Iranian National Institute for Oceanography and Atmospheric Science

INSF

Shahid Beheshti University

## Assessment, Mitigation and Adaption :

# Ocean-Climate Change Dialogue between China and Iran

Tehran, Iran & Online 26-28, January, 2026

SKLEC

IMBeR

# Assessment, Mitigation and Adaption: Ocean-Climate Change Dialogue between China and Iran

**Date: 26-28 January 2026 – Tehran & Online**

# Assessment, Mitigation and Adaptation: Ocean-Climate Change Dialogue between China and Iran

## General Information for the Conference

### Date and Time:

**Registration:**

- January 26, 2026, at 08:30-09:00 (Tehran Time)

**Conference:**

- January 26, 2026, at 09:00-15:50 (Tehran Time) / 13:30-20:20 (Beijing)
- January 27, 2026, at 09:00-15:30 (Tehran Time) / 13:30-20:00 (Beijing)

### Conference Location:

- **In-person:** Conference Room, Faculty of Earth Sciences Building, Shahid Beheshti University, Shahid Shahriari Square, Evin, Tehran, Iran
- **Online:** Skyroom (invited only)
  After entering the meeting, please change your name to full name – affiliation/institution

  Meeting Link: https://www.skyroom.online/ch/inioas/workshop

  Meeting ID: inioas@inio.ac.ir

### Sponsors:

Iran's Natural Science Foundation (INSF)

National Natural Science Foundation of China (NSFC)

### Organizer:

Iranian National Institute for Oceanography and Atmospheric Science (INIOAS)

### Co-organizer:

State Key Laboratory of Estuarine and Coastal Research, East China Normal University (SKLEC)

### Endorsed by:

Integrated Marine Biosphere Research (IMBeR)

## Workshop Objectives

This workshop aims to promote scientific dialogue between Chinese and Iranian researchers on ocean-climate change, discuss strategies for mitigation and adaptation in coastal and marginal seas, share recent research on carbon and nutrient fluxes, biogeochemical tracers, ocean-climate interactions, and human impacts on coastal ecosystems, support capacity-building and knowledge exchange through interactive sessions, and strengthen regional and international partnerships for sustainable ocean research.

## Presentation Guidelines & Practical Information

### Presentation Time:

- Each presentation is scheduled for 25 minutes (approximately 20 min talk + 5 min Q&A).

### Slides Requirements:

- Prepare slides in Microsoft PowerPoint (preferred) or PDF
- Conference computers are equipped with Microsoft Office
- All slides will be copied in advance by conference staff to ensure proper display

### Weather Conditions & Clothing Recommendations:

Tehran in January typically experiences winter conditions, with cool to cold temperatures.

Average daytime: 5-10 °C

- Nighttime: around 0 °C or slightly below
- Conditions: Generally dry; occasional rainfall or light snowfall possible

**Recommended clothing:**

- Medium to heavy coat or jacket
- Long-sleeved shirts or sweaters
- Comfortable closed shoes suitable for walking
- Scarf and optionally gloves
- Layered clothing is recommended (indoor environments are usually well heated)

### Contact Person:

Dr. Maryam Ghaemi

- Phone: +98-9177026815
- E-mail: mghaemi@inio.ac.ir

## Workshop Leadership

**Dr. Ying Wu**
**Scientific Secretary**

Dr. Ying Wu is a coastal biogeochemist whose research focuses on sedimentary organic carbon dynamics, iron–redox interactions, and carbon burial processes in estuarine and coastal systems. She has extensive experience in river-dominated margins, integrating field observations and geochemical analyses to investigate organic matter stabilization under varying environmental conditions.

Dr. Wu has contributed to national and international research projects on coastal carbon cycling and environmental change and is actively involved in interdisciplinary collaborations within the global marine biogeochemistry community. She plays a key coordinating role in fostering scientific dialogue and cooperation between Chinese and Iranian research communities within the framework of this workshop. As the Scientific Secretary of this workshop, she supports the scientific coordination and thematic integration of the programme.

**Dr. Maryam Ghaemi**
**Scientific and Executive Secretary**

Dr. Maryam Ghaemi is a marine chemist and oceanographer specializing in chemical oceanography, nutrient dynamics, ocean acidification, and marine pollution, with a particular focus on coastal ecosystems such as mangroves. She has extensive experience studying the biogeochemistry of the Persian Gulf, the Gulf of Oman, and the northwest Indian Ocean.

As Vice-Chair of IOCINDIO and IMBeR National Contact for Iran, Dr. Ghaemi plays an active role in advancing regional and international collaboration in ocean science and sustainability. Her research integrates field observations and laboratory analyses to assess long-term environmental change in marginal seas. As the Scientific and Executive Secretary of this workshop, she oversees its scientific framework, international coordination, and overall implementation.

# Schedule of Sessions

## Sunday, 25 January 2026

Arrival of participants; airport pick-up and hotel transfer arranged

## Day 1 – Monday, 26 January 2026 (Tehran & Online)

**Opening and Group Photo**

| Item | Tehran Time | Beijing Time | Activity | Speaker / Country / Mode | Moderator / Notes |
|---|---|---|---|---|---|
| **On-site registration** | 08:30–09:00 | 13:00-13:30 | Registration | - | Registration desk open at venue |
| **Opening** | 09:00–09:10 | 13:30–13:40 | Opening Remarks | Behrooz Abtahi<br>Ali Mehdinia | Maryam Ghaemi |
| **Opening** | 09:10-9:15 | 13:40-13:45 | Workshop Overview | Ying Wu<br>Maryam Ghaemi | Maryam Ghaemi |
| **Group Photo** | 09:15–09:20 | 13:45–13:50 | Group Photo | All participants | – |

### *Session 1– Sedimentary and Molecular Approaches to Carbon and Nutrient Cycling*

| Session/ Item | Tehran Time | Beijing Time | Title/Activity | Speaker / Country / Mode | Moderator/ Notes |
|---|---|---|---|---|---|
| **S1** | 09:20–09:45 | 13:50–14:15 | Molecular Identification of Organic Compounds in the Marine Environment: Techniques, Challenges and Applications | Miaolei Ya, China, online | Abolfazl Saleh |
| **S1** | 09:45–10:10 | 14:15–14:40 | Hydrodynamic–Redox Controls on Iron-Bound Organic Carbon Across Contrasting Coasts | Ying Wu, China, on-site | Abolfazl Saleh |
| **S1** | 10:10–10:35 | 14:40–15:05 | Sedimentary Phosphorus in the Persian Gulf and the Gulf of Oman | Kamalodin Kor, Iran, on-site | Abolfazl Saleh |
| **Coffee / Tea Break** | 10:35–10:55 | 15:05–15:25 | Coffee / Tea Break | - | Refreshments |

### *Session 2– Tracers and Isotopes in Carbon and Coastal Fluxes*

| Session/ Item | Tehran Time | Beijing Time | Title/Activity | Speaker / Country / Mode | Moderator/ Notes |
|---|---|---|---|---|---|
| **S2** | 10:55–11:20 | 15:25–15:50 | Radiocarbon as a dating tool and paleo-proxy in the ocean: challenges and some progress | Ning Zhao, China, on-site | Ning Zhao |
| **S2** | 11:20–11:45 | 15:50–16:15 | Global patterns of organic carbon transfer and accumulation across the land–ocean continuum constrained by radiocarbon data | Chenglong Wang, China, online | Ning Zhao |
| **S2** | 11:45–12:10 | 16:15–16:40 | Using Radium Isotopes to Estimate SGD and Dissolved Carbon Exports | Qianqian Wang, China, online | Ning Zhao |
| **Lunch Break** | 12:10–13:40 | 16:40–18:10 | Lunch | - | Near venue |

### *Session 3– Physical, Geochemical, and Atmospheric Forcing of Marine and Earth Systems*

| Session/ Item | Tehran Time | Beijing Time | Title/Activity | Speaker / Country / Mode | Moderator/Notes |
|---|---|---|---|---|---|
| **S3** | 13:40–14:05 | 18:10–18:35 | White Hydrogen and Ophiolitic Lands in Iran | Hamid Nazari, Iran, on-site | Maryam Ghaemi |
| **S3** | 14:05–14:30 | 18:35–19:00 | Dissolved Ga and Its Isotopes in the Minjiang Estuary | Jing Zhang, China, on-site | Maryam Ghaemi |
| **S3** | 14:30-14:55 | 19:00-19:25 | Atmospheric Nitrogen Loading in the West Pacific and East Indian Ocean | Shan Jiang, China, online | Shang Jiang |
| **S3** | 14:55–15:20 | 19:25–19:50 | Contrasting Stratification Controls and Biogeochemical Responses in the Arabian Sea and Bay of Bengal | Xu Yi, China, online | Shang Jiang |
| **S3** | 15:20–15:45 | 19:50–20:15 | Three-Dimensional Hydrodynamic Modeling of the Persian Gulf with Emphasis on Air–Sea Heat Fluxes | Zhong Peng, China, online | Maryam Ghaemi |
| **End of Day 1** | 15:45–15:50 | 20:15–20:20 | Scientific Reflections and Announcements | - | Maryam Ghaemi |

## Day 2 – Tuesday, 27 January 2026 (Tehran & Online)

### *Session 4– Pollution Impacts and Ecosystem Responses in Coastal Systems*

| Session/ Item | Tehran Time | Beijing Time | Title/Activity | Speaker / Country / Mode | Moderator/ Notes |
|---|---|---|---|---|---|
| **S4** | 09:00–09:25 | 13:30–13:55 | Microplastic pollution of bird colonies as an indicator of ecosystem health in the Persian Gulf | Behrooz Abtahi, Iran, on-site | Behrooz Abtahi |
| **S4** | 09:25–09:50 | 13:55–14:20 | Wildlife and Laboratory Evidences for Crude Oil–Induced Reproductive Disorders in Fish | Sayyed Mohammad Hadi Alavi, Iran, on-site | Behrooz Abtahi |
| **S4** | 09:50–10:15 | 14:20–14:45 | Habitat Complexity and Macro-Epibionts in Mangrove Forests | Ali Nasrolahi – Iran, on-site | Behrooz Abtahi |
| **Coffee/Tea Break** | 10:15–10:35 | 14:45–15:05 | Coffee / Tea break | – | Refreshments |

### *Session 5– Natural Archives, Paleogeography, and Long-Term Environmental Change in Iran*

| Session/ Item | Tehran Time | Beijing Time | Title/Activity | Speaker / Country / Mode | Moderator/ Notes |
|---|---|---|---|---|---|
| **S5** | 10:35–11:00 | 15:05–15:30 | Postglacial Flooding in the Persian Gulf | Abdolmajid Naderi Beni, Iran, online | Ali Nasrolahi |
| **S5** | 11:00–11:25 | 15:30–15:55 | Studying the paleogeography of the Iranian mangroves in relation to climate changes and sea level variations | Mohammad Ali Hamzeh, Iran, on-site | Ali Nasrolahi |
| **S5** | 11:25–11:50 | 15:55–16:20 | Ferns as bioindicators of climate–ocean interactions: Insights from genetic diversity, spatial modeling, and adaptation in Iran | Fahimeh Koohdar, Iran, on-site | Ali Nasrolahi |
| **Lunch Break** | 11:50–13:30 | 16:20–18:00 | Lunch | - | Near venue |

### *Session 6– Climate Change Impacts on the Caspian Sea: Physical, Biogeochemical, and Ecosystem Responses*

| Session/ Item | Tehran Time | Beijing Time | Title/Activity | Speaker / Country / Mode | Moderator/ Notes |
|---|---|---|---|---|---|
| **S6** | 13:30–13:55 | 18:00–18:25 | Climate-induced hazards in the Caspian Sea, focusing on sea level decline and desertification | Mehdi Abedi, Iran, on-site | Yi Xu/ Mehdi Abedi |
| **S6** | 13:55–14:20 | 18:25–18:50 | Climate-Driven Greenhouse Gas (CO2) Emissions from the Southern Caspian Sea: Effects of Size, Productivity, and Nutrient Enrichment | Hassan Nasrollahzadeh Saravi, Iran, on-site | Yi Xu/ Mehdi Abedi |
| **S6** | 14:20–14:45 | 18:50–19:15 | Climate Stressors, Fishing Pressure, and Ecosystem Responses: Lessons from Caspian Sea Fisheries | Hasan Fazli, Iran, on-site | Yi Xu/ Mehdi Abedi |

### *MoU Exchange and Closing Ceremony*

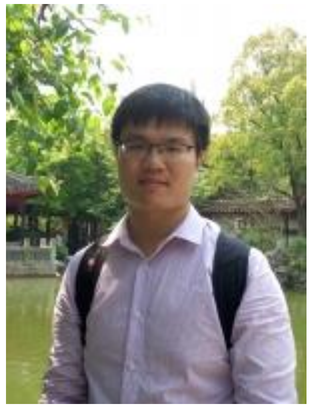
| Item | Tehran Time | Beijing Time | Description | Moderator |
|---|---|---|---|---|
| **MoU Exchange** | 14:45–15:00 | 19:15–19:30 | Exchange of MoU between SKLEC and Shahid Beheshti University | Maryam Ghaemi & Ying Wu |
| **Closing Session** | 15:00–15:30 | 19:30–20:00 | Open discussion, overall synthesis and closing remarks | Maryam Ghaemi & Ying Wu |

**Day 3– Wed, 28 Jan 2026**

| Activity | Tehran Time | Beijing Time | Details |
|---|---|---|---|
| **Visit to INIOAS** | 09:30–12:30 | 14:00-17:00 | Visit to the INIOAS; welcome and institutional presentation; discussion on potential China–Iran cooperation |
| **Lunch** | 12:30–14:00 | 17:00-18:30 | Lunch hosted by INIOAS |
| **Meeting with INSF Representative *(TBC)*** | 14:00–15:30 | 18:30-20:00 | Meeting with representative(s) of INSF |
| **Dinner** | 18:00 | 22:30 | Local restaurant |
| **Day 4– Thu, 29 Jan 2026** | | | |
| **Tehran City Tour** | 09:00–16:00 | 13:30-20:30 | Sightseeing in Tehran |
| **Dinner** | 18:00 | 22:30 | Group dinner at a local restaurant |
| **Day 5– Fri, 30 Jan 2026** | | | |
| **Farewell and departure (shuttle service provided)** | All day | All day | Individual airport transfers and departures according to participants' flight schedules |

# Brief introduction and Abstract

## Miaolei Ya



Miaolei Ya is a researcher at the State Key Laboratory of Estuarine and Coastal Research, East China Normal University. His research focuses on marine organic geochemistry and marine environmental science. Currently, he employs advanced molecular-level organic geochemical techniques, including compound-specific radiocarbon analysis of natural hydrocarbons, high-resolution chromatography coupled with high-resolution mass spectrometry, and integrates active/passive sampling, ultrafiltration separation, multimedia partitioning, and interfacial transport modeling. His work investigates the sources, multimedia distribution, multi-interface transport, cross-system fluxes, dynamics, and regulatory mechanisms of typical terrestrial organic pollutants and hydrocarbon biomarkers in estuarine and coastal land–sea–atmosphere systems. Through this research, he aims to quantitatively characterize the impacts of human activities on estuarine–coastal ecosystems under the climate change.

# Molecular Identification of Organic Compounds in the Marine Environment: Techniques, Challenges and Applications

Yu Fu, Xuhong Huang, Geying Hu, Weixin Zhu, Shencong Wu, Ying Wu*, Miaolei Ya*

State Key Laboratory of Estuarine and Coastal Research (SKLEC), East China Normal University, Shanghai, China

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The molecular characterization of organic compounds in the marine environment serves as a fundamental basis for understanding the marine organic carbon cycle (including its sources, transport, and transformation) and for assessing marine ecosystem health (in terms of pollution, risks, and management). Due to the significant differences in properties such as molecular weight, solubility, and volatility among marine organic compounds, comprehensive analysis of their molecular composition often relies on the synergistic and complementary use of multiple analytical techniques. Among the various analytical methods, chromatography-mass spectrometry coupling has emerged as a core approach for the qualitative and quantitative analysis of organic molecules. This paper first systematically reviews several commonly used chromatography-mass spectrometry techniques, including gas chromatography/liquid chromatography-quadrupole mass spectrometry, gas chromatography/liquid chromatography-triple quadrupole mass spectrometry, gas chromatography/liquid chromatography-high-resolution time-of-flight mass spectrometry, and Fourier-transform ion cyclotron resonance mass spectrometry, among others. Their technical characteristics, applicable scopes, and limitations are also compared. Particularly critical is the focus of this paper on the comprehensive two-dimensional gas chromatography-high-resolution time-of-flight mass spectrometry platform established in our laboratory. By integrating practical analytical cases from complex environmental matrices such as marine sediments, the atmosphere, and seawater, this paper elaborates on the application efficacy of this technology in identifying hydrocarbon compounds, biomarkers, and environmental pollutants. It highlights its significant advantages in overcoming matrix interferences and enabling high-throughput screening and identification of non-target compounds. Finally, potential cooperation directions between China and Iran in areas such as method standardization, data sharing, and technology integration are discussed, aiming to provide scientific support for the two countries in jointly addressing marine environmental challenges.

## Ying Wu

Prof. Dr. Ying Wu is a leading marine organic geochemist whose research focuses on the transport, cycling and preservation of carbon on various scales. She is a Ph.D. graduate of the Ocean University of Qingdao and a professor at SKLEC (ECNU). She has also served as a visiting scientist at the Woods Hole Oceanographic Institution and the Alfred Wegener Institute in Germany, as a Humboldtian. Her pioneering studies link land-based inputs to coastal carbon dynamics and organic matter preservation, extending from the upper ocean to bottom sediments, thereby enhancing our understanding of the role of carbon sequestration in the context of climate and human stressors.

# Hydrodynamic–Redox Controls on Iron-Bound Organic Carbon Across Contrasting Coasts

Chen Zhong[1], Miaolei Ya[1], Ratsirin Supcharoen[2], Chawalit Charoenpong[2], Penjai Sompongchaiyakul[2], Yiyun Wang[1,*], Ying Wu[1,*]

[1] State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China

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Estuaries & Coasts are dynamic interfaces where intensive organic matter transformation and burial shape regional and global carbon cycling. Iron–organic associations can enhance sedimentary organic carbon (OC) stability, yet their behavior remains poorly constrained due to strong environmental heterogeneity among estuaries. Here, we present a comparative analysis of the Yangtze Estuary and the Upper Gulf of Thailand—two river-dominated systems with contrasting sedimentary regimes. We quantified total OC, iron-bound OC, and iron speciation in surface sediments, and evaluated how climate and hydrodynamic conditions regulate OC burial. Both regions exhibited declining shore-to-offshore iron-bound OC, confirming the widespread role of iron in stabilizing terrestrial OC. However, the dominant iron-bound OC forms differed: all three forms decreased offshore in the Yangtze Estuary, whereas only highly crystalline and organo-complexed fractions showed similar patterns in the Upper Gulf of Thailand, reflecting contrasting terrestrial inputs. Finer sediments in the Gulf also favored higher contents of highly crystalline and complexed iron-bound OC. Across both systems, all iron-bound OC forms reached minima where dissolved oxygen approached 3 mg $L^{-1}$. Redox-controlled incubation experiments further showed that highly crystalline iron-bound OC responds strongly to fluctuating redox conditions and decreases with the dissolution of its host phase, indicating weaker sequestration potential under redox oscillations. Preferential OC association with newly formed, more reactive iron phases explains the observed minima in redox transition zones. Overall, our findings reveal how terrestrial inputs, sediment texture, and local redox–hydrodynamic settings jointly shape iron-bound OC speciation and burial outcomes across estuaries, offering new insights into the mechanisms stabilizing organic carbon in coastal sediments.

## Kamalodin Kor

Kamalodin Kor is an Assistant Professor at the Iranian National Institute for Oceanography and Atmospheric Science, specializing in marine pollution and sedimentary geochemistry. He earned his Ph.D. in Chemistry and have spent nearly a decade studying the fate, transport, and ecological impacts of pollutants in marine environments. His current research focuses on microplastic contamination in marine systems and the geochemical evaluation of phosphorus in marine sediments. Through the integration of chemical, geochemical, and environmental methodologies, his research seeks to advance understanding of the biogeochemical processes governing nutrient cycling and pollutant dynamics in coastal and marine ecosystems.

# Sedimentary Phosphorus in the Persian Gulf and the Gulf of Oman


Kamalodin Kor*, Hamid Ershadifar, Abolfazl Saleh

Iranian National Institute for Oceanography and Atmospheric Science (INIOAS), Tehran, Iran

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Phosphorus is a key nutrient regulating primary productivity in marine ecosystems, while excessive inputs can lead to eutrophication, harmful algal blooms, and hypoxic conditions. This study presents the first basin-scale investigation of sedimentary phosphorus geochemistry in the Persian Gulf (PG) and the Gulf of Oman (GO), with a focus on chemical fractionation, seasonal variability, potential bioavailability, and ecological risk. Surface sediment samples were collected from 95 stations during summer and winter cruises (2021–2022), and phosphorus speciation was determined using the sequential extraction (SEDEX) method, which distinguishes loosely adsorbed phosphorus (Ad-P), iron-bound phosphorus (Fe-P), calcium-bound phosphorus (Ca-P), detrital phosphorus (De-P), and organic phosphorus (O-P).

TP ranged from 636.0 to 1341.3 µg/g and 599.6 to 1354.1 µg/g in the summer and winter, respectively. Calcium-bound phosphorus (Ca-P) and detrital phosphorus (De-P) were the dominant forms of TP in surface sediments, with following descending order to other forms: O-P>Fe-P>Ad-P. Inorganic phosphorus (P) comprised over 83% of the TP in the study area's sediments, indicating a low contribution from organic phosphorus. A mean of 29.1% and 25.3% of TP was found to be bioavailable phosphorus during the summer and winter sampling periods, respectively. Seasonal stratification, elevated temperatures, and reduced dissolved oxygen during summer—particularly in the GO—enhanced the release of redox-sensitive Fe-P and increased phosphate concentrations in overlying waters. Monsoonal hydrodynamics further promoted detrital phosphorus input at near-shore stations.

Phosphorus pollution index exceeded one at most stations in both seasons, indicating sediment phosphorus pollution. Effective management of phosphorus inputs and maintenance of phosphorus balance are recommended to prevent eutrophication and HABs in the PG and GO.

## Ning Zhao

Ning Zhao is a professor and the deputy director of the State Key Laboratory of Estuarine and Coastal Research, East China Normal University. His research focuses on paleoceanography, paleoclimatology, and the carbon cycle. He has published in leading journals such as Nature Communications and Nature Geoscience, and served as a reviewer for the IPCC 6th Assessment Report.

# Radiocarbon as a dating tool and paleo-proxy in the ocean: challenges and some progress

Ning Zhao*
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Radiocarbon is a rare but important isotope of carbon. It has a wide spectrum of applications in earth, biological and archaeological sciences. In particular, radiocarbon is a well-developed dating tool and a powerful tracer for studying carbon cycling in the past. However, when applied to the ocean, there are some complicating factors that could lead to inaccurate chronological information and/or wrong interpretations of paleoenvironment. A major complication is the radiocarbon reservoir age of the surface ocean. In this talk, I will present results from the first global synthesis of paleo surface ocean reservoir ages. On the other hand, high-quality paleoceanographic radiocarbon data are still quite limited given the generally low sedimentation rates and high-water mass heterogeneity in the ocean. This presentation will also show some efforts and progress on generating new data from key regions and making quantitative interpretations of ocean ventilation strength in the past based on a compilation of marine radiocarbon data.

## Chenglong Wang

Dr. Chenglong Wang is a fellow of Nanjing University. His primary research focus lies in marine organic carbon burial under the impacts of human activities and climate change. He specializes in integrating multiple disciplines, including marine sedimentology, organic geochemistry, and artificial intelligence, while leveraging multi-proxy tracers to explore the fate of organic carbon in river-coastal systems from both regional and global perspectives. To date, he has published over 40 academic papers in relevant fields, among which 23 were authored as first author or corresponding author in prestigious journals such as Nature Geoscience, Geophysical Research Letters, Geochimica et Cosmochimica Acta, and Water Research. Currently, he serves as a member of the marine geography commission of the Geographical Society of China and a director of the Jiangsu Ocean Society.

# Global patterns of organic carbon transfer and accumulation across the land-ocean continuum constrained by radiocarbon data

Chenglong Wang[1,*], Yifei Qiu[1], Zhe Hao[2], Junjie Wang[3], Chuchu Zhang[1], Jack Middelburg[3], Yaping Wang[1], Xinqing Zou[1,*]

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As an effective tracer for identifying the origin and cycling of carbon in aquatic ecosystems, the distribution pattern of the radiocarbon of organic carbon in riverine particles and coastal sediments are essential for understanding the contemporary carbon cycle, but are poorly constrained due to under-sampling. This hinders our understanding of organic carbon transfer and accumulation across the land–ocean continuum worldwide. Machine learning approaches and >3,800 observations have been used to construct a high-spatial resolution global atlas of radiocarbon values in river–ocean continuums and show that radiocarbon values of river particles and corresponding coastal sediments can be similar or different. Four characteristic organic carbon transfer and accumulation modes are recognized: the old–young mode for systems with low river and high coastal sediment radiocarbon values; the young–old and old–old modes for coastal systems with old organic carbon accumulation receiving riverine particles with high and low radiocarbon values, respectively; and the young– young mode with young organic carbon for both riverine and coastal deposited particles. Distinguishing these modes and their spatial patterns is critical to furthering our understanding of the global carbon system. Specifically, among coastal areas with high organic carbon contents worldwide, old–old systems are largely neutral to slightly negative to contemporary atmospheric carbon dioxide removal, whereas young–old and old–young systems represent carbon dioxide sources and sinks, respectively. These spatial patterns of organic carbon content and isotope composition constrain the local potential for blue carbon solutions.

## Qianqian Wang

Qianqian Wang is a Research Professor of State Key Laboratory of Estuarine and Coastal Research at the East China Normal University (ECNU), holding a Ph.D. in coastal hydrogeology from China University of Geosciences (Beijing). His research mainly focuses on coastal groundwater and submarine groundwater discharge in estuaries, bays, shelves and coral reefs, involving nutrient, carbon and metal fluxes and biogeochemical processes. The main research methods include natural radioactive (radium and radon) isotope tracing. Dr. Wang has secured funding by National Natural Science Foundation of China (NSFC), and has published more than 30 papers in peer reviewed journals such as Geochimica et Cosmochimica Acta, Global Biogeochemical Cycles and Water Research.

# Using radium isotopes to estimate submarine groundwater discharge and dissolved carbon exports in Daya Bay (China)

Qianqian Wang*
State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, China
* Corresponding author (E-mail: qqwang@sklec.ecnu.edu.cn)

Submarine groundwater discharge (SGD) serves as an important pathway for the transport of dissolved carbon from land to ocean, significantly affecting the coastal biogeochemical cycles. However, the impact of SGD-derived dissolved carbon on the coastal carbon budget remains poorly understood. This study first quantified SGD and associated dissolved organic carbon (DOC), dissolved inorganic carbon (DIC) and total alkalinity (TA) fluxes in Daya Bay using mass balance models based on radium isotopes ($^{223}Ra$, $^{224}Ra$, $^{226}Ra$ and $^{228}Ra$). We then constructed carbon mass balance models to evaluate the impact of SGD-derived carbon on the buffering capacity against coastal ocean acidification. The estimated SGD fluxes ranged from $0.80\times10^7$ to $2.64\times10^7$ $m^3$ $d^{-1}$. The DIC, DOC and TA fluxes from SGD were 17.90-36.44 mmol $m^{-2}$ $d^{-1}$, 0.93-2.13 mmol $m^{-2}$ $d^{-1}$, and 21.19-28.47 mmol $m^{-2}$ $d^{-1}$, respectively. Based on carbon mass balances, the DIC flux from SGD was 19-39 times the riverine input, accounting for 27.16 % ~ 37.64 % of the total carbon source. These results suggest that SGD is a major contributor to DIC, significantly affecting the coastal carbon budget. Furthermore, the average TA:DIC ratio of groundwater discharging into Daya Bay was approximately 1.13. High TA exports enhance the buffering capacity of the coastal ocean and contribute bicarbonate to the ocean, playing a significant role in the ocean carbon sequestration process. This study demonstrates the importance of SGD-derived dissolved carbon in the assessment of coastal carbon budgets.

## Hamid Nazari

Hamid Nazari is a UNESCO Chairholder in Coastal Geo-Hazard Analysis (since 2021) and a senior geoscientist with over three decades of professional experience at the Geological Survey of Iran and the Research Institute for Earth Sciences (RIES), where he previously served as Vice-Director and Deputy of Research (2009–2021) and currently heads the Innovation Department. He holds BSc and MSc degrees in Geology from Iranian universities, a PhD in Paleoseismology from Université Montpellier II, France, and completed postdoctoral research in Active Tectonics at the University of Cambridge, UK, followed by the Habilitation à Diriger des Recherches (HDR) in Science of the Universe from Université de Montpellier. His expertise spans geohazards, geo-archaeology, paleoclimatology, and the application of machine learning and artificial intelligence in geological mapping, supported by extensive international collaborations and close engagement with UNESCO. He has authored numerous Web of Science–indexed publications and, since 2025, is the founder and CEO of Intelligent Geo-Mine Co., focusing on advanced geological and mining technologies, while also being active as a social commentator in Iranian media.

# White Hydrogen and Ophiolitic lands in Iran!

Hamid Nazari[1,2,*]

[1] UNESCO Chair on Coastal Geo-Hazard Analysis, Research institute for Earth Sciences, Tehran-Iran

[2] Intelligent Geo-Mine Co Ltd., Tehran-Iran

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Natural (or “white”) hydrogen is a geologically derived hydrogen resource that differs fundamentally from industrially produced variants (green, blue, gray, brown). Characterizing its formation mechanisms, reservoir behavior, and extraction feasibility is essential to evaluating its role in low-carbon energy systems. White hydrogen is generated by subsurface geological processes, including hydrogen degassing from crustal and mantle sources, water-rock redox reactions such as serpentinization of ultramafic rocks, and other mineral–water interactions. Research to date has concentrated on settings where these processes are active—most notably ophiolite complexes and mid-ocean ridge environments—where serpentinization has been shown to produce measurable hydrogen fluxes. These same geological environments may also offer suitable targets for CO2 sequestration, creating potential synergies for integrated subsurface energy and carbon management. Despite its promise as a carbon-free energy vector, white hydrogen poses significant technical and economic challenges: episodic and diffuse fluxes, complex subsurface plumbing, and uncertainties in resource size and producibility limit near-term commercial application. Globally, hydrogen production remains dominated by fossil feedstocks, though long-term projections anticipate a shift toward electricity-based production pathways by mid-century. Several hydrocarbons-rich nations and regional projects (for example in the Middle East) are actively investigating natural hydrogen occurrences and pilot extraction efforts. To realize white hydrogen’s potential contribution to decarbonization, targeted geological surveys, improved subsurface characterization, pilot extraction trials, and integration into national energy planning are required.

## Jing Zhang

Jing Zhang is a full professor of chemical oceanography and biogeochemistry. His research activity is focused on the behavior of trace and biogenic elements in the ocean. His early research experiences were on the biogeochemical processes in the estuarine and coastal waters. Recently, he has participated in several sea-going cruises in the tropical Western Pacific Ocean and Eastern Indian Ocean, focusing on the structure and dynamics of trace elements and plant nutrients, to understand cutting-edge questions between chemistry, physics, and biology.

# Dissolved Ga and Its Isotopes in the Minjiang Estuary

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Minjiang (Note: "jiang" means "river" in Chinese) drains in the subtropical area of China, with a water flow of 1980 $m^3/s$ (i.e. $62.5\times10^9$ $m^3/yr$) on average, length of 562 km and a drainage area of $61.0\times10^3$ $km^2$. The estuary is dominated by a semi-diurnal tide with a range of 4 m to 5 m. In this study, water samples for dissolved gallium (Ga) and its stable isotopes (i.e. $^{71}Ga/^{69}Ga$) were taken in December 2021 (i.e., dry season) across the entire mixing zone of Minjiang Estuary, from riverine reference to the salinity of 30. Riverine sampling was repeated in February 2025.

Concentration of dissolved Ga (dGa) was 31 pmol/kg (sw) to 505 pmol/kg in the Mingjiang Estuary, with $\delta^{71}Ga$ of -0.57‰ to 1.20‰. In the Minjiang Estuary, dGa illustrated an estuarine maximum in the mixing zone between fresh and marine waters, with elevated concentrations in the salinity range of 5 to 20. Such a structure is observed for DIP and DSi, but rather different from $NO_3^-$. In the meantime, $\delta^{71}Ga$ of dissolved concentration was also high (i.e. >0.5‰) in the upper part of the estuary. The elevated dGa and $\delta^{71}Ga$ in the Minjiang Estuary can be related in part to the dynamic process of the turbidity maximum zone, but also maintained by the internal sources. Data examination and repeated sampling indicate that observed high dGa concentration and elevated $\delta^{71}Ga$ values are most likely sustained by the discharge from nearby industrial processing activities, but this effect remains local.

## Shan Jiang

Dr. Shan Jiang works at the State Key Laboratory of Estuarine and Coastal Research (SKLEC), East China Normal University (ECNU), specializing in marine biogeochemistry with particular expertise in nitrogen cycling. Over the past decade, his research has spanned multiple coastal ecosystems across Asia and Europe through extensive international collaborations. Utilizing stable isotope techniques and metagenomic analyses, Dr. Jiang has systematically investigated nitrogen sources, transformation pathways, and their ecological impacts, contributing significantly to the understanding of coastal biogeochemical processes. His scholarly output includes over 70 peer-reviewed publications in prestigious journals. Additionally, Dr. Jiang serves as an editor for several scientific journals and holds leadership positions including co-chair of the IMBeR Indo-Pacific Region (IMBeR IPR) study group, demonstrating his active engagement in the marine science community.

# Atmospheric Nitrogen Loading in the West Pacific and East Indian Ocean: Sources and Impacts

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Atmospheric deposition is the primary pathway for exogenous nitrogen (N) input to the open ocean. Rainwater samples from 31 stations in the equatorial East Indian Ocean (EIO) and West Pacific Ocean (WPO) revealed nitrate ($NO_3^-$) and ammonium ($NH_4^+$) as the dominant N species. $NO_3^-$ and $NH_4^+$ concentrations were significantly higher near coastal regions (e.g., Malacca Strait, New Guinea) compared to remote ocean sites, coinciding with elevated non-sea salt ions (e.g., $Ca^{2+}$, $SO_4^{2-}$), reflecting anthropogenic influences from coal combustion and vehicle emissions from surrounding lands.

$\delta^{15}N$–$NH_4^+$ values shifted from natural marine emissions (−5.7‰ to −9.3‰) in remote areas to anthropogenic sources (−15.5‰ near coasts, e.g., fertilizer volatilization). $\delta^{15}N$–$NO_3^-$ in remote oceans (−1.7‰ to 0.4‰) was lower in the WPO due to Walker Circulation-driven air ascent, while coastal values (1.5‰ to 3.5‰) varied with fossil fuel contributions.

Rainwater N was enriched relative to surface ocean water, enhancing dissolved N availability. However, N redundancy relative to the Redfield–Brzezinski ratio (N:Si:P = 16:16:1) suggests potential shifts in marine productivity.

## Yi Xu

Dr. Xu Yi is an Associate Professor at the State Key Laboratory of Estuarine and Coastal Research, East China Normal University. Her research focuses on understanding how climate change shapes multi-scale ecological and physical processes in the global ocean. Her work integrates satellite data analysis, in situ observations, and ecosystem biogeochemical modeling to investigate primary bloom dynamics, phytoplankton phenology, and biogeochemical variability in both coastal and open-ocean environments.

# Contrasting Stratification Controls and Biogeochemical Responses in the Arabian Sea and Bay of Bengal

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The northern India Ocean is one of the world's fastest-warming ocean regions and also one of the most severely oxygen-depleted. It features complex monsoon systems and climate phenomena operating across multiple spatial and temporal scales. Among them, ENSO and the Indian Ocean Dipole (IOD) are the dominant climate modes, both of which can trigger anomalous monsoons and precipitation, thereby altering ocean stratification and ultimately affecting primary productivity and oxygen conditions.

To date, climate models have not reached a consistent prediction regarding future trends in primary productivity and deoxygenation, particularly in the Arabian Sea and the Bay of Bengal. Therefore, it is essential to understand the past spatial–temporal variations of shelf primary productivity and to elucidate the environmental mechanisms that drive these patterns. In this study, we use Argo profiles to quantify the respective contributions of temperature and salinity to stratification stability. In the Bay of Bengal, low-salinity surface water is the primary contributor to strong stratification, consistent with the region's intense precipitation. In contrast, in the Arabian Sea, high-salinity surface water weakens stratification stability. A biogeochemical model at a horizontal resolution of 1/12° was built for this region to compare the stratification and associated biogeochemical cycle in Arabian Sea and Bay of Bengal.

## Zhong PENG

Professor Zhong Peng is from the State Key Laboratory of Estuarine and Coastal Research at East China Normal University. His research focuses on wave dynamics and coastal engineering, with particular emphasis on wave and hydrodynamic modelling, wave–structure interactions, and wave–flow–sediment coupling under extreme conditions.

In recent years, he has concentrated on ecosystem-based coastal defense, investigating how natural elements such as vegetation, wetlands, and hybrid green–grey systems can enhance coastal protection while delivering ecological co-benefits. Professor Zhong has professional experience working with Deltares and Fugro GB Marine Ltd., and actively collaborates with international research institutions as a key contributor to interdisciplinary efforts addressing climate change impacts, coastal protection, and sustainable delta development.

# Three-Dimensional Hydrodynamic Modeling of the Persian Gulf with Emphasis on Air–Sea Heat Fluxes

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A three-dimensional comprehensive hydrodynamic model of the Persian Gulf was developed using the latest bathymetric data, multiple vertical layers, calibrated atmospheric and tidal forcing, and HYbrid Coordinate Ocean Model (HYCOM) reanalysis data. Owing to the Persian Gulf's arid climate, characterized by extremely low precipitation, intense solar radiation, and strong evaporation, air–sea heat exchange plays a dominant role in governing the regional hydrodynamics and thermohaline structure. Therefore, a detailed surface heat flux model incorporating spatially and temporally varying atmospheric parameters—including cloud cover, relative humidity, air temperature, and net solar radiation—was implemented to accurately resolve these processes. The model was extensively calibrated and validated across the entire Persian Gulf against observations of water levels, currents, salinity, and temperature. The results show good agreement with in situ measurements and satellite data, demonstrating that the developed model is capable of reliably simulating hydrodynamic processes and climatological conditions in the Persian Gulf.

## Behrooz Abtahi

Dr. Behrooz Abtahi is a Professor of Marine Biology and a faculty member in the Department of Life Sciences and Biotechnology at Shahid Beheshti University, Tehran, Iran. He also serves as the Vice-Rector for International Scientific Cooperation.

# Microplastic pollution of bird colonies as an indicator of ecosystem health in the Persian Gulf

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Microplastic pollution is a significant but under-recognized component of climate change, driven by emissions throughout its life cycle and interactions with the environment. Plastics and microplastics (MP), as a group of emerging pollutants, are the main marine environmental concerns, threatening ecosystems and wildlife. Ingestion of microplastics has been documented among marine species, but the extent of exposure to it in many seabird species remains to be determined. This is the first of its kind conducted in habitats for the lesser crested tern, *S. bengalensis*. The study aims to compare the prevalence of MP pollution in Persian Gulf areas. Since the terns reside in protected zones managed by the Wildlife Bureau of the Department of the Environment (DOE) in Iran, a non-lethal sampling method was utilized.
By collecting and analyzing feces and sediments from tern colonies, this study seeks to provide insights into the level of MP pollution present in the terns' diet. We assessed the exposure of the Lesser Crested Tern (*Sterna bengalensis*) on islands in the Persian Gulf by measuring microplastics in its nest sediment and feces. As shown in the results, MPs were present in the nest sediment at all study sites and in the fecal samples of over 80% of samples on Nakhiloo and Ghabr-e Nakhoda Islands. These findings suggest that the tern colonies may act as hotspots for microplastics, formed by the reverse transport of these particles from the sea to the sand of the colony. Additionally, the data collected from these investigations can support the development of policies and management strategies aimed at reducing pollution and protecting coastal ecosystems.

## Sayyed Mohammad Hadi Alavi

Sayyed Mohammad Hadi Alavi is an Assistant Professor of Reproductive Biology at the School of Biology, College of Science, University of Tehran, specializing in the cell and molecular biology of reproduction, comparative reproductive physiology, and the biology of gametes and fertilization in fishes. He obtained his PhD in Animal Breeding–Fishery from the University of South Bohemia, Czech Republic, and has held research positions at the University of South Bohemia, Tohoku University in Japan, and the Czech University of Life Sciences before joining the University of Tehran in 2017. Dr. Alavi has authored about 80 publications indexed in Web of Science with an h-index of 30 and more than 2600 citations, and is co-author of the book "Fish Spermatology," which received the 20th Iranian Annual Academic Book Award. His research focuses on the effects of environmental and anthropogenic pollutants, including endocrine-disrupting chemicals, on sperm quality, reproductive biomarkers, and fertility in fishes, particularly in the Caspian Sea and the Persian Gulf, and he has received several prestigious national and international awards and grants, including the Early Career Faculty Award of the National Elites Foundation of Iran.

# Wildlife and Laboratory Evidences for Crude Oil–Induced Reproductive Disorders in Fish

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Crude oil is one of the most widespread contaminants in the aquatic environment as it resides for many years, and even threatens next generations. Crude oil is composed of polycyclic aromatic hydrocarbons (PAHs) and metals including mercury, nickel, and vanadium. Frequents studies have assessed the adverse effects of a particular PAH or heavy metal on reproductive system, however there are a few numbers of studies investigating reproductive impairments following exposure to crude oil. In the present study, we conducted serial wildlife and laboratory research to elucidate endocrine-disrupting function of crude oil on male reproductive system in fish. Gonadal histology, sex steroid hormones, and fertility endpoints were assessed in adult goldfish (*Carassius auratus*) and donkey croaker (*Pennahia aneus*). The later species was sampled from Mousa Bay (Persian Gulf) with crude oil contamination. Exposure of male goldfish to crude oil with 0.22 mg/L nickel, 1.10 mg/L vanadium, and 12.87 mg/L PAHs resulted in histopathological defects of the testes (hyperplasia or hypertrophy of Sertoli cells, depletion of the Leydig cells, necrosis of germ cells, and fibrosis of lobular) and diminished sperm quality (Sperm production and motility kinematics) along with inhibition of androgen biosynthesis in the testes. Further studies reveled crude oil stimulation of aryl hydrocarbon receptor and inhibition of steroidogenic genes encoding enzymes in steroidogenesis pathway. In Mousa Bay, donkey croaker were collected from three sites were contained nickel, vanadium and PAHs of 0.03-0.12, 0.06-0.24, and 0.33-33.88 respectively. Out of 87 specimens, 59 individuals were female accounting for 67.82%. Gonadal development was inhibited with higher degree or gonadosomatic index was lower at the sampling site with higher crude oil contamination, however sex steroid hormones did not differ among sampling site. Taken together, our results suggest that crude oil inhibits sex steroid biosynthesis to disrupts gonadal development resulting in diminished sperm or egg quality.

## Ali Nasrolahi

Dr. Ali Nasrolahi is an Associate Professor of Marine Ecology at Shahid Beheshti University, Tehran, Iran, where he has served as a faculty member since 2012. In this role, he actively engages in both research and teaching in the field of Marine Biology, supervising undergraduate, master's, and Ph.D. students. He earned his Ph.D. in Marine Ecology from Christian-Albrechts University of Kiel, Germany, in 2012, where he focused on the interactive effects of temperature and salinity on barnacle larval development. His research spans marine eco-engineering, biofouling communities, and the ecological impacts of climate change on soft-sediment and mangrove habitats. Dr. Nasrolahi has led multiple national and international projects on coastal eco-engineering, macrobenthic communities, and the impact of global warming on marine ecosystems in the Persian Gulf and Gulf of Oman. His recent work applies a diverse array of biodiversity-friendly coastal infrastructure designs using eco-engineering approaches. He has published extensively in peer-reviewed journals such as *Marine Biology*, *Biofouling*, *Estuarine, Coastal and Shelf Science*, and *Environmental Pollution*.

# Habitat complexity and macro-epibiont assemblages in mangrove forests under climate-driven coastal change

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Mangrove ecosystems are increasingly recognized as natural buffers against climate-driven coastal change, offering shoreline stabilization, carbon storage, and habitat for diverse biota. Macro-epibionts that colonize mangrove trees and roots form part of this biogenic habitat and contribute to ecosystem functioning, yet little is known about how their structure varies across regions or how it is connected to habitat complexity. This study assessed the composition, abundance, biomass, and structural complexity of macro-epibionts associated with mangrove forests along the northern Persian Gulf and Gulf of Oman—regions strongly exposed to warming, salinity extremes, and sea-level rise.

Field sampling was conducted in multiple mangroves stands dominated by *Avicennia marina* and red mangroves. Epibionts were collected from tree surfaces and pneumatophores to quantify taxonomic composition, abundance, and biomass. To quantify habitat complexity, prop-roots were scanned using computed tomography and reconstructed in 3D. Structural metrics, including surface area, fractal dimension, and interstitial voids, were calculated and related to epibiont community attributes.

Across sites, four dominant taxa were recorded on *A. marina*: the oyster *Crassostrea* sp., barnacles *Amphibalanus amphitrite* and *Microeuraphia permitini*, and the snail *Littoraria intermedia*. Species composition showed no clear regional pattern, but abundance and biomass differed significantly among locations. Oysters contributed most of the biomass. The absence of a geographic trend along the Persian Gulf–Gulf of Oman gradient suggests that local hydrographic conditions, rather than large-scale geography, structure epibiont communities under current environmental pressures.

3D reconstructions of prop-roots revealed 25 macro-epibiont taxa, primarily calcifiers. Surface area and fractal dimension were the strongest contributors to habitat complexity. Surface area correlated positively with species richness and biomass, whereas interstitial spaces influenced abundance and inorganic matter content.

The results demonstrate that structural complexity is a key determinant of biodiversity in mangrove epibiont assemblages, and may therefore enhance ecosystem resilience in the face of climate-driven change. Although community composition was relatively consistent, variations in biomass and abundance across sites highlight the importance of local physical conditions, which are likely to be altered by warming, salinity shifts, and hydrodynamic changes. These findings provide baseline data for mangrove conservation in a climate-vulnerable region and highlight the role of habitat heterogeneity in sustaining biodiversity and ecosystem functioning under future climate scenarios

## Abdolmajid NADERI BENI

Abdolmajid NADERI BENI is a fellow of the Iranian National Institute for Oceanography and Atmospheric Science. Dr. NADERI BENI is a marine geologist and sedimentologist specializing in Quaternary science, paleoclimatology, and coastal geomorphology. He is currently affiliated with the Aix-Marseille University, Centre for Research and Teaching in Environmental Geosciences (CEREGE) in France where he spends his sabbatical as a palaeoclimate researcher on West Asian archives. His academic background includes a PhD in Sedimentology, an MSc in Petrology, and a BSc in Geology.

He has conducted his studies more on the Caspian Sea abrupt sea level changes, the Persian Gulf flooding during the Holocene, and paleoclimatic changes of the West Asia using lake and wetland archives. His work integrates multi-proxy approaches, including sedimentology, geochemistry, archaeology, geo-archaeology and history to investigate the impacts of the past environmental changes on human communities. These studies highlight the interplay between the Indian Ocean Summer Monsoon (IOSM) and the Mid-latitude Westerlies (MLW), and Siberian High Pressure and their impacts on vegetation, hydrology, and human settlement patterns.

# Postglacial flooding in the Persian Gulf

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Postglacial flooding of the Persian Gulf was a critical driver of landscape evolution and human settlement dynamics in West Asia, yet its chronology and environmental consequences remain incompletely understood. We present a multi-proxy study of three sediment cores from the deepest sectors of the Persian Gulf, combining sedimentological, palynological, geochemical, and radiocarbon analyses to reconstruct flooding phases and Holocene climate variability. Results indicate successive transgression events beginning around 11.5 calibrated kilo years Before Present (ka cal BP), with prominent phases centered at 10.4 and 9.2 ka cal BP, and the establishment of definitive marine conditions by ~8.8 ka cal BP. Climatic reconstructions highlight the dominance of the Indian Ocean Summer Monsoon (IOSM) from ~9 to 6.3 ka cal BP, followed by a decline in IOSM intensity and strengthening of the Mid-latitude Westerlies (MLW). These shifts induced marked changes in vegetation, hydrology, and sedimentation, and likely contributed to socio-cultural transformations across West Asia.

Importantly, our findings demonstrate that the Persian Gulf basin acted as a sensitive recorder of both global sea-level rise and regional hydroclimatic transitions. The observed Holocene migration of the Inter-Tropical Convergence Zone (ITCZ) and its interaction with IOSM and MLW systems provides a valuable analogue for present-day climate dynamics. Recent studies document a northward propagation of the ITCZ and intensified IOSM since 2002, conditions that mirror the early Holocene climatic regime. This ongoing shift, coupled with accelerated sea-level rise in the Persian Gulf (>3.5 mm $yr^{-1}$), underscores the relevance of paleoenvironmental reconstructions for anticipating future environmental and socio-economic impacts in the region.

By linking past flooding phases and monsoon–westerly transitions with current ITCZ migration, our study highlights the importance of long-term perspectives in understanding the vulnerability of semi-enclosed basins like the Persian Gulf to climate-driven transformations. These insights refine models of postglacial flooding and emphasize the need to integrate paleoenvironmental archives into assessments of future climate risks for coastal societies in West Asia.

## Mohammad Ali Hamzeh

Dr. Mohammad Ali Hamzeh is a marine geology and paleoclimate reconstruction researcher at the ocean department, Iranian National Institute for Oceanography and Atmospheric Science (INIOAS), Tehran, Iran. Initially, his studies were mostly about the Environmental geochemistry of urban and industrial areas, and has some research projects on coastal pollution and palaeotsunami. During and after PhD, his research interests shifted to the reconstruction of Holocene paleoclimate, paleoenvironment, palaeoceanography, and paleohydrology of SE Iran, the Persian Gulf, and the Oman Sea using a variety of proxies consisting of stable isotopes, geochemistry, sedimentology, and the ecology of foraminifera. Among his most prominent research in recent years is the reconstruction of sea surface temperatures in the Strait of Hormuz over the past 5,000 years and its impact on the paleoceanography of the Persian Gulf and Oman Sea, using the chemistry of (Ma/Ca) planktonic foraminifera and the ecology of benthic foraminifera. Additionally, in recent years, he has conducted comprehensive research on the history of the formation and evolution of mangrove forests in southern Iran and their blue carbon stock. He has also participated in more than 10 cruises of RV Persian Gulf Explorer.

# Studying the paleogeography of the Iranian mangroves in relation to climate changes and sea level variations

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This study investigates the evolution of mangrove ecosystems along the coasts of the Persian Gulf and the Gulf of Oman in Iran, focusing on the interplay between climate change and sea level fluctuations during the mid-to-late Holocene. The Iranian mangroves are classified as subtropical dry zone forests, characterized by their adaptation to extreme conditions such as high salinity, scarce freshwater, and elevated temperatures. These harsh environmental factors limit their species diversity, productivity, and overall growth compared to mangroves in more humid tropical regions.

Historically, the primary drivers of ecological and sedimentary changes in these northern Indian Ocean coasts have been climatic shifts and variations in sea level during the Holocene. These factors critically influence the development of tidal creeks, estuaries, and the mangrove forests themselves. In suitable geomorphological settings, such as shallow coastal areas like lagoons and tidal flats, changes in relative sea level and sediment supply from rivers and tides drive the formation of diverse sub-environments, facilitating mangrove establishment and expansion.

While mangroves across the region responded uniformly to broad Holocene climate and sea level trends, the precise timing of their emergence, growth, and decline varied locally. This spatiotemporal variability is controlled by local geomorphology, hydrodynamics, tectonic movements, and factors like topography, sediment availability, and the configuration of intertidal zones. To reconstruct this complex paleogeography, the study employs an integrated analysis of sediment properties, benthic foraminiferal assemblages, and radiocarbon dating to trace the evolution of estuaries and coastal environments in response to environmental changes over the past several millennia.

## Fahimeh Koohdar

Fahimeh Koohdar is an Associate Professor at the Faculty of Life Sciences and Biotechnology at Shahid Beheshti University in Tehran. She holds a Ph.D. in Plant Systematics and a Master's degree in Systematics–Ecology from Shahid Beheshti University, along with a Bachelor's degree in Plant Sciences from the University of Tehran. Her research spans molecular systematics, genetic diversity, phylogeny, population and landscape genetics, integrating molecular markers, biostatistical approaches, and spatial modeling to investigate evolutionary processes in plants. In recent years, she has contributed to studies on species sensitive to climate-driven environmental variability, including coastal plants such as Avicennia and ferns used as bioindicators of temperature and humidity shifts. These efforts have advanced understanding of how climatic factors influence genetic structure and adaptive responses. Dr. Koohdar is also experienced in species barcoding, phylogenetic assessments, population structure analysis, and comparative studies across diverse Iranian plant groups, contributing broadly to biodiversity and conservation research.

# Ferns as bioindicators of climate–ocean interactions: Insights from genetic diversity, spatial modeling, and adaptation in Iran

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Ferns represent one of the oldest vascular plant lineages and are highly sensitive to variations in temperature, humidity, and precipitation, making them valuable indicators of environmental change. Their life cycle, spore-mediated dispersal, and dependence on microclimatic conditions provide unique opportunities to examine how large-scale climate–ocean dynamics influence terrestrial ecosystems. Recent advances in climate science underscore the importance of ocean-driven atmospheric variability, including fluctuations in sea-surface temperature, moisture transport, wind circulation, and monsoon systems, which together shape the hydroclimatic conditions of continental regions. These processes are particularly relevant in parts of Asia and the Middle East, where the influence of ocean-driven climate modes affects seasonal rainfall, drought intensity, and environmental stability.

In this study, ferns native to Iran are used as a model to explore how climate–ocean interactions shape patterns of genetic diversity, population structure, and ecological adaptation. Integrating genetic analyses, anatomical and morphological variation, and landscape-level environmental gradients reveals strong spatial structuring that reflects both historical processes and ongoing ecological pressures. Spatial distribution modeling under current and future climate projections further demonstrates that shifts in temperature and moisture regimes can substantially impact the potential range of several fern species. These projected changes are consistent with the known influence of large-scale ocean-atmosphere interactions that regulate regional hydroclimatic conditions relevant to fern survival and dispersal.

By linking genetic patterns, ecological traits, and spatial modeling with broader climate–ocean dynamics, this work highlights the potential of ferns to act as sensitive bioindicators of changes driven by ocean-related climate variability. These findings provide insight into how terrestrial plant groups respond to environmental fluctuations connected to oceanic processes, offering a new perspective on monitoring ecological impacts of climate change in regions influenced by complex interactions between land, atmosphere, and ocean. This integrated approach strengthens our understanding of plant sensitivity to global hydroclimatic shifts and emphasizes the relevance of ferns in detecting early ecological signals of broader climate–ocean transformations.

## Mehdi Abedi

Dr. Mehdi Abedi is an Associate Professor at Tarbiat Modares University, specializing in functional ecology and nature conservation. He received his PhD in Ecology and Conservation from the Department of Botany, University of Regensburg, Germany.

His research interests include functional ecology, seed ecology, biodiversity and ecosystem functioning, phytochemistry, functional foods, and ecophysiology.

# Climate-induced hazards in the Caspian Sea, focusing on sea level decline and desertification

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Climate hazards in the Caspian Sea are becoming more interconnected, requiring coordinated efforts. This document outlines key risks, including drought, desertification, dust storms, and sea-level decline. It also reviews challenges, STI tools, policies, and Iranian organizations involved. The Caspian Sea, bordered by Iran, Azerbaijan, Kazakhstan, and Turkmenistan, has experienced declining water levels since the 1990s due to rising temperatures and reduced inflows. These changes threaten coastal cities, fisheries, and ecosystems. Iran's Miankaleh Wetland Restoration Program, supported by the Department of Environment, demonstrates successful wetland recovery. Another case study highlights the ongoing drought and desertification affecting land and rural communities in Iran and Turkmenistan. Both emphasize the need for collaboration in developing early warning systems and information platforms. Policy recommendations include establishing a Caspian–Aral Adaptation Taskforce, harmonizing laws on coastal, rangeland, and woodland management, and integrating climate risk education into Caspian Sea initiatives.

## Hassan Nasrollahzadeh Saravi

Hassan Nasrollahzadeh Saravi is professor of environmental biology, academic member of Iranian Fisheries Sciences Research Institute (IFSRI) and Caspian Sea Ecology Research Center (CSERC). Hassan is the author of dozens of scientific papers on topics that include water quality, water chemistry, sediment chemistry, ecology, and pollutions in national and international journals and conferences. He has received some awards, including a superior Researcher in Mazandaran Province, his company (IFSRI), and in the Ministry of Jihad-e-agriculture.

Hassan holds a B.Sc. in Pure Chemistry from Shiraz University, as well as M.Sc. degrees in Organic Chemistry from Mazandaran University in Iran and a Ph.D. in Environmental Biology from the University of Science Malaysia (USM). As an at Caspian Sea Ecology Research Center (CSERC) and of, He has contributed to many of the projects registered in the Ministry of Jihad-e-agriculture. He taught a wide range of courses, including Ecology, Limnology, Water and sediment chemistry, and Pollutions.

# Climate-Driven Greenhouse Gas ($CO_2$) Emissions from the Southern Caspian Sea: Effects of Size, Productivity, and Nutrient Enrichment

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The Caspian Sea, the world's largest enclosed inland water body, has undergone pronounced ecological fluctuations in recent decades due to climate change and anthropogenic pressures. A major consequence is the emission of carbon dioxide ($CO_2$) from surface waters, which significantly contributes to regional carbon cycling and climate dynamics. This study investigated $CO_2$ fluxes in the southern Caspian Sea with a focus on three critical parameters: basin size, primary productivity (chlorophyll-a), and nutrient loads (phosphorus (TP) and nitrogen (TN)). Data were compiled from satellite repositories (CMEMS, NASA Giovanni) and regional studies, and analyzed using multivariate matrix modeling. Results showed that surface water $CO_2$ concentrations ranged between 180 and 260 µmol $L^{-1}$, strongly correlated with enhanced productivity and nutrient enrichment. Coastal areas, particularly in the southern basin, exhibited higher emissions due to eutrophication and algal blooms triggered by elevated phosphorus and nitrogen inputs. Climate change, through surface warming and altered light regimes, is projected to increase $CO_2$ concentrations by 15–30% in the coming decades. Upscaled estimates suggest that annual $CO_2$ emissions from the southern Caspian may account for approximately 2–3% of Iran's fossil fuel-related emissions. These findings underscore the importance of continuous monitoring, nutrient load management, and regional climate policy integration to mitigate environmental impacts and prevent further ecological degradation in the Caspian ecosystem.

## Hasan Fazli

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# Climate Stressors, Fishing Pressure, and Ecosystem Responses: Lessons from Caspian Sea Fisheries

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The Caspian Sea, the world's largest enclosed inland water body, has undergone profound ecological and fisheries transformations over the past three decades. Multiple stressors, including climate variability, marine heatwaves, hydrological changes, and intensified fishing pressure, have converged to reshape fish stock dynamics and ecosystem functioning. Long-term monitoring and modeling reveal that climate drivers such as rising temperatures and declining sea surface levels interact with anthropogenic pressures to accelerate declines in commercially important species.

Marine heatwaves (MHWs), defined as periods of exceptionally high sea surface temperature, have become increasingly prevalent under global warming, leading to significant degradation of biodiversity and ecosystem health. This study presents the first comprehensive assessment of MHWs in the Caspian Sea from 1982 to 2022 and their impacts on fish communities. It identified 103 events, including the longest lasting 64 days and the most intense exceeding 4.45 °C above the climatological mean. MHWs were linked to water vapor, rainfall, river discharge, and sea surface level fluctuations. Biological indices and catch per unit effort (CPUE) declined markedly following warming events, with 2018 showing the lowest Shannon–Weiner diversity and reduced condition factors in *Rutilus kutum* and *Acipenser stellatus*. In 2022, CPUE of *Clupeonella engrauliformis* and *C. grimmi* dropped sharply, reflecting widespread reductions in abundance.

Analyses of multi-species datasets demonstrate that sturgeon populations, once the cornerstone of Caspian fisheries, are highly sensitive to environmental variability and cumulative stressors. Dynamic factor analysis and multivariate approaches highlight the combined influence of fishing effort and climate drivers, explaining a substantial proportion of variation in stock condition. These findings underscore the importance of integrating ecological modeling with adaptive management to disentangle natural and human-induced effects.

Overall, the evidence points to dramatic ecological reorganization, with shifts in species dominance, reduced biodiversity, and compromised ecosystem services. Such changes carry direct socio-economic implications, threatening food security, livelihoods, and regional cooperation. Addressing these challenges

requires a multifactorial perspective that recognizes the interplay between climate stressors, fishing practices, and broader environmental changes, while promoting adaptive, ecosystem-based management strategies.