Volume 1, Issue 2

May 2015

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1. Introduction

The second issue of the quarterly Cardiff IAHR Young Professional Network newsletter brings updates from a highly successful period from our group, both from personal perspectives in terms of individual awards, and fantastic progress from the group in terms of continued interaction with our industry partners as well as highly enjoyable and productive events.

The group extended their congratulations to two of our members, Athanasios Angeloudis and Yvonne Murphy for winning awards at the ICE Wales Dinner, detailed further in this issue. We were also delighted to receive the recognition and distinction of winning the CIWEM Otter Trophy for Best Presentation of the Year at the Annual CIWEM Welsh Branch Dinner for the first Micro-presentation event, hosted in December. This has been recently followed up with another highly successful Micro-presentation event and we are extremely pleased with this innovation which has attracted much attention.

It has been a busy period of conferences including the UK Young Coastal Scientists and Engineers Conference in Manchester, the Oil Spill and Ecosystem Science Conference in Houston USA, and the excellent MAREN2 conference hosted in Cardiff. Congratulations to the group members that presented their research at these events and good luck to those who are presenting at the IAHR World Conference next month in The Hague.

The Cardiff IAHR YPN committee invite you to read on for more information about the recent activity of the network, as well as some excellent research updates from two selected members and upcoming plans for the next quarter.

2. Events

CIWEM Welsh Branch Annual Dinner

On the 6th of March 2015 a representation of Cardiff IAHR YPN attended the Charted Institution of Water and Environmental Management (CIWEM) Welsh Branch Annual Dinner. The presence of many recognised professionals of the water and environmental fields provided a great networking opportunity and a good example of the benefits that professional accreditation may provide. It was exciting and encouraging to share time and conversations with the other assistants and being able to discuss about the recent news regarding our field in UK and particularly in Wales.

Furthermore, the CIWEM Micro-Presentations Evening organised and hosted by the Cardiff IAHR YPN was awarded with the Institutions of Water and Environmental Management Welsh Branch Award for Best Presentation of the Year. We would like to thank CIWEM for this prize and for supporting us in these activities. This recognition encourages us to keep working in our aim to build bridges between Academy, Industry and Society.

Figure 1: The winning of Otter's Trophy for the Best Presentation Award in Environmental Engineering by Morlais Owens (May 1991).

11th UK Young Coastal Scientists and Engineers Conference. Manchester, UK

Research on coastal physical processes in the UK occurs under various disciplinary labels, including oceanography, geography, geology and engineering. This results in a fragmented coastal research community with limited interaction and collaboration between different disciplines. The lack of integration is felt most by young coastal researchers (post-docs and PhDs), who should be open to multi- and interdisciplinary interaction. Since the 1st Young Coastal Scientists and Engineers Conference (YCSEC) was held in Nottingham in 2005, this has now become an annual event travelling the UK, which has played an important role to assist with developing an integrated UK coastal research community.

Last year, on April 2014, we had the opportunity to successfully hold the X YCSEC at Cardiff University. This year, on March 2015, the XI YCSEC has been held at The University of Manchester. Some of our YPN members, Fernando Alvarez, Chao Jiang and Dr. Sooyoul Kim, had the opportunity to attend the event and present both oral and poster presentations. As expected, it was a great opportunity for showing our work and for networking with other early-career researchers.

Following the conference, we had the opportunity to visit the Hydro-Lab for a demonstration on tidal turbine modelling, a wave energy converter and wave impacts on caissons which was highly interesting. Next year, 2016, the XII YCSEC will be held at Swansea University and we would like to encourage PhD students and Post-Docs to attend the event as it will surely be a success.

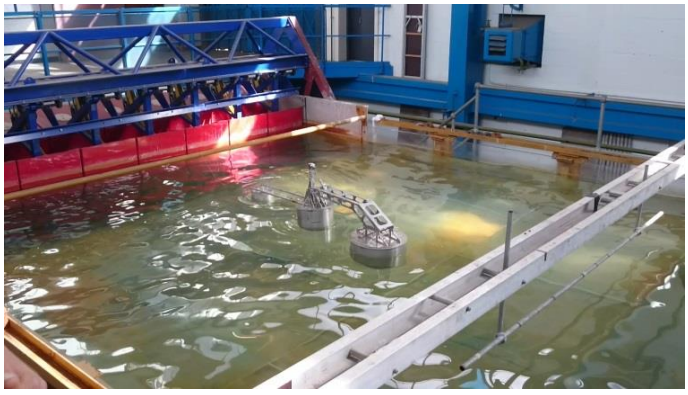

Figure 2: Wave energy converter.

2015 Oil Spill and Ecosystem Science Conference. Houston, USA

On 20 April 2010, the Deep Water Horizon (DWH) drilling rig operating approximately 50 miles (80 km) off the coast of Louisiana experienced a catastrophic failure that resulted in the release of petroleum (oil and gas) and subsequent explosion and fire, the ultimate sinking of the rig, and a discharge of gas and light sweet crude oil from an ocean depth of nominally 5000 feet (1525 m). Eleven people were never found and it is considered the largest accidental marine oil spill in the history of the petroleum industry.

On 24 May 2010, BP committed $500 million over a 10-year period to create a broad, independent research program to be conducted at research institutions primarily in the US Gulf Coast States. The GoMRI Research Board has 20 members who are science, public health, and research administration experts.

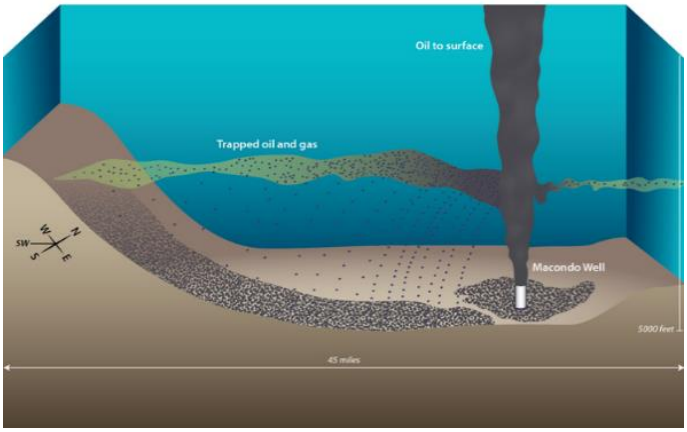

Figure 3: Schematic view of the DWH blowout.

The goal of the 2015 conference was to highlight oil spill and ecosystem science research results with a focus on the five years since the DWH oil spill. The 2015 Gulf of Mexico Conference brought together more than 1000 registrants from 22 countries, more than 145 universities and 80 companies.

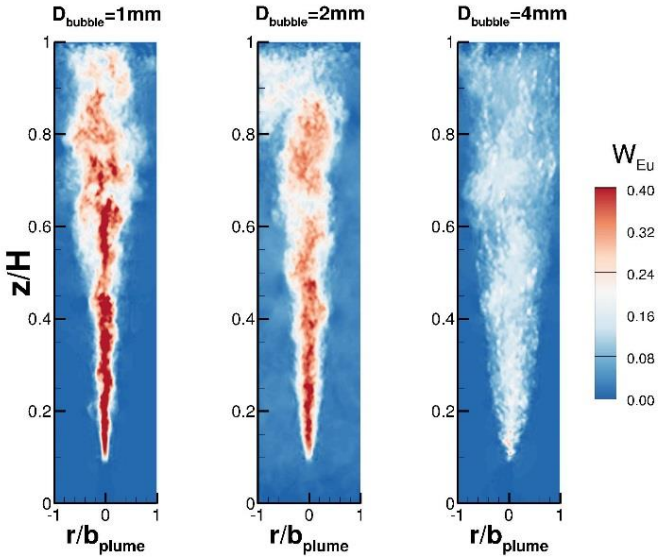

Figure 4: Large Eddy Simulation of gas plumes generated by different bubble sizes.

Cardiff University and the HRC are also involved in this gigantic project through the work of Prof. Thorsten Stoesser and RA Bruño Fraga, vice-president of YPN Cardiff. His research for the last two years has been focused on the prediction of gas plumes within a liquid carrier. A home-made large-eddy simulation (LES) solver was used for that purpose, and a new model was developed to deal with the interaction between liquid and gas.

Bruño Fraga attended the Gulf of Mexico Conference in 2014 in Alabama and in 2015 in Houston. He had the chance to show the results of his work in two oral presentations at the 'Applications of Research in Oil Spill Fate and Transport Modeling for Decision Support' session and on the 'Near-field Modelling' Workshop conducted by Scott Socolofsky from Texas A&M University. The new findings and capabilities of the model were very well received, bringing interest of several research groups and companies in the oil business.

2015 ICE Wales Awards Dinner

Another noteworthy event was the attendance of several YPN members to the Regional Institution of Civil Engineers Awards ceremony that took place at the Marriot Hotel in Cardiff on the 1st of May. Two members of our network have been given awards during the ceremony, namely Yvonne Murphy and Athanasios Angeloudis. Yvonne has been awarded the prestigious Ben Barr award which is annually presented to an outstanding civil engineer who has just become professionally qualified. Athanasios was awarded the ICE Wales Emerging Engineer Award according to a paper submission detailing findings and outcomes of the numerical modelling work on tidal impoundments as part of the MAREN2 project.

Figure 5: Yvonne Murphy wins the Ben Barr Award.

Figure 6: Athanasios Angeloudis presented with the ICE Wales Emerging Engineer Award 2015.

MAREN2 Conference

The final MAREN2 conference has been held in Cardiff on the 5-7 May 2015, an event extensively attended by members of the Cardiff IAHR YPN.

Presentations primarily expanded on the work from MAREN2 partners from Portugal, Spain, France, and the Republic of Ireland as well as from the EU, the US and from a wide range of experts in Marine Renewable Energy from within the UK. The conference was aimed at bringing together a wide range of stakeholders of the Marine Renewables sector including delegates from academia, industry, national, regional and local governments,

NGOs, general public etc. Focus of the MAREN2 project has been the hydro-environmental assessment of multi-platform Marine Renewable Energy applications with the main objective to speed up the exploitation of the renewable energy potential of the marine and coastal environment and protecting, securing and enhancing its sustainability.

The conference also facilitated the opportunity to showcase the contributions and research developments in the field of marine energy extraction of many Cardiff YPN members, which were all positively received by the audience. Examples include the work on Tidal Impoundments and Barrages (Sam Bray and Athanasios Angeloudis), a focal point of the MAREN2 studies, the experimental and computational findings associated with the development of Vertical Axis Turbines (Luis Priegue and Pablo Ouro Barba) and the resource assessment of certain sites around the Welsh coast for the deployment of tidal stream technologies (Paul Evans).

Figure 7: Delegates of the MAREN 2 Conference at the Cardiff Castle.

The MAREN2 project, which is part funded by the European Regional Development Fund (ERDF) through the Atlantic Area Transnational Programme (INTERREG). For more information, please contact: Dr Athanasios Angeloudis AngeloudisA@cf.ac.uk, Dr Bettina Bockelmann-Evans, Bockelmann-Evans@cf.ac.uk, Dr Reza Ahmadian AhmadianR@cf.ac.uk or Prof Roger A. Falconer FalconerRA@cf.ac.uk.

Badminton

Cardiff YPN Social Secretary organises biweekly social events which include badminton sessions. This event was held in the Talybont Sports Centre. YPN members enjoyed the badminton session very much and tend to make this a permanent social event.

Figure 8: The badminton's evening session at Talybont Sports Centre.

3. Research progress

Testing a Tidal Turbine in a Natural Environment, *by Luis Priegue Molinos*

As it was informed in the previous newsletter, a prototype of a cross-flow turbine was tested in the White Water Rafting Centre. These raft of tests completed the intermediate stage for the development of this technology at Cardiff University. In the hydraulics laboratory from the School of Engineering, different experiments were carried out in order to optimize a 1:25 scale prototype. These experiments were the basis for the 1:15 scale turbine that was deployed in the White Water Centre.

These facilities were excellent to test the turbine without any blockage effect. With a variable cross-section that reaches up to 10 meters width, the range of flow discharge varied from 4m3/s to 8m^3/s, in order to get different flow speeds and also to analyse the behaviour of a turbine partially submerged.

Two flowmeters were set to measure the flow speeds in the position where the turbine was positioned. Depending on the flow discharge, the

currents varied from 1.17 to 1.42 m/s.

The turbine prototype consists of a vertical axis cross-flow turbine with three helical blades, 58 cm height and 40 cm of diameter. A 0.2KW generator was attached to the bottom of the turbine, generating real electricity that was led to a AC circuit where current and voltage were measured. In addition to extract electrical data, a magnetic encoder was mounted on top of the shaft to record the rotational speed.

These tests have been a very significant stage for the project. As the power coefficients of the turbine were between the expected ranges, we were able to check that the results obtained from our lab were reliable. Also, a journal paper with all the information of the tests will be written in the near future.

The next stages of the turbine development include its scaling up to a 1:5 ratio. In addition to this, new research would be done in the laboratory and in the White Water centre for new improvements.

If anybody is interested in knowing more about the project or has any question, please do not hesitate to contact Luis Priegue (PriegueL@cardiff.ac.uk).

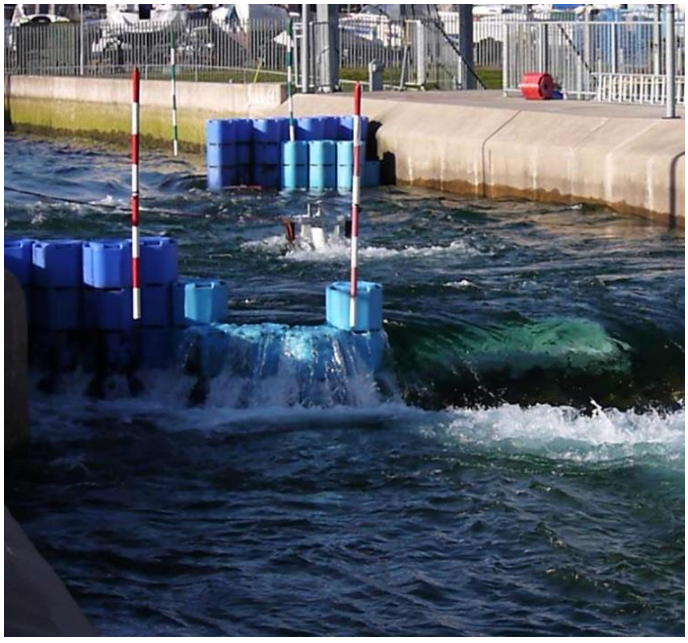

Figure 9: The cross-flow turbine prototype with scale of 1:15 that deployed in the White Water Centre.

Constraints on Extractable Power from Energetic Tidal Straits, *by Paul Evans*

National efforts to reduce energy dependency on fossil fuels have prompted examination of macrotidal nearshore sites around the United Kingdom (UK) for potential tidal stream resource development. A number of prospective tidal energy sites have been identified, but the local hydrodynamics of these sites are often poorly understood. Although first-order appraisals may make macrotidal tidal straits appear attractive for development, detailed, site-specific hydrodynamic and bathymetric surveys are important for determining site suitability for tidal stream turbine (TST) installation. Understanding the ways in which coastal features affect tidal velocities at potential TST development sites will improve identification and analysis of physical constraints on tidal energy development.

This study examines tidal velocity data measured in Ramsey Sound, Pembrokeshire, Wales, UK (Figure 10), an energetic macrotidal strait, which will soon host Wales' first TST demonstration project. While maximum tidal velocities in the strait during peak spring flood exceed 3 ms^{-1}, the northern portion of Ramsey Sound exhibits a marked flood-dominated tidal asymmetry. Furthermore, local bathymetric features affect flow fields that are spatially heterogeneous in three dimensions, patterns that depth-averaged velocity data (measured and modelled) tend to mask. Depth-averaging can therefore have a significant effect on power estimations (Figure 11). Analysis of physical and hydrodynamic characteristics in Ramsey Sound, including tidal velocities across the swept area of the pilot TST, variations in the stream flow with depth, estimated power output, water depth and bed slope, suggests that the spatial and temporal variability in the flow field may render much of Ramsey Sound unsuitable for tidal power extraction (Figure 12). Although the resource potential depends on velocity and bathymetric conditions that are fundamentally local, many prospective tidal energy sites are subject to similar physical and hydrodynamic constraints. Results of this study can help inform site selection in these complicated, highly dynamic macrotidal environments.

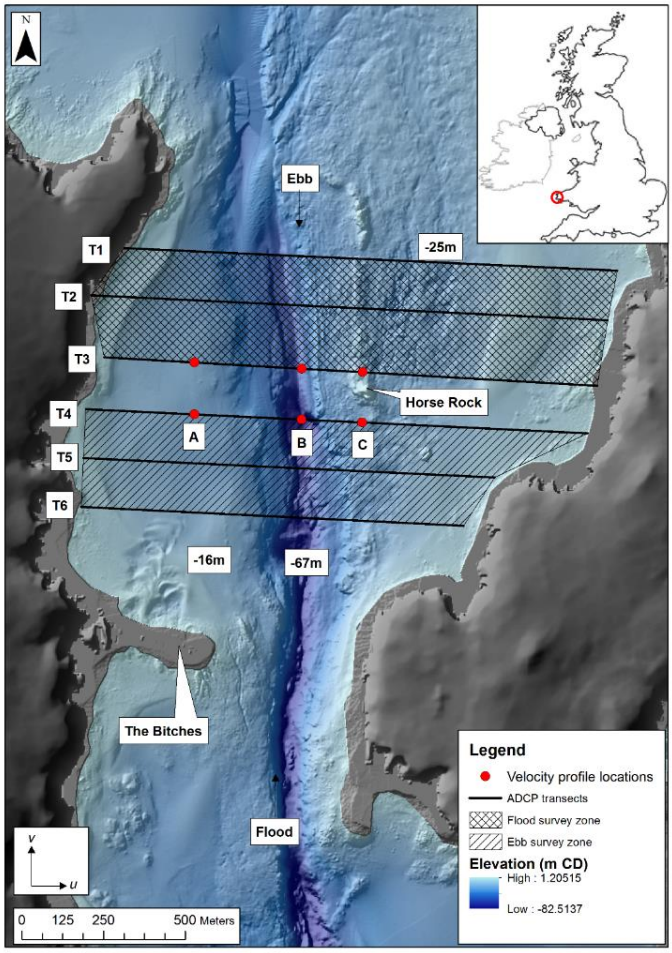

Figure 10: Location map of Ramsey Sound, Pembrokeshire (UK). Bathymetric contours show seabed elevation. ADCP transects are represented by black lines and red dots represent velocity profile locations.

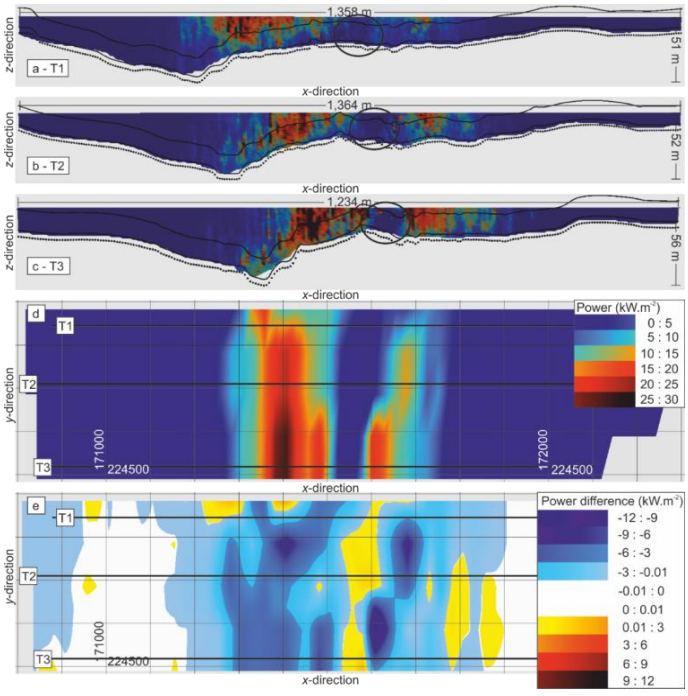

Figure 11: Power flux at peak flood for cross-sections T1 (a), T2 (b) and T3 (c); contour plot of vertically-averaged velocities over 15 m diameter TST sweep (d); and difference in power flux when depth-averaging tidal velocities over the entire water column (e).

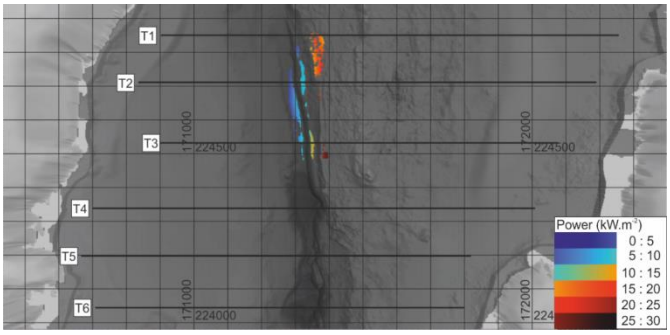

Figure 12: Contour plot of power flux for suitable TST areas at peak flood and ebb based on a minimum vertically-averaged streamwise velocity over the 15 m TST swept area of 2 ms^{-1}, a minimum water depth of 30 m and a maximum seabed slope of 5°.

In order to fully characterise the structure of the tidal currents, these data should be supplemented with 3-D modelling, particularly in areas subject to a highly irregular bathymetry and complicated tidal regime.

The study was carried out as a part of Low Carbon Research Institute (LCRI) Marine Consortium, which is part funded by the Welsh Government, the Higher Education Funding Council for Wales, the Welsh European Funding Office and the European Regional Development Fund Convergence Programme.

For more information, please contact: Dr Paul Evans EvansPS3@cardiff.ac.uk, Prof Tim O'Doherty Odoherty@cardiff.ac.uk, or Dr Allan Mason-Jones Mason-JonesA@cardiff.ac.uk.

4. Future activities

International Experience Fund – Cinvestav, Mérida, México

Cardiff University offers to their PhD students the possibility to travel abroad to other Universities in order to complete their skills by taking advantage of laboratories or equipment that are not available at Cardiff University. One of our YPN members, Fernando Alvarez, got awarded with the

International Experience Fund and will be travelling to the Cinvestav (Center for Research and Advanced Studies of the National Polythecnic Institute) at Merida, Mexico. He will have the opportunity to join a team led by Dr. Ismael Mariño Tapia for a bathymetric surveying campaign in the Yucatan Peninsula coast, using shallow water multi-beam echo sounder technology. After a couple of years working with bathymetrical data provided by others as X,Y,Z coordinates, this will be a great opportunity to fully understand how a bathymetrical campaign is plan and executed, the different devices available for bathymetrical surveying as well as related costs, precisions and potential issues and errors.

35th IAHR World Congress

The 35th IAHR World Congress will be hold in The Hague from June 28th June until July 3rd. During these five days, the recent and advanced research in many field of hydraulics is presented. Apart from the main sessions, there are 14 special sessions where very interest topics are discussed, such as Marine Renewable Energy, Oil Spill modelling, Deltas or Long waves and relevant extremes among others.

The host Delft YPN is organizing different events focused on building stronger links between all the YPNs, such as: YPN forum, YPN corner and YPN tour and dinner. Comments and opinions are going to be shared on how to focus the activities of the YPN organizations, how to achieve stronger relations with companies or what are the benefits of becoming member of an YPN member. Our President, Sam Bray, will be presenting the recent activity of the Cardiff YPN and how we focus the future of our YPN.

Some of the presentations that our representatives will expose at the conference are:

Athanasios Angeloudis: *Effect of Three-Dimensional Mixing Conditions on Water Treatment Reaction Processes*; and *Combined Potential and Impacts of Tidal Lagoons along the North Wales Coast*.

Bruño Fraga Bugallo: *LES for bubble plumes: impact of the interpolation technique and the size of the bubbles on the entrained liquid velocity*.

Luis Priegue Molinos: *Effect of blade parameters and arrangement on the performance of a cross-flow turbine*.

Richard McSherry: *Bed Friction on Rough-Bed Free-Surface Flows*.

Pablo Ouro Barba: *Large eddy simulation of a Vertical Axis Tidal Turbine: study of the blockage effect*.

Yan Liu: *Large eddy simulation of fine sediment suspension in open channels.*

For more information about the event, please visit: http://www.iahr2015.info/

Social events

For the following months, Cardiff YPN will be supporting more social events. Among the future events, it can be highlighted the participation on the ICE football tournament or the successful badminton evenings every two weeks.

5. Publications

Some of the publications of the HRC members since the last newsletter issue are:

1. Angeloudis, A., Stoesser, T. and Falconer, R.A. 2015. Flow, Transport and Disinfection Performance in small- and full- scale Contact Tanks. *Journal of Hydro-environment Research*, 9(1), 15-27.
2. Evans P.S., Mason-Jones A., Wilson, C.A.M.E., Wooldridge, C.F., O'Doherty, T. and O'Doherty, D.M. 2015. *Constraints on Extractable Power from Energetic Tidal Straits, Renewable Energy*, 81, 707-722.
3. Fraga, B. and Stoesser, T. 2015. An improved Large-eddy Simulation-based Eulerian-Lagrangian approach to predict bubble plume dynamics. Submitted to *Ocean Modelling*.
4. Fraga, B. and Stoesser, T. 2015. LES study of the main parameters influencing the integral behaviour of bubble plumes. Submitted to *Geophysical Research*.
5. Kara M.C., Stoesser, T. and McSherry, R. Calculation of fluid-structure interaction: methods, refinements, applications. *Proceedings of the ICE- Engineering and Computational Mechanics*, 168 (2), 59-78.

6. Ouro Barba, P., Stoesser, T. and McSherry, R. 2015. Large-eddy simulation of a Vertical Axis Tidal Turbine using an Immersed Boundary Method. *CFD for Wind and Tidal Offshore Turbines*, Springer.

If you wish to request more information about the newsletter, please contact to:

- Sam Bray (President): BrayS@cardiff.ac.uk,
- Bruño Fraga Bugallo (Vice-president): FragaB@cardiff.ac.uk,
- Pablo Ouro Barba (Secretary): OuroBarbaP@cardiff.ac.uk