Constraints and Adaptations to Global Change at the Land-Sea Interface: For a Shared Ecological and Energy Transition

From left to right: A part of the French and Japanese delegations at the “Abbaye aux Hommes” (Caen, France); An old small harbour on the Normandy Coast (Saint-Vaast-La-Hougue, France); Oyster beds on the Normandy Coast (Saint-Vaast-La-Hougue, France); A general view of the Mont Saint-Michel (France). Copyright Nicole Prouzet

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Eric Feunteun · Teruhisa Komatsu ·
Osamu Matsuda · Patrick Prouzet
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Constraints and Adaptations to Global Change at the Land-Sea Interface: For a Shared Ecological and Energy Transition

Proceedings of the 19th French—Japanese Oceanography Symposium

Springer

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ISBN 978-3-031-90049-5 ISBN 978-3-031-90050-1 (eBook)
https://doi.org/10.1007/978-3-031-90050-1

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

From left to right: Professor T. Komatsu (President SFJO Japan); Professor J.-Cl. Dauvin (Chairman Organization Committee Coast Caen 2023); Professeur D. Goutte (Vice-president Caen La Mer in charge of the Higher Education and Research); Professor O. Matsuda (Vice-president International EMECS Center); Dr I. Nakayama (President FRA Japan) and Dr P. Prouzet (President SFJO France). Copyright N. Prouzet

French and Japanese scientists visiting the harbour of Saint-Vaast-La-Hougue on the Normandy coast. At the forefront, a line of whelk pots. Copyright N. Prouzet

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Foreword

The 19th Franco-Japanese Oceanography Symposium. Further Proof of the Vitality of the Links and the Continuity of Relations Between the French and Japanese Scientific Communities in the Field of Oceanography

This 19th Franco-Japanese Oceanography Conference is in line with previous ones and shows the vitality of the links established between the Japanese and French scientific communities. President Patrick Prouzet traces the history of these bonds of friendship established over time, the continuity of these relationships and the mutual aid movements, spontaneously appearing when certain specialized fields were in difficulty. These connections endure and have immense value. They are all the more precious because they are fragile, but they are essential in the face of the considerable problems that climate change will create in the world to come. Each country will approach these future difficulties with its experience and culture, with particular scientific and technical approaches. Their friendly confrontation and the exchanges that will result from it are always very rich, as all previous conferences have shown. They have often led to high quality joint work.

Thank you to President Komatsu Teruhisa, SFJO Japan and our many Japanese colleagues for coming to Normandy, both to discover this beautiful French province, and also to bring new Franco-Japanese cooperation to life.

Thank you to the major Japanese and French organizations for continuing to support these efforts, the future results of which will be fruitful, and often unexpected.

Thanks especially to President Patrick Prouzet, to his solid team: Prof. Jean-Claude Dauvin, Dr. Yves Henocque, Prof. Anne-Claire Bennis, Dr. Franck Lagarde and Prof. Eric Feunteun. With their colleagues and collaborators, they have carried out considerable work to make this 19th conference a great success and strengthen the links between the two scientific communities of the two countries.

The message I want to convey combines both science and friendship. Take advantage of the meetings during this conference to get to know your colleagues from the

other country better personally. They will introduce you to another culture, other traditions, another way of thinking and approaching your own problems.

Success will be there when you have worked together, published together, created together. Do not hesitate to tackle original, even difficult subjects together: many discoveries are born in these unexplored avenues.

Make these connections continue later, experience will show you that they are priceless.

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Synthesis and Prospects

Adaptation to global change will require shared and cross-disciplinary knowledge. Limits of sectorial approach have been emphasised many times. Wind energy cannot be developed in isolation from other existing constraints.

The creation of Scientific Interest Groups is an interesting initiative, but the multiplication of these structures must not lead to a dispersion of human resources or duplication of research. Interconnection seems necessary in order to, at least, share knowledge. In this respect, feedback from Northern countries can help to resolve certain issues.

Some stakeholders remain particularly vulnerable to global change. This is the case for fishers and oyster farmers, but also for those involved in seaside tourism, with the proliferation of toxic species leading to the closure of bathing areas.

Academic research is involved and will have to step up its action with the appropriate resources in order to work on physical forcing, evolution of the coastline and proliferation of invasive and toxic species. The development of wind power cannot be disconnected from this context and will take place in an environment that is already largely exploited, where there is little space for flexibility if we do not want to further disrupt the sometimes very fragile equilibrium that characterises our aquatic ecosystems.

The summary of work developed as part of the Fisheries Research and Education Agency Japan (FRA Japan)/Ifremer MOU (Memorandum of Understanding) on the sustainability of fishing and aquaculture activities under the pressure of global change is an interesting initiative that structured session 2 of the Forum.

Alongside academic knowledge, there is traditional knowledge that is important to integrate, particularly at local and regional levels.

The importance of environmental education was emphasised. It is a component of the "Nature and Culture" project of the two SFJOs. In this context, the participation of teachers from French and Japanese high schools (Sète and Okayama high schools) is important and should be continued.

Session 4 of the meetings, co-organised with EMECS, was structured around the concept of "Sato-umi". The need for more bottom-up approaches was emphasised in order to better incorporate the opinions and actions of local communities and thus

increase their degree of acceptance and adaptation to change. The eel approach as developed in France is very similar to a "Sato-umi" approach, but still comes up against far too many "top-down" decisions.

While the development of low-carbon energies is essential to reduce greenhouse gas emissions, the need to develop a less energy-consuming society has also been emphasised. In the fisheries sector, a technological leap must be made in order to develop fishing techniques that consume less fossil fuel and more carbon-free means of propulsion.

The President of the SFJO Japan announced that the 20th Franco-Japanese oceanography symposium would be held in Japan in November 2025 in Toba, prefecture of Mie. This is a place characterised not only by its Ama divers, but also as the place where pearl farming was invented by Mr. Mikimoto in 1893.

The Editorial Board

Opening Speeches

Introductory Speech—First Secretary Japanese Embassy in France

I congratulate the French-Japanese Society of Oceanography and the Japanese-French Oceanographic Society for the tremendous success of the 19th French-Japanese Symposium of Oceanography, which took place at Caen in October 2023.

Japan-France bilateral cooperation covers many fields, and relations between the two countries as "exceptional partners" are better than ever, from political and diplomatic to industrial spheres. Our science and technology cooperation has always occupied an important position as one of the major pillars of Japan-France cooperation.

In particular, the maritime field has been a driving force in our science and technology cooperation since the signing of the Japan-France Science and Technology Cooperation Agreement in 1974. So far, the two countries have held a series of dialogues on promoting joint projects through 27 Japanese-French Ocean Development Sub-Committees.

Today, we face diverse and complex social challenges such as climate change and biodiversity loss. Expectations and interest in promoting marine science and technology are increasing internationally due to the need to tackle these challenges beyond national boundaries. In this context, it is essential for innovation in the marine field to share the differences between Japanese and French approaches and mutually generate stimuli for research through interdisciplinary exchanges.

In this sense, it was highly significant to hold the Symposium, which brought together various participants from Japan and France. I am convinced that the outcome of the Symposium will be an impetus for further developing international research

cooperation and, ultimately, lead to strengthening bilateral relations between Japan and France.

T. Ohno
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Introductory Speech—Vice-President in Charge of International Affairs University Caen-Normandie

Mr. First secretary of the Japanese embassy in France, dear Mr. Ohno Takahiro,
Mr. President of the French-Japanese society of oceanography Japan, dear Professor Komatsu Teruhisa,
Mr. President of the French-Japanese society of oceanography France, dear Dr. Patrick Prouzet,
Mr. President of the Japan fisheries research and education agency, dear Dr. Nakayama Ichiro,
Dear Professor Matsuda Osamu, representative of International EMECS Center,
Mr. Director of the continental and coastal morphodynamics laboratory, dear Laurent Dezileau,
Madam Chairwoman of the Conference scientific committee, dear Professor Anne-Claire Bennis,
Mr. Chairman of the Conference scientific and technical committee, dear Professor Eric Feunteun,
Mr. Chairman of the Conference organizing committee, dear Professor Jean-Claude Dauvin,
Ladies and Gentlemen,
Dear colleagues,

On behalf of Prof. Lamri Adoui, President of the Université de Caen Normandie, it is a distinct privilege and an honour to welcome you to this international conference, Coast Caen—Between Land and Sea, and to the 19th Franco-Japanese symposium on oceanography, which is taking place here today in the Pierre Daure amphitheatre.

The University Caen-Normandie was founded in 1432, making it one of France's oldest universities. It is a higher education institution with an enrolment of 33,000 students across several campuses in Caen and the wider region. As a comprehensive University, it offers a wide range of degree programmes in five main fields. It welcomes students from around the world, with over three thousand three hundred and seventy (3370) international students having studied in Normandie over the last year, and over four hundred and eighty (480) students having participated in exchange programmes.

Furthermore, our institution is distinguished by its active engagement in research, which is structured into three pluridisciplinary axes.

(i) science and technology, (ii) humanities and social sciences, and (iii) biology, imaging, health, and environment. It has forty-one research units, making it a leader in innovation at the national and international levels. Many of its researchers are engaged in international research programs with foreign laboratories. Additionally, some of its postgraduate students benefit from international joint supervision of their Ph.D. thesis, which contributes to their recognition at an international level.

A University Involved in the Challenges of Ecological Transition

Furthermore, the University is engaged in addressing the challenges of ecological transition through its training and research programmes. In June 2023, the University was awarded the DD&RS (sustainable development and social responsibility) label. The label is awarded to higher education establishments that demonstrate a commitment to sustainable development. To be considered for the award, an institution must provide evidence that its approach to sustainable development is genuine, integrated and structured.

The concept of sustainable development represents a model of development that encompasses not only ecological considerations, but also the balance between environmental, economic and social factors. The Université de Caen Normandie is acutely aware of the pivotal role that sustainable development plays in the future careers of its students and is consistently refining its training programmes in this regard. The University currently offers 40 courses directly linked to the challenges of transitions, including seven University bachelor's degrees, six bachelor's degrees, seven professional bachelor's degrees, 19 master's courses, and one engineering degree. Additionally, one in five degrees incorporates the notion of sustainable development, and by the start of the 2025 academic year, all undergraduates will be trained in these issues.

Ultimately, a considerable proportion of the research projects conducted by our research laboratories and their associated partners fall within the overarching domain of sustainable development and social responsibility. All academic disciplines play a role in the pursuit of solutions to the challenges inherent in transitions.

A University Strong in Oceanography Research

The University is situated in the Normandie region, which boasts 600 km of coastline, and many of our research activities are focused on the fields of oceanography, marine biology and coastal environments. The Université de Caen Normandie is a leading institution in the field of oceanography. In the Shanghai thematic rankings, the University is ranked 151st in the world in this discipline.

A significant number of the University's labs and their researchers are engaged in research activities within this field. These include:

Continental and coastal morphodynamics—M2C, co-organizer of this symposium
Biology of aquatic organisms and ecosystems—BOREA
Identity and differentiation of space, environment and societies—IDEES
Human and animal ethology—ETHOS
Cherbourg Applied Sciences Laboratory—LUSAC

And of course, our Coastal Environment Research Centre—CREC

They are engaged in a number of significant national and international projects that serve to reinforce the dynamism of our University in the field of oceanography.

This international conference and symposium form part of this dynamic process, and we are pleased to offer our support to any collaborative work that may be identified during this conference.

We are grateful for your choice to visit our University. I would like to extend my gratitude and congratulations to all the organisers and partners of this event and wish you all fruitful exchanges. To our colleagues from other parts of France and abroad, we extend a warm welcome to our beautiful region.

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Introductory Speech—President of the French-Japanese Society of Oceanography France

The strong bond that exists between the two French-Japanese Oceanography Societies (SFJOs France and Japan) has been forged little by little over the course of a history spanning more than half a century.

Professor Sasaki Tadayoshi founded the SFJO Japan in 1960, when France and Japan were working together to explore the deep seabed off Japan with the FNRS-3 bathyscaphe.

In 1984, Prof. Hubert-Jean Ceccaldi and other pioneers of Franco-Japanese cooperation founded the French-Japanese Society of Oceanography France.

Since their creation, the objective of these two sibling societies has remained unchanged: to highlight, through a process of scientific outreach, the work carried out by the French and Japanese scientific communities in the fields of oceanography, fisheries and aquaculture, without overlooking the social and economic components, or the policies generated by the exploitation of marine and, more broadly, aquatic resources. In this context, we would like to mention the ongoing support of the French-Japanese Sasakawa Foundation, which works to develop friendly and cultural links between France and Japan.

In the course of this long and fruitful cooperation, two major events have taken place that have strengthened the ties of friendship between these two communities.

The first event dates from the late 1960s. It corresponded to severe epizootic crises that seriously affected the French oyster industry. The industry recovered thanks to the invaluable help of Japanese scientists and oyster farmers, who successfully imported and acclimatised Japanese oyster spat (*Crassostrea gigas*, now known as *Magallana gigas*) from the Sanriku coast in the Tohoku region.

The second one was in March 2011, when a tremendous tsunami hit the same coastline from which the spat that saved the French oyster industry originated. It destroyed everything in its path and devastated the Japanese Sanriku oyster industry. From the outset, French oyster farmers and scientists, notably through the SFJO, contributed to the revival of oyster farming in this region.

Since then, and in order to adapt to the current concerns of our societies: climate change, global change, sustainable development, adapting to change, the two societies have defined a project called: "Nature and Culture" to highlight the need for environmental governance (minimising the ecological footprint) and to incorporate a cultural component in the sense of traditional knowledge and know-how and environmental education that provides a link with future generations.

The general theme of this 19th Franco-Japanese Symposium on Oceanography, held at the University Caen-Normandie, should contribute to the implementation of a new paradigm, one that is no longer based on a sectoral approach in which each sector ignores the needs of the other, but on a more global approach, based on greater solidarity, in which the needs of everyone, and first and foremost of Nature, are taken into account by all stakeholders. It's a great challenge to take up if we want to adapt to global change, which is inevitably on the horizon, in a way that is well understood and shared, to ensure food, health and energy security for our future generations. Two renowned Japanese organisations have joined forces with the two SFJOs: the International EMECS Center and the Japan Fisheries Research and Education Agency. We would like to extend our warmest thanks to them and to all the partners and sponsors who helped make this event a reality.

Finally, I wouldn't want to end this speech without mentioning once again the strong involvement of our Japanese colleagues, which makes this event a highlight of scientific cooperation between France and Japan in the field of oceanography.

This is underlined by the sponsorship of the Japanese Embassy in France and the presence of Mr. Ohno Takahiro, First Secretary and Scientific Attaché of the Japanese Embassy in France.

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Introductory Speech—President of French-Japanese Society of Oceanography Japan

On behalf of the 34 Japanese participants present and the Japanese-French Oceanographic Society of Japan, I would like to express my sincere gratitude to our French colleagues for their efforts in making this symposium possible. I would also like to thank the many sponsors, including the University of Caen Normandy, the CNRS, the Japanese Embassy in France, the French Embassy in Japan, the Normandy Region, the La Manche department, the Fondation franco-japonaise Sasakawa and all the

companies that sponsored this event. In particular, I would like to thank Profs. Jean-Claude Dauvin, Anne-Claire Bennis, Eric Feunteun and Dr. Patrick Prouzet for their efforts in organizing this Symposium. We are honoured by the presence of Mr. Takahiro Ohno, Scientific Attaché of the Japanese Embassy in France today.

Coast Caen 2023 is also the 19th French-Japanese Oceanography Symposium. It takes two forms: the International Conference and the Forum which are hosted mainly by the two Japanese-French Oceanographic Societies of Japan and France. The Japan Fisheries Education and Research Organisation and Ifremer are holding a session at the Forum as part of the Japanese-French Scientific Cooperation Agreement. The concept of "Satoumi" was introduced at the 17th Japanese-French Oceanography Symposium held at the University of Bordeaux-II in 2017. This time, organisations practising satoumi activities as grassroots activities in local areas of Japan participate and discuss in a Forum session. This session is supported by the International EMECS (Environment Management of Enclosed Coastal Seas) Centre in Kobe, Japan.

On the 22nd of October, the Japanese delegation visited the Bay of Mont-Saint-Michel, guided by researchers from the M2C laboratory (continental and coastal morphodynamics), to gain a better understanding of coastal erosion, restauration efforts of salt marshes and the region's ecosystems.

On the 23rd of October, we visited the oyster beds, guided by the Normandy Regional Shellfish Farming Committee (Comité régional de la conchyliculture de Normandie), to gain a better understanding of the oyster farming situation in the region. The visits are used at the conference to complement the relevant presentations to understand the social, economic and environmental context and deepen the discussion.

By bringing together marine and fisheries researchers from two different cultures—France in the West and Japan in the Far East—to present, discuss and exchange the results of their research, discover each other's characteristics and apply them concretely in the field, we can not only develop and advance new research, but also contribute to achieving a sustainable marine environment and fishing industry for the future.

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Introductory Speech—Vice-President of International EMECS Center, Japan

I have really appreciated the organizer for providing me of such a wonderful opportunity to attend Coast Caen 2023. I am at the International EMECS Center located in Kobe, Japan. EMECS stands for Environmental Management of Enclosed Coastal Seas, which is now crucial issue all over the world.

The International EMECS Center is established to construct an organized network linking governments, researchers, companies, private citizens and other entities to promote academic exchanges on an international level and conduct research, training and support activities, in order to conserve existing enclosed coastal sea environments and create new ones and help create a society capable of sustainable development in which human beings can coexist with the tremendous diversity of nature.

Aiming to establish an international and academic network to solve the environmental problems of enclosed coastal seas in an integrated way, the 1st International Conference on the Environmental Management of Enclosed Coastal Seas (EMECS1) was held in Kobe, Japan in 1990. Afterward, the EMECS Conference has been continuously held around the world every two or three years. Based on presentations and discussions in a wide range of fields held by participants such as researchers, administrative officials, enterprises, citizens, etc., the importance of the integrated management of enclosed coastal seas and their backlands, and "Shared Responsibility" has been transmitted to the world as "EMECS Conference Declaration" at each conference.

Among these International EMECS Conferences, it is a matter worthy of special mention that the 7th International EMECS Conference (EMECS7) was held here in Caen, Normandie, France in May 9–12, 2006, about 17 years ago. The main theme of the conference was "Sustainable Co-development of Enclosed Coastal Seas: Our Shared Responsibility" and it was attended by some 350 persons from 25 countries.

Theme of Technical Session 3, EMECS7 was "New Concept and Innovative Experiences in Coastal Management" in which the new concept, experiences and case studies of Satoumi were presented by the late Professor Tetsuo Yanagi, Osamu Matsuda (myself) and other Japanese scientists. These presentations were highly evaluated at the overall evaluation session as that Satoumi is a rational vision of coexistence designed to achieve symbiosis among human communities and coastal areas. As a result, EMECS7 held in Caen in 2006 became a good opportunity for international debut of Satoumi concept.

Therefore, I am very glad to be here to participate in the meeting held in Caen again. Since Satoumi related session will be also held in Coast Caen 2023, I am expecting that we will be able to recognize the progress of Satoumi related activities and discussion during the last 17 years.

It was also pointed out that progress in coastal management will become increasingly advanced and multifaceted, and that coastal management will require cooperation at the international, regional, national and local levels. Since subjects of Coast Caen 2023 to be discussed soon are very broad and diversified, I wish the conference will bear fruitful discussion and productive results.

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Introductory Speech—President of the Organization Committee—Coast Caen 2023

After Bordeaux in 2017, Tokyo in 2020 but postponed by videoconference in 2021 to celebrate the 60th anniversary of the Franco-Japanese Oceanography Society Japan, due to the strong impact of Japan by COVID-19, it was decided by our two societies that the 19th Franco-Japanese Oceanography Symposium would be held in Caen and to entrust me with the organization. So, the 19th Franco-Japanese Symposium had been organised at the campus 1 of the Caen Normandy University which is in the centre of Caen near the Guillaume the conqueror Castel in October 2023.

The Normandy coast of the English Channel is a highly impacted ecosystem concerned by numerous human activities. It is subjected to heavy historic anthropogenic pressures and the emergence of new human activities: fishing, harbour extension, aggregate extraction, and deposition of dredged sediment, aquaculture and future offshore wind farms. By contrast, this area shows a high level of protection of its natural heritage, mainly owing to the Natural Reserve and Natura 2000 sites. All these human pressures in interactions influence the functioning and the dynamic of this complex ecosystem.

Four topics have been retained for the 19th Symposium corresponding to regional challenges of research, development, innovation and controversies between human activities in Normandy. All these topics are precisely described on the website of this international events: http://coastcaen2023.socfjp.com/.

Session 1—Exploitation of Living Resources: Necessity and Constraints;

Session 2—Development of Renewable energies and impact on socio-ecosystems;

Session 3—Coastline evolution and submersion of coastal territories.

A special topic was organized in the French-Japanese Forum on: The Satoumi concept and the management and Commons—an integrated approach, a link between land and sea and between Nature and Culture.

Before the beginning of this international event, two-day trips had been organised. The Sunday October 22, excursion has been organised for the visit of the famous abbey and Mount Saint-Michel Bay with a tidal range higher 12 m by Bernadette Tessier, Research Director at the CNRS. The second excursion was on the eastern coast of Cotentin at Saint-Vaast-La-Hougue to visit the harbour installation and the oyster parks, a lunch with the local products allowed us to test three Normandy oyster vintages, king scallops from the Bay of Seine and whelks and Venus clams from the Normand-Breton Gulf, and Normandy cider. Then, there were the visit of the SMEL laboratory and the shellfish Viking enterprise on the western coast of Cotentin. Thanks to the Regional Fisheries, Regional Shellfish Aquaculture Committees and the Manche Department for the day organization.

During the symposium, we have the opportunity to visit the Men Abbey (Abbaye–aux–Hommes), Caen City Hall on the 25th of October, this historic landmark of Caen that links us to William the Conqueror. In 2025, we will celebrate the 1000th anniversary of Caen, a regional anchorage to the sea with its port connected to the sea by its canal dug in the nineteenth century and completed in 1857. The Gala dinner had been held at the Peace Memorial of Caen on the 26th of October.

Finally, the last day on Friday the 27th of October, there was the visit of the maintenance centre of the "Parc Eolien en Mer du Calvados" at Ouistreham. Thanks to Caen La Mer and EDF Renewable for the visits and their hospitalities.

I would like to thank all the 31 sponsors who have given us their financial support, label or help. A special thanks to Marc Delahaye, director of the "Comité Régional des Pêches et des Elevages Marins de Normandie", for the submission of the application of European funding which made it possible to finance the interpreters who will accompany us during these four days.

Thanks to all the 24 members of the organizing committee, in particular to the staff and Direction of my UMR M2C Caen. A special thanks to Marie-Pierre Bouet for her precious, unfailing, efficient help, in a word, essential to the life of the laboratory. Thanks to Mrs. Chauvet for the management of the CNRS Azur Colloque tool.

Finally, a huge thank you to the University of Caen Normandy, its President Prof. Lamri Adoui, the logistics services, the printing press, the managers, the "Maison de la Recherche en Sciences Humaines" in which the two days of the international conference will take place. Without the help of UNICAEN and the provision of premises such as the prestigious Pierre Daure amphitheater in which we are staying during four days, the conference would not have been possible in this form.

We are 125 registrants, including a great delegation from Japan and a representation from the Japanese Embassy present to the open ceremony of the symposium. Thank you for your presence and for all your communications, thank to Prof. Teruhisa Komatsu, President of the Franco-Japanese Society Japan.

Thank to Ms. Reiko Vachot-Inukai, Ms. Miyu Mitake-Leroy and Ms. Anna Devaux-Tsuru for their interpreting work. The participants appreciated your professionalism. Thank you to the caterer the Durand Company of Caen for all your support throughout the conference from Saturday the 23rd to Friday the 27th of October, thanks to Mr. Duchemin and your team; all the guests appreciated the quality and the variety of the meals that were served. Thanks to MTCA for the installation of the sound system and your presence throughout the symposium.

I reiterate my thanks to all the participants who made this symposium a success. Thank you to the guest speakers in the plenary and thematic sessions and to all the poster and oral presentations for the diversity of the topics addressed and the quality of their presentations.

It seems to me that we have dealt more broadly with oceanographic issues than at previous conferences. In addition, the societal future of our coastal and coastal areas has taken a more important place in our research themes. The holistic vision, the only scale that allows us to try to understand, analyze and project ourselves on the future of our Earth System and our Global Ocean, is appropriate in the face of climate change and the well-being of our current and future human societies.

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Contents