EQSPAE - 2016

International Conference on Deriving Environmental Quality Standards for the Protection of Aquatic Ecosystems

PROGRAMME & ABSTRACTS

18 - 20 June 2016
The University of Hong Kong

Key Sponsor:

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The 2nd International Conference on Deriving Environmental Quality Standards for the Protection of Aquatic Ecosystems (EQSPAE – 2016)

18-20 June 2016

The University of Hong Kong
Hong Kong

Tentative Programme

Key Sponsor:
Environment and Conservation Fund
The Government of the Hong Kong Special Administrative Region

Sponsors and Organizers:
School of Biological Sciences and The Swire Institute of Marine Science,
The University of Hong Kong

Faculty of Science, The University of Hong Kong

ACKNOWLEDGEMENTS

The organizing committee of the EQSPAE-2016 gratefully acknowledges the following organizations for their generous support and sponsorship to this conference:

- Environment and Conservation Fund, the Government of the Hong Kong Special Administrative Region of the People's Republic of China
- Faculty of Science, The University of Hong Kong
- School of Biological Sciences, The University of Hong Kong
- The Swire Institute for Marine Science, The University of Hong Kong
- The State Key Laboratory in Marine Pollution, City University of Hong Kong

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Preface

Welcome to the 2nd International Conference on Deriving Environmental Quality Standards for the Protection of Aquatic Ecosystems (EQSPAE-2016)

Environmental quality benchmarks (EQB) such as water and sediment quality guidelines of chemical contaminants are indispensable tools for effective monitoring and regulation of these environmental contaminants so as to protect aquatic ecosystems, precious natural resources, and human health. In recent years, many regions and countries, such as Australia, Canada, China, Europe, Hong Kong, Korea and the United States have been updating and revising their own water and sediment quality guidelines. Hence, there are rapid developments in the science and methodology for deriving generic EQB and site-specific EQB as well as advancements in their related policy and application for water quality management in different parts of the world. However, there are a number of challenging issues which are yet to be fully tackled, for example:

- How can we modify the current EQB of chemical pollutants while considering the combined effect of the chemicals and climate change (e.g. temperature and pH changes) to aquatic life?
- How can we derive and apply appropriate EQB of individual chemical pollutants while we are in fact required to manage chemical mixtures and multiple stressors in the aquatic environment of concern?
- How can we make use toxicity information from non-native species to protect locally un-tested species?
- How can we make use toxicity information from temperate regions to protect topical aquatic ecosystems?
- What are the best ways to design and conduct field experiments to validate the effectiveness of EQB for protecting biodiversity and ecosystem functions?
- How can we increase ecological realism in scientific derivation of EQB?

These questions are important for environmental protection and scientific answers are needed to support the efforts of our government, the Central Government of China and authorities in other countries involved in setting legislation to reduce pollution and protect the aquatic environment. Scientists and environmental experts from Australia, Bangladesh, Brunei, Canada, China, Hong Kong, Italy, Korea, Russia, Saudi Arabia, Singapore, Sweden, Switzerland, the United Kingdom, the United States and elsewhere will address and discuss these questions, and provide their recommendations at this EQSPAE-2016 Conference.

The EQSPAE-2011 Conference, which was also funded by Environment and Conservation Fund of the Government of the Hong Kong Special Administrative Region (SAR), was a very successful international conference in this field of study. It attracted over 150 delegates from 14 countries, and consisted of 36 platform presentations, 40 poster presentations, 2 training workshops and 3 breakout group sessions. The results of this first conference were published as a 243-page special issue in the international peer-review journal, *Environmental Science and Pollution Research* (published by Springer):

> Leung, K.M.Y., Merrington, G., Warne, M.St.J., Wenning, R.J. (Eds.) (2014). Environmental quality benchmarks for protecting aquatic ecosystems. *Environmental Science and Pollution Research* 21(1): 1–243. (URL http://link.springer.com/journal/11356/21/1/page/1)

Following the great success of EQSPAE-2011, this second conference aims to bring leading experts in the field of EQB derivation and application from different parts of the world to Hong Kong where they will share their knowledge and expertise on the latest development in the field with our local experts and environmental practitioners from government, academia and private sector. The EQSPAE-2016 will focus on the rapidly expanding body of aquatic biota, water, and sediment information collected from river, estuary and coastal marine monitoring studies conducted in Mainland China and elsewhere in the Asia Pacific region during the past 5–10 years, and consider how these data could be interpreted using the latest advancements in EQB derivation and applications for environmental protection.

The EQSPAE-2016 Conference consists of 1-day training workshop, and 2-day scientific symposium. It provides an important platform that enables knowledge exchange and fosters research collaboration among the participants. Therefore, this meeting will be highly beneficial to our local and national environmental practitioners. The outcomes of this conference will facilitate the further improvement in deriving and applying EQB and hence the betterment of aquatic ecosystems worldwide.

The specific objectives of this proposed conference include:

- To provide a platform for knowledge transfer and idea exchange with respect to the latest development in scientific derivation and application of EQB (e.g. water and sediment quality criteria or standards) in different parts of the world;
- To foster national and international collaboration in research and development among scientists, environmental consultants, policy makers and governmental officers engaging in the field of water quality management;
- To resolve some of the pressing scientific and practical issues in the establishment and application of EQB;
- To identify knowledge gaps and prioritize emerging research areas in the field, and

- To train young scientists and environmental practitioners on how to derive and apply EQB for water quality management.

The presentations, both oral and poster, in the ESAPE-2016 Conference cover the following topics:

- Scientific methodologies for the derivation of short- and long-term water and sediment quality guidelines for ecosystem protection in different parts of the world;
- Scientific derivation of site-specific water and sediment quality guidelines;
- Quality control and assurance on acquisition of ecotoxicity data for EQB development;
- Advance methods for setting microbial quality standards;
- Establishment of benchmarks for indicating ecosystem health status;
- Application and validation of water and sediment quality guidelines/ criteria/ standards;
- The relationship between EQB, environmental policy and legislation for water and sediment quality management; and
- Plan for international collaboration in data sharing and knowledge exchange in relation to the derivation and application of EQB.

Based on the figures obtained a month before the conference, the EQSPAE-2016 will consist of 30 platform presentations and 23+ poster presentations with a total of 100+ participants from 15 countries. The results of this meeting will be published as a special issue in *Environmental Science and Pollution Research* by early 2017. I would like to thank the Editor-in-Chief, Professor Philippe Garrigues and Editorial Assistant, Dr. Géraldine Billerot of *Environmental Science and Pollution Research* for their trust, and continuous and unfailing support to our conference series, allowing our scientific outcomes reaching out to a wider group of audiences and benefiting practitioners in the field of water quality management around the globe.

On behalf of the Organising Committee of the EQSPAE-2016, I would like to sincerely thank all of the sponsors including the Environment and Conservation Fund of the Hong Kong SAR Government, and the School of Biological Sciences and Faculty of Science, the University of Hong Kong (HKU) for making this conference possible. We specially thank Ms. Helen Leung, Ms. Tracy Wong, Mr. Albert Au, Ms. Esther Liu, Ms. Katie Yeung, Mr. Jason Yau and other student helpers for their dedication and wonderful efforts in organising this conference. We are also grateful to other colleagues of the School of Biological Sciences of HKU for their assistance and support to this important endeavour.

The Organizing Committee would also like to thank all of the invited speakers, in particular those who have travelled from afar to Hong Kong. We especially thank Dr. Kevin Kwok, Dr. Graham Merrington, Dr. Adam Peter, Dr. Stuart Simpson, Dr. Michael Warne and Mr. Richard Wenning for kindly organising and teaching the training workshops. We are very thankful to Mr. Patrick C. K. Lei, Principal Environmental Protection Officer (Water Policy & Science), Environmental Protection Department, the Hong Kong SAR Government, and Professor Pauline Chiu (Dean, Faculty of Science, HKU) for officiating the Opening Ceremony of this conference. I am in debt to members of the Organizing Committee, including Dr. Janet Chan, Dr. Leo Chan, Mr. Vincent Lai, Dr. Kevin Kwok, and Dr. Jasmine Ng for their great contributions to the overall planning and organisation of the EQSPAE 2016. I should thank Mr. Richard Wenning for his kindness to read and comment on an early draft of this preface.

Following the practice of EQSPAE-2011, I would like to end this preface with two Chinese idioms, namely “格物致知” (extracted from 《禮記：大學》, i.e., “Book of Rites: University”) and “好水魚壯” (please see them on the next page). They denote that “Study the underlying principle to acquire knowledge and pursue knowledge to the end”, and “Good water quality results in healthy fishes”. With the attitude of “格物致知”, we shall be able to determine and apply appropriate and scientifically sound EQB for protecting the aquatic ecosystem, and in turn safeguarding the water quality and sustaining the healthy ecosystem, i.e., “好水魚壯”. “Where there is a will, there is a way". Let us make concerted efforts to accomplish this common goal together!

Finally, I am thankful to all of you for your participation and contribution to the EQSPAE-2016 Conference. I wish the conference a great success and wish you a pleasant and memorable stay in Hong Kong.

With very best wishes,

Professor Kenneth Leung
Chairman
Organizing Committee of EQSPAE-2016

格物致知

好水魚壯

第二屆推導水生生態環境質量標準國際研討會

于香港大學舉辦・丙申年

Organizing Committee

Prof. Kenneth M. Y. LEUNG (Chairman)	Professor, School of Biological Sciences, and Associate Dean (Research & Graduate Studies), Faculty of Science, The University of Hong Kong, Hong Kong
Dr. Janet K.Y. CHAN	Lecturer, School of Biological Sciences, The University of Hong Kong, Hong Kong
Dr. Leo L. CHAN	Associate Director, State Key Laboratory in Marine Pollution, City University of Hong Kong, Hong Kong
Dr. Kevin W. H. KWOK	Research Assistant Professor, Department of Applied Biology and Chemical Technology, Hong Kong Polytechnic University, Hong Kong
Mr. Vincent C. S. LAI	Managing Director, Ecosystem Limited, Hong Kong **M**
Ms. Helen Y. M. LEUNG (Conference Secretary)	Senior Technician, School of Biological Sciences, The University of Hong Kong, Hong Kong
Dr. Jasmine S. S. NG	Principal Consultant, Environmental Resource and Management (ERM) Limited, Hong Kong

Invited Keynote Speakers (in alphabetical order)

Dr. Marlene Ågerstrand	Researcher, Department of Environmental Science & Analytical Chemistry, Stockholm University, Sweden
Prof. Youn-Joo An	Professor and Department Chair, Department of Environmental Science, Konkuk University, Korea
Prof. Bryan Brooks	Professor and Director, Environmental Health Science Programme, Department of Environmental Science, Baylor University, USA
Prof. Allen Burton	Professor and Director, Cooperative Institute for Limnology & Ecosystems Research; Director of the University of Michigan Water Centre, University of Michigan, USA
Dr. Peter M. Chapman	Principal Environmental Scientist, Chapema Environmental Strategies, Canada
Dr. Kathryn Gallagher	Branch Chief, Ecological Risk Assessment Branch, United States Environmental Protection Agency (US EPA) Office of Water, USA
Prof. John P. Giesy	Professor and Canada Research Chair in Environmental Toxicology, Department of Veterinary Biomedical Sciences and Toxicology Centre, University of Saskatchewan, Canada
Dr. James C.W. Lam	Assistant Professor, Department of Science and Environmental Studies, The Education University of Hong Kong, Hong Kong, China
Dr. Stanley Lau	Assistant Professor, Division of Life Science, Hong Kong University of Science and Technology, Hong Kong, China
Prof. Kenneth M. Y. Leung	Professor and Associate Dean, School of Biological Sciences and The Swire Institute of Marine Science, The University of Hong Kong, Hong Kong, China
Prof. Zheng-yan Li	Professor, College of Environmental Science and Engineering, Ocean University of China, China
Prof. Zheng-tao Liu	Director, State Environmental Protection Key Laboratory of Ecological Effect and Risk Assessment of Chemicals, Chinese Research Academy of Environmental Sciences, China
Dr. Graham Merrington	Director, WCA Environment Limited, Faringdon, Oxfordshire, UK

Dr. Adam Peters	Principal Scientist, WCA Environment Limited, Faringdon, Oxfordshire, UK
Dr. Stuart Simpson	Senior Principal Research Scientist, Commonwealth Scientific and Industrial Research Organisation, CSIRO Division of Land and Water, Australia
Dr. Jenny Stauber	Chief Research Scientist, Commonwealth Scientific and Industrial Research Organisation, CSIRO Division of Land and Water, Australia
Dr. Rick Van Dam	Director & Senior Principal Research Scientist, Environmental Research Institute of the Supervising Scientist, Australian Government Department of the Environment, Australia
Dr Ju-ying Wang	Director, Marine Chemical Department, National Marine Environmental Monitoring Centre, State Oceanic Administration, China
Prof. Zi-jian Wang	Professor, Research Centre for Eco-Environmental Science, Chinese Academy of Sciences, China
Dr. Michael Warne	Senior Research Fellow, Centre for Agroecology, Water and Resilience, Coventry University, UK
Mr. Richard J. Wenning	Principal Consultant, Ramboll EnvironUSA
Prof. Feng-chang Wu	Director, State Key Laboratory in Environmental Criteria and Risk Assessment, and State Environmental Protection Key Laboratory for Lake Pollution Control, Chinese Research Academy of Environmental Sciences, China
Prof. Rudolf S. S. Wu	Research Chair Professor, Department of Science and Environmental Studies, The Education University of Hong Kong, Hong Kong, China
Dr. Zheng-guang Yan	Associate Professor, State Environmental Protection Key Laboratory of Ecological Effect and Risk Assessment of Chemicals, Chinese Research Academy of Environmental Sciences, China
Prof. Xiao-wei Zhang	Professor, School of the Environment, Nanjing University, China

Workshop Programme

WORKSHOP PROGRAMME (A)

18 June 2016 (Saturday)

Workshop on Derivation and Application of Water Quality Guidelines

Instructors:
Graham Merrington, Director, WCA Environment, Faringdon, UK
Adam Peter, Principal Scientist, WCA Environment, Faringdon, UK
Michael Warne, Senior Research Fellow, Centre for Agroecology, Water and Resilience, Coventry University, UK

Venue: 3N01 Kadoorie Biological Sciences Building, HKU Main Campus

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This workshop will provide an international perspective of the overall process of deriving water quality guidelines and related environmental quality standards. Key steps in the derivation process will be discussed in detail, while practical examples will be given. Attendees will undertake real-world activities within the workshop and additional activities will be available on-line for follow-up work. It is aimed at researchers, post-graduate students, environmental consultants, officers of environmental authorities, and regulators who do not yet have expertise in deriving water quality guidelines.

0830—0900 Registration

0900—1030 Preparation: Everything You Need to Know to Derive Water Quality Guidelines

1. What is an EQS or an WQG? What are the differences? Summary of what countries have.
    a. Why derive one? What can they be used for?
    b. What kinds of things should criteria be set for?
2. Bioavailability, does this need a different WQG?
    a. What challenges are there?
    b. What substances are affected?
    c. Why are they different?
3. How can we derive an EQS-WQG (examples of PALs)
    a. Similarities and differences in key regulatory approaches,
        i. US, EU, Australia, Environment Canada etc…
        ii. Different types of substances or pressures

   b. Data selection
      i. Definitions of acute and chronic
      ii. Trophic levels or taxonomic representation
      iii. Minimum requirements for EQS-WQG derivation
      iv. Other data, e.g. mode of action, fate and behaviour, QSARs
   c. Quality checking
      i. Relevance and reliability
      ii. Klimisch codes
      iii. CRED system and others

1030—1100 Coffee Break

1100—1230 Lecture II: Deriving Water Quality Guidelines

1. Deriving an EQS
   a. What are the suitable approaches for deriving an EQS-WQG and when are they suitable?
      i. Deterministic and probabilistic approaches
      ii. Chemicals with specific modes of action
      iii. Effect of model used
      iv. Region specific vs. generic data
      v. Acute vs. chronic
   b. Chemical examples
      i. Non-specific mode of action (e.g. a polar narcotic)
      ii. Specific mode of action (e.g. herbicide)
      iii. Volatile, adsorbing, or degradable substances?
   c. Ground-truthing/validation (see Session 4 – does it do what it says on the tin)
      i. Microcosms and mesocosms
      ii. Evidence from field monitoring
      iii. Site specific information
   d. Extrapolating from toxicity data to ecosystem protection
      i. Precautionary principle and assessment factor based approaches
      ii. Statistically based approaches

1230—1400 Lunch Break

1400—1530 Lecture III: Including Bioavailability into Water Quality Guidelines

1. Bioavailability – what does it mean? Key concepts.
    a. Bioavailability definition
    b. Specifics relating to EQS-WQG
        i. BLMs and mechanisms
        ii. Application to ecosystems
        iii. Improving ecological relevance
2. Regulatory use of bioavailability
    a. Historic applications (hardness based standards)
    b. Risk assessment/PNECs EQS-WQG

3. Deriving a bioavailability based limit value
    a. Bioavailability conditions in tests
    b. Bioavailability normalisation models
    c. Site specific EQS-WQG

1530—1600 Coffee Break

1600-1730 Lecture IV: Guideline Implementation and Application

1. Implementation requirements
    a. Appropriate analytical method (sensitivity, reproducibility)
    b. Sampling locations and sample collection infrastructure
    c. Compliance assessment (confidence of failure?)
    d. Mechanisms for taking remedial action and driving improvements
2. Implementing bioavailability
    a. Full BLMs or user-friendly tools?
    b. Advantages, disadvantages
    c. Practical exercise with bio-met
3. Feasibility trials, data and resource needs?
    a. Challenges in monitoring
    b. Interpretation and the tiered approach
4. Summary and conclusions

1730 Adjourn

WORKSHOP PROGRAMME (B)

18 June 2016 (Saturday)
Workshop on Derivation and Application of Sediment Quality Guidelines

Instructors:
Kevin Kwok, Research Assistant Professor, Department of Applied Biology and Chemical Technology, Hong Kong Polytechnic University, Hong Kong, China
Stuart Simpson, Senior Principal Research Scientist, CSIRO Land and Water, Australia
Richard Wenning, Principal Consultant, Ramboll Environ, Sn Francisco, California, USA

Venue: 6N11 Kadoorie Biological Sciences Building, HKU Main Campus

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This workshop will provide an international perspective of the overall process of deriving and using sediment quality guidelines (SQGs) and related environmental quality standards. The presentation will describe a range of approaches for deriving SQGs and the uncertainties with the approaches. Sediments are more complex than waters, and the bioavailability of contaminants generally needs to be determined prior to assessing risks. Key aspects of SQG derivation processes, and how contaminant bioavailability is incorporated into assessments will be discussed, while practical examples will be given. It is aimed at researchers, post-graduate students, environmental consultants, officers of environmental authorities, and regulators who do not yet have expertise in the derivation and use of SQG.

0830—0900 Registration

0900—1030 Lecture I: Introduction to Sediment Contaminants and Need for Sediment Quality Guidelines [R.J. Wenning, USA]

1. Contaminant accumulation in sediments and organism requiring protection
    a. Sediment and benthic organism types
    b. Contaminant exposure pathways and toxicity
2. Types of sediment quality guidelines
    a. Derivation processes
    b. Information requirements for setting site-specific guidelines
3. Application of sediment quality guidelines
    a. SQGs as part of a weight of evidence environmental quality assessment
    b. Use of SQGs in decision making
    c. Use of SQGs in environmental monitoring strategies

1030—1100 Coffee Break

1100—1230 Lecture II: Bioavailability and Effects of Contaminants in Sediment [S. Simpson, Australia]

1. Principles of contaminant bioavailability
    a. Differences between sediments and waters
    b. Contaminant partitioning, stratification and exposure routes
    c. Why does bioavailability matter?
2. Understanding metals in sediments
    a. Exposure routes and metal binding phases
        i. Partitioning to organic carbon metal binding phases
    b. Methods for assessing metal bioavailability
        i. Dilute-acid extractable metals
        ii. Acid volatile sulfide (AVS)
        iii. Metal bioavailability in oxidised sediments
        iv. Use of passive samplers and other measurement methods
3. Understanding organic contaminants in sediment
    a. Equilibrium partitioning methods
    b. Non-exhaustive extraction methods
    c. Use of passive samplers and other measurement methods

1230—1400 Lunch Break

1400—1530 Lecture III: Emerging Contaminants and the Need for Sediment Quality Guidelines [K.W.H. Kwok, China]

1. Overview of current understanding of emerging contaminants in sediments
    a. Global surveys, patterns and trends in coastal areas, river, oceans and biota
    b. New contaminants now and into the future
2. Example 1- Nanomaterials are a global concern in sediments
3. Example 2 - Plastics are a global concern in sediments
4. Methods for derivation of emerging contaminants
    a. Deriving site-specific bioavailability for use in sediment management
    b. Approaches to setting SQGs for new substances

1530—1600 Coffee Break

1600—1700 Lecture IV: Implementation of Sediment Quality Guidelines in North America, Australia, and China [R.J. Wenning, S. Simpson, K.W.H. Kwok]

1. SQGs in North America
    a. Legal standing in regulations
    b. Scientific and environmental monitoring requirements
    c. Current practices and future changes

2. SQGs in Australia
    a. Legal standing in regulations
    b. Scientific and environmental monitoring requirements
    c. Current practices and future changes
3. SQGs in China
    a. Legal standing in regulations
    b. Scientific and environmental monitoring requirements
    c. Current practices and future changes
4. SQGS elsewhere in the Asia Pacific Region
    a. Current practices in different countries and regional authorities

1700—1730 Discussion and Summary of Workshop

1730 Adjourn

Conference Programme

The 2nd International Conference on Deriving Environmental Quality Standards for the Protection of Aquatic Ecosystems (EQSPAE-2016)

PROGRAMME

19 June 2016 (Sunday) — Conference Day 1

Opening Ceremony

Lecture Theatre KKL202, K. K. Leung Building, HKU Main Campus

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0830-0900 **Registration**

0900-0925 **Opening Ceremony**

Masters of Ceremony
Miss. Katie W. Y. Yeung and Mr. Jason K. C. Yau
Postgraduate Students, The University of Hong Kong (HKU)

Welcoming Remarks
Prof. Pauline Chiu
Dean, Faculty of Science, HKU

Opening Remarks
Mr. Patrick C. K. Lei
Principal Environmental Protection Officer (Water Policy & Science)
Environmental Protection Department, the Government of the Hong Kong Special Administrative Region, China

Conference Introduction
Prof. Kenneth M. Y. Leung
Chairman, Organizing Committee of the EQSPAE 2016 Conference; Associate Dean (Research & Graduate Studies), Faculty of Science, HKU

0925 – 0930 **Group Photography**

PROGRAMME

19 June 2016 (Sunday) — Conference Day 1
Lecture Theatre KKL202, K. K. Leung Building, HKU Main Campus

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Session I — Chairpersons: Jenny Stauber and Adam Peters

0930-1000	**Keynote 01** Environmental Quality Benchmarks – The Good, the Bad, the Ugly **Peter M. Chapman** Chapema Environmental Strategies, North Vancouver, British Columbia, Canada
1000-1030	**Keynote 02** U.S. EPA's Current Approach to Developing Aquatic Life Ambient Water Quality Criteria, Recent Successes, and Efforts to EPA's Methodology for Deriving Criteria **Kathryn Gallagher** United States Environmental Protection Agency (U.S. EPA), Office of Water, Office of Science and Technology, Washington, DC, USA
1030-1100	**Coffee Break and Poster Viewing**
1100-1130	**Keynote 03** CRED – Criteria for Reporting and Evaluating Ecotoxicity Data **Marlene Ågerstrand** Department of Environmental Science and Analytical Chemistry, Stockholm University, Sweden
1130-1200	**Keynote 04** High-throughput Screening and Prioritization for Chemicals with Hazard or Risk Potencies **Zi-jian Wang** State Key Laboratory of Environmental Aquatic Chemistry, Research Centre for Eco-Environmental Science, Chinese Academy of Sciences, Beijing, China
1200-1220	**Invited Talk 01** Screening of Priority Pollutants and Resident Test Organisms for Development of Water Quality Criteria in China **Zhen-guang Yan** State Environmental Protection Key Laboratory of Ecological Effect and Risk Assessment of Chemicals, Chinese Research Academy of Environmental Sciences, Beijing, China
1220-1240	**Invited Talk 02** Perspectives on Alternative Endpoints in Aquatic Toxicology and Environmental Quality Criteria Derivation **Bryan W. Brooks** Department of Environmental Science, Baylor University, Waco, Texas, USA

PROGRAMME

19 June 2016 (Sunday) — Conference Day 1
Lecture Theatre KKL202, K. K. Leung Building, HKU Main Campus

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1240-1400 **Lunch Break and Poster Viewing**

Session II — Chairpersons: Peter Chapman and Bryan Brooks

1400-1430 **Keynote 05**
Application of QSAR in Deriving Water Quality Criteria for Metals
Feng-chang Wu
State Key Laboratory of Environmental Criteria and Risk Assessment, Chinese Research Academy of Environmental Sciences, Beijing, China

1430-1500 **Keynote 06**
Development of Water Quality Guidelines for Metals in Tropical Ecosystems
Jenny L. Stauber
CSIRO Land and Water, Sydney, New South Wales, Australia

1500-1530 **Keynote 07**
Study of Environmental Criteria of Heavy Metals (Cr(VI), Pb and Cd) in China
Zheng-tao Liu
State Environmental Protection Key Laboratory of Ecological Effects and Risk Assessment of Chemicals, Chinese Research Academy of Environmental Sciences, Beijing, China

1530-1550 **Invited Talk 03**
How Specific is Site-Specific? Proposed Guidance for Deriving Location-Specific Water Quality Guideline Values
Rick A. van Dam
Environmental Research Institute of the Supervising Scientist, Australian Government Department of the Environment, Australia

1550-1610 **Invited Talk 04**
WQC Derivation and Ecological Risk Assessment for Bisphenol A Considering its Endocrine Disrupting Features
Zheng-yan Li
College of Environmental Science and Engineering, Ocean University of China, Qingdao, China

1610-1630 **Coffee Break and Poster Viewing**

PROGRAMME

19 June 2016 (Sunday) — Conference Day 1
Lecture Theatre KKL202, K. K. Leung Building, HKU Main Campus

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Session III — Chairpersons: Kenneth Leung and Uwe Schneider

1630-1700 **Keynote 08**
Current Status of Water Quality Standards for the Protection of Human Health and Aquatic Ecosystems in Korea
Youn-Joo An
Department of Environmental Health Science, Konkuk University, Seoul, Korea

1700-1730 **Keynote 09**
Recent Developments in the Derivation and Implementation of Environmental Quality Standards for Chemicals in the UK
Graham Merrington
WCA Environment Limited, Faringdon, Oxfordshire, UK

1730-1800 **Keynote 10**
Recent Development of Water Quality Guidelines in Australia and New Zealand
Michael St J. Warne
Centre for Agroecology, Water and Resilience (CAWR), Coventry University, UK

1800-1830 ***Roundtable Discussion***
Panellists: Y. J. An (Korea), P. M. Chapman (Canada), K. Gallagher (USA), Z. J. Wang (China) and M. St J. Warne (Australia)

1830-2230 ***Conference Dinner***
19 June (Sunday) — Conference Day 1
Lamma Rainbow Restaurant, Lamma Island, Hong Kong

Taking Shuttle Bus to the Aberdeen Pier
Assembling Point: LG2, K. K. Leung Building, HKU main campus

PROGRAMME

20 June 2016 (Monday) — Conference Day 2
Lecture Theatre KKL202, K. K. Leung Building, HKU Main Campus

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Session IV — Chairpersons: Youn Joo An and Rick van Dam

0900-0930 **Keynote 11**
Water Quality Criteria in the 21st Century
John P. Giesy
Department of Veterinary Biomedical Sciences, the University of Saskatchewan, Saskatoon, Canada

0930-1000 **Keynote 12**
Challenges in Derivation of Water Quality Guidelines for Dissolved Oxygen, the Alien
Rudolf S. S. Wu
Department of Science and Environmental Studies, The Hong Kong Institute of Education, Tai Po, Hong Kong , China

1000-1030 **Keynote 13**
Breaking from Tradition: Establishing More Realistic Sediment Quality Guidelines
Jr. G. Allen Burton
University of Michigan, USA

1030-1100 **Coffee Break and Poster Viewing**

PROGRAMME

20 June 2016 (Monday) — Conference Day 2
Lecture Theatre KKL202, K. K. Leung Building, HKU Main Campus

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1100-1130 **Keynote 14**
The Scientific Foundation for Derivation of Sediment Quality Guidelines in Mainland China
Ju-ying Wang
National Marine Environmental Monitoring Centre, State Oceanic Administration, Dalian, China

1130-1200 **Keynote 15**
Incorporating Bioavailability within Environmental Quality Standards: Use of *in situ* Fluxes of Contaminants from Sediments
Stuart L. Simpson
CSIRO Land and Water, Lucas Heights, NSW, Australia

1200-1220 **Invited Talk 05**
Development of Sediment Quality Guidelines Using Multivariate Modelling and Comparison to Single-Chemical Approaches
Teresa C. Michelsen
Farallon Consulting, LLC., Issaquah, WA, USA

1220-1240 **Invited Talk 06**
Sediment Toxicity Identification Evaluation: A Case Study in Guangzhou
Jing You
State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, China

1240-1300 **Invited Talk 07**
Assessment and Management Implication of the Long-term Anthropogenic Influences on Coastal Seawaters Based on Quantitative Methods
K. Chen[1], Y. Liu[2] & M. G. Cai[1,3]
[1]Coastal and Ocean Management Institute, Xiamen University, Xiamen, China;
[2]Department of Finance, Ocean University of China, Qingdao, China;
[3]College of Ocean and Earth Sciences, Xiamen University, Xiamen, China

1300-1400 **Lunch Break and Poster Viewing**

PROGRAMME

20 June 2016 (Monday) — Conference Day 2
Lecture Theatre KKL202, K. K. Leung Building, HKU Main Campus

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Session V — Chairpersons: Allen Burton and Xiao-wei Zhang

1400-1430 **Keynote 16**
A Peptide Identification-Free Shotgun Proteomics Workflow to Differentiate *Escherichia coli* Isolates by Faecal Sources
Stanley Lau
Division of Environment and Division of Life Science, the Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong, China

1430-1500 **Keynote 17**
Critical Review of Mercury Sediment Quality Values
Richard J. Wenning
Ramboll Environ, Portland, Maine, USA

1500-1520 **Invited Talk 08**
Sediment Quality Criteria Development: A Roadmap for Switzerland
M. Carmen Casado-Martinez
Swiss Centre for Applied Ecotoxicology Eawag-EPFL, Switzerland

1520-1540 **Invited Talk 09**
Development and Validation of Freshwater Sediment Quality Guidelines for Metals in Korea
J. H. Lee
Research Institute of Environmental Health and Safety (RIEHS), EH R&C Co. Ltd., Bucheon, Korea

1540-1600 **Invited Talk 10**
Emerging Persistent Organic Pollutants (POPs) in Marine Mammals from South China
James C. W. Lam
Department of Science and Environmental Studies, The Education University of Hong Kong, Tai Po, Hong Kong, China; State Key Laboratory in Marine Pollution (SKLMP) and Department of Biology and Chemistry, City University of Hong Kong, Kowloon Tong, Hong Kong, China

1600-1630 **Coffee Break and Poster Viewing**

PROGRAMME

20 June 2016 (Monday) — Conference Day 2
Lecture Theatre KKL202, K. K. Leung Building, HKU Main Campus

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Session VI — Chairpersons: Michael Warne and Graham Merrington

1630-1700 **Keynote 18**
Understanding the Influence of Multiple Stressors on Chemical Effect Thresholds Is a Prerequisite of the Quest for the "Holy Grail"
Kenneth M. Y. Leung
The Swire Institute of Marine Science and School of Biological Sciences, The University of Hong Kong, Hong Kong, China

1700-1730 **Keynote 19**
Field-Based Approaches to Derive Environmental Quality Standards
Adam Peters
WCA Environment Limited, Faringdon, Oxfordshire, UK

1730-1800 **Keynote 20**
Metagenomic Profiling of Zooplankton Community Reveals Environmental Threshold of Ammonia in Eutrophic Aquatic Ecosystem: A Case Study on Tai Lake, China
Xiao-wei Zhang
State Key Laboratory of Pollution Control & Resource Reuse, School of the Environment, Nanjing University, Nanjing, China

1800-1830

Roundtable Discussion

Panellists: Jr G.A. Burton (USA), M.C. Casado-Martinez (Switzerland), Uwe Schneider (Canada), S. L. Simpson (Australia), J.W. Wang (China) and R.S.S. Wu (Hong Kong)

Closing Ceremony

Kenneth M. Y. Leung
Chairman of the Organizing Committee of EQSPAE-2016

Abstracts of Keynote & Invited Lectures

Keynote 01

Environmental Quality Benchmarks – The Good, the Bad, the Ugly

Chapman P. M.

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Benchmarks such as water or sediment quality guidelines comprise one line of evidence for assessing the potential harm from chemicals and other stressors (physical, biological). They are useful but not perfect tools, should not always be used, and should never be used alone for final decision-making. The 'Good' includes: can be designed to be situation-specific; can provide understandable scientific input to decision-makers. The 'Bad' includes: perception that they are absolutes (i.e., 'lines in the sand'); no or limited adaptability based on good science or common sense; protection of individual organisms not populations of organisms. The 'Ugly' includes: benchmarks based on simplistic indices (information loss, misleading results); misuse of biomarkers; misapplication of benchmarks. Other factors that will be discussed during this talk include: appropriately deriving benchmarks; uncertainty; the laboratory is not the field; contaminant uptake and cause-effect; and, specifics regarding sediment quality benchmarks (i.e., their specific 'Good', 'Bad', and 'Ugly' components). The talk will conclude with comments outlining when benchmarks are needed and when they are not needed.

Keynote 02

U.S. EPA's Current Approach to Developing Aquatic Life Ambient Water Quality Criteria, Recent Successes, and Efforts to EPA's Methodology for Deriving Criteria

Gallagher K. and Elias M.

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The U.S. EPA's Office of Water develops U.S. national Aquatic Life Ambient Water Quality Criteria by gathering all available, high quality toxicity data on a range of taxa. Criteria include recommended limits on the magnitude, frequency and duration of exposure to a given chemical that are intended to be protective of 95% of aquatic organisms an ecosystem. EPA uses all available data in a weight-of-the-evidence analysis that includes consideration of information on chemical mode of action, potential exposure pathways, bioaccumulation potential, persistence, as well as field data, in developing criteria. In the past several years, EPA has been focusing on developing criteria that follow EPA's Ecological Risk Assessment Paradigm, including problem formulation and development of conceptual models, and on accelerating its efforts to develop more high quality criteria more rapidly. Recent key criteria issued in the past few years include: the updated final freshwater ammonia criteria, which include consideration of site pH and temperature, and are protective of sensitive mussel and snail species; and an updated draft freshwater selenium criterion, which accounts for the bioaccumulation and persistence of selenium and is EPA's first aquatic life fish tissue criterion. EPA is also moving forward with updated freshwater and saltwater copper aquatic life criteria. The updates to the freshwater and saltwater copper criteria will be based on use of a Biotic Ligand Model which incorporates consideration of water chemistry effects on the bioavailability of copper to aquatic organisms.

Recognizing that EPA's methods need to be updated to reflect more current approaches to effects analysis development, EPA has begun a focused effort to update its *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (USEPA 1985). EPA held an "Invited Expert Meeting on Revising Guidelines for Deriving Numerical National Water Quality Criteria" in September of 2015, which represented a first major step in the Guidelines revision process. Based on the 2015 meeting, EPA has decided to take a two-pronged approach to updating its Aquatic Life Criteria methods: 1) a "Fast-track" criteria approach focused on developing a larger number of criteria more rapidly, for the broader protection of aquatic life, and 2) a "Comprehensive Criteria" approach which will be focused on refining methods for deriving state-of-the-science criteria through comprehensive analyses. The first objective reflects the recognition that tens of thousands of chemicals enter the environment from anthropogenic activities. Because rigorous testing of all chemicals is infeasible, EPA is in interested applying existing approaches to efficiently derive criteria by estimating safe environmental concentrations with limited empirical data, and as necessary, developing new approaches to accomplish this task. The second objective reflects the issue that for a smaller group of chemicals, criteria development may be scientifically complex, and deriving robust criteria may require extensive study.

This presentation will provide an overview of recent advances in criteria development, recent and upcoming criteria releases, as well as a discussion of EPA's efforts to update its criteria methodology.

Keynote 03

CRED – Criteria for Reporting and Evaluating Ecotoxicity Data

Ågerstrand M.

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Predicted No Effect Concentrations (PNECs) or Environmental Quality Standards (EQSs), are derived in a large number of legal frameworks worldwide. When deriving these safe concentrations, it is necessary to evaluate the reliability and relevance of ecotoxicity studies. This evaluation is often subject to expert judgment, which may introduce bias and decrease consistency when risk assessors evaluate the same study.

The CRED-project, short for Criteria for Reporting and Evaluating ecotoxicity Data, is a collaboration between the Dutch RIVM, the Swiss Centre for Applied Ecotoxicology, EAWAG, and Stockholm University. It aims at improving the reproducibility, consistency and transparency of reliability and relevance evaluations of ecotoxicity studies, both within and between regulatory frameworks, countries, institutes and individual assessors. To this end, the CRED evaluation method was developed. The method contains 20 reliability and 13 relevance criteria. Each criterion is accompanied by extensive guidance that helps evaluators navigate throughout the assessment.

Reliability concerns the intrinsic quality of a study, regardless of the purpose for which it is assessed. It is determined by an assessment of the design, performance and analysis of the experiment. For example, a study may be considered less reliable because of an inadequate experimental design (e.g. too few replicates), poor performance (e.g. too high mortality in the controls) or insufficient data analysis (e.g. inadequate statistics).

The relevance of a study depends on the purpose of the assessment or the regulatory framework for which it is evaluated. Thus, a reliable study can be very relevant for one assessment but not relevant for another.

In addition, to improve the reporting of ecotoxicity studies, a set of recommendations for reporting methodological details and results was established. Researchers performing aquatic ecotoxicity studies are advised to use these recommendations when designing their experiments to make sure that all aspects connected to reliability are considered.

Keynote 04

High-throughput Screening and Prioritization for Chemicals with Hazard or Risk Potencies

Wang D. H. and Wang Z. J.

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Thousands of industrial chemicals have been produced and released into the environment. Nevertheless some of the chemicals have been classified to have risks on both human and ecosystem by the targeted risk assessment, they represent only a small portion of potential hazardous contaminants. Prioritization procedures are generally required before any action could be taken as the countermeasures, such as setting up the environmental quality criteria or benchmarks for regulatory supervision. Among varieties of prioritization algorithms, ranking methods based on field monitoring data or on the fugacity models are generally adapted in practical uses. In the presentation, a prioritization approach based on high-throughput screening analysis and tier-1 risk assessment was proposed for targeting the potential aquatic contaminants for further actions.

A screening tool includes a high efficiency analytical method and a tier-1 hazard and risk assessment procedure. Hazard assessment was performed on both health and ecotoxicological data with focus on EMR categories or environmental endocrine disruptors when there is no sufficient information, such as HC5 or NOEC. Risk assessment was performed by the risk quotient (RQ) approach when PNEC was the deliverable. For risk assessment, a HQ larger than unity was regarded as "chemical at risk", and a RQ larger than 0.3 and below unity was regarded as "chemical at potential risk". In the approach, a universe data bank, a process for ranking and a candidates list would be the outputs. In general, a larger data bank implies more potential targets being inclusive. However, in chemical analysis, more targets indicate the increasing difficult for separation and resolution.

Two approaches have been verified for field application, i.e., the targeted analysis for chemicals known as toxicants and the non-targeted analysis for chemicals reported to present in the environment. In the targeted analysis, traditional methods include Standard Protocols issued by different authority organizations (USEPA methods for example), multi-residues analysis applied in pesticides analysis, qualitative mass spectrum allocation using NIS data bank, as well as group analysis developed in recent years. In the targeted screening, the group analysis shows to be a powerful tool when combined with retention time lock (RTL) and chromatogram deconvolution (CD). As an example, more than 50 phenol compounds with HPV property were selected to build up a mass data bank, and priority phenolic contaminants with potential risk in Taihu Lake were listed as a candidates list for further tire-2 risk assessment.

The group analysis could be extended to a high-throughput screening procedure, in which more targets could be added and calibrated each by the representative one within each group. In this way, 1283 chemicals including pesticides, PCBs, EDCs etc. were semi-quantified from river water and sediment for further quantification and risk analysis. An example was given on screening for priority contaminants in sediment of Haihe River, in which the most important chemicals have been targeted for further risk management.

The non-target screening was performed by a two-dimensional chromatography (2xGC-TOFMS). While there are many advantages using 2xGC/MS, the disadvantages of the method are lacking tools for extracting useful information from mass data and for verification/confirmation of the targets found from chromatogram. Index of retention time during temperature programming proposed by Van den dool and Kratz etc was adapted to increase the accuracy of target identification in the complex matrix.

In our recent survey for Chinese waters, 137 chemicals were identified from more than 400 chemicals known as toxicants by applying the targeted screening. About 3000~3500 chemicals could be found from waters of Chinese major river basins by the non-targeted screening, and 93 emerging chemicals were categorized into the candidate list because of their hazardous level or at risk level.

In the presentation, we would like to share our recent knowledge and research progress so as to stimulate the discussion and future collaboration.

<u>Invited Talk 01</u>

Screening of Priority Pollutants and Resident Test Organisms for Development of Water Quality Criteria in China

Yan Z. G.

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Priority pollutants and test organisms are two important issues for development of water quality criteria (WQC). In order to identify the priority pollutants for the development of China's WQC, we selected 160 pollutants from the priority pollutants list of EU, USA and China. Using the species sensitivity distribution (SSD) method, we preliminarily identified some pollutants whose WQC values were significantly different between China and the US. Finally, we identified 20 priority pollutants and suggested that the WQC of about 75% of the total pollutants should be studied in China. There are few studies on the screening of resident test organisms for the development of WQC in literature. To provide test species for deriving China's WQC, we screened Chinese resident test organisms through the SSD method. The results showed that there are about 50 aquatic species whose species sensitivities are higher and suitable to be used in ecotoxicity tests. The screened test organisms include fish, crustaceans, amphibian and algae etc. I will present the lists of the priority pollutants and the test organisms which are favoured for the derivation of WQC in China.

<u>Invited Talk 02</u>

Perspectives on Alternative Endpoints in Aquatic Toxicology and Environmental Quality Criteria Derivation

Brooks B. W.

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Though environmental quality criteria have been developed in various countries over the past three decades, criterion values exist for only a small percentage of chemicals currently in commerce and legacy contaminants. This reality results from sufficient empirical toxicity data for a limited number of chemicals. Traditionally, model organisms and endpoints employed for criteria development have focused on survival, growth and/or reproduction responses in a few model species. Further, biomarkers of exposure and effect have been routinely employed during exposure and effects characterization, yet integration of such responses during hazard assessment including criterion derivation has been rare. Whether alternative endpoints and non-traditional model systems can contribute to the development of criteria has often remained elusive. However, more recent advances in the diversity of model organisms, comparative biology, molecular biomarkers and high throughput screening present unique opportunities to accelerate toxicity testing and criteria development, particularly when placed within an adverse outcome pathway framework. In this presentation I will examine opportunities and challenges associated with integration of alternative models and endpoints during environmental quality criteria derivation for biological active chemicals.

Keynote 05

Application of QSAR in Deriving Water Quality Criteria for Metals

Wu F. C.[1], Mu Y. S.[1], Chen C.[1], Wang Y.[1], Qie Y.[1], Zhao X. L.[1] and Giesy J. P.[2]

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Metals are widely-distributed pollutants in water, and can have detrimental effects on some aquatic life and humans. Over the past few decades, the United States Environmental Protection Agency (USEPA) has published a series of criteria guidelines, which contain specific criteria maximum concentrations (CMCs) for 10 metals. However, CMCs for other metals are still lacking due to financial, practical or ethical restrictions on toxicity testing. Herein, a quantitative structure activity relationship (QSAR) method was used to develop a set of predictive relationships, based on physical and chemical characteristics of metals, and predict acute toxicities of each species for five phyla and eight families of aquatic organisms for 25 metals or metalloids. In addition, species sensitivity distributions (SSDs) were developed as independent methods for determining predictive CMCs. The quantitative ion character-activity relationships (QICAR) analysis showed that the softness index (σp), maximum complex stability constants (log-β_n), electrochemical potential (ΔE_0) and covalent index ($X_m^2 r$) were the minimum set of structure parameters required to predict toxicity of metals to eight families of representative organisms. Predicted CMCs for 10 metals are in reasonable agreement with those recommended previously by the US EPA within a difference of 1.5 orders of magnitude. CMCs were significantly related to σp (r^2 = 0.76, p = 7.02×10^{-9}) and log-β_n (r^2 = 0.73, p = 3.88×10^{-8}). The novel QICAR-SSD model reported here is a rapid, cost-effective, and reasonably accurate method, which can provide a beneficial supplement to existing methodologies for developing preliminarily screen level toxicities or criteria for metals, for which little or no relevant information on the toxicity to particular classes of aquatic organisms exists.

Keynote 06

Development of Water Quality Guidelines for Metals in Tropical Ecosystems

Stauber J. L.[1], Gissi F.[1,2], Adams M. S.[1], Binet M. T.[1], Golding L. A.[1], Smith R. E. W.[3], Schlekat C. E.[4], Garman E. R.[4], Merrington G.[5], Peters A. J.[5], Leung K. M. Y.[6], Wang Z.[6] and Jolley D. F.[2]

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Tropical regions have unique ecosystems comprising sensitive habitats, unusual taxa and a unique biodiversity compared to temperate regions. Direct application of environmental quality standards developed for North America, Europe and Australasia to tropical regions may not be appropriate due to differences in geochemistry, organic matter, climatic conditions and differences in the physiology of the evolutionarily distinctive biota. These differences may be particularly important for metals, for which bioavailability models have been developed in temperate regions to support refined risk assessment. Bioavailability-based water quality guidelines for metals rely on accurate knowledge of metal speciation and the ability to predict effects to wide ranges of taxa, both of which are poorly studied in the tropical Asia-Pacific region. Both typical exposure data, such as temperature, pH and dissolved organic carbon, as well as effects data for metals, particularly to key species such as corals, are lacking in tropical regions. Consequently guidelines for the protection of tropical species are usually generated from species sensitivity distributions of temperate data, which may be over- or under-protective depending on species, water quality parameters and the metal of interest. In order to develop environmental quality guidelines for tropical ecosystem protection, we need:

1. Read across methods to determine if temperate data can be used to predict effects in tropical systems
2. Additional chronic tropical toxicity tests with key taxa, especially for marine waters and sediments
3. Generation of effects data using these tests
4. Better understanding of how water quality parameters in tropical systems affect metal bioavailability
5. Using nickel as an example, this paper will discuss recent work to fill these gaps to enable the development of water quality guidelines in tropical regions, with particular reference to SE Asia, Melanesia and Northern Australia.

Keynote 07

Study of Environmental Criteria of Heavy Metal Cr(VI), Pb and Cd in China

Liu Z. T.

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Purpose: This study aims to develop aquatic life criteria and soil environmental criteria for Cr(VI), Pb and Cd in China using the toxicity data of native species.

Experimental description: First of all, toxicity data of native species for Cr(VI), Pb and Cd were selected. The quality and quantity of selected toxicity data were checked. Secondly, acute/chronic toxicity tests were carried out when toxicity data of native species were lacking. Thirdly, aquatic life criteria and soil environmental criteria based on toxicity data of native species were derived using the species sensitivity distribution method recommended by US EPA (i.e., US-SSD method).

Results: The acute/chronic toxicity data of aquatic life for Cr(VI), Pb and Cd were selected. The chronic toxicity of terrestrial species for Cr(VI), Pb were tested. The aquatic life criteria based on toxicity data of native species for Cr(VI), Pb and Cd were derived using the US-SSD method. The soil environmental criteria based on tested toxicity data for Cr(VI) and Pb were derived using the log-logistic SSD method.

Conclusions: The criteria maximum concentrations of protecting aquatic life for Cr(VI), Pb and Cd were 17.73, 131 and 1.15 μg/L, respectively. The criteria continuous concentrations of protecting aquatic life for Cr(VI), Pb and Cd were 12.15, 5.1 and 0.12 μg/L, respectively. The soil environmental criteria for Cr(VI) and Pb were 1.5~7.7 and 31.7~158.3 mg/kg, respectively.

Invited Talk 03

How Specific is Site-Specific? Proposed Guidance for Deriving Location-Specific Water Quality Guideline Values

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Whilst generic water quality guidelines values (GVs) provide an important starting point for managing water quality, they cannot account for the large spatial and/or temporal variation in natural water quality, including variation in environmental variables that influence the bioavailability and toxicity of contaminants. Consequently, the past decade has seen increasing awareness of the need for site-specific GVs, with several jurisdictions (e.g. Australia, New Zealand, Canada, Europe) recommending them over generic GVs where ever possible, and with some providing formal guidance on their derivation. In reality, there exists a continuum of 'types' of water quality GVs, based on both temporal (e.g. annual, seasonal, daily) and spatial (e.g. national, regional, local) factors, which is far more complex than the binary comparison of generic versus site-specific GVs suggests. Adding to this complexity, GVs can be derived or modified in various ways with varying robustness. When the above issues are considered in the context of the increasing use of site-specific GVs for regulatory purposes, it becomes apparent that there is a need for clear guidance on the different types that can exist, including their strengths and weaknesses and appropriate applications. This presentation addresses some key questions about site-specific GVs and, in doing so, aims to move towards clear guidance for their appropriate classification and, consequently, use.

Relevant questions that will be discussed include:

What factors need to be considered when determining the requirements for a site-specific GV (e.g. spatial scale, spatial and temporal variability of water quality)?

What constitutes a location (e.g. a site, a reach, a catchment, a region) and why is this important?

Can we classify site-specific GVs that have been derived using different approaches and/or modified to different degrees?

Examples, drawing on our experience in northern Australia, will be used to illustrate the key issues and support recommendations.

Invited Talk 04

WQC Derivation and Ecological Risk Assessment for Bisphenol A: Considering its Endocrine Disrupting Features

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Bisphenol A (BPA) occurs widely in natural waters with diverse toxicity effects on reproduction, development, growth or survival of various aquatic species. Its water quality criteria (WQC), however, have not been established in either freshwater or saltwater ecosystem in China, which hinders the ecological risk assessment for this emerging pollutant. This study therefore aims to derive the WQC and to assess the ecological risk of BPA in surface waters of China. The acute toxicity values tested with freshwater and saltwater species resident in China were collected separately, which were simulated with the species sensitivity distribution (SSD) models for the derivation of criterion maximum concentration (CMC). The chronic toxicity values were divided into reproductive and non-reproductive ones and simulated separately for the derivation of criterion continuous concentration (CCC). The two datasets were then pooled and simulated as a whole for traditional CCC. The results showed that the CMC, reproductive CCC (CCC_r), non-reproductive CCC (CCC_{nr}) and traditional CCC (CCC_t) for freshwater system were derived as 1518 μg L^{-1}, 0.86 μg L^{-1}, 3.87 μg L^{-1} and 2.19 μg L^{-1}, respectively. The reproductive CCC was therefore much lower than non-reproductive CCC, reflecting the sensitive features of reproductive effects of BPA. Similarly, the CMC, CCC_r, CCC_{nr} and CCC_t for saltwater system were derived as 273 μg L^{-1}, 0.30 μg L^{-1}, 3.30 μg L^{-1} and 0.83 μg L^{-1}, respectively. The saltwater criterion was 18%-85% of the freshwater values, indicating the higher sensitivity of saltwater species to BPA. The acute risk of BPA was negligible with RQ (risk quotient) values much lower than 0.1. The chronic risk was, however, much higher with RQ values up to 3.76 and 9.57 based on traditional and reproductive CCC, respectively. The ecological risk assessment with traditional criteria, therefore, may not guarantee the safety of aquatic biota for endocrine disruptors such as BPA.

Keynote 08

Current Status of Water Quality Standards for the Protection of Human Health and Aquatic Ecosystems in Korea

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Since the year 2006, the Korean water quality standards (WQS) for the protection of human health have been continuing to be expanded up to twenty substances. The Korean Ministry of Environment (MOE) has prepared the list of priority chemicals using Chemical ranking and scoring system named CRAFT (Chemical RAnking of surFacewater polluTants), and the stepwise system of expanding the new WQS. Three substances namely 1,4-dioxane, formaldehyde, and hexachlorobenzene were added to the list of WQS based on the human health risk assessment in the year 2012. The Korean MOE has previously considered the introduction of WQS for the protection of aquatic ecosystems, but postponed it due to the shortage of ecotoxicity data generated from domestic species in Korea. Recently, The Korean MOE plans to add WQS for the protection of aquatic ecosystems by the year 2017. To achieve the goal, a collaborative research project is in progress to construct an ecotoxicity database using domestic aquatic species including *Daphnia galeata, Branchinella kugenumaensis*, and *Misgurnus anguillicaudatus*. They are widespread aquatic organisms, and can reflect the characteristics of Korea water environment. More balanced management system is expected to protect both human and ecological receptors in the near future.

Keynote 09

Recent Developments in the Derivation and Implementation of Environmental Quality Standards for Chemicals in the UK

Merrington G.[1], Peters A.[1], Whitehouse P.[2] and Clarke R.[3]

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In the UK, Environmental Quality Standards (EQS) are a regulatory tool linked to the delivery of specific environmental objectives under the European Union's Water Framework Directive (WFD)(2000/60/EC). These objectives include the prevention of deterioration of the quality status of all surface water and groundwater bodies; and to protect, enhance and restore all bodies of surface water and groundwater. Under the WFD, EQS are set to be applied across all of the EU for certain chemicals (Priority Substances) and for other chemicals (Specific Pollutants), deemed to be of national importance only standards are set by individual Member States. Importantly, for both sets of EQS, the same guidance is followed for derivation. In the UK, there are several key stages in the delivery of a legally binding EQS. Many of these stages, especially those of prioritisation and in-part derivation, will be readily recognisable with other jurisdictions. However, there are some fundamental differences too especially in relation to the consideration of higher-tier effects data in EQS derivation and in implementation assessment. This ensures that the standards proposed can actually be applied in practice, and are sufficiently robust to be used to justify enforcement action where appropriate. In this context, implementation is the term used to describe how the EQS is used in practice and covers aspects such as the form or measure of the monitoring matrix, how this measure is compared to the EQS, how failure or exceedance is assessed, what action an exceedance triggers, etc. Implementation assessment may also include some form of socio-economic consideration of EQS adoption. A desire to validate standards for chemicals against information from the field, and take account of the uncertainties associated with intermittent monitoring, ensure that limited resources can be targeted where they will be most effective. This presentation will provide recent examples illustrating how the UK regulatory authority derives and implements (or does not implement) environmental relevant EQS for chemicals.

<u>Keynote 10</u>

Recent Development of Water Quality Guidelines in Australia and New Zealand

Warne M. St. J.[1,2,3,4], Batley G. E.[5], Van Dam R.[6,7], King O.[2] and Smith R. A.[2,3,8]

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Water quality in Australia is managed through the National Water Quality Management Strategy (NWQMS), a key document of which is the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. This document is revised periodically to maintain its relevance, scientific accuracy, to address new knowledge gaps and to derive guideline values (GVs) for new chemicals and improved GVs for existing chemicals. The current revision began in July 2009 and has had three distinct phases: (1) the development of the scope of work; (2) the development of a new BurrliOZ software program to calculate toxicant GVs and revision of the GV derivation method; and (3) derivation of new guideline values for over thirty priority chemicals using the products from Phase 2. Phases 1 and 2 have been completed and Phase 3 will be completed by December 2016.

Some of the major improvements that will be discussed are:

- a statistical distribution fitting method that is more appropriate for small samples; the enhanced functionality of the BurrliOZ software;
- new definitions of acute and chronic toxicity with examples;
- a data preference hierarchy and a procedure for phasing out the use of no-observed-effect concentration data;
- a new GV reliability classification scheme based on: (i) a hierarchy of acceptable data, (ii) sample size, and (iii) a visual estimate of goodness of fit; and
- a formal process to permit the derivation and approval of GVs derived by third parties (e.g. governments, industries, research organizations).

Examples will be used to highlight key steps in the revised GV derivation

procedures. In addition, proposed freshwater and/or marine GVs for 2,4-D, ametryn, atrazine, diuron, glyphosate, hexazinone, imazapic, isoxaflutole, metolachlor, metsulfuron-methyl, metribuzin, simazine and tebuthiuron will be discussed.

Keynote 11

Water Quality Criteria in the 21st Century

Giesy J. P.[1,2,3,4], Zhang X. Q.[4], Jin X. W.[5],Li Y. B.[4], Xu E. G. B.[6], Liu W.[3], Chen Y.[7], Liu H. L.[4], Xing L. Q.[8], Liu Z. T.[9], Jin X. W.[9], and Yu H. X.[4]

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There have been a number of advances in derivation of water quality criteria, to make them more ecologically relevant. Over the last 20 years, probabilistic analyses have been applied to describe a greater proportions of sensitivities among species likely to occur in ecosystems. Water quality criteria, determined based on controlled laboratory studies with individual surrogate species, do not incorporate the complexity of ecosystems. Probabilistic approaches, such as Species Sensitivity Distributions (SSDs) have been incorporated into derivation of WQC. Historically, ecosystems have been characterized by use of taxonomic descriptions based on visual characteristics, which was labour intensive, for collection and identification and enumeration and required extensive experience to assign each individual to a species or genus. Here an apparent effects threshold (AET) approach based on meta-barcoding was used to characterize genetic diversity in the mitochondrial cytochrome, c oxidase I (COI) region of DNA of freshwater zooplankton as a novel environmental monitoring tool, with which to identify adverse effects on ecosystems. A novel, rapid SSD approach based on operational taxonomic units (OTUs) observed under field conditions for development of water quality criteria (WQC) to protect the aquatic environment from exposure to toxic ammonia. The WQC developed was then compared to values developed, using more traditional, laboratory based approaches. DNA meta barcoding significantly increased the number of zooplankton observed.

Oversupply of ammonia and other nutrients can lead to eutrophication and

subsequent toxicity in Tai Lake, the third largest lake in China. Nutrients, especially total ammonia and nitrite, which can be toxicity to zooplankton, had a significant effect on the structure of the zooplankton community than did other environmental factors in the catchment of Tai Lake, freshwater ecosystem in China that has been culturally eutrophicated. This has affected both the lotic and benthic communities. Over decades, the significant decline in diversity of the benthic invertebrate community of Tai Lake (from 68 species in 5 phyla in 1980s to 40 species in 3 phyla in 2008) could be attributed to continuous exposure to unionized ammonia (NH_3).

Keynote 12

Challenges in Derivation of Water Quality Guidelines for Dissolved Oxygen, the Alien

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Eutrophication and hypoxia are now a wide spreading problem worldwide. Setting up water quality guidelines (WQG) for dissolved oxygen is inarguably important, and yet very difficult.

First, dissolved oxygen (DO) is very different from other water quality parameters in many aspects. Both temporal and spatial variations of DO in a single water body are typically large, and this is further augmented by marked diurnal oscillations. This makes it extremely difficult to have a representative estimate of DO without extensive measurements (i.e., different days including both sunny and dull days, day and night, and different depths), which is often impractical. Jurisdictions adopting average DO in their WQG is obviously wrong and misleading.

Second, DO levels may not necessarily be low enough to cause mortality. More often, low to moderate DO levels may lead to growth reduction, reproductive impairment and abnormal development, thereby posing a threat to sustainability of the aquatic species. While numerous studies have been carried out to determine the short term acute effects caused by extreme hypoxic conditions, there is an acute shortage of scientific data on chronic exposure and sublethal effects of hypoxia. The required scientific studies, albeit important, are understandably difficult, since: (a) the effective window for sublethal hypoxic effects to occur is typically narrow, and (b) the physiological response and adaptive strategy of most species is largely dependent upon the period of hypoxic exposure.

Third, tolerance of aquatic organisms varies considerably among different species (particularly between warm-water and cold-water species), and different life stages (eggs, larvae, adults). Reproductive and developmental stages appear to be more sensitive. Very few information is available on the hypoxic tolerance of marine and estuarine species, especially for warm water species. Since most existing WQG for DO are derived from cold water and/or freshwater species, their applicability to warm water marine environments is questionable.

The use of a field-based biological assessment approach for deriving WQG of DO will be discussed.

Keynote 13

Breaking from Tradition: Establishing More Realistic Sediment Quality Guidelines

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For over 50 years, chemical-specific guidelines have been developed for assessing the environmental quality of sediments. Originally, guidelines were based on total concentrations of metals and were only indirectly related to biological effects, rather based more on percentile levels of chemical concentrations. In the 1980's both empirical and theoretical guidelines developed based on the adverse responses of biota (benthic macroinvertebrates). During the past 30+ years, these guidelines have been expanded and modified, and evaluated in the laboratory and field, and shown to be useful for screening, but not as a definitive line-of-evidence establishing causality or ecosystem impairment. In the meantime – many have called for using "weight-of-evidence" based approaches that rely on several assessment methods, in addition to the chemical-specific guidelines. The science of environmental quality assessment has progressed significantly, and should not ignore the overwhelming influence of co-occurring stressors that may dominate ecosystem impairments. In addition, laboratory-based guidelines are overly conservative, ignoring spatial-temporal exposure and chemical bioavailability dynamics, the influence of refugia, ecosystem-context, and the artefacts associated with sediment homogenization and chemical spiking. A more realistic and accurate approach will be described that combines both laboratory- and *in situ*-based approaches for defining site-specific sediment quality guidelines.

Keynote 14

The Scientific Foundation for Derivation of Sediment Quality Guidelines in Mainland China

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The ecological risk assessment for contaminated sediments is technically challenging due to heterogeneity and complexity of sediment's physicochemical characteristics. Several decision-making tools for addressing the magnitude of the chemical threat in sediments have been developed (Wenning et al., 2005; Mount et al, 2003). Among the approaches, the derivation of sediment quality guidelines (SQGs) development is relatively simple and inexpensive when comparing to the other approaches depending on toxicity tests, bioaccumulation studies, benthic community studies, or other data-intensive tools (Burgess et al., 2013).

The currently developed SQGs can be categorized into two general forms: empirical and mechanistic ones. The empirical approach was employed in this study. The target contaminants included copper, lead, zinc, cadmium, mercury, arsenic, chromium, total petroleum hydrocarbon, DDTs and HCHs. The paired data of sediment's chemistry and infaunal diversity were concurrently collected in Tangshan, Yinkou, Jinzhou, Dalian, Xiamen coasts and Changjiang estuary. The amphipods *Grandidierella japonica* and bivalves *Ruditapes philippinarum* were exposed to field-collected bulk sediments, and spiked sediments for acute toxicity test and bioaccumulation test. Both the ecological risk of contaminants elutriated from the sediment to overlaying water and the health risk of contaminants transferred from food chain to human were taken into consideration. A biological effect database which matched with sediment's chemistry and indaunal diversity, sediment acute and/or chronic toxicity data, and bioaccumulation data was constructed. The threshold effect level (TEL) and probable effect level (PEL) were derived with varying likelihoods of causing adverse effects to benthic organisms. The probability of adverse effects for each of the target contaminants with chemical concentrations in the sediment sample < TEL was found to be no more than 15%, and the probability with chemical concentrations in the sediment sample > PEL was more than 75% except 66.6% for HCHs due to limited data.

On the basis of the derived TELs and PELs, and taking into consideration of the marine sediment quality status and social economic development stage in China, the 1st version of Chinese national sediment quality guidelines "Marine Sediment Quality (GB18668-2002)" was released and brought into effect. The guidelines are widely applied in national and local monitoring programs, and play an important role in marine environment protection.

Keynote 15

Incorporating Bioavailability within Environmental Quality Standards: Use of *in situ* Fluxes of Contaminants from Sediments

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The quantification of the risk posed by contaminated sediments is critical for regulators. This process considers the concentrations and forms of sediment contaminants, and the likelihood that the contaminants may cause adverse effects to selected receptors in the environment. Chemical and biological (ecotoxicological and ecological) methods provide useful lines of evidence for the assessment process, however, inadequacies in the misapplication of guidelines, assessment tools and frameworks frequently impede decision-making processes, increasing the costs to both industries and regulators.

Sediment properties (e.g. particle size, organic carbon, sulfide content) strongly influence the bioavailability of contaminants. Consequently, environmental quality standards ("guidelines") based on total concentrations of contaminants are often not effective for predicting effects on benthic organisms. Although these properties are now well embedded in risk-based assessment frameworks, contaminant bioavailability is often overlooked in the management of risks due to an inadequate knowledge or unavailability of suitable tools. In this presentation, I will describe our recent experiences, and several advances, in the use of both existing and new methods for assessing contaminant bioavailability and toxicity.

Toxicity occurs when the contaminant exposure results in the rate of uptake exceeding a tolerance threshold of the organism (influenced by the combined rates of detoxification and excretion). Thus, the measurements of the flux of bioavailable contaminants from the sediment to an organism may enable guideline development. Metal fluxes measured using diffusive-gradients-in-thin-films (DGT) may be used to predict metal exposure or effects to a range of benthic organisms in field, and laboratory exposures to metal-contaminated freshwater and marine sediments. The method is compared with traditional approaches to estimate the bioavailable metal fraction, e.g. pore waters, acid-volatile sulfide-simultaneously extractable metal (AVS-SEM) relationships, and other non-exhaustive metal extraction procedures. For metal and organic contaminants, guidelines based on *in situ* measurements of fluxes or non-exhaustive extractions that target the more labile concentrations are increasingly becoming effective for assessing risks and potentially setting guidelines.

Invited Talk 05

Development of Sediment Quality Guidelines Using Multivariate Modelling and Comparison to Single-Chemical Approaches

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Environmental agencies in North America have managed sediments in their cleanup and dredging programs since the late 1980s using sediment quality guidelines (SQGs) based on observed associations between sediment chemistry and toxicity. However, it became apparent in the late 2000s that most available SQGs greatly over-predicted toxicity, to the extent that it was difficult for a regulatory agency to accurately identify and prioritize contaminated sites. To meet the need for greater efficiency, we developed a novel approach to deriving SQGs based on multivariate modelling using regional chemistry and bioassay data. We found that when SQGs for all chemicals are derived simultaneously, it is possible to reduce both Type I and Type II errors compared to SQGs derived using single-chemical approaches, increasing efficiency without reducing protectiveness. Freshwater SQGs were derived using this approach for Washington State, USA, and subjected to a variety of statistical tests to verify lack of bias and the accuracy of the model in identifying impacted stations, river reaches, and contaminated sites. Comparisons were run against existing SQGs to identify differences and the reasons for those differences, which were mainly attributed to the multivariate nature of the model. These SQGs were adopted as sediment cleanup standards in Washington State and as dredging guidelines for Washington, Oregon, and Idaho. The model can be used regionally or site-specifically, and can also be applied to other media for which chemistry and adverse effects endpoints are available, such as water, tissue, and soil.

Invited Talk 06

Sediment Toxicity Identification Evaluation: A Case Study in Guangzhou

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In aquatic environment, hydrophobic organic contaminants preferentially deposit into sediment. Over time, sediment becomes an important sink for these contaminants, posing a hazard to aquatic organisms. Therefore, the assessment of sediment quality is one of the vital tasks for understanding the risk of these contaminants and establishing appropriate sediment criteria for these contaminants. It is well accepted that bioavailability of sediment-bound contaminants is affected by many factors, such as sediment characteristics, chemical properties, and chemical-sediment contact time, which makes the bulk sediment concentration a poor indicator for sediment toxicity. Thus, a variety of methods have been developed for estimating contaminant bioavailability in recent decades. As a more relevant dose metric when compared to bulk sediment concentration, bioavailable concentration can better reflect the exposure and the bioaccumulation potential of contaminants to organisms. By incorporating bioavailable concentration into the dose-response relationship, exposure indicated by bioavailable concentration is directly linked to adverse effects. In this presentation, a case study will be used to demonstrate the applications of bioavailability-based sediment toxicity testing in identifying major toxicants in sediment samples from urban waterways in Guangzhou. Our results showed that both current-use pesticides and heavy metals contributed to sediment toxicity to benthic invertebrates in the study area.

Invited Talk 07

Assessment and Management Implication of the Long-term Anthropogenic Influences on Coastal Seawaters Based on Quantitative Methods

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Coastal zones play an important role in supporting local socioeconomic development. Meanwhile, coastal environment has been disturbed by human activities for a long time, especially in the rapidly urbanizing and industrializing areas. Fujian as one of China's developed area has achieved great economic success in the past 30 years. Its coastal environment is seriously affected by pollutants and facing increasing ecological pressure, drawing the attention of the government and the public. However, the coastal environment is dynamic, complex and site-specific, and thus a scientific quantitative evaluation framework is necessary for environment quality analysis and effective coastal management. In this study, a typical semi-closed bay in Fujian province was chosen to analyse the long-term variations of water quality indices (pH, DO, COD, DIN, PO_4-P and Oil) with quantitative methods (Bai-Perron's structural break test), and also to examine the effectiveness of coastal management actions during past 30 years. In addition, we used multivariate statistical methods to identify the relationship between water quality situation and local socioeconomic level, and further used the modified Environmental Kuznets Curve model to predict the probable variation trend of water quality in the future. This work hopes to provide an epitome of the conflicts and consolations between socioeconomic development and environmental quality in the past, and hints for coastal management in the future.

Keynote 16

A Peptide Identification-free Shotgun Proteomics Workflow to Differentiate *Escherichia coli* Isolates by Faecal Sources

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Microbial source tracking of faecal pollution is an emerging tool for water resources management. Conventionally, it is performed using PCR-DNA fingerprinting or PCR-detection of specific gene markers of target faecal bacteria. Here we report a novel, peptide identification-free and thus genome sequence-independent shotgun proteomics workflow as a bacterial fingerprinting method. This method uses a similarity-clustering algorithm to segregate mass spectra that are presumably derived from different peptides and merge them into discrete units of consensus spectra that comprise of the proteomic fingerprints of the bacterial isolates being investigated. The performance of this novel method was compared to a traditional peptide identification-based shotgun proteomics workflow and a PCR-DNA fingerprinting technique in terms of differentiating 73 isolates of *E. coli* by their corresponding animal sources (i.e., human, cow, dog, and pig). The fingerprints generated using the novel method were richer in information, more discriminative in differentiating the *E. coli* isolates by animal sources, and more accurate in assigning query isolates to the correct sources. Our data suggest that, by taking a snapshot of the system-wide expression of bacterial cells and circumventing peptide identification, the novel method generated fingerprints that presumably represented the adaptation of *E. coli* to different animal hosts more precisely than PCR-DNA fingerprinting and constituted a fuller representation of the bacterial cells' proteome than traditional shotgun proteomics. Upon further testing, the novel method may be used in the tracking of animal sources of faecal pollution in water resources and also in studies that aim at, for example, testing whether bacteria isolated from different micro(habitats) are adapted to different (micro)niches.

Keynote 17

Critical Review of Mercury Sediment Quality Values

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Sediment quality values (SQV) are commonly used to characterize the need for environmental investigation and to derive strategies for commercial effluents and sediment management. At present, approximately 40 SQVs have been set for mercury, nearly all of which are co-occurrence SQVs derived from databases of paired chemistry and benthic invertebrate effects data obtained from field-collected sediment. Co-occurrence SQVs are rarely derived in a manner that reflects cause–effect, concentration–response relationships for individual chemicals, because multiple potential stressors often co-occur in the datasets used to derive SQVs. This work highlights the current limitations in mercury SQVs. Current available sediment chemistry and toxicity data were compiled to characterize mercury-specific effect thresholds. The median (interquartile range) co-occurrence SQVs associated with a lack of effects (0.16 mg/kg [0.13–0.20 mg/kg]) or a potential for effects (0.88 mg/kg [0.50–1.4 mg/kg]) were orders of magnitude lower than no-observed-effect concentrations (NOEC) reported in mercury-spiked toxicity studies (3.3 mg/kg [1.1–9.4 mg/kg]) and at mercury-contaminated sites (22 mg/kg [3.8–66 mg/kg]). Additionally, there was a high degree of overlap between co-occurrence SQVs and background mercury levels. Consequently, spiked sediment and site data may provide more appropriate and useful information for characterization and management purposes. Further research is recommended to refine mercury effect thresholds for sediment that address the bioavailability and causal effects of mercury exposure.

Invited Talk 08

Sediment Quality Criteria Development: A Roadmap for Switzerland

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According to the Swiss Water Protection Ordinance, the water quality shall be such that: the water, suspended matter and sediments contain no persistent synthetic substances to ensure the protection of aquatic life. The Swiss Centre for Applied Ecotoxicology has proposed environmental quality standards (EQS) for water quality monitoring for numerous substances, which will be brought into regulation in the near future. The EQS were derived following the Technical Guidance Document of the European Union. Local agencies are in charge of water quality monitoring, using set of validated methods. The so called Modular Stepwise Procedure (MSP), provides the framework for the standardized investigation of the hydrology, ecomorphology, biology, chemistry and ecotoxicology of surface waters. To date, a ″module″ for the monitoring of sediment quality does not exist, although several local agencies have sediment monitoring programs in place while others have performed occasional investigations. According to the responses to a questionnaire, the most pressing needs for sediment monitoring were the availability of harmonized sampling protocols and sediment quality criteria guidelines to classify sediments according to their ecotoxicological risk. In January 2015, a project for the development of a "module sediment" within the framework of the MSP was launched by the Swiss Centre for Applied Ecotoxicology, in partnership with Eawag and the Swiss Federal Office of the Environment. The first project phase foresees the development of a harmonized protocol for sediment sampling to allow a robust interpretation of data at a pan-national level, and the derivation of sediment quality criteria for a list of substances prioritized according to their presence in Swiss waters and their potential for toxicity. Information on the occurrence or effects of chemicals in the sediment compartment is taken into account to prioritise substances for which actions to reduce, monitor or gather additional data are needed.

Invited Talk 09

Development and Validation of Freshwater Sediment Quality Guidelines for Metals in Korea

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Sediment quality guidelines (SQGs) are developed for building the assessment system of freshwater sediment quality as a regulatory program. In Korea, SQGs were firstly issued in 2012 to assess sediment monitoring data using sediment effect concentration (SEC) for the apparent severe conditions of sediment quality originated from USA and Canada. This study was conducted to revise these SQGs considering characteristics of aquatic ecosystem and background concentration of metals in Korea. In 2015, Korean Government revised SQGs for metals in freshwater sediment. The revised SQGs are based on sediment toxicity database, which was built based on field collected sediments from 96 sites and whole sediment bioassays with two indigenous species (*Gammarus sobaegensis* and *Chironomus kiiensis*) and the foreign amphipod *Hyalella azteca*. The percent of toxic samples were 80% for *H. azteca*, 60% for *C. kiiensis*, and 45% for *G. sobaegensis*. Three levels of SECs were derived based on the probability of the occurrence of toxicity: Threshold Effect Level (TEL), Probable Effect Level (PEL), and Apparent Effect Threshold (AET). Background concentrations of metals in freshwater sediments in Korea were used instead of the TEL values as the TEL values were lower than the corresponding background concentrations. To validate the SECs, a separate database using *G. sobaegensis* (71 sediments, 68% toxic sediments) was built to analyse the reliability of SECs. Applying the mPEL-Q value of 0.34, the reliability was maximized as 87% with positive predictive value of 94% and negative predictive value of 85%. These results show that newly derived SQGs for metals are very useful to assess and predict the toxicity of freshwater sediments in Korea. Finally, the three levels of SQGs for metals were used for the classification of the sediment quality of field collected sediments into four categories: Good, Fair, Bad and Very Bad. The criteria for Very Bad category will be suggested as a trigger value for screening of sediment remediation.

Invited Talk 10

Emerging Persistent Organic Pollutants (POPs) in Marine Mammals from South China

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Halogenated flame retardants (HFRs) and perfluroalkyl substances (PFASs) are considered crucial components in manufacturing a wide variety of consumer products. Well-known examples of HFRs and PFASs are polybrominated diphenyl ethers (PBDEs) as well as perfluorooctane sulfonate (PFOS), respectively. Due to their persistence, toxicity, bioaccumulation and long-range transport potential, these chemicals have been added to the Persistent Organic Pollutants (POPs) list of the Stockholm Convention. Since the worldwide restriction on their production and use, the demand for these compounds is expected to decline, whereas that for their alternatives is projected to increase. Although these chemicals are banned or voluntarily phased out in the developed countries, some of these emerging POPs such as PFOS and PFOS-related chemicals are still produced in China currently. As Pearl River Delta (PRD) region is one of the most heavily industrialized and urbanized regions in China, it is conceivable that this region is contaminated by HFRs, PFASs and their replacements. Our recent monitoring study carried out in South China Sea has revealed that the highest PBDEs and PFAS concentrations in the environmental samples were observed in the region of PRD. HFRs and PFASs have emerged as global environmental contaminants, however, the information on these persistent toxic substances, particularly the changes in levels and patterns of their alternatives, is still very limited in the region. This study, therefore, aims to examine temporal trends in concentrations of HFRs and PFASs in two species of marine mammals, the Indo-Pacific humpback dolphin (*Sousa chinensis*) and finless porpoise (*Neophocaena phocaenoides*), in the PRD region of China. In addition, a preliminary risk assessment on these ecologically important marine species due to exposure to these groups of persistent and toxic substances was also conducted in this study.

Keynote 18

Understanding the Influence of Multiple Stressors on Chemical Effect Thresholds is a Prerequisite of the Quest for the "Holy Grail"

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Over the past 15 years, I have been working on environmental quality benchmarks such as water and sediment quality guidelines for regulating and managing chemical contaminants in Europe and China. Ideally, if we know the effect threshold of a chemical (i.e., trigger value or the "Holy Grail") and ensure its environmental concentration below this threshold, then the aquatic ecosystem and organisms therein should be protected. However, I have gradually realized that there are still a number of unresolved issues in the quest of the "Holy Grail". In this presentation, I will specifically highlight how multiple stressors like temperature, salinity and pH can influence the "Holy Grail". Through both laboratory experiments and metadata analyses, it is possible to develop some predictive models for deriving trigger values of chemicals at any given environmental condition including the worst case scenario. I will also address the issue regarding whether environmental quality benchmarks derived from non-native species can offer appropriate protection for native species, and whether temperate and tropical species share the same tolerance towards the same chemical exposure. I will argue these essential fundamental scientific questions present a real challenge to risk managers and environmental researchers. I do not intend to 'open a can of worms' here, but instead I would like to advocate more research effort to be made for fortifying the ecological realism in scientific derivation of the "Holy Grail".

Keynote 19

Field-Based Approaches to Derive Environmental Quality Standards

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Environmental quality standards (EQS) and objectives for chemical toxicants are typically derived from the results of laboratory toxicity tests. A potential alternative approach involves the use of observations of ecological quality in the field in relation to the levels of the toxicant(s) of interest. In situations where there is a comparable assessment of ecological quality, for example under the Water Framework Directive (WFD) in Europe, the use of field evidence to derive guidelines and standards may allow a closer link between the assessment of environmental quality for both the chemistry and ecology.

A limiting function approach, based on quantile regression analysis, has proved to be a valuable tool in assessing datasets which may be affected by a wide range of potential pressures. This approach derives a threshold concentration for a substance above which a high state of ecological quality is unlikely to be achieved, regardless of the concentrations of other toxicants which may also be present. This approach has been used to derive thresholds for individual families and whole communities directly from field data, and may also be used in the validation of standards derived from laboratory data only. The approaches require extensive datasets of matched chemical and ecological monitoring information, and data availability is likely to be a significant limitation to the inclusion of direct field evidence in EQS setting.

Assessments may also be based on the identification of sensitive taxa from field monitoring information, or comparisons between standards derived from laboratory data and evidence of adverse effects in the field. There may be differences between the principles behind chemical and ecological quality standards which mean that they are not directly comparable with one another. Possible solutions to some of the problems which may be encountered are considered and examples of the derivation or validation of environmental quality standards for chemicals using field data will be presented which make use of a variety of different approaches.

Keynote 20

Metagenomic Profiling of Zooplankton Community Reveals Environmental Threshold of Ammonia in Eutrophic Aquatic Ecosystem: A Case Study on Tai Lake, China

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The adverse effects of eutrophication will directly affect the composition of planktonic community. The community effect of ammonia that is the only toxic component of nitrogen species has been overlooked in previous studies. Here the high-throughput sequencing (HTS) and DNA metabarcoding technology were used to study the species composition and intraspecific diversity of zooplankton in different levels of eutrophic water in an aquatic ecosystem scale. The number of zooplankton operational taxonomic units (OTUs) was significantly decreased following the increase of ammonia nitrogen. The species sensitive to eutrophication included *Schmackeria forbesi*, *Synchaeta pectinata* and *Schmackeria* sp. in eutrophic lake and *Bosmina* sp., *Sinocalanus dorrii*, *Mesocyclops* sp., *Keratella quadrala* and *Sinocalanus* sp. in eutrophic river. In lake ecosystem, with the aggravation of eutrophication, the proportion of copepods' DNA was decreasing and the proportion of cladocerans' DNA was increasing. Moreover, the proportions of dominant OTUs were higher in eutrophic water, suggesting that the ecosystem become more simple and fragile. A quantitative model was developed to derive threshold of ammonia based on the metagenomics.

List of Poster Presentations

P-01	Toxicity of Cypermethrin on Embryo and Larvae of *Gangetic Mystus* (*Mystus Cavasius*)
P-02	Assessment of Elemental Composition of Vegetation, Soil and Bottom Sediments along a Transect in the Coastal Zone of Anapa for Indicating Ecosystem
P-03	The Benthic Ecological Status in Four Sewage Draining Exits in Xiamen Harbour, being Assessed with Three Biotic Indices (H', AMBI and M-AMBI)
P-04	Assessing Benthic Ecological Status in Mangrove Wetlands and Salt Marsh in Quanzhou Bay with AMBI and M-AMBI
P-05	Potential Application of Passive Water Sampling in Environmental Quality Standards of Aquatic Ecosystem
P-06	Difference Analysis of Fitting Models to Derive Water Quality Criteria for Transition Metals in the Fourth Period
P-07	Spatio-Temporal Variations of Water and Sediment Qualities in Liaohe and Taihu, China
P-08	Impacts of Deforestation on Macroinvertebrate Communities in Tropical Freshwater Streams
P-09	Environmental Risk of Nanomaterial-Incorporated Consumer Products and Their Regulations
P-10	Ciguatera Fish Poisoning and its Potential Impacts on Coral Ecosystems
P-11	Accumulation of Mercury in Marine Sediments and Biotas from Coastal Waters of Hong Kong
P-12	Global Geographic Differences in Sensitivity of Marine Organisms to Heavy Metals
P-13	Application of Cytogenetic and Molecular Techniques for the Toxicological Evaluation of a Bottling Plant Effluent
P-14	Conserving Intertidal Habitats: What is the Potential of Ecological Engineering to Mitigate Impacts of Coastal Structures?
P-15	History of Point and Non-point Sources of Pollution along Jeddah Coast, Red Sea
P-16	Tissue-specific Accumulation of Triphenyltin Compounds in Marine Fishes in Hong Kong
P-17	Ammonia Toxicity to Six Tropical Species in Low pH Waters, and Derivation of Site-specific Water Quality Guidelines
P-18	The Ecological Realism of Benchmarks Can be Improved by a Link of Ecological Effects in Community-level to Contaminant Concentrations: A Case Study with Water Accommodated Fraction of Crude Oil
P-19	Ecological Methods for Establishing Nutrient Criteria in the Jiulong River Estuary, Southeast China

P-20 Influences of Surface Modified Zinc Oxide Nanoparticles on their Toxicities to Freshwater and Marine Microalgae

P-21 Influences of Temperature and Salinity on Physicochemical Properties and Toxicities of Zinc Oxide Nanoparticles to Marine Diatom *Thalassiosira pseudonana*

P-22 Water-Effect Ratio of Copper and its Application on Setting Site-specific Water Quality Criteria for Protecting Marine Ecosystems of Hong Kong

Abstracts of Poster Presentations

P-01

Toxicity of Cypermethrin on Embryo and Larvae of *Gangetic Mystus* (*Mystus Cavasius*)

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Cypermethrin is a pyrethroid insecticide used widely for crop protection in Bangladesh. Since most of the agricultural lands in this country are located in the floodplains, this pesticide readily contaminates the immediate aquatic environment through various ways including spray drift, surface runoff, and groundwater leaching. Hence, the objective of the present study was to elucidate the effects of cypermethrin on the embryo and larvae of a small indigenous catfish named *Gangetic Mystus* (*Mystus cavasius*). Fertilized eggs (n=100) and newly hatched larvae (*n*=100) were exposed to different concentrations of cypermethrin (0, 2, 4, 8, 16 and 32 μg/L) separately in plastic bowls in triplicate replicates. The median lethal concentration (LC50) values for embryo and larvae were calculated using Probit analysis. The 24-h LC50 (with 95% confidence interval) value of cypermethrin for embryo was found to be 5.57 (0.686-2.349) μg/L. The mortality of embryo increased with increasing cypermethrin concentrations. The hatching rate was estimated to be 75.33±2.52%, 64.67±5.03%, 45.33±3.21%, 38.33±4.16%, 28.67±3.21%, and 8.33±3.51% in cypermethrin concentrations of 0, 2, 4, 8, 16 and 32 μg/L, respectively. The 24-h LC50, 48-h LC50, and 72-h LC50 (with 95% confidence interval) for larvae were found to be 9.97 (1.703-3.064), 6.81 (1.227-2.492) and 5.68 (0.850-2.016) μg/L, respectively. The mortality of larvae significantly increased with increasing cypermethrin concentrations. Several malformations (i.e., damaged germinal ring, edema, egg shell cracking for embryo; and edema, notochord deformity, damaged dorsal and caudal fin, abnormal body shape for larvae) were observed in different concentrations of cypermethrin. The findings of the study indicate that the different cypermethrin concentrations in the aquatic environment may have deleterious effects on the development and reproduction of *Gengetic Mystus*.

P-02

Assessment of Elemental Composition of Vegetation, Soil and Bottom Sediments along a Transect in the Coastal Zone of Anapa for Indicating Ecosystem

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Neutron activation analysis was used to determine elemental concentrations of 41 macro- and microelements in vegetation, soil and bottom sediments, which were sampled at 7 stations along the transect, i.e., "from the source of anthropogenous pollution – the mouth of the river Anapka to the Black Sea coast". It was shown that the content of the majority of elements in the samples decreased by 1-2 orders of magnitude with increasing the distance from the source of pollution. The average elemental concentrations followed different decreasing trends according to the kind of samples: in soil, Ca > Al > Fe, S > K > Na > Mg > Ti > Cl > Mn, Sr > Ba > Zn, Zr > V > Cr, Rb, Br > Ce > Ni > I, As, Nd > La > Co > Sc, Th, Dy, Mo, Nb, Hf > Sm, Cs, U > Yb, W, Sb > Eu > Tb, Ta, Se > Tm> Au; in bottom sediments, Ca > Al > Fe, S > K > Na > Mg > Ti > Cl > Sr > Mn > Ba > Zr > Zn > V, Cr > Rb > Br, Ce > Ni > I, As, La > Nd > Co > Sc, Th, Mo > Dy > Hf, Nb, Sm, Cs, U > Yb, W, Sb > Eu, Tb, Ta, Se > Tm > Au; in *Phragmites communis*, K > Cl > S > Na, Ca > Fe > Mg, Al > Mn > Ti > Sr, Br > I, Zn > Ba> Rb > As, Cr, Ce > V, Ni > Co, Mo > Nb, La, W > U, Yb, Sc > Th, Tm, Hf > Cs, Sm > Eu > Tb, Ta > Au; in *Cladophora seriace*, Ca > K > Cl > S, Al > Na, Fe > Mg > Sr > Ti, Br > Mn > Ba, I > Zn > Rb, V, As, Ce > Ni, Cr, La > Co > Sc > Th > Nb, Mo, Hf, W > Cs, Sm > U, Yb, Sb, Se > Eu, Tb, Tm, Ta > Au. A strong positive correlation was found between roots and bottom sediments across all elements except for Na, Cl and Br. The strong positive correlations between elemental concentrations in *Phragmites communis* and the environment suggest that this plant is potentially useful for monitoring pollution in general, and most elements examined in particular. This work represents the preliminary results of a complex ecosystem of the Anapa region.

P-03

The Benthic Ecological Status in Four Sewage Draining Exits in Xiamen Harbour, being Assessed with Three Biotic Indices (H', AMBI and M-AMBI)

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Rapid economic development in recent decades has resulted in environmental degradation of Xiamen Harbour, Fujian, China. To assess the benthic ecological status in Xiamen Harbour, the species diversity index (H'), AZTI's Marine Biotic Index (AMBI) and multivariate-AMBI (M-AMBI) were applied using benthic macrofaunal data collected from the four draining exits of sewage treatment plants in Xiamen Harbour in every summer from 2008 to 2015. The results showed that AMBI value in Tong'an draining exit was the highest, but both M-AMBI and H' values in Tong'an draining exit were the lowest in summer 2012 during eight-year period, which showed that the benthic ecological status in Tong'an draining exit was bad in summer 2012. There were only 7 benthic macrofauna species occurring in Tong'an draining exit in 2012, indicating that its benthic ecological status was poor. The dominant species in Tong'an draining exit in summer 2012 was *Ruditapes philippinarum*, which was well-known as pollution tolerance species and a commonly dominant species in sewage draining exits in Xiamen Harbour. *Ruditapes philippinarum* was classified into ecological group I in AZTI's AMBI software. According to the above results, we suggest that *Ruditapes philippinarum* should be classified into ecological group III in Xiamen Harbour. There was a significantly positive correlation between M-AMBI and H' in all four draining exits in Xiamen Harbour, supporting that the benthic ecological status assessed from these two indices was quite similar.

P-04

Assessing Benthic Ecological Status in Mangrove Wetlands and Salt Marsh in Quanzhou Bay with AMBI and M-AMBI

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Quanzhou Bay, Fujian, China, is situated at 118° 38′–118 ° 52′E and 24° 47′ –24° 58′N and covers an area of 136.42 km^2. The mangrove wetlands in Quanzhou Bay have been subjected to a variety of anthropogenic pressures and an invasion of an exotic species, *Spartina alterniflora*, over the last three decades. To assess the current benthic ecological health of the mangrove wetlands and salt marshes, four surveys were conducted between 2010 and 2011. The species diversity index (H'), AZTI's Marine Biotic Index (AMBI) and multivariate-AMBI (M-AMBI) based on benthic macrofauna were applied to assess the benthic ecological status in mangrove wetlands and *Spartina alterniflora* marsh. The average values of H', AMBI and M-AMBI in Xunpu *Spartina alterniflora* marsh were all higher than that in Baisha *Spartina alterniflora* marsh. The average values of H', AMBI and M-AMBI in Baisha *Kandelia obovata* wetland were all lower than that in Luoyang estuary *Kandelia obovata* wetland. The average values of H', AMBI and M-AMBI in Baisha *Kandelia obovata* wetland were all lower than that in Baisha *Spartina alterniflora* marsh. The results of the analysis of variance showed that three biotic indices between two *Spartina alterniflora* marshes were significantly influenced by sediment grain size, and that three biotic indices between two *Kandelia obovata* wetlands were significantly influenced by season. There was a significantly positive correlation between M-AMBI and H' across all habitats.

P-05

Potential Application of Passive Water Sampling in Environmental Quality Standards of Aquatic Ecosystem

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Passive water sampling has seen a remarkable rise in popularity for monitoring programmes of emerging organic pollutants in recent years; it offers a number of distinct advantages compared with the conventional sampling methods. It can provide an *in situ* technique which accumulates the freely dissolved fraction of the target analytes without affecting the bulk solution, providing either equilibrium or time-weight average (TWA) concentrations.

Environmental quality standards (EQSs) were set up to limit the level of the chemicals in the environment to maintain ecosystem function and protect the human health. However, they are currently mainly focusing on conventional inorganic and selected organic pollutants (or priority pollutants). Few emerging organic contaminants have been listed as priority pollutants and have associated with EQSs due to the lack of supporting evidence of their harm to ecosystem and human health. For example, endocrine disrupting chemicals (EDCs) have not been listed and restricted by the Environmental Quality Standards for Surface Water developed in China. The EU-Water Framework Directive has just begun to include threshold levels for some EDCs such as 17β-estradiol (E2) and 17α-ethinylestradiol (EE2) in the newest version.

Passive water sampling can not only be used as an alternative method of sampling of EDCs to study their fate and behaviour in the aquatic environment, but also could be potentially applied for toxicological research and quantifying the bioavailability of these emerging contaminants. This passive sampling approach will provide additional data to evaluate potential risks of EDCs to aquatic ecosystems and human health, and boost the development of EQSs.

P-06

Difference Analysis of Fitting Models to Derive Water Quality Criteria for Transition Metals in the Fourth Period

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Metals in the fourth period of the periodic table are widespread in aquatic environments, mostly at small concentrations, but can exert detrimental effects on aquatic life and human health. Due to the use of different parametric models for establishing species sensitivity distributions to derive water quality criteria, water quality criteria (WQC) for metals of the same period in the periodic table might be biased. To address this inadequacy, the non-parametric kernel density estimation was developed, and optimal bandwidths and testing methods were proposed. The non-parametric kernel density estimation, as well as several conventional parametric density estimations, were used to derive acute HC5 and WQC of transition metals in the fourth period and the subgroups from I B-II B and III B-VIII B to protect aquatic species. The decreasing sequence of HC5 values was Ti > Mn > V > Ni > Zn > Cu > Fe > Co > Cr(VI), which were not proportional to atomic number in the periodic table. The results were then compared with WQC obtained from other jurisdictions. The present study provides an alternative approach for developing SSDs that could be widely applied to derive WQC of transitional metals, and assess their ecological risks in the aqautic environments.

P-07

Spatio-Temporal Variations of Water and Sediment Qualities in Liaohe and Taihu, China

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Using multivariate statistical techniques such as cluster analysis (CA) and principal component analysis (PCA), we assessed the qualities of water and sediment in Liaohe (Liao River) and Taihu (Lake Tai), China. Spatial and temporal variations of 10 physical parameters, and concentrations of 21 metals and 64 organic compounds were analysed in 27 and 37 stations in Liaohe and Taihu, respectively over 2012–2013. Inductively coupled plasma mass spectrometry and gas chromatography mass spectrometry were used to quantitate the concentrations of organics and metals, respectively. Our results showed that concentrations of metal and organics demonstrated clear spatial and temporal patterns along tributaries of Liaohe and at different areas of Taihu. For instance, CA differentiated the sampling locations in the tributaries of Liaohe into four groups based on their water chemistry. PCA identified that in the upstream of Liaohe near Fushun city, the antimony concentrations in water were exceptionally high in both seasons, whereas in another tributary near Shuangliao, there were high concentrations of manganese and lead in water in summer. Along the downstream of Liaohe, there were high concentrations of antimony, silver and mercury in sediment. For Taihu, in the areas near downtown Wuxi, there were higher concentrations of antimony, cadmium and PAHs than other areas in both summer and winter, while the western bank of Taihu was characterized by high concentrations of copper, lead and zinc in sediment, and barium, copper, nickel and zinc in water in summer respectively. Overall, this study provided a comprehensive analysis to the water chemistry of Liaohe and Taihu, which could improve our understanding of the sources of these chemical pollutants in these two important water bodies of China, and highlight the priority chemicals for control.

P-08

Impacts of Deforestation on Macroinvertebrate Communities in Tropical Freshwater Streams

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This study examined the effects of disturbance and habitat degradation arising from gravel quarrying and its associated deforestation on freshwater macroinvertebrate communities in streams and river of the Temburong catchment in Brunei Darussalam (Borneo, Southeast Asia). Comparisons were made between communities in streams and rivers that flowed through deforested catchment areas and those in pristine forest areas, while the relationship between community structure and the abiotic environment was assessed. The effects of seasonal rainfall on temporal changes in the community structure were also examined to determine its interaction with primary disturbance explored in this study.

Impacted (disturbed) streams and river stations showed significant changes in macroinvertebrate community structure. One stream showed dramatic change in community structure comprising chironomids and lumbriculids, while another showed moderate community changes with high abundance of a grazing gastropod species. The impacted river stations were slightly more diverse with respect to ephemeropteran and coleopteran taxa compared to the pristine river station. Only impacted streams showed significant changes in physicochemical variables (i.e., water temperature, pH, dissolved oxygen, total dissolved solids, substrate heterogeneity and canopy cover). Water temperature, pH and canopy cover were the most important predictors of macroinvertebrate community structure in the impacted streams. Community structure showed significant temporal variation with higher abundance and richness observed during the dry period compared to the wet period of the year. Additionally, the abundance and species richness of the macroinvertebrate community in each stream/river varied more during the wet period but became relatively stable during the dry period.

The shift from a highly diverse community to a depauperate community in the impacted stream suggests detrimental effects of quarrying and deforestation on the stream ecology. Notwithstanding the effects of quarrying, change in the abiotic environment was also strongly linked to the loss of riparian vegetation, highlighting the value of riparian forest buffers in moderating the effects of disturbance on aquatic ecosystems and their communities.

P-09

Environmental Risk of Nanomaterial-Incorporated Consumer Products and Their Regulations

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Engineered nanomaterials with at least one dimension less than 100 nm present unique physicochemical characteristics when compared to their bulk forms because of their larger surface-to-volume ratio and/or their customized shape and surface properties. Owing to their unique properties, nanomaterials are broadly applied in various commercial products, ranging from textile and electronics, to cosmetic, pharmaceutical and food products. In 2014, more than 1800 nano-based consumer products are available in the global market. Such wide applications of nanomaterials create a multi-trillion business globally. However, the extensive applications of nano-based products will inevitably result in an increased release of nanomaterials into the environment, triggering a new challenge to environmental regulators. Recent toxicological studies on nanomaterials have revealed their potential risks to aquatic organisms and humans. Meanwhile, uncertainties remain because environmental factors such as the presence of humic acids, temperature and salinity can alter their toxicity while field studies on the interactions are scarce. In reality, it is very difficult to detect and trace the nanomaterials released into the environment while it is a prerequisite for accessing their environmental and health risks. Such a deficiency of knowledge has hindered the effectiveness on regulations of nano-based commercial products for protection of environmental and human health. This study aimed to: (1) prioritize the nanomaterials for immediate investigation based on their estimated global production and prevalence in the consumer products; (2) review available toxicity data of the prioritized nanomaterials and their environmental concentrations; (3) summarize current regulations in different regions and countries on the release of nanomaterials from the consumer product; and (4) discuss the challenges in regulation, risk assessment and management of nanomaterials. This study will be essential and beneficial for developing guidelines to manage the potential hazards of nanomaterials to the environment and humans.

P-10

Ciguatera Fish Poisoning and its Potential Impacts on Coral Ecosystems

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Ciguatoxins (CTXs) that accumulated in fish are natural biotoxins resulted from biotransformation of algal precursors produced by benthic dinoflagellates such as *Gambierdiscus* spp. in the coral ecosystems. They are neurotoxins that activate voltage-gated sodium channels and disrupt ion influx of the excitable tissues such as skeletal muscle, brain and heart of mammals and fish. They are of great concerns as consumption of CTX-contaminated coral reef fishes may induce ciguatera fish poisoning (CFP) in human. Attention has been recently paid to the ecological impacts of CTXs. A number of laboratory and field studies have proven that CTXs can induce mortalities of crustaceans, fishes and marine mammals. To examine the effects of CTXs on predatory fishes, different concentrations of Pacific-CTXs (P-CTXs) were administrated to the marine medaka fish (*Oryzias melastigma*) in single dose and the orange-spotted groupers (*Epinephelus coioides*) in multiple doses. Their growth rate, respiration rate, heartbeat rate, appetite, swimming pattern and survival were monitored over the course of exposure.

The results showed that the effects of P-CTXs on the survival, locomotion, respiration and cardiovascular function of the marine medaka fish and orange-spotted groupers were dose-dependent. Based on these results, we considered that P-CTXs may affect heart development, motor co-ordination and reproductive success of fishes. Exposed orange-spotted groupers exhibited weight loss after P-CTX exposure. The liver somatic index (LSI) of the orange-spotted grouper in the high-dose group was altered as compared with that in the control group, indicating an increased capacity to metabolize xenobiotics such as P-CTXs. Directed locomotion, which refers to movement in response to specific external stimuli, was changed in both the marine medaka and orange-spotted grouper upon P-CTX exposure, suggesting that the exposed fish may not be able to effectively avoid

predation in the wild. Although the survivability of the exposed marine medaka was significantly decreased, there was no significant change observed in the exposed orange-spotted grouper. The sensitivity of the two fish species to P-CTXs is, therefore, different. The adverse effects caused by repeated low-dose P-CTX administration was comparable to those of single high-dose exposure. Predators of high trophic levels may be exposed to greater CTX levels via their diets and therefore can be at higher risk.

P-11

Accumulation of Mercury in Marine Sediments and Biotas from Coastal Waters of Hong Kong

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The ocean plays a key role in global mercury (Hg) cycling, with sediments serving as an important sink and secondary source of Hg and aquatic organisms as an effective "concentrator and transporter" of Hg from water/sediment to humans. Located on the southern coast of China and surrounded by the sea, Hong Kong is an important port-city in the world, with Victoria Harbour as the most famous. Due to the uncontrolled discharge of domestic and industrial wastewater in the past, the coastal waters and marine sediment of Hong Kong were seriously contaminated. Elevated Hg concentrations have been observed in sediments from Victoria Harbour. Seafood contributes to an important part of food for residents in Hong Kong, and the accumulation of Hg in seafood from Hong Kong coastal waters triggers our particular concern. It is, therefore, essential to study the environmental fate of Hg after its release into seawaters in this subtropical coastal region.

This work studied the Hg pollution status in Hong Kong coastal waters by analysing total Hg (THg) concentration in 35 surface sediments from the sampling sites established by Hong Kong Environmental Protection Department (EPD), and 99 biotas (including mollusk, shrimp, crab and fish) collected through trawling. The present data showed a large spatial variation (23.4-947.3 μg kg^{-1}) of THg in sediments, with 43% exceeding the background level. Concentrations of THg in sediments had a significant correlation with population densities of corresponding regions, with the highest ones located at Victoria Harbour. This indicated the impacts of urbanization and industrialization. The concentrations of THg in all the biotas were below the permissible limit in China of 500 μg kg^{-1} for methylmercury (MeHg) in seafood. Mean THg followed the trend: crab > mollusk > fish > shrimp. Benthos (crab and mollusk) accumulated higher THg levels than fish and shrimp, suggesting the influence of sediments.

P-12

Global Geographic Differences in Sensitivity of Marine Organisms to Heavy Metals

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Geographic differences in temperature and salinity can affect the bioavailability and ecological risks of heavy metals to some extent. Although a large number of experimental studies have been conducted on aquatic toxicology and bioavailability of metals at the individual level, risk assessments on different sensitive species were reported rarely at the community level. In the present study, we investigated the global change of temperature and salinity on the basis of real-time data monitored by the Argo. Under these ranges of variations in these two environmental factors, we established a quantitative correlation between structure properties of six metals (i.e., mercury, cadmium, copper, zinc, nickel, and chromium), combined with temperature and salinity, and their toxicity data to eight sensitive saltwater species. A species sensitivity distribution (SSD) analysis was performed with response to the multiple factors, identifying differences in the sensitivity of the eight saltwater organisms. We finally proposed a novel universal pattern of SSDs in the seawater, expounded the quantitative relationship between metal soft index (σp), temperature (T), salinity (S), and key fitting parameters of the SSD curves. This finding contributes to generate a unifying model for rapid prediction of the "site-specific" toxicity and water quality criteria of heavy metals, and provides a theoretical framework to assess the ecological risks of the metals, and hence protect the marine ecosystem.

P-13

Application of Cytogenetic and Molecular Techniques for the Toxicological Evaluation of a Bottling Plant Effluent

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The study evaluates the impact of effluents from a bottling plant on the integrity of DNA of onion root cells. The effluents were analysed for physicochemical parameters and assessed for cyto-genotoxicity using the *Allium cepa* test. The random amplified polymorphic DNA (RAPD) assay was used to determine the level of DNA damage in root tip meristems of the onion bulbs cultivated in the bottling plant effluent. Results of the physicochemical analysis showed that most of the parameters of the wastewater were present at amounts within limits set by national (NESREA) and international (USEPA) regulatory bodies for effluent discharge. On the contrary, results obtained from the cyto-genotoxicity studies showed that, compared with the control, there was significant concentration-dependent reduction of mitotic index and induction of chromosomal aberrations at all tested concentrations of the effluent. DNA polymorphism was discernible by changes in the RAPD profiles as variation in the intensity, disappearance of old and appearance of new bands compared to the control. A total of 116 bands were detected and 92 (79.3%) of these fragments were polymorphic. The loss and gain of bands increased with concentration of the effluent. The data obtained from this investigation suggests that the system of waste management of this effluent is inefficient to guarantee minimal risks associated with its discharge into the environment.

P-14

Conserving Intertidal Habitats: What is the Potential of Ecological Engineering to Mitigate Impacts of Coastal Structures?

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Globally, coastlines are under pressure as coastal human population growth and urbanization continues, while climatic change leads to stormier seas and rising tides. These trends create a strong and sustained demand for land reclamation and infrastructure protection in coastal areas, requiring engineered coastal defence structures such as sea walls. Here, we review the nature of ecological impacts of coastal structures on intertidal ecosystems, seek to understand the extent to which ecological engineering can mitigate these impacts, and evaluate the effectiveness of mitigation as a tool to contribute to conservation of intertidal habitats. By so doing, we identify critical knowledge gaps to inform future research. Coastal structures alter important physical, chemical and biological processes of intertidal habitats, and strongly impact community structure, inter-habitat linkages and ecosystem services while also driving habitat loss. Such impacts occur diffusely across localised sites but scale to significant regional and global levels. Recent advances in ecological engineering have focused on developing habitat complexity on coastal structures to increase biodiversity. 'Soft' engineering options maximise habitat complexity through inclusion of natural materials, species and processes, while simultaneously delivering engineering objectives such as coastal protection. Soft options additionally sustain multiple services, providing greater economic benefits for society, and resilience to climatic change. Currently however, a lack of inclusion and economic undervaluation of intertidal ecosystem services may undermine best practice in coastline management. Importantly, reviewed evidence shows mitigation and even restoration do not support intertidal communities or processes equivalent to pre-disturbance conditions. Crucially, an absence of comprehensive empirical baseline biodiversity data, or data comprising additional ecological parameters such as ecosystem functions and services, prohibits quantification of absolute and relative magnitudes of ecological impacts due to coastal structures or effectiveness of mitigation interventions. This knowledge deficit restricts evaluation of the potential of ecological engineering to contribute to conservation policies for intertidal habitats. To improve mitigation design and effectiveness, a greater focus on in-situ research is needed, requiring stronger and timely collaboration between government agencies, construction partners and research scientists.

P-15

History of Point and Non-point Sources of Pollution along Jeddah Coast, Red Sea

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Jeddah is one of the major economic urban city laying on the central part of the Red Sea. Due to drastic increase in population and industrialization (presence of more than 450 factories and desalination plants) in past years, enormous waste production and their disposal were becoming a great issue in the city. Here we reviewed the history of organic (e.g. petroleum hydrocarbons, PCBs etc.) and inorganic (e.g. heavy metals, nutrients etc.) pollution in different matrices from research articles published since 1980-present. Past studies showed that Jeddah coast is a highly polluted area among the Saudi Arabian coasts. Little water exchange occurs between coast and offshore; south coast is polluted by sewage while north area is polluted by both sewage as well as spilled petrol. Treated and non-treated wastes dumped into coastal areas especially in two lagoons, which negatively affected to marine ecosystems such as coral reefs and fishes in the Red Sea. The eutrophic conditions in the two lagoons (Al-shabab and Al-Arbaeen) triggered algal blooms as well as drastic colour changes in the water column. Redfield ratio was very high (N/P=17) in the lagoons where were affected by massive inputs of sewage, whereas the Redfield ratio was well below (1.7) for offshore stations. The sediment record showed high concentrations of heavy metals deposited in the past from multiple sources. Most of the pollutants were below the critical levels, but they may present chronic threats to the ecosystem. In order to mitigate the pollution problem, improved wastewater treatment is required. After rehabilitation project of the two lagoons, one of the solutions is to keep healthy condition that dilution of treated sewage and aeration of the lagoons should be implemented. However, in this review, we will try to answer whether these mitigation measures are enough or not.

P-16

Tissue-specific Accumulation of Triphenyltin Compounds in Marine Fishes in Hong Kong

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Organotin (OT) compounds, in particular tributyltin (TBT) and triphenyltin (TPT), are ubiquitous in the marine environment due to their wide applications in antifouling paints and other industrial uses (e.g. as fungicides, wood preservatives and antibacterial textiles). These compounds are endocrine disruptive, and have threatened marine lives for more than 40 years. The International Maritime Organization (IMO) of the United Nations enacted a global prohibition on the usage of OT-based antifouling agents on hulls of sea-going vessels in 2008, yet Mainland China and Hong Kong have not adopted any policy to restrict the production, usage and release of these compounds. Thus high concentrations of these compounds, especially TPT, are still detected in marine organisms in South China Sea areas like Hong Kong and Shenzhen. Previous studies have demonstrated that marine organisms can accumulate TPT compounds from their surroundings and through the food chain; however, the distribution pattern of this group of compounds in fishes is not well-known. Here, we study the tissue-specific accumulation of TPT compounds with respect to their concentration in the whole organism. Four piscivorous fish species were sampled in the western waters of Hong Kong, and concentrations of TPT and its degradation products (i.e., diphenyltin and monophenyltin) in fifteen different tissue types (including bones, brain, dorsal muscles, fins, gills, gonad, head-remains, heart, liver, scale, skin, stomach, swim bladder, ventral muscles, and whole fish) were quantified using gas chromatography mass-spectrometry. Our results showed that the bioaccumulation of TPT was highly tissue-dependent. Liver consistently contained the highest concentration of TPT, whereas the lowest concentrations were found in skin and bones. The mass-balance model showed that dorsal muscles generally contributed to 30% of the total body burden of TPT compounds in fish. Currently, we are conducting statistical analyses (e.g. stepwise regression analysis) to investigate the relationships of TPT concentrations between the target tissues and the whole fish, and to identify the tissue(s) that has/have the most significant effect on TPT concentration of the whole fish. This would aid in predicting TPT concentration in the whole fish based on the level of TPT in a single tissue, and investigating the biomagnification of TPT in marine ecosystems.

P-17

Ammonia Toxicity to Six Tropical Species in Low pH Waters, and Derivation of Site-specific Water Quality Guidelines

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Anthropogenic use of ammonia has caused vary degrees of surface water contamination globally, the environmental toxicity of which varies depending on the pH and temperature of the receiving water. The present study assessed ammonia toxicity in the slightly acidic waters (~pH 6), soft waters of Magela Creek, Kakadu National Park, Northern Territory, Australia. This region is of high environmental significance, and is potentially at risk of ammonia contamination due to uranium mining-related activities. Six local species were tested: *Chlorella* sp., *Lemna aequinoctialis*, *Hydra viridissima*, *Moinodaphnia macleayi*, *Amerianna cumingi* and *Mogurnda mogurnda*. Throughout testing, test water pH was maintained at approximately pH 6, and temperatures between 27.5 to 30°C, dependent on species. Low effect chronic inhibition concentration (IC10) and acute lethal concentration (LC10) values ranged between 1.8 to 66.0 mg L^{-1} total ammonia nitrogen (TAN). Of the species tested, *H. viridissima* was the most sensitive and the fifth most sensitive in the international literature. The macrophyte, *L. aequinoctialis* was the second most sensitive species of those tested. Tests with *M. mogurnda* derived the most sensitive acute toxicity estimate for a species of fish in the international literature. Toxicity estimates were normalised using well established algorithms to pH 7 and 20°C. Normalised (pH 7, 20°C) international data for the chronic toxicity of ammonia compiled by the USEPA (2013) were combined with the normalised (pH 7, 20°C) toxicity estimates for the invertebrate and fish species from the present study into a species sensitivity distribution. From this, a 99% protection guideline value of 0.47 mg L^{-1} TAN was derived. Using well-established temperature and pH algorithms for ammonia toxicity, a matrix of site-specific water quality guideline values, of between 0.60 and 0.03 mg L^{-1} TAN encompassing pHs 6 to 9 and temperatures 25 to 32°C, was developed.

P-18

The Ecological Realism of Benchmarks can be Improved by a Link of Ecological Effects in Community-level to Contaminant Concentrations: A Case Study with Water Accommodated Fraction of Crude Oil

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We developed a method to quantify and link the toxic effects in community-level with concentration of the contaminant. The biomasses of *Platymonas helgolandica var. tsingtaoensis*, *Isochrysis galbana*, and *Brachionus plicatilis* in a customized ecosystem were examined in response to a concentration gradient of water accommodated fraction of crude oil (WAF). Using a simplified plankton ecosystem model with interspecies competition-grazing relationships, the threshold concentration of the WAF was determined to be 0.376 mg/L with a new endpoint of equilibrium point, equilibrium biomasses of the customized ecosystem. This value was distinct from those calculated with single-species endpoints. The proposed indicator incorporated interspecies relationships and integrated the growth, mortality, and sub-lethal effects into a single measurement in order to describe the ecotoxicological effects of the plankton community. The indicator also provided a more relevant ecological impact measurement than that of single individual-level endpoints. Equilibrium points could be used as endpoints in order to partially negate the uncertainties resulting from the extrapolation of single-species effect data to community-level effects, a method used frequently to determine the ecological threshold concentrations of pollutants.

P-19

Ecological Methods for Establishing Nutrient Criteria in the Jiulong River Estuary, Southeast China

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Estuarine and coastal eutrophication becomes one of the major concerns worldwide. Nutrient criteria are needed to protect estuarine and coastal waters from eutrophication. However, current nutrient quality standard system for estuary mainly has either ignored or misunderstood ecosystem responses to receiving nutrients and the threshold of such disturbances. Furthermore, nutrient distributions determined by mixing process and biogeochemical behaviours in estuary are often not taken into account. The objective of this study was to propose scientifically sound approaches for developing nutrient criteria in an estuarine zone. Based on the natural geographical characteristics, chemical and nutrient elements, the Jiulong River Estuary is divided into three sea sub-areas. The historical data of nutrient during 1997-2014 were used for developing nutrient criteria in the Jiulong River Estuary. Furthermore, a cumulative frequency regressive method and a mixing model were used to model the nutrient concentration gradient in different sub-areas. The recommended criteria values of dissolved inorganic nitrogen (DIN) in the three sea sub-areas of the Jiulong River Estuary were 33, 12, 9 μmol/L, respectively, and the values of soluble reactive phosphorus (SRP) were 0.60, 0.60, 0.60 μmol/L, respectively. Thus, these concentrations provide a basis for further establishment of the estuarine water quality standards.

P-20

Influences of Surface Modified Zinc Oxide Nanoparticles on their Toxicities to Freshwater and Marine Microalgae

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Zinc oxide nanoparticles (ZnO-NPs) are effective blockers of ultraviolet radiation but they can cause growth inhibition and mortality in various aquatic micro-organisms due to the release of zinc ions and the interaction between the nanoparticles and the cells. Recently, concerns have been raised over the potential environmental impacts of silane-coated ZnO-NPs because of their wide applications in commercial sunscreens and their easiness of being released into the aquatic environment. This study aimed to compare the physicochemical properties between silane-coated and uncoated ZnO-NPs, and elucidate their toxicities towards aquatic microalgae. The surface of ZnO-NPs (20 nm) was modified by 3-aminopropyltrimethoxysilane (A-ZnO-NPs), and dodecyltrichlorosilane (D-ZnO-NPs). These two coated-nanoparticles, uncoated ZnO-NPs and bulk ZnO were characterized in terms of particle size, zeta potential, aggregate size, dissolution and surface chemistry. Three freshwater algae and three marine algae species were exposed for 96 h to ZnO, uncoated ZnO-NPs, the two coated ZnO-NPs and $ZnSO_4$ at 10 concentrations ranging from 0.1 to 100 mg/L. The results showed that uncoated ZnO-NPs formed larger aggregates and released more zinc ions than the two coated ZnO-NPs. Although the sensitivity towards the test chemicals among the test algal species varied, A-ZnO-NPs and uncoated ZnO-NPs were consistently more toxic than D-ZnO-NPs in terms of algal growth inhibition. The marine diatom *Thalassiosira pseudonana* exposed to ZnO-NPs, A-ZnO-NPs and D-ZnO-NPs resulted in different gene expression profiles, suggesting that they exhibited different toxic mechanisms to this algal species. The results of the study provide some useful insights for development of eco-friendly nanoparticles for sunscreen products in the future.

P-21

Influences of Temperature and Salinity on Physicochemical Properties and Toxicities of Zinc Oxide Nanoparticles to Marine Diatom *Thalassiosira pseudonana*

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Climate change can result in rising average seawater temperature with more extreme thermal events, and frequent heavy rainfalls in some coastal regions. It is imperative to understand how naturally mediated changes in temperature and salinity can modulate the toxicity of chemical contaminants to marine life. Since zinc oxide nanoparticles (ZnO-NPs) are widely used in commercial sunscreens and commonly released into coastal marine environments, they are selected as a model pollutant in this study. Here, we experimentally investigated how temperature and salinity could influence the physicochemical properties and toxicity of ZnO-NPs to a marine diatom *Thalassiosira pseudonana* using a 5 × 5 × 6 factorial design (i.e., 5 temperatures × 5 salinities × 6 concentrations of ZnO-NPs). Our results showed that an increase in both temperature and salinity led to larger aggregates of bulk ZnO and ZnO-NPs, and a reduction in zinc ion concentration being released from ZnO and ZnO-NPs; these changes, in turn, lowered the concentration of bioavailable zinc ions and reduced the toxicity of ZnO-NPs to the diatom from 10°C to 25°C in terms of median inhibition concentration on the algal growth. However, a significant increase in the toxicity of ZnO-NPs was observed at 30°C, possibly due to a synergistic effect of the chemical toxicity and thermal stress. Consistently, ZnO-NPs were more toxic than ZnO and $ZnSO_4$ to *T. pseudonana*. The diatoms exposed to ZnO, ZnO-NPs and $ZnSO_4$ displayed substantially different gene expression profiles, suggesting that these chemicals have different modes of toxic action against the diatoms. The current results enable us to forecast the toxicity of ZnO-NPs to the diatoms at various combinations of salinity and temperature under different global climate change scenarios.

P-22

Water-Effect Ratio of Copper and its Application on Setting Site-specific Water Quality Criteria for Protecting Marine Ecosystems of Hong Kong

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Generic water quality objective (WQO) of a chemical is usually set based on toxicity tests conducted using standard laboratory water with well-controlled physiochemical properties. However, in natural aquatic environments, physicochemical characteristics (e.g. salinity, total suspended solid, total organic carbon and the coexistence of chemical contaminants) often vary spatially and temporally. These parameters can, in turn, alter the bioavailability of contaminants, and thus influence their toxicities to marine organisms. To account for site specificity, the U.S. Environmental Protection Agency's water-effect ratio (WER = site-water-LC50 / laboratory-water-LC50) procedure can be applied to derive site-specific WQOs. Most past studies, however, were conducted for freshwater systems. This study, for the first time, determined the WER of copper (Cu) for three marine water control zones (WCZs) in Hong Kong, namely Victoria Harbour, Deep Bay and Southern WCZs. Site water samples were collected from three locations within each WCZ, and acute toxicity tests were conducted using the diatom *Skeletonema costatum*, the copepod *Tigriopus japonicus* and the larvae of medaka fish *Oryzias melastigma* with the site water samples, and an artificial seawater (laboratory water), respectively. Our results showed that the conservative final WER of Cu ranged from 0.57 to 0.73 for the three WCZs, and the site water samples from some locations induced >30% mortality in the fish larvae in the controls (i.e., without Cu addition). These results suggested that the generic WQO for Cu could be under-protective for marine organisms in these three areas, which should be tightened by multiplying it with site-specific WER to safeguard the local marine ecosystems.

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General Information

BANKING SERVICES

Banks on Campus

Hong Kong and Shanghai Banking Corporation (HSBC)
G/F, Run Run Shaw Building, Main Campus
Opening Hours: Monday to Thursday 9:00 - 16:30
Friday 9:00 – 17:00
Saturday 9:00 - 13:00

Bank of East Asia
Shop P0030, G/F, Centennial Campus
Opening Hours: Monday to Friday 9:00 – 17:00
Closed on Saturday

ATMs on Campus

Hong Kong and Shanghai Banking Corporation
G/F, Run Run Shaw Building, Main Campus

Bank of East Asia
Shop P0030, G/F, Centennial Campus
Run Run Shaw podium (Chong Yuet Ming Amenities Centre)

Bank of China
Podium of Haking Wong Building, Main Campus

INTERNET CONNECTION

Wi-Fi. HK via HKU
The WiFi programme provides free WiFi service to members and visitors of the University so that users can surf the Internet freely for instructional, learning, research or administrative purposes whenever they are on campus.
For details, please visit
http://www.its.hku.hk/documentation/guide/network/wifi/wifihk

SUPERMARKETS

PARKnSHOP Supermarket
Room 204, Chong Yuet Ming Amenities Centre, Main Campus
Opening Hours: Monday to Friday 9:00 – 19:00
Saturday 9:00 – 17:00

Centennial Campus Supermarket
G/F, Cheng Yu Tung Tower (adjacent to Super Super Congee and Noodle)
Opening Hours: 8:00 – 20:00 (daily)

SECURITY CONTROL CENTRE

Room 310, 3/F, Pao Siu Loong Building
Operation Hours: 0:00-24:00 (daily)
Tel:
3917 2882 (24-hour)
3917 2883 (lost and found)
3917 8280 (parking)
Fax: 2546 3950

HEALTH SERVICE

For urgent medical attention, please go straight to the Accident & Emergency Department of any major hospitals of Hong Kong. All regional hospitals offer 24-hour emergency service for acute illnesses or injuries. The nearest hospital to the University with an Accident & Emergency Department is Queen Mary Hospital located at 102 Pok Fu Lam Road. For ambulance service, please dial 999 or 2735 3355.

BOOKSHOPS

University Bookstore
G/F, Chi Wah Learning Commons, Centennial Campus
Opening Hours: Monday to Friday 10:00 – 17:00

Hong Kong University Press Bookshop
G/F, Run Run Shaw Heritage House (HKU MTR Station Exit C1)
Centennial Campus, The University of Hong Kong
Opening Hours: Monday to Friday 10:00 – 17:00
Closes on public and University holidays

SPECIAL ARRANGEMENTS DURING TYPHOON, RAINSTORMS OR OTHER ADVERSE WEATHER CONDITIONS

If a No. 8 typhoon warning signal or above, or a rainstorm black warning remains hoisted at or after 7:00am on a day during the conference period, all presentations scheduled for the morning sessions will be postponed to the next day. Presentations in the afternoon sessions will resume after 1:30pm if the signal is lowered.
If a No. 8 typhoon warning signal or above, or a rainstorm black warning remains hoisted at or after 12:00nm, all presentations scheduled for the afternoon sessions will be postponed to the next day.

HKU CATERING OUTLETS

Main Campus

FRU: YO Factory	G/F, Chong Yuet Ming Amenities Centre	9:30 a.m. - 7:00 p.m. (Daily)
Café 330	2/F, Chong Yuet Ming Amenities Centre	8:30 a.m. – 7:30 p.m. (Mon – Fri) 8:30 a.m. – 7:30 p.m. (Sat) CLOSED (Sun & public Holidays)
Maxim's FOOD^2	4/F, Chong Yuet Ming Amenities Centre	7:30 a.m. – 9:00 p.m. (Daily) ['Around the World' counter will be CLOSED after 2:15 p.m.]
Starbucks Coffee	G/F, Composite Building, Main Campus	7:30 a.m. - 10:00 p.m. (Mon - Fri) 7:30 a.m. - 8:00 p.m. (Sat) 11:00 a.m. - 6:30 p.m. (Sun & public holidays)
U-Deli	G/F, Composite Building, Main Campus	9:00 a.m. - 2:00 a.m. (Mon - Fri) 10:00 a.m. - 6:00 p.m. (Sat, Sun & public Holidays)
U-Sweet	G/F, Composite Building, Main Campus	9:00 a.m. - 2:00 a.m. (Mon - Fri) 10:00 a.m. - 6:00 p.m. (Sat, Sun & public holidays)
Ebeneezer's Kebabs & Pizzeria (Halal Food)	1/F, Fong Shu Chuen Amenities Centrre	10:00 a.m. - 8:45 p.m. (Mon - Sat) Closed (Sun & public holidays)
Fong Shu Chuen Amenities Centre Restaurant	2/F, Fong Shu Chuen Amenities Centre	7:30 a.m. – 8:00 p.m. (Mon – Fri) CLOSED (Sat, Sun & University holidays)
Union Restaurant	4/F, Haking Wong Building	7:30 a.m. - 9:30 p.m. (Daily)
Starbucks Coffee	G/F, Main Library Building (Old Wing)	7:30 a.m. - 10:00 p.m. (Mon - Fri) 7:30 a.m. - 7:00 p.m. (Sat) 10:00 a.m. - 7:00 p.m. (Sun & public holidays)

Mangrove Tuck Shop	Main Library Covered Podium (near Sun Yat-sen Place)	10:00 a.m. - 4:00 p.m. (Mon - Fri) Closed (Sat, Sun & public holidays)
SUBWAY	Runme Shaw Podium	8:00 a.m. - 8:30 p.m. (Mon - Sat) 8:00 a.m. - 6:00 p.m. (Sun & public holidays)
iBakery	Run Run Shaw Podium	8:00 a.m. - 5:00 p.m. (Mon - Fri) or until stock last Closed (Sat, Sun & public holidays)
Rome Café **[**Waiter-serviced Restaurant}	Graduate House	11:00 a.m. - 9:30 p.m.

Centennial Campus

GROVE Café	LG/F, The Jockey Club Tower, Centennial Campus	8:00 a.m. – 8:00 p.m. (Mon – Fri) 8:00 a.m. – 8:00 p.m. (Sat) 8:00 a.m. – 7:30 p.m. (Sun & public holidays)
Delifrance	G/F, The Jockey Club Tower, Central Podium, Centennial Campus	7:30 a.m. - 9:00 p.m. (Mon - Fri) 8:00 a.m. - 8:00 p.m. (Sat, Sun & public holidays)
Super Super Congee & Noodle	G/F, Run Run Shaw Tower, Central Podium, Centennial Campus	7:30 a.m. - 5:00 p.m. (Mon - Sat) Closed (Sun & public holidays)
BIJAS Vegetarian	G/F, Run Run Shaw Tower, Central Podium, Centennial Campus	8:00 a.m. - 9:00 p.m. (Mon - Fri) 11:30 a.m. - 9:00 p.m. (Sat & Public holidays) Closed (Sun)

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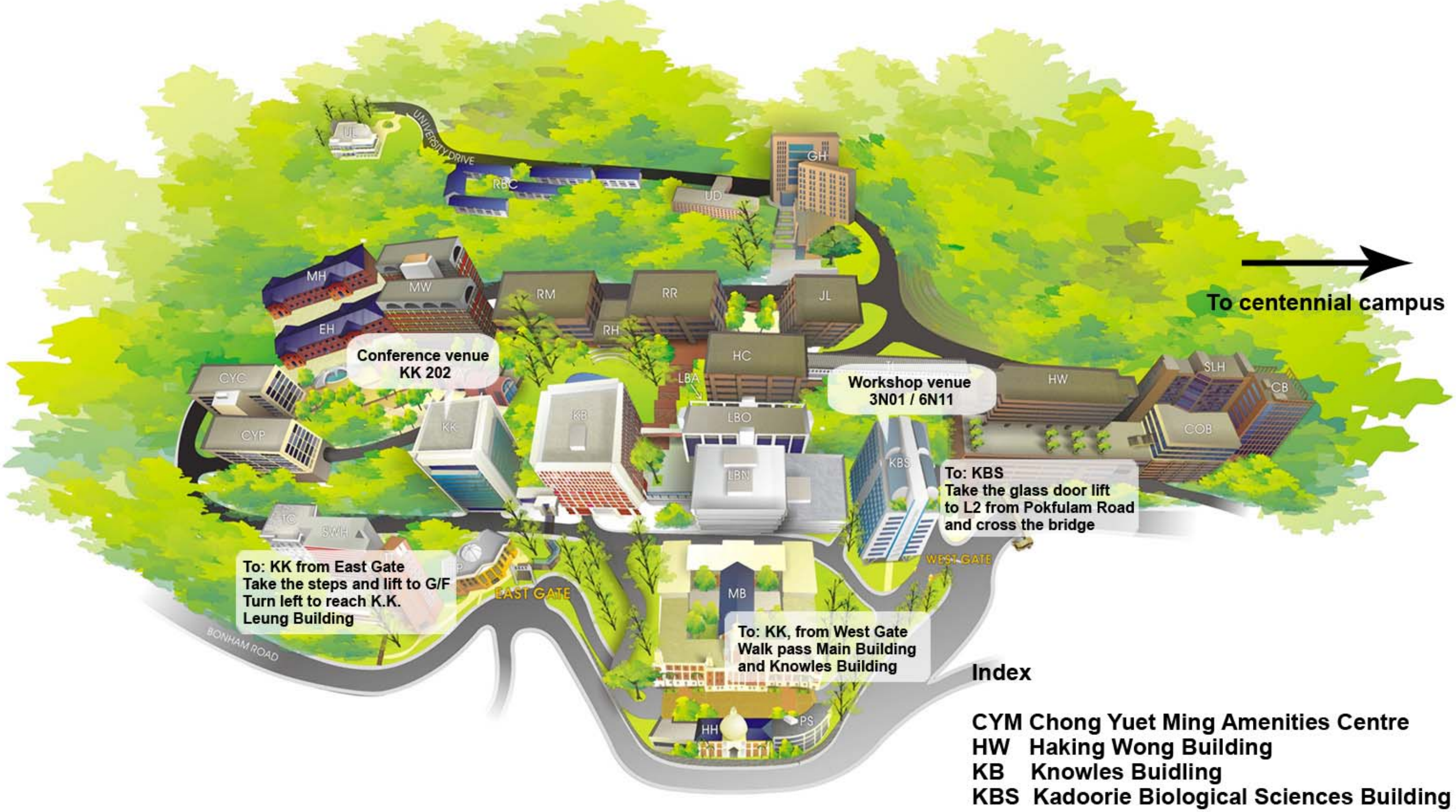

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CYM Chong Yuet Ming Amenities Centre
HW Haking Wong Building
KB Knowles Buidling
KBS Kadoorie Biological Sciences Building
KK K.K. Leung Building
LBO Library Building (old wing)
MB Main Building
RM Runme Shaw Building
RR Run Run Shaw Building
SWH Swire Hall / Fong Shu Chuen Amenities Centre

The University of Hong Kong
Main Campus