Ocean Science and Marine Technology Research and Education for Sustainable Utilisation of Ocean Resources

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Overview

- Introduction
- Identification of Impact Sources
- Current Impacts and Mitigation
- Inter-Disciplinary Collaboration
- Potential Research Roadmap
- Renewable Energies from the Ocean
- Fossil Fuels and Row Materials
- Fishery and Aquaculture
- The Role of the Education in supporting the Sustainable Utilisation of Ocean Resources
- General Recommendations

IMPORTANCE OF OCEANS FOR SUSTAINABLE UTILISATION

- Oceans occupy 71% of the Earth's Surface.
- Cradle of life, and an important component of life-supporting system of the globe
- A great environmental regulator
- A gateway for countries in their contacts with the rest of the world . Easy and cheap way of transportation for trade

IMPORTANCE OF OCEANS FOR SUSTAINABLE UTILISATION

- Ocean is a treasure house of resources, including minerals (sand, polymetallic nodules, cobalt crust, hydrothermal vents) energy (oil and gas, gas hydrate, renewables) and food (fish etc.) for sustainable human development
- Ocean economy is and important component of world's economy and increases rapidly It represents roughly 5.4 million jobs and generates a gross added value of almost €500 billion a year in Europe and $27 trillion dollars internationally.

IMPORTANCE OF OCEANS FOR SUSTAINABLE UTILISATION

- The coastal zone is a suitable homeland for human beings. At present, 60% of the world's population lives within 100km from the coast lines
- The coastal zone, particularly coastal cities, are where centres of finance, business and science and technology concentrate and interact with each other.
- The coastal zone now represents the locomotive in world's economy

IMPORTANCE OF OCEANS FOR SUSTAINABLE UTILISATION

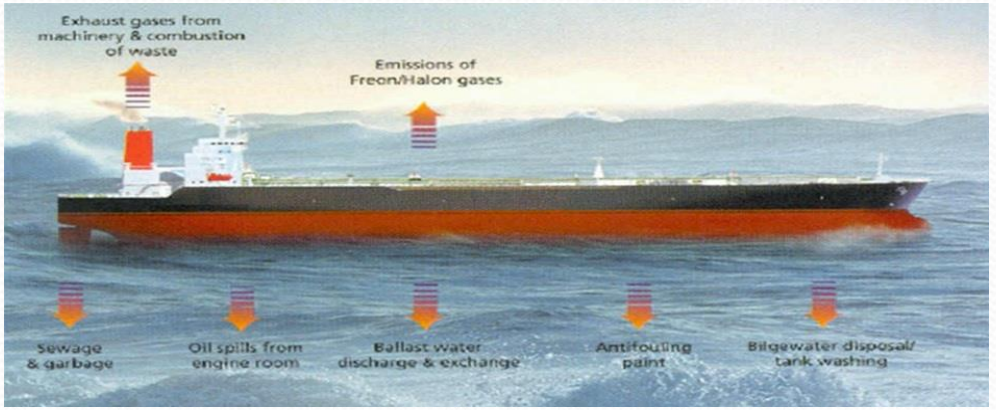
- The coastal areas are where problems of economic development and environmental protection are most serious.
- The oceans are both the CO2 source and sink. It is where scientific uncertainties for climate change are apparent.
- In 2001, the United Nations declared that 21st century is the “Century of the Oceans” . Last frontier for human development

Many sources of impact on the Oceans:

- Maritime Emissions
  - —Toxic Substances from antifouling paint
  - —Underwater Noise
  - —Operational Oil Spills
- Wash
- Operational Waste
  - —Solid
  - —Waste Treatment Residues
  - —Sewage
  - —Noxious Liquid Substances
  - —Oily Residue
  - —Ozone Depleting Substances

- Airborne Emissions
  - —Exhaust Emissions
  - —Cargo Emissions
  - —Noise
  - —Fire Extinguishers
  - —Refrigerants
- Invasions through
  - —Ballast Water / Sediments
  - —Hull / Anchor
- Accidents
  - —Oil
  - —Emissions to Atmosphere
  - —Discharge of Hazardous Material

Focus on highlighted topics:



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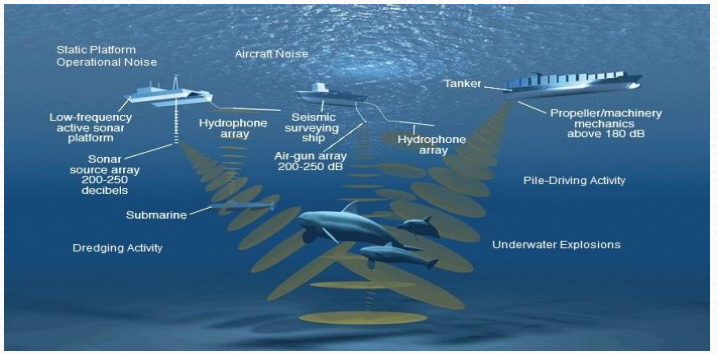
Underwater Noise

- Pressure on IMO to address this issue
- May cause masking phenomena and avoidance behaviour
- Lack of data for majority of marine wildlife species

- Need for suitable limits to be investigated
- Noise propagation and ambient levels globally need to be better understood
- Improve monitoring and measuring systems and procedures

Underwater Noise



Potential developments over the next 15 years include:

- Improved monitoring of global noise levels, and water property data
- Review on propagation prediction methods, especially for Polar waters
- Development of suitable regulations and limits, possibly goals-based
- Greater understanding of marine wildlife, and links with noise
- Improved monitoring , data collection, and wildlife proximity technologies
- Development of current ship hull designs and propulsions systems for lower noise, without economic penalties
- Collaboration with marine sciences for greater general understanding

Bio-Fouling and Anti-Fouling

- Increased vessel operational and maintenance costs
- Potential transfer of alien species on hulls
- Impacts of coating removal and re-painting

- Need for new coatings and systems
- Development of monitoring sensors
- Potential use of Bio-Mimetic coatings

Bio-Fouling and Anti-Fouling

Potential developments over the next 15 years include:

- Identification / modification of susceptible hull designs
- Development of 100% efficient and zero-impact anti-fouling and fouling-release coatings / surfaces
- Impact monitoring on marine flora and fauna
- Development of monitoring sensors
- Knowledge transfer to oceanography and marine biology sciences

Wash

- Could cause erosion, re-suspension of sediment and water column aeration
- Potential damage to other vessels and structures
- EU, national and global limits for operation in restricted waters

- Investigation into full environmental consequences
- Improvements to hull designs and propulsion systems

Wash

Potential developments over the next 15 years include:

- Improve existing hull-form designs and propulsion systems
- Research possible use of Bio-Mimetic propulsion commercially
- Aim for 50% reduction in wave heights and sediment re-suspension
- Possible limits on vessel size and speeds in restricted waters
- Collaborate to also potentially reduce airborne emissions and noise

Airborne Emissions

- Concern over CO_2, NO_x and SO_x emission levels
- Majority of emissions from diesel engines as prime ship movers

- Technological challenge is to achieve significant reductions
- Exact level of global impact on marine environment not well understood
- Requires monitoring and assessment

Airborne Emissions

Potential developments over the next 15 years include:

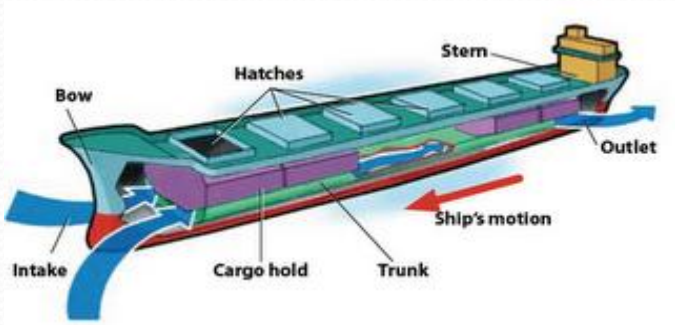
- Standardise measurement and definition protocols
- Carry out global measurements and observations on emission levels
- Identify quantitative impacts on marine life and climate change
- Create a Geographic Information-Based System (GIS) for impact mapping
- Inter-disciplinary collaboration for potential combination with noise level monitoring and mapping in GIS

Ballast Water

- Introduction of non-indigenous organism into other ecosystems
- Economic and environmental penalties and increases in fuel consumption
- IMO D2 Regulations came into force in 2014 / 2016

- Improvement of current treatment systems and technologies
- Development of alternative and economically viable solutions such as in-tank treatment, continual flow options and zero-ballast vessels

Ballast Water



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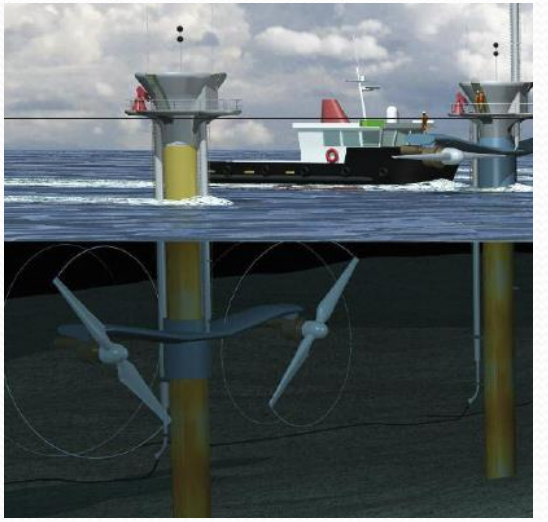
Potential developments over the next 15 years include:

- Assess effectiveness and impact of current ballast water treatment systems
- Investigate impacts of treated ballast water on the marine environment
- Develop in-tank treatments to reduce space and power requirements
- Carry out feasibility studies for continuous flow solutions
- Research and develop designs for solid / potable ballast and zero ballast vessels
- Collaboration could also improve air emissions

1. Renewable Energies from the Ocean

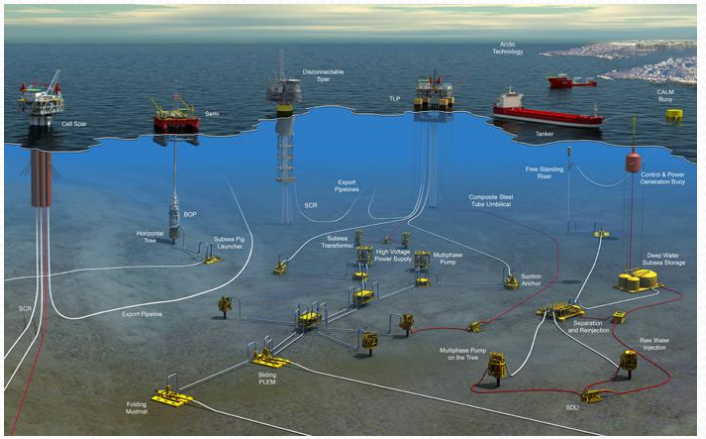


- Challenges
  - ambitious policy goal (20% renewable in 2020)
  - offshore wind in industrial pioneering phase
  - logistics + maintenance not yet economic
  - wave, tidal + other ocean energy must manage the step to feasible MW-demonstrators
  - no harmonized standards for services in EU waters

- Expected Outcome
  - making energy supply more sustainable
    - less dependent on energy imports
    - cleaner (reduced CO2-output)
  - reducing renewable power generating costs
  - reducing conflicts with safety and environment goals

Pictures: Houlder, EAOE, Statkraft

2. Fossil Fuels and Raw Materials



Challenges

- future O+G wells are mainly in ultra deep water and harsh environment
- risks for safe and environmentally unfriendly operations must be minimized to achieve public acceptance
- harvesting offshore O+G, methane hydrates and ocean minerals must be economically vable
- to use the enormous potential of CCS for reducing CO2

footprint of fossil energy use, safety processes have to be demonstrated

- large scale desalination must be made energy efficient to be a viable option

Expected Outcome:

- securing the primary energy supply future
- securing a reliable and economical basis for critical raw materials
- to have an economically viable option for fresh water supply by using desalination and thus to reduce tension potentials

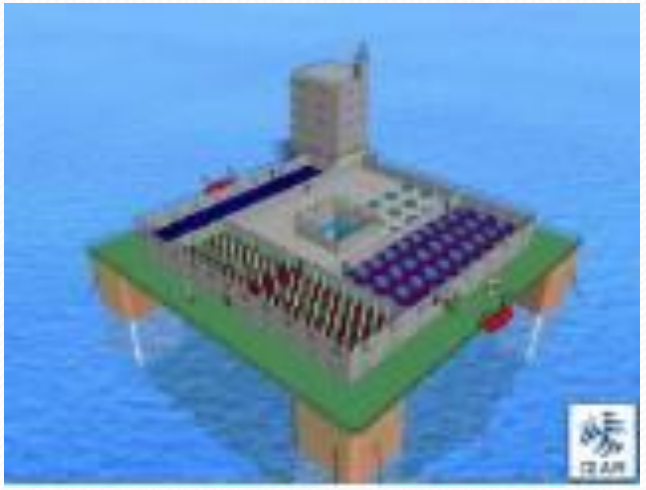
3. Fishery and Aquaculture

- **Challenges**

- future fisheries must include stock management principles and thus use compatible data acquisition, simulation and catching methods
- mariculture can lead to substantial pollution; thus closed cycles as well as means for open ocean operation must be developed
- the actual cost level of offshore operation is too high for economically viable large scale introduction of mariculture, a step change by new technologies and scale effects would be needed

- **Expected outcome**

- securing a sustainable and healthy nutrition of a growing world population
- opening a new raw materials base for medical and cosmetics induistry, but also other branches
- energy (oil) from algea is a long term perspective for the world‘s energy mix



The Role of the Education in supporting the Sustainable Utilisation of Ocean Resources

- The education, training and continuous professional development of human resources at every level in Ocean Sciences and Marine Technology is of utmost importance for addressing the challenges described in the earlier slides. In order to achieve this the following objectives need to be met.

Sustainable access to skilled human resources

- The Education, training and continuous professional development policies must support the creation of highly skilled managers, engineers, scientists, seafarers and other human resources required for the ocean science and marine technology discipline areas. In addition an appropriate communication/promotion policy should be developed to attract high achievers to our discipline areas.

Quality and focus of education and training in the marine technology sector

- The evolution of the marine technology sector towards a structure with a few major construction companies and a large number of subcontractors requires new management skills based on innovation, adaptability and effective networking. Continuous professional development schemes and tools should be established throughout the world for further or re-training of technical, management and research staff in marine technology sector. E-learning and long distance training geared to maritime professionals in the globalisation era should be developed to accelerate the upgrading of skills and the transfer of knowledge amongst mature and freshman, as well as non-marine staff. The expected increase in the LNG production and transport which have unique features will require a special training and education, thus training and education provisions for this sector of the industry should be developed. This applies also to the recreational ship market (small, large and fast crafts), expected to steadily grow until 2020. A reduction of marine accidents of recreational craft requires special training for the users, thus proper policies and procedures should be developed to create proper safety culture amongst the users.

Recommendations

- Wide range of often inter-related sources of impact on the marine environment, flora and fauna have been described
- Outlined areas for research and development requirements
- Innovative ideas and solutions to problems and regulations needed, and should be encouraged
- Greater inter-disciplinary collaboration could benefit many aspects of marine science, technology and the environment