Deep-Sea Ecosystems

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SEAS-ERA Atlantic Science Consultative Workshop, 28-29 February 2012

Deep-sea research in the broader picture

There are important links between the deep-sea and the rest of the Earth system ⇒ link deep-sea research with:

- all basic research themes: ecosystem functioning and processes, climate change & acidification, marine biodiversity
- applied research: marine environmental research; assessment support; sea fisheries; marine high tech products and services (e.g. smart AUVs, sensors, deep observatories, multi-purpose monitoring stations); marine biotechnology; oil & gas and mineral

Missing key deep-sea research issues

- Continued discovery of **deep-sea biodiversity**, from microbes to megafauna.
- Deep-sea ecosystem **connectivity** → patterns of biodiversity and biogeography → deep-sea ecology.
- Continent to shallow seas to deep-sea **transfers of matter, energy, carbon and pollutants**, and their implications (living resources, health of deep ecosystems, goods and services).
- **Climate change** and **acidification** impacts on deep-sea properties, circulation and ecosystems; incl. modeling, *in-situ* research and monitoring.
- Morphodynamic **evolution of the seafloor** across time, space and scales: main natural and anthropogenic drivers (incl. extreme events such as major storms, cascading events, seafloor eruptions, landslides,..), and influence on deep-sea ecosystems.

Missing key deep-sea research issues

- **Exchanges** between the sub-seafloor, seafloor and water column/atmosphere (e.g., CH_4 & CO_2 release, CH_4 natural sequestration, C-sequestration, natural C-capture via benthic pelagic coupling) and prediction of how they might modulate climate change or vary due to it.
- Assessment of **potential resources** of the deep ocean; options for **ecologically sustainable exploitation** of the deep-seafloor and its living, mineral and energy resources (incl. governance, risk assessment, planning and monitoring)
- **Geo-hazards** and the threats they pose to coastal locations, incl. observatories and warning systems to mitigate their effects.

Overall Comments

- Vision: “harnessing new and emerging science, technology and innovation” but also build on **existing good practices, science and technologies**
- Introduction: stress **ecological value** and ecosystem **goods and services**
- Benefits: link with forthcoming European Ecosystem Assessment
- High-level objectives: add development of long-term **monitoring strategies** (ecosystems, human activities, impacts)
- **Wording matters**… e.g. “sustainable exploitation” or environmentally, socially and economically sustainable use?
- **Social sciences**, and socio-economic research: an afterthought? or genuine interdisciplinarity across natural and social sciences?
  - ✓ Just as for natural sciences, the ocean brings new challenges to social sciences (lack of scientific and stakeholder knowledge, complexity, uncertainties, …

Missing key research issues

- Research on drivers and pressures of biodiversity and ecosystem change (important in particular for ecosystem approach)
- Research on existing and emerging activities and technologies:
  - ✓ risks/environmental and health impacts
  - ✓ economic feasibility (subsidies, alternatives, …)
  - ✓ mitigation techniques / precautionary approaches
  - ✓ monitoring of activities
- Governance research: e.g. adequacy of governance and management (incl. MPAs); *ex ante* and *ex pos*t policy assessment
- Mapping: not only seabed morphology but also habitats and ecosystems (support for habitat/biotope classification), species range, and human activities
- Ecosystem functioning and processes:
  - ✓ connectivity research (e.g. to design MPA networks)
  - ✓ Links between ecosystem functions and goods and services
- The role of teleconnections (e.g. atmospheric processes having effects over large geographical distances).
- Low impact practices and technologies (e.g. fishing)

Missing key enabling actions

- Marine biodiversity enabling action to provide input to IPBES and other assessments (e.g. Regular Process; EU ecosystem assessment)
- Trans-Atlantic cooperation also with South-America

Note:

- References to MSFD:
  - ✓ Clarify: 11 descriptors of GES, each associated with several criteria and indicators.
  - ✓ Sometimes more than one relevant descriptor. Need supporting data for indicators

Thank you!

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