

Thinking our future in connection with the sea : Nine Grand Challenges by the PROSPER Network

Having methodically screened the links between Ocean and Society by 2030, the PROSPER Network, with the help of Futuribles and the financial support of Ifremer, proposes to "think about the future" in this field by nine Grand Challenges. Each one is illustrated by two issues deserving a particular attention, in particular because of their transverse aspect.

Grand Challenge 1 :

To understand and anticipate the development of marine ecosystems

This is the challenge of sustainability by definition. Acceleration of climate change and increasing human activities in the marine area (extraction, processing, waste ...) drive us into a future still largely unknown.

Two specific issues to illustrate :

Issue 1-1 : Measure and monitoring networks

To understand current developments requires first to have the means to detect and measure what happens at all scales and in all latitudes. How to overcome current scientific, political and economic divisions for in a global coordination? How to develop instrumentation and measurement networks, open the databases and merge data? How to involve citizens in this data race underlying our ability to know and understand?

Issue 1-2 : Ecosystem modeling

To understand the overall dynamics of these ecosystems, from local to global scale, knowledge about marine ecosystems are too segmented and expertise is too specialized. Progress in modeling ecosystem dynamic would have the dual benefit: increase meetings and interactions between fields of expertise, allow multiple simulations for the evolution of these ecosystems under different forcing conditions (climate, anthropogenic ...). How to conduct this cross to develop models and involve widely actors and decision makers in society to their use for the purpose of understanding, accountability and anticipation?

Grand Challenge 2 :

To secure marine origin food intake and therapy

In a context of growing consumption of sea products for food or therapeutic purposes (animal, plant and mineral), There is a need to take a global shift - both for fishing and for farming – from productivity to quality, safety and sustainability.

Issue 2-1 : Best practices in aquaculture

Growing demand for food generates a massive expansion of aquaculture with levels of quality, and regulations procedures which may vary widely from one country to another. Through transport and processing in a globalized market, track of these products are easily lost, not easing sanitary control nor encouraging virtue. How each country can insure compliance of these products to its national requirements? Is it better to protect oneself or act at the source? By constrain or by the development of good practice in a win-win relationship? What kind international coordination to implement?

Issue 2-2: Synergies on the continental shelf

The continental shelf is a competing issue for space, especially between food activities (fishing, aquaculture) and energy (wind, tidal, algae fuel ...). Current experiences (Japan in particular) show gain of developing synergies (e.g. wind energy / artificial reef). How to stimulate and develop these transverse approaches, from research to implementation?

Grand Challenge 3 :

To control colonization of oceans, from the coast to high seas

The population is concentrated on the coasts and the economy develops in conditions that may become critical. It spreads over the sea, further from the coast, but also rules.

Issue 3-1 : Control of coastal densification

The number of people living by the sea is increasing, partly because of economic opportunities that develop. The former integrated ports in cities, dissociate progressively. Urban areas themselves stratify in rings of decreasing wealth; from economic and touristic prosperous hearts, to disadvantaged peripheries where insecurity, disease, violence and the underground economy grow. Land tensions spread at sea, where wild settlements (slums on stilts or floating) contrast with the ostentatious luxury homes and floating leisure spaces. How to go to regulate coastal densification, develop balanced coastal urbanization and harmonize living together?

Issue 3-2 : Environmental Integration

Intensification of housing in the coastal zone and its offshore extension, not to mention the development of inhabited offshore platforms, adds pressure on fragile ecosystems. How to address the issue of better environmental integration, or even a symbiosis between marine habitats and ocean sphere? Is the answer only to be found through technology and regulation? Who should grab the issue?

Grand Challenge 4 :

To develop safe and sustainable technologies for resource development

The oceans are an "Eldorado" of resources (energy, minerals, bio ...) that technological progress makes more accessible, in shallow as well as in deep waters . But, being a medium both hostile and fragile, oceans require technologies with the highest level.

Issue 4-1 : Sustainable processing in deep waters

Mining of mineral resources in deep waters requires special technologies, in an extreme environment and away from rear bases. Issues of autonomy of action, mechanical and chemical resistance, energy efficiency, environmental safety are essential. The value chain from sea to the use ashore is to be optimized, with probably steps performed on offshore platforms. How to articulate the technological, economic, environmental and regulatory approaches in order to ensure relevance and sustainability of such operations?

Issue 4-2 : Marine energy resources

The marine energy potential is enormous, with a wide variety of options for capturing mechanical thermal or biochemical energy. Devices such as mechanical energy storage, carbon dioxide storage, etc are envisioned. How far can to support these developments? How to arbitrate developments particularly in relation to conflicts of use, risks and nuisances?

Grand Challenge 5 :

To prevent natural and man-made risks and manage crisis situation

The concentration of coastal population and activities, the exploitation of marine resources and the colonization of the oceans increase ecosystem sensitivity and exposure to risks. Coastal society becomes itself more vulnerable to natural and health risks in a context of growing climate change impact.

Issue 5-1 : Resilience of coastal areas

Coastal areas concentrate risks, both natural and anthropogenic, from marine and terrestrial origin. Urban and industrial pollution, uncontrolled human activities, the natural evolution of the coastline, extreme weather events and future climate effects, etc.. are sources of vulnerability for coastal ecosystems, for people and for the economic and social infrastructure. How to develop a systemic approach to these issues? What management to increase coastal resilience to these attacks?

Issue 5-2 : Risk management and crisis situations

Marine and coastal activity generates ordinary and extraordinary risks. Scattered risks are related to the proliferation of coastal facilities that can generate timely incidents and accidents (hooking cables, collisions ...) or permanently harm or injure health and the environment. Maritime transport can be associated with risks to people and property, risks of pollution, transport and spreading of invasive species and pathogens, not to mention piracy at high seas, port violence or unlawful activities. A number of these risks (marine pollution, spread of pathogens, piracy) overlap global, regional and local levels. How to ensure proper management of these risks, and develop the necessary coordination in crises?

Grand Challenge 6 :

To develop biotechnology for industrial, sanitary and curing use

Nature can work for us, we must ensure that it is better and safe to produce what we need, recycle what we no longer need or repair what we have degraded.

Issue 6-1 : Bio-reduction of anthropogenic footprint

Anthropogenic pressure is strong throughout the littoral zone. There is particular urgent need of sanitation solutions in densely populated areas : bio-processes and bio-remediation treatments could be effective and sustainable solutions, but not always easy to finance and implement. In general, eco-planned approaches are promising, but they have to face ROI (Return On Investment) questions, since benefits are diffuse and in the long term. Through which policies, technical, financial, educational, etc., could a wide use of sustainable bio-treatment processes be promoted?

Issue 6-2 : Marine bio-economy

The promises of marine biotechnology are great for making raw materials for industry including health. But the rise of a bio-based economy of marine resources is slowed by funding issues (R & D in particular), rules for intellectual property (ownership of living) and regulation. How to approach transversely all these questions?

Grand Challenge 7 :

To develop education, sustainable tourism and responsible social practices

Anthropogenic pressure on marine environments is increasing, both in a professional and in a private setting, because of sea attraction for living or for leisure.

Issue 7-1 : Education and responsible social practices

Interest in natural environments conservation thrives on discovery, wonder and understanding of ecosystem functioning: education issues are essential to develop responsible practices. Beyond school education, the role of marine protected areas, reports, discovery websites, games related to the sea, is essential. How to start a virtuous economy which would expand understanding of marine ecosystems and social responsible practices?

Issue 7-2 : Sustainable Tourism

The increase in the global standard of living and the development of free time lead to mass entertainment, for which the seas play an important part. What technological or organizational innovations in the field of tourism could meet people expectations while decreasing the pressure on marine ecosystems? What alternative "immersion" in the marine environment through virtual reality? What support, improvement or supervision of independent tourism through portable applications?

Grand Challenge 8 :

To build international set of laws of the sea to the extend of new challenges

New global changes are challenging the existing regulatory frameworks: valuable submarine resources are made available by technological progress, intensification of marine traffic generates new risks, and aggressive predatory behavior develops.

Issue 8-1 : National sovereignty and the maritime common good

Increasing geostrategic and economic importance of maritime areas leads to tensions among States about the limits of different maritime areas (including in particular Economic Exclusive Zones) or international conventions or specific agreements for operations in international maritime areas. How to reconcile interests of individual States with the defense of the public interest and the preservation of the common asset? What new regulatory frameworks could be established to put on the agenda all deserving subjects and to negotiate sustainable and equitable solutions? What links between national public power and multinational private power? What incentive or new regulatory role for public opinion and sustainability stakeholders?

Issue 8-2 : Standards and regulations at sea

Intensification of traditional maritime activities (fishing ...), the emergence of new offshore activities (industrial platforms), increasing traffic, more predatory behavior, etc.. require more specific standards and rules defined with international consistency. How to ensure that harmonization of technical standards converge internationally to the best ones? What related measures (training of crews, etc ...) can help effectiveness or efficiency a number of measures? What new areas should be subject to regulations?

Grand Challenge 9 :**To systemize and globalize monitoring, control and regulation of activities**

The proper functioning of our societies depends increasingly on the proper functioning of economic activities at sea. Monitoring implementation conditions of these activities, detecting illegal activities and predatory behavior, preventing incidents and accidents become vital.

Issue 9-1 : Survey and monitoring at sea

Development of measurement technologies, of sensor integration, of transmission, storage and processing of data opens up new possibilities for monitoring maritime activities. How to build consistent and effective surveillance and control systems at international level? What links between State monitoring (Defence) and civil, public and private? How to break down barriers, boundaries and interests of all kinds to consolidate and use the data? What could bring civil society, through the sea lovers and social networks?

Issue 9-2 : Securing vital maritime flows

Vital flows (food, energy ...) traveling by sea are increasing and are more and more in just-in-time. Any disruption in the supply chain can become critical. Securing these flow becomes a major concern in terms of transport, storage and distribution (including vulnerabilities due to the density of facilities in port areas), on one hand, in terms of quality security (origin of food, how to store), on the other. How to link the different levels of responsibility in the supply chain? What forms of monitoring, control, action and crisis management developed at international level? How to involve all stakeholders to develop a comprehensive global approach and deploy it?