may actually appear as a rather trivial achievement to a person not at all familiar with advanced fluid dynamics, turbulence modeling, sediment transport, the solution of complex

Figure 1. Photo of the Menderes River (courtesy of Prof. Gary Parker, University of Illinois at Urbana-Champaign).

TMENTS OF EQUILIBRIUM – AND BEYOND

systems of differential equations, and the difficulties (and cost) associated with the acquisition of laboratory and field data to verify and validate the models. To those early scientists dealing with meandering at the end of the 19th and first part of the 20th century, such simulations would be unimaginable. Given the length limitations of this article, it is not possible to provide here references to multiple papers where very successful calculations of meandering bed deformation have been presented. However, the interested reader needs only to do a Google search under "Computation of bed deformation of meandering streams" to acquire such information.

Recent research on meandering is marked by substantial efforts by several authors from different parts of the world to extend previous models for the computation of bed deformation also to the computation of bank deformation, with the goal of capturing the plan developments of meandering streams (which involve both downstream migration and lateral expansion of meander loops, as illustrated in Fig. 2, showing one of the landmark experiments carried out by Friedkin 1945, at the US Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi). The problem is challenging, as the physical processes involved in the shifting of the banks are complex and far from being completely understood and/or satisfactorily described in mathematical terms. The problem is compounded by the spatial and temporal scales involved. Planimetric adjustments of equilibrium in a meandering stream can range from a matter of hours/days in a laboratory stream, years in a small creek, to many decades (and sometimes centuries) in large rivers. An insightful discussion of some of the existing challenges has been presented by Mosselman (1995) in a paper which, despite substantial progress in the field over the past ten years or so, nonetheless remains nowadays as up-to-date as when it was first published. A comprehensive review of post-1995 research efforts has been presented by Nasermoaddeli (2012).

The present focus on meandering planimetric adjustments of equilibrium is motivated by practical needs. On one hand, there is an increasing demand for stream re-naturalization and, in particular, stream "re-meandrization". On the other, the need to develop mitigation and adaptation strategies to climate change has been brought to the forefront of our concerns. For these reasons, it has become particularly pressing to develop the ability to accurately answer the question "*How exactly will a meandering river respond, over time, to changes in water and sediment yields caused by land-use changes at the watershed scale, or changes in intensity and patterns of precipitation as a result of climate change?*" (This question is, of course, pertinent to all rivers, be they straight, meandering or braiding; the reference to meandering rivers only in this question is merely because this article is restricted to the case of such rivers).

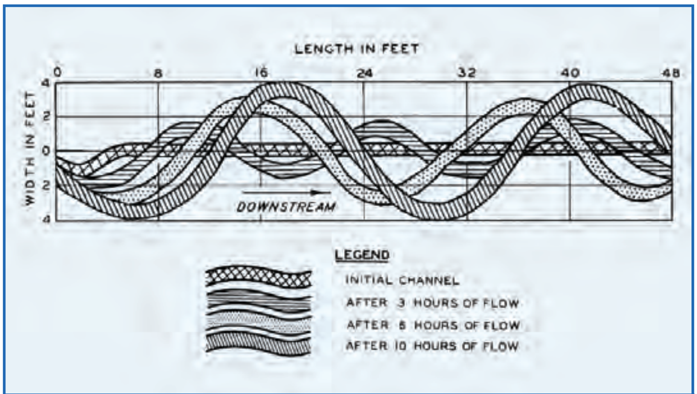

Figure 2. Temporal evolution of a meandering stream in a laboratory stream (from Friedkin 1945).

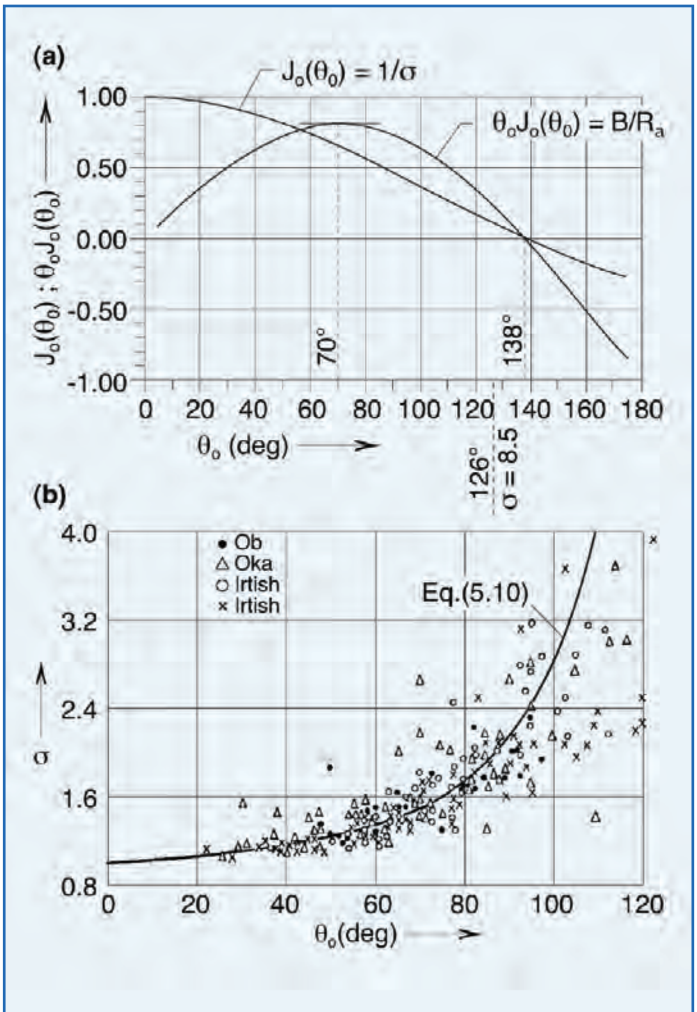

Figure 3. Plots of stream sinuosity versus meandering deflection angle at the crossover (from Yalin and da Silva 2001).

A completely satisfactory answer to the question requires that we become proficient in accurately simulating the evolution of a meandering river, as it simultaneously undergoes bed and plani-metric changes until it adjusts to a new state of equilibrium. Echoing Mosselman (1995), "so far none of the (existing computer) models has reached the level of being a generally valid and easy-to-use software package". Yet, at the beginning of the 21st century, we can stand confident that it is only a matter of time until such a day will arrive – even if it is clear that substantial research efforts will be required before such a state is reached.

Insight into the question above can also be obtained by resorting to the very extensive body of knowledge on river morphology and river dynamics accumulated over the past 100 years. In the following, the author will attempt to briefly illustrate this point, by seeking an answer to the following hypothetical (and obviously simplistic in its nature) question: "A meandering river appears as stable over a long stretch, where the sinuosity is 1.57. The bankfull flow rate is $Q = 1670\ m^3/s$; the average grain size of the cohesionless alluvium is 0.18 mm. What kind of morphological changes in flow plan can we expect this river to undergo if some changes (climatic or of land-use at the watershed level) will, over some period of time, result in a bankfull flow rate increase of 30%?" The stream used as example here is, however, not hypothetical: the conditions of the original river are based on those of the Bhagirathi River (India), as reported by Chitale (1970). To get insight into the problem, the considerations on regime (or stable) channels and meandering in Yalin and da Silva (2001) will be combined with the findings on meandering river morphology by Leopold and Langbein (1966). In particular, use will be made of the following principles and relations:

1. In agreement with Yalin and da Silva (2001) (see also Bettess and White 1983 and Chang 1988), the expansion of meander loops is viewed here as a means for a stream to achieve its regime (or stable) state: starting from the initial slope when the stream is straight (= the valley slope S_V), the meander loops will expand as much as needed until the (positive) difference ($S_V - S_R$), where S_R is regime slope, will be eliminated.

2. According to Leopold and Langbein (1966), regular meandering streams closely follow sine-generated curves. It can be shown, as done by Yalin and da Silva (2001), that in this case the stream sinuosity is uniquely related to the meandering deflection angle at the crossover, θ_0. This relation is illustrated in Figs. 3a and b. It should be recalled that the stream sinuosity σ is given also by $\sigma = S_V/S$, where S is stream slope. Therefore, at the regime state, $\sigma = \sigma_R = S_V/S_R$.

Figure 4. Erosion of outer bank in the Hardebek-Brokelander Au River, in northern Germany (courtesy of Dr. M. Hassan Nasermoaddeli, Technical University of Hamburg-Harburg).

We start by calculating the regime channel characteristics (regime width B_R, depth h_R and slope S_R) with the aid of the computer program BHS-STABLE (in Yalin and da Silva 2001). The method of calculation incorporated in this program was tested against numerous field and laboratory data by da Silva (2009), showing satisfactory agreement between measured and computed values of B_R, h_R and S_R. For the case of the example under consideration, BHS-STABLE yields:

a) For the original flow rate (= 1670 m^3/s):
B_R = 235m; h_R = 6.37m; S_R = 0.000086 (noting that these values are comparable to the measured values of B, h and S reported by Chitale 1970);
b) After the 30 % increase in flow rate:
B_R = 267m; h_R = 7.28m; S_R = 0.000074.

From the just calculated values of S_R and the geometric relations and graphs mentioned in point 2 above, it follows that the increase in flow rate would lead to an increase in sinuosity from 1.57 to 1.82, corresponding to an increase in θ_0 from approximately 72° to 82°. By plotting the sine-generated curves corresponding to these angles (by assuming that the meander wavelength would remain unchanged), it is found that such increase in sinuosity is associated with an "outwards shift" of 95 m of the channel centerline at the apex section.

The calculations above indicate that, over time, the increase in 30% in flow rate in such a stream should lead to an increment in flow width of some 30m. Repositioning of the stream in the landscape would also be observed. When both stream widening and meander loop expansion are taken it account, the expected amount of lateral shifting at the apex would be of the order of 110m. This amount of bank shifting is by no means insignificant, and the associated bank erosion would be substantial. Outer bank erosion in a meandering stream is illustrated in Fig. 4, showing a photo of the Hardebek-Brokelander Au River in northern Germany, currently undergoing very active meander loop expansion.

I would like to end this article by thanking my Ph.D. student Mohsen Ebrahimi for producing the sine-generated curve plots mentioned above.

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FIELD-SCALE EXPERIMENTATION IN FLUVIAL HYDRODYNAMICS: EXPERIENCE AND PERSPECTIVES

BY ALEXANDER N. SUKHODOLOV

Dr. Alexander N. Sukhodolov **is an associate editor of the Journal of Hydraulic Research, and a senior scientist of the Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany. He has over thirty years of experience in field studies in river hydrodynamics, transport processes, and flow-biota interactions. he participated and organized more than fifty field measurement studies and expeditions in Russia, Ukraine, Moldova, Poland, Germany, Italy, and the USA. These studies were focussed on river turbulence, hydrodynamics of recirculation flows and confluences, flow structure in meander bends, effects of bedforms, longitudinal dispersion and implications of hydrodynamics for benthic invertebrates, fish, and aquatic vegetation. During the last decade he has been developing an original field-scale experimental approach in which high resolution flow measurements are combined with in-situ control of flow variables. Presently he is a coordinator of IGB research platform on the Tagliamento river.**

Field measurements and observations have been traditionally basic methods in fluvial hydraulics before laboratory studies became successful and widespread. Despite the success of laboratory work, observations and measurement studies in nature have remained a major source of inspiration. Up-scaling the results obtained in the laboratory is often performed against coarse and episodic measurements completed in the field. Recent developments in acoustic velocimetry, computer technologies, laser survey and global positioning systems have greatly expanded the possibilities for carrying out detailed field measurements. Nevertheless, the results of field observations remain snapshots of reality while laboratory experiments give an insight into the dynamics of idealized systems. This paper reports on experience and outlines perspectives in development of an alternative approach which combines field measurement studies with the techniques of control on experimental variables.

During the last century research in fluvial hydraulics has demonstrated several successful attempts to expand the methods of experimentation to a prototype scale – the scale of natural streams. With a few exceptions those research activities were primarily focusing on the propagation of flood waves in rivers and the results of those studies were used to verify and calibrate numerical models. An experimental control of principal variables – a core element of laboratory experimentation – in those studies was achieved through the manipulation of flow rates during the releases of water from reservoirs. These studies allowed rigorous testing of many theoretical approaches, for instance a theory of kinematic wave propagation, and expanded their application for large-scale management and engineering of fluvial systems.

Although the advantages of experimentation on the prototype-scale are quite obvious, implementation of this approach to the study of river hydrodynamics until recently was almost impossible due to the technical limitations. Most of the studies carried out in the field until 1995 can be classified as measurements rather than true “experiments”. The measurements facilitated the assessment of flow resistance and mainly focused on the vertical structure of mean flow and, sometimes, turbulence. However, some of those studies, as for example the systematic studies of river turbulence carried out in the USSR by the late Prof. David I. Grinvald and his colleagues over thirty years period [1] and systematic research on river confluences carried out over the last two decades by Prof. B.L. Rhoads [2] in the USA, have contributed to the development of experimental techniques and established a methodology for interpretation of the results.

In the mid- nineties, with the invention of commercial acoustic doppler velocimeters

Fig. 1
A view of the experimental river reach on the Tagliamento river in Italy.

Fig. 2
Experiments in vegetated groyne fields with rigid emergent vegetation (left), and flexible submerged models of aquatic plants (right).

(ADV), research on river hydrodynamics has gained a new inspiration and valuable prerequisites for the development of experimentation on a prototype scale. Several field measurement studies have proved ADVs as reliable and robust instruments capable of the accurate assessment of turbulent flows [2, 3]. Progress was further strengthened by developments in geodetic instrumentation and acoustical survey technologies which made routine surveys of extended river reaches easy and accurate. Concomitant with these technical advances there appeared an obvious trend for carrying out experimental research on larger scale facilities. Probably the most well-known example today of these facilities is the Outdoor StreamLab built in 2007 at the University of Minnesota in the USA. This paper informs on another initiative in field-scale experimentation which for a while received less attention in the media though it has proven a success through a series of recent research projects.

Environmental Fluid Dynamics Laboratory in the Field

Field studies of turbulent flows have been of a special interest for the scientists of the Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB) – the largest research center in Germanyfocused on the ecology of freshwater systems. The necessity to quantify fluxes of momentum, heat, solutes and particulate matter which drive the functionality of aquatic ecosystems in lotic and lentic environments comprises a modern paradigm in ecology. This interest and the financial support provided by the Deutsche Forschungsgemeinschaft and by the Netherland Organization for Scientific Research allowed establishing of a research platform called the “Environmental Fluid Dynamics Laboratory in the Field (EFDL)”. EFDL was initiated by the Ecohydraulics group of IGB in 2005 and joined by the Environmental Fluid Mechanics Section of Delft University of Technology in 2006 [4].

EFDL was launched with a series of pilot-studies which were focused on flow hydrodynamics around a finite size patch of aquatic vegetation [5] and on the dynamics of shallow lateral shear layers [6]. Those studies were carried out on the lowland river Spree and employed two types of experimental control techniques. In the case of aquatic vegetation the experimental control was established by selection of position specific for the vegetation patch and its composition (plant species, size of the plants, and spatial pattern). Population density in the patch was varied between the experimental runs and the response in the flow structure was documented by detailed measurements. This experimental approach has supported the development of several theoretical solutions and a rigorous comparison with laboratory results [5]. In the studies of lateral shallow shear layers experimental control was provided by the regulation of flow rates in two parallel flows separated by a splitter wall. This field experiment included several factors (unhomogeneity of riverbed roughness and pressure distribution) which were excluded in the previous laboratory studies. The results obtained provided new insights into the problem and have facilitated the development of a theoretical approach that accounts for the factors ubiquitous in natural environments [6].

International Research Platform Tagliamento

Since 2008 the studies of EFDL are continuing on the river Tagliamento in Italy, Fig. 1. This almost intact Alpine river system represents a model fluvial ecosystem of European importance on which intensive research has been

carried out by several international teams during the last decade [7]. This research is based on a research station located at the village of Manazzons in Friuli, Italy. The station has an ecological lab, a set of field equipment, a dorm for the personnel and a field vehicle for transportation to the study sites. The region of the Tagliamento River provides highly diverse natural environments suitable for a wide spectrum of scientific research. Typical studies carried out during the last decade include research on bio-diversity of fluvial ecosystems, morphodynamics of braided channels and the effects of riparian vegetation, transport processes of organic matter.

Most recent studies of EFDL have benefited from the advantages of the Tagliamento research platform. In August-September 2012 the studies of hydrodynamics in a vegetated groyne field were carried out there. A series of seven emergent groynes was built of gravel in a straight and shallow river reach. An experimental groyne field was populated with the model vegetation of two kinds: rigid cylinders and flexible silicone models of aquatic plants, Fig. 2. In the experimental runs the population density of vegetation, its submergence and spatial patterns were varied. The experimental setup consisted of portable rails that supported a flat frame with an array of ADV and a bridge for deployment operation. Detailed measurements resolved the flowfield on a fine grid. In total eight experimental runs were successfully completed at the steady conditions of the main flow in the river thus allowing for further direct evaluation of the vegetation effect in this complex recirculation flow.

Perspectives and new directions

The interest to EFDL is steadily growing and more research groups are joining this initiative. Since 2010 the IGB EFDL team was extended by the participation of Prof. H.M. Nepf (MIT, USA) and Prof. G.S. Constantinescu (University of Iowa, USA) in the research project on flow-vegetation interaction at a scale of a patch (DFG SU 629/1). This project exploits the synergy between the field, laboratory and numerical experimental approaches carried on the same methodological platform. The studies of this project will deliver understanding on how relevant are species-specific properties of natural aquatic plants for hydrodynamic processes at the scale of individual plants and a scale of a vegetation patch.

In 2012 the EFDL research program was expanded with a new direction focusing on the

Fig. 3
Measurements of wind profiles over the floodplain of the Tagliamento.

dynamics of atmospheric boundary layers over fluvial floodplains and the role this dynamics play in the dispersal of aquatic insects. Aquatic insects are vital components of fluvial ecosystems. They spend most of their life cycle underwater as benthic invertebrates. To reproduce aquatic insects emerge for short periods of time and are subjected to the aerial flows over river floodplains. Only little is currently known about these linkages between environmental factors and dispersal of aquatic insects and the new research within the context of EFDL seeks to bridge this knowledge gap. In this research the experience gained in EFDL on vegetated flows in rivers will be expanded to the aerial flows and their interaction with riparian vegetation in river corridors. In these studies the EFDL team employs ultrasonic anemometers mounted on the portable expositional musts, Fig. 3

There is strong evidence that field-scale experimentation has become a reliable approach that opens new fascinating perspectives in fluvial hydrodynamics.

Most of the experimental and theoretical research in fluvial hydrodynamics is focusing on idealized flows. In idealized setups researchers eliminate or minimize some processes or components of dynamic systems and thereby seek for particular solutions in the dynamics of complex systems. Field-scale experiments have the potential for encountering solutions of a more general character. For example, recent field measurements on river confluences have clearly demonstrated the importance of lateral fluxes of mean momentum [2] and inspired detailed field experimentation research that addresses the role of those fluxes in the behavior of the lateral shear layers [4].

Although this short article demonstrates the importance and effectiveness of the field experimental approach, field measurements and experimentation remain difficult and rare. One of the principal reasons for a relatively small number of field studies and field experiments is the lack of a specialized education and training of both scientific and technical personnel. Presently this gap in educational programs is not compensated by any occasional training program in framework of summer schools or short courses. Another reason is the absence of specialized equipment for field experiments. For instance, mounting equipment for instrumentation in the field is presently manufactured only on customized basis. There is a lack of guidelines and information on the methodical aspects of field measurements and experimentation is scattered among specialized papers. In conclusion I would like express a hope that the IAHR community might consider these points of concern and can improve the situation by offering some educational courses in the framework of existing summer schools and supporting the preparation of guidelines.

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THIRD INTERNATIONAL SYMPOSIUM ON SHALLOW FLOWS IOWA CITY, USA, JUNE 4-6 2012

BY GEORGE CONSTANTINESCU

The International Symposium on Shallow Flows (ISSF) series of symposia was established by the (then) International Association of Hydraulic Research (IAHR). ISSF is the key international meeting in the area of shallow flows. The meeting is held every 5-6 years and attracts scientists and engineers interested in understanding fundamental physics of shallow flows as well as in applications of shallow flows in diverse areas including geosciences, coastal and river engineering, eco-hydrology and atmospheric dynamics.

The 3rd ISSF symposium was organized for the first time in the U.S. by the University of Iowa and the University of Notre Dame. The Symposium is co-organized by IIHR-Hydroscience and Engineering of the University of Iowa (Convener: George Constantinescu) and by the Department of Civil Engineering and Geosciences at the University of Notre Dame (Co-Convenor: H.J.S. Fernando). The meeting was co-sponsored by the US National Science Foundation (NSF), the American Society of Civil Engineers (ASCE-EWRI) and the American Geophysical Union (AGU). The 3rd ISSF symposium was the first in the series to introduce ecological aspects and large scale geophysical flows as main topics. A special session honoring the contributions of the late Prof. G. Jirka was organized as part of the symposium.

Shallow flows are important in many applications in water and air environments. Major advances are underway in gaining insights into the dynamics of shallow flows using state-of-the-art experimental (e.g., particle image velocimetry) and numerical (e.g., highly resolved direct numerical simulation, large eddy simulation, large-scale predictive models) techniques. In particular, these advances should allow for better understanding of the role played by the quasi-2D large-scale coherent structures and the interactions between these large scales and three-dimensional turbulence; the degree of non-uniformity of shallow flows in the vertical direction and the role of vertical motions; and the effect of the large-scale turbulence on bottom friction and morphodynamic processes. Shallow water models are routinely used for coastal construction activities as well as to aid risk assessment.

Three of the most important and imminent challenges in shallow flow research are understanding to what extent the physics of these flows is dependent on scale effects; how the physics changes between the simpler geometries studied in the laboratory in controlled environments or using eddy resolving simulations; and how understanding of shallow water flows and their interaction with natural elements can culminate to better predictive models. Another challenge is the use of this detailed information on processes and mechanisms to develop accurate simpler analytical models that can help understand global quantities characterizing the spatial and temporal development of these flows. As in nature, shallow flows occur most often over alluvial beds, the investigation of morphodynamics processes in shallow flows was another major focus area of the symposium. In many shallow aquatic environments, the interactions among flow, turbulence, vegetation, macroinvertebrates and other organisms, as well as the transport and retention of particulate matter, have important consequences on the ecological health of rivers and coastal areas. Large scale atmospheric flows are also often analyzed using shallow water theory, and hence will be of particular interest in the symposium. The main themes of the symposium reflected these areas of active research in shallow flows:

1. Laboratory and eddy resolving (DNS, LES) numerical investigations of fundamental physical processes and transport mechanisms in shallow mixing layers, wakes, jets and open channels
2. Experimental and numerical investigations of transport of heat, solutes and pollutants in canonical shallow flows or simplified geometries
3. Field studies and numerical investigations of shallow flows at field conditions and/or in realistic geometries.
4. Experimental and numerical aspects of sediment transport and morphodynamics in shallow flows
5. Shallow flows and stratification
6. Ecological aspects of shallow flows
7. Engineering applications of shallow flows (more applied experimental and numerical–RANS modeling- studies)
8. Shallow flow models for prediction of flood related phenomena
9. Analytical modeling of shallow flows
10. Innovative field and laboratory instrumentation for the study of shallow flows

***Dr. Constantinescu* is Associate Professor of Civil and Environmental Engineering at the University of Iowa and Chair of the IAHR Fluid Mechanics Committee**

About 200 abstracts were originally submitted and after preliminary selection about 170 full papers were submitted and presented in four parallel sessions. Six recognized international experts in shallow flows presented plenary talks, focusing on broader applications of shallow flows for environmental problems. Additionally, six invited keynote lectures were presented by leading world scientists in different areas of shallow flow research. An important public education objective was to take advantage of the meeting to increase awareness of the importance of shallow flows for the society.

The 3-day program was attended by close to 140 participants from 23 countries. Among them close to 50 were graduate students. The 3rd ISSF Proceedings were published on a CD-ROM. The CD-ROM will be available free of charge of IIHR members via the IIHR website starting in 2014. A special issue of the Environmental Fluid Mechanics journal will contain several review papers on important aspects of shallow flows as well as extended versions of papers presented during the ISSF symposium. We think the special issue has the potential to become a main reference for scientists interested in shallow flows and their application in the environment.

Record number of submitted abstracts!

35th IAHR WORLD CONGRESS

The Wise find Pleasure in Water

成都

September 8 to 13, 2013 Chengdu China

CHENGDU, A CHARMING CITY READY TO WELCOME YOU

BY LIN PENGZHI, AN RUIDONG

Dr. PENG Jing **Director, Division of International Cooperation, China Institute of Water Resources and Hydropower Research (IWHR). Secretary General of 35th IAHR Congress**

AN Rui-dong, **PH.D., Associate Professor, research on environmneteal water conservancy, State key laboratory of hydraulics and mountain river engineering, Sichuan University, Chengdu, China Secretary of 35th IAHR Congress LOC**

Chengdu, known as "Land of Abundance," is the capital of Sichuan Province in West China. Located in the west of the Sichuan Basin, the city covers a total area of 12,300 km² with a population of over 11 million. Chengdu has four distinct seasons and September is one of the best months of year with the average temperature of 22°C.

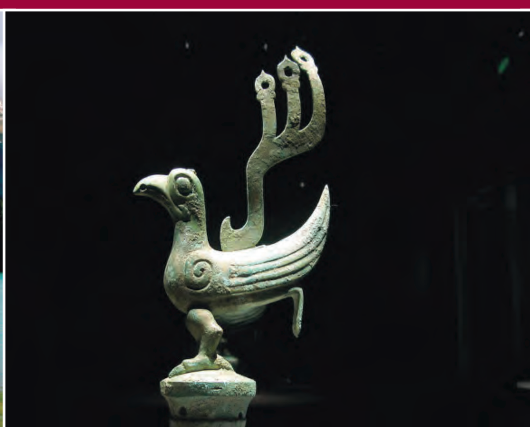
Chengdu has a proud history over 2,300 years. It was the starting point of the well-known "silk road", which connected ancient China to India, Iran and the western world 2,000 years ago. Chengdu used to be the capital of the Shu Kingdom during the period of Three Kingdoms (220-280 AD). The Wuhou Temple was built to honor Zhuge Liang -- Prime Minister of the Shu Kingdom. In addition, many other historical sites and artefacts are scattered around the city, such as the Sanxingdui Museum for the exhibition of precious relics discovered in the Sanxingdui Ruins (3,000 years ago), and the Thatched Cottage of Du Fu, who was one of the most well-known Chinese poets (712-770 AD).

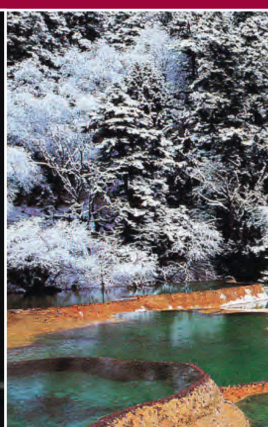
Benefiting from the Dujiangyan Irrigation System (constructed in 256 BC and a UNESCO heritage site), Chengdu became a place richly endowed with natural resources. The 2,500 years old irrigation system is still functioning today, protecting the Chengdu Plain from major floods and irrigating an area of more than 6,687 km².

Chengdu is famous as a "leisure city." While you are walking on the street, you can easily find many local people enjoying their life in different ways, such as playing mahjong, drinking tea in parks and teahouses and walking through the old streets scattered with small local restaurants and shops of folk antiques. Another popular place for tourists is the Chengdu Research Base of Giant Panda Breeding.

Chengdu is blessed with many rare and valuable world-renowned natural resources in its surroundings. For instance, the Jiuzhai Valley, located deep in the heart of the Aba Autonomous Prefecture 400 km from Chengdu, has been a UNESCO World Heritage site since 1992. Jiuzhai Valley is an impressive spot, known as paradise on the earth, famous for its stunning natural landscape, including peaceful lakes, great waterfalls and colorful rocks. Another natural scenic site is Mount Qingcheng, with over 20 temples and religious sites for Taoism, the very local religion of China, and the Sichuan style of architecture.

SEE YOU IN





Chengdu has its distinctive culture and art. It produces one of China's four most famed embroideries and has its own local genre of opera. The performance of face-changing is globally known, and the local tea culture is old and characteristic. In March 2012, Sichuan was included into the list of cities with the fastest economic growth in the world. The southwestern city is also one of China's four largest scientific and educational cities, with 28 universities, 27 junior colleges, 152 key labs (among which are 10 state key labs) and 111 engineering and technical research institutes. Sichuan University is the most comprehensive university in southwest China.

Last but not the least, enjoying the spicy Sichuan food offers a deeper understanding of Chengdu. Sichuan Cuisine is one of the Eight Great Cuisines in China and is famous all over the world for its richness and variety of tastes. To name a few, Kung Pao Chicken, Twice Cooked Pork, Tea Smoked Duck and hot pot are the typical dishes of Sichuan food.

When tourists come to Chengdu, they will quickly indulge themselves in the unique and charming environment of the city. They will find Chengdu a city mixed with ancient traditions and modern culture. After all, Chengdu is the city you will hate to leave once you come. Chengdu warmly welcomes delegates from all parts of the world and we believe your stay in Chengdu will be a life-time memory of happiness and unique experience.

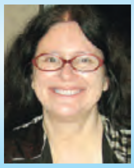
CHENGDU!

CHENGDU, THE PLACE TO BE FROM SEPTEMBER 8-13, 2013

2147 ABSTRACTS SUBMITTED!!

General Reports

Dr. JIAO Yong,
Vice Minister of Water Resources of P. R. China



Title of Report to Be Decided
Dr. Gretchen KALONJI, Assistant Director-General for Natural Sciences, UNESCO

Keynote Speeches

New Progress in Sustainable Dam Construction

Dr. JIA Jinsheng, Vice President, China Institute of Water Resources and Hydropower Research, China

Large Eddy Simulation in Hydraulics: the Method and its Potential

Prof. Wolfgang RODI, Institute for Hydromechanics, Karlsruhe Institute of Technology, Germany

Sustainable Delta Development: Living with Water, Building with Nature

Prof. Arthur MYNETT, UNESCO-IHE Institute for Water Education, Netherlands

The Battle of Fluids: Air-Water-Fluvial Interactions

Prof. Harindra Joseph FERNANDO, University of Notre Dame, US

2011 Tohoku Tsunami and Future Directions for Tsunami Disaster Mitigation

Prof. Shinji SATO, Civil Engineering Department, The University of Tokyo, Japan

Water Policy Elements: Engineering to Provide Solutions

Tomás A. SANCHO, President World Council of Civil Engineers, Spain

ABSTRACTS SUBMITTED

Themes		Number
A	Water Engineering and Civilization	13%
B	Hydro-Environment	20%
C	Fluvial Hydraulics and River Management	23%
D	Maritime Hydraulics and Coastal Engineering	10%
E	Water Resources and Hydroinformatics	18%
F	Climate Change and Hazard Mitigation	12%
J.F.K Competition		3%
Total		100%

Record number of submitted abstracts!

35th IAHR WORLD CONGRESS

The Wise find Pleasure in Water

成都

September 8 to 13, 2013 Chengdu China

A GLIMPSE OF WATER RESOUR

BY KIT MING LAM

A delegation of representatives from IAHR China Chapter and IAHR Hong Kong Chapter made a five-day visit to Addis Ababa University, Ethiopia during July 30 to August 3, 2012. The visit was initiated by the Local Organizing Committee (LOC) of the 35th IAHR Congress to be held in Chengdu in September 2013. The purpose of the visit was to: (i) promote the forth-coming IAHR World Congress; (ii) to initiate a dialogue between IAHR and water researchers and professionals in Ethiopia; (iii) to develop long term academic and professional exchanges between IAHR members and Africa; and (iv) to present opportunities for young researchers to connect to the global community of hydro-environment experts for scientific capacity building and research collaboration.

The team was led by Prof. Joseph Lee, immediate past IAHR Vice-President and Executive Chair of the LOC of the Chengdu Congress, and Prof. L.X. Wang, Secretary General of IAHR APD. The delegation consisted of key members of the LOC of the Chengdu Congress: Prof. P.Z. Lin (Sichuan University), Prof. Y.C. Chen (Tsinghua University) and Prof K.M. Lam (University of Hong Kong) – as well as

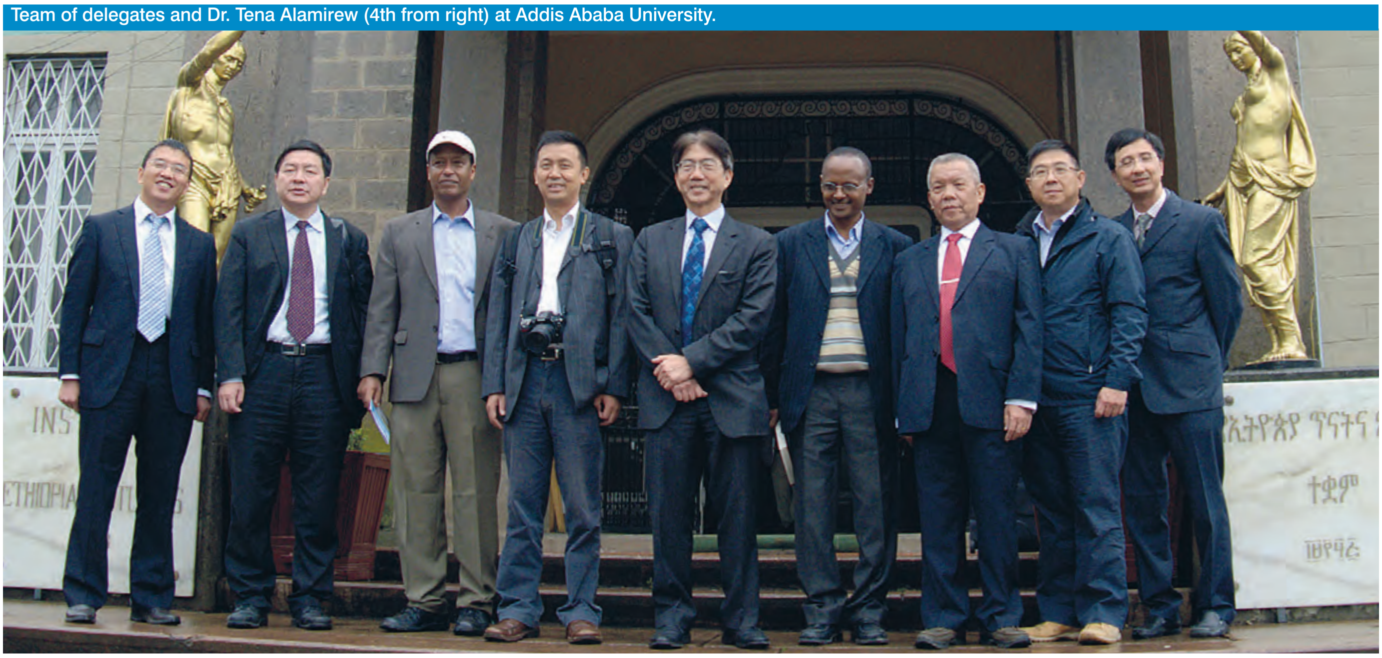
hydraulic experts from academia and industry – Prof Z.W. Liu (Tsinghua), Dr. Ander Chow of Arup and Dr. Feleke Arega of Tetra Tech. The delegation was received by the Ethiopian Institute of Water Resources (EIWR) and the Institute of Technology (AAiT) – of Addis Ababa University – the premier University of Ethiopia.

During the discussion meetings, Dr. Tena Alamirew, Director of EIWR described the need for sustainable water resources in Ethiopia and the mission of his Institute. Dr. Yilma Seleshi, Head of Department of Civil Engineering at AAiT, also introduced some water engineering projects undertaken by the University.

Ethiopia has abundant water resources – it claims to be the "Water Tower of Africa" with Lake Tana giving birth to the Blue Nile. Almost all major development problems in Ethiopia are water-related. There are nine river basins in Ethiopia with 122 billion cubic meters of surface water with huge irrigation capacity and hydropower generation potential. The government recognizes the need to develop water resources to enhance food security, energy production and environmental protection. And yet there is a significant shortage of water-related researchers and high-level engineering professionals.

EIWR aims to produce 25 PhD and 90 MSc within five years to serve the water sector and to further train the next generation of engineers and water-related professionals. Prof. Joseph Lee introduced IAHR as a leading global water organisation and platform for future collabo-ration with Ethiopia. Prof. Wang went on to promote the forthcoming IAHR Congress in

Team of delegates and Dr. Tena Alamirew (4th from right) at Addis Ababa University.



CES MANAGEMENT IN ETHIOPIA

Chengdu and invited the participation of Ethiopian researchers in the Congress, especially in the Special Seminar devoted to African issues. During the visit the IAHR delegation also presented the following talks: "How to write a good paper in a top international journal" (Lee); "Water issues in China and their hydro-informatics solutions" (Lin); and "Super-saturation of total dissolved gas below the Three Gorges Dam" (Liu). There was active discussion and exchanges with EIWR and AAiT. During the wrap-up meeting on the last day of the visit, a number of solid proposals were agreed on by both sides towards future interactions and collaboration as well as the imminent participation in the Chengdu Congress. It was agreed that one person each from EIWR and AAiT will participate in the co-organisation of the African special seminar. The Ethiopian hosts also expressed interest to join IAHR activities – in particular EIWR is eager to enhance capacity building and short term attachments of PhD students in international research institutions.

On the third and fourth day of the visit, the team made site visits to two hydraulic projects in the Awash River Basin, about 200 km to the south-east of Addis Ababa. The first project is the construction of a 90-meter tall earth dam across the Kessem River – which is a joint venture between Ethiopia and China. The reservoir to be impounded will provide irrigation to the sugar cane industry in the downstream areas. The delegation saw the bottom outlet, overflow spillway, as well as the water intake tower under construction. The construction of this dam has been plagued by many difficulties including lack of reliable hydro-geological data, serious dam foundation and grouting problems arising from the high ground water table, and a failure of the cofferdam during a flash flood. The delegation also noted the significant sediment content in the high-flow river discharge and appreciated potential issues with reservoir sedimentation problems in Ethiopia.
The delegation also travelled to visit a river diversion – the Fentale irrigation project –which is built to provide a maximum flow of 18 cubic meters to irrigate 18,000 hectares - with the objective of developing the local agriculture economy. The water supply comes from the Awash River via a diversion structure upstream of the 10 km long irrigation channel. At the diversion, the water level and diversion flow are regulated by a 110 m wide weir and an 18-meter wide sluice gate section. The diversion project is entirely Ethiopian designed and built, and succeeded to achieve fertile agriculture yields in an area that used to be a desert. However, high sediment concentrations in the diverted water still presented problems at a pumping station which necessitated frequent manual desilting.

This short visit is the first step towards engendering more active collaboration between IAHR and African countries where there are many challenging water-related problems – IAHR expertise can definitely help, and it is timely for IAHR to be more pro-active in engaging Africa on global issues such as water and food security. Members are welcome to participate in the discussions in the forthcoming Special Seminar on "Challenges and issues of water resources management in Africa" in Chengdu.

***Kit Ming Lam,* University of Hong Kong**
Vice-Secretary General, LOC,
IAHR 2013 World Congress.
He is Associate Professor of the Department of Civil Engineering in The University of Hong Kong. He is Executive Committee Member of the Asia & Pacific Division ofIAHR and Associate Editor of the Journal of Hydro-Environment Research.

Diversion structure on Awash River for Fentale irrigation project (intake to the left of sluice gates).

21ST IAHR INTERNATIONAL SYMPOSIUM ON ICE 2012
JUNE 11 – 15, 2012, DALIAN, CHINA

BY ZHIJUN LI, PENG LU

The 21st IAHR International Symposium on Ice was held at the International Convention Center of Dalian University of Technology in Dalian, China, from June 11 – 15, 2012. Altogether 119 papers were presented in poster and oral sessions. The orals were divided into three parallel series 1) Ice engineering, 2) Sea ice and lake ice properties and characteristics, and 3) River ice processes, ecology under ice and measurement technology, with nearly equal numbers in each series. Each day started with invited talks for all participants, and thereafter the three parallel sessions were started.

Programme

The symposium was completed in five days. Oral presentations were given in 3.5 days, and half of the day was set aside for visiting the Dalian University of Technology (Exhibition of University History, State Key Laboratory of Coastal and Offshore Engineering, School of Naval Architecture).

The official opening was given by Professor Guohai Dong, President of State Key Laboratory of Coastal and Offshore Engineering, Dalian University of Technology. After that, the Greetings from Professor Zhaoyin Wang, Vice-Chairman of IAHR, Senior Research Scientist, Jizhang Gao, Chairman of IAHR China Chapter, and Professor Patricia Langhorn, Chairman of IAHR Ice Research and Engineering Committee were given.

Ice engineering sessions included Ship dynamics in ice, Sea ice induced vibrations, Ice management, Laboratory and physical model studies, Ice loads on structures. Sea ice and lake ice properties and characteristics sessions consisted of Ice physics and mechanical properties, Water quality and ecology, Sea ice characteristics, Ice ridges and icebergs, Ice-waves interactions, River ice remote sensing and data collection techniques, Yellow River ice condition forecast, impacts of climate change and engineering. River ice processes, ecology under ice and measurement technology sessions included River ice processes, Ice resources and climate changes, Combating methods of oil spills in ice, Sea ice remote sensing and measurement technology, and a special session on lake ice physical environments under lake ice, Ecology and water quality in ice-covered lakes.

The number of participants was 171 representing 12 countries. There were 89 participants from the host country,

Invited presentations

Invited presentations were given in the opening session by Professor Yongxue Wang (Dalian University of Technology, Dalian, China), who gave a keynote talk on “Ice research and engineering in SLCOE”, and Professor Aleksey Marchenko (The University Centre in Svalbard, Longyearbyen, Norway), who talked of “Measurements of thermally-induced deformations in saline ice with fiber bragg grating sensors”. Dr. Xingren Wu (NCEP/NWS/NOAA, Camp Springs, Maryland, USA) lectured on “Characteristics of sea ice in the NCEP climate forecast system reanalysis”, Professor Pat Langhorne (University of Otago, Otago, New Zealand) lectured on “Influence of a sub-ice platelet layer on landfast sea ice freeboard and thickness estimates near an Antarctic ice shelf”, Dr. Georgiy Kirillin (Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany) lectured on “Convective mixing by solar radiation under lake ice”, and

Dr. Kari Lampela (Finnish Environment Institute, Helsinki, Finland) lectured on "Baltic Sea experiences in mechanical oil recovery in ice". Dr. Kailin Yang (Institute of Water Resources and Hydropower Research, Beijing, China) lectured on "Safety regulations of middle route Project of South to North Water Diversion in winter-spring period", Professor Yasuharu Watanab (Kitami Institute of Technology, Kitami, Japan) lectured on "Tsunami run-up to the ice covered rivers in Hokkaido at the 2011 great east Japan earthquake".

Awards

The Best Student Paper Prize was granted to Ian M. Knack, whose presentation was entitled "River ice modeling for fish habitat analysis". He is a student in Clarkson University, Potsdam, USA and was the first author of the awarded paper with the co-author of Hung Tao Shen. The other Best Student Paper Prize was granted to Wenjun Lu, whose presentation was entitled "Ventilation and backfill effect during ice-sloping structure interactions". He is a student in the Norwegian University of Science and Technology, Trondheim, Norway and was the first author of the awarded paper with the co-authors of Sveinung Løset, and Raed Lubbad. This award was established in 1994 and in total thirteen students have been granted the award.

Scientific topics

The articles and presentations in this congress relate to all aspects of ice researches, and are especially associated with the topic of the congress "ice research for a sustainable environment". They do not only present advances in ice research, but also reveal the improved concerns on the sustainable development and environmental problems.
Ice physical and mechanical properties are the bases for studies on ice dynamics and thermodynamics. Laboratory experiment is still the main method employed on such research, but numerical modeling also begins to express some advantages on calculating ice properties, such as Ji of Dalian University of Technology and Bai of Bohai University.
There is a long history of river ice study, and it was also an important topic of the congress. On the river ice processes, except for the traditional ice dam and ice jam, a study on the influence of tsunami on river ice after the earthquake from a Japanese scientist attracted much attention. Because under the background of global warming, such kind of ultimate natural disaster and weather accident may occur more frequently - but similar studies on ice are few.
Besides, for ice observation technology, more remote sensing methods have been employed in monitoring of river ice. For example, a UAV of Chinese Academy of Sciences had been used in ice observations in the Yellow River. Water quality and ecology under ice is tightly associated with the congress topic, field observations and numerical modeling on the Porcupine River, Amur River and the Songhua River were presented here as examples. Moreover, ice management is important for all ice-infested rivers where river structures are expected to survive the winter ice conditions. Nine papers from different countries were concerned with this topic, and most of them were related with real engineering problems. Except the methods on ice conditions observations, they were concerned with a more systemic method of ice management instead of simply defeating the ice disaster. Ice problems in the Yellow River of China was another main concern of the congress, with twelve papers from different institutes and companies presenting the ice conditions, ice disaster and anti-ice measures in the Yellow River.

Presentations on sea ice characteristics were focussed on the Arctic Oceans and sub-Arctic seas such as the Bohai Sea, and on the spatial and temporal distribution of sea ice, ridges and icebergs. Besides, the relationship between sea ice change and global climate, ice zone environment protections are issues tightly associated with the theme of the congress, and thus also received much attention.
Interaction of ice on structures is a traditional issue in ice studies. Except for the static ice force on fixed structures, the congress focussed more on dynamic ice forces such as ice induced vibration. Especially, a study comprising three papers from the Norwegian University of Science and Technology presented a systemic experiments on ice induced vibration, and received much attention from the attendees. On the other hand, owing to the rapid decay of Arctic sea ice and increased possibilities in using Northern Route through the Arctic Ocean, more and more projects have been carried out to study ship capability in ice-infested regions, and methods of physical modeling, numerical modeling and in-situ observations are employed in such researches.
Lake ice is a special section organized in this congress. Although it has a smaller spatial scale than sea ice in the polar regions, the influence from climate change is also significant, and in-situ observations on lake ice are always easy to conduct. Articles on lake ice in the congress mainly concerned topics such as the ice optical properties, thermodynamic properties, water quality and ecology under lake ice.

***Zhijun Li,* Chairman of the Scientific Committee of 21st IAHR Ice Symposium. Professor Zhijun Li is professor in Dalian University of Technology, China. His professorial research field is sea ice physics and mechanics.**

***Peng Lu*, State Key Laboratory of Coastal and Offshore Engineering, Dalian University, China. Peng Lu is currently at Dalian University of Technology, as an associate professor. His interest includes sea ice dynamics, and image processing in sea ice remote sensing.**

Proceedings

The Symposium Proceedings was published on USB and paper version. The PDF proceedings will be available free in IAHR web site later on the year.
ISBN: 978-7-89437-020-4
TITLE: ICE RESEARCH FOR A SUSTAINABLE ENVIRONMENT
Date of Publication: May, 2012

Next Symposium

It was announced that the 22nd IAHR International Symposium on Ice will be held in Nanyang Technological University, Singapore in August 18–22, 2014. Invitation to Singapore was given by Associate Professor Adrian Wing-Keung Law.

LETTERS TO THE EDITOR

Reflections on the Bologna Process

In this column we publish brief letters to the editor, where our readers can give their opinion and comments on subjects tackled in past issues or new ones of interest for our readers.

Below you will read two letters referring to the Bologna process. Even if it is (desirable) well known to European teachers, some readers of ours might not know the Bologna Process, i.e. the series of ministerial meetings and agreements between European countries designed to ensure comparability in the standards and quality of higher education qualifications in the different European countries. If so, our readers interested in the question could visit the web site www.ehea.info

As written in the letters below the huge objective of the Bologna process, that has many positive aspects, is also encountering some difficulties, revealing that implementing the agreement is not so easy, but also highlighting that many achievements have been accomplished.

The Editor

Dear Editor,

Bologna is not a city anymore! At least it is not a city for most European university students and lecturers. Bologna sounds like a student perspective, not teaching but helping to learn, continuous assessment, learning by doing, more teamwork and less of a master class. It sounds fine to me, but how do we take it to daily practice in every classroom of every university of every country in the European University Space (EUS)?

This huge objective encounters several difficulties; among others are the clash of education models, force of habit, overcrowding and the rather troubled duo of academic title and professional competence. Two antagonistic education models are present in the EUS: one of them is based on a strong theoretical training and aimed at developing a "general" professional, like in France or Spain, while the Anglo-Saxon model is mainly based on student practice and aims to educate a "specialist" professional. The feeling is that the Anglo-Saxon model won the battle in the attempt to harmonize the curricula in the EUS, and there is resistance to so dramatic a change in the countries with a different education tradition. The weight of tradition and, at a personal level, the force of habit, lead to changes in the form of fulfilling the legal requirements, but not in the content. In such a way, the prevailing model remains. Furthermore, university overcrowding hinders the necessary personal contact and interaction between the lecturer and the students inside and outside of the lecture room. Finally, as the university gives an education to students which is later taken to professional work, education and professional models should be considered jointly in the harmonization process. In some of the countries of the EUS the university degree directly and fully entitles graduates to carry out professional work, while in others a period of training outside the university is necessary. Educational requirements should not be the same in the two cases, so harmonization of the curricula in the EUS should imply harmonization of the method for acquiring professional certification too.

Anyway, the change is in motion. University lecturers usually have a certain vagueness in an advanced perception of lightening the university student workload. Numbers say the contrary: subject programmes have been compressed and student workload has risen. In the compression process, a certain rationalization can be observed. In many cases, the opportunity to adapt the subjects to the new times has been seized. The challenge is to motivate students and help them to acquire an integral and adaptable education in a changing environment. Bologna is an opportunity for advancing in the right direction.

Miguel Ángel Toledo, Polytecnic University of Madrid, Spain

Dear Editor,

Twelve years have passed since the Bologna declaration has been signed amongst European countries. The ambitions and intentions of the declaration were very high, driven by the needs for employability of the graduates. The need of employability changes the teaching demands, compared to five or ten years back. Demands of graduates are rapidly changing and are significantly different over 5-10 years and this triggers an ongoing evaluation of the curricula. By having a common European understanding of the curricula, the chances of the graduates to find jobs is increased.

In order to meet these new demands of the students and to make the European Higher Education Area attractive for learners all over the world, twenty-nine European countries agreed to adopt the Bologna agreement, which shows their commitment for improving the education and finding common ways forward to promote European education. One of the most important changes that comes with the Bologna agreement is the European Credit Transfer System (ECTS), leveling education in Bachelor's and Master's. Bachelor's and Master's Degrees are formulated with clearly defined learning outcomes and associated competencies, which can also serve for comparison of higher education among different universities and countries. These are changes that help in shaping the common education arena in Europe. A second big advantage of Bologna agreement is the recognition that in addition to all necessary changes in education, there is a clear need for lifelong learning (LLL) and professional development. The LLL is especially relevant for engineering education.

The process of implementing the agreement is not an easy one, and still tries to adapt to different views on education. However many achievements have been accomplished so far and there are still challenges ahead.

Ioana Popescu, UNESCO-IHE Institute for Water Education, The Netherlands

Send your comments to the Editor: m.mossa@poliba.it

PEOPLE & PLACES

Professor Stoesser has joined the Hydro-Environmental Research Centre at Cardiff University

Professor Thorsten Stoesser (M) has joined the HRC - hydro-environmental research centre at Cardiff University as Professor of Hydro-environmental Engineering. Prior to joining Cardiff, Thorsten was an Associate Professor in the School of Civil and Environmental Engineering at the Georgia Institute of Technology, Atlanta. USA; he was previously a Research Associate at the University of Karlsruhe, Germany and he acquired his PhD from Bristol, UK. His research interests span a broad range of topics in computational fluid dynamics, open-channel hydraulics and environmental fluid mechanics, with his research being funded by US government agencies such as the US EPA, National Science Foundation and various state agencies, or by industrial partners for example, British Petroleum. Thorsten is particularly interested in the modelling of turbulence in environmental flows and he has developed advanced Computational Fluid Dynamics models to simulate fluid flow in complex geometries.

IAHR welcomes during 2012 the following new Institute Members!

HR Wallingford	United Kingdom
Università Degli Studi Di Cassino E Del Lazio Meridionale, Facoltà Di Ingegneria	Italy
Institute of Water Modelling (IWM)	Bangladesh
Vietnam Academy for Water Resources (VAWR)	Vietnam
University of Auckland	New Zealand
The Key Laboratory of River and Coastal Engineering (KLORCE)	Vietnam

Proceedings of River Flow 2012

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New Vice Chair of the IAHR Committee on Ice Research

Margaret Knuth is a civil engineer at the US Army Cold Regions Research and Engineering Laboratory (CRREL). Her primary research interests are in Arctic and Antarctic logistics and engineering. Recent projects have included work on potable water production in polar environments, firn air cooling systems for food and scientific sample storage, snow roads and runway construction and maintenance and methods for consolidating airfields at McMurdo Station, Antarctica. Ms. Knuth is also involved in discrete element modeling for sea ice and granular materials. Recent work in this area has included modeling of ice crushing on Arctic structures and simulations of mobility and excavation tools for Martian and Lunar rovers..

Introducing the new IAHR Communications and On line Media Officer and Programme Officer, IAHR Hydro- Environment Division

Maria Galanty is responsible for managing online media in IAHR and in particular looks after the monthly IAHR NewsFlash World and Newsflash Europe e-zines. She is also responsible for co-ordinating IAHR-sponsored events. Last but not least she is Programme Officer for the IAHR Hydro-Environment Division in support of the Division Chair Prof. Zhaoyin Wang and Secretary Prof. Jorge Matos.

Maria is from Krakow in Poland but lived in the UK, and Vietnam, before moving to Madrid in 2011. She holds an MA in Philology, and Foreign Languages from Jagiellonian University in Krakow (one of the oldest universities in the world). Before joining IAHR she worked for an online media company in the UK applying new technologies to marketing and sales. She also worked as a teacher of foreign languages in Vietnam for two years.

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