ABSTRACT BOOKLET

2023 SYMPOSIUM ON ENVIRONMENTAL SCIENCE AND SUSTAINABLE TECHNOLOGY (ESST2023)

Bridging Macao and the Greater Bay Area

26-27 October 2023

University of Saint Joseph

Ilha Verde Campus, Macao

ORGANISED BY

Catholic Foundation for Higher Education

University of Saint Joseph

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PREFACE

On behalf of the organising committee, I would like to extend my warmest welcome to all of the attendees to the first edition of the Symposium on Environmental Science and Sustainable Technology (ESST2023).

With increasing environmental problems such as air, water and soil pollution that threaten both human health and the environment, this symposium aims to bring together researchers, experts and practitioners from academia, industry and government to share their latest research findings and discuss the latest developments in the field of Environmental Science and Sustainable Technology. The theme of this year's symposium is "Bridging Macao and the Greater Bay Area" with a focus on addressing environmental challenges faced by Macao and the Greater Bay Area (GBA). The symposium aims to become a platform for scholars and professionals to share and discuss effective and sustainable technologies to tackle these challenges and to establish new collaborations between Macao and the GBA researchers to develop sustainable solutions for a better future.

As the first edition of this Symposium, the 2-day programme is compact but rich. There are a total of 2 keynote speeches, 6 invited talks, 11 oral presentations, and 16 poster presentations. Speakers and attendees are from Macao, Hong Kong, and China, with most of them from the GBA cities. The total number of onsite participants exceeds 60 people.

ESST2023 has received great support from the government and local companies. In addition to Macao Foundation, generous financial support has been received from BNU, FIDELIDADE, and NK Sustainable Solutions to subsidise the participants, and programme support from Sands China ltd. These supports have been indispensable in making ESST a great success.

Overall, the Symposium provides a unique platform for local and regional scholars and professionals to share their experiences and insights. Thank you all for your valuable contributions, and we look forward to meeting you all at ESST2023.

Chair of ESST2023,
David Gonçalves
Institute of Science and Environment
University of Saint Joseph

Venue of ESST2023

University of Saint Joseph, Ilha Verde Campus, Kent Wong Gallery

INTRODUCTION

With increasing environmental problems such as air, water and soil pollution that threaten both human health and the environment, this symposium aims to bring together researchers, experts and practitioners from academia, industry and government to share their latest research findings and discuss the latest developments in the field of Environmental science and Sustainable technology. The theme of this year's symposium is "Bridging Macao and the Greater Bay Area" with focus on addressing environmental challenges faced by Macao and the Greater Bay Area (GBA). The symposium will provide a platform for experts to share and discuss effective and sustainable technologies to tackle these challenges and to establish new collaborations between Macao and the GBA researchers to develop sustainable solutions for a better future. We invite you to join us in this exciting opportunity to connect, collaborate, and contribute to the development of sustainable solutions.

The two-day symposium will include invited speeches and oral presentations selected from abstract submissions. Eminent scientists from the region will be invited as well as practitioners from industries in Macau and the GBA. Three poster sessions will be arranged for sharing latest and on-going projects. The mobile exhibition of "Macau Mangroves & Ocean Plastic Pollution" will be on display throughout the symposium.

CALL FOR ABSTRACTS

The symposium will address a wide range of issues related to environmental science and sustainable technology. Topics of interest include, but are not limited to:

- Climate change mitigation and adaptation
- Renewable energy and energy efficiency
- Air quality and water quality
- Water resources and management
- Waste management and recycling
- Environmental pollution and remediation
- Sustainable agriculture and food systems
- Sustainable materials and manufacturing
- Biodiversity and conservation for a sustainable future
- Sustainable tourism and Ecotourism
- Circular Economy
- Environmental data science and AI

ABSTRACT SUBMISSION DUE
16 July 2023

SYMPOSIUM DATES
26 - 27 October 2023

Ilha Verde Campus
University of Saint Joseph

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PROGRAM SCHEDULE

Day 1 Thursday, 26 October 2023

Time	Activity	Speaker
8.30 – 9.00	Arrival/Registration	Moderated by Sammy Chan
9.00 – 9.25	Welcome ESST2023 Opening Token of Appreciation for Sponsors	**Stephen Morgan** (Rector, USJ) **David Gonçalves** (Chair of ESST2023)
9.25 – 9.30	Group Photo	
9.30 – 10.15	**Keynote Speech**	Moderated by David Gonçalves (USJ)
9.30 – 10.15	Bioremediation of polybrominated biphenyl ethers (PBDEs) in mangroves	**Nora Fung-yee Tam** (HKMU)
10.15 – 10.45	**Invited Talk**	Moderated by David Gonçalves (USI)
10.15 – 10.45	Nontarget and suspect screening and identification of leached chemicals from plastics in digesting fluids of organisms	**Xianzhi Peng** (SKLOG, CAS)
10.45 – 11.15	Coffee Break + Poster Session 1	
11.15 – 12.15	**Invited Talks**	Moderated by David Gonçalves (USJ)
11.15 – 11.45	Macau 2030/2060 Targets — What are the Options?	**Roland Schoorl** (CESL)
11.45 – 12.15	Enhanced *n*-butanol production from lignocellulosic biomass hydrolysates by metabolically engineered *Clostridium tyrobutyricum* immobilized in fibrous-bed bioreactor	**Hojae Shim** (UM)
12.30 – 2.00	Lunch Break	
2.00 – 3.20	**Oral Presentations**	Moderated by Danny Leong (UIC)
2.00 – 2.20	[003] Biodiesel production from food waste and domestic wastewater by *Rhodosporidium toruloides*	**Naiwen Chen** (UM)
2.20 – 2.40	[015] A Study on the transformation of *Cerbera manghas* oil into an Eco-friendly bio-diesel fuel	**Junjie Richard Li** (UIC)

2.40 – 3.00	[008] A low-cost measurement method for environmental monitoring: example applications in Macao's coastal environment	**Alexandre Lebel** (USJ)
3.00 – 3.20	[011] Developing an eco-friendly insect barrier glue and testing this effectiveness against a range of insect species in urban green spaces	**Jiayi Huang** (UIC)
3.20 – 4.00	Coffee Break + Poster Session 2	
4.00 – 5.40	**Oral Presentations**	Moderated by Thomas Lei (USJ)
4.00 – 4.20	[005] Insights into enhanced triclosan removal and microbial community succession using *Burkholderia sp.* bioaugmentation in river water	**Lan Qiu** (UM)
4.20 – 4.40	[004] Effective immobilization of *Bacillus sp.* MY156 on scrap tyres for degradation of three typical phthalate esters	**Yimin Xie** (UM)
4.40 – 5.00	[007] Mangroves as a source of polyethylene terephthalate (PET) degrading and biopolymer-producing bacteria	**Muhammad Bashir Saidu** (USJ)
5.00 – 5.20	[006] Isolation and characterization of an indigenous chloroxylenol degrader *Rhodococcus sp.* GG1	**Xiaoyuan Guo** (UM)
5.20 – 5.40	[002] Ant Communities and their Functional Trait Responses to Land-use Change in Greater Bay Area, China	**Yuanyuan Tan** (UIC)
5.40 – 7.00	Break	
7.00 – 9.30	**Banquet**	

Day 2 Friday, 27 October 2023

Time	Activity	Speaker
8.30 – 9.00	Arrival/Registration	
9.00 – 9.45	**Keynote Speech**	Moderated by David Gonçalves (USJ)
9.00 – 9.45	When there is more light that meets the eyes: Light pollution and its impacts	**Jason Chun Shing Pun** (HKU)
9.45 – 10.45	**Invited Talks**	Moderated by Franz Gassner (USJ)
9.45 – 10.15	Impacts of Policies and Infrastructure on the Usage of Electric Vehicles in Macao	**Florence Weng Chi Lei** (USJ)
10.15 – 10.45	Harnessing Technology for Sustainable Development: A Vision for Macao and the Greater Bay Area	**Terence Lee** (Sustaincia)
10.45 – 11.10	Coffee Break + Poster Session 3	
11.10 – 11.50	**Oral Presentations**	Moderated by Ivan Arraut (USJ)
11.10 – 11.30	[001] Using Machine Learning Methods to Forecast Air Quality: A Case Study in Macao	**Thomas Lei** (USJ)
11.30 – 11.50	[013] Construction and Applications of Flora Database in Fengshui Forests for the Conservation of Urban Biodiversity and Cultural Heritage	**Lingzi Liang** (UIC)
11.50 – 12.20	**Invited Talk**	Moderated by Karen Tagulao (USJ)
11.50 – 12.20	Sands ECO360 Global Sustainability Program: Our Commitment towards Low-Carbon and Responsible Tourism	**Stephanie Zhao** (SCL)
12.20 – 12.40	Best Oral & Poster Award Ceremony ESST2023 Closing	**David Gonçalves** (Chair, ESST2023)
1.40 – 2.00	Lunch Break	
2.00 – 5.00	**Macao Environment & Sustainability Tour**	
2.00 – 3.30	Macao Ecological Zone, Taipa	**Karen Tagulao** (USJ)
3.30 – 5.00	Sands China Sustainability Infrastructure & Practices *Location: Venetian Hotel, Taipa*	**Stephanie Zhao** (SCL)
5.00	**End of ESST2023**	

Oral Presentations

Presenter	Title of Contribution
Thomas Lei	[001] Using Machine Learning Methods to Forecast Air Quality: A Case Study in Macao
Yuanyuan Tan	[002] Ant Communities and their Functional Trait Responses to Land-use Change in Greater Bay Area, China
Naiwen Chen	[003] Biodiesel production from food waste and domestic wastewater by Rhodosporidium toruloides
Yimin Xie	[004] Effective immobilization of *Bacillus sp. MY156* on scrap tyres for degradation of three typical phthalate esters
Lan Qiu	[005] Insights into enhanced triclosan removal and microbial community succession using *Burkholderia sp.* bioaugmentation in river water
Xiaoyuan Guo	[006] Isolation and characterization of an indigenous chloroxylenol degrader Rhodococcus sp. GG1
Muhammad Bashir Saidu	[007] Mangroves as a source of polyethylene terephthalate (PET) degrading and biopolymer-producing bacteria
Alexandre Lebel	[008] A low-cost measurement method for environmental monitoring: example applications in Macao's coastal environment
Jiayi Huang	[011] Developing an eco-friendly insect barrier glue and testing this effectiveness against a range of insect species in urban green spaces
Lingzi Liang	[013] Construction and Applications of Flora Database in Fengshui Forests for the Conservation of Urban Biodiversity and Cultural Heritage
Junjie Richard Li	[015] A Study on the transformation of Cerbera Manghas oil into an Eco-friendly bio-diesel fuel

Poster Presentations

Presenter	Title of Contribution
Xiaofan Zhang	[101] Research on the Correlation between Coastal Marine Ecological Environment and (Marine) Industrial Clusters
HIO WAI LAO	[102] Evaluation of Mangroves Blue Carbon as a potential for climate change mitigation in Macau
Ieng Hou Lau	[104] Uptake and accumulation of polystyrene microparticles in the marine medaka (Oryzias melastigma) larvae
Sara Cardoso	[105] Exploring the ecological implications of micro and nanoplastics: a focus on fish as model organisms, methods, and differences in approaches
Sut Ieng Lam	[106] Nature hazard and the role of mangroves as a nature-based solution for coastal protection in Macao SAR
Junlong Mi	[108] Equilibrium Bifurcation and Extreme Risk in the European Carbon Futures Market——Based on the catastrophe theoretical framework of multi-system impact and investor heterogeneity
Xiaoying Chen	[109] Study on Green Development Mechanism of Guangdong-Hong Kong-Macao Greater Bay Area ——Based on comparison with the other three major bay areas in the world
Xing Yang	[110] Research on coupling collaborative pricing of EUA and CER based on the co-evolution theory of complex systems and competition and cooperation game
Jiajun Chen Huada Daniel Ruan	[111] The Calcination Effect on the Physical-Chemical Properties and Adsorption Abilities of Inorganic-Organic Montmorillonite
Jianzun Lu	[112] Fabrication of superhydrophobic soil stabilizers derived from solid wastes applied for road construction: A review
Ivan Arraut	[113] Enhancing Sustainability and Profitability in Urban Farming through Remote Farming Analytics
Ziyang Deng	[114] ENVIRONMENTAL NOISE IN MACAO S.A.R.: INSIGHTS FOR NOISE POLLUTION MANAGEMENT
Andreia Ramos	[115] Effects of shipping noise on the marine medaka (Oryzias melastigma)
Yichuan Wang	[116] A New Measurement of the Invasive Level of the Imported Red Fire Ant: a case study in a Wetland Park on Hengqin Island, China

Presenter	Title of Contribution
Yitong Xu	[117] Insect diversity in Zhuhai City, China: review, current research status, and challenges

KEYNOTE SPEECH

Bioremediation of polybrominated biphenyl ethers (PBDEs) in mangroves

Nora Fung-yee Tam[1,2]

[1]School of Science and Technology, Hong Kong Metropolitan University, Kowloon, Hong Kong SAR, China

[2]Department of Chemistry, City University of Hong Kong, Kowloon, Hong Kong SAR, China

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Mangroves are unique intertidal wetlands along tropical and subtropical coasts. They have significant ecological functions but are subject to anthropogenic impacts particularly pollution. Polybrominated diphenyl ethers (PBDEs) are a group of persistent organic pollutants commonly found in aquatic ecosystems, but studies on effects of PBDEs on mangrove plants, their degradation and the associated functional microbial communities in mangrove sediment are rare. Our research demonstrates that mangrove sediment accumulated PBDEs, particularly BDE-209, and mangrove plants had tolerance to PBDE contamination. Mangrove sediment possessed an intrinsic potential to remove PBDE congeners such as BDE-47 and -153, and the potential was higher than other types of aquatic sediments, with removal rates of BDE-153 in mangrove, mudflat, marine and freshwater sediments of 0.013, 0.013, 0.011 and 0.009 day^{-1}, respectively. Mangrove sediment harbored higher proportions of microorganisms related to degradation, particularly in the five genera of Phylum *Proteobacteria* (*Acinetobacter*, *Sulfurimonas*, *Pseudomonas*, *Psychromonas* and *Pelobacter*) than marine and freshwater sediments, and these intrinsic microorganisms determined the removal efficiency of BDE-153. On the other hand, there were significant positive linear relationships between anaerobic removal rates of BDE-47 and 16S *rRNA* gene copy numbers of total bacteria, *Dehalococcoides* and *Dehalogenimonas* in sediment, with *Dehalococcoides* being the most important dehalogenating bacteria affecting the removal of BDE-47 in mangrove sediment. In mangrove sediment, BDE-47 could go through both anaerobic debromination and aerobic degradation under alternating anaerobic–aerobic conditions created by different flushing regimes. More reduction of BDE-47 (75.2%) was found in sediment under 1-day high tide and 1-day low tide flushing regime (1:1d with relatively more frequent tidal flushing) than that under 1-week low tide and 1-week high tide, 1:1w (58.8%) or 2-week high tide and 2-week low tide, 2:2w (51.4%) regimes at the end of a 40-week microcosm experiment. Sediment redox potential of 1:1d regime was maintained at more negative values (around −200 mV) than that of the other two regimes during the experiment, indicating that the sediment under 1:1d regime was more anaerobic with higher abundance of anaerobic bacteria, such as *Dehalococcoides* and *Dehalogenimonas*. Under 1:1d regime, the concentrations of lower brominated congeners, including BDE-28, -17, -8 and -7, were higher in sediment but that of 4'-OH-BDE17, the most dominant hydroxylation product and the abundance of *bphC* gene in sediment were lower than that under 2:2w and 1:1w

regimes. These results imply tidal flushing in mangroves created alternating anaerobic–aerobic conditions in sediment which support both debromination and oxidation processes resulting a complete removal of PBDEs in contaminated environments. Intrinsic degrading microorganisms in mangrove sediment could be developed as a promising natural attenuation strategy for *in situ* bioremediation of persistent organic pollutants in contaminated environments.

SPEAKER BIOGRAPHY

Nora Fung-yee Tam, BBS, JP

Professor Dr. Nora Fung-yee Tam is currently the Chair Professor of Environmental Science and Conservation in the Hong Kong Metropolitan University (HKMU), and the Emeritus Professor in the City University of Hong Kong (CityU). She obtained her PhD in Environmental Sciences from University of York (UK), MSc from University of Sheffield (UK), MPhil and BSc (1st Class Hons) from Chinese University of Hong Kong. Before joining HKMU, she was the Chair Professor of Biology in Department of Chemistry and Director of Futian-CityU Mangrove R&D Centre, CityU. Prof. Tam has more than 35 years of research experiences in ecology and conservation of wetlands, bioremediation and pollution control. She is one of the most cited researchers in environmental sciences, and is the top 2% of the World's most highly cited scientists (career-long/single year) according to the report released by Stanford University in 2021 and 2022. She also receives the Environmental Sciences Leader Award for 2023 from Research.com. Prof. Tam has extensive publication records, with over 380 original SCI journals articles, 10 books and 30 book chapters; and trained more than 30 PhD graduates and numerous master graduates. Prof. Tam has close connections with government, private sectors and green groups. She is currently the Chairman of the Research & Testing Committee and Sustainable Consumption group of the Hong Kong Consumer Council, Management Committee of Marine Ecology Enhancement Fund of the Airport Authority of Hong Kong, Management Committee of Marine Conservation Enhancement Fund of the China Light & Power and Hong Kong Electric Company Limited; and Member of Environment and Conservation Fund Committee, Theme-based Research Scheme Selection and Area of Excellent Selection Panels of Research Grants Committee, Lantau Development Advisory Committee and High Level Steering Committee on Antimicrobial Resistance of Food and Health Bureau.

KEYNOTE SPEECH

When there is more light than meets the eyes: Light pollution and its impacts

Chun Shing Jason PUN
Department of Physics, The University of Hong Kong
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Light pollution is a form of environmental degradation caused by inappropriate and/or excessive use of artificial outdoor lighting that affects the natural environment. Poorly designed outdoor lighting not only wastes energy, money, and valuable earth resources, but also has negative impacts on our ecological systems and possibly our health. Saving electricity by reducing improper outdoor lighting also means less air pollution. This could in turn reduce global warming caused by the power generation process. In this talk, I will introduce light pollution, the current situation in Hong Kong, Macao and the Greater Bay Area, and its damaging impacts. The talk will end with ideas to remedy the problem from the technological, policy, and educational perspectives.

SPEAKER BIOGRAPHY

Chun Shing Jason PUN

Dr Chun Shing Jason Pun is currently Principal Lecturer at the Department of Physics, The University of Hong Kong (HKU). Since 2003, he has been conducting scientific studies on the level of the night sky brightness in Hong Kong. He is also actively involved in the public education on the negative impacts of the environmental problem of light pollution. He has served in the Working Group on External Lighting to assist the HKSAR Government to review the effectiveness of the Charter on External Lighting, and to devise measures to better manage external lighting. Since 2020, he has served as a member of the Research Projects Vetting Subcommittee under the Environment and Conservation Fund. In appreciation and recognition of these efforts to preserve night skies, Dr Pun had been awarded one of the Dark Sky Defender Awards 2018 of the International Dark Sky Association (Darksky).

INVITED TALK

Nontarget and suspect screening and identification of leached chemicals from plastics in digesting fluids of organisms

Xianzhi Peng[a,c], Shang Guo[a,b], Jing Zhou[a,b], Guangshi Chen[a,b], Jianhua Tan[d]

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[b] University of Chinese Academy of Sciences, Beijing 100049, China

[c] CAS Center for Excellence in Deep Earth Science, Guangzhou 510640, China

[d] Guangzhou Quality Supervision and Testing Institute, Guangzhou 510050, China

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Plastic pollution has become an increasing global issue. Plastic debris in the environment are not only a pollutant but may also be a long-term source for a variety of contaminants. This work investigated chemical leaching of plastics in digestive system of animals by exposing plastic particles in artificial digestive fluids. Nontarget and suspect screen analysis based on ultrahigh high liquid chromatogram coupled with high resolution mass spectrometry (UHPLC-HRMS) was adopted to screen and identify the released chemicals. Impacts of environmental factors including particle size, aging, and digestive fluid on chemicals leaching from plastics were investigated to elucidate potential of chemical leaching after plastic debris in the environment ingested by warm-blooded terrestrial and cold-blooded aquatic animals. Chemicals leached from 11 commonly used plastic products, including 7 food contact products in the artificial bird gastrointestinal fluid were finally characterized. It's shown that after 120 h of exposure in gastrointestinal fluid of bird, a total of 4382 chemicals could have been released from polyvinyl chloride (PVC) cord particles, in which >90% were unknown. Bisphenol A (BPA), bis(2-ethylhexyl) phthalate (DEHP), tris(chlorisopropyl)phosphate (TCPP), and UV234 were usually identified CL1 compounds in leachates of plastic particles. The finer and the more aged the plastic particles, the longer the exposure time, the higher levels and more of leached chemicals. More and higher levels of chemicals were released from PVC cord particles exposed in the artificial bird digestive fluids than in the fish digestive fluid. In addition, hundreds to thousands of features were screened in the leachates of food contact plastic products (polysterene spoon, melamine chopstick, polypropylene lunchbox, polysulfone milk bottle, water bottle, straw, and plastic wrap) incubating in the artificial bird gastrointestinal fluid. Novel bisphenol analogues (e.g., bisphenol B, bisphenol G, and BPAP) substituting BPA, UV329, triethyl phosphate were identified in the leachates of at least one food contact plastic products, suggesting potential human exposure to known toxic chemicals and hundreds to thousands of chemicals without known toxicities through uptake food contacted with these plastic products. The results revealed that once plastic debris in the environment were ingested by animals, hundreds to thousands of chemicals may be leached into animal's digestive system in hours, suggesting potential synergistic toxicities *of the plastic debris to animals, even to human beings*. Plus, plastic debris may pose higher risks to warm-

blooded animals than to cold-blooded animals based on greater number and higher levels of potentially leached chemicals in the digestive systems. In addition to well-known plastic additives such as phthalates, organophosphates, bisphenols, and ultraviolet absorbents, more than 85% of the leached chemicals are unknown novel compounds without information about the environmental behavior and toxicity. Future research should pay more attentions on the unknown chemicals potentially released from plastic debris when considering risks of plastic pollution in the environment.

SPEAKER BIOGRAPHY

Xianzhi Peng

Dr Xianzhi Peng is a full-time professor at the State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences. She received her Ph.D degree in Geochemistry in 2000 from Guangzhou Institute of Geochemistry, Chinese Academy of Sciences. Over the last 20 years, Dr. Peng and her group studied contamination, persistence, bioaccumulation, and biotransfer of PPCPs/EDCs, plastic debris/microplastics, and plastic-related chemicals in the environment of the Pearl River catchment. Relevant results have been published in over 80 peer reviewed papers. Dr Peng current research interests focus on (1) Non-target and suspect screening of novel contaminants in the environment, (2) Geochemical behavior of plastics and related chemical contaminants in aquatic ecosystems.

INVITED TALK

Macau 2030/2060 Targets – What are the Options?

Roland Schoorl
COO & Executive Director of CESL Asia
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China pledged to reach a carbon emission peak by 2030 and to attain carbon neutrality before 2060, while Hong Kong SAR has committed to halve its carbon emission before 2035 and to reach carbon neutrality by 2050. Macau SAR will strive to reach peak carbon dioxide emissions by 2030, in conjunction with the country's environmental development strategies.

Based on 30 years of practical experience in building low-carbon facilities across Asia and China, the speaker will provide insights on the drivers that could accelerate the transformation of Macau into a low carbon city. Regulations and technologies are clearly the keys to success, but technologies have been evolving rapidly over the last 10 years. While certain rules can be applied by and large globally, the local conditions should always weight heavily on the search for the appropriate technologies.

Macau had no specific advantage from traditional renewable energies and is now relying on the Mainland for power supply. In a way, it has exported not only its energy security but also most of its CO2 emissions to the Mainland. Under such conditions, should it be concerned of its environmental footprint?

According to COP21 signed in Paris in 2015, one is not only responsible for its direct CO2 emission but also for the emission occurred in the supply chain including from the energy that we buy. Electricity (air-conditioning), construction material, consumer goods and transportation are the main source of CO2 emission in Macau. Regulations and technologies could strongly reduce their carbon footprint leading to an early carbon peak and rapid total emission reduction. It is a social and political choice but legal frameworks and technologies are readily available.

Regulations from Authorities and their enforcement will be the first drivers of success. Participation of local qualified institutions, enterprises and population at large in planning, executing plans, policies and projects would ensure the success of the energy transition in Macau.

The world is becoming more and more conscious on the need to promote sustainable tourism or eco-tourism. Macao should be at the forefront of such evolution as a major attraction for tourist in Asia. Investing in low-carbon regulation and technology will be a relatively small investment whereas its impact on Macau reputation and its aim for diversification would be considerable.

SPEAKER BIOGRAPHY

Roland Schoorl

Roland was recently appointed COO & Executive Director of CESL Asia, leading the development and operations of the group energy, technical assets & services in Macau and Portugal. CESL Asia operations cover a vast area of activities such as Facility Management, Project Management & Engineering, Renewable Energies, Regenerative Agriculture and Sustainable Cattle Breeding. Roland is also the Chairman of a start-up, called DELC (达远), operating Distributed Energy & Low Carbon projects in Jinan City (Shandong Province), Liaoyang City (Liaoning Province) and Urumqi City (Xinjiang Province).

All operations are now implementing advanced technologies such as A.I., IOT, and Asset Management Application to increase transparency, efficiency and lower energy consumptions.

He joined EDF at the end of 2013 to spearhead the development of a new District Energy activity in China. He launched several joint ventures in Industrial Utilities, Biomass Cogeneration, District Heating and Cooling in various locations in Henan, Hubei, Hainan and Shandong. Under his leadership, the fourth-generation district heating digitalization was developed in all EDF subsidiaries in China. He was also responsible for EDF China development of new businesses in digitalization, hydrogen, storage and electrical mobility.

He was nominated Chairman CEO of Dalkia Asia in 2005 (now under the Veolia brand). Over the next 8 years he started and developed new activities in China. Most prominent projects were the Development and operation of District heating in Northeast China (Jiamusi & Harbin municipalities), the Development and operation of industrial cogeneration facilities in Central China (Chengdu & Chongqing municipalities) and the development and operation of District Cooling operations in Hong Kong and Macau SARs.

He originally moved back to Southeast Asia in 1995 to take the position of Deputy CEO of newly created Dalkia Asia. Main projects were the acquisition, management, listing and divesting of the second largest gas distribution company in Seoul, South Korea; The operation of five Waste-to-Energy facilities in South Korea and Thailand; the Development and operation of various District cooling facilities across the region and especially the establishment of a joint venture with Singapore Power for the Marina South New Downtown District Cooling.

He joined Dalkia as CEO of Dalkia start-up in the Netherlands in 1991 and was briefly Project Director for the development of a Waste-to-Energy project in Birmingham, UK.

He holds a Degree in Thermodynamics from EPFL (Switzerland) and a MBA from INSEAD (France). Roland is a Dutch citizenship born on 23 May 1959.

INVITED TALK

Enhanced *n*-butanol production from lignocellulosic biomass hydrolysates by metabolically engineered *Clostridium tyrobutyricum* immobilized in fibrous-bed bioreactor

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Keywords: Biofuel, Butanol, Clostridium tyrobutyricum, Fermentation, Fibrous-bed bioreactor, Lignocellulosic biomass

Acetone-butanol-ethanol (ABE) fermentation suffers from high substrate cost and low butanol titer and yield. In this study, engineered *Clostridium tyrobutyricum* CtΔack-adhE2 immobilized in a fibrous-bed bioreactor was used for butanol production from glucose (major hexose) and xylose (major pentose) present in the hydrolysates of low-cost lignocellulosic (LC) biomass (agricultural waste) including corn fiber, cotton stalk, soybean hull, and sugarcane bagasse. The biomass hydrolysates obtained after acid pretreatment and enzymatic hydrolysis were supplemented with corn steep liquor and used in repeated batch fermentations. Butanol production with high titer (~15 g/L), yield (~0.3 g/g), and productivity (~0.3 g/L·h) was obtained from cotton stalk, soybean hull, and sugarcane bagasse hydrolysates, while corn fiber hydrolysate with higher inhibitor contents gave somewhat inferior results. The fermentation process was stable for long-term operation without any noticeable degeneration, demonstrating its potential for industrial application. A techno-economic analysis showed that *n*-butanol could be produced from LC biomass using this novel fermentation process at ~$2.5/gal for biofuel application.

Acknowledgements
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SPEAKER BIOGRAPHY

Hojae SHIM

He worked as a post-doctor at Ohio State University and University of Connecticut in U.S.A., followed by as a research professor at Hanyang University in Korea. Then, he has been teaching at University of Macau/Department of Civil and Environmental Engineering since 2003. He has completed many research projects funded by the Korean Ministry of Environment and the University of Macau Multi-Year Research Grant/the Science and Technology Development Fund of Macao (FDCT), as a principal investigator (PI)/co-PI, in cooperation with Tongji University, Institute of Urban Environment/Research Center for Eco-Environmental Sciences under Chinese Academy of Sciences, Nanjing University, University of Hong Kong, and Sun Yat-sen University in China. His main research areas in Environmental Biotechnology include: a) bioremediation/rhizoremediation of soil and groundwater contaminated with petroleum and chlorinated compounds, b) biological wastewater treatment, sludge treatment, and resources recovery, and c) generation of renewable energy (biodiesel/biogas) from (food) waste and wastewater.

INVITED TALK

Impacts of Policies and Infrastructure on the Usage of Electric Vehicles in Macao

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Keywords: Electric vehicles, Emission, Energy policy, Fuel switching, Macao, Public infrastructure, Renewable energy, Sustainable transportation

Considering the fuel-switching effects of electric vehicles (EV), the Macao government has implemented policies and invested on infrastructure to encourage the purchase and adoption of EVs. Examples are tax incentives and license fee waivers for EVs in the "Environmental Protection" category, allocation of parking spaces for EVs, and installation of charging facilities. Although the number of EVs remains a small proportion of the total number of motor vehicles in Macao, it has experienced tremendous growth in the past decade. This study aims to evaluate the impacts of public policies and infrastructure on EV usage in Macao. To do so, we surveyed 114 residents on their experiences and perspectives. The Kruskal-Wallis ANOVA tests indicate no statistically significant differences due to socio-demographic characteristics – gender, age, marriage status, education level, employment status and income level. However, the Mann-Whitney U test shows statistically significant differences between peak-hour and non-peak-hour road users. The Spearman correlation analyses find that to non-peak-hour road users, stronger policy incentives increase people's willingness to buy EVs. Non-peak-hour road users also believe that the adequacy of government's promotion of the EV infrastructure is positively correlated with people's satisfaction with the distribution of charging facilities and the effectiveness of the EV policies. The results of this study have important policy implications. First of all, current government policies and infrastructure have desirable effects on EV usage of road users during non-peak hours but not on those during peak hours. These peak-hour road users are weekday commuters, who are more likely to encounter heavy traffic and are therefore more sensitive to the timeliness and efficiency of EV services. To raise the adoption of EVs in Macao, the government should strengthen the promotion of the relevant policy incentives and complementary infrastructure and enhance public services that target the needs of peak-hour EV users.

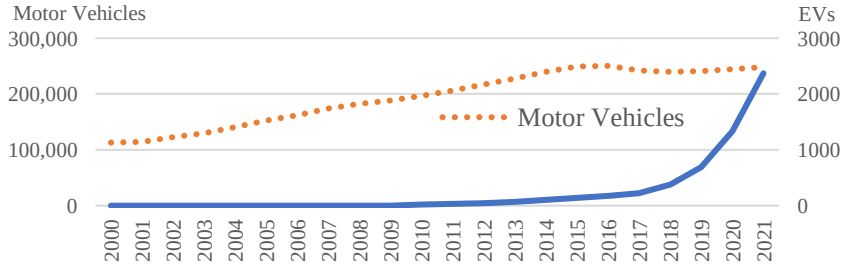

Figure 1: Number of Electric Vehicles and Total Number of Motor Vehicles in Macao, 2000 – 2022. Data from Statistics and Census Service.[1]

References: 1. Statistics and Census Service. Time Series Database. Accessed August 2, 2022. https://www.dsec.gov.mo/ts/#!/step1/en-US.

INVITED TALK

Harnessing Technology for Sustainable Development: A Vision for Macao and the Greater Bay Area

Terence Lee
Sustaincia
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This talk will explore how technology and social efforts can help us achieve sustainable development in Macao and the Greater Bay Area (GBA). The speaker will share his first hand experience and insights from various topics related to sustainability, such as green technology, digital economy, green finance, sustainability education and clean energy. The speaker will also present projects from his association using technology such as IoT, AI, blockchain, synthetic fuel, biotech, fintech, aquaponics, smartcity and more; and how these can help us fight against environmental problems in a more efficient and effective way. Moreover, the speaker will highlight the role of Macao as a platform for green technology exchange between China and Portuguese-speaking countries. The talk aims to show how to connect with various GBA counterparts, to collaborate on research and innovation projects, and to increase awareness of sustainable solutions for common environmental problems. The participation of everyone on projects which encourages sustainable development is key to their adoption and we're not alone, with expertise hubs across the GBA at our disposal, together with market and innovations from Portuguese speaking countries; as Macau diversify from the resort industry as it's primary industry, Macau has the potential to become a hub for sustainability.

SPEAKER BIOGRAPHY

Terence Lee

Co-founder of Sustaincia.org, a non-profit organization encouraging sustainability using technology and social efforts. Professionals from all industries come together for projects such as to develop smart city with IoT. We organize events for green transportation, renewable energy, biotechnology exchange, green finance in technology and future career paths for youth. Our members consists of technologists, financial experts and education practitioners from all over the world. We have a saying "at sustaincia we launch sustainability!"

INVITED TALK

Sands ECO360 Global Sustainability Program: Our Commitment towards Low-Carbon and Responsible Tourism

Stephanie Zhao
Sustainability Team
Sands China
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The talk will provide an overview of Sands China Limited's commitment to sustainability through their ESG strategies, with a specific focus on their Sands Eco360 Program. It will highlight ESG policies and management practices, underscoring their commitment to integrating sustainable practices into every facet of their operations. This commitment extends to energy saving projects, which span renewable energy endeavors and sustainable transportation initiatives, showcasing the company's dedication to reducing its carbon footprint and environmental impact. Furthermore, the talk will offer insights into the company's accomplishments in achieving low carbon targets and its role as a steward of water resources.

SPEAKER BIOGRAPHY

Stephanie Zhao has been working in sustainability for over 12 years. Throughout her career, she has had the privilege of working on a variety of exciting projects, including improving lighting performance projects and waste management systems. She is particularly proud to be leading the team to achieve the Macao Green Hotel Award, especially the Macao Green Hotel Platinum Award for Venetian, and to be in charge of the Sands ECO360 ambassador program. Additionally, she is leading the initiative to minimize single-use plastic, such as implementing a one bin office campaign.

Currently, as the leader of Sands China's sustainability team, she is responsible for setting the vision and strategy for sustainability initiatives and overseeing their implementation. She is passionate about sustainability and is committed to making a positive impact on the environment and society. She believes that sustainability is not just a buzzword, but a crucial part of ensuring a better future for generations to come. She looks forward to continuing to work towards this goal and making a difference in the world.

ORAL PRESENTATION 001

Using Machine Learning Methods to Forecast Air Quality: A Case Study in Macao

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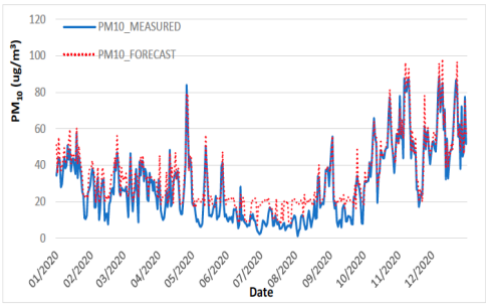
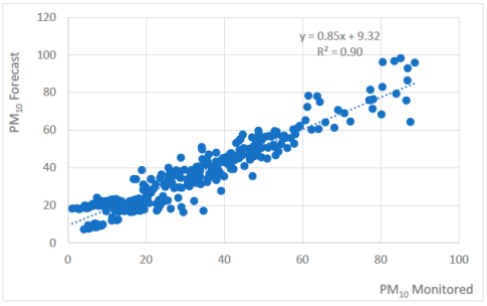
Keywords: random forest; gradient boosting; support vector regression; multiple linear regression; air quality forecast; COVID-19; air quality; air pollution

Abstract

Despite the levels of air pollution in Macao continuing to improve over recent years, there are still days with high-pollution episodes that cause great health concerns to the local community. Therefore, it is very important to accurately forecast air quality in Macao. Machine learning methods such as random forest (RF), gradient boosting (GB), support vector regression (SVR), and multiple linear regression (MLR) were applied to predict the levels of particulate matter (PM_{10} and $PM_{2.5}$) concentrations in Macao. The forecast models were built and trained using the meteorological and air quality data from 2013 to 2018, and the air quality data from 2019 to 2021 were used for validation. Our results show that there is no significant difference between the performance of the four methods in predicting the air quality data for 2019 (before the COVID-19 pandemic) and 2021 (the new normal period). However, RF performed significantly better than the other methods for 2020 (amid the pandemic) with a higher coefficient of determination (R^2) and lower RMSE, MAE, and BIAS. The reduced performance of the statistical MLR and other ML models was presumably due to the unprecedented low levels of PM_{10} and $PM_{2.5}$ concentrations in 2020. Therefore, this study suggests that RF is the most reliable prediction method for pollutant concentrations, especially in the event of drastic air quality changes due to unexpected circumstances, such as a lockdown caused by a widespread infectious disease.





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ORAL PRESENTATION 002

Ant Communities and their Functional Trait Responses to Land-use Change in Greater Bay Area, China

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Keywords: Biodiversity, Community, Ecology, Formicidae, Functional traits

Abstract

Urbanization has extensively altered natural habitats through changes in land use, resulting in corresponding impacts on species diversity. The rapid urbanization and industrial development in the Greater Bay Area have resulted in the conversion of natural habitats into urban landscapes, leading to biodiversity loss. In particular, the scientific and empirical studies in the two specific cities of Zhuhai and Foshan are barely known. Ants have been widely served as bio-indicator, and their functional traits responses between forests and urban areas have been developed. In this study, the relationship between ant community biodiversity and body size, canopy coverage, and leaf litter depth was quantified and characterized. Leaf litter samples were collected along transects ranging from forest interiors to forest edges to urban parks, while ant communities surveys were conducted. Additionally, changes in canopy coverage and leaf litter depth from forests to urban areas were recorded. We hypothesized that the results showed significant land use drivers in ant taxonomic and functional diversity across the three habitat types (i.e., rural forest, sub-rural forest, urban garden). I hypothesized that at sites with lower canopy coverage and leaf litter depth, ant species diversity should be relatively low, accompanied by smaller ant body sizes due to habitat distribution. Higher vegetation cover influences the mechanisms governing more complex food web structure and functioning, particularly concerning resource availability and habitat complexity. Our study can highlight the potential role of functional traits in mediating ant species' responses to the environment and apply ants as the bio-indicator to monitoring forest ecosystem restoration and conservation.

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ORAL PRESENTATION 003

Biodiesel production from food waste and domestic wastewater by *Rhodosporidium toruloides*

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Keywords: Biodiesel, Biolipid, Food waste, Food waste hydrolysis, Oleaginous yeast

Abstract

Producing biodiesel from food waste (FW) would benefit both environment and economy. Current study investigated biodiesel production from food waste and domestic wastewater by utilizing the oleaginous yeast *Rhodosporidium toruloides* under non-sterile condition. The potential of biolipid production from the mixture of effluents of existing local FW treatment facilities and domestic wastewater was firstly evaluated. Then, to increase the nutrient recovery efficiency, three FW hydrolysis processes were introduced and compared. And the hydrolysis process by crude enzymes produced from solid FWs by *Aspergillus oryzae* was further optimized. The optimized hydrolysis process resulted in reducing sugar (RS) yield of 251.81 ± 8.09 mg g_{dryFW}^{-1} and free amino nitrogen (FAN) yield of 7.70 ± 0.74 mg g_{dryFW}^{-1} while waste oil with the RS yield of 93.54 ± 0.01 mg g_{dryFW}^{-1} was easily separated without solvent usage. Compared to the hydrolysate only used, when mixed with domestic wastewater, the results showed obvious enhancement on biomass yield, biolipid yield, and wastewater treatment efficiency. The maximum biolipid yield was 29.80 ± 0.50 mg g_{dryFW}^{-1} and the estimated quality of biodiesel produced from the biolipid met both EN 14214 and ASTM D6751 standards.

Acknowledgements

This work was partially supported by grants from the Science and Technology Development Fund of Macao (FDCT0034/2021/AFJ) and the University of Macau Multi-Year Project (MYRG2018-00108-FST).

ORAL PRESENTATION 004

Effective immobilization of Bacillus sp. MY156 on scrap tyres for degradation of three typical phthalate esters

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Keywords: Immobilization, scrap tyres, adsorption capacity, bacteria community, esterase.

Abstract

Scrap tyres can enhance degradation of frequently existed phthalate esters (PAEs) contaminants, which are di 2-ethyl hexyl phthalate (DEHP), dibutyl phthalate (DBP) and diethyl phthalate (DEP). However, there is limited understanding of the potential application of resourceful utilization of tires as immobilizing matrix to biological degradation of PAEs and the interaction mechanisms behind it. Thus, the current work examines the adsorption and immobilization properties of scrap tires on degradation of common PAEs. The results suggest that tires exhibit a competitive adsorption capacity of PAE contaminants, the effect of which is influenced by pH, temperature, dosage of the adsorbed material, and contaminant concentration. Hydrophobicity may be the dominant adsorption mechanism for PAE contaminants in tire sorption. Previous immobilization of isolated *Bacillus* strain MY156 on tires significantly enhanced degradation of PAEs and bacterial growth in culture. Enzymatic activity results suggest that immobilization promotes dehydrogenase and decreases esterase activity. Cell surface response was further assessed in terms of morphological observations, FTIR, XRD and analysis of extracellular polymers to understand the interaction between microorganisms and tires. No significant trends in bacterial community changes were found during adsorption and immobilization treatment of municipal wastewater. Therefore, scrap tyre could be considered as a promising strategy of sustainable environmental management.

Acknowledgements

This work was supported by a grant from the Science and Technology Development Fund of Macao (FDCT0034/2021/AFJ).

ORAL PRESENTATION 005

Insights into enhanced triclosan removal and microbial community succession using *Burkholderia* sp. bioaugmentation in river water

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Keywords: TCS, antimicrobial agent, toxicity pressure, bacteria, community succession

Abstract

Triclosan (TCS), a synthetic and broad-spectrum antimicrobial agent, is ubiquitously detected in environmental matrices due to its pervasive utilization. Bioaugmentation involving microbial degradation is a promising strategy for mitigating and eliminating TCS pollution in these ecosystems, taking into account both degradation efficiency and community stability. In this study, a novel *Burkholderia* strain, efficient in TCS degradation, was isolated from a local domestic wastewater treatment facility. This strain demonstrated the capability of metabolically degrading 5 mg/L of TCS under neutral conditions. Bioaugmentation of this strain in non-sterile river water yielded an enhanced TCS degradation rate of 0.0694 mg/(L·h), compared to the natural degradation rate of 0.0245 mg/(L·h) in the river water without the inoculum. High-throughput 16S rRNA gene amplicon sequencing revealed that the increased absolute biomass of the *Burkholderia* strain was the key contributor to the enhanced TCS degradation in bioaugmentation tests. TCS introduction shifted the community succession similarly by reducing species richness. However, the inoculation of the *Burkholderia* strain could partially buffer TCS-induced stress by reducing toxicity and enhancing community evenness, resulting in a more stable community in the bioaugmented system. These findings underscore the effectiveness of the *Burkholderia* strain in TCS bioremediation and emphasize the critical role of microbial communities in the bioremediation of TCS-contaminated environments.

Acknowledgement

This work was supported by a grant from the Science and Technology Development Fund of Macao (FDCT0034/2021/AFJ).

ORAL PRESENTATION 006

Isolation and characterization of an indigenous chloroxylenol degrader *Rhodococcus* sp. GG1

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Keywords: PCMX; *Rhodococcus*; Biodegradation; Metabolic pathway; CYP450

Abstract

The coronavirus disease 2019 (COVID-19) pandemic has significantly increased the demand of disinfectant use. Chloroxylenol (para-chloro-meta-xylenol, PCMX) as the major antimicrobial ingredient of disinfectant has been widely detected in water environments, with identified toxicity and potential risk. An indigenous PCMX degrader, identified as *Rhodococcus* sp. GG1, was isolated and found to be capable of completely and rapidly degrading PCMX as high as 80 mg/L in a metabolic way. The growth kinetics of GG1 followed Haldane's inhibition model, with maximum specific growth rate, half-saturation constant, and inhibition constant of 0.38 h^{-1}, 7.64 mg/L, and 68.08 mg/L, respectively. The cultivation conditions (inoculum size, temperature, and pH) for *Rhodococcus* sp. GG1 were optimized, and the presence of additional carbon source stimulated strain GG1 to alleviate inhibition from high concentrations of PCMX. A potential degradation pathway was proposed, with 2,6-dimethylhydroquinone identified as the major intermediate metabolite. Cytochrome P450 (CYP450) was found to play a key role in dechlorinating PCMX via hydroxylation and also catalyzed the hydroxylated dechlorination of other halo-phenolic contaminants through co-metabolism. This study characterizes an aerobic bacterial pure culture capable of degrading PCMX metabolically, which could be promising in effective bioremediation of PCMX-contaminated sites and in treatment of PCMX-containing waste streams.

Acknowledgement

This work was supported by a grant from the Science and Technology Development Fund of Macao (FDCT0034/2021/AFJ).

ORAL PRESENTATION 007

Mangroves as a Source of Polyethylene Terephthalate (PET) Degrading and Biopolymer-Producing Bacteria

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[2]Universidade Católica Portuguesa, CBQF–Centro de Biotecnologia e Química Fina –Laboratório Associado, Escola Superior de Biotecnologia.
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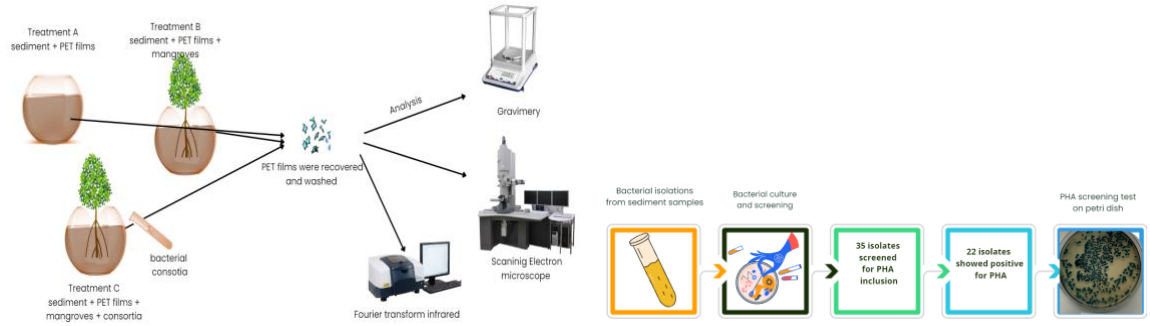
Keywords: Biodegradation, Polyethylene Terephthalate, *Bacillus* sp., *Enterococcus* sp., Mangroves, Pollution, Consortia, Polyhydroxyalkanoates

Abstract

Polyethylene terephthalate (PET) is one of the most widely used plastics, and its accumulation in the environment has become an issue of great concern. This study investigated the biodegradation of crystalline PET films in the soil in the presence or absence of mangrove plants and with or without bioaugmentation with a bacterial consortium made of the genus *Bacillus* sp. and *Enterococcus* sp. The experiment was performed in an open garden at ambient environmental conditions for 240 days. Biodegradation assays of PET monomers, terephthalic acid (TPA, 1000 mg/L), monoethylene glycol (MEG, 1113mg/L), and intermediate, bis-2-hydroxyethyl terephthalate (BHET, 1000 mg/L) were further performed using the bacterial consortia isolated from the soil of the different treatments. The compounds were added to a liquid medium as the sole carbon source and incubated for ten days at 30°C. Growth of the consortia was monitored by spectrophotometry, and degradation was followed by HPLC analysis of aliquot samples. The study further investigated the PET monomers' biodegradation and biopolymer recovery by a bacterial isolate from a mangrove environment. The gravimetry analysis showed no significant changes in PET films in any of the treatments, with a maximum PET film degradation percentage of only 0.118 %. As for the compounds, complete degradation of TPA and significant degradation of BHET (96.09%) and MEG (83.65%) were observed for all assays independently of treatment. The bacterial isolate from a mangrove environment, *Bacillus* sp. EC2-30-3 showed the ability to utilize MEG as the carbon source and produce polyhydroxyalkanoate (PHA). The maximum PHA accumulation in media supplied with MEG was 40.31% and 25.53% with glucose. The FTIR profile for the PHA recovered from the isolate EC2-30-3 showed a structure closely related to PHB. The results suggest that although direct biodegradation of PET may be challenging, bacteria capable of degrading the intermediates and monomers of PET to produce biopolymers are readily available in the natural environment.



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ORAL PRESENTATION 008

A low-cost measurement method for environmental monitoring: example applications in Macao's coastal environment

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Keywords*:* Instrumentation, Monitoring, Water management, Wave measurement, RP2040

Abstract

Water management is a prime concern in megacities such as the Greater Bay Area of China. Implementing and monitoring new policies and programs requires reliable and accessible data, which is often costly in terms of specialized equipment and workforce. In this study, we used cost-effective methods for measuring the discharge in open channels and monitoring tidal activity. In both setups, the liquid pressure sensor's raw analog data signal was transmitted to an RP2040 microcontroller, converted into a 16-bit digital signal, and processed through a moving average filter. We calibrated and validated the sensor with a laboratory water column, direct volume measurement, and wave simulator. Using a water column (10–1,800 mm), the precision increased with the window size (SD< 0.001; RSD< 0.1%). The calibration curve produced complete linearity (R2= 0.9999), with a resolution higher than 1 mm, and no visible hysteresis (SD< 0.001). The accuracy of the device, paired with a 90-degree triangular weir (V-Notch), in an open channel was superior to 95% for flow rates ranging between 0.1 L/min to 20 L/min. In the wave simulator (F= 0–1.0 Hz), we recorded up to 36 data points per second. We installed multiple submersible devices along a coastal area to simultaneously measure the impact of tides and waves during a tropical storm. The field survey shows that the device is suitable for medium-scale measurement studies in harsh weather conditions. While using simple electronic components and open-source libraries, this study provides reliable tools for designing and monitoring small water management projects, such as community-based initiatives for coastal wave measurements and decentralized infrastructures, thus playing a significant part in local sustainability strategies and educational programs.

ORAL PRESENTATION 011

Developing an eco-friendly insect barrier glue and testing this effectiveness against a range of insect species in urban green spaces

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Presenter email: Jiayi Huang: r130004018@mail.uic.edu.cn

Keywords: pest control, environment-friendly, plant health, integrated pest management.

Abstract

Pests are a significant problem in our world, causing billions of dollars in damage every year. However, the use of chemical-based pesticides to control pests can exacerbate the problem by polluting the environment. This pollution can have long-lasting effects on ecosystems, including damage to soil, water, and air quality, as well as harm to non-target organisms. With the development of science and technology, as well as human awareness of the environment, pest management began to shift from chemical control to environmentally friendly and sustainable control, chemical pesticide reduction has been a world consensus, and the implementation of green control areas continues to grow. Physical pest control methods are crucial for sustainable urban agriculture. Although insect trappers are effective, they pose risks to wildlife such as lizards and birds. Therefore, an eco-friendly insect barrier is needed for effective pest management that is safe for the environment and promotes biodiversity. This experiment aims to 1) optimize the formula for an insect barrier with excellent properties, 2) evaluate the effectiveness of the insect barrier in preventing insect pests on tree surfaces, and 3) assess its impact on the environment and human survival. We will produce an eco-friendly insect barrier glue and study its effectiveness in deterring insect species in urban gardens. We will also examine the effectiveness of the chemical compounds on insects and wildlife in the lab. Our goal is to create a chemical barrier that effectively controls pests without trapping wildlife. This study will contribute to sustainable pest control and urban agriculture practices.

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ORAL PRESENTATION 013

Construction and Applications of Flora Database in *Fengshui* Forests for the Conservation of Urban Biodiversity and Cultural Heritage

Lingzi LIANG[1,2,4], **Xiuzhi WANG**[1,2,4], **Jianwen QIU**[1], **Qin GONG**[2,4], **Xun LI**[2,4], **Siu-Tai TSIM**[2,3,4]
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Presenter email: lianglingzi@uic.edu.cn / 22483098@life.hkbu.edu.hk

Keywords: Fengshui Forests, Database, Urban Biodiversity, Biodiversity Conservation, Landscape Design.

Abstract

The current design of urban parks and landscapes presents several issues, such as a relatively simple plant community structure, limited plant diversity[1], and an increased risk of invasive species due to the introduction of ornamental plants[2]. *Fengshui* forests, a distinctive type of secondary forests in China, are considered the outcome of traditional *fengshui* theory with a long historical background[3]. Research on *fengshui* forests, initiated in the 1970s, has primarily focused on plant communities, rural ecology, and landscape design[4]. Although numerous studies have explored plant species diversity and plant communities within *fengshui* forests, a comprehensive database incorporating information on plant physiology and societal values is lacking. The objectives of our study are as follows: 1) to establish a systematic database encompassing the flora found in *fengshui* forests; 2) to review the ecological functions and humanistic values associated with *fengshui* forests; and 3) to investigate the potential application of fengshui forests, particularly in urban landscape design and sustainable urban development. To accomplish these goals, we conducted an extensive review of more than 30 papers focusing on plant diversity surveys in *fengshui* forests, as well as consulted five relevant books. Through this process, a systematic database, which is containing detailed information on over 700 plant species found in *fengshui* forests, has been constructed. The database includes crucial plant physiological characteristics such as distribution patterns, flowering and fruiting periods, and it also provides a summary of the economic and social values of these plants. This comprehensive database, in conjunction with the principles of *fengshui* theories, holds immense potential for applications in cultural heritage conservation, protection of native species, and urban landscape design. Furthermore, its utilization can contribute to urban biodiversity conservation, sponge city design, and sustainable urban development.

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ORAL PRESENTATION 015

A Study on the transformation of *Cerbera Manghas* oil into an Eco-friendly bio-diesel fuel

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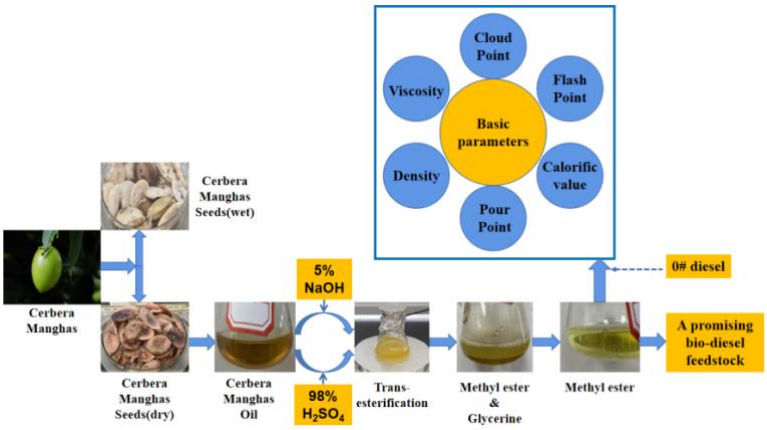
Keywords: *Cerbera Manghas* Oil, Bio-diesel, Acid-alkaline trans-esterification, Oil to methanol ratio

Abstract

Cerbera Manghas, a small evergreen coastal tree in mangroves and regarded as one of the few oil-producing plants in the world. However, it has not been widely used due to its unstable methyl ester production efficiency. In this study, the correlation between the mixing ratio of *Cerbera Manghas* oil and theorganic substance and the acidity-alkalinity of the solution was investigated in order to acquire the highest methyl ester formation efficiency. The results showed that the highest production capacity of methyl ester occurred under the reaction ratio of 1:9 (oil:alcohol) with 5% sodium hydroxide + 98% sulfuric acid. The increased alcohol level in the solution improved the robustness and productive rate of methyl ester. Moreover, the relatively stable production levels of methyl ester were obtained in all testing groups. The physical and chemical properties of *Cerbera Manghas* methyl ester and its bio-diesel blends was also tested. The performances of *Cerbera Manghas* Bio-diesel 10 (CMB10), *Cerbera Manghas* Bio-diesel 20 (CMB20), *Cerbera Manghas* Bio-diesel 30 (CMB30) in Viscosity 、Density、Flash point、Pour point、Cloud point、Calorific value are higher than those of other bio-diesels in the same category. Meanwhile, the further application of *Cerbera Manghas* wooden shell can be used in bio-ethanol production and the pulp can be used as a raw material for composting process.



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POSTER 101

Research on the Correlation between Coastal Marine Ecological Environment and (Marine) Industrial Clusters

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Keywords: Marine ecological, Industrial cluster, Correlation, Coupling.

Abstract

China's marine economy provides an inexhaustible impetus for the development of the national economy with a contribution rate of nearly 10% each year. In this process, the effect of industrial agglomeration has become increasingly prominent. While the marine ecological environment system is encountering the serious threats from the human society while it carries the rapid development of the marine economy. Therefore, exploring the relationship between the coastal marine ecological environment system and industrial agglomeration has important theoretical and practical significance.

Based on the analysis of the interaction mechanism between the coastal marine ecological environment and industrial agglomeration, through the establishment of a coupling degree model, the empirical analysis of the coupling state of the coastal marine ecological environment of Jiaozhou Bay and the marine industrial agglomeration of Qingdao is carried out, and it is believed that: industrial development Vitality is a decisive factor affecting industrial agglomeration; the coastal marine ecological environment in Qingdao and the marine industrial agglomeration level show a fluctuating upward trend, and the change in industrial agglomeration is greater than the change in the coastal marine ecological environment; the interaction between the two systems is strong; During the process of the two-system interaction, the coupling degree C has a two-stage inverted "U" change, and the C value keeps increasing, indicating that: on the one hand, the alternation of promoting and constraining relationships between the level of industrial agglomeration and the nearshore marine ecosystem occurs; on the other hand, the frequency of interaction between the two systems spirals up; the coupling between the two systems has a good benign interaction and coordination. The relationship has risen from "severely unbalanced development" to "well-coordinated development", and the direction of interaction and association has evolved to a higher level.

The four targeted suggestions including industrial development direction, scientific and technological innovation capability, industrial layout and guarantee support are put forward to achieve a benign and coordinated association between the two systems.

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POSTER 102

Evaluation of Mangroves Blue Carbon as a potential for climate change mitigation in Macau

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Keywords: Mangroves, blue Carbon, Carbon dioxide, Carbon sequestration, total organic Carbon

Abstract

Climate change is a global issue but its impact can be felt locally. Macau SAR has been rapidly developing since the single shift towards a gaming industry-dominated economy, the overwhelming anthropogenic activities contributing to increasing pollution. Mangroves, which play an essential role as the blue carbon system with a high carbon sequestration rate could be a natural base solution to the pollution. This study aims to determine 1) the total organic Carbon (TOC) in the soil of Macau mangrove sites, 2) comparison with the methodology evaluating the organic Carbon, and 3) organic Carbon comparison between Macau and other regions. Soil sampling were processed under the Blue Carbon Initiative guideline, and the samples were divided into two parts for determining the TOC%, combustion method from Hong Kong, and methodology of ashing in our laboratory. The overall estimated TOC% of Macau mangrove sites was 1.29%. There are still a lot of potentials in Carbon storage and for climate change mitigation in Macau.

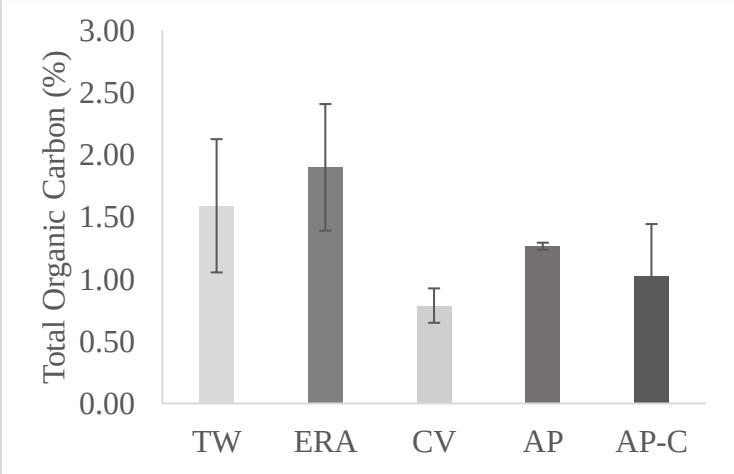

Figure 1: TOC% among all sites based on ISE laboratory results

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POSTER 104

Uptake and accumulation of polystyrene microparticles in the marine medaka (*Oryzias melastigma*) larvae

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Keywords: bioaccumulation, plastic pollution, marine medaka (Oryzias melastigma), fluorescent polystyrene microparticles, larvae locomotion

Abstract

Microplastics (MPs) are an emergent environmental pollutant. The persistent and widespread presence of these particles in marine ecosystems poses a threat due to their bioavailability to organisms at different developmental stages, which, both actively and passively, are interacting with microplastics. Nano-sized plastic particles are of particular concern as these small particles are more likely translocated into different tissues after ingestion by passing through biological barriers, and, as a result, these particles can accumulate in organisms at every trophic level, amplifying their impact over time, while causing severe health issues, such as developmental and behavioural abnormalities. In the present study, we aim to investigate the accumulation of micro and nanoplastics and their effect on development and behaviour *in vivo* by using the marine medaka *Oryzias melastigma* as a model species. Larvae of marine medaka were exposed to different concentrations and sizes of fluorescent polystyrene microspheres (PS MPs) during the first two weeks of their development, followed by an assessment of PS MPs ingestion, morphological features, and swimming behaviour. Preliminary results showed that PS MPs are being ingested by larvae as early as 3 dph (days post hatch), and exposure to 500 nm PS MPs resulted in a delay of development (*i.e.* reduced body length), which is proportional to the concentration of PS MPs. However, most of the PS MPs were found only on the body surface and in the digestive tract, while translocation of microspheres into other tissues was not detected. Additionally, no differences in locomotion between control and exposed larvae to PS MPs were observed. Future experiments will investigate the uptake of both micro and nanoplastic particles on larvae and adult marine medaka, as well as the effect of plastic ingestion on development, behaviour, and gene expression.

POSTER 105

Exploring the ecological implications of micro and nanoplastics: a focus on fish as model organisms, methods, and differences in approaches

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Keywords: microplastic pollution, nanoplastic pollution, marine ecosystems, fish model species, methodology

Abstract

In recent years, micro and nanoplastics (MNPs) have emerged as significant environmental pollutants, raising concerns about their potential ecological impacts. In marine environments, the unique characteristics of MNPs influence their distribution, bioavailability, and trophic transfer, ultimately resulting in bioaccumulation within food webs. Ingestion is the most likely interaction between organisms and MNPs due to the small size of these particles, leading to severe consequences such as impaired growth, neurotoxicity, oxidative stress, reproductive toxicity, and tissue damage. Fish species have been commonly used as model organisms to investigate the effects of MNPs, given their ecological importance and sensitivity to environmental changes. However, variations in methodological approaches among studies have added complexity to the interpretation and comparison of results, calling for the need of more standardized experimental protocols and development of new and more sensitive methods for MNP detection. In this work, we provide an overview of the literature exploring the ecological implications of MNPs on fish, emphasizing species-specific responses. Specifically, we compare methodologies used in controlled laboratory experiments, including (1) experimental design, (2) MNP concentration, size, administration (i.e., dietary exposure vs waterborne exposure) and exposure time; (3) fish species, (4) life stage (i.e., embryo, larvae, juvenile, and adult); (5) MNP detection and quantification; and (6) assessment of ecotoxicological effects of MNPs. Lastly, we summarise the results from previous research in fish species to identify patterns and key findings in relation to MNPs' ecological implications and assess future directions.

POSTER 106

Natural hazard and the role of mangroves as a nature-based solution for coastal protection in Macao SAR

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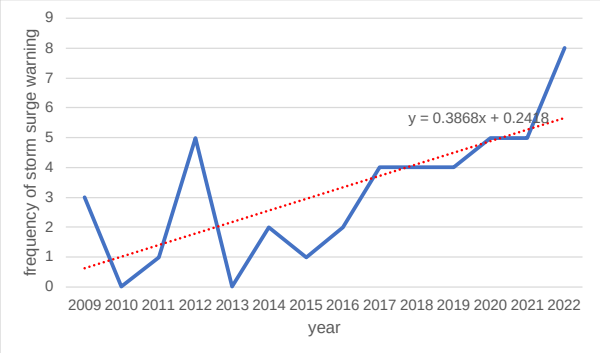
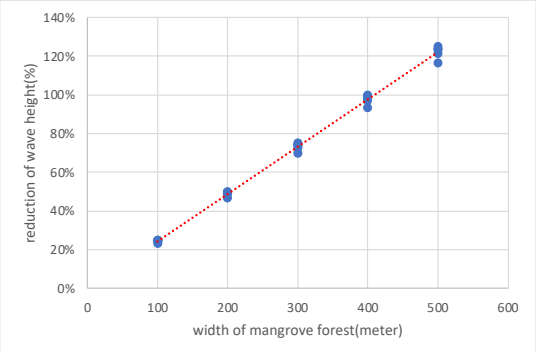
Keywords: mangroves, inundation, wave attenuation, storm surges, sea-level rise, Nature-based Solutions

Abstract

The inundation problem in Macao is getting more attention recently, especially after the destructive impacts of typhoons Hato (2017) and Mangkut (2019). The inundation caused by storm surges is getting more severe with the rapid sea-level rise in Macao. Moreover, the potential threat of a tsunami in Macao, may be enhanced with rising sea-level. This research evaluated the risk of coastal hazards in Macao by analyzing the local meteorological data. The results of the analysis indicate a rising trend in the tropical cyclone intensity and more severe storm surges are expected to occur in the future. Moreover, this research explores the potential of Nature-based Solutions (NbS), particularly mangroves, to address the inundation problem in Macao. The study included a preliminary laboratory-based experiment and the application of local mangroves data in numerical models. The results of the experiment and numerical models demonstrate the ability of mangroves to attenuate waves. These findings, although preliminary, indicate that mangroves could be a promising NbS to address inundation issues in Macao. To effectively implement this NbS, further field investigations are needed to measure attenuation in-situ, as well as determine optimal locations for mangrove restoration projects.





POSTER 108

Equilibrium Bifurcation and Extreme Risk in the European Carbon Futures Market——Based on the catastrophe theoretical framework of multi-system impact and investor heterogeneity

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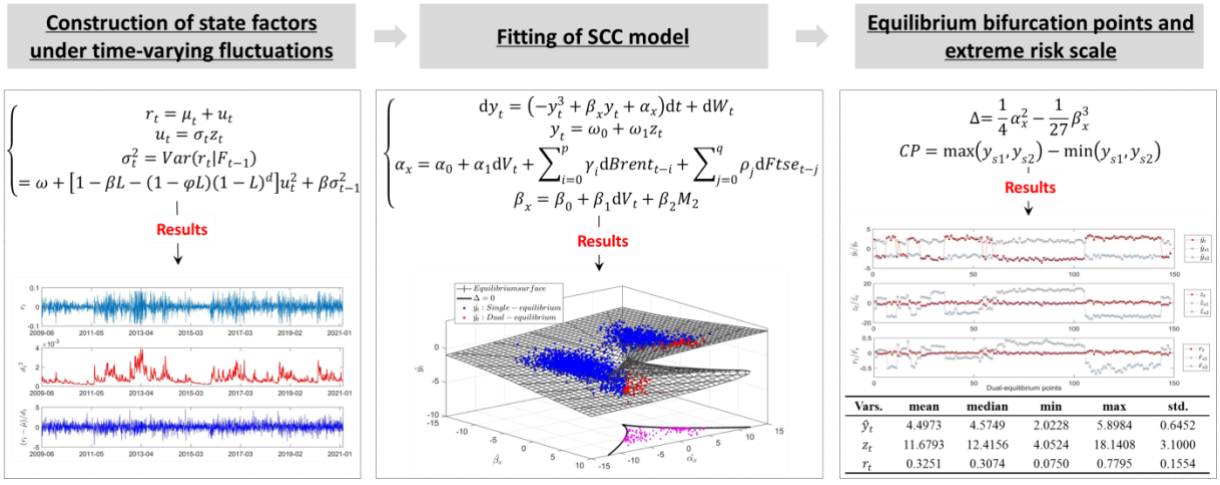
Keywords: carbon futures market, equilibrium bifurcation, extreme risk, investor heterogeneity, catastrophe theory.

Abstract

Considering the long-term memory and volatility clustering of the European (EU) carbon futures returns, the time-varying volatility is estimated through the fractionally integrated generalized autoregressive conditional heteroscedasticity model (FIGARCH). The returns adjusted by volatility are used as state factor to construct state variable, and the control variables are constructed based on the "Economy-Energy-Environment" system perspective and investor heterogeneity assumption, then obtain the stochastic cusp catastrophe model (SCC), The equilibrium bifurcation and extreme risk of the EU carbon futures market are studied by the SCC model. The results show that: (1) under the modeling method, SCC model has good fitting effect and evaluation ability, which is an effective method to study the catastrophe behavior under the condition of time-varying volatility; (2) in the EU carbon futures market, chartists are mainly affected by short-term price and trading volume change, leading to the emergence of equilibrium bifurcation, while fundamentalists make investment decisions based on the economy, energy market and market supply and demand level, affecting the asymmetry of equilibrium bifurcation; (3) by using the mutation criterion (i.e. the Cardan's discriminant of the equilibrium surface equation), 148 equilibrium bifurcation points are identified in the EU carbon futures market during the period from December 3, 2009 to September 16, 2020, and most of them are concentrated in two upward period. Moreover, influenced by the catastrophe behavior of the state variable, the average extreme risk scale of the returns is about 32.51%.



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POSTER 109

Study on Green Development Mechanism of Guangdong-Hong Kong-Macao Greater Bay Area —— Based on comparison with the other three major bay areas in the world

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Keywords: Guangdong-Hong Kong-Macao Greater Bay Area, Green development mechanism, Three major international bay areas, Carbon trading, Urban agglomeration

Abstract

Objectives:To build the Guangdong-Hong Kong-Macao Greater Bay Area into a world-class bay area and Urban agglomeration is a national strategy put forward in 2017, and green development is the mainstream trend in the development of city agglomeration around the world, and developed countries have accumulated rich experience. The study on the mechanism of green development in the Greater Bay Area is of great significance. Methodology:Based on the comparison with the three major international bay areas, such as Tokyo Bay Area, New York Bay Area and San Francisco Bay Area, the green economic growth mechanism, ecological compensation mechanism and interest coordination mechanism of Guangdong, Hong Kong and Macao are constructed, and corresponding policy recommendations are put forward. Recommendations and inspirations:In the future development of the Greater Bay Area, attention should be paid to the sound division of green industries among cities, strengthen innovation platforms for green and low-carbon technologies and build green city clusters. Pilot the development of regional trading platforms for ecological products such as carbon sink trading, and establish and improve a unified trading system for ecological services in the Guangdong-Hong Kong-Macao Greater Bay Area; Gradually form a low-carbon, circular and green development market system; Improve industrial emission standards and strengthen carbon emission management; Learn from each other and introduce each other's market practices in the field of green development.

Table Comparison between the Guangdong-Hong Kong-Macao Greater Bay Area and other international Bay areas

	The Guangdong-Hong Kong-Macao Greater Bay Area	Tokyo Bay Area	New York Bay Area	San Francisco Bay Area
Area (10,000 square kilometers)	5.6	3.7	3.3	1.8
Major industries	Finance, shipping, Internet, electronics, high-tech, tourism	Steel, petrochemical, logistics, equipment manufacturing, high and new technology	Finance, shipping, information, health care	Electronics, Internet, biology, high-tech
Features Area	Integrated Bay Area (Target)	Industrial Bay	Financial Bay Area	Technology Bay Area
Representing cities	Hong Kong, Macao, Shenzhen, Guangzhou, Dongguan, Zhuhai, Foshan	Tokyo, Yokohama, Kawasaki, Chiba	New York, New Jersey, Connecticut	San Francisco, Oakland, SAN Jose

Green economic growth mechanism	ecological compensation mechanism	interest coordination mechanism

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POSTER 110

Research on coupling collaborative pricing of EUA and CER based on the co-evolution theory of complex systems and competition and cooperation game

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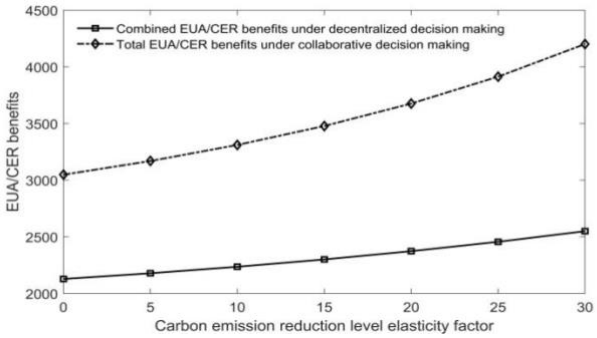
Keywords: EUA, CER, Coupling synergy, Competition and cooperation game, Collaborative pricing.

Abstract

Based on the co-evolution theory of complex systems and the basic principles of evolutionary games, this article starts with the degree of order and coupling synergy and uses competitive and collaborative games to study the co-pricing problem of EUA and CER. (1) In the sample interval, the order degree of the EUA subsystem and CER subsystem showed an overall downward trend. From 2008 to 2011, the order degree of the CER subsystem was greater than that of the EUA subsystem. After 2012, the order degree of the EUA subsystem exceeded that of the CER subsystem. It shows that EUA contributes more to the whole system than CER. (2) The coupling synergy of EUA and CER showed a trend of first increasing and then decreasing. The period from 2008 to 2013 was a high level of coupling coordination. The years from 2014 to 2016 and 2019 to 2021 are intermediate coupling synergies. From 2017 to 2018, it was a low-level coupling synergy. In general, the coupling synergy degree between the EUA subsystem and the CER subsystem is 85.7%. It shows that the two have good coupling and coordination abilities. (3) The total return curve of EUA and CER under collaborative decision-making is significantly above the combined return curve of EUA and CER under decentralized decision-making. It shows that the total return of EUA and CER under coordinated decision-making is significantly greater than the combined return under decentralized decision-making. (4) There are multiple stagnation points under collaborative decision-making. At the equilibrium stagnation point (38.6555, 0.7563), that is, when the coordinated pricing is 38.6555 euros and the government issue quota is 0.7563, the total revenue of the coordinated pricing will reach the maximum (4201.68). At the same time, the yield curve of the two increases steadily with the increase of the elasticity coefficient of the carbon emission reduction level. It shows that the demand for low-carbon products will bring about a steady increase in total revenue.



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POSTER 111 (waiting email to confirm if participate)

The Calcination Effect on the Physical-Chemical Properties and Adsorption Abilities of Inorganic-Organic Montmorillonite

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Keywords: Adsorption, Calcination, Inorganic-organic montmorillonite, Physical-chemical properties

Abstract

In this study, inorganic-organic montmorillonite (IOMMt) was synthesized by modifying montmorillonite (MMt) with Keggin Al_{13} complex (Al_{13}) and Hexadecyltrimethyl ammonium (HDTMA) simultaneously (Co-MMt). For comparison, Al_{13} modified montmorillonite (Al-MMt) and HDTMA modified montmorillonite (O-MMt) were also synthesized. To study the calcination effect, MMt, Al-MMt, O-MMt, and Co-MMt were calcined at different temperatures (200-800℃). The changed physical-chemical properties and adsorption abilities of IOMMts towards nine types of pollutants including methylene blue (MB), methyl orange (MO), bis-phenol A (BPA), enrofloxacin (ENR), phosphorus (P), arsenic (As), chromium (Cr), lead (Pb), and cobalt (Co) were investigated. The XRD, TGA, and FTIR results indicated that the structural change of Co-MMt was similar to O-MMt, but it was alleviated by the intercalated Al_{13} in Co-MMt. The surface area of O-MMt and Co-MMt increased to the highest values at 400 and 450℃, respectively. The effect of calcination on the adsorption abilities of MMt and modified MMts towards different pollutants were different. MMt could adsorb MB, ENR, Pb, and Co, while it could adsorb MO, As, P, and Cr after calcination. Al-MMt have ability to adsorb MB, MO, ENR, and P, but the adsorption abilities of it decreased after calcination. For O-MMt and Co-MMt, the adsorption abilities depended on the existence of HDTMA, providing abilities to adsorb MB, MO, ENR, BPA, As, P, and Cr. Therefore, the adsorption abilities of O-MMt and Co-MMt were greatly affected by the calcination, especially at 200-300℃. In addition, it observed that the formed carbonous materials provides O-MMt and Co-MMt abilities to adsorb MB, MO, ENR, P, Pb, and Co, during calcination at the range of 200-600℃.

POSTER 112

Fabrication of superhydrophobic soil stabilizers derived from solid wastes applied for road construction: A review

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Keywords: Road construction, Soil stabilizer, Solid waste, Superhydrophobic

Abstract

The rapid increase in solid waste is one of the hot environmental issues due to the exponential global population growth and ever increasing urbanization. In order to achieve sustainable development, recycling of solid waste becomes a highly desirable target for humans. Solid wastes including geopolymer, biopolymer and synthetic polymer can be processed to produce nontraditional soil stabilizers that are able to replace the traditional ones in road construction. Although the traditional soil stabilizers can improve the mechanical properties of problematic soils, they cannot ensure an adequate amount of water resistance for the treated soils. High water content in the soil structure leads to soil erosion and a reduction in the quality of road construction. Therefore, this paper systematically reviews the recent literature studies on not only the mechanisms of soil stabilization and the current applications of soil stabilizers derived from solid wastes containing geopolymer, biopolymer, and synthetic polymer, but also the fabrication of superhydrophobic materials applied to soil stabilizers. Furthermore, the nontraditional soil stabilizers derived from solid wastes are expected to be fabricated into superhydrophobic ones via certain physical, chemical, and biological treatments. Finally, this review paper discusses the fabrication of new superhydrophobic soil stabilizers that will be available to be applied as future construction materials.

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POSTER 113

Enhancing Sustainability and Profitability in Urban Farming through Remote Farming Analytics

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Keywords: Sustainability, Agriculture, Internet of things.

Abstract

Remote Urban Farming Analytics has emerged as a promising approach for achieving sustainable and profitable urban farming practices. This study highlights the opportunity and significance of employing low-cost and ubiquitous sensors, internet connectivity, data mining techniques, and data visualization to enhance the accuracy and resolution of agricultural data, foster the generation of meaningful insights, and promote community engagement. The technical objectives of this project revolve around the development of a scalable Internet of Things (IoT) sensor package that enables users to efficiently evaluate environmental criteria such as temperature, turbidity, and more. The package stands out for its low-cost nature compared to existing market alternatives and its easy setup on drones, making it suitable for testing over lakes and other areas. The collected data is seamlessly transmitted through the internet and securely stored on the GE Predix cloud, enabling the creation of predictive models for future behavior analysis. The sensor package is designed with a user-friendly interface and lightweight construction, ensuring ease of use and flexibility. The solution encompasses real-time communication, connected sensors, community engagement, and can be employed in various environmental sections such as air, water, and soil. Moreover, it enables data transmission from any location, empowering researchers, practitioners, and stakeholders to collaborate and exchange knowledge. This research presents a significant advancement in remote urban farming analytics, paving the way for sustainable and profitable urban agricultural practices.

POSTER 114

ENVIRONMENTAL NOISE IN MACAO S.A.R.: INSIGHTS FOR NOISE POLLUTION MANAGEMENT

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Keywords: Noise management, Mitigation, Environmental policies, Legislation

Abstract

With the rapid urban development, Macao SAR has become one of regions with the with highest population density in the world, being characterized by excessive traffic and dense building aggregations. Noise has become one of the major environmental problems worldwide and particularity regions like Macao. Besides having an impact on human health and wellbeing, noise pollution is known to impact ecological ecosystems with unpredictable consequences for their conservation. Hence, it is paramount to have a baseline understanding of the current noise levels in Macao, how they have changed over and the critical locations that require improvements in noise management strategies.

This work relies on the publicly available data from DSPA (Macao Environmental Protection Bureau) monitoring stations concerning noise levels over the past decade. The main research goals were to: 1) characterize changes in noise levels from 2010 to 2021 during daytime and nighttime across the different Peninsulas (Macao, Taipa, and Coloane); and 2) associate changes in noise levels with potential factors such as local activities, number of residents/tourists, number of vehicles, among others.

Our work shows that overall noise in Macao SAR is above the recommended exposure levels, and that specific regions such as the Ecozones (Cotai) characterized by important biodiversity are being threatened by increasing noise levels over the past decade. We provide an important framework for future studies concerning noise monitoring and mitigation strategies.

POSTER 115

Effects of shipping noise on the marine medaka (Oryzias melastigma)

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Keywords*:* noise pollution, hearing loss, physiological stress, anxiety, reproduction

Abstract
Anthropogenic noise is currently recognized as a global environmental pollutant of marine environments, presenting significant challenges to the survival and well-being of aquatic organisms. Hence, it becomes critical to identify the types of anthropogenic noise that are causing negative effects on organisms such as fishes, to develop adequate conservation and management strategies. Moreover, limited information is known on the effects of chronic noise exposure on fish physiology and reproduction.

Marine medaka (*Oryzias melastigma*) has been established as a model for ecotoxicology research. In this study, we exposed adult medaka to shipping noise and tested the effects on auditory sensitivity, behavioural stress, and reproduction.

Our results point to noise-induced hearing loss of 8-12 dB sensitivity loss within the best hearing range 200-800 Hz and anxiety-like responses when animals are introduced in a novel environment. Exposure to increased noise levels also seem to impact the number of eggs laid, but due to the high variability this is still under investigation.

Such effects may compromise the species adaptation to the aquatic sensory environment, lead to behavioural stress with implications for social interactions, and disrupt reproduction patterns. This work contributes to our growing body of knowledge on the ecological effects of underwater noise on fishes, highlighting the importance of considering long-term exposures of this environmental stressor.

POSTER 116 (not yet confirm attendance)

A New Measurement of the Invasive Level of the Imported Red Fire Ant: a case study in a Wetland Park on Hengqin Island, China

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Keywords: Insects, Invasive, Pest assessment

Abstract

The imported red fire ant (*Solenopsis invicta* Buren) is a genus of *Solenopsis* in the Hymenoptera. It is one of the 100 most dangerous invasive organisms in the world and is also the target of domestic and inbound agricultural plant quarantine in China. S.invicta are highly aggressive, invasive, adaptive and reproductive. They can survive by nesting in areas such as agricultural fields, orchards, woodlands, parks, green spaces, and street trees, migrate in close proximity by flying in pairs, splitting nests, and flowing water, and complete long-distance dispersal by transporting lawn grass and flower seedlings with soil, dirt, compost, and agricultural equipment. Wherever they go, they pose a great threat to human and animal health, agricultural and forestry production, biodiversity and to human and animal health, agricultural and forestry production, biodiversity and public safety. The existing criteria for assessing the hazard level of red fire ants only take the colony distribution density of red fire ants as an assessment criterion. Our research aims to find a new measurement of the invasive level of the imported red fire ants by making multiple linear regression model: $y_i=b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_0$.$y_i$ refers to active worker density, x_1 refers to monthly temperature, x_2 refers to colony density, x_3 refers to thickness of litter leaf, x_4 refers to environmental data.

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POSTER 117

Insect Diversity in Zhuhai City, China: Review, Current Research Status, and Challenges

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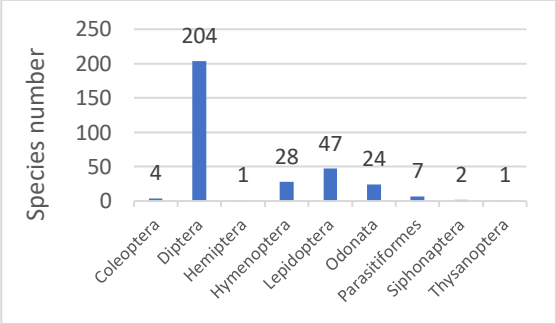
Keywords: Biodiversity, Zhuhai, Review, Taxonomy checklist

Abstract

Between 1970 and 2018, the World Wild Fund reported that the relative abundance of monitored wildlife populations globally declined by an average of 69%. As the global rate of species extinction continues to accelerate, biodiversity loss and ecosystem degradation pose significant risks to human welfare. As the most abundant group of organisms on Earth, insects form the basis of complex ecological food webs in agricultural, natural, and urban areas. In addition, insects can be utilized as bio-indicators in various fields, such as water quality monitoring and forest conservation. They also exhibit high diversity in urban ecosystems, making them valuable study subjects for ecological research. Zhuhai, the second largest port city in China after Shenzhen and one of the eleven cities in the Greater Bay Area has a unique geographical location and a well-developed urban community. However, research gaps in Zhuhai's biodiversity research and review exist, particularly regarding insects. To address this gap, we conducted a review of all formally published literature related to insect diversity in Zhuhai, utilizing the Web of Science, Google Scholar, and CNKI. A total of 28 valid papers were obtained, documenting 311 insect species in 8 orders and 28 families, with the largest proportion of 204 species in Diptera. At the same time, Zhuhai, as the nearest city in the Greater Bay Area to Macao, can take advantage of the mutual influence of ecosystems to establish a basis for insect diversity surveys in Macao and provide a reference for the biodiversity database of the Greater Bay Area, China, so as to better serve the biodiversity monitoring in China and provide a scientific basis for promoting the construction of national eco-civilization and ensuring ecological and biological security.



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