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UNIVERSIDADE DE MACAU
UNIVERSITY OF MACAU



科技學院
Faculdade de Ciências e Tecnologia
Faculty of Science and Technology

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2º Fórum de Investigação e Ensino Oceânicos
entre a China e os Países de Língua Portuguesa

2nd China and Portuguese-speaking Countries
Ocean Research and Education Symposium

(CPCORES)

澳門大學

Universidade de Macau

2023/10/12-13

12-13 de Outubro de 2023

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It is our great pleasure to welcome you all to the "2nd China and Portuguese-speaking Countries Ocean Research and Education Symposium (2nd CPCORES)", organized by the University of Macau.

This symposium is being held against the backdrop of the United Nations Decade of Ocean Science for Sustainable Development (2021-2030). The overarching goal of this global initiative is to advance ocean science and promote sustainable ocean utilization through international collaboration. As coastal nations located along the Atlantic and Indian Oceans, the ocean represents a vital natural resource for both China and Portuguese-speaking countries. At the same time, maintaining ocean health and environmental safety is a shared challenge facing us all.

Portuguese-speaking countries are important partners for China under the Belt and Road Initiative. Deepening ocean cooperation in research and education aligns well with the needs and priorities of China and Lusophone regions. Leveraging its unique position and longstanding connections with Portuguese-language institutions worldwide, University of Macau serves as an ideal platform to facilitate such exchanges.

With the theme of "Ocean Health and Safety", the symposium will bring together renowned ocean experts from China, Portugal, Brazil, Angola, Mozambique and other regions to discuss cutting-edge science, innovative theories and technologies in ocean science and technology. We aim to explore cutting-edge issues and opportunities for collaborative progress in sustainable ocean management and governance.

We hope that the insights and discussions at this symposium will help strengthen partnerships and inform targeted actions to address global ocean challenges. We wish all delegates a productive and rewarding experience in Macau.

Honorary Chair:

Prof. Rui P. Martins (University of Macau, Macao SAR, China)

Chair:

Prof. Jie Xu (University of Macau, Macao SAR, China)

Organizing Committee:

Prof. Jie Xu (University of Macau, Macao SAR, China)

Prof. Carlos Jorge Ferreira Silvestre (University of Macau, Macao SAR, China)

Prof. Zhongya Cai (University of Macau, Macao SAR, China)

Prof. Liang Gao (University of Macau, Macao SAR, China)

Prof. Huabin Shi (University of Macau, Macao SAR, China)

Conference Program

04



OCTOBER 11 2023

15:00 - 18:00

Registration

OCTOBER 12 2023

8:30 - 8:55

Registration

9:00 - 9:20

Opening ceremony

9:20 - 9:30

Photo taking

Ocean Health and Governance

Dake Chen

9:30 - 9:45

A Sustainable Blue Economy
Toward Carbon Neutrality

Minhan Dai

9:45 - 10:00

Ocean, society and cultural
anachronism

Ricardo Serrão Santos

10:00 - 10:15

Challenge and mitigation of coastal
hypoxia off the Greater Bay Area:
a physical and biogeochemical
coupling paradigm

Jianping Gan

10:15 - 10:30

Coffee Break

Climate Change and the Ocean

Ricardo Serrão Santos

10:30 - 10:45

The seas around China in a
warming climate

Fan Wang

10:45 - 11:00

Multi-stage Development within
Anisotropy Insight of an Anticyclone
Eddy in Northwestern South China
Sea in 2021

Dongxiao

11:00 - 11:15

Marine and meteorological disasters in
China: A perspective from three
oceans

Chunzai Wang

Marine Innovation and Blue Economy

Kehou Pan

11:15 - 11:30

LARSyS: Laboratory of Robotics and
Engineering Systems Activities on
Ocean Research and Education

José Santos-victor

11:30 - 11:45

Developments on Underwater
Robotics at the University of Macau:
The ORVIS AUV

Carlos Jorge
Ferreira Silvestre

11:45 - 12:00

Underwater Technology at USP and
Applications to Research on Marine
Environment Protection

Ettore de Barros

12:00 - 12:15

Marine surface robotics at the
University of Macau: trends and
challenges

Joel Oliveira Reis

12:15 - 14:00

Lunch



Conference Program

OCTOBER 12 2023

Climate Change and the Ocean

Wenju Cai

14:00 - 14:15

Transport and dispersion processes associated with runoffs and fronts in a river delta area

Meng Zhou

14:15 - 14:30

Evolution of Kuroshio shedding anticyclonic eddy in the South China Sea

Yan Du

14:30 - 14:45

Three-dimensional water exchanges in the shelf circulation system of the Northern South China Sea under climatic modulation from ENSO

Zhongya Cai

14:45 - 15:00

Impacts of Mindoro-Sibutu and Karimata Straits on South China Sea circulation and Indonesian Throughflow

Mingting Li

Ocean Health and Governance

Jianfang Chen

15:00 - 15:15

Coastal Blue Carbon: An Important Carbon Sink to Achieve the Carbon Neutrality

Hongbin Liu

15:15 - 15:30

Marine research in Portugal: main challenges and opportunities

Jorge Gonçalves

15:30 - 15:45

An uneven distribution of global marine chlorophyll a patches based on Seascape Heterogeneity Index

Huiwang Gao

15:45 - 16:00

The Top-down control of bacterioplankton in the coastal front off the Pearl River Estuary

Jie Xu

16:00 - 16:30

Coffee break

16:30 - 18:00

Discussion

Fei Chai

18:30 - 21:00

Banquet

OCTOBER 13 2023

Climate Change and the Ocean

Jianping Gan/
José Santos victor

9:00 - 9:15

Changing ENSO and impacts in a warming climate

Wenju Cai

9:15 - 9:30

Comparative Study on Rifting Processes and Lithospheric Structures in the South China Sea and the West Iberia Margins

Chunfeng Li

Conference Program

06



OCTOBER 13 2023

9:30 - 9:45	Wind field and surface ocean circulation in the Mozambique Channel: Perspectives from different estimations	Avelino Langa
9:45 - 10:00	Changes of the storm surge flooding hazard risk in Macao under sea level rise	Huabin Shi
10:00 - 10:15	Increased occurrences of consecutive La Niña events under global warming	Tao Geng
10:15 - 10:30	Attributing interdecadal variations of southern tropical Indian Ocean dipole mode to rhythms of Bjerknes feedback intensity	Guangli Zhang
10:30 - 11:00	Coffee Break	
	Ocean Health and Governance	Jorge Gonçalves
11:00 - 11:15	Isolating microalgae for carbon sequestration and their molecular responses to high CO ₂ exposure	Feng Chen
11:15 - 11:30	Anthropogenic riverine organic matter switch the Pearl River estuary from carbon source to carbon sink	Kedong Yin
11:30 - 11:45	Management of Angola's Marine Space: Perspectives and Challenges	Moisés Kajico Lucas
11:45 - 12:00	Pathways toward Ocean Carbon Neutrality-biological pump and phytoplankton	Jun Sun
12:00 - 12:15	Study the mechanism of hypoxia formation with online observation in the Changjiang River Estuary	Haiyan Jin
12:15 - 12:25	Closing	
12:25 - 14:00	Lunch	
14:00 - 16:00	UM visit tour	
18:00 - 21:00	Dinner	

OCTOBER 14 2023

Departure from Macao



🕒 **October 12 2023**

Session: Ocean Health and Governance

A Sustainable Blue Economy Toward Carbon Neutrality

Minhan Dai

Xiamen University

The oceans, seas, and coasts provide opportunities for a wide range of economic activities to take place, and today the ocean economy consists of an extensive network of interlinked established and emerging sectors. The oceans, seas, and coasts also offer a wide array of opportunities to mitigate CO₂ emissions, which can substantially contribute to reaching global and domestic carbon neutrality goals. Sustainable Blue Economy (SBE) and ocean-based carbon mitigation are tightly intertwined and connected. A sustainable ocean governance based on adaptive ecosystem-based integrated management approaches will be key to solving the current and ongoing climate and nature crisis while at the same time allowing for the further development of sustainable ocean economies.

We examined a suite of ocean-based solutions for carbon neutrality and identified issues hampering the application of these solutions. Also, we discussed the synergy between carbon neutrality and sustainable blue economy, including issues such as accounting systems of ocean industry. Besides, we considered how the reduction of marine plastics in the marine environment can and should be an integral part of an SBE. Finally, we addressed how changes in fishery governance can contribute to an SBE. Through thorough reviews, we put forth policy recommendations that would contribute to transforming the current ocean economy into an SBE that would contribute toward the carbon neutrality goals at the same time.

Ocean, Society and Cultural Anachronism

Ricardo Serrão Santos

University of the Azores, Portugal

The Ocean, if you like, the seas and oceans have always represented the most enigmatic, unfathomable and inaccessible, and therefore intangible and impregnable, part of Planet Earth.

Even today, in an analogy that seems forced and discrepant to me, it is promoted that we know the hidden face of the Moon or the surface of Mars better than the bottom of the oceans. The idea reflects our ignorance of our planet's largest "ecosystem".

The stability of the geological epoch in which human society and civilisations developed and prospered, the Holocene, gave humanity a sense of constancy and durability.

In this speech, I will address the thesis that until the 21st century, questions about the ocean were marked by a vision formed in the Renaissance and remained a cultural "meme" until the 20th century.

Hugo Grotius, a Dutch diplomat and jurist, published a small booklet in 1609 that has influenced the international conventions and law of the sea. He based his arguments on the assumption that "(...) if many hunt on land or fish in a river, the forest will be without game and the river without fish, which is not so in the sea" (...) "for which the sea loses nothing".

The ideas of the intangible "immunity" and "generosity" of the seas and oceans and their resources took their first steps and became an indelible meme in our culture.

The idea of "oceanic feeling", coined in the first half of the 20th century by French humanist and Nobel Prize winner Romain Rolland to describe the feeling of "unity, limitlessness and infinity", or the book by two American scientists published in 1954, "The Inexhaustible Sea", help us to understand how marine sustainability has been an unimportant, unconcerned issue rooted in our cultural and political edifice. A cultural anachronism.

It took the sight of the uncomfortable expansion of "floating marine plastics" for society and politics to start revising their sentiment towards the oceans and reflecting it in global policies, as scientists, but also artists, adventurers, activists and other "enlightened" laypeople have long demanded.

Challenge and mitigation of coastal hypoxia off the Greater Bay Area: a physical and biogeochemical coupling paradigm

Jianping Gan

Hong Kong University of
Science & Technology

Like in many coastal oceans around the world, the waters off Guangdong-Hong Kong-Macau Greater Bay Area (GBA) are affected by persistent and increasing eutrophication and hypoxia. This deteriorating situation results in other ecosystem disruptions. The grand OCEAN_HK project (<https://ocean.ust.hk/>), through coupled physical-biological-chemical observational and modeling studies over the interactive river-estuary-shelf (RES) system in the regions, aims to determine sources and sinks of nutrients, their biogeochemical and physical controls on the eutrophication/hypoxia in the RES waters off the GBA. Unlike conventional biogeochemistry consideration alone, we found that biogeochemical substances and processes are necessary conditions for hypoxia formation, while they become sufficient conditions by combining with the unique hydrodynamics in the coastal transition zone (CTZ) between the estuary and adjacent shelf. The distinct hypoxic centers off the GBA waters are mainly induced by oxygen consumption of eutrophication-induced organic matter in the CTZ. Nutrient-rich plume waters with vortex-induced long residence time in CTZ provides a favorable coupled physical-biogeochemical hub for the formation of hypoxia. We holistically provide scientific evidence to explain where, when and how hypoxia occur, predict its long-term trend under changing climate, and provide potential mitigation scheme to tackle this marine environmental challenge we are facing globally.

Session: Climate Change and the Ocean

The seas around China in a warming climate

Fan Wang

Institute of Oceanology,
Chinese Academy of Sciences

Anthropogenic forcings have led to multifaceted changes in the seas around China, which include the Bohai, Yellow, East China and South China Seas, affecting the functions and services they provide. In this Review, we synthesize physical, biogeochemical and biological findings to understand how the seas around China have changed and are projected to change under a warming climate. The average surface temperature of these seas increased by 0.10-0.14 °C dec⁻¹ over 1950-2021. Meanwhile, the annual frequency and average intensity of marine heatwaves increased by 1-2 dec⁻¹ and 0.1-0.3 °C dec⁻¹ since the 1980s, respectively. Terrestrial input has increased nutrient concentrations and composition changes in coastal waters. These warming and nutrient changes have increased the severity of hypoxia and acidification, leading to complex changes in primary productivity. Changes to marine organisms such as plankton, benthos and fish are also apparent, including the northward invasion of warm-water species and miniaturization. These observed changes are projected to persist into the future. These coupled physical-ecological changes highlight the need for strengthened multidisciplinary oceanographic research in the seas around China.



Multi-stage Development within Anisotropy Insight of an Anticyclone Eddy in Northwestern South China Sea in 2021

Dongxiao Wang

Sun Yat-sen University

Mesoscale eddies help regulate ocean energy cascades. Eddies deformation influences barotropic instability, which represents kinetic energy transfer between scales; however, the barotropic instability structure has not been well studied. We investigated an intra-thermocline eddy (ITE) and developed a novel anisotropic method to examine the horizontal barotropic instability. The development of the ITE was monitored using a state-of-the-art autonomous underwater vehicle from May to July 2021. A thermal front at 300 m depth was observed on the western side of the ITE. Based on anisotropic theory, the kinetic cascade was separated into source/sink and anisotropic terms. The anisotropy contained information regarding the asymmetry, orientation, and mean-flow feedback of the eddy. Barotropic instability is the main source of ITE kinetic energy and is dominated by anisotropic instability. Following a shape and anisotropy change, the ITE extracts the mean-flow kinetic energy from the mean-flow shear while stationary and mean-flow stretch when moving eastward.

Marine and meteorological disasters in China: A perspective from three oceans

Chunzai Wang

South China Sea Institute of Oceanology,
Chinese Academy of Sciences

The three-ocean (Pacific Ocean, Indian Ocean, and Atlantic Ocean) interaction is currently a hot and cutting-edge issue in international marine and climate research. This talk, starting from a perspective of the three-ocean interaction, reveals and understands their impacts and physical mechanisms on marine and meteorological disaster events in China, especially heavy rainfall and flooding, marine heatwaves, and extreme ENSO (El Niño-Southern Oscillation) events. The advancement of research on the three-ocean interaction not only enriches and improves the theory of global ocean-atmosphere interaction but also enhances the prediction level of marine and meteorological disasters, thereby strengthening China's ability to respond to marine and meteorological disasters.



Session: Marine Innovation and Blue Economy Developments on Underwater Robotics at the University of Macau: The ORVIS AUV

Carlos Jorge Ferreira Silvestre

University of Macau

In this presentation, I will discuss the latest advancements in underwater robotics at the University of Macau, focusing on the ORVIS autonomous underwater vehicle (AUV) funded by the FDCT. The ORVIS AUV is designed for shallow water operations in Macau waters, with specific objectives including precise shallow water bathymetry, marine biodiversity studies, underwater structural inspections, assessment of human impact on marine environments, and detection and localization of toxic spills, among others. The equipment onboard the ORVIS AUV includes a comprehensive multi-sensor suite comprising a Multibeam Imaging Sonar and a Doppler Velocity Log. Additionally, it is outfitted with essential navigation sensors such as an Inertial Measurement Unit, GPS Unit, Depth Sensor, and Sonar Altimeter. Anticipated mission requirements have driven the development of algorithms for high-precision bathymetry and seabed mapping utilizing cost-effective multibeam imaging and Doppler velocity log sonars. Moreover, the AUV features innovative nonlinear trajectory tracking and path-following controllers. These incorporate bottom-following and obstacle avoidance functionalities, enabling the vehicle to achieve accurate bathymetry with complete seabed coverage in target areas, even when faced with unexpected static or dynamic obstacles. The vehicle's shape and weight distribution have been optimized to balance open-loop stability against closed-loop maneuverability. This balance is achieved while maintaining an affordable power consumption, catering to the various mission types envisioned.

Underwater Technology at USP and Applications to Research on Marine Environment Protection

Ettore de Barros

Universidade de São Paulo (USP), Brazil

This work presents a proposal for marine environment monitoring, and recent results produced at the Unmanned Vehicles Laboratory (LVNT-USP).

The main focus of the LVNT-USP is on research and development of unmanned marine vehicles and the application of those vehicles to marine environment monitoring and inspection of underwater structures. In particular, this presentation highlights an application related to marine environment mapping- "The Underwater Habitat Mapping Program for Marine Protected Areas, PROMAP". This project focus on the development of methods for mapping underwater habitats and identifying ecosystems to be managed in the marine protected areas located in the São Paulo state coast. The "PROMAP" is planned to be executed in three phases: a) construction of a prioritization model of marine areas, b) mapping of sea bed habitats in target areas, and c) development of ecosystem-based management models. The participation of the LVNT-USP is expected to occur in the second phase, using mainly its ROV to collect sea bed images. Tests using the AUV and a new hybrid vehicle which merges the ROV and AUV modes are also considered in this phase.

In such kind of a mission, the self-localization capability of unmanned underwater vehicles can bring enhancements. Therefore, this work also presents some recent results on sensor fusion techniques applied to the navigation system alignment and UUV trajectory estimation. Results on alignment methods applied to the marine vehicle in mooring and different maneuvering conditions were compared in field tests. In addition, a trade-off between sensitivity and robustness was used to tune a sensor fusion tool and produced satisfactory estimates of the underwater vehicle trajectory in field tests.



Marine surface robotics at the University of Macau: trends and challenges

Joel Oliveira Reis

University of Macau

In this talk, we will review the latest development in control of surface vehicles at the University of Macau, focusing on the DELMAC Autonomous Surface Craft, a fully instrumented twin-engine boat designed for bathymetric surveys and coastal surveillance, featuring advanced navigation systems that include LiDAR and real-time kinematic positioning. A brief historical overview of the marine vessel industry will be presented to better understand our present, in particular within the context of the Greater Bay Area, followed by the examination of some of the current trends and challenges, both theoretical and practical, that go well beyond addressing the need to get to places quickly, for instance, how to generate intelligent onboard decision-making skills, how to leverage automatic weather monitoring systems, among others. The continuous advances in digitalization in the maritime industry have been enabling an expanded access to and use of uncrewed marine surface vessels. Scientists and engineers, through the adoption of innovative technology, are now gradually metamorphosing these systems into a range of new products and services, intending to help societies and organizations combining their resources, leading to more effective and synergetic operations, e.g., waterborne transportation, and offshore drilling and energy. Indeed, the increasingly profitable offshore market, as well as the need for inspection, repair and maintenance of critical marine infrastructures and assets, reflects on the myriad of modern applications exploiting autonomous surface vehicles, from collecting ocean data, to studying marine environments, to carrying scientific payload for conducting ocean research.

Session: Climate Change and the Ocean Three-dimensional water exchanges in the shelf circulation system of the Northern South China Sea under climatic modulation from ENSO

Zhongya Cai

University of Macau

Using the numerical calculations of exposure time (θ), this study investigated the three-dimensional characteristics of water exchanges associated with the coastal-shelf circulations of the Northern South China Sea (NSCS). The circulation connectivity and its interannual variability under the modulation of El Niño Southern Oscillation (ENSO) were investigated. The θ gradually increased from approximately 50 days over the outer shelf to more than 150 days in the shallower coastal seas with the Beibu Gulf displaying a significantly longer θ (approximately 300 days). The Beibu Gulf played an influential role in the water exchange that had a contribution of over 30% to θ in the most regions. In the water column, the vertically contrasting cross-isobath transport did not induce a significant vertical difference of θ , except over the shelf neighboring the 200m isobath and to the southeast of the Hainan Island with approximately 1 month longer θ in the surface than that of the deep water. Analysis revealed a clear modulation from ENSO on water exchange, wherein El Niño and La Niña years displayed symmetrical morphologies in θ distribution anomalies, albeit with varying intensities. During El Niño years, the weakened southwestward shelf current increased θ and the shelf water was less likely to reach the Beibu Gulf, and once arrived, these waters were trapped inside to elongate θ . In contrast, during La Niña years, the strengthened southwestward shelf current shortened θ and more shelf waters were transported away from the NSCS by an intensified southwestward shelf current.



Impacts of Mindoro-Sibutu and Karimata Straits on South China Sea circulation and Indonesian Throughflow

Mingting Li

Sun Yat-sen University

Based on a high-resolution ($0.1^\circ \times 0.1^\circ$) regional ocean model covering the entire North Pacific and the South China Sea (SCS), through a set of sensitivity experiments with closed straits and passages this study investigates the impact of key straits/passages of the Maritime Continent on the SCS circulation and the Indonesian Throughflow (ITF). Closing the Sibutu Strait produces significant impacts on the SCS interior circulation patterns: the Luzon transport into the SCS is reduced by 75%, and the Mindoro-Sibutu deep throughflow outflow is reversed opposite, flowing into the SCS. In contrast, no significant changes occur over the shallow Sunda shelf, which is primarily driven by local monsoon winds. The impact of closing Karimata Strait is limited to the Sunda shelf and the Java Sea. Both the Sibutu and Karimata Straits affect the Makassar ITF transport and variability. The Sibutu Strait controls the SCS freshwater plugging into the ITF in the upper 200-m depth, whereas the Karimata Strait significantly inhibits a more limited surface layer, upper 50 m of the Makassar throughflow. Closing both Sibutu and Karimata Straits, the southward Makassar flow transport, which is fed from the Mindanao Current, is increased by ~ 3 Sv. And its variability is controlled completely by the Mindanao Current inflow.

Session: Ocean Health and Governance

Coastal Blue Carbon: An Important Carbon Sink to Achieve the Carbon Neutrality

Hongbin Liu

Hong Kong University of
Science and Technology

We have just experienced the hottest summer ever. It is widely accepted that the cause for global warming is the anthropogenic emission of greenhouse gases, of which CO₂ contributes more than half of the greenhouse effect. Ocean is the largest carbon pool on Earth, contributing about half of the primary production and uptake $\sim 1/3$ of carbon from human emissions. Blue Carbon refers specifically to the coastal wetland ecosystems, which mainly include mangrove, seagrass, and salt marsh. These are the most productive ecosystems that sequester and store a great quantity of carbon. However, human impact and global climate change has put great pressure on these ecosystems. For example, long-term exposure of seagrass meadows to nutrient enrichment can lead to depressed growth, reduced productivity, less reproductive activities, increased tissue nitrogen metabolism levels, and decreased carbon reserves. How can we stop that and mitigate that? I will give a few examples of recent research in this presentation.



Marine research in Portugal: main challenges and opportunities

Jorge Gonçalves

University of Algarve, Portugal

Marine research in Portugal has been growing exponentially in the last decades. The increase in the number of Universities, Research Centres and in their international connections, has promoted the scientific culture needed to boost the creation of new knowledge about the oceans. In the last United Nations Ocean conference convened in June 2022 in Lisbon, Portugal as an oceanic nation (3rd EEZ in Europe and 21st in the world) has assumed a relevant role on achieving marine conservation goals. Consequently, marine research has been engaged in promoting acquisition of more accurate oceanic open data and more effective and clear metrics to protect our oceans. Turning Marine Protected Areas in more effective tools to promote the health of the oceans is currently one of the most challenging goals.

An uneven distribution of global marine chlorophyll a patches based on Seascape Heterogeneity Index

Huiwang Gao

Ocean University of China

Due to its uneven distribution, the spatiotemporal variations in Chl-a patches across global marine surface remains unclear. In this study, we utilize a fusion of multi-satellite data to categorize global marine Chl-a into five distinct patch types based on varying concentration levels. Research has uncovered that the global marine Chl-a patch area exhibits an obvious variation, marked by desertification in the Northern Hemisphere and greening in the Southern Hemisphere. The spatial scale of Chl-a patches shows an inverse correlation with its concentration, ranging from approximately 100 to 2000 km. However, the interannual trend of Chl-a patch spatial scale is inconsistent with the area. To quantify the uneven distribution of Chl-a patches, we gauge the heterogeneity of global marine Chl-a patches (including patch density, connectivity, and diversity) by developing a set of index (the Seascape Heterogeneity Index, SHI). Our analysis unveils significant spatiotemporal fluctuations in Chl-a heterogeneity. Temporally, there is an increase followed by a subsequent decrease, with the peak heterogeneity in 2011. Spatially, heterogeneity progressively intensifies from offshore to nearshore regions, and from low to high latitudes. Moreover, the variability in Chl-a heterogeneity is regulated by climatic factors, with co-influencing mechanisms of sea surface temperature and horizontal mixing by mesoscale processes.

Abstract

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The Top-down control of bacterioplankton in the coastal front off the Pearl River Estuary

Jie Xu

University of Macau

An investigation was conducted to examine the regulation of protist grazing and viral lysis on bacterial mortality by physical processes along an environmental gradient in coastal waters off the Pearl River Estuary in 2016, in order. Our results showed that the density gradient in the frontal zone and the pycnocline played a significant role in regulating the top-down control of bacterioplankton in the coastal front off the Pearl River Estuary. The highest bacterial growth rate and the highest contribution of protist grazing to bacterial mortality occurred, as well as the lowest contribution of viral lysis to bacterial mortality, in the frontal zone. Spatial variability in bacterial growth rate and the role of protist and viruses in mediating bacterial mortality was related to the presence of the density gradient in the front. The density gradient aggregated phytoplankton and bacterial cells, enhancing their biomass in the coastal front. Meanwhile, high phytoplankton biomass provided more labile organic carbon to bacterioplankton in the front, improving bacterial growth. Hence, the density gradient improved bacterial abundance, consequently enhancing the efficiency of protist grazing and its contribution to bacterial mortality. Our findings implied that the density gradient improved bacterial carbon converted to high trophic levels and altered carbon flow in microbial food web in frontal zone.

 **October 13 2023**

Session: Climate Change and the Ocean

Changing ENSO and impacts in a warming climate

Wenju Cai

Laoshan Laboratory

Under greenhouse warming, majority of latest climate models project a weakening in the Walker Circulation and an increase in sea surface temperature (SST) variability associated with extreme of El Nino-Southern Oscillation (ENSO), amid warming background SSTs. Model simulation of the 20th century suggests that ENSO has increased by greenhouse warming. The projected changes have important implications. In this presentation I will discuss the impacts on tropical-extratropical interactions, variability of tropical North Atlantic SST, extreme subtropical high events, and Southern Ocean warming, Antarctic ice shelf, and global economic growth.



Comparative Study on Rifting Processes and Lithospheric Structures in the South China Sea and the West Iberia Margins

Chunfeng Li
Zhejiang University

In this China-Portugal cooperative research on continental margin evolution, we compared the South China Sea (SCS) continental margin with the classic magma-poor examples of West Iberian. We imaged the deep seismic velocity structure of continental ocean transition zone (COT), and compared the structures of tectonic domains and breakup unconformity between these two margins. The COT in the northeastern SCS coincides well with a Moho reflection gapping zone, where the V_p and V_s velocity structure obtained from OBS data shows a high-velocity anomaly zone of ~70-km wide and ~4-km thick, likely attributable to serpentinization of upwelled uppermost mantle. Both seismic velocity structures and gravity anomalies indicate that mantle upwelling/serpentinization could be the most severe in the northeasternmost SCS. In contrast, the western Iberian COT is wider (100 km) and is composed of serpentinized/exhumed mantle with limit amount of syn-rift gabbro intrusive bodies. This suggests that the lower crust was weak and played a dominant role in the continental breakup. Joint geological field trips were carried out in both East China and Portugal coasts to gain better understanding of the continental margin tectonics.

Wind field and surface ocean circulation in the Mozambique Channel: Perspectives from different estimations

Avelino Langa
Universidade Eduardo Mondlane,
Mozambique

The ocean surface circulation depends on the local or regional wind regime. Hydrodynamic models usually apply wind field, ocean currents, as well as temperature and salinity data as initial and boundaries conditions. Currently, there are several datasets available, which can be used for forcing regional oceanic models. However, accurate wind fields, ocean currents, temperature and salinity datasets are required, to enable the proper representation of these processes by the model. In this study, an assessment is made for three different datasets derived from scatterometers (wind), altimetry (currents) and reanalyzes (wind, currents, temperature and salinity) in the Mozambique Channel. Generally, atmospheric circulation in the Mozambique Channel is dominated by semiannual and annual wind field cycles, however on a local scale there is noticeable differences in the magnitude of wind velocity between the three analyzed datasets. For instance, in the Northern region of the Mozambique Channel the estimated magnitude of wind stress is higher for CCMP and QSCAT than the ASCAT. In the central part of Mozambique Channel, the seasonal pattern of the wind stress is similar for both CCMP and ASCAT, while QSCAT shows no seasonal variation. The analysis suggest that CCMP represents better the wind field in the Mozambique Channel. For the oceanic surface current, the analyzed datasets show strong currents during the winter in the Northern and Southern limits of the Mozambique Channel, but SODA and NCEP underestimate the magnitude of the current, when compared with circulation derived from altimetry. It is important to highlight that SODA have a better representation of the surface circulation than NCEP. The vertical profiles of temperature indicate a deeper mixed layer during the winter season for all dataset (CARS2009, SODA and NCEP), however SODA is in better agreement with climatology dataset from CARS2009. Differences were noted on salinity vertical profiles between three datasets, mainly within the first 200-meter depth. These differences found in wind field, currents, temperature and salinity, may have implications if applied in oceanic numerical models.



The observation, mechanisms and biological effect of mesoscale eddies' deformation

Chunhua Qiu

Sun Yat-sen University

Mesoscale eddies play vital roles in ocean circulation and are important in energy cascades between large-scale ocean circulation and dissipate scales. Their deformation easily produces submesoscale processes with small spatial and temporal scales, which was difficult to quantify by using traditional instrument. In the present talk, the deformation characteristics were observed by satellite and automatic unman vehicles. We observed a three-dimensional deformation, defined a vortex-deformation index, and then revealed its mechanisms by using high resolution numerical model. Finally, we present the deformation effect on heat, salt and chlorophyll-a concentration distributions.

Changes of the storm surge flooding hazard risk in Macao under sea level rise

Huabin Shi

University of Macau

Under sea level rise and climate change, Macao, a typical small-scale low-lying and densely-populated city, is facing an increasing risk of storm surge flooding. The tropical cyclones Hato (1713) in 2017 and Mangkhut (1822) in 2018 both caused catastrophic damage to Macao. It is critical to assess the vulnerability of Macao to storm surge in the future under sea level rise and climate change. In this study, a hazard-risk-level assessment framework is proposed for the future hazard management in Macao. In the framework, an index system of hazard assessment is set up, which includes indexes of hazard, social vulnerability, and disaster-bearing capability. The weights of the indexes are determined utilizing both subjective and objective methods. The hazard-risk levels of all the sub-districts of Macao in Hato (1713) as well as the typhoons with the same track and intensity but under different rising heights of sea level are determined.

Increased occurrences of consecutive La Niña events under global warming

Tao Geng

Laoshan Laboratory

Unlike most El Niño events that occur sporadically and peak in a single winter, La Niña tends to develop after an El Niño and last for two years or longer, referred to as multi-year or consecutive La Niña events. Relative to single-year La Niña, consecutive La Niña features meridionally broader easterly winds hence a slower heat recharge of the equatorial Pacific, enabling the cold anomalies to persist, exerting prolonged impacts on global climate, ecosystems, and agriculture. However, how greenhouse warming might affect multi-year-long La Niña events remain unknown. Here, using latest climate models under future greenhouse gas forcings, we find an increased frequency of consecutive La Niña ranging from $19\pm 11\%$ in a low emission scenario to $33\pm 13\%$ in a high emission scenario, supported by an inter-model consensus stronger in higher emission scenarios. Under greenhouse warming, a mean-state warming maximum in the subtropical northeastern Pacific enhances the regional thermodynamic response to perturbations, generating anomalous easterlies that are further northward than in the 20th century in response to preceding El Niño warm anomalies. The sensitivity of the northward-broadened anomaly pattern is further increased by a warming maximum in the equatorial eastern Pacific. The slower heat recharge associated with the northward-broadened easterly anomalies facilitates the cold anomalies of the first-year La Niña to persist into a second-year La Niña. Thus, climate extremes as seen during historical consecutive La Niña episodes are likely to occur more frequently in the 21st century.



Attributing interdecadal variations of southern tropical Indian Ocean dipole mode to rhythms of Bjerknes feedback intensity

Guangli Zhang

Sun Yat-sen University

The changes in the intensity of the southern tropical Indian Ocean dipole mode (STIOD) are investigated using observations and the Community Earth System Model Large Ensemble (CESM-LE) project in this study. The positive STIOD is characterized as cold SST anomalies over the tropical southeastern Indian Ocean (SEIO) and warm SST anomalies over the southcentral Indian Ocean (SCIO), which peak in boreal summer. It is suggested that the intensity of interannual variability in the STIOD experienced prominent interdecadal changes from 1970 to the present. The STIOD was relatively weak before the late 1980s, while it is enhanced significantly during the late 1980s to early-2000s and displayed some decrease in the intensity after the early -2000s. As an important generation mechanism, changes in the strengths of the Bjerknes feedback between the SCIO and SEIO mainly contribute to the variations of the STIOD intensity. The changes in Bjerknes feedback are associated with the variations in climatological mean states over the tropical Indian Ocean. The warmer climatological SST strengthens the efficiency of the SEIO SST in driving wind. On the other hand, the combined effects of the Indonesian Throughflow and surface climatological zonal winds alter the mean thermocline depth over the SEIO, contributing to the variations in the relationship between the thermocline depth and SST anomalies in situ. Two sets of historical and RCP8.5 simulations from CESM1-LE with 35 ensemble members are analyzed to confirm the roles of mean state changes on the intensity of interannual variability of STIOD.

Session: Ocean Health and Governance

Isolating microalgae for carbon sequestration and their molecular responses to high CO₂ exposure

Feng Chen

University of Maryland Center for Environmental Science, USA

Certain microalgal species can grow under high CO₂ conditions and they hold the potential for tackling climate change by sequestering CO₂ produced by power plants and other industries. Here we show how to select suitable algal species or strains for carbon sequestration and understand their responses to the high CO₂ level (10%) at the molecular level. A community-based approach was used to enrich CO₂-tolerant microalgae from a local water source. During the incubation process, changes in bacterio- and phytoplankton communities were monitored. At the end of CO₂ enrichment, green algae *Scenedesmus* species dominated the algal community. Isolated *Scenedesmus* strains are able to grow rapidly with high CO₂, wastewater, chicken manure nutrient, etc. The growth of algae also increased alkalinity and pH in the culture which can lead to additional carbon sequestration via the formation of CaCO₃ precipitate. To understand how *Scenedesmus obliquus* responds to 10% CO₂ exposure at the molecular level, we applied time-resolved transcriptomics (2, 12, 24 and 72 hrs) to investigate differential gene expression of the alga. Certain genes responsible for light-harvesting, chlorophyll synthesis, and carbon fixation (i.e. *rbcS*) were up-regulated at 10% CO₂, and these functional responses are consistent with the increased photosynthesis efficiency and algal biomass under 10% CO₂. Key genes like RuBisCO (*rbcl*) and carbonic anhydrase in carboxysomes did not respond actively to 10% CO₂. *S. obliquus* responded quickly (2 hr) and became adaptive within 12 h when exposed to 10% CO₂.

Session: Ocean Health and Governance

Anthropogenic riverine organic matter switch the Pearl River estuary from carbon source to carbon sink

Kedong Yin

Sun Yat-sen University

The traditional view is that terrestrial organic matter exported from rivers into the ocean is a carbon source in estuaries based on higher carbon to nitrogen (C:N) ratio of terrestrial organic matter than marine phytoplankton organic matter (~7:1). Human population has rapidly increased in last few decades, particularly in coastal regions, which leads to an increase in organic matter in rivers. Due to the higher nitrogen content of organic matter input by humans compared to natural sources, the carbon to nitrogen ratio of river organic matter will decrease. When it is below 7:1, terrestrial organic matter will transform from a carbon source to a carbon sink in the estuarine and adjacent coastal waters, thus having a significant impact on the carbon cycle and carbon flux in the nearshore waters. We hypothesize that riverine organic matter in the Pearl River estuary has switched the estuary to the carbon sink from the carbon source. Our investigation started in the pristine section (a National Nature Reserve) of the Xijiang River (a west branch of the Pearl River), took samples along the section passing through urban cities and farmlands and ended at the river gate at the head of the estuary. The results show that the C:N ratio of organic matter is 12:1 in the pristine section in the Pearl River and decreased in the river passing through urban cities and reached to 5.0:1 at the upstream head of the estuary. Organic carbon flux from the Pearl River to the sea is estimated to be about 8.0×10^{11} g/y. According to the C:N ratio of 12:1, it is estimated that the organic matter would produce a carbon source of 2.8×10^{11} g C/y in the receiving coastal sea. However, when the C:N ratio of the Pearl River organics is changed to 5.0:1, the organic matter would generate a carbon sink of 2.2×10^{11} g C/y. This finding shows that human influenced riverine organic matter has switched the receiving coastal water from a carbon source to a carbon sink. There is a great need to re-evaluate the traditional view that "terrestrial organic matter is the carbon source", which is important for revising the global carbon budget.

Management of Angola's Marine Space: Perspectives and Challenges

Moisés Kajico Lucas

Universidade Agostinho Neto (UAN), Angola

Angola has a variety of coastal-marine ecosystems (mangroves, sandy beaches, dunes, among others). Its coastline extends for approximately 1650 km, covering seven provinces (Cabinda, Zaire, Bengo, Luanda, Cuanza-Sul, Benguela and Namibe). The Angolan government recognizes that marine ecosystems are an essential component of the system that supports life on the planet, and is an asset that presents key opportunities for Sustainable Development. However, the lack of formal protection of key marine and coastal ecosystems is a cause for concern. The objective of this article is to present the new challenges and strengths of the Angolan government in the management of the sea and the coast of Angola. In this context, the Marine Spatial Planning Plan stands out, which opens an environmental perspective and establishes actions and measures for Marine Spatial Planning. Projects related to management, conservation, benefit sharing, scientific research, stakeholder engagement, awareness and monitoring of sea resources are defined here. For this purpose, the National Strategy for the Sea of Angola 2030 was created, which defines a set of strategic objectives that fundamentally aim to contribute to the improvement of social well-being, through the economic valorization of maritime space, its resources and natural values, in an integrated and sustainable way. In addition to making the marine space productive, healthy, accessible and safe, it is intended to be economically developed and socially fair for the benefit of all users, taking into account the socioeconomic uses and ecological functions of the ocean.



Pathways toward Ocean Carbon Neutrality – biological pump and phytoplankton

Jun Sun

**China University of
Geosciences, Wuhan**

In recent years, China is facing the dual carbon target and pressure of "carbon peak by 2030 and carbon neutrality by 2060". Carbon neutrality includes natural and artificial carbon sink processes, and the ocean is an important site for carbon neutrality in the future. This paper gives a brief description of 6 pathways for future ocean carbon neutrality. They are: biological pump; coastal blue carbon; fisheries carbon sink; microbial carbon pump; artificial marine ecosystem carbon sink; estuary de-eutrophication with carbon sequestration, etc.

Study the mechanism of hypoxia formation with online observation in the Changjiang River

Haiyan Jin

**Second Institute Of Oceanography,
Ministry of Natural Resource**

Typical seasonal hypoxia systems was located off the Changjiang Estuary in summer. It is one of the largest coastal hypoxic systems in the world. The hypoxia formation is related to the diffusion of Yangtze River, water stability and strength of stratification, upwelling, water invasion of Taiwan warm current, nutrient supply and supply of a large amount of organic matter etc. In brief, suitable hydrological conditions(strong stratification) , sufficient nutrient supply and large amount of organic matter input formed and maintained the summer hypoxia off Changjiang Estuary. To investigate and monitor the hypoxia processes, in previous work, we relied more on ship-based surveys, and now more online technology is used in hypoxia monitoring. In this study, we conducted the cruise, combined with the remote sensing means to obtain the distribution of the key parameters such as temperature, salinity, chl a, nutrient, DO etc. Besides, buoys with sets of sensors on different depth layers (surface, water column, bottom) were deployed in the study area to get the timeseries observation data. Sensors including temperature, salinity, DO, pH, chl a and nitrate are attached on the buoy for online monitoring of the formation and development history of hypoxia in the Yangtze Estuary. The online observation system also recorded the relevant changes of these key parameters before and after the typhoon.

CONFERENCE VENUE INFORMATION

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VENUE

The venue of 2nd CPCORES is in the N1 Multi-function Hall (G008, G014 and G018), University of Macau, Avenida da Universidade, Taipa, Macao SAR, China



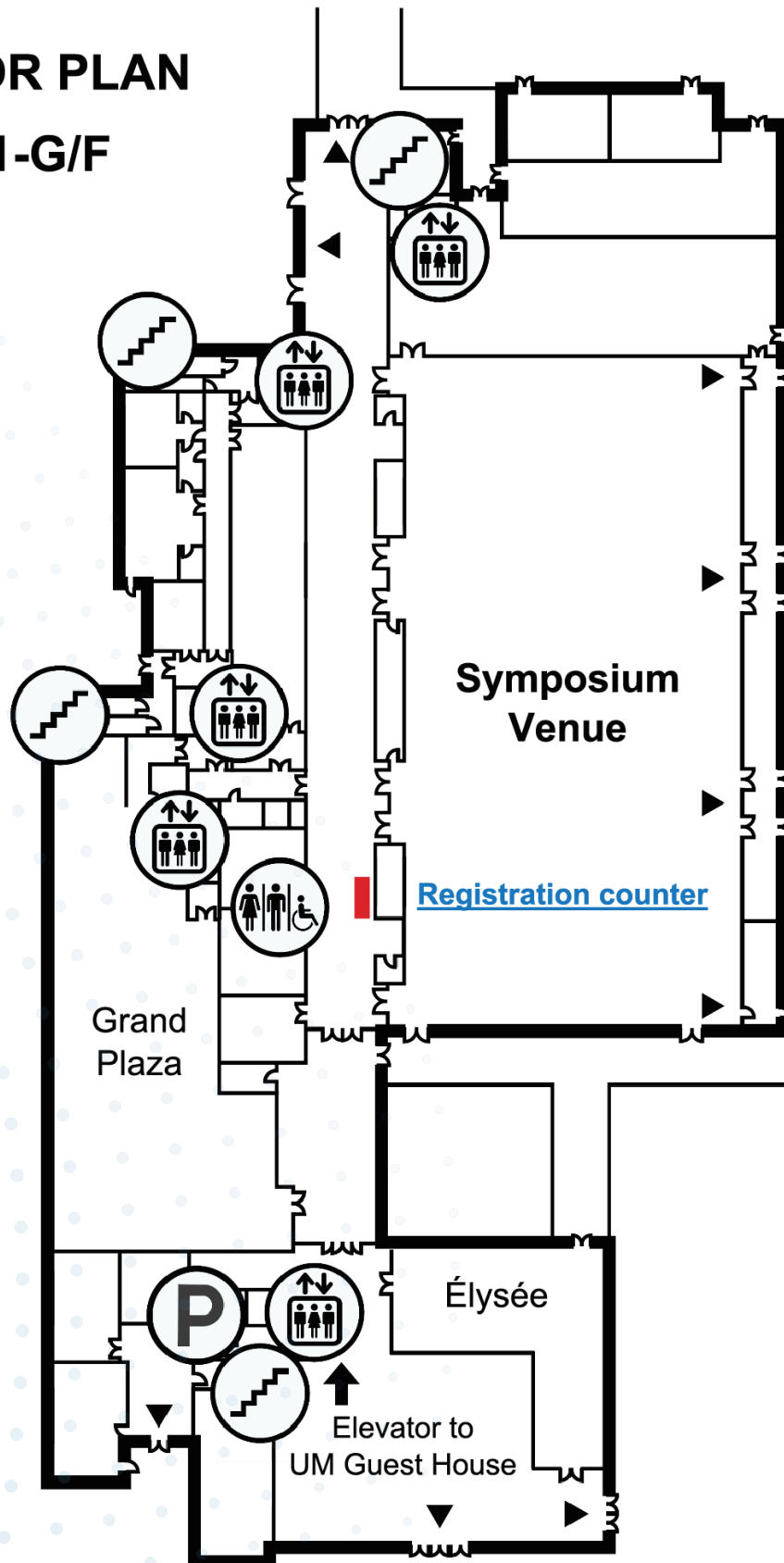
MAP

UM Campus map is available at <https://maps.um.edu.mo/>





FLOOR PLAN N1-G/F



Bus Stop UM / UNIVERSITY HALL ↓



BUS

Public buses operate frequently throughout Macau, Taipa, and Coloane. Buses have onboard stop notifications in Cantonese, Portuguese, Mandarin and English.

Price: MOP 6.00 in cash / MOP 3.00 with a Macau Pass.

There are several buses to the University of Macau: 71/71S/72/73/73s and a night bus N6.

The nearest bus stop to the symposium venue and UM Guest House is UM / UNIVERSITY HALL.

You can check bus routes and real-time locations at <https://www.dsat.gov.mo/bus/site/busstopwaiting.aspx?lang=en>



TAXI

The taxi in Macau is in black with a cream roof. For radio taxi service, please call +853 8500 0000 / +853 2828 3283.

There is also a special radio taxi service, which the vehicle is either in blue or red in colour. For special radio taxi service, please call: +853 2881 2345, visit <http://macaotaxi.com/en/>, download mobile app "Macau Taxi" or scan the QR code on the right.

Price: Base price (first 1.6 km) MOP 19.00, additional MOP 2.00 for each 260 m afterwards. Extra fees: Taxi waiting fee is MOP 2.00 for every minute, Luggage storing fee is MOP 3.00 per luggage. Additional fee may be charged based on boarding and arrival locations. See

<http://macaotaxi.com/en/%E6%94%B6%E8%B2%BB%E6%A8%99%E6%BA%96/> for more detailed information.



Boarding From	Estimated Time	Estimated Price
Macau International Airport / Taipa Ferry Terminal 澳門國際機場 / 氹仔客運碼頭	20-30 min	MOP 72-92
Outer Harbour Ferry Terminal 外港客運碼頭	30-40 min	MOP 108-129
Zhuhai-Macao Artificial Island of Hong Kong-Zhuhai-Macao Bridge 港珠澳大橋珠澳口岸人工島	40-50 min	MOP 138-164
Border Gate / Qingmao Port 拱北口岸 / 青茂口岸澳門邊檢大樓	35-45 min	MOP 120-143
Macao Port Zone of Hengqin Port 橫琴口岸	25-30 min	MOP 77-92



UM GUEST HOUSE 聚賢樓

Located in N1, the exquisitely furnished UM Guest House provides a comfortable and quiet environment. All guest rooms will be equipped with full hotel amenities, and will provide guests with modern, simple, charming and stylist accommodation experience.



CHECK-IN

1. Kindly approach the UM Guest house reception at 2/F of N1 Building for checking in (phone no.: +853 8822 3000). It is open in 24-hour and 7-day operation. Please use the elevator opposite to the Élysée Bakery.
2. Check-in has to be completed at the UM Guest House reception by the guest in person with proper identification documents. During check-in, the identification document will be recorded. Guest rooms are solely for the use by the guests registered and cannot be transferred to any other party.
3. In case of any damage charges, UM Guest House will directly impose the charges to the guest(s) during the stay period.



CHECK-OUT

1. Upon guest(s)' departure, please return the room cards / keys to the UM Guest house reception at 2/F of N1 Building and complete the check-out procedure.
2. Payment can be made at UM Guest House reception upon check-in or before check-out.



POINTS TO NOTE:

1. Any cancellation or amendment must be made to the local organizing committee of CPCORES2023 by email at felixcheong@um.edu.mo at least 3 working days prior to the guest's check-in day. Otherwise, a special charge of 1 night room rate will be applied.
2. Any payment that has been made for the accommodation fees is non-refundable.
3. In accordance with Law no. 5/2011 Regime of Tobacco Prevention and Control, smoking is prohibited in entire UM Guest House. All guests should observe the University's No Smoking Policy and should only smoke at designated smoking areas.
4. For assistance, please do not hesitate to contact UM Guest House reception through the phone number as stated above.
5. Breakfast is not inclusive in room charge. You may consider to have breakfast at the Élysée Bakery which is located at the G/F of N1 which opens at 8am daily.



Wifi connection in UM Campus

UM wireless indoor coverage is around 92% and outdoor coverage is around 38% of campus with more than 7,900 access points.

Our wireless access points support the standard of IEEE 802.11b/g/a/n/ac/ax for radios of 2.4 GHz/5 GHz and provide the speed up to 1Gbps for wireless connections. The wireless network service is provided to different users with different accounts and different policies.

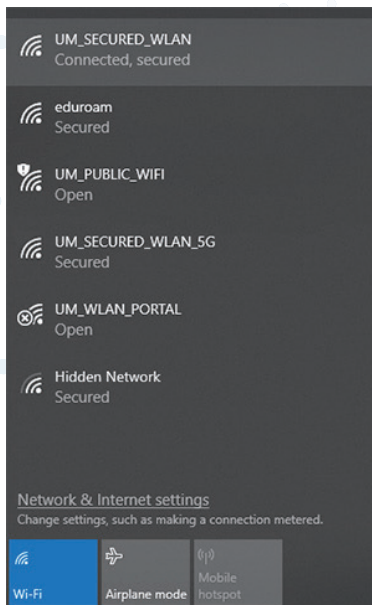
GUEST USERS

University of Macau provides a short term Wi-Fi account for guests of CPCORES 2023 during October 11st – 16th as below.

User ID: guest4022

Password: CPCORES2023

1. Search for “UM_SECURED_WLAN” SSID as shown in the following image.

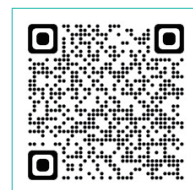


2. After connecting to UM_SECURED_WLAN, input the provided User ID and password for authentication.
3. You can use UM wireless network service around the campus after successful authentication.
4. In case you encounter any difficulty using the above account, you may connect to “UM_PUBLIC_WIFI” SSID for urgent use. It allows to access Internet for the maximum of 8 hours per day.

For more information, please visit

<https://icto.um.edu.mo/wireless-network-service/>

or scan the QR code below



Campus Outlets

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There are 26 outlets at the University of Macau, with Dining, Retails, Culture and Banking all under one roof, to serve the various needs from students, staff and visitors. The outlets are mainly distributed at the mall of southern part of campus, academic units at the eastern part and Guest House and research buildings at the northern part.



More detail is available at <https://css.cmdo.um.edu.mo/outlets/>

DINING

Name	Location	Business Hours
Grand Plaza	N1 UM Guest House	Monday to Sunday 08:00-15:00 & 17:30-22:00
Élysée Bakery	N1 UM Guest House	Monday to Sunday 08:00 - 22:00
Azucar	N21 Research Building	Monday to Sunday 12:00 - 20:00
Café Rose Garden	E2 Library	Monday to Sunday 08:00 - 22:00
Next Kitchen	E5/E6 Central Teaching Building	Monday to Sunday 08:00 - 20:00
Koufu Food Court	S8 Umall	Monday to Sunday 10:00 - 22:00
Pizza Hut	S8 Umall	Monday to Sunday 11:00 - 21:30
Siu Gwan Gon	S8 Umall	Monday to Sunday 10:30 - 22:00
Subway	S8 Umall	Monday to Sunday 08:00 - 22:00
Padaria da Guia	S8 Umall	Monday to Sunday 07:30 - 22:00
Chopsticks	S8 Umall	Monday to Sunday 11:00 - 21:00
Häagen-Dazs	S8 Umall	Monday to Sunday 10:00 - 21:00
Anyone Tea	S8 Umall	Monday to Sunday 10:30 - 21:00

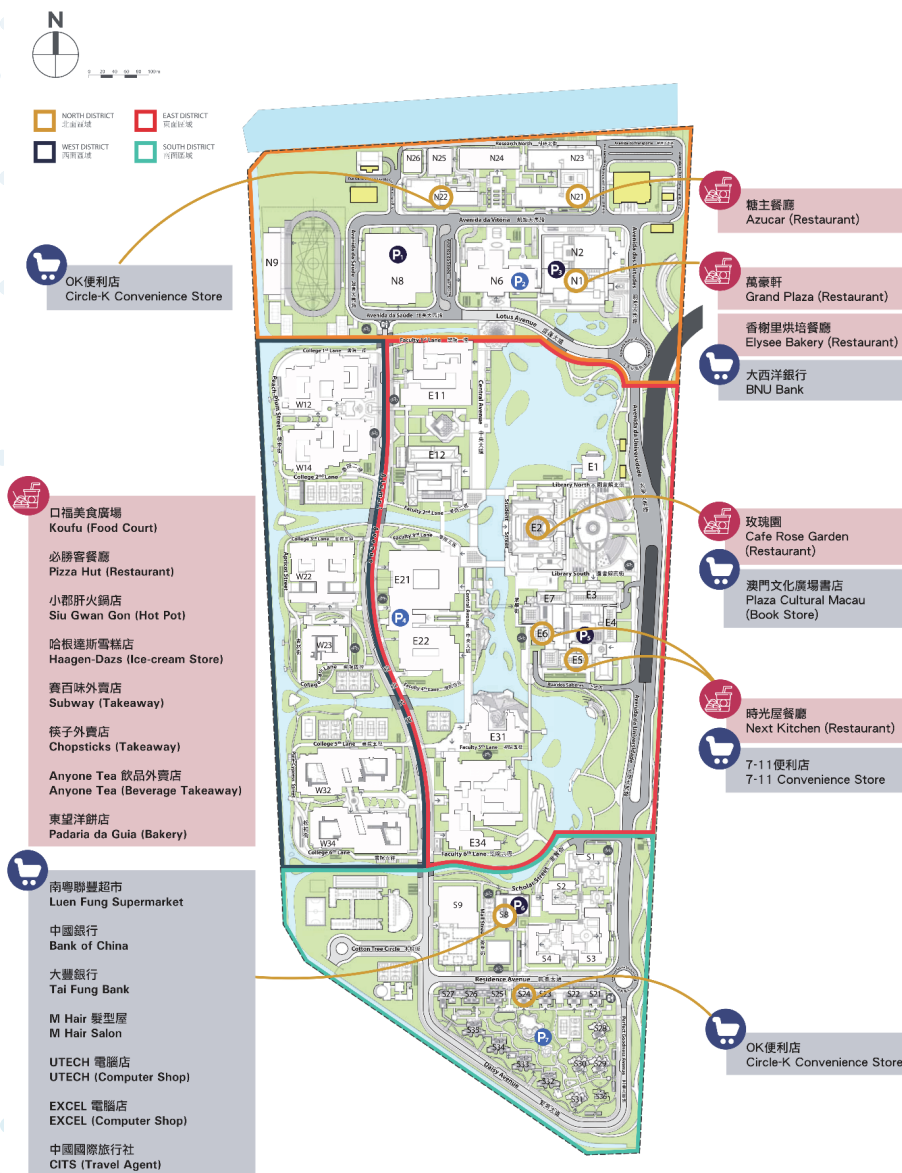


Campus Outlets

SUPERMARKET AND CONVENIENCE STORES

Name	Location	Business Hours
Luen Fung Supermarket	S8 Umall	Monday to Sunday 08:30 – 23:00
Circle K	S24 Staff Quarter	Monday to Sunday 24 hours
Circle K	N22 Research Building	Monday to Sunday 24 hours
7-Eleven	E6 Central Teaching Building	Monday to Sunday 24 hours

CAMPUS OUTLETS DISTRIBUTION



Medical Center of University of Macau

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Service content: Medical consultation service, nursing and first aid service, measurement service of height, weight, blood pressure, body fat percentage, etc.

Location: Room G002, ground floor, UM Sports Complex

Opening hours: Monday to Saturday 09:00 – 13:00 & 14:00 – 18:00

Contact phone number: 8822 4123

EMERGENCY ASSISTANCE

If you need medical assistance during non-office hours or public holidays, please contact the following entities:

UM Security Centre	8822-4126
Emergency (ambulance service)	999
Hospital Conde de São Januário	2831-3731
Island Emergency Station of Hospital Conde de São Januário	2899-2230
Nossa Senhora do Carmo – Largo Health Centre	2850-0400
Ocean Gardens Health Centre	2881-3089
Seac Pai Van (Coloane) Temporary Health Station	2850-2001
Kiang Wu Hospital	2837-1333
Kiang Wu Hospital Taipa Clinic	8295-4001



For more information, please visit
<https://hseo.um.edu.mo/health-and-hygiene-affairs/>



MAINLAND & HONGKONG

Name	Title	Affiliation
Jilan SU	Academician of CAS, Professor	Second Institute of Oceanography, Ministry of Natural Resource
Dake CHEN	Academician of CAS, Professor	Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai)
Minhan DAI	Academician of CAS, Professor	Xiamen University
Wenju CAI	Academician of AAS, Professor	Laoshan Laboratory
Fei CHAI	Chair Professor	Xiamen University
Jianfang CHEN	Associate Director & Professor	Second Institute Of Oceanography, MNR
Yan DU	Professor	State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology CAS
Jianping GAN	Head & Chair Professor	Department of Ocean Science, Hong Kong University of Science and Technology
Huiwang GAO	Dean & Professor	College of Environmental Science and Engineering, Ocean University of China
Tao GENG	Postdoctoral Fellow	Laoshan Laboratory
Zhan HU	Professor	School of Marine Sciences, Sun Yat-sen University
Haiyan JIN	Professor	Second Institute Of Oceanography, Ministry of Natural Resource
Chunfeng LI	Professor	Zhejiang University
Mingting LI	Associate Professor	School of Marine Sciences, Sun Yat-sen University
Xiangfu LI	Associate Professor	State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology CAS
Yanwei LI	Head	Department of International affair, Institute of Oceanology, Chinese Academy of Sciences
Hongbin LIU	Associate Head & Chair Professor	Department of Ocean Science, Hong Kong University of Science and Technology
Zhiqiang LIU	Assistant Professor	Department of Ocean Science and Engineering, Southern University of Science and Technology
Kehou PAN	Assistant Director & Professor	Laoshan Laboratory
Chunhua QIU	Professor	School of Marine Sciences, Sun Yat-sen University

Participants List

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MAINLAND & HONGKONG

Name	Title	Affiliation
Zhen SHI	Associate Professor	State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology CAS
Jun SUN	Dean & Professor	College of Marine Science and Technology, China University of Geosciences, Wuhan
Haibo TANG	Postdoctoral Fellow	School of Marine Sciences, Sun Yat-sen University
Chunzai WANG	Director & Professor	State Key Laboratory of Tropical Oceanography, South China Sea Institute of Oceanology CAS
Dongxiao WANG	Dean & Professor	School of Marine Sciences, Sun Yat-sen University
Fan WANG	Director & Professor	Institute of Oceanology, Chinese Academy of Sciences
Ning WANG	Head	Department of International Affair, Laoshan Laboratory
Zongling WANG	Associate Director	The First Institute of Oceanography, MNR
Jingping XU	Associate Head & Professor	Department of Ocean Science and Engineering, Southern University of Science and Technology
Kedong YIN	Professor	School of Marine Sciences, Sun Yat-sen University
Rencheng YU	Director & Professor	Institute of Oceanology, Chinese Academy of Sciences
Chuanlun ZHANG	Associate Head & Chair Professor	Department of Ocean Science and Engineering, Southern University of Science and Technology
Guangli ZHANG	Postdoctoral Fellow	School of Marine Sciences, Sun Yat-sen University
Yi ZHANG	Postdoctoral Fellow	School of Marine Sciences, Sun Yat-sen University
Jiewen ZHENG	Associate Researcher	Laoshan Laboratory
Meng ZHOU	Dean & Chair Professor	School of Oceanography, Shanghai Jiao Tong University



OVERSEAS

Name	Title	Affiliation
José Santos-Victor	President	Laboratory of Robotics and Engineering Systems (LARSyS), Portugal
Ricardo Serrão Santos	Full member of PAS, Professor	Universidade dos Açores, Portugal
Ettore Apolónio de Barros	Associate Professor	Universidade de São Paulo (USP), Brazil
Jorge Gonçalves	Senior Researcher	University of Algarve, Portugal
Avelino Langa	Director	School of Marine and Coastal Sciences, Universidade Eduardo Mondlane, Mozambique
Moisés Kajico Lucas	Assistant Professor	Universidade Agostinho Neto (UAN), Angola
Feng CHEN	Professor	University of Maryland Center for Environmental Science, USA

MACAO

Name	Title	Affiliation
Yonghua SONG	Rector	University of Macau
Rui Martins	Vice Rector	University of Macau
Wei GE	Vice Rector	University of Macau
Kai Meng MOK	Vice Rector	University of Macau
Cheng-Zhong XU	Dean	Faculty of Science and Technology, University of Macau
Chunming WANG	Director	Research Services and Knowledge Transfer Office, University of Macau
Ruibing WANG	Director	Global Affairs Office, University of Macau
Wanhuan ZHOU	Associate Dean	Faculty of Science and Technology, University of Macau
Jie XU	Department Head	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Carlos Jorge Ferreira SILVESTRE	Professor	Department of Electrical and Computer Engineering, Faculty of Science and Technology, University of Macau

Participants List

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MACAO

Name	Title	Affiliation
Yongjie LI	Associate Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Zhongya CAI	Assistant Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Liang GAO	Assistant Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Tianwei HAO	Assistant Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Ping SHEN	Assistant Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Huabin SHI	Assistant Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Ping ZHANG	Assistant Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Joel Oliveira REIS	Post-doctoral Fellow	Department of Electrical and Computer Engineering Faculty of Science and Technology, University of Macau
Weng Seng LAI	Research Assistant Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau
Guangsheng QIAN	Research Assistant Professor	Department of Ocean Science and Technology, Faculty of Science and Technology, University of Macau



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澳門大學
UNIVERSIDADE DE MACAU
UNIVERSITY OF MACAU



科技學院
Faculdade de Ciências e Tecnologia
Faculty of Science and Technology