

Numerical modelling of wave interaction with coastal and offshore structures using a CFD solver

Devolder Brecht¹, Gruwez Vincent¹, Rauwoens Pieter² and Troch Peter¹

¹ Department of Civil Engineering, Ghent University, Technologiepark 904, 9052 Zwijnaarde (Ghent), Belgium
E-mail: Brecht.Devolder@UGent.be

² Construction TC, Technology Campus Ostend, Department of Civil Engineering, KU Leuven, Zeedijk 101, 8400 Oostende, Belgium

Sustainable development of coastal and offshore structures – from conceptual layouts, optimisation, stability and environmental assessment to detailed design – requires a thorough understanding of coastal and offshore processes. Numerical modelling is a suitable tool to investigate these physical processes and to deliver valid, accurate, efficient and usable results and solutions. Parallel to the increase of the available computational power, the use of numerical models is growing rapidly, also in the design of all kinds of coastal and offshore structures, such as breakwaters, wave energy converters, etc.

In this work, the Computational Fluid Dynamics (CFD) software OpenFOAM (<http://openfoam.org/>) has been used to study wave interaction with coastal and offshore structures. The numerical simulations are performed in a numerical wave tank, which is the equivalent of a physical wave tank used for experimental model testing at a smaller scale. However, the idea behind both wave tanks is the same: reproducing the physics as observed in the ocean or the sea in a controllable environment to study particular physical processes in detail. The numerical wave tank is characterised by a length, width and height. Boundary conditions are needed at the sides of the tank, for example to generate and absorb waves. The CFD software solves a set of partial differential equations, the Navier-Stokes equations, representing the physics with a very high accuracy. Therefore, the numerical wave tank is split up in a large amount of small grid cells and the governing differential equations are discretised to algebraic equations using a finite volume method. In each grid cell, the algebraic equations are solved numerically using linear systems, taking the boundary conditions into account.

In this study, we present several simulations of coastal and offshore structures using a CFD solver:

- Wave propagation in a two-dimensional wave flume,
- Wave breaking on a sloping beach,
- Wave run-up on a monopile,
- Modelling of wave energy converter arrays.

The first author is Ph.D. fellow of the Research Foundation – Flanders (FWO), Belgium (Ph.D. fellowship 1133815N).

Keywords: waves; numerical modelling; CFD; OpenFOAM; numerical wave tank

BOOK OF ABSTRACTS



VLIZ MARINE SCIENCE DAY - 3 MARCH 2017 - VIVES BRUGES



BOOK OF ABSTRACTS

VLIZ MARINE SCIENCE DAY

VIVES, BRUGES
3 MARCH 2017

VLIZ SPECIAL PUBLICATION 79

This publication should be quoted as follows:

Jan Mees and Jan Seys (Eds). 2017. Book of abstracts – VLIZ Marine Science Day. Brugge, Belgium, 3 March 2017. VLIZ Special Publication 79. Vlaams Instituut voor de Zee – Flanders Marine Institute (VLIZ): Oostende, Belgium. 129 + x p.

Vlaams Instituut voor de Zee (VLIZ) Flanders Marine Institute VLIZ – InnovOcean site Wandelaarkaai 7, 8400 Oostende, Belgium Tel. +32-(0)59-34 21 30 Fax +32-(0)59-34 21 31 E-mail: info@vliz.be
<http://www.vliz.be>

Photo cover: VLIZ

This book is based on the information submitted by the respective authors.

Reproduction is authorized, provided that appropriate mention is made of the source.

ISSN 1377-0950

PREFACE

This is the 'Book of Abstracts' of the 17th edition of the VLIZ Marine Science Day, a one day event that was organised on 3 March, 2017 in VIVES, Brugge.

This annual event has become more and more successful over the years. With more than 400 participants and more than 100 scientific contributions, it is fair to say that it is the place to be for Flemish marine researchers and for the end-users of their research. It is an important networking opportunity, where scientists can meet and interact with their peers, learn from each other, build their personal professional network and establish links for collaborative and interdisciplinary research.

Marine scientists from all Flemish universities and scientific institutes – and representing all marine science disciplines – have contributed to this volume. The book thus illustrates the diversity, quality and relevance of the marine sciences in Flanders (and Belgium): it provides a beautiful and comprehensive snapshot of the state-of-the-art of marine scientific research in Flanders.

Pre-doc and post-doc scientists present their research in an exciting way and communicate their fascinating science – and its importance to society – to the wider public. We thus hope to demonstrate the excellence of Flemish marine science and to increase its national and international visibility.

The volume of research that is presented here holds a great promise for the future. It shows that marine science is a very lively discipline in Flanders, and that a new generation stands ready to address the grand challenges and opportunities that our seas and oceans represent.

New this year are the Brilliant Marine Research Ideas, an initiative sponsored through the philanthropy scheme of VLIZ. We are proud to announce that an initial batch of 4 ideas will be sponsored. We'll hear about the results in the next edition of the Marine Science Day.

I want to congratulate all participants with their contributions, and I invite them all to become members of VLIZ and to actively participate in our events and activities in the future.

Bruges, 3 March 2017
Prof. Dr Jan Mees
General Director VLIZ

TABLE OF CONTENTS

Preface	iii
Table of contents	iv
Oral, Demo and Poster Presentations	
Abdulbur Alfakhoury Ehab, Leermakers Martine and Bratkic Arne - Development of diffusive gradients in thin films (DGT) passive samplers for simultaneous measurement of Platinum, Palladium, Rhodium and Mercury in surface water.....	- 2 -
Amadei Martínez Luz, Blanco Fernández Carmen, Braeckman Ulrike, Geldhof Ruben, Peene Nathalie, Vanaverbeke Jan, Wittoeck Jan and Depestele Jochen - Consumption of discarded plaice (<i>Pleuronectes platessa</i>) by epibenthic scavengers: common starfish (<i>Asterias rubens</i>) and hermit crabs (<i>Pagurus bernhardus</i>)	- 3 -
Amisi Joel - Benthos response to physical disturbance: “The case of deep-sea trawling at the Portuguese Margin off Sines”	- 4 -
Barrios Trullols Africa, Hugé Jean, Satyanarayana Behara, and Dahdouh-Guebas Farid - Carbon-neutral silviculture in Matang Mangrove Forest Reserve (Malaysia): a becoming reality?	- 5 -
Bekaert Karen , Maertens Ilse, Moerman Martine and Torreele Els - Determination of the best otolith preparation method for aging of dab (<i>Limanda limanda</i>).....	- 6 -
Braeckman Ulrike, Pasotti Francesca, Hoffmann Ralf, Vázquez Susana, Torstensson Anders, Vanreusel Ann and Wenzhöfer Frank - Carbon cycling in Antarctic benthic communities subject to glacier retreat	- 7 -
Brand Evelien, Montreuil Anne-Lise, Dan Sebastian and Chen Margaret - One year of monthly beach morphological changes in Mariakerke (Oostende) related to their forcing factors.....	- 8 -
Bruneel Stijn, Verhelst Pieter-Jan, Reubens Jan, Moens Tom and Goethals Peter - Abiotic modelling options of estuarine areas as building blocks for ecological predictions	- 9 -
Burdorf Laurine, Hidalgo-Martinez Silvia, Van de Velde Sebastiaan and Meysman Filip - Cable bacteria protect coastal waters from toxic nightmares	- 10 -
Callebaut Ine, Van de Velde Sebastiaan, Gao Yue and Meysman Filip - Electrogenic sulfur oxidation drives trace metal cycling in sediments from the Belgian Coastal Zone.....	- 11 -
Christiansen Henrik, Van de Putte Anton P. and Volckaert Filip A.M. - Connectivity the Southern Ocean: population genomics of icefish	- 12 -
Cransveld Alice, Amouroux David, Tessier Ammanuel, Bérail Sylvain, Barre Julien, Michel Loïc and Das Krishna - Mercury stable isotopes discriminate different populations of common Seabass around Europe and provide insight on mercury cycle	- 13 -
Dam Thi-minh-tho, Devriendt Bert, Bossier Peter and Vanrompay Daisy - Recombinant sea bass Transferrin inhibits and kills <i>Vibrio anguillarum</i>	- 14 -
Damseaux France, Lepoint Gilles and Das Krishna - A meta-analysis of isotopic compositions of North Sea marine mammals	- 15 -
De Backer Annelies, Debusschere Elisabeth, Ranson Jan and Hostens Kris - Extremely loud and incredibly close: <i>in situ</i> exposure of Atlantic cod to pile driving.....	- 16 -
De Blok Reinhoud, Tyberghein Lennert, Mortelmans Jonas, Deneudt Klaas, Hernandez Francisco, Sabbe Koen and Vyverman Wim - <i>Phaeocystis</i> blooms in the Belgian coastal zone - Routine phytoplankton monitoring with the Cytosense flowcytometer	- 17 -
De Bock Sander, De Jager Sarah, Bouten Janne, Dumortier Jasmien, Bourgeois Gil, Derom Eric, Boone Jan, Herregods Luc and Bourgeois Jan G. - Diving response: an argument for the Aquatic Ape Theory in human evolution?.....	- 18 -
De Clercq Maikel, Missiaen Tine, Busschers Freek and De Batist Marc - Late Pleistocene palaeogeographical evolution of the southern North Sea	- 20 -

De Jager Sarah, De Bock Sander, Dumortier Jasmien, Bouten Janne, Bourgois Gil, Boone Jan, Herregods Luc and Bourgois Jan G. - Apnea trained athletes: rather marine mammals than humans?	21 -
De Raedt Jonathan, Janssen Colin R., Baert Jan and De Laender Frederik - Movement of chemical stressors changes the relationship between regional diversity and productivity	22 -
De Schampelaere Kristine, Teuchies Johannes, Ysebaert Tom, Blust Ronny and Meire Patrick - Development of a triad assessment method for brackish sediments in Flanders	23 -
De Smet Bart, Pape Ellen, Riehl Torben, Bonifácio Paulo, Colson Liesbeth and Vanreusel Ann - The community structure of deep-sea macrofauna in an area of interest for deep-sea mining.....	24 -
De Swaef Evelien, Vercauteren Maaïke, Haesebrouck Freddy and Decostere Annemie - Development of the first standardized biotic challenge model for Dover Sole (<i>Solea solea</i>) and its validation by assessing the protective potential of probiotic candidates	25 -
Dekeyzer Stefanie, Deneudt Klaas, Vandepitte Leen, Goffin Annelies, Claus Simon and Hernandez Francisco - The LifeWatch infrastructure	26 -
Delerue-Ricard Sophie, Styneen Hanna, Barbut Leo, Vanden Bavière Andres, Goscia Ilaria, Robbens Johan, Lacroix Geneviève and Volckaert Filip A.M. - Where goes the flow? – Tracing sole of the North Sea with genomics and otolith shape	27 -
Deprez Tim, Bossier Peter, Cattrijsse André, Chiers Koen, De Clerck Olivier, Decostere Annemie, Deneudt Klaas, De Troch Marleen, Hernandez Francisco, Mascart Thibaud, Moens Tom, Tkint Tim, Vanstappen Gilbert, Verstraeten Tim, Willems Anne and Vanreusel Ann - EMBRC.be – The Belgian node of the European Marine Biological Resource Centre	28 -
Deprez Tim, Roelofs Marleen, Tkint Tim and De Troch Marleen - Join the International Master of Science in Marine Biological Resources (IMBRSea) now!	29 -
Deschutter Yana, Everaert Gert, De Schampelaere Karel and De Troch Marleen - How to cope(pod) with a multistressor environment?.....	30 -
Devolder Brecht, Gruwez Vincent, Rauwoens Pieter and Troch Peter - Numerical modelling of wave interaction with coastal and offshore structures using a CFD solver	31 -
Devriese Lisa, Van Poucke Reinhart, Bossaer Matthias, Tack Filip, Hostens Kris and Robbens Johan - With a pinch of salt: microplastics and trace elements in sea salts for human consumption	32 -
Dissanayake P.A. Kushlani N. and Kochzius Marc - Population structure and connectivity patterns of Giant Clams (<i>Tridacna</i> spp.) along the Western Indian Ocean	33 -
Echappé Caroline, Gernez Pierre, Meleder Vona, Jesus Bruno, Cognie Bruno, Decottignies Priscilla, Sabbe Koen and Barillé Laurent - The relationship between oysters and microscopic benthic algae revealed by satellite remote sensing	34 -
Gallach-Sánchez David, Troch Peter and Kortenhaus Andreas - Wave overtopping on steep low-crested structures: another climate change challenge	35 -
Gaulier Camille, Superville Pierre-Jean, Guo Wei, Bayens Willy, Gao Yue and Billon Gabriel - Study of geochemical behaviour of pollutants in the Belgian coastal marine environment	37 -
Gordigiani Lorenzo, Pavan Gianni and Kochzius Marc - Inter Pulse Interval analysis of Sperm Whale (<i>Physeter macrocephalus</i> , Linnaeus 1758) “clicks” recorded in Mediterranean Sea between 1996 and 2011: Population structure and distribution of sizes	38 -
Grosemans Tara, Asselman Jana, Boets Pieter, Mees Jan, De Schampelaere Karel and Janssen Colin R. - Detection and degradation of environmental DNA (eDNA) in the marine environment: a lab and field approach using plaice.....	39 -
Gruwez Vincent, Kortenhaus Andreas and Troch Peter - Advanced modelling of wave overtopping for climate resilient coastal defence systems	40 -
Hademenos Vasileios, Kint Lars, Missiaen Tine, Stafleu Jan and Van Lancker Vera - Introducing data and model uncertainty into the new 3D voxel model of the Belgian part of the North Sea.....	41 -
Heindler Franz Maximilian, Christiansen Henrik, Dettai Agnes, Collins Martin A., Couloux Arnaud, Volckaert Filip A.M. and Van de Putte Anton - DNA barcoding of small mesopelagic fish from the Southern Ocean	42 -
Heylen Brigitte and Pichegru Lorien - Tracking a marine predator to design flexible boundaries of marine protected areas for an ecosystem approach to fisheries	43 -

Huyghe Filip - Connectivity of the skunk clown fish in the Indian Ocean using a combination of microsatellite and mitochondrial genetic markers	44 -
Ivanov Evgeny, Capet Arthur, Barth Alexander, Delhez Eric, Soetaert Karline and Grégoire Marilaure - Tri-dimensional modeling of Southern Bight of the North Sea: First results and perspectives	45 -
Kerkhove Thomas, Boyen Jens, De Backer Annelies, Mol Jan, Volckaert Filip A.M. and De Troch Marleen - Sustainability of a tropical shrimp fishery: can genetic research give additional clues?.....	46 -
Kint Lars, Van Heteren Sytze, Lagring Ruth and Van Lancker Vera - Versatility of marine geological databases in view of MSFD related assessments	47 -
Liu Xiaoxia, Zhao Weishu and Xiao Xiang - Poly-extreme adaptation of early life in deep ocean: Minimum amino acid requirement for hyperthermophilic archaea, <i>Thermococcus eurythermalis</i> , under pH boundaries	48 -
Lopes-dos-santos Ruy - Unravelling the contribution of halophilic bacteria to the <i>Artemia</i> diet	49 -
Lowie Nils, Van Rooij David, Degrendele Koen and Roche Marc - Evaluation of the sand extraction impact on the seabed and the water column at short time and space scale in an intensively dredged area of the Belgian part of the North Sea by using multibeam echosounder bathymetric, backscatter strength and water column data.....	50 -
Maier Sandra, Kutti Tina, Bannister Raymond, Van Rijswijk Pieter, Van Breugel Peter, De Froe Evert and Van Oevelen Dick - Survival in a feast-famine environment: Resource utilization, storage and recycling in cold-water coral reefs.....	52 -
Martin Miguez Belen and Calewaert Jan-Bart - EMODnet: the gateway to marine data in Europe	53 -
Martinez Espinosa Columba, Otero Fadul Viviana, Vande Velde Katherine, Hugé Jean, Satyanarayana Behara, Dahdouh-Guebas Farid - Crab community structure as ecological indicator of Matang mangrove forest in Malaysia.....	54 -
Mascart Thibaud, Tkint Tim, Roelofs Marleen, Verstraeten Tim, Vanreusel Ann and Deprez Tim - MarineTraining.eu - An overview of Europe's Marine and Maritime education landscape	55 -
Mascart Thibaud, Deprez Tim, Tkint Tim, Deprez Karoline, Vyverman Wim and Vanreusel Ann - EMBRIC - The European blue bio-economy cluster for aquaculture and biotechnology innovations	56 -
Mavraki Ninon, De Mesel Ilse and Degraer Steven - Preliminary study of the water gradient within a Belgian offshore windfarm	57 -
McDonough Niall, Muñoz Piniella Angel and Donaldson Karen - The ticking time bomb of climate change and sea-level rise	58 -
Michel Loic, Dubois Philippe, Eleaume Marc, Fournier Jerome, Gallut Cyril, Jane Philip, and Lepoint Gilles - Increased sea ice cover disrupts food web structure in coastal Antarctica.....	59 -
Mortelmans Jonas, Debusschere Elisabeth, Vranken Sofie, Tyberghein Lennert, Deneudt Klaas and Hernandez Francisco - Studying plankton diversity in the Belgian Continental Zone: Research opportunities	61 -
Mutisya Bonface, Kairo James, Kervyn Matthieu, Ndungu Jane and Koedam Nico - Modelling soil erosion potential using remotely sensed data	62 -
Narváez Krupskaya and Osaer Filip - Angelshark-ID: Photo-identification as a non-invasive monitoring tool.....	63 -
Ndarathi John, Dahdouh-Guebas Farid and Munga Cosmas - Unveiling the artisanal fish trade network in coastal Kenya (with focus on key stakeholders and fish products).....	64 -
Nehemia Alex and Kochzius Marc - Salt-making in mangroves, an economic activity that influences genetic diversity and structure of the fiddler crab <i>Uca annulipes</i> (H. Milne Edwards 1837).....	65 -
Neve Magdalene, Van der Stocken Tom, Koedam Nico and Triest Ludwig - Patterns of regional- and local- scale genetic connectivity in Eastern Atlantic mangroves	66 -
Ong Ee Zin, Van Colen Carl, Briffa Mark and Moens Tom - Interactive effects of next-century ocean acidification and warming on the common cockle <i>Cerastoderma edule</i>	67 -

Ortenzio Francesca and Dan Sebastian - Relationship between water and sediment dynamics at Mariakerke beach	- 68 -
Osaer Filip and Narváez Krupskaya - Hammerhead Shark Research: Knowledge from the populations in the Canary Islands	- 69 -
Osaer Filip and Narváez Krupskaya - Micropredator and parasites: an indicator for the status of angelsharks?	- 70 -
Oset Garcia Paula, Souza Dias Francisco, Claus Simon, De Hauwere Nathalie, Vanhoorne Bart, Hernandez Francisco and Mees Jan - A new version of the Maritime Boundaries Geodatabase.	- 71 -
Otalora Paula, Geelhoed Jeanine, Hidalgo-Martinez Silvia, Burdorf Laurine and Meysman Filip - Diversity and natural distribution of electricity-generating cable bacteria in the seafloor.....	- 72 -
Potters Geert, Boretska Mariia, Mohsynets Oleana, Bellenberg Soer, Poesen Timo, Rogalsky Sergey, Voychuk Sergey, Suslova Olga, Meskens Raf, Willemen Remke and De Baere Kris - Ionic liquids: Defending ships' hulls against corrosion and biofouling	- 73 -
Reubens Jan, Verhelst Pieterjan, Pauwels Ine, Van Hoey Stijn, Deneudt Klaas, Desmet Peter, and Hernandez Francisco - The acoustic receiver network: a sea of opportunities	- 75 -
Royer Colin - Dimethylsulfonopropionate as a reactive oxygen species scavenger for phytoplankton cell	- 76 -
Rumes Bob, Debusschere Elisabeth, Reubens Jan, Norro Alain and Deneudt Klaas - The influence of pile driving noise on harbour porpoises.....	- 77 -
Sannen Laurien, Volckaert Filip A.M. and De Troch Marleen - Lipidomics of harpacticoid copepods in a changing ocean	- 78 -
Sotillo Alejandro, Stienen Eric, De Neve Liesbeth and Lens Luc - The "Landgull": how important is terrestrial food for Lesser Black-backed gulls <i>Larus fuscus</i> in Belgium, and are there consequences to this diet?	- 79 -
Souza Dias Francisco, Claus Simon, Pirlet Hans, McMeel Oonagh and Calewaert Jan-Bart - We want YOU to join the EMODnet/IMEC Open Data Competition!	- 80 -
Stienen Eric, Desmet Peter, Hernandez Francisco, Lens Luc and Müller Wendt - GPS tracking network of Lesser Black-backed Gulls and Herring Gulls breeding at the southern North Sea coast.....	- 81 -
Stock Willem, Willems Anne, Mangelinckx Sven, De Troch Marleen, Vyverman Wim and Sabbe Koen - The importance of the little things: Bacteria-diatom interactions in intertidal mudflats	- 82 -
T'jampens Roeland, Hernandez Francisco, Vandecasteele Florian and Verstockt Steven - Automatic monitoring of birds in marine video content	- 83 -
Toussaint Elise, Braeckman Ulrike, De Borger Emil, Soetaert Karline and Vanaverbeke Jan - Impact of macrofaunal activities on the biogeochemical cycling in anthropogenically disturbed sediments.....	- 84 -
Van 't Land Mike - Determining nutritional quality and chemical changes during storage of fish silage produced using different combinations of undersized quota species.....	- 85 -
Van Acker Emmanuel, De Rijcke Maarten, De Schamphelaere Karel, and Janssen Colin R. - Phycotoxins in sea spray aerosols: friend or foe?.....	- 86 -
Van Coppenolle Rebecca, Schwarz Christian and Temmerman Stijn - Role of mangroves and salt marshes for nature-based flood risk mitigation in major deltas of the world	- 87 -
Van De Velde Sebastiaan, Gao Yue and Meysman Filip - The impact of dredging on the geochemical cycling in coastal ecosystems	- 88 -
Van der Stocken Tom and Menemenlis Dimitris - Modeling mangrove propagule dispersal trajectories using high-resolution estimates of ocean surface winds and currents.....	- 89 -
Van Eynde Benigna, Christiaens Olivier, Vuylsteke David, Cooreman Kris, Smagghe Guy and Delbare Daan - First steps to rear <i>Crangon crangon</i> larvae successfully in captivity	- 90 -
Van Oyen Tomas and Nnafie Abdel - Influence of anthropogenic measures on large-scale estuarine morphodynamics.....	- 91 -

Van Putte Niels, Verreydt Goedele, Meire Patrick, Seuntjens Piet and Temmerman Stijn - Historical agricultural land use leads to reduced groundwater dynamics in a restored freshwater tidal marsh	- 92 -
Vandebeek Ine, Toorman Erik and Troch Peter - Towards a climate resilient coast: Numerical modeling of wave overtopping and wave loads considering the influence of sediment transport	- 93 -
Vandecasteele Loes, Vanelslander Bart, Torreele Els and Hans Polet - Sole in the Irish Sea: Do fishermen and fisheries-scientists see things from a different perspective?	- 95 -
Vanhellemont Quinten - A near-shore phytoplankton bloom in Belgian waters observed from space	- 96 -
Verao Fernandez Gael, Balitsky Philip, Stratigaki Vasiliki and Troch Peter - Coupling methodology for modelling the near field and far field effects of an array of wave energy converters.....	- 97 -
Verbrugghe Tim and Vasarmidis Panagiotis - Waves: an ocean of modelling options	- 98 -
Vercauteren Maaïke, De Swaef Evelien, Devriese Lisa, Polet Hans, Decostere Annemie and Chiers Koen - Visualization of small lesions in skin of fish using fluorescein dye	- 99 -
Vergara Gabriela, Deschutter Yana and De Troch Marleen Distribution of zooplankton in the coastal area of the Belgian part of the North Sea, with focus on the harbors of Oostende, Zeebrugge and Nieuwpoort	- 100 -
Withoutck Inne and González-Wangüemert Mercedes - Is the sea cucumber <i>Holothuria polii</i> a potential indicator species for organic enrichment in the sediments of coastal lagoons?.....	- 101 -
Wittek Boris Impact of seasonal environmental stress in sea ice on the production and emission of dimethylsulfide by microbial communities	- 102 -
Zhang Qinghui, Monballiu Jaak and Toorman Erik - From measured 2D short wave spectrum to infragravity wave surface modulation in deep water	- 103 -

VLIZ Master Thesis Awards

Bossuyt Stijn Een 'Search Group Algoritme' voor de optimalisatie van offshore windmolenparken .-	105 -
De Blick Yves - The use of echosounder tools for fish detection in the North Sea.....	- 107 -
Heylen Brigitte - Tracking a marine predator to design flexible boundaries of marine protected areas for an ecosystem approach to fisheries	- 110 -
Seghers Stephie - Habitat suitability modelling for the harbour porpoise (<i>Phocoena phocoena</i>) in the Belgian part of the North Sea.....	- 112 -
Van Putte Niels - Groundwater flow in freshwater tidal marshes: A comparison of a natural and a restored marsh (<i>winner</i>).....	- 113 -
Wils Katleen - Reconstructie van de aardbevingsgeschiedenis van Aysén fjord (Zuid-Chili) aan de hand van seismische stratigrafie en de analyse van een sedimentkern (<i>winner</i>)	- 114 -

VLIZ North Sea Award

Debusschere Elisabeth - On the effects of high intensity impulsive sound on young European sea bass <i>Dicentrarchus labrax</i> , with special attention to pile driving during offshore wind farm construction	- 120 -
Deruytter David - Bioavailability and mixture effects of metals in different European mussel populations	- 124 -
Everaert Gert - Realistic environmental mixtures of hydrophobic compounds do not alter growth of a marine diatom (published in the Marine Pollution Bulletin (2016), 102, 58-64)	- 126 -
Scoma Albero - The " <i>Alcanivorax paradox</i> ": mild hydrostatic pressure impacts deep-sea oil bioremediation (<i>winner</i>).....	- 127 -

**ORAL, DEMO AND
POSTER PRESENTATIONS**

Development of diffusive gradients in thin films (DGT) passive samplers for simultaneous measurement of Platinum, Palladium, Rhodium and Mercury in surface water

Abdulbur Alfakhoury Ehab¹, Leermakers Martine¹ and Bratkic Arne¹

¹ Department of Analytical, Environmental and Geochemistry, Vrije Universiteit Brussel (VUB), Pleinlaan 2, 1050 Brussels, Belgium
E-mail: ehab.chemistry@gmail.com

Increasing anthropogenic activity often has detrimental effects on human health and the environment due to the accompanying emissions of toxic compounds. The increased application of Platinum Group Elements (PGEs) (Pt, Pd, Rh, Ru, Os and Ir) in the last decades, especially as car catalysts but also in other applications, makes it necessary to monitor the concentration of these elements in the environment, investigate their environmental transformations and bioavailability. Mercury (Hg) is also recognized as one of the most toxic trace elements, whose natural cycle has been altered by anthropogenic activities. Complex biogeochemical transformations result in different chemical species, with varying toxicities and mobility, which need close monitoring. The concentration of these elements usually extremely low in the aquatic environment, which makes the analysis challenging.

As the toxicity, bioavailability and the cycle of environmental contaminants can strongly be influenced by their chemical speciation, in recent years, the importance of speciation analysis has been recognized by the environmental monitoring and assessment community, leading to the development of an increasing number of speciation techniques. The in situ passive sampling technique diffusive gradients in thin films (DGT) as a speciation tool is based on the binding of labile metal species on a resin gel layer via the diffusion through a diffusive hydrogel (agarose or polyacrylamide) using Fick's Law. The concentration gradient built between the bulk solution and the resin gel makes pre-concentration of solutes possible. Using Fick's law, the time-weighted average concentrations of labile metal species can be obtained in situ. This technique has been widely used to assess trace elements such as Cd, Cu, Ni, Pb, Co, Zn in aquatic systems, but never been applied to test PGE elements until now.

The aim of this study was to develop the DGT technique for the assessment of PGE and Hg using two novel resins R14 and R20, which were designed specifically for above elements. This implies that the binding of the PGEs to the resin is strong, irreversible, almost instantaneous and the accumulated metals amounts are well below the capacity of the resin. The method development involves several different steps: 1) selection of an appropriate diffusive gel 2) the selection of an appropriate resin or binding phase for the PGEs and Hg, 3) development of an efficient elution method for the PGEs and Hg from the resin gel, 4) evaluation of the linear response in function of the deployment time, 5) determination of diffusion coefficients for the PGEs and Hg in the diffusive gel, 6) study the selectivity of the tested resins gels, 7) the accumulated metal amount is well below the capacity of the binding gel, 8) fast kinetics of the resins gels.

Agarose diffusive gel (AGA) (1.5% agarose) was chosen for lower interaction with PGEs and Hg, adequate blank values and linear response ($R^2 = 0.99$) in function of the time were obtained for the new resins gels and diffusion coefficients could be determined. An aqua regia and thiourea in hydrogen chloride elution methods gave a recovery for PGEs and Hg over 90% and 80% for the R20 and R14 resins gels, respectively. The selectivity test showed these two resins have higher selectivity to PGE and Hg than other trace elements even though they are at very high concentration level and the analysis of PGEs and Hg by sector field ICP-MS optimized. The new resin gels showed capability of accumulation concentration of PGEs and Hg of each hundred times higher than their reported concentrations in the aquatic environments.

Preliminary deployments in the Zenne River and UZ hospital effluent, Brussels, Belgium, showed that Pt, Pd, Rh and Hg can be quantified by the DGT technique using both evaluated resins in fresh water.

Keywords: DGT; PGEs; Hg; SF ICP-MS; diffusive coefficient; surface water; speciation