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The World Ocean in Globalisation: Challenges and Responses for the Anthropocene Epoch

Davor Vidas and Peter Johan Schei

Increasingly, scientists have been voicing a new concern: that the Earth may be undergoing a shift from the latest known geological epoch, the Holocene,¹ to a new one – *the Anthropocene*.² Human-induced effects may have contributed decisively towards pushing the Earth System³ away from the environmental stability achieved in the Holocene. This is not meant to imply an imminent scenario of a natural catastrophe: rather, it is more a matter for serious inquiry into whether the Earth System has left its stable period and is facing new, uncertain prospects. If scientifically verified through the process initiated within the International Commission on Stratigraphy, this hypothesis of the Anthropocene should invite fundamental reflection on our current social structures.

¹ By current criteria, the most recent geological epoch is the Holocene: this is the longest (now defined to be around 11,700 years) interglacial interval of relative stability in climate and sea level – factors that proved significant for the development of human civilization. On the definition and dating of the base of the Holocene, see M. Walker et al., ‘Formal Definition and Dating of the GSSP (Global Stratotype Section and Point) for the Base of the Holocene Using the Greenland NGRIP Ice Core, and Selected Auxiliary Records’, *Journal of Quaternary Science*, Vol. 24, 2009, pp. 3–17, who conclude that the Holocene started 11,700 years ago, as counted from year 2000 – based on an archived ice core constituting the GSSP for the base of the Holocene epoch, as ratified in 2008 by the International Union of Geological Sciences.

² See Jan Zalasiewicz and Mark Williams, chapter 2 in this book; see also, in the context of an overview of marine science, John Montgomery and Lionel Carter, chapter 3 in this book.

³ The term ‘Earth System’ as defined by Lovelock: ‘a system made from the living organisms of the Earth, and from their material environment, the two parts being tightly coupled and indivisible’; J.E. Lovelock, ‘Hands up for the Gaia Hypothesis’, *Nature*, Vol. 344, 1990, pp. 100–102, at p. 100.

Important questions may arise about the sustainability of some aspects of current international law – a system of rules resting on foundations that evolved in the circumstances of the Holocene, assumed to be ever-lasting. Some segments of international law, in particular the law of the sea – a branch of international law applying to 71 per cent of the Earth's surface area – involve certain causal links with this development.⁴ Other aspects, such as human rights,⁵ may gain in prominence and acquire new dimensions, all likely to require a profound re-examination of accepted perspectives of international law.

In this book and its companion volume,⁶ various aspects of ocean governance and the law of the sea structures of today are re-examined in light of contemporary and emerging challenges and responses, largely prompted by the increasing globalisation of the seas and oceans.

CONCEPT OF THE ANTHROPOCENE IN NATURAL SCIENCE

In 2009, the International Commission on Stratigraphy established a working group to examine the stratigraphic basis for the term 'Anthropocene'.⁷ This *Anthropocene Working Group*, composed of prominent experts in geology and a range of other scientific disciplines, is to evaluate the validity of scientific evidence for formally recognizing the Anthropocene as a new geological time-unit. The process for changing the Geological Time Scale, as involved here, is a complex one that requires approval by the International Commission on Stratigraphy and the International Union of Geological Sciences.

The concept of the Anthropocene was put forward by Paul Crutzen (Nobel Prize Laureate in Chemistry for his work on atmospheric ozone), who linked it to the global environmental effects of economic development

⁴ See D. Vidas, 'The Anthropocene and the International Law of the Sea', *Philosophical Transactions of the Royal Society – A*, Vol. 369, 2011, pp. 909–925.

⁵ See Marie Jacobsson, chapter 4 in this book.

⁶ D. Vidas (ed.), *Law, Technology and Science for Oceans in Globalisation* (Leiden: Martinus Nijhoff, 2010) which addresses, in addition to the overall issues of the World Ocean in the Anthropocene (Part I, pp. 3–73), several specific issue-areas: IUU fishing – regulatory framework and use of technology (Part II, pp. 77–210); marine pollution caused by illegal oil spills from ships; the interaction of technology and law (Part III, pp. 213–305); marine genetic resources and bioprospecting (Part IV, pp. 309–419); and the continental shelf beyond 200 nautical miles (Part V, pp. 423–589).

⁷ The Commission is the only global-scale organisation concerned with stratigraphy (the study of rock layers, *strata*, as geological formations); the Subcommission on Quaternary Stratigraphy, within which the Anthropocene Working Group operates, is the body that deals with the units of the current Ice Ages.

and increased human population.⁸ According to Crutzen, this new, human-dominated epoch emerged after the major shift to fossil fuels, when the transition to a high-energy society made it possible for the global population to soar from one billion in the early 19th century to almost seven billion today.⁹ As explained by Zalasiewicz et al.,¹⁰ population growth is closely linked to the massive expansion in the use of fossil fuels, which powered the Industrial Revolution and allowed the mechanization of agriculture that enabled additional billions to be fed. The growth in human impact has been highly exponential: over the past 50 years, humans have changed the world's ecosystems more rapidly and more extensively than in any other comparable period in human history.¹¹

Various environmental, biological and chemical changes caused by the progressive increase in human activities are now well established – but the significance of their extent and their causal effects are still hotly debated. Some changes in the Earth System are, however, now seen as permanent even on the Geological Time Scale.¹² These may differ from natural causes and may lead to consequences in strata distinct from the previous geological time-units. The question to science is, as formulated in 2008 by the members of the Stratigraphy Commission of the Geological Society of London: *Are we now living in the Anthropocene?*¹³

LINKAGES TO INTERNATIONAL LAW PERSPECTIVES

Key meetings among scientists concerning the Anthropocene will be held during this decade. Formal recognition of the Anthropocene as a new epoch in the geological history of our planet could critically raise awareness and highlight the magnitude of the human impact on the Earth System.

⁸ See P.J. Crutzen and E.F. Stoermer, 'The "Anthropocene"', *Global Change Newsletter*, No. 41, 2000, pp. 17–18; and P.J. Crutzen, 'Geology of Mankind', *Nature*, Vol. 415, 2002, p. 23.

⁹ See figures in Population Reference Bureau, *2010 World Population Data Sheet*, available at <www.prb.org>. The world human population is expected to reach seven billion by the second half of 2011.

¹⁰ J. Zalasiewicz, M. Williams, W. Steffen and P.J. Crutzen, 'The New World of the Anthropocene', *Environmental Science and Technology*, Vol. 44, 2010, pp. 2228–2231.

¹¹ W. Steffen, P.J. Crutzen and J.R. McNeill, 'The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?' *Ambio*, Vol. 36, 2007, pp. 614–621.

¹² Zalasiewicz et al., 'The New World of the Anthropocene', p. 2228.

¹³ J. Zalasiewicz, M. Williams, A. Smith, T.L. Barry, A.L. Coe, P.R. Bown, P. Brenchley, D. Cantrill, A. Gale, P. Gibbard, F.J. Gregory, M.W. Hounslow, A.C. Kerr, P. Pearson, R. Knox, J. Powell, C. Waters, J. Marshall, M. Oates, P. Rawson and P. Stone, 'Are We Now Living in the Anthropocene?', *GSA Today*, Vol. 18, 2008, pp. 4–8.

But will such a shift prompt a new paradigm for international law, as earlier argued for in another context?¹⁴ Today we have a legal framework that covers various aspects of human activities, but remains unable to respond adequately to the overall challenges to humankind possibly already living in the Anthropocene (and presumably contributing to it). Will our recognition of a new epoch in the Earth's history prompt new international law concepts, pragmatic in responding to fundamentally new challenges?

We first need to conceptualize linkages between the shift to the Anthropocene epoch and the development of international law so far. These may have deep roots.¹⁵ The ideological foundations of the law of the sea, especially as formulated in Hugo Grotius' *Mare Liberum* of 1609 vs. John Selden's *Mare Clausum* of 1635, involve 'deep-time' origins for the later processes that ultimately (under the current hypothesis) brought about the Anthropocene. The ideology of the 'free sea' eventually facilitated the emergence of forces that led to the Industrial Revolution and then to levels of development entailing ever-greater human impacts on the Earth System.

Today's picture of the international law of the sea received its frame in the near-universal 1982 UN Law of the Sea Convention, which builds on some four centuries of development. Around 90 per cent of global trade today uses the sea. Human nutrition involves protein secured by fisheries. All states are entitled to use the sea; also land-locked states have the right of access and freedom of transit. There are around 150 coastal states in the world, with their maritime zones of sovereignty and sovereign rights extending mainly in relation to coastal geography and submarine geology. Challenging the normative and institutional structures established on these bases would mean challenging international law – in itself a relatively recent achievement of human civilisation. However, simply continuing along the same path does not seem feasible either. In the context of Anthropocene, new scientific insights may spur major consciousness-raising effects.

With few exceptions, our rules regulate the human impact on the ocean components of the Earth System depending on the political boundaries of sovereignty and jurisdiction, as translated into law. Notwithstanding more general provisions, this is what is expressed through the various maritime zones and the basic division of jurisdictional competences among coastal and flag states. However, we may need to shift the ultimate objectives,

¹⁴ See R. Falk, 'The Grotian Moment: Unfulfilled Promise, Harmless Fantasy, Missed Opportunity?', *International Insights*, Vol. 13, 1997, pp. 3–34; and, in a more comprehensive work, R. Falk, *Law in an Emerging Global Village* (New York: Transatlantic Publishers, 1998).

¹⁵ For more comprehensive discussion, see D. Vidas, 'Responsibility for the Seas', in Vidas (ed.), *Law, Technology and Science for Oceans in Globalisation*, pp. 3–40, especially at pp. 10–33.

crafting international regulations primarily so as to enable us to channel and confine the human impact on the Earth System, while taking into account territorial sovereignty and sovereign rights considerations as well as legitimate profit demands. One prospect might involve approaches that emphasize not entitlement to, but *responsibility for*, the seas¹⁶ and envisage application in areas located *both* within and outside national jurisdiction.¹⁷ That does not mean a call for disregarding the jurisdictional dimension – much more that, we must consider seriously how to place it within the context of changing circumstances.

The difficulties are not related solely to ‘territorial temptation’¹⁸ and hesitations about confining economic activities to a sustainable level. A global approach initially conceived as uniform might in fact lead to global inequality, since levels of development/consumption and population growth are uneven around the globe – and the gaps are increasing. Moreover, aspects of human rights may require fundamental re-examination in international law as we enter the Anthropocene, prompting the *law of humanity*. Among the key considerations in these respects is our relation to the use of oceans and marine ‘resources’.

THE WORLD OCEAN:¹⁹ CHALLENGES AHEAD

The oceans today are negatively impacted by many different factors. These factors interact synergistically: as a result, the effects on marine ecosystems are continuously accelerating.²⁰ Although we have developed major instruments such as the LOS Convention and a series of other international treaties for the marine environment and resources, we still lag far behind when it comes to implementing these instruments. The global governance of the seas is highly inefficient, and will remain a serious reason for concern in the years to come. This book examines many of these challenges from both scientific and legal perspectives. In the following, some of these issues and

¹⁶ *Ibid.*, especially at pp. 33–38.

¹⁷ See also T. Treves, ‘The Development of the Law of the Sea since the Adoption of the UN Convention on the Law of the Sea: Achievements and Challenges for the Future’, in Vidas (ed.), *Law, Technology and Science for Oceans in Globalisation*, pp. 41–58; and V. Golitsyn, ‘Major Challenges of Globalisation for Seas and Oceans: Legal Aspects’, in *ibid.*, pp. 58–73.

¹⁸ B.H. Oxman, ‘The Territorial Temptation: A Siren Song at Sea’, *AJIL*, Vol. 100, 2006, pp. 830–851.

¹⁹ The term ‘World Ocean’ refers to the seas and oceans as forming an integrated unit; see ‘Oceans’ in *The New Encyclopaedia Britannica – Macropaedia*, Vol. 25, 15th edn (Chicago: Encyclopaedia Britannica, 1986), p. 123.

²⁰ See, e.g., Harry Scheiber, chapter 5 in this book.

challenges are briefly described, and references are provided to the relevant chapters.

CO₂, Climate Change and the Oceans

The oceans play an important and complex role in the climate system. They constitute a crucial heat buffer, and absorb between 25 and 50 per cent of the anthropogenic CO₂ released into the atmosphere,²¹ thereby slowing the global warming effect of GHGs (greenhouse gases). However, this absorption leads to a general acidification of the oceans as CO₂ dissolves and lowers their pH values.²² Since the times of the Industrial Revolution, surface ocean acidity has increased by 30 per cent.²³ The future trend of CO₂ increase in the atmosphere seems highly predictable, but the effects on the marine ecosystems are difficult to anticipate – although they seem rather gloomy for coral reefs and organisms dependent on solid carbonate shells, like many of those that constitute the very basis of the marine food chain.

The increase in ocean temperature over the past centuries, although seemingly rather insignificant – between 0.10 and 0.15°C – now represents a clear global warming of the upper ocean layer.²⁴ This is predicted to accelerate,²⁵ and will have grave effects on marine ecosystems. Moreover, water expands as it heats: this warming is considered to contribute to between one third and one half of the sea-level rise in this century.²⁶

Both acidification and the rise in sea-water temperatures will have synergistic effects on the spread of invasive alien species, pollution and other human-induced impacts on marine ecosystems.

Several aspects of climate change and the oceans are addressed in Part II of this book. Yvon Le Maho and Joël Durant discuss impacts of climate

²¹ Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report*, R.K. Pachauri and A. Reisinger (eds) (Geneva: IPPC, 2007).

²² See, for instance, Zalasiewicz and Williams, chapter 2 in this book.

²³ J.C. Orr, K. Caldeira, V. Fabry, J.-P. Gattuso, P. Haugan, P. Lehodey, S. Pantoja, H.-O. Pörtner, U. Riebesell, T. Trull, M. Hood, E. Urban and W. Broadgate, *Report on Research Priorities for Ocean Acidification. Second International Symposium on the Ocean in a High-CO₂ World, Monaco, 6–9 October 2008*, available at <www.ocean-acidification.net/Symposium2008/ResearchPrioritiesReport_OceanHighCO2WorldII.pdf>.

²⁴ J.M. Lyman, S.A. Good, V.V. Gouretski, M. Ishii, G.C. Johnson, M.D. Palmer, D.M. Smith and J.K. Willis, ‘Robust Warming of the Global Upper Ocean Layer’, *Nature*, Vol. 465, 2010, pp. 334–337.

²⁵ For recent finding see, e.g., R.J. Nicholls, N. Marinova, J.A. Lowe, S. Brown, P. Vellinga, D. de Gusmao, J. Hinkel and R.S.J. Tol, ‘Sea-level Rise and Its Possible Impacts Given a “Beyond 4°C World” in the Twenty-first Century’, *Philosophical Transactions of the Royal Society – A*, Vol. 369, 2011, pp. 161–181

²⁶ Lyman et al., ‘Robust Warming of the Global Upper Ocean Layer’.

change on marine ecosystems (chapter 7), while Steinar Andresen and Tora Skodvin provide an overall review of the climate regime (chapter 10). Two additional chapters turn the focus to the polar regions: Olav Orheim examines the impacts of climate change and the polar oceans (chapter 8), while David Caron illustrates climate change and Arctic governance by presenting three images of a changing Arctic (chapter 9). Finally, Moritaka Hayashi in chapter 11 discusses legal issues likely to be prompted by the sea-level rise in the foreseeable future.

Marine Pollution

Even though the 1972 London Dumping Convention and the 1973/78 MARPOL have been in force for several years, and strict legislation has been introduced for terrestrial, potentially polluting activities, marine pollution remains a major problem for marine ecosystems. More than 80 per cent of this pollution comes from terrestrial runoff.

Economic activities both at sea and on land are still not sufficiently regulated or controlled. Different types of marine pollution, varying from wastewater, sewage and garbage to heavy metals, pesticides and fertilizer runoff from agriculture, are causing harm to marine life. In chapter 2 of this book, Jan Zalasiewicz and Mark Williams point to the issue of the marine dead zones that are spreading in many ocean regions where currents do not wash out fertilizer runoff.

Some 70 per cent of marine oil pollution coming from human activities originates from petroleum consumption spills on land. Spills from oil and gas activities at sea contribute only around 5 per cent to this total. Blow-outs, of course, give a different situation. Spills during transport, refinement and distribution, mostly along shipping routes and pipelines, contribute to approximately 22 per cent.²⁷

Invasive Alien Species

During the 1980s and 1990s the world scientific and thereafter political communities became increasingly aware of the negative effects caused by invasive alien species, also in the marine environment. Stephan Gollasch presents this problem in chapter 17 of this book. Invasive alien species are considered the second most serious threat to world biodiversity, after habitat destruction, and this may well apply also as regards the marine environment. Here, the interaction with impacts from pollution, acidification and climate change is also significant.

²⁷ National Research Council, *Oil in Sea III: Inputs, Fates, and Effects* (Washington, DC: National Academy Press, 2002).

The Convention on Biological Diversity devotes a separate provision, Article 8(h), to the issue of invasive alien species. True, there is now a separate convention adopted at the International Maritime Organization (IMO) in 2004 – the International Convention for the Control and Management of Ships’ Ballast Water and Sediments – dealing with the problem in the context of ballast water, as analysed in this book by Davor Vidas and Maja Markovčić Kostelac (chapter 21). However, implementation has so far fallen short of the standards envisaged, as the Ballast Water Convention has not yet come into force and the prospects for its entry into force and actual implementation of the standards provided under the Convention remain uncertain. Unless greater efforts are devoted to strict implementation of these and other regulatory measures, we will face serious consequences for native ecosystems in many regions around the world.

Habitat Destruction

The destruction of marine habitats is particularly significant in coastal regions. Here large areas of protective mangrove forests are being destroyed by extensive agricultural expansion. A study analysing 750 satellite images across Asia found that 81 per cent of the destruction of mangrove forests from 1975 to 2005 came from clearance for agricultural purposes.²⁸ Only 12 per cent was due to aquaculture, mostly shrimp farming (which is mistakenly often held to be the largest factor); and 2 per cent was the result of urban development.²⁹

Further out at sea, bottom-trawling is destroying ocean floor habitats, and dredging for cable and pipeline deployment are increasingly impacting on seafloor habitats. In coral reef areas, dynamite fishing often has disastrous impacts, but it still seems extremely difficult to stop or control. Coral reefs are also heavily affected by acidification, temperature rise and pollution.

Poorly Managed Fisheries

One of the most challenging issues in global marine management today is the governance of fisheries, particularly in the ‘high seas fisheries’ – in sea areas beyond national jurisdiction.³⁰ Part III in this book contains chapters

²⁸ It is in this part of the world that mangrove forest destruction is most serious.

²⁹ C. Giri, Z. Zhu, L.L. Tiezen, A. Smith, S. Gillette and J.A. Kelmelis, ‘Mangrove Forest Distributions and Dynamics (1975–2005) of the Tsunami-affected Region of Asia’, *Journal of Biogeography*, Vol. 35, 2008, pp. 519–528.

³⁰ For an overall discussion on high seas governance, see especially David Freestone, chapter 6 in this book.

addressing that challenge.³¹ These authors focus on various aspects of ‘high seas fisheries’, but all point to the difficulties of managing the ‘global commons’, especially in those areas where IUU fishing still seems very prominent. Van Bohemen also discusses challenges and differences between various regional fisheries management organisations (RFMOs), the South Pacific RFMOs in particular.

For many years now, FAO statistics have shown that approximately 75 per cent of the world’s fish stocks are either overexploited or fully exploited.³² Recently, the total global wild-caught marine fish harvests have levelled off and even started to decline. The need to ensure sustainable fishing has today become more important than ever before, due to the precarious state of many fish stocks. As to high-seas fishing, especially the problem of illegal, unreported and unregulated (IUU) fishing has over the past decades become one of the most complex and difficult issues of ocean governance.

The open-access paradigm and the poor practice of state responsibility and cooperation, or absence of these, make for a rather gloomy situation as to good governance in the high seas. The control situations are especially challenging, with often long distances for flag-state authorities, and large marine areas for coastal-state authorities – and high costs involved for adequate implementation and enforcement of, for instance, the 1995 UN Fish Stocks Agreement. Flawed rule-making, frequently not based on updated science, makes the situation even worse.

For regional and local fisheries the situation is somewhat better, but still gives no particular grounds for optimism. The prevailing over-capacity of the fishing fleet is part of the basis for political pressure for setting the quotas too high, or even catching illegally beyond the quotas, creating a situation which is not only IUU (illegal, unreported and unregulated) – but IUUU (illegal, unreported, unregulated and unsustainable).

One specific problem related to poorly regulated fisheries is the bycatch of non-targeted species – mainly seabirds, but also whales and other cetaceans, turtles and other groups of seriously threatened species. In chapter 15 of this book, Euan Dunn discusses this problem. He shows that there exist rather inexpensive methods and practices that can be introduced to solve or drastically reduce the problems experienced by many seabirds. The situation is particularly serious for the albatrosses, where 17 of the existing 22 species are to varying degrees threatened with extinction. We must act rapidly and with determination to literally ‘get them off the hook’!

³¹ See chapter 12 by Nobuyuki Yagi, chapter 13 by Kristina Gjerde, and chapter 14 by Gerard van Bohemen.

³² FAO, *The State of the World Fisheries and Aquaculture 2010* (Rome: FAO, 2010).

Oil and Gas Activity

As the sources of hydrocarbons become depleted on land, the industry is moving offshore, to increasingly deeper waters with the development of advanced underwater technologies. The world received a reminder of the risks associated with this activity by the tragic 'Deep Water Horizon' disaster in the Gulf of Mexico in 2010. Millions of barrels of oil were poured into the Gulf, floated ashore and devastated the environment and the economy for years to come. However, as noted above, the bulk of marine oil and hydrocarbon pollution does not stem from blowouts or direct oil spills at exploration and exploitation sites, but from regular shipping operations, loading, reloading, refining and distribution, and from the use of hydrocarbon products on land.

Shipping and Transport

Around 90 per cent of the total global transport of goods today takes place at sea. To a large extent, this activity is now regulated by various conventions and other instruments under the IMO. However, as to the impact of shipping on the marine environment in various regions, problems less obvious at the time when the LOS Convention was adopted have since emerged as crucial. As noted above, one such problem is the introduction of alien, potentially invasive species from one marine environment into other, by vectors such as ballast water and ship fouling; while technically not understood as 'marine pollution' under the LOS Convention, this issue has given rise to major concerns.

Part IV in this book addresses various challenges and responses involved in the global maritime transport. In chapter 19, Jean Claude Sainlos discusses the effectiveness and efficiency of the IMO and its regulatory instruments in safeguarding the quality of the marine environment. Particularly important in this context is the interaction of the IMO instruments with the LOS Convention.

Lawson Brigham (chapter 18) turns the focus to the Arctic, examining the specific challenges for safety of maritime transport and shipping there. With the current melting of the Arctic Ice Sheet and the opening up of new areas for human exploration and other activity, we will need to pay increased attention to the new challenges for viable governance of activities in these harsh and vulnerable areas of the oceans.

Important other matters of maritime traffic are taken up in chapter 16 by Eelco Leemans and Thomas Rammelt, who discuss the conflicts and possible balances for the maritime industry in view of the current and emerging

marine environmental issues, and by Henrik Ringbom in chapter 20, who delves into the complexity of regulatory layers in shipping.

Marine Protected Areas

Most of the marine environment remains unprotected by area conservation regulations. Only a meagre 1.7 per cent of the oceans, which constitute around 71 per cent of the Earth's surface, are regulated under some form of Marine Protected Areas (MPAs) as of 2011. This is a striking contrast to the situation regarding protection of the terrestrial environment, where some 12.7 per cent is under formal protection as Protected Areas (PAs).³³ On the other hand, the coastal areas (out to 12 nautical miles) have fared somewhat better: 7.2 per cent of these areas are now under protection.

As the boundaries between marine ecosystems are often not very clear, and large portions of the biodiversity within these systems tend to move beyond these borders as salinity, temperature or other environmental factors change, we face additional challenges in delimiting and governing MPAs. The years to come will see a growing, and crucial, need for far more extensive work on safeguarding the marine environment under MPAs.

One example is the emergence of the Particularly Sensitive Sea Area (PSSA) concept as politically salient. Already several regional initiatives by EU countries have been granted PSSA designation in seas surrounding Europe, but these require global acceptance through the IMO.

Seas Surrounding Europe: Regional Responses to Global Challenges

Responses to many of the above problems, involving global drivers and regional concerns, are found in the interface between global and regional regulatory levels. The final part of this book (Part V) deals with some key issues for the seas surrounding Europe and their regulatory responses to global challenges.

Complex regional responses to the uses of the seas and marine resources are being developed within the EU, in the context of its development of a Maritime Policy that can integrate various sectors. This, along with the regionalisation of the 'European seas', represent the main elements behind the recent EU Marine Strategy Directive. Chapter 22 by Robin Churchill provides a thorough overview and analysis of the EU facing challenges of marine governance, developing from sectoral response towards an integrated policy. David Agnew (chapter 23) analyses a particularly salient segment of

³³ Charles Besancon, *UNEP World Conservation Monitoring Centre*, personal communication, 11 April 2011.

EU policy – the Common Fisheries Policy – and the need for its further reform, while Irini Papanicolopulu addresses a new concern for EU regulation – as related to underwater noise pollution (chapter 24).

The intensification of ship traffic, especially tanker transport of oil and other hazardous cargo, and changes in both the volume and the nature of maritime traffic in some regions are also cause for concern. The Eurasian space has witnessed major changes since the dissolution of the Soviet Union, which led to the creation of a number of independent states in the oil-rich Caspian region. And in the late 1990s, Russia itself re-emerged as the world's second-biggest (after Saudi Arabia) oil exporter. Competing priorities have led to new overseas export projects, some of which are already in operation. Important developments are underway not only in the Mediterranean,³⁴ where over a quarter of the world's oil is transported every year, but also in the Black Sea and the Baltic Sea and in other seas surrounding Europe. Key recent developments in the Black Sea and the Baltic Sea are dealt with, respectively, by Nilüfer Oral (chapter 25) and Hans Corell (chapter 26).

THE WORLD OCEAN IN GLOBALISATION: AN OUTLOOK

For some four centuries, the development of the law of the sea has built on the conflict between *mare liberum* (the 'free sea') and *mare clausum* (or, the 'territorial temptation'). Now we are beginning to recognise that nature does limit the ways and extent of the use of the seas and oceans, and their 'resources'. Such limits to our freedom, but also to our sovereignty, have increasingly become scientifically documented. It may well be that more alarming scientific evidence about the state of the oceans and marine resources has been acquired in the three decades that has passed since the adoption of the LOS Convention, than in all the centuries since the publication of *Mare Liberum* in 1609 and *Mare Clausum* written soon thereafter (but not published until 1635). Moreover, various aspects of globalisation – affecting also the use of the seas – have probably had more impact on the state of the marine environment and resources in the past several decades than all human activities have had in the entire span of prior human history.

Against this backdrop, it is the conviction of the editors of this book – and indeed a conviction shared in many contributions to it – that our individual and common goal must be to channel our scientific and technological capabilities, and our policy objectives and legal rules, so as to make it possible to

³⁴ As to the Mediterranean responses to global challenges, see chapter 27 by Evangelos Raftopoulos.

reconcile human impacts on the Earth System with the absorbing capacity of the planet and its component elements – which we often like to call ‘resources’.

In the pages that follow, international experts on marine sciences, ocean affairs and the law of the sea examine the emerging challenges for the World Ocean, inquiring into developments prompted by globalisation in central issue-areas of the law of the sea. These are explored systematically in sections on the key challenges and developments in the interface of science, economic uses and law (Part I); climate change and the oceans (Part II); sustainability of fisheries (Part III); challenges and responses related to global maritime transport (Part IV); and the regulatory responses to global challenges in seas surrounding Europe (Part V).

