2025 TAIWAN POLAND

Symposium on Marine Science and Technology

2025 臺灣-波蘭海洋科學與技術研討會

日期 : November 3 - 4, 2025

地點 : 第二演講廳 2nd Auditorium

▼指導單位 / Adviser

NSTC 國家科學及技術委員會
National Science and Technology Council

▼主辦單位 / Organizer

國立臺灣海洋大學
National Taiwan Ocean University

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16:10-17:30	**Campus Tour**

Speaker Profile and Abstract

Łukasz Weremiuk (魯偉明)

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Professional Services:

Łukasz Weremiuk is a career diplomat – member of the Polish Foreign Service since 2004, currently with the rank of I counsellor. Following a secondment in the Ministry of Foreign Affairs of Portugal in 2007, he served in the Embassy of Poland in Portugal. More recently he was posted to Canada as Deputy Chief of Mission. From 2016 to 2017 he was also Poland's diplomatic representative in Canada in the rank of chargé d'affaires. In the course of his career he worked in several MFA departments, including North America and Foreign Economic Diplomacy. He also held the function of Deputy Director responsible for the development and training of employees of the Ministry of Foreign Affairs. Before coming to Taiwan he worked in the Security Policy Department as Poland's representative in the European Union hybrid threats countering working group. He serves as the Deputy Director of Polish Office in Taipei from 2022.

Chen-Tung Arthur Chen (陳鎮東)

Personal Information:

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Professional Position:

2024.7–present: Academician, Academia Sinica
2019.6–present: Adjunct Chair Research Professor, Department of Oceanography, National Sun Yat-Sen University (NSYSU)
2006–2011: Professor and Director, Asia-Pacific Ocean Research Center, NSYSU
1989–1995: Professor and Director, Marine Sciences Research Center, NSYSU
1989–1992: Professor and Dean, College of Marine Sciences, NSYSU
1985–2019: Professor, Department of Oceanography, NSYSU
1985–1989: Professor and Director, Institute of Marine Geology, NSYSU
1984–1985: Visiting Professor, Institute of Marine Biology, NSYSU

Education:

1977: Ph. D in Chemical Oceanography, University of Miami, Miami, Florida, U.S.A.

Professional Services:

2022–present: Fellow, Integrated Marine Biosphere Research (IMBeR)
2022–present: Fellow, American Geophysical Union (AGU)

Contributions to Science:

For many decades, Professor Chen-Tung Arthur Chen, has been a creative and thought-provoking marine chemist, contributing significantly to advancing marine chemistry in global and coastal ocean carbon cycle research and leading international programs.

In the 1970s, the pioneering researcher Wally Broecker suggested that it would be decades before ocean carbon measurements could quantify the uptake and storage of anthropogenic CO_2 in the ocean. In 1978 and 1979 articles in Science and Nature, respectively, Chen defied this expectation and became the first to suggest a groundbreaking concept of isolating the anthropogenic CO_2 signal in the oceans.

Since his return from the United States to Taiwan in 1984, Chen has been a leader in carbon cycle research in ocean margins and estuaries. He focused on coastal carbon long before the broader community recognized the critical issues at the interface between land and the ocean. His work has maintained the general thread of understanding carbon cycling in dynamic and complicated coastal regions.

In addition to his direct contributions to advancing the field of ocean sciences and carbon cycle research, Chen has selflessly contributed his time to lead or assist international programs. His most recent international activity was serving seven years as a vice-chair of the ICSU International Geosphere-Biosphere Programme, an important global change program. Before that, he was a member of the Global Carbon Project.

In summary, Prof. Chen has made groundbreaking and paradigm-shifting research and his enormous impact on our understanding of the ocean carbon cycle in the open ocean and coastal waters. Dr. Chen has led interdisciplinary research on regional and global scales, working towards an integrated ocean science system. He has a history of participating in international programs and contributing to the scientific community, and is instrumental in groundbreaking research on the marginal seas processes related to the ocean carbon cycle and uptake of anthropogenic CO_2.

Selected publications:

1. Huang, T.H. and C.T.A. Chen* (2025) Nutrient footprint from the origin of the Kuroshio Current to the East China Sea continental shelf. *Oceanography*, 38(3):40–50.
2. Chen, C.T.A.*, H.K. Lui*, C.H. Hsieh, T. Yanagi, N. Kosugi, M. Ishii and G.C. Gong (2017). Deep oceans may acidify faster than anticipated due to global warming. *Nature Climate Change*, 7, 890–894.
3. Chen, C.T.A.*, T.H. Huang, Y.C. Chen, Y. Bai, X. He, and Y. Kang (2013). Air–sea exchanges of CO_2 in the world's coastal seas. *Biogeosciences*, 10 (10), 6509-6544.
4. Chen, C.T.A.* and A.V. Borges. (2009). Reconciling opposing views on carbon cycling in the coastal ocean: continental shelves as sinks and near-shore ecosystems as sources of atmospheric CO_2. *Deep-sea Research II*, 56, 578-590.
5. Chen, C.T.A.* (2009). Chemical and physical fronts in the Bohai, Yellow and East China Seas. *Journal of Marine Systems*, 78 (3), 394-410.
6. Chen, C.T.A.*, H.C. Lan, J.Y. Lou and Y.C. Chen (2003). The dry Holocene Megathermal in Inner Mongolia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 193 (2), 181-200.
7. Chen, C.T.A.* (2000). The Three Gorges Dam: reducing the upwelling and thus productivity in the East China Sea. *Geophysical Research Letters*, 27 (3), 381-383.
8. Chen C.T.A.* (Chen, C.T) and S.L. Wang (1999). Carbon, alkalinity and nutrient budgets on the East China Sea continental shelf. *Journal of Geophysical Research*, 104 (C9), 20675-20686.
9. Chen C.T.A.* (1996). The Kuroshio intermediate water is the major source of nutrients on the East China Sea continental shelf. *Oceanologica Acta*, 19(5), 523-527.
10. Chen, C.T.* (G. T. Chen) and F.J. Millero (1979). Gradual increase of oceanic CO_2. *Nature*, 277, 205-206.
11. Chen, C.T.A.* (1978). Decomposition of calcium carbonate and organic carbon in the deep oceans. Science, 201 (4357), 735-736.

Carbon and Nutrients in Submarine Groundwater Discharge around Taiwan and Svalbard

Chen-Tung Arthur Chen and Ting-Hsuan Huang

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The submarine groundwater discharge (SGD) exists around Taiwan even though groundwater overdrawing on the island is serious. Some nearly freshwater SGD (salinity⩽1.0) samples were obtained, providing strong and direct evidence for the existence of fresh meteoric groundwater entering the ocean from Taiwan. The total SGD flux is estimated to be about 14% of the annual river output. The freshwater component of the SGD is about 5.2% of the annual river discharge in Taiwan. The collected SGD has a composition similar to seawater with an addition of Ca, CO_3 and HCO_3 due to dissolution of calcareous rocks. Some samples with high Cl/(Na+K) may indicate pollution. Exploratory sampling at Svalbard has been done.

Keywords: submarine groundwater discharge, carbon, nutrients, Taiwan, yield, flux, hetero-trophy

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Professional Position:

2025.8–present: Distinguished Professor, National Taiwan University
2018.8–2023.7: Distinguished Professor, National Taiwan University
2017.8–2020.7: Director, Institute of Oceanography, National Taiwan University
2014.8–2017.7: Deputy Director, Institute of Oceanography, National Taiwan University
2013.4–2014.4: Deputy Director, Taiwan Ocean Research Institute, NARLabs
2012.8–present: Professor, Institute of Oceanography, National Taiwan University

Education:

1995: Ph.D. Physical Oceanography, Institute of Oceanography, National Taiwan University, Taiwan

Professional Services:

2017–2023: Managing Director, Oceanography Society of Republic of China
2015–2018: Editor, *Terrestrial, Atmospheric and Oceanic Sciences*
2015–2016: Guest Editor, *Continental Shelf Research* (Special Issue: 18th PAMS meeting)
2015–2016: Guest Editor, *Oceanography* (Special Issue: Volume 28, 4, December 2015)
2012–2014: Guest Editor, *Progress in Oceanography* (Special Issue: Volume 121, February 2014)
2012–2013: Guest Editor, *Journal of Marine Research* (Special Issue: Volume 71, 1-2, March 2013)

Contributions to Science:

My research interests include circulation and water masses in the Taiwan Strait, barotropic tides and their associated dynamics in the East Asian waters, internal tides in the northern South China Sea, variability and dynamics of Kuroshio transport, submesoscale processes and underlying dynamics in the western boundary current, the dynamics of large-amplitude internal solitary waves in the South China Sea, and the driving mechanisms of intraseasonal current variability in the central South China Sea. Gaining an in-depth understanding of these processes and underlying dynamics is crucial for improving subgrid parametrizations in numerical models, thereby enhancing the accuracy of numerical ocean predictions. Through mooring array observations, I revealed how impinging mesoscale eddies drive seesaw-like sea level anomalies and pycnocline depth shifts across the Kuroshio east of Taiwan, leading to pronounced variability in hydrography, velocity, and transport. Using the autonomous underwater vehicle, Seaglider, I observed the form, propagation speed, and arrival timing of internal solitary waves in the northern South China Sea and showed good agreement between in-situ data and the solutions to the Dubreil–Jacotin–Long

(DJL) equation. My broader contributions are reflected in more than 100 peer-reviewed publications.

Selected publications:

1. Vladoiu, A. Lien, R.-C., Kunze, E., Ma, B., Essink, S., Yang, Y. J., Chang, M.-H., Jan, S., Chen, J.-L., Yang, K.-C., & Yeh, Y.-Y. (2025). Finescale measurements of Kelvin-Helmholtz instabilities at a Kuroshio seamount. *Journal of Physical Oceanography*
2. Malugao, M. E. D., Jan*, S., Chang, M.-H., Ho, T.-Y., & Yang, Y. J. (2025). Connection of central South China Sea current variability with tropical Rossby waves in the western North Pacific. *Progress in Oceanography*, 235, 103481.
3. Yang, K.-C., Jan*, S., Yang, Y. J., Chang, M.-H., Wang, J., Wang, S.-H., et al. (2023). Anatomy of mode-1 internal solitary waves derived from Seaglider observations in the northern South China Sea. *Journal of Physical Oceanography*, 53, 11, 2519–2536.
4. Jan*, S., M.-H. Chang, Y. J. Yang, C.-H. Sui, Y.-H. Cheng, Y.-Y. Yeh & C.-W. Lee (2021). Mooring observed intraseasonal oscillations in the central South China Sea during summer monsoon season. *Scientific Reports*, 11:13685.
5. Jan*, S., S.-H. Wang, K.-C. Yang, Y. J. Yang, & M.-H. Chang (2019). Glider observations of interleaving layers beneath the Kuroshio primary velocity core east of Taiwan and analyses of underlying dynamics. *Scientific Reports*, 9:11401.
6. Yang*, Y. J., M.-H. Chang, C.-Y. Hsieh, H.-I Chang, S. Jan, and C.-L. Wei (2019). The role of enhanced velocity shears in rapid ocean cooling during Super Typhoon Nepartak 2016. *Nature Communications*, 10, 1627.
7. Jan*, S., Mensah, V., Andres, M., Chang, M.-H., & Yang, Y. J. (2017). Eddy-Kuroshio interactions: Local and remote effects. *Journal of Geophysical Research: Oceans*, 122, 9744–9764.
8. Tsai, C.-J., Andres*, M., Jan*, S., Mensah, V., Sanford, T.-B., Lien, R.-C., & Lee, C. M. (2015). Eddy-Kuroshio interaction processes revealed by mooring observations off Taiwan and Luzon. *Geophysical Research Letters*, 42, 8098–8105.
9. Alford, M. H., et al. (2015). The formation and fate of internal waves in the South China Sea, *Nature*, 521(7550), 65-U381.
10. Jan*, S., Yang, Y. J., Wang, J., Mensah, V., Kuo, T.-H., Chiou, M.-D., et al. (2015). Large variability of the Kuroshio at 23.75°N east of Taiwan. *Journal of Geophysical Research: Oceans*, 120, 1825–1840. (AGU's Research Spotlight)
11. Jan*, S., Chern, C.-S, Wang, J., & Chiou, M.-D. (2012). Generation and propagation of baroclinic tides modified by the Kuroshio in the Luzon Strait. *Journal of Geophysical Research: Oceans*, 117, C02019.
12. Chiou, M.-D., Jan*, S. Wang, J., Lien, R.-C., & H. Chien (2011). Sources of baroclinic tidal energy in the Gaoping Submarine Canyon off southwestern Taiwan. *Journal of Geophysical Research: Oceans*, 116, C12016. (AGU's Research Spotlight)
13. Jan*, S., Chern, C.-S., Wang, J., & Chao, S.-Y. (2004). The anomalous amplification of M_2 tide in the Taiwan Strait. *Geophysical Research Letters*, 31, L07308.

A Quarter Century of Advancements in Oceanographic Research and Smart Observations in Taiwan

Sen Jan [1,2]

[1]Institute of Oceanography, National Taiwan University, Taipei, Taiwan.
[2]Ocean Center, National Taiwan University, Taipei, Taiwan.

For more than 65 years, Taiwan has developed a strong tradition of systematic and modern ocean observations across physical, biological, biogeochemical, geological, and geophysical disciplines, producing detailed bathymetric, tectonic, hydrographic, and circulation charts of the surrounding seas and establishing a scientific foundation for Taiwan's oceanographic research community. Since 2000, Taiwan and the United States have further deepened this foundation through a long-standing partnership in ocean science, supported by Taiwan's National Science and Technology Council (NSTC) and the U.S. Office of Naval Research (ONR). This collaboration opened a new era for Taiwan's oceanographic research. The first major joint program, "Asian Seas International Acoustics Experiment" (ASIAEX) in the northern South China Sea, not only revealed the life cycle of large nonlinear internal waves but also established the basis for a quarter-century of U.S.–Taiwan collaborative research in the western North Pacific. Over these 25 years, the collaborations have produced substantial scientific achievements and significantly advanced our understanding of the northern South China Sea, waters northeast and southwest of Taiwan, the Kuroshio, and the broader western North Pacific. Beyond scientific discovery, these collaborations have trained a new generation of Taiwan's ocean scientists, strengthened Taiwan's ocean observational technologies, and fostered sustained partnerships with leading U.S. institutions. Building on this foundation, we have increasingly embraced smart observations—integrating autonomous framework, AI-driven data analysis, and high-resolution modeling—to enhance efficiency, precision, and predictive capability in ocean research. These innovations not only expand observational capacity but also set the stage for future international collaborations.

Keywords: advancement, autonomous observing framework, AI-driven data analysis, high-resolution modeling

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Professional Position:

Since 2023: Professor at Institute of Oceanology, Polish Academy of Sciences, Poland

Since 2019: Institute of Oceanology, Polish Academy of Sciences, Poland.
Head, CORE-Climate and Ocean Research and Education Unit.

2018 – 2019: Institute of Oceanology, Polish Academy of Sciences (IO PAN), Sopot, Poland.
Deputy Director for Communication and Education.

Since 2010: Institute of Oceanology, Polish Academy of Sciences (IO PAN), Sopot, Poland.
Assoc. Professor.

1998 – 2010: Institute of Oceanology, Polish Academy of Sciences (IO PAN), Sopot, Poland.
Senior Scientist.

2008 – 2009: University of Szczecin, Poland.
Professor, Head of the Marine and Environmental Physics Faculty, 1 year contract.

Education:

Institute of Oceanology Polish Academy of Sciences, Postdoctoral degree “habilitacja”, 2008.

University of Gdansk, Poland, Department of Biology, Geography and Oceanography, Ph.D., 1996.

Professional Services:

Since 2024 Representing Eastern Europe and since 2025 Deputy Joint Coordinator in the Group of Experts for the 3rd cycle of the UN Regular Process for Global Reporting and Assessment of the State of Marine Environment, including Socioeconomic Aspects.

Since 2024 Chair of the European Marine Board Communication Panel.

Since 2023 Member of the Program Council for the Polish Academy of Sciences unit in Paris.

2025 Co-organizer of the EU Mission Ocean Arena 4, Sopot, Poland.

Contributions to Science:

Professor Tymon Zielinski leads the CORE – Climate and Ocean Research and Education team at the Institute of Oceanology of the Polish Academy of Sciences in Sopot. Tymon is a co-author of over 100 scientific articles and over 200 presentations and serves as an editor in scientific journals, e.g. Frontiers in Marine Science, Atmosphere, Oceanologia, Sustainability. Since 2025, Tymon is a Deputy Joint Coordinator in the United Nations Regular Process for Global Reporting and Assessment of the State of the Marine Environment and has been representing Central-Eastern Europe in this Program since 2016. In 2024, Tymon became a Chair of the Steering Committee of the European Marine Board Communication Panel, while in 2020-2022 he chaired the EU4Ocean Coalition Climate and Ocean Working Group. Tymon

participates in scientific and educational projects related to widely understood climate change and sustainability processes. In recognition of his scientific, organizational and educational achievements, Tymon became, in 2021, the "face" of the European action on Research Integrity and was also awarded a title of a Green Hero by BNP Paribas for climate research and education. Full CV is available at: **https://old.iopan.pl/KlimatOceany/ZielinskiTymonCV.html**

Selected publications:

1. Prokopciuk, N., Tarasiuk, N., Franck, U., Schraufnagel, D.E., Valiulis, A., Kostantinova, M., Zielinski, T., Valiulis, A. On possible climatic consequences of the large oil spills in oceans. Atmosphere 2024, 15, 1216. https://doi.org/10.3390/atmos15101216. 2024.
2. Zielinski, T.; Willems, A.; Lartigaud, M. Impact of Biomass Burning, Wildfires, and Wind Events on Aerosol Optical Depth: Implications for Climate Change. Appl. Sci. 2024, 14, 5633. https://doi.org/10.3390/app14135633. 2024.
3. SESS report 2022 – Summary for Stakeholders. The State of Environmental Science in Svalbard – an annual report. Publisher: Svalbard Integrated Arctic Earth Observing System (SIOS). ISSN 2535-6313 (printed); ISSN 2535-6615 (pdf); ISBN 978-82-93871-09-5 (pdf).
4. Zbizika, R., P. Pakszys, T. Zielinski. Deep Neural Networks for Aerosol Optical Depth Retrieval. Atmosphere 2022, 13, 101, https://doi.org/10.3390/atmos13010101. 2022.
5. Zielinski, T., E. Bolzacchini, K. Evans, L. Ferrero, K. Gregorczyk, T. Kijewski, I. Kotynska-Zielinska, P. Mrowiec, P. Pakszys, E. Piechowska, J. Piwowarczyk, J. Sobieszczanski, M. Wichorowski. Abundance of environmental data vs. low public interest in ocean and climate issues. Where is the missing link? Frontiers in Marine Science, doi: 10.3389/fmars.2021.619638 2021.
6. Dumała, H., M. Łuszczuk, J. Piwowarczyk, T. Zielinski. Transnational municipal networks as a mechanism in the marine governance towards climate change adaptation and mitigation: between potential and practice. Front. Mar. Sci. 8:626119. doi: 10.3389/fmars.2021.626119. 2021.
7. Evans, K., Zielinski, T., Chiba, S., Garcia-Soto, C., Ojaveer, H., Park, C., Ruwa, R., Schmidt, J., Simcock, A., Strati, A., Vu, C. Transferring complex scientific knowledge to useable products for society: the role of the global integrated ocean assessment and the challenges in effective delivery of ocean knowledge to society. Frontiers in Environmental Science, doi: 10.3389/fenvs.2021.626532, 2021.
8. Garcia-Soto, C., L. Cheng, L. Caesar, E. B. Jewett, A. Cheripka, I. Ganzon Rigor, A. Caballero, S. Chiba, J. C. Báez, T. Zielinski, J. P. Abraham. An update of Ocean Climate Change Indicators: Sea Surface Temperature, Ocean Heat Content, Ocean pH, Arctic Sea Ice Extent, Sea Level and strength of the AMOC (Atlantic Meridional Overturning Circulation). Frontiers in Marine Science. DOI: 10.3389/fmars.2021.642372. 2021.

Ocean Role in the Climate System with Focus on Coastal Areas. The Most Recent Findings Based on the UN World Ocean Assessment III.

Tymon Zielinski[1]

[1]Institute of Oceanology Polish Academy of Sciences, Sopot, Poland.

Climate change, and resulting global warming and acidification of oceans causes serious and yet not fully understood effects on ocean environment, which, in turn, have serious implications on global ecosystems, food security and variety of maritime industries. It is of key importance to better understand these changes, to identify both knowledge gaps and capacity needs in order to develop effective and sustained observation systems that are necessary for enhancing proper ocean related knowledge.

At a time where sustainable development is globally recognized as a future desired pathway for society, through the United Nations 2030 Agenda and associated sustainable development goals and the United Nations Decade of Ocean Science for Sustainable Development, the global integrated assessment of the marine environment has a role to play in increasing awareness of the ocean, the challenges it faces and the solutions that all of society can provide.

This presentation outlines the knowledge brokering role that the UN World Ocean Assessment (WOA) provides on ocean issues to all aspects of society from policy makers, ocean managers, ocean users to the public. The WOA III identifies key knowledge and capacity gaps that limit the delivery of observations, information dissemination, and implementation of effective responses to changes and management of human activities to ensure sustainable practices that support marine environment and the delivery of services the marine environment provides.

It identifies some of the challenges faced in successfully carrying out that role and potential solutions that could be implemented looking forward as we are half way through the UN Decade of Ocean Science for Sustainable Development in the form of instructions or guidelines of use of the assessment.

Keywords: ocean, climate, coastal area, UN Ocean Decade, World Ocean Assessment

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Professional Position:

1984.3–present: Lecturer Faculty of Economics University of Gdańsk, currently:
Professor, head of Department of International Economics and Economic Development
2025.8–present: Main specialist in Institute of Oceanology of Polish Academy of Sciences
2009.4–2025.7: Professor Main specialist in Maritime Institute of Gdynia Maritime University
2007.8–2009.1: Main specialist in Gdańsk Maritime Institute
2008.6–2009.3: Director, Joint Secretariat of South Baltic INTERREG
1996.1–2007.7: Deputy Director, Joint Secretariat of interministerial VASAB Programme
1993.6–1996.2: Main Specialist central Office of Planning.
1992.8-1993.6 Scholarship Princeton University

Education:

1993: Ph.D., University of Gdansk; 2009:, Professor of University of Gdańsk; 2019: Professor with tenure awarded by President of the Republic of Poland

ProfessionalServices:

1992–1996: Member of the Committee on Spatial Planning and Development of the Baltic Sea Region and its Chairmen in 2017-2018
1996–2007. member of the Baltic 21 Agenda Senior Officials Group
2023–2024: Guest Editor of the *Marine Policy* (in Marine Spatial Planning)

Contributions to Science:

Jacek Zaucha Professor of Economics at the University of Gdańsk Faculty of Economics. His research focuses on supranational spatial planning and development, maritime spatial development, Baltic Sea Region integration, territorial cohesion, EU Cohesion Policy and spatial aspects of growth. He is an author of more than 170 scientific publications, and principal investigator in several international research projects funded by Horizon, Bonus and ESPON. His knowledge and expertise has been used for preparing key national, and EU strategic spatial documents such as "Concept of the Spatial Development of Poland", "The Territorial State and Perspectives of the European Union" and the revised "Territorial Agenda of the EU", as well as the first maritime spatial plan in Poland. He has served in several international bodies and national networks in the field of his research interests. He acted as an expert of Polish EU Council Presidency in 2011 and in 2025. He is actively involved in the work of the Board of the Committee for

Spatial Economy and Regional Planning, Polish Academy of Sciences.

Selected publications:

1. Zaucha J., *Pilot Draft Plan for the West Part of the Gulf of Gdańsk. First Maritime Spatial Plan in Poland*, Maritime Institute in Gdansk, Gdańsk 2010
2. Zaucha J., *Offshore Spatial Information - Maritime Spatial Planning in Poland* "Regional Studies" vol. 46/ April 2012 , pp. 459-473
3. Zaucha J. *Sea basin maritime spatial planning: A case study of the Baltic Sea region and Poland* "Marine Policy", vol. 50, Part A/ December 2014, pp. 34–45
4. Zaucha J., Conides A., Klaoudatos D., Noren K. *Can the ecosystem services concept help in enhancing the resilience of land-sea social-ecological systems*? "Ocean & Coastal Management", vol. 124,/ 2016, pp. 33-41
5. Zaucha J., Davoudi S., Slob A., et al.. *State-of-the-lagoon reports as vehicles of cross-disciplinary integration*."Integrated Environmental Assessment and Management", vol.12(4)/ 2016, pp. 690–700.
6. Davoudi S., Zaucha J., Brooks E., *Evolutionary resilience and complex lagoon systems*. ."Integrated Environmental Assessment and Management", vol.12(4)/ 2016, pp. 711–718
7. Zaucha J., *Methodology of Maritime Spatial Planning in Poland. "*Journal of Environmental Protection and Ecology", vol. 19(2)/ 2018, pp. 713-720.
8. Hassler B., Blažauskas N., Gee K., Luttmann A., Morf A., Piwowarczyk J., Saunders F., Stalmokaitė I., Strand H., Zaucha J. *New generation EU directives, sustainability, and the role of transnational coordination in Baltic Sea maritime spatial planning*. "Ocean & Coastal Management", vol. 169/2019,pp. 254-263.
9. Calado H., E. Papaioannou A., Caña-Varona M., Onyango V., Zaucha J., et al. *Multi-uses in the Eastern Atlantic: Building bridges in maritime space.* "Ocean & Coastal Management", vol. 174/2019, pp. 131-143
10. Zaucha J., Gee K. (eds.) *Maritime Spatial Planning – Past, Present and Future.* Palgrave Macmillan, Cham 2019,
11. Jerzak, K., Shrayer, M.D., Krośnicka, K.A., Lorens, P., Zaucha, J., & Pardus, J., *The essence of marine and coastal space – an interdisciplinary perspective.* "Europa XXI", vol. 36/December 2019, pp. *15-33*
12. Zaucha J., Matczak M., Witkowska J., et al. , *Maritime Spatial Rent for Modelling Maritime Spatial Development.* "Studia Regionalne i Loklane", vol. 1/2020, pp. 5-29
13. Mogila Z., Ciołek D., Kwiatkowski J., Zaucha J., *The Baltic blue growth - A country-level shift-share analysis*," Marine Policy", vol. 134/2021, ISSN 0308-597X, Article 104799, pp. 1-10,
14. Stancheva M., Stanchev H., Zaucha J., et al. (2022) *Supporting multi-use of the sea with maritime spatial planning. The case of a multi-use opportunity development - Bulgaria, Black Sea*, "Marine Policy", vol. 136/ 2022: 104927, pp. 1-11
15. Zaucha J., Jay S., *The extension of marine spatial planning to the management of the world ocean, especially areas beyond national jurisdiction*, "Marine Policy", vol. 144/2022, pp. 1-10
16. Kwiatkowski J.M and Zaucha J. (2023) *Measuring the blue economy in the EU: The Polish experience*. Front. Mar. Sci. 10:1129075
17. Zaucha J., Gee K., Ramieri E.o, Neimane L., Alloncle N., Blažauskas N., Calado H., Cervera-Núñez C., Marohnić Kuzmanović V. , Stancheva M.: *Implementing the EU MSP directive: current status and lessons learned in 22 EU Member States*, Marine Policy, 171/2025: 106425, pp. 1-23,

Coastal Defense in Polish Marine Spatial Planning

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Until recently, the management of maritime space in Poland was governed by sectoral decisions. Individual government agencies were responsible for decision-making in this area, and the processes often failed to take into account their mutual impacts. This situation changed following the introduction of the European Union requirement to develop maritime spatial plans (EU MSP Directive 2014), which provide a holistic framework for the sustainable use of marine space

The Polish Maritime Spatial Plan was prepared between 2016 and 2019 by scientific institutions and approved by the Council of Ministers in 2021. A problem of the protection of the coastline is among important concerns of the plan. A large proportion of the Polish coast is subject to erosion. The plan adopts the principle of avoiding interference with natural coastal protection processes and secures sediment necessary for beach nourishment and coastal replenishment. It serves as a platform for resolving conflicts between the need to maintain coastal stability and the other interests e.g. of coastal municipalities, which insist on developing tourism-related infrastructure extending into the sea, such as piers, promenades, and boulevards.

The planning process revealed two major shortcomings. First, there is insufficient detailed knowledge regarding the geomorphological processes that ensure coastal stability along different sections of the Polish shoreline. Second, the effects of marine engineering structures on these processes remain inadequately understood. Consequently, the plan is based on the precautionary principle, complemented by the application of theoretical knowledge and the adoption of a learning-by-doing approach.

An update of the plan is currently anticipated. Therefore, we are in the phase of collecting new knowledge, on both natural coastal protection processes and the spatial planning solutions applied in other countries worldwide.

Keywords: maritime/marine spatial planning, coastal protection, sea use conflicts

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2012–2017: Assistant Professor, Dept. of River and Ocean Eng. of the National Taiwan Ocean University
2003–2012: Technical manager, Dept. of Hydraulic and Ocean Engineering, Sinotech Engineering Services Ltd.

Education:

2002: Ph.D., Department of Harbor and River Engineering, National Taiwan Ocean University

Professional Services:

2015–present: International Society of Offshore and Polar Engineers, Technical Program Committee (TPC)
2015–present: Member the Taiwan Society of Ocean Engineering
2021–present: Deputy Secretary General of Chinese Ocean and Underwater Technology Association)

Contributions to Science:

In response to the development needs of sustainable coastal management, I have conducted a comprehensive study over the past five years focused on formulating a national coastal protection policy. My research includes proposals for compensatory measures and sediment management plans to address coastal erosion disasters caused by coastal development. Furthermore, I have devised sustainable ecological approaches for existing coastal protection facilities while minimizing the use of concrete. Additionally, I have researched the mechanisms behind coastal bathymetric changes to propose effective measures for coastal erosion protection and management. Lastly, to synthesize and assess previous research methodologies and findings as a foundation for future coastal governance and management, I have invested efforts in coastal risk analysis and the creation of risk maps, enabling a thorough evaluation of current coastal conditions and the changes anticipated following the implementation of specific countermeasures.

Selected publications:

1. Jui-Chan Hsu*, Wei-Po Huang* and Chun-Jhen Ye (2024, Jun). Comparing the Dominant Factors in Coastal Morphology: Inappropriate Infrastructure vs. Climate Change—A Case Study of the Hsinchu Fishery Harbor, Taiwan. *Sustainability*, 16, 5563. NSTC 112-2625-M-019-003.
2. Wei-Po Huang*, Jui Chan Hsu , Chun Jhen Ye (2023, Aug). Assessing the impact factors and

corresponding weights affecting the coastal morphology of Hsinchu Coast, Taiwan. *Journal of Sea Research*. nstc 111-2625-M-019-003.

3. Wei-Po Huang*, Chun-Jhen Ye, and Jui-Chan Hsu (2022, Nov). Forecasts of the Compound Coastal Erosion Risks Based on Time-Variant Assessment: A Case Study on Yunlin Coast, Taiwan. *Sustainability*, 14.21 (2022): 14505. nstc 111-2625-M-019-003.
4. Wei-Po Huang* (2022, Jun). Impact of coastal development on coastal morphology of Taiwan: Case studies and proposed countermeasures. *Journal of Sea Research*, 186(2022), 102234. MOST 109-2625-M-019-006.
5. Ming-An Lee*, Wei-Po Huang, Yi-Lo Shen, Jinn-Shing Weng, Bambang Semedi, Yi-Chen Wang, and Jui-Wen Chan (2021, Sep). Long-Term Observations of Interannual and Decadal Variation of Sea Surface Temperature in the Taiwan Strait. Journal of Marine Science and Technology, 29(4), 7.
6. Cheng-Yu Ku*, Li-Dan Hong, Chih-Yu Liu, Jing-En Xiao and Wei-Po Huang*, (2021, Apr). Modeling Transient Flows in Heterogeneous Layered Porous Media Using the Space‐Time Trefftz Method. *Applied Sciences*, 11, 3421. MOST 109-2625-m-019-007.

Coastal Risk Management in the Face of Climate Change: Sharing Practical Experiences from Taiwan

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The study begins by outlining the legal framework for coastal protection in Taiwan. Similar to many developing nations, Taiwan's coastal areas have historically been used for various purposes without adequate planning during the development stage since the 1970s. The ongoing expansion and diversity of urbanization have exacerbated natural disasters in certain regions. This has led to persistent conflicts between coastal exploitation and regulation, particularly since the Coastal Zone Management Act had not yet been enacted as statutory law. Consequently, formulating strategies for Integrated Coastal Zone Management (ICZM) was challenging due to the lack of a legal basis for land use planning in coastal areas. The Act was finally implemented in February 2015, with the primary objectives of preserving natural systems, ensuring zero loss of the natural coastline, addressing climate change, preventing coastal disasters, implementing integrated coastal zone management, and promoting the sustainable development of coastal regions. The study further explores the designation of Coastal Protection Zones and the corresponding strategies, focusing on YunLin and TaiDong Counties to illustrate the process. Ultimately, we will discuss methods for assessing and implementing retreat strategies based on scientific approaches in the context of climate change threats.

Keywords: Integrated Coastal Zone Management (ICZM), Coastal Protection Zone, Degraded Coastal Zone, Sustainable Development

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Professional Position:

2019–present: Specialist, Climate and Ocean Research and Education Laboratory, Institute of Oceanology Polish Academy of Sciences

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Education:

2002: Ph.D., Faculty of Biology, University of Gdańsk: Gdańsk, PL

1996: MSc, Faculty of Biology and Earth Sciences; Nicolaus Copernicus University: Toruń, PL

Contributions to Science:

With a background in general biology and a specialization in the genetics of marine fauna, I combine rigorous scientific research with a deep commitment to public engagement, bridging the worlds of science and society.

I currently serve as a science communicator at the Climate and Ocean Research and Education Laboratory of the Institute of Oceanology of the Polish Academy of Sciences (IO PAN) in Sopot, where I contribute to numerous scientific projects, focusing on dissemination and outreach.

As co-creator of the Ocean of Changes project (https://oceanofchanges.com), I have developed and delivered innovative initiatives that bring ocean science to diverse audiences. My work ranges from interactive, “heads-on” workshops for students to inspiring lectures for adults, as well as the co-organization of major public events such as science festivals—all designed to deepen understanding of the ocean’s role in our changing climate and to promote sustainable development.

I am also a member of the editorial and production team behind the acclaimed YouTube film series The Oceanic Non-Handbook, which translates complex marine topics into compelling visual narratives as part of UNESCO-IOC’s Ocean Literacy programme. Beyond film, I have authored numerous scientific and popular-science publications, and continue to share insights through my blog Ryba na piątek (Fish for Friday) (www.rybanapiatek.wordpress.com), weaving together research, observation, and storytelling.

Through both research and outreach, I strive to spark curiosity, foster stewardship of the marine environment, and inspire the next generation of ocean advocates.

Selected publications:

1. Kijewska A., et al. (2023) Molluscs—A ticking microbial bomb; Frontiers in Microbiology **https://doi.org/10.3389/fmicb.2022.1061223**
2. Zieliński T. et al. (2021) Abundance of Environmental Data vs. Low Public Interest in Climate and Ocean Issues. Where Is the Missing Link? Frontiers in Marine Science **https://doi.org/10.3389/fmars.2021.619638**
3. Wenne R. et al. (2020) Trans-Atlantic Distribution and Introgression as Inferred from Single Nucleotide Polymorphism: Mussels Mytilus and Environmental Factors; Genes **https://doi.org/10.3390/genes11050530**
4. Kijewski T. et al. (2019) Random forest assessment of correlation between environmental factors and genetic differentiation of populations: Case of marine mussels Mytilus; Oceanologia **https://doi.org/10.1016/j.oceano.2018.08.002**
5. Najda K. et al. Distribution of ascaridoid nematodes (Nematoda: Chromadorea: Ascaridoidea) in fish from the Barents Sea (2018) Oceanological and Hydrobiological Studies **https://doi.org/10.1515/ohs-2018-0014**
6. Głażewska I. and Kijewski T. (2017) A new view on the European feline population from mtDNA analysis in Polish domestic cats; Forensic Science International: Genetics **https://doi.org/10.1016/j.fsigen.2016.12.010**
7. Kijewska A. et al. (2011) Analysis of Population and Taxonomical Structure of Atlantic Cod, <I>Gadus Morhua</I> (Actinopterygii: Gadiformes: Gadidae) from the Baltic Sea with Use of Microsatellite DNA; Acta Ichthyologica Et Piscatoria **https://doi.org/10.3750/aip2011.41.4.07**
8. Kijewski T. et al. (2011) Distribution of Mytilus taxa in European coastal areas as inferred from molecular markers (2011) Journal of Sea Research **https://doi.org/10.1016/j.seares.2010.10.004**
9. Kijewski T. et al. (2009) Genetic composition of cultured and wild mussels Mytilus from The Netherlands and transfers from Ireland and Great Britain; Aquaculture **https://doi.org/10.1016/j.aquaculture.2008.10.048**
10. Kijewski T. et al. (2006) Introgression and mitochondrial DNA heteroplasmy in the Baltic populations of mussels Mytilus trossulus and M. edulis; Marine Biology **https://doi.org/10.1007/s00227-006-0316-2**

eCUDO.pl – Integrated Marine Data Infrastructure for Sustainable Coastal Management: Science and Engineering Together for Coastal Resilience

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Coastal regions face accelerating pressures from climate change, population growth, and expanding human activities, requiring innovative approaches that unite science and engineering. The Polish Integrated Marine Data Infrastructure – **eCUDO.pl** – addresses this challenge by federating national oceanographic data resources into a coherent, FAIR-compliant framework. Building on the expertise of leading Polish research institutions, eCUDO.pl integrates heterogeneous datasets—from in-situ observations and laboratory analyses to satellite products and digital twins—ensuring their long-term curation, discoverability, and interoperability with European and global infrastructures such as EMODnet, SeaDataNet, and EOSC. This initiative empowers coastal researchers, engineers, and policymakers with high-quality information to design sustainable management strategies, from ecosystem-based approaches to advanced engineering solutions like offshore wind development and coastal defense systems. By bridging the gap between data stewardship, scientific research, and applied engineering, eCUDO.pl strengthens national capacity to support the UN Ocean Decade goals and contributes to resilient coastal communities and ecosystems.

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Education:

2006-Doctor of Design , Harvard University

Research Interests:

Marine Protected Areas, Environmental Planning Strategies, Climate Adaptation in Coastal Planning, GIS Applications in Coastal Planning, Wetland Planning and Design

Courses Offered:

Introduction to Planning Theory, Recording Environmental Changes, Ocean and Coastal Management, Research Methods, Environmental Planning, Special Topics in Wetland and Islands, Planning and Design in Coastal Landscape.

Selected publications:

1. 2021 Chia-Fa Chi, Shiau-Yun Lu*, Willow Hallgren, Daniel Ware, Rodger Tomlinson. “Role of Spatial Analysis in Avoiding Climate Change Maladaptation: A Systematic Review.” *Sustainability*, 13(6), (2021), pp. 3450. (SSCI/SCI)
2. 2020 Wenting Chen, Phoebe Koundouri, Osiel Gonzalez Davila, Claire Haggett, David Rudolph, Shiau-Yun Lu, Chia-Fa Chi, Jason Yu, Lars Golmen, Yung-Hsiang Ying. “Social acceptance and socioeconomic effects of Multi-Use Offshore Developments: Theory and Applications off the Liuqiu Island.” In: Koundouri P. (eds) *The Ocean of Tomorrow. Environment & Policy*, vol 57 (2020). Springer, Cham. https://doi.org/10.1007/978-3-030-56847-4_4
3. 2020 Shiau-Yun Lu. “Edge Cities”. In *The International Geodesign Collaboration: Changing Geograpgy by Design*. (2020). ESRI Press: 80-81.
4. 2020 Chia-Fa Chi, Shiau-Yun Lu*, Jeng-Di Lee. “Ostensibly Effective Adaptive Measures Could Potentially Be Maladaptations: A Case Study of the Jiadung Coastal Area, Pingtung County, Taiwan.” *Coastal Management*, 48(6) (2020), pp. 643-676. (SSCI/SCI)
5. 2020 Wenting Chen, Phoebe Koundouri, Osiel Gonzalez Davila, Claire Haggett, David Rudolph, Shiau-Yun Lu, Chia-Fa Chi, Jason Yu, Lars Golmen, Yung-Hsiang Ying. “Social acceptance and

socioeconomic effects of Multi-Use Offshore Developments: Theory and Applications in MERMAID and TROPOS projects." DEOS Working Papers, NO 2021(2020).

6. 2018 Ya-Tsune Sie, Pierre-Alexandre Château, Yang-Chi Chang, Shiau-Yun Lu. "Stakeholders Opinions on Multi-Use Deep Water Offshore Platform in Hsiao-Liu-Chiu, Taiwan." *Int. J. Environ. Res. Public Health* 15(2) (2018).
7. 2014 Shiau-Yun Lu*, Cheng-Han Shen, Wen-Yan Chiau. "Zoning Strategies for Marine Protected Areas in Taiwan: Case Study of Gueishan Island in Yilan County, Taiwan." *Marine Policy* 48 (Sep. 2014), pp. 21-29. doi: 10.1016/j.marpol.2014.03.001 (SSCI, IF=2.23; subject categories Environmental Studies 18/93=19.35%; subject categories International Relations 5/83=6.02%)

Rethinking Marine Spatial Resilience through the Lens of Marine Pollution Emergency Response

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From a policy perspective, this presentation examines how disaster response thinking can be systematically incorporated into marine spatial planning (MSP) to enhance ocean resilience. In 2024, several typhoons struck Taiwan, leading to eleven vessels grounding and/or sinking. Although these incidents did not result in marine pollution, they exposed the vulnerability of coastal and maritime spatial management under extreme weather events. This experience underscores the need to move beyond sectoral management and integrate emergency preparedness into spatial governance frameworks.

The discussion proposes a resilience-oriented framework that links MSP with the three key stages of marine pollution emergency management. **Prevention** requires spatial risk zoning, appropriate planning for designated vessel evacuation and sheltering routes during maritime disasters. **Response** emphasizes spatial coordination - defining logistics corridors, containment zones, and command areas to minimize response time, covering the full planning, allocation, and mobilization of emergency response resources. **Recovery** involves spatial prioritization for ecological restoration, post-incident monitoring, and rehabilitation of sensitive marine habitats.

By reflecting on Taiwan's typhoon experience, this talk underscores the importance of linking MSP with emergency management policies. Embedding disaster preparedness and pollution response frameworks into marine spatial governance can enhance both ecological protection and maritime safety - ensuring that ocean spaces remain not only productive but also resilient in the face of a changing climate.

Keywords: marine pollution emergency response, emergency preparedness, prevention, response, recovery

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2016.8–2020.7: Vice President, National Taiwan Ocean University
2012.8–2020.7: Director, Center of Excellence for Engineering, NTOU
2012.8–2017.8: Director, Office of Research and Development, NTOU
1990.7–1992.9: Visiting Scholar, Institute of Hydraulic Research, University of Iowa, U.S.A.
2000.7–2000.10: Visiting Scholar, Department of Physical Sciences, Virginia Institute of Marine Science, U.S.A.

Education:

1990: Ph.D., Hydraulic and Ocean Engineering, National Cheng Kung University, Taiwan

Professional Services:

2022–2025: President, The Taiwan Society of Ocean Engineering
2018–2022: President, Taiwan Society of Deep Ocean Water Resource Application
2019–2023: President, Chinese Ocean and Underwater Technology Association

Contributions to Science:

My academic expertise spans **coastal development and conservation, wave theory, nearshore hydrodynamics, ocean and marine engineering, and offshore wind and marine energy**. I have published several textbooks, including *Nearshore Hydrodynamics* (1st and 2nd editions), *Coastal Engineering*, and *Sustainable Diamond Coast*, which have been widely applied in teaching and engineering practice, contributing to localized engineering solutions.

In research, I have focused on the **development and application of hydrodynamic models**. I developed the **WWM wave model**, capable of effectively forecasting extreme waves and storm surges, particularly over steep topography and shallow waters. I also created the **EEMSE wave diffraction–refraction model** for harbor stability analysis and Bragg resonance prediction, and applied the **RANS model** to investigate three-dimensional vortex dynamics under wave–current–structure interactions.

In practice, I have promoted **nature-based coastal engineering methods**, successfully implementing beach nourishment and protection projects in Pingtung Wenfeng, Kaohsiung Cijin and Cieding, Tainan Golden Coast, and Hualien Nanbin. In 2011, I was seconded to establish the **Center of Ocean Engineering Technology and Strategy (COETS) at NTOU**, integrating facilities and expertise to conduct large-scale interdisciplinary research, securing approximately NT$80 million annually. From 2018 to 2022, the center was funded by the Ministry of Education as an **International Center of Excellence**, focusing on coastal disaster prevention, offshore wind, and marine energy.

From 2015 to 2017, I served as convener of the **National Submarine Program and Marine Engineering Division**, and led the **NEP-I national energy project** on offshore wind turbine support structures, including field visits to wind farms in Germany and the UK. In the **NEP-II phase**, I acted as convener of the **bridging and communication taskforce**, establishing a coordination office to resolve critical issues such as fishery compensation, geothermal regulations, and environmental assessment procedures. I also helped establish dynamic and field measurement benchmarks for offshore wind turbine design, providing technical support to the Bureau of Standards in formulating national codes and guidelines.

Selected publications:

1. G. **Sahoo**, H. Behera* and T.-W. Hsu* (2025). Wave-Power Extraction by an Oscillating Water Column Device over a Step Bottom. *Mathematics*, Vol. 13(7), 1067.
2. G. **Sahoo**, H. Behera* and T.-W. Hsu* (2025). Wave Load Reduction and Tranquility Zone Formation Using an Elastic Plate and Double Porous Structures for Seawall Protection. *Mathematics*, Vol. 13(17), 2733.
3. N.-J. Wu, T.-W. Hsu* and T.-C. Lin* (2025). A Pattern-Based Machine Learning Model for Imputing Missing Records in Coastal Wind Observation Networks. *Meteorological Applications*, Vol. 32(3), e70050.
4. A. Biswal, H. Behera*, D.-J. Jwo and T.-W. Hsu* (2025). One-Dimensional Four-Layered Photonic Heterostructures: Analysis of Transmittance. *Materials*, Vol. 18(7), 1433.
5. B. Sarkar, S.-M. De, C.-C. Tsai* and T.-W. Hsu* (2025). Hydroelastic analysis of oblique wave interaction with submerged L-shaped Jarlan-type breakwater. *Journal of Fluids and Structures*, Vol. 138, 104389.
6. B. Sarkar, P. Sharma, S. De, C.-C. Tsai and T.-W. Hsu* (2025). Flexural-gravity wave interaction with dual inverse Π-type breakwaters. *Ships and Offshore Structures.*
7. B. Sarkar, P. Sharma, S. De, C.-C. Tsai and T.-W. Hsu* (2025). Wave scattering by an infinite trench in the presence of bottom-mounted inverted Π-shaped or floating Π-shaped structure. *Physics of Fluids*, Vol. 37(1), 017131.

8. I.-M. Prasad, N.-M. Prasad, R.-M. Prasad, C.-C. Tsai, T.-W. Hsu and H. Behera* （2025）. Surface and Interfacial Wave Propagation over an Undulating Bottom in a Stratified Fluid with a Moored Porous-Flexible Barrier. *Journal of Engineering Mechanics*, Vol. 151（2）, 04024109. （SCIE, IF=3.3, R=46/183=25% （EM）, Cited=0）.
9. I.-M. Prasad, H. Behera*, T.-W. Hsu, S.-M. Zheng and B.-N. Mandal （2024）. Impact of bottom explosions on wave formation in the presence of an inertial surface and wave current in a viscous fluid. *Physics of Fluids*, Vol. 36（12）, 127167. （SCIE, IF=4.1, R=2/40=5% （MS）, Cited=0）.
10. H.-J. Tang, M.-C. Ong and T.-W. Hsu* (2024). Dynamic analysis of a 15 MW semi-taut mooring floating offshore wind turbine at intermediate water depth: Investigating mooring line failure under operating and parked conditions. *Ocean Engineering*, Vol. 312 (3), 119108. (SCIE, IF=4.6, R=2/25=8% (EM), Cited=0).
11. C.-R. Ho, K.-H. Cheng, H.-J. Lee and T.-W. Hsu* (2024). Characteristics Analysis of Acoustic Doppler Current Profile Measurements in Northeast Taiwan Offshore. *Journal of Marine Science and Engineering*, Vol. 12(9), 1632. (SCIE, IF=2.7, R=6/25=24% (EM), Cited=0).
12. H.-C. Tao, T.-W. Hsu* and C.-M. Fan (2024). An Improved One-Line Evolution Formulation for the Dynamic Shoreline Plan-forms of Embayed Beaches. *Water*, Vol. 16(5), 774. (SCIE, IF=3, R=40/128=31% (WR), Cited=0).
13. R. Gayathri, J.-Y. Chang, C.-C. Tsai and T.-W. Hsu* (2024). Wave Energy Conversion through Oscillating Water Columns: A Review. *Journal of Marine Science and Engineering*, Vol. 12(2), 342. (SCIE, IF=2.7, R=6/25=24% (EM), Cited=4).
14. C.-C. Lin, H.-C. Lee, T.-W. Hsu* and W.-H. Liu* (2024). Offshore wind energy and fisheries: Sustainable development goals, enterprise practices, and fishermen's perspectives. *Sustainable Development*, Vol. 32(5), 5224-5239. (SSCI, IF=9.9, R=1/63=1% (DS), Cited=1).
15. I.-M. Prasad, H. Behera, C.-C. Tsai and T.-W. Hsu* (2024). Effects of topographical disturbances on flexural wave motion in a viscous fluid. *Physics of Fluids*, Vol. 36(3), 037103. (SCIE, IF=4.1, R=2/40=5% (PF), Cited=5).
16. K.-K. Barman, A. Chanda, C.-C. Tsai* and T.-W. Hsu* (2024). Bragg scattering of gravity waves by a sea bed of varying depth in the presence of uniform current covered by a floating membrane. *Physics of Fluids*, Vol. 36, 012118. (SCIE, IF=4.1, R= 2/40 =5% (PF), Cited=7).

Resilient Coastal Protection under Climate Change: Sustainable Challenges and Opportunities of Land Reclamation

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This presentation addresses the challenges faced by Taiwan's coasts under climate change, including sea-level rise, extreme weather events, and compound disasters that accelerate coastal erosion and damage critical infrastructure. While conventional hard engineering approaches such as coastal dikes provide short-term benefits, they may also exacerbate environmental degradation and water attraction. A shift toward nature-based and hybrid protection strategies is urgently needed. Land reclamation, beyond expanding usable land, can be designed as a multi-layered coastal defense system that enhances disaster resilience, dissipates wave energy, and supports industrial development. Using Waisanding Sandbar as a demonstration site, the presentation proposes integrated solutions that combine beach nourishment, ecological planting, circular economy practices, and renewable energy applications. Drawing lessons from international cases and innovative techniques such as CaO-modified steel slag utilization, the study emphasizes the importance of central government coordination, local engagement, and academia–industry collaboration. Ultimately, the goal is to establish a sustainable demonstration zone that balances ecological conservation, green energy development, and disaster prevention, offering a forward-looking blueprint for Taiwan's coastal resilience.

Keywords: Coastal Resilience, Climate Change Adaptation, Nature-Based Solutions, Land Reclamation and Multi-layered Defense, Integrated Coastal Management

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Education:

2011: PhD, Institute of Hydro-Engineering Polish Academy of Sciences, Poland (IBW PAN).

2005: MSc, Faculty of Applied Physics and Mathematics, Gdansk University of Technology, Poland.

Professional Services:

2024-present: Expert in Flood Protection and Coastal Engineering at Maritime Office in Gdynia (government agency responsible for Coastal Protection in Poland).

2023-present: Member of the Pomerania Voivodeship Urban and Architectural Commission.

2020-present: Section Editor for Coastal and Offshore Engineering in the Polish-language scientific-technical bimonthly published regularly since 1980: Marine Engineering and Geotechnics (ISSN 0867-4299).

2017–present: Academic lecturer at the University of Gdansk, Faculty of Oceanography and Geography and Gdansk University of Technology, Faculty of Civil Enginnering.

Contributions to Science:

My professional activities are divided into two main areas: scientific research and engineering project management. In my scientific work, I focus on: (1) studying seabed, coast and dune evolution processes, wave generation and propagation in the open sea, current generation and sediment transport in the coastal zone, wave and current interactions with structures, fundamental issues in wave mechanics and sediment transport, mechanisms of generation and evolution of seabed scours around marine structures. All these issues relate to designing coastal protection measures, breakwaters in ports, and other marine infrastructure. My scientific activities have contributed to advancing the understanding of coastal processes and have provided a solid foundation for informed Polish decision-makers in coastal zone management and marine engineering. This has led to my involvement in all the most significant projects built in the South Baltic Sea since 2011. Methodologies typically include calculation of wave transformation, coastal current generation, sediment transport, dune erosion, seabed/coastline evolution, wave interaction in ports, and wastewater discharge modelling. I utilise software such as DELFTD3D, FUNWAVE, PHAROS, UNIBEST,

MIKE 21 Shoreline Morphology, and custom Matlab scripts.

Selected publications:

1. Harenda, M., Dudkowska, A., **Szmytkiewicz, P**. Spatio-Temporal Morphodynamics of a Nourished Sandy Shore Based on LiDAR Measurements. *Water* 2024, *16*, 1055. **https://doi.org/10.3390/w16071055.** Impact Factor 3.0. CiteScore 5.8.
2. Cerkowniak, G., Ostrowski, R., Schönhofer, J., Stella-Bogusz, , M., Szmytkiewicz, M., **Szmytkiewicz, P**.: *Optimized regulation of the Vistula River at its connection to the sea*. CONTINENTAL SHELF RESEARCH, 2024, 105244. doi: 10.1016/j.csr.2024.105244. Impact Factor 2.1. CiteScore 4.3.
3. Uścinowicz, G., Jegliński, W., Pączek, U., Szarafin, T., **Szmytkiewicz, P**., Uścinowicz, S. *New insights into coastal processes in the southern Baltic Sea: relevance to modelling and future scenarios*. GEOLOGICAL QUARTERLY, 2024, 1. doi: 10.7306/gq.1737. IF 2022 = 1.0 37/48 in Category Geology (Rank by Journal Citation Indicator: 38/61).
4. Harenda, M.; Dudkowska, A.; **Szmytkiewicz, P.** *Spatio-Temporal Morphodynamics of a Nourished Sandy Shore Based on LiDAR Measurements*. *WATER*, 2024, *16*, 1055. **https://doi.org/10.3390/w16071055.** Impact Factor 3.0. CiteScore 5.8.
5. **Szmytkiewicz, P**., Szmytkiewicz, M., Ostrowski, R., Marcinkowski, T.: *Determination of the Optimal Groin Length on a Sandy Multibar Shore of a Nontidal Sea: Case Study of the Hel Peninsula, Poland, South Baltic Sea.* JOURNAL OF WATERWAY PORT COASTAL AND OCEAN ENGINEERING, 2022, Volume 148, Issue 4, DOI10.1061/(ASCE)WW.1943-5460.0000714. Impact Factor: 1.4. Impact Factor (5yr): 1.9. Cite Score: 4.4.
6. **Szmytkiewicz, P**., Ostrowski R., Cerkowniak, G.: *Impact of the Revetment on the Seashore in the Region of Babie Doły (KM 93.6–93.9), Poland*. APPLIED SCIENCES, 2022, 2, 668. *doi: 10.3390/app12020668.* Impact Factor: 2.5. Cite Score: 5.3.
7. **Szmytkiewicz P**., Szmytkiewicz M., Uścinowicz G.: *Lithodynamic Processes along the Seashore in the Area of Planned Nuclear Power Plant Construction: A Case Study on Lubiatowo at Poland*. ENERGIES, Vol. 16, No. 6, 2021, str. 1636-1-1636-16 , DOI: **10.3390/en14061636.** Impact Factor: 3.0. Cite Score: 6.2.
8. Abramowicz-Gerigk T., Burciu Z., Jachowski J., Kreft, Majewski D., Stachurska B., Sulisz W., **Szmytkiewicz P**.: *Experimental Method for the Measurements and Numerical Investigations of Force Generated on the Rotating Cylinder under Water Flow*. SENSORS, **2021**, 21, 2021, str. 2216-1-2216-17 , DOI: **10.3390/s21062216.** Impact Factor 3.4. CiteScore 7.3.
9. Stella M., Ostrowski R., **Szmytkiewicz P**., Kapiński J., Marcinkowski T.: *Driving forces of sandy sediment transport beyond the surf zone*. OCEANOLOGIA, Vol. 61, No. 1, 2019, str. 50-59 , DOI: **10.1016/j.oceano.2018.06.003.** Impact Factor 2.6. CiteScore 5.3.

Engineering Challenges in Ports, Coastal Protection and Wastewater Management in the Era of Climate Change

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Climate change in the South Baltic Sea is characterized by an increase in storm events during the autumn and winter seasons, alongside a rise in periods of calm weather during the summer season. Additionally, the South Baltic region is experiencing dynamic economic development, marked by the construction of new ports, container terminals, a seawater-cooled nuclear power plant, and offshore wind farms. These developments are accompanied by accelerated coastal erosion and heightened pressure on environmental protection. These factors present new engineering challenges in port infrastructure, coastal protection, and wastewater management in the era of climate change. Addressing these challenges in port and coastal infrastructure will require the development of new types of breakwaters that maintain reflection coefficients similar to rubble mound breakwaters but occupy less space. On the other hand, structures on sandy seabed in areas affected by stronger storms can cause increased scour effects in the vicinity of coastal or port structures. This also necessitates the implementation of mitigation measures to prevent the occurrence of such phenomena. Furthermore, the creation of innovative hybrid coastal protection methods is essential. These solutions should integrate Nature-Based Solutions with enhanced resilience to increasingly severe storm conditions, while also accounting for the prolonged calm periods and heatwaves observed in recent years, which must be considered in the design of wastewater management systems. The impact of these factors on the design of marine structures under changing climatic conditions has been extensively analysed.

Keywords: coastal engineering, coastal dynamics, climate change, wave mechanics, breakwaters

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Professional Position:

2021 – present, Professor, National Taiwan University
2004 – 2020, Team Lead, Chevron Energy Technology, USA
2002 – 2004, Manager, David Tein Consulting, USA
1997 – 2001, Senior Engineer, American Bureau of Shipping, USA
1996 – 1997, Engineer, Mil Systems, Canada

Education:

1994: Ph.D., U.C. Berkeley, Naval Architecture & Offshore Engineering, USA

Professional Services:

- 2021, Fellow of Yushan, Taiwan ROC.
- 2018, Fellow of SNAME, USA.
- 2019, Chair, ISO 19901-7 Committee, Station Keeping.
- 2018, Chair, API Sub-Committee 2, RG2 Station Keeping, USA.

Contributions to Science:

Prof. Ma has 30 years of industrial experience in the United States and Canada. He is currently a professor at Dept. of Engineering Science & Ocean Engineering, National Taiwan University. Recently, Prof. Ma formed a design team and completed the design of Taiwan's 1st floating platform which is capable of carrying 15MW wind turbines. With a PhD degree from UC Berkeley, his expertise is mainly in floating platforms, and anchor mooring systems. He is the author of a textbook "Mooring System Engineering for Offshore Structures". He has published over 50 papers, plus several patents.

Selected publications:

TEXT BOOKS:

1. Kai-Tung Ma, Y. Luo, C. Kwan, and Y. Wu, "Mooring System Engineering for Offshore Structures", 330 pages, Gulf Professional Publishing, Elsevier, Paperback ISBN: 9780128185513, eBook ISBN: 9780128185520, June 2019. (Elsevier 出版原文教科書)
2. K. Ma, and F. Yin, "Harvest Wind – Offshore Engineering", NSTC Project, Ship & Ocean Technology Research Center, National Taiwan University, Paperback ISBN: 9786267214350, November 2023.

3. 馬開東, 銀甫, “御風任務 - Offshore Engineering”, 國科會計畫, 國立臺灣大學船舶及海洋技術研究中心出版, Paperback ISBN: 9786267214244, July 2023.

JOURNAL PAPERS

1. Kai-Tung Ma, Wen-Yu Huang, Kuan-Yi Wu, and Glib Ivanov, "Wind Farm Design with 15 MW Floating Offshore Wind Turbines in Typhoon Regions" *Journal of Marine Science and Engineering* 13, no. 4: 687. https://doi.org/10.3390/jmse13040687 2025. **(SCI)**
2. Glib Ivanov, Y. Wu, and Kai-Tung Ma, “Optimized Mooring Solutions for Floating Offshore Wind Turbines in Harsh Environments”, Journal of Ocean Engineering, OE-D-25-02610R2, July 26, 2025. **(SCI)**
3. Glib Ivanov, and Kai-Tung Ma. "Floater Assembly and Turbine Integration Strategy for Floating Offshore Wind Energy: Considerations and Recommendations", Wind 4, no. 4: 376-394. November 2024.
4. Hung-Chun Chang, Amir Noorizadegan, Yi-Hsiu Liu and Kai-Tung Ma, “A Study on Offshore Anchor Selection with a Focus on Torpedo Anchor Stability and Performance” Journal of Marine Science and Engineering, JMSE- 3204162, September 2024. **(SCI)**
5. Glib Ivanov, I Jen Hsu, K. Ma, “Design Considerations on Semi-Submersible Columns, Bracings and Pontoons for Floating Wind”, Special Issue: Recent Advancements in Sustainable Sea Space Utilisation via Floating Solutions, Journal of Marine Science and Engineering, JMSE-2518581, August 2023. **(SCI)**
6. 徐一仁, 雲在天, 馬開東, 黃政彰, 吳華桐, 黃韻慈, 周志明, “浮式風機之半潛式浮臺結構初設計優化”, Journal of Taiwan Society of Naval Architects and Marine Engineers (中國造船暨輪機工程學刊), Vol.41, No.4, pp.175-187, 2022.

Designing Floating Wind Turbines for Taiwan - Leveraging Experience from The Oil & Gas Industry

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As renewable energy developers start venturing into deeper waters, the floating offshore wind turbines (FOWTs) are becoming a preferred solution over fixed structures. Many similarities can be identified between a FOWT and a floating oil & gas platform, such as floater concepts (e.g., spar, semi-submersible, tension leg platform, etc.). This paper focuses on the designs of floater and mooring systems for FOWTs by leveraging the experience gained from the offshore oil & gas industry. Similarities and differences are highlighted in design criteria, analysis, integrity management, installation method and project execution. The established practices regarding mooring design and analysis are reviewed. Anchor radius is recommended based on water depth by referencing sample mooring designs from the oil & gas industry. Long-term mooring integrity and failure rates are summarized. Meanwhile, a few integrity issues are discussed, such as line break due to fatigue, corrosion on chain, and issues with clump weights. Regarding installation, the established method for prelay and hook-up is reviewed. Finally, opportunities for cost reduction of mooring systems of FOWTs are presented related to project execution of wind farms as well as potential areas of innovation, such as installation methods, and synthetic fiber rope. In summary, the state-of-the-art practices from the oil & gas industry are reviewed to benefit the developments of upcoming FOWT projects offshore Taiwan.

Keywords: FOWT, floating wind, mooring, anchor, oil & gas, semi-submersible, mooring integrity

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Professional Position:

2024–present: Vice-Dean for Scientific Research, Faculty of Civil and Environmental Engineering, Gdańsk University of Technology (FCEE GUT)
2022–present: Head of Department of Geotechnical and Hydraulic Engineering, FCEE GUT
2021–present: Professor, FCEE GUT
2015–2021: Associate professor, FCEE GUT
2009-2012: Visiting scholar, Institute of Hydraulic Engineering (IWS), University of Stuttgart, Germany (3 visits, 10 months in total)
2008–2015: Assistant professor, FCEE GUT
2004–2008: Assistant professor, Institute of Hydro-Engineering of the Polish Academy of Science, Gdańsk, Poland

Education and academic degrees:

2021: Professor title granted by the President of the Republic of Poland
2013: Habilitation (DSc) degree in Civil Engineering granted by FCEE GUT
2004: Ph.D., Laboratory of Hydrology and Environment (LTHE), Universite Joseph Fourier, Grenoble, France
2000: Master in Environmental Engineering, GUT

Professional Services:

2024–present: Member of the Committee for Water Science and Water Mangement, Polish Academy of Sciences
2022: Chairman of the Organizing Committee of the 24th International Conference on Computational Methods in Water Resources (CMWR)
2018: Chairman of the Organizing Committee of the 25th Salt Water Intrusion Meeting (SWIM International Conference)
2016-2020: Member of the Committee for Civil and Water Engineering, Polish Academy of Sciences
2011-2019: Associate editor of *Acta Geophysica* journal

Contributions to Science:

My research focuses on modeling flow and transport processes in the subsurface, including coastal areas. I

elaborated novel theoretical approaches to describe single- and multiphase flow in heterogeneous soils and rocks, as well as improved numerical schemes to solve the unsaturated flow equation. I contributed to studies which advanced our understanding of groundwater recharge processes and how they are affected by changing climate. I have been also participating in the development of modeling platforms based on coupling models for different hydrological compartments (MODFLOW, SWAT, HYDRUS), some of which are dedicated to Polish coastal areas. Currently I am involved in international research projects dealing with three crucial aspects of coastal groundwater systems: (i) transport of nutrients from land into coastal water bodies via submarine groundwater discharge, (ii) renewability of fresh groundwater resources in coastal areas in the face of climate change, and (iii) groundwater vulnerability to combined threat from salinization and leaching of agricultural contaminants.

Selected publications:

1. Rahman, A. S., Šimůnek, J., Bradford, S. A., Ajami, H., Meles, M. B., Chen, L., Szymkiewicz, A., Pawłowicz, M., Acero Triana, J.S., Casillas-Trasvina, A. & Beegum, S. (2025). A new externally coupled, physically-based multi-model framework for simulating subsurface and overland flow hydrological processes on hillslopes. Journal of Hydrology, 133842.
2. Pawłowicz, M., Balis, B., Szymkiewicz, A., Šimůnek, J., Gumuła-Kawęcka, A., & Jaworska-Szulc, B. (2024). HMSE: A tool for coupling MODFLOW and HYDRUS-1D computer programs. SoftwareX, 26, 101680.
3. Biesek, B. J., Szymkiewicz, A., Šimůnek, J., Gumuła-Kawęcka, A., & Jaworska-Szulc, B. (2024). Numerical modeling of PFAS movement through the vadose zone: Influence of plant water uptake and soil organic carbon distribution. Science of the Total Environment, 935, 173252.
4. Gumuła-Kawęcka, A., Jaworska-Szulc, B., Szymkiewicz, A., Gorczewska-Langner, W., Angulo-Jaramillo, R., & Šimůnek, J. (2023). Impact of climate change on groundwater recharge in shallow young glacial aquifers in northern Poland. Science of the Total Environment, 877, 162904.
5. Dzierzbicka-Glowacka, L., Dybowski, D., Janecki, M., Wojciechowska, E., Szymczycha, B., Potrykus, D., Nowicki, A., Szymkiewicz, A., ... & Puszkarczuk, T. (2022). Modelling the impact of the agricultural holdings and land-use structure on the quality of inland and coastal waters with an innovative and interdisciplinary toolkit. Agricultural Water Management, 263, 107438.
6. Szymkiewicz, A., Potrykus, D., Jaworska-Szulc, B., Gumuła-Kawęcka, A., Pruszkowska-Caceres, M., & Dzierzbicka-Głowacka, L. (2020). Evaluation of the influence of farming practices and land use on groundwater resources in a coastal multi-aquifer system in Puck region (Northern Poland). Water, 12(4), 1042.
7. Szymkiewicz A. (2013) Modelling water flow in unsaturated porous media: Accounting for nonlinear permeability and material heterogeneity, Springer, Heidelberg-Berlin.

Development of Modeling Tools for Polish Coastal Groundwater Systems

Adam Szymkiewicz [1]

[1]Faculty of Civil and Environmental Engineering, Gdańsk University of Technology, Gdańsk, Poland.

Coastal aquifers are characterized by complex interactions between fresh and saline water. Seawater intrusion (SWI) is the encroachment of saline water into freshwater aquifer, while submarine groundwater discharge (SGD) is the inflow of fresh groundwater into the sea, often carrying important load of nutrients or contaminants. Both SWI and SGD are influenced by local geology, human activity and climate change, impacting in turn the availability of groundwater resources to coastal populations. Numerical models can be used to improve our understanding of coastal groundwater systems and inform decision making process. However, their development is a non-trivial task, due to complicated geology and diversity of processes that must be taken into account. This contribution presents modeling approaches developed for selected aquifers on the Polish Baltic coast in the framework of several recent national and international research projects. Special attention is given to the coupling of models for different hydrological compartments.

Keywords: coastal groundwater, seawater intrusion, submarine groundwater discharge, numerical modeling

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Professional Position:

2016–present: Distinguished Professor, Department of Oceanography, National Sun Yat-sen University (NSYSU), Kaohsiung, Taiwan
2013-2016, Professor, Department of Oceanography, NSYSU, Kaohsiung, Taiwan
2011-2013, Professor, Institute of Marine Geology and Chemistry, NSYSU, Kaohsiung, Taiwan
2010-2011, Professor, Institute of Marine Environmental Chemistry and Ecology, NTOU, Taiwan
2006-2010, Asso. Professor, Institute of Marine Environmental Chemistry and Ecology, NTOU, Taiwan
2005-2006, Associate Res. Scientist, Dept. of Marine Science, TAMUG, TX, USA

Education:

1999: Ph.D., Department of Ocean, Earth, Atmos. Sciences, Old Dominion University, Virginia, USA

Professional Services:

2014-present: Editorial Board Member of Frontiers in Marine Science

2019–present: Editorial Board Member of Scientific Reports

2022–present: Associate Editor of Frontiers in Marine Science

2020-present: Editorial Board Member of Marine Research

2023-2025: Core Expert of the National Science Council's “Taiwan Net-Zero Technology Program Promotion Program

Contributions to Science:

Dr. Hung earned his Ph.D. from Old Dominion University, Virginia, in 1999, followed by postdoctoral research at Texas A&M University. He currently serves as Director of the Taiwan–Palau Ocean Science Education Center and is a Distinguished Professor at National Sun Yat-sen University (NSYSU). His research centers on the oceanic carbon cycle, with a particular focus on carbon sequestration through the biological carbon pump in the open ocean and seaweed-based blue carbon systems in coastal waters. In recent years, he has expanded his work to include sustainable technologies, such as innovative seaweed farming to mitigate coastal eutrophication and green-energy–powered artificial upwelling systems to reduce the impacts of global warming on marine ecosystems. Dr. Hung has authored more than 120 peer-reviewed articles in internationally recognized journals, achieving an h-index of 46 and over 5,600 citations according to Google Scholar. He also serves on the editorial boards of several SCI-indexed journals. Selected publications are listed below.

Selected publications: (*:corresponding author)

1. Weerakkody, W.S., H.-H. Hsieh, V.G. Abedneko, K.H. Ling, T.-C. Chung, Z.-Y. Wang, Y.-Y. Shih, T.-M. Lee , C. Xu, P.H. Santschi, C.-C. Hung* (2025) Diluted swine and aquaculture wastewater enhance carbon sequestration and nutrient removal by the red seaweed *Agardhiellasubulata*. Bioresource Technology, 427, 132327.
2. Hung,C.-C., J.-S. Chang, C.-H. Liao, T.-M. Lee* (2024b) Exploring the impact of ocean warming and nutrient overload on macroalgal blooms and carbon sequestration in deep-sea sediments of the subtropical western North Pacific. Marine Pollution Bulletin, 208,116918.
3. Hung, C.-C., H.-H. Hsieh, W.-C. Chou, E.-C. Liu, C.H. Chow, Y. Chang, T.-M. Lee, P.H. Santschi, R.R.M.K.P. Ranatunga, H.P. Bacosa, Y.-Y. Shih* (2024a) Assessing CO2 sources and sinks in and around Taiwan: Implication for achieving regional carbon neutrality by 2050. Marine Pollution Bulletin, 206, 116664. 14.
4. Weerathunga V., C.-C. Hung, S. Dupont, H.-H. Hsieh, N. Piyawardhana, F.-L. Yuan, K.-J. Kao, K.-C. Huang, W.-J. Huang* (2023) Ocean acidification increases inorganic carbon over organic carbon in shrimp's exoskeleton. Marine Pollution Bulletin, 192, 115050.
5. Hsieh H.-H., Y.-Y. Shih, S.-H. Wu, H. P. Bacosa and C.-C. Hung* (2023) Oceanic Blue Carbon in Seas around Taiwan. Marine Research, 3(2), 19-36, DOI:10.29677/MR.202312_3(2).0002.
6. Weerakkody, W.S., K.H. Ling, H.-H. Hsieh, V.G. Abedneko, J.-F. Shyu, T.-M. Lee, Y.-Y. Shih, K. Ranatunga, P.H. Santschi, C.-C. Hung* (2023) Carbon capture by macroalgae *Sarcodia suae* using aquaculture wastewater and solar energy for cooling in subtropical regions. Science of the Total Environment, https://doi.org/10.1016/ j.scitotenv.2022.158850
7. Chang*, Y., Y.-Y. Shih, Y.-C. Tsai, Y.-H. Lu, J. T. Liu, T.-Y. Hsu, J.-H. Yang, X.- H. Wu and C.-C. Hung* (2022) Decreasing trend of Kuroshio intrusion and its effect on the chlorophyll-a concentration in the Luzon Strait, South China Sea. GIScience & Remote Sensing, 59:1, 633-647.
8. Piyawardhana N., V. Weerathunga , H.-S. Chen , L. Guo , P.-J. Huang , R.R.M.K.P. Ranatunga , C.-C. Hung* (2022) Occurrence of microplastics in commercial marine dried fish in Asian countries. Journal of Hazardous Materials, DOI: https://doi.org/10.1016/j.jhazmat.2021.127093.
9. Hsieh, H. H., V. Weerathunga , W. S. Weerakkody, W. J. Huang , F. L. L. Muller , M. C. Benfield & C. C. Hung* (2021) The effects of low pH on the taste and amino acid composition of tiger shrimp. Scientific Reports, 11:21180.
10. Hsieh, H.-H., M.-H. Chuang, Y.-Y. Shih, S.W. Weerallodige, W.-J. Huang, C.-C. Hung*, F.L.L. Muller, R.R.M.K.P. Ranatunga and D.S. Wijethunga (2021) Eutrophication and Hypoxia in Tropical Negombo Lagoon, Sri Lanka. Frontiers in Marine Science. 2021.678832.
11. Hung*,C.-C., C.-W. Tseng, G.-C. Gong, K.-S. Chen, M.-H. Chen, S.-C. Hsu (2013) Fluxes of particulate organic carbon in the East China Sea in summer. Biogeosciences, 10, 6469–6484.
12. Chen, K.-S., C.-C. Hung*, G.-C. Gong, W.-C. Chou, C.-C. Chung, Y.-Y. Shih, C.-C. Wang (2013) Enhanced POC export in the oligotrophic northwest Pacific Ocean after extreme weather events. Geophysical Research Letters, 40(21), 5728–5734.

Marine Blue Carbon Pathways: Seaweed's Role in Climate Mitigation and Coastal Resilience

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As climate change accelerates, achieving net-zero emissions by 2050 has become a global imperative. While terrestrial afforestation—commonly referred to as "green carbon"—has long dominated carbon sequestration strategies, increasing attention is now being directed toward marine ecosystems, especially in coastal nations and island states like Taiwan. These ecosystems—including phytoplankton, mangroves, seagrasses, and seaweeds—collectively form the foundation of "blue carbon" solutions. This presentation focuses on the emerging role of **seaweed-based blue carbon i**n supporting both climate mitigation and coastal adaptation. Drawing on field measurements from Taiwan, we present quantitative data on the carbon sequestration capacity of various seaweed species and cultivation systems. In addition to carbon capture, seaweeds also play a vital role in **removing excess nutrients such as nitrogen and phosphorus** from coastal waters, offering a natural strategy to combat eutrophication—a concern particularly relevant to regions like the Baltic Sea. The talk will explore the potential of seaweed cultivation not only as a climate solution but also as a scalable approach for enhancing **coastal ecosystem resilience**, water quality improvement, and sustainable aquaculture. We welcome opportunities for international collaboration, especially with researchers in Poland, to co-develop science-based frameworks that integrate seaweed farming into blue carbon and climate adaptation strategies.

Keywords: macroalgae, seaweed, blue carbon, eutrophication, nutrient removal, carbon dioxide removal

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Professional Position:

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2023.8–present: Distinguished Professor, Institute of Marine Environment and Ecology, NTOU

2015.8–2023.8: Professor, Institute of Marine Environment and Ecology, NTOU

2019.8–2019.12: Visiting scholar, Research Center for Environmental Changes, Academia Sinica

2016.8–2019.7: Director, Institute of Marine Environment and Ecology, NTOU

2015.2–2016.7: Director, Center for Research Vessel Management, NTOU

2010.7–2011.7: Visiting scholar, Department of Marine Sciences, University of Georgia, U.S.A.

Education:

2004: Ph.D., Institute of Marine Geology and Chemistry, National Sun Yat-sen University, Taiwan

Professional Services:

2023–2025: Member of the Scientific Steering Committee for the Integrated Marine Biosphere Research (IMBeR) project

2023–present: Associate Editor of *Estuaries and Coasts (ESCO)*

2021–present: Associate Editor of the *Journal Frontiers in Marine Science* (in Marine Biogeochemistry)

Contributions to Science:

As a chemical oceanographer, I have dedicated my career to advancing the understanding of carbonate chemistry in ocean margins and coastal waters—critical for evaluating the ocean's role in regulating atmospheric CO_2 and mitigating climate change. With an H-index of 31 and over 4,000 citations from more than 88 peer-reviewed publications, my work ranges from foundational studies in the South and East China Seas to recent advancements in ocean acidification and coastal blue carbon. I was among the first to document anthropogenic CO_2 accumulation in subtropical marginal seas and to reveal how climate variability and riverine nutrients shape coastal carbon fluxes. More recently, my pioneering research has highlighted the critical yet underrecognized roles of dissolved inorganic carbon (DIC) and total alkalinity (TA) in blue carbon accounting, showing that seagrass ecosystems—especially those in organic-rich reef sediments—act as natural hotspots for ocean alkalinity enhancement. Combining field observations, mesocosm experiments, and theoretical advances, my work not only pushes the frontiers of marine biogeochemistry but also informs climate policy, ecosystem restoration, and the development of blue

carbon credits.

Selected publications:

1. Natividad, M. B., Chen, J. J., Chou, H. Y., Fan, L. F., Shen, Y. L., Chou, W. C.* (2025). Estimation of metabolic dynamics of restored seagrass meadows in a Southeast Asia islet: Insights from ex situ benthic incubation. *Biogeosciences* (in press)
2. Chou, W.-C.*, Fan, L.-F., Natividad, M. B., Chen, J.-J., Tang, Z.-W., Chen, H.-F., et al. (2025). Contrasting CO_2 dynamics in seagrass meadows between organic carbon (OC)-rich reef and OC-poor terrestrial sediments: Implications for enhanced alkalinity production. *Geophysical Research Letters*, 52, e2024GL112373.
3. Chen, T.-Y., Chen, J.-J., & Chou, W.-C.* (2024). Rethinking blue carbon: Unlocking invisible carbon sinks. *Environmental Research Letters*, 19(101001).
4. Pezner, A.K., Courtney, T.A., Barkley, H.C., Chou, W.-C., et al. (2023). Increasing hypoxia on global coral reefs under ocean warming. *Nature Climate Chang.*, 13(4):1-7.
5. Chou, W.-C.*, Fan, L.-F., Yang, C.-C., Chen, Y.-H., Hung, C.-C., Huang, W.-J., Shih, Y.-Y., Soong, K., Tseng, H.-C., Gong, G.-C., Chen, H.-Y., & Su, C.-K. (2021). A unique diel pattern in carbonate chemistry in the seagrass meadows of Dongsha Island: The enhancement of metabolic carbonate dissolution in a semi-enclosed lagoon. *Frontiers in Marine Science*, 8:717685.
6. Chou, W.-C.*, Liu, P.-J., Chen, Y.-H., & Huang, W.-J. (2020). Contrasting changes in diel variations of net community calcification support that carbonate dissolution can be more sensitive to ocean acidification than coral calcification. *Frontiers in Marine Science*, 7:3.
7. Chou, W.-C.*, Chu, H.-C., Chen, Y.-H., Syu, R.-W., & Hung, C.-C., Soong, K. (2018). Short-term variability of carbon chemistry in two contrasting seagrass meadows at Dongsha Island: Implications for pH buffering and CO_2 sequestration. *Estuarine Coastal and Shelf Science*, 210:36-44.
8. Chou, W.-C.*, Gong, G.-C., Hsieh, P.-S., Chang, M.-H., Chen, H.-Y., Yang, C.-Y., & Syu, R.-W. (2015). Potential impacts of effluent from accelerated weathering of limestone on seawater carbon chemistry: a case study for the Hoping power plant in northeastern Taiwan. *Marine Chemistry*, 168:27-36.
9. Chou, W.-C.*, Gong, G.-C., Hung, C.-C., & Wu, Y.-H. (2013). Carbonate mineral saturation states in the East China Sea: present conditions and future scenarios. *Biogeosciences*, 10:6453-6467.
10. Chou, W.-C.*, Gong, G.-C., Cai, W.-J., & Tseng, C.-M. (2013). Seasonality of CO_2 in coastal oceans altered by increasing anthropogenic nutrient delivery from large rivers: evidence from the Changjiang-East China Sea system. *Biogeosciences*, 10:3889-3899.
11. Cai, W.J.*, Hu, X., Huang, W.J., Murrell, M.C., Lehrter, J.C., Lohrenz, S.E., Chou, W.C., Zhai, W., Hollibaugh, J.T., Wang, Y., Zhao, P., Guo, X., Gundersen, K., Dai, M., & Gong, G.C. (2011). Acidification of subsurface coastal waters enhanced by eutrophication. *Nature Geoscience*, 4:766-770.

Broadening Blue Carbon Assessments in Seagrass Meadows: the Overlooked Role of Alkalinity

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Seagrass meadows are globally recognized as vital blue carbon ecosystems due to their ability to capture and bury organic carbon within sediments. However, conventional blue carbon assessments largely emphasize organic carbon burial while overlooking a critical yet underappreciated pathway: alkalinity production. This study highlights how metabolic processes, including carbonate dissolution and anaerobic organic matter degradation, can substantially increase total alkalinity (TA) within seagrass sediments. Elevated TA facilitates the conversion of dissolved CO_2 into bicarbonate and carbonate ions, thereby promoting long-term carbon storage and mitigating ocean acidification. Field observations across contrasting sedimentary settings demonstrate that seagrass meadows on organic carbon–rich reef sediments exhibit benthic alkalinity fluxes nearly two orders of magnitude higher than those on organic carbon–poor terrestrial sediments. These findings underscore the role of such meadows as alkalinity "hotspots." Incorporating these overlooked inorganic carbon dynamics into blue carbon frameworks offers a more comprehensive assessment of the climate mitigation potential of seagrass ecosystems and provides guidance for restoration strategies aimed at maximizing both organic and inorganic carbon sequestration.

Keywords: seagrass, blue carbon, alkalinity enhancement, carbon dioxide removal, ocean acidification

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Contributions to Science:

Professor An Yi Tsai is an ecologist specializing in the study of planktonic organisms in both marine and freshwater environments. His research primarily focuses on nanoflagellates, viruses, and picoplankton, as well as their trophic interactions. He has a particular interest in the ecology of the microbial loop in polar regions and has received funding to investigate mixotrophy in the Pacific and Arctic Oceans. Additional research grants have supported his studies on protistan feeding, nutrient remineralization, and the ecological significance of viruses in marine ecosystems.

Selected publications:

1. Chia-Mei Chang, Bangqin Huang, Xin Liu, Kailin Liu, An-Yi Tsai* (2025). Influence of short-term warming and irradiance on bacterivory in different sized heterotrophic and pigmented nanoflagellates in coastal waters. Marine Ecology Progress Series. (Accepted).
2. Madeline Olivia, Ruei-Feng Shiu, Patrichka Wei-Yi Chen, Chia-Mei Chang, Clara Natalie Annabel, Chuen-Fa Ni, Hwa Chien, Slawomir Jack Giletycz, An-Yi Tsai* (2025). Relative importance of

nanoflagellate grazing and viral lysis for heterotrophic bacterial and Synechococcus spp. mortality in a high-latitude fjord (Adventfjorden, Svalbard) during the summer. Polar Research. (Accepted).

3. Madeline Olivia, Patrichka Wei-Yi Chen, Clara Natalie Annabel, Wen-Chen Chou, Jian-Jhih Chen, Vladimir Mukhanov, Chien-Fu Chao and An-Yi Tsai* (2025). Dynamics of microbial abundance in unvegetated and seagrass habitats: a case study. Journal of Marine Science and Engineering. (Accepted).
4. Olivia, M., Chen, P. W. Y., Chou, W. C., Mukhanov, V., Ufimtseva, M., Liashko, T., ... & Tsai, A. Y. (2025). Grazers Play Different Roles in the Microbial Loop of Oligotrophic and Eutrophic Subtropical Marine Ecosystems. Continental Shelf Research, 105490.
5. Patrichka Wei-Yi Chen, Madeline Olivia, Vladimir Mukhanov, Grace Sitorus, Ufimtseva Margarita, Liashko Tatiana, Sakhon Evgenii, Supriyadi, Intan Dwi Puspitasari, Arpita Ghosh, and An-Yi Tsai* (2025). Diel variations in abundance of microbial communities in the coastal waters of the subtropical western Pacific in spring: potential role of picoeukaryotes. Journal of Marine Science and Technology. (Accepted).
6. Madeline Olivia, Patrichka Wei-Yi Chen, Pei-Chi Ho, Vladimir Mukhanov, An-Yi Tsai* (2025). Experimental warming effects on microbial community growth and mortality during the cold season in coastal waters of Taiwan and Japan. Continental Shelf Research, 286, 105407.
7. Madeline Olivia, Clara Natalie Annabel, Patrichka Wei-Yi Chen, Chih-hao Hsieh, Feng-Hsun Chang, Pei-Chi Ho, Chia-Te Chien, Chien-Fu Chao, Vladimir Mukhanov, An-Yi Tsai* (2025). Dramatic effect of extreme rainfall event and storm on microbial community dynamics in a subtropical coastal region. Science of the Total Environment, 984, 178560.
8. Patrichka Wei-Yi Chen, Madeline Olivia, Gwo-Ching Gong, Sen Jan, Tung-Yuan Ho, Louis St. Laurent, An-Yi Tsai* (2024). Distinct water mass between inside and outside eddy drive changes in prokaryotic growth and mortality in the tropical Pacific Ocean. Frontiers in Marine Science, 11, 1443533.
9. Patrichka Wei-Yi Chen, Madeline Olivia, Gwo-Ching Gong, Sen Jan and An-Yi Tsai* (2024). Viral Dynamics in the Tropical Pacific Ocean: A Comparison between Within and Outside a Warm Eddy. Viruses, 16, 937.
10. Patrichka Wei-Yi Chen, Clara Natalie Annabel, Madeline Olivia, Wen-Chen Chou, Jian-Jhih Chen, Ruei-Feng Shiu, Vladimir Mukhanov, Mariche Natividad, Yi-Le Shen and An-Yi Tsai* (2024). Investigation of the growth and mortality of bacteria and Synechococcus spp. in unvegetated and seagrass habitats. Water, 16, 939.
11. Feng-Hsun Chang, Gwo-Ching Gong, Chih-hao Hsieh, Patrichka Wei-Yi Chen, Vladimir Mukhanov, An-Yi Tsai* (2024). Vertical variations of bacterial growth, mortality loss to nanoflagellates, and viruses in the subtropical northwestern Pacific Ocean. Journal of Marine Systems, 243, 103963.

The Differing Roles of Viral Lysis and Flagellate Grazing in Regulating Bacterial Populations in the Coastal Waters of the Baltic Sea and the Pacific Ocean

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Nanoflagellate grazing and viral lysis have distinct effects on the microbial food web, making it essential to evaluate their respective contributions to bacterial mortality. Additionally, the relative impact of these loss factors often varies by geographic location. In this study, samples were collected from the coastal waters of Gdynia (St. G), Poland, in July 2025, and from the northeastern coastal waters of Taiwan (St. T) during March and April 2025. Although temperatures were comparable at both sites during sampling, salinity levels differed significantly. Field measurements revealed that bacterial and viral abundances at St. G were considerably higher than those observed at St. T. Bacterial growth rates ranged from 0.05 to 0.49 d^{-1} at St. G and from 0.81 to 1.81 d^{-1} at St. T, with significantly higher growth rates recorded at St. T. Notably, viral-induced bacterial mortality could not be estimated at St. G during the study period. On average, grazing accounted for approximately 60% of total bacterial mortality at St. T, surpassing the influence of viral lysis. Interestingly, despite the higher viral abundance in the Baltic Sea waters, no significant viral-driven bacterial mortality was detected. These findings highlight the need for further research to accurately determine picophytoplankton growth and mortality rates and to deepen our understanding of viral production dynamics in the Baltic Sea.

Keywords: nanoflagellates grazing, viral lysis, bacterial mortality, viral abundance, Baltic Sea

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Professional Services:

2024.1–present: Early Career Director of the Cushman Foundation for Foraminiferal Research

2020–present: Board member of Sopot Science Association (STN)

Contributions to Science:

I am an oceanographer specializing in the intersection of biology and geology, with a focus on the history of ocean–climate interactions over the past 15,000 years in the Arctic Ocean and Nordic Seas. My primary tools for climate reconstruction include micropaleontology and multiproxy analyses of sediments, such as biomarkers, stable isotopes, elemental composition, and other geochemical indicators. I have published research on climatic changes recorded in European Arctic sediments, meltwater events during the Holocene, and contemporary shifts in benthic foraminiferal assemblages driven by modern climate change. I am a Fulbright Scholar and a recipient of National Science Centre of Poland grants. I have experience in leading research projects, supervising students, and managing international research collaborations and foundations. In addition, I am deeply passionate about science communication and public outreach.

Selected publications:

1. Devendra, D., Łącka, M., Szymańska, N., Nethupul, H., Pawłowska, J., Szymczak-Żyła, M., Krajewska, M., De Silva, P., Bondevik, S., Gibbons, S. J., Zajączkowski, M. (2025). Expanding the footprint of the Storegga tsunami through new evidence from Arctic marine sediments. *Scientific Reports*.

2. Szymańska, N., Pai, M., Devendra, D., Łącka, M., Zajączkowski, M. (2025). Foraminiferal carbonate production decrease in a rapidly changing fjord (Hornsund, Svalbard 2002–2019). *Journal of Foraminiferal Research*.
3. Devendra, D., Łącka, M., Szymańska, N., Szymczak-Żyła, M., Krajewska, M., Weiner, A. K., De Schepper, S., Simon, M. H., Zajączkowski, M. (2023). The development of ocean currents and the response of the cryosphere on the Southwest Svalbard shelf over the Holocene. *Global and Planetary Change*, 104213.
4. Nguyen, N. L., Devendra, D., Szymańska, N., Greco, M., Angeles, I. B., Weiner, A. K., Ray, J. L., Cordier, T., De Schepper, S., Pawłowski, J., Pawłowska, J. (2023). Sedimentary ancient DNA: A new paleogenomic tool for reconstructing the history of marine ecosystems. *Frontiers in Marine Science*, 10, 1185435.
5. Szymańska, N., Łącka, M., Koziorowska, K., Kuliński, K., Pawłowska, J., Telesiński, M. M., Zajączkowski, M. (2021). Foraminifera-derived carbon contribution to sedimentary inorganic carbon pool: A case study from three Norwegian fjords. *Geobiology*, 19(6), 631–641.
6. Kujawa, A., Łącka, M., Szymańska, N., Telesiński, M. M., Zajączkowski, M. (2021). Could Norwegian fjords serve as an analogue for the future of the Svalbard fjords? State and fate of high latitude fjords in the face of progressive "atlantification". *Polar Biology*, 44, 2217–2233.
7. Hänninen, J., Weckström, M., Pawłowska, J., Szymańska, N., Uurasjärvi, E., Zajączkowski, M., Hartikainen, S., Vuorinen, I. (2021). Plastic debris composition and concentration in the Arctic Ocean, the North Sea and the Baltic Sea. *Marine Pollution Bulletin*, 165.
8. Łącka, M., Michalska, D., Pawłowska, J., Szymańska, N., Szczuciński, W., Forwick, M., Zajączkowski, M. (2020). Multiproxy paleoceanographic study from the western Barents Sea reveals dramatic Younger Dryas onset followed by oscillatory warming trend. *Scientific Reports*, 10, 15667.
9. Telesiński, M., Szymańska, N., Pawłowska, J., Zajączkowski, M. (2020). Does the foraminiferal test size reflect changes in palaeoenvironmental conditions? – A case study from the southern Svalbard shelf. *Polar Research*, 39.
10. Szymańska, N., Pawłowska, J., Kucharska, M., Kujawa, A., Łącka, M., Zajączkowski, M. (2017). Impact of shelf-transformed waters (STW) on foraminiferal assemblages in the outwash and glacial fjords of Adventfjorden and Hornsund, Svalbard. *Oceanology*, 59, 525–540.
11. Pawłowska, J., Łącka, M., Kucharska, M., Szymańska, N., Koziorowska, K., Kuliński, K., Zajączkowski, M. (2017). Benthic foraminifera contribution to fjord modern carbon pools: A seasonal study in Adventfjorden, Spitsbergen. *Geobiology*, 15, 704–714.

Studying Marine Microorganisms to Understand the Impacts of Environmental and Climatic Changes in the Coastal Regions

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Marine microorganisms are among the most vital components of the global carbon cycle. They influence Earth's climate, as demonstrated by both historical records and modern studies of elemental cycles. In addition, they serve as a fundamental food source for more complex organisms. Marine microorganisms are highly dynamic: they can grow rapidly under favorable conditions but may also decline quickly in response to stressors such as pollution or other environmental changes. Diatoms are responsible for producing an estimated 20–50% of the Earth's oxygen. Foraminifera and coccolithophores contribute to both organic carbon (stored within their cells) and inorganic carbon (in the form of calcium carbonate shells), highlighting the dual feedbacks they exert on the carbon cycle when their populations fluctuate. Modern climate change affects marine microorganisms in numerous ways, the most severe being oxygen loss and shifts in water temperature and salinity. In our studies, we observed a significant decline in Arctic foraminifera abundance in response to climate change. This group, characterized by calcium carbonate shells, plays a crucial role in regulating inorganic carbon deposition in coastal sediments, and their contribution to the sedimentary inorganic carbon pool decreased more than fourfold in 20 years. Additionally, foraminifera are widely used as proxies for reconstructing climate variability across geological timescales. Our findings emphasize that in a rapidly changing ocean, the smallest organisms can provide critical insights into the trajectory of environmental change, particularly when comparing past warming events with those unfolding today.

Keywords: marine microorganisms, protists, climate change, ocean-atmosphere interactions, carbon cycle, foraminifera

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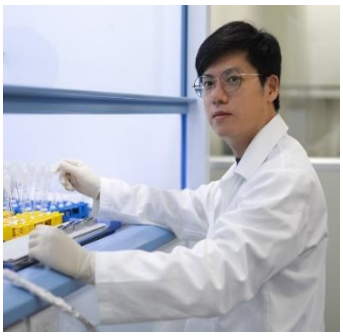

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Specialties:

Marine micro-/ nanoplastic pollution; Fate, air-water exchange and ecological risk of organic pollutants (PAHs, PFASs, Organophosphate esters); Marine organic matter exchange (marine snow formation); Microbial extracellular polymeric substances (EPS)

Contributions to Science:

Dr. Ruei-Feng Shiu is a chemical oceanographer and environmental scientist by training. He is currently working as Associate Professor of Institute of Marine Environment and Ecology, National Taiwan Ocean University (NTOU). His research focused on answering fundamental questions about fate, transport and ecological risk of organic pollutants (e.g. microplastics, polycyclic aromatic hydrocarbons, perfluoroalkyl compounds and plasticizers, etc.) in a variety of environments. He is especially interested in how aquatic organic aggregates such as gel- or snow-like particles affect the transport of pollutants on a variety of scales. His latest research is centered on the transformations of microplastics across the land-ocean-atmosphere continuum, the ultimate fate of missing plastic in environments, the role of gel-particles in carbon sequestrations. His group has extended analysis from microplastic to nano-plastic with py-GC-MS and Nanoparticle Tracking Analysis (NTA) to help measure nano-plastics to understand the real plastic abundance in environments. In addition, he currently develops public ocean focused environmental education programs.

Selected publications:

1. Madeline Olivia, Wu, W.-H., Tsai, A.-Y., Hsu, H.-C., Gong, G.-C. & **Shiu, R.-F.*** (2025). Marine snow accelerates microplastics to ocean interior by aggregation. *Water Research* (Minor Revision)
2. **Shiu, R.-F.*** et al. (2025). Risk-based integrated framework for evaluating effects of microplastics to aquatic ecosystems and human health. *Environmental Research* 279, 121838.
3. Vazquez C. I., Chang H.M., Gong, G.-C., **Shiu, R.-F.*** & Chin, W.-C.* (2024). Impact of nanoplastics on microgel formation from effluent organic matter" *Science of the Total Environment* 954, 176209.
4. **Shiu, R.-F.***, Lee, H.-J., Hsu, H.-T. & Gong G.-C. (2023). Suspended particulate matter-bound per- and polyfluoroalkyl substances (PFASs) in a river-coastal system: Possible correlation with transparent exopolymer particles. *Marine Pollution Bulletin* 191, 114975
5. **Shiu, R.-F.***, Chen, L.-Y., Lee, H.-J., Gong, G.-C. & Lee, C. (2022). New insights into the role of marine plastic-gels in microplastic transfer from water to the atmosphere via bubble bursting. *Water Research* 222, 118856.
6. **Shiu, R.-F.**, Gong, G.-C., Fan, M.-D., Chow, C.-H. & Chin, W.-C. (2021). Marine microplastics in the surface waters of "pristine" Kuroshio. *Marine Pollution Bulletin* 172, 112808.
7. **Shiu, R.-F.**, Carlos I. Vazquez, Chiang, C.-Y., Chiu, M.-H., Chen, C.-S., Ni, C.-W., Gong, G.-C., Quigg A., Santschi, P.H. & Chin, W.-C. (2020). Nano- and microplastics trigger protein-rich microbial extracellular polymeric substance release. *Science of the Total Environment* 748, 141469.
8. **Shiu, R.-F.**, Chiu, M.-H., Vazquez Carlos I, Tsai, Y.-Y., Le Andre, Kagiri Agnes, Xu C, Kamalanathan Manoj, Bacosa Hernando, Doyle Shawn, Sylvan Jason, Santschi P H, Quigg A, Chin W.-C. (2020). Protein to carbohydrate (P/C) ratio changes in microbial extracellular polymeric substances induced by oil and Corexit. *Marine Chemistry* 223, 103789.
9. **Shiu, R.-F.**, Carlos I. Vazquez, Tsai, Y.-Y., Gabriela V. T., Chen, C.-S., Peter H. Santschi, Antonietta Quigg, Chin, W.-C. (2020). Nano-plastics induce aquatic particulate organic matter (microgels) formation. *Science of the Total Environment* 706, 135681.
10. **Shiu, R.-F.**, Lee, C.-L. and Chin, W.-C., (2018). Reduction in the exchange of coastal dissolved organic matter and microgels by inputs of riverine organic matter" *Water Research* 131, 161-166.
11. **Shiu, R.-F.** and Lee, C.-L., (2017). Role of microgel formation in scavenging of chromophoric dissolved organic matter and heavy metals in a river-sea system. *Journal of Hazardous Materials* 328, 12-20.
12. **Shiu, R.-F.** and Lee, C.-L., (2017). Effects of anthropogenic surfactants on the conversion of marine dissolved organic carbon and microgels. *Marine Pollution Bulletin* 117 (1-2), 156-160.

Fate of Missing Plastics in the Ocean

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Abstract

Plastic pollution are increasingly recognized as ubiquitous contaminants in the Earth, and pose an ecological risk to both ecosystems and humans. Fresh plastics and debris enter natural systems and undergo various degradation processes, to gradually break down this material into micro-plastics (MPs) and nano-plastics (NPs). As plastic materials degrade (i.e. NPs), their ecological and toxic impacts become more complex. Additionally, the global mass of measured marine microplastics in surface water is still much smaller than expected based on the loads of mismanaged plastics releasing into the ocean, sparking discussions regarding to “missing plastics” and final sinks. In this talk, I plan to share my personal experiences working with missing plastics including microplastic transport between air-sea surface microlayer-water, marine plastic-snow aggregation and subsequent sedimentation, microplatic breaking down into nanoplastics as well as NP analysis (py-GC/MS). The presentation will provide information about possible controlling factors in determining environmental fate of plastics, and search for potential collaboration topics on marine pollution.

Keywords: micro-plastics, nano-plastics, marine plastic-snow, py-GC/MS

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Editor-PloS ONE

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Contributions to Science:

Chih-hao (Zac) Hsieh is a Professor of Oceanography at National Taiwan University. Chih-hao Hsieh's academic journey began with an MS/BA in Zoology from National Taiwan University, followed by a PhD in Oceanography from the University of California-San Diego. Since joining the faculty of National Taiwan University in 2007, he has played a major role in research and teaching. He served as Director of the Institute of Oceanography from August 2020 to July 2023. His notable achievements include receiving the Biwako Prize for Ecology, the Ministry of Science and Technology Outstanding Research Award of Taiwan, recognition as one of the Ten Outstanding Young Persons of Taiwan, and the Young Scientist Research Innovation Award. Chih-hao Hsieh's research prowess is evidenced by his authorship of over 140 research articles, many of which have been published in prestigious journals such as Nature and Science. His research focuses on developing methods for time series analysis in dynamical systems, with applications in environmental management, economics, epidemiology, ecology, medical sciences, and

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Selected publications:

1. Grziwotz F., C. W. Chang, V. Dakos, E. H. van Nes, M. Schwarzländer, O. Kamps, M. Heßler, I. T. Tokuda, A. Telschow, and C. H. Hsieh. (2023) Anticipating the occurrence and type of critical transitions. Science Advances. 9: eabq4558.
2. Chang, C. W, T Miki, H. Ye, S. Souissi, R. Adrian, O. Anneville, H. Agasild, Y. S., Ban, Be'eri-Shlevin, Y. R. Chiang, H. Feuchtmayr, G. Gal, S. Ichise, M. Kagami, M. Kumagai, X. Liu, S. I. Matsuzaki, M. M. Manca, P. Nõges, R. Piscia, M. Rogora, F. K. Shiah, S. J. Thackeray, C. E. Widdicombe, J. T. Wu, T. Zohary, and C. H. Hsieh (2022) Causal networks of phytoplankton diversity and biomass are modulated by environmental context. Nature Communications. 13:1140.
3. Chang, C. W., T. Miki, M. Ushio, P. J. Ke, H. P. Lu, F. K. Shiah, C. H. Hsieh (2021) Reconstructing large interaction networks from empirical time series data. Ecology Letters. 24: 2763– 2774.
4. Chang, C. W., H. Ye, E. R. Deyle, T. Miki, S. Souissi, O. Anneville, R. Adrian, Y. R. Chiang, S. Ichise, M. Kumagai, S. S. Matsuzaki, F. K. Shiah, J. T. Wu, C. H. Hsieh, and G. Sugihara (2020) Long-term warming weakens stabilizing effects of biodiversity in aquatic ecosystems. Global Change Biology 26: 6413-6423.
5. Wang J. Y., T. C. Kuo, and C. H. Hsieh (2020) Causal effects of population dynamics and environmental changes on spatial variability of marine fish. Nature Communications. 11: 2635.
6. Wu, W., H. P. Lu, A. R. Sastri, Y. C. G. C. Gong, W. C. Chou, and C. H. Hsieh (2018) Contrasting the relative importance of species sorting and dispersal limitation in shaping marine bacterial versus protist communities. ISME Journal. 12: 485-494.
7. Yang, J. W., W. Wu, C. C. Chung, K. P. Chiang, G. C. Gong, and C. H. Hsieh (2018) Predator and prey biodiversity relationship and consequences on marine ecosystem functioning—Interplay between nanoflagellates and bacterioplankton. ISME Journal. 12: 1532-1542.
8. Ushio, M., C. H. Hsieh, R. Masuda, E. Deyle, H. Ye, C. W. Chang, G. Sugihara, and M. Kondoh (2018) Fluctuating interaction network and dynamic stability of natural fish community. Nature 554: 360-363.
9. Sugihara, G., R. May, H. Ye, C. H. Hsieh, E. Deyle, M. Fogarty, and S. Munch (2012) Detecting causality in complex ecosystems. Science 338: 496-500
10. Anderson, C.N.K., C.H. Hsieh, S.A. Sandin, R. Hewitt, A. Hollowed, J. Beddington, R.M. May, and G. Sugihara (2008). Why fishing magnifies fluctuations in fish abundance. Nature, 452: 835-839
11. Hsieh, C.H., S.C. Reiss, J. R. Hunter, J.R. Beddington, R. M. May, and G. Sugihara (2006) Fishing elevates variability in the abundance of exploited species. Nature. 443: 859-862.
12. Hsieh, C.H., S.M. Glaser, A.J. Lucas, and G. Sugihara (2005) Distinguishing random environmental fluctuations from ecological catastrophes for the North Pacific Ocean. Nature. 435: 336-340.

Marine ECOsystem Dynamics with Hi-Frequency Time Series Monitoring and Analysis (EcoHiMA)- Research Opportunity and Challenges

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Being able to understand ecosystem responses to environmental impacts is a pressing concern. To fulfill the societal need, many studies have been conducted to investigate impacts of environmental disturbances on community and diversity as well as ecosystem functioning and stability, using either lab experiments or field observations. Thus far, existing studies have focused mainly on changes of states, e.g., ecosystems with/without disturbance in manipulative experiments, or before/after disturbance in field observations (i.e., snapshot view). Those approaches often do not accommodate the dynamical view of nature and thus can only provide limited understandings.

To bridge the knowledge gap, we collected high-frequency (daily) time series data in Chao-Jing, northern Taipei, for a consecutive of 100 days focusing on communities of microbial organisms in the marine foodweb and environmental variables. Sampling started on September 18 and ended on December 26, 2025. Three typhoons hit northern Taiwan, which tentatively disrupted the sampling.

Principal component analysis (PCA) of environmental variables shows that the environmental conditions shifted from high temperature and high chlorophyll-a to low temperature and high inorganic nutrient concentration through the 100-day time series. Chl*a* and POC decreased through time with large fluctuations, while DIC and TA increased with fluctuations.

No clear trend was observed in bacterial abundance and production; rather, substantial temporal variability was observed. High-throughput amplicon sequencing targeting 16S and 18S rRNA reveals temporal variation of bacteria, phytoplankton, and eukaryotic communities. Both eukaryotic and prokaryotic communities exhibited a marked decline in diversity during the interval between the two typhoons that affected Chaojing. Principal coordinate analysis (PCoA) based on Bray-Curtis beta-diversity illustrates the community structure of prokaryotes, phytoplankton, and eukaryotes. The results show that prokaryotic and phytoplankton communities underwent significant shifts in composition during the first half of the time series, followed by relative stability through the remaining sampling period. Eukaryotic communities, in contrast, showed a gradual transition through time. Time series analysis based on Empirical Dynamic Modeling revealed time-varying complex interaction networks in microbiome.

Keywords: empirical dynamic modeling; environmental changes; anthropogenic impacts; marine foodweb; time-varying interactions

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2025 TAIWAN POLAND

Symposium on Marine Science and Technology

2025 臺灣-波蘭海洋科學與技術研討會

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