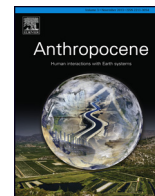




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Review

International law for the Anthropocene? Shifting perspectives in regulation of the oceans, environment and genetic resources

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ABSTRACT

This article reviews the potential implications of the Anthropocene for the future development of international law in general, and for its distinct fields of the law of the sea, environmental law, and rules governing genetic resources in particular. Stability is deeply embedded in the fundamentals of international law, where it operates on two levels. One is the conscious objective of working towards legally guaranteed stability in international relations, in turn prone to frequent political change. The other level of stability is implied: it is the assumption, based on human experience so far, of the relatively stable circumstances of the late Holocene. The onset of the Anthropocene and the changes introduced in that underlying element of stability entail the potential for an unprecedented type of tension in inter-state relations. This may spill over to and aggravate existing tensions between the territorial integrity of states and territorial claims, coupled with the fact of immense geopolitical differences, on the one hand, and sovereign equality of states as the founding postulate of international law, on the other. The international legal order will always be in search of stability and, ultimately, solutions to facilitate peace and prevent conflict. However, with a fundamental change of the context in which international law operates – and with the challenges increasingly recognized as the consequences of natural, not only political, change – new legal axioms will have to evolve.

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Contents

1. Introduction	00
2. International law and the Anthropocene: introductory considerations	00
2.1. International law: basic features and tensions	00
2.2. The Anthropocene: the tension of the Earth system under human-induced change	00
2.3. International law beyond the stability of the late Holocene	00
3. The law of the sea and the Anthropocene	00
3.1. The law of the sea: basic characteristics and driving forces	00
3.2. The Anthropocene and impacts on the oceans	00
3.2.1. Regulating across the maritime zones: a new functional need	00
3.2.2. Limits of the maritime zones: sea-level rise perspective	00
3.3. Resilience of the law of the sea system in the changing Anthropocene conditions	00
4. International environmental law for the Anthropocene	00
4.1. Some basic characteristics of international environmental law	00
4.2. Sovereignty, sovereign rights and jurisdiction	00
4.3. Changing the principles of international environmental law?	00
4.4. Issues regarding resilience—responding to challenges	00
5. Genetic resources: between patent law and sovereign rights	00
5.1. Basics of law governing genetic resources	00
5.2. Sovereign rights, exclusive private rights, and jurisdiction	00

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5.3. Issues regarding resilience	00
5.4. Responses to challenges	00
6. Conclusions	00
Acknowledgments	00
References	00

1. Introduction

The *Anthropocene* is a concept that has spread rapidly in recent years. Initially an informal scientific term proposed to indicate that human imprint on the Earth system may have already reached a geological magnitude (Crutzen and Stoermer, 2000; Crutzen, 2002), the Anthropocene hypothesis is now under scrutiny within stratigraphy. In 2009, the International Commission on Stratigraphy established the *Anthropocene Working Group*,¹ in order to examine whether, based on stratigraphic evidence, the Earth may be undergoing a shift from the Holocene Epoch and entering a new interval of geological time—the Anthropocene. Findings of the Anthropocene Working Group are expected in 2016.

The Holocene, comprising the past 11,700 years,² has been characterized, especially in its later stage, by the longest relative stability in environmental conditions on the Earth since the appearance of *Homo sapiens* some 200,000 years ago. Unlike the Holocene, however, the Anthropocene is seen as thoroughly characterized by change, uncertainty and, probably, considerable instability in the behaviour of the Earth system (Zalasiewicz et al., 2012; Williams et al., 2015).

What is fundamentally new in the Anthropocene concept is its focus on the role of humans in the destabilization of the *Earth system*, and not just the human impact on the environment, as in various earlier approaches (Hamilton and Grinevald, 2015).³ The Anthropocene concept offers a broad framework for bridging the perceived divide between *nature* (the Earth system we find ourselves in) on the one hand, and *humans* (and the political world we have created), on the other.

The Anthropocene hypothesis has already passed beyond the boundaries of natural science, emerging as a new way of understanding the human role and the implications of our actions for the world we live in and its future. Among the many societal consequences (Dalby, 2009; Tickell, 2011), there arises the question of possible implications for international law on the horizon of this convergence of geological epochs (Vidas, 2010, 2014; Falk, 2010).

This article first reviews some general aspects of international law and the potential implications of the Anthropocene for its development. We then ask: how does international law – in particular the law of the sea, environmental law, and rules governing genetic resources – relate, and might respond, to the challenges likely to appear with a shift from the Holocene to the conditions of the Anthropocene?

¹ On the Anthropocene working group, see at: <http://quaternary.stratigraphy.org/workinggroups/anthropocene/>.

² The lower boundary of the Holocene, as formally accepted and ratified through stratigraphic process in 2008. The lower boundary for the late Holocene is currently proposed at 4200 years BP (Walker et al., 2012).

³ Hamilton and Grinevald (2015) explain that ‘the Earth as a total complex “ecosystem”, including the global climate system, is a very recent interdisciplinary and paradigmatic concept developed in the 1980s and 1990s’, and officially adopted by the major international scientific cooperation programmes only in the early 2000s.

2. International law and the Anthropocene: introductory considerations

2.1. International law: basic features and tensions

International law is, unlike national law, marked by the sovereignty of its principal subjects, *the States*⁴; each of these is a sovereign possessing supreme authority within its own jurisdiction. No legal authority or power – no legislator or ruler – is by itself hierarchically above any member of that key group of subjects of international law. Thus, international law is based on the principle of *sovereign equality* of states in their mutual relations (see Tomuschat, 2001; Kokott, 2011); this principle is reflected in Article 2(1) of the UN Charter and is in the fundamentals of the United Nations.

Due to the lack of a legislative process as known within the national legal systems of individual states, international treaties – in practice, the most frequently used source of international law⁵ – are negotiated by states themselves; and states become bound by treaties only with their explicit consent, through ratification, accession or other procedural means.⁶ Likewise, a state must give its acceptance in order to be subjected to the jurisdiction of an international court or arbitral tribunal in any given case, whether by accepting the jurisdiction in advance for some types of cases, or subsequent to the emergence of an individual case. State *consent* and *reciprocity* are among fundamental ingredients of international law. Nonetheless, the explicit consent of all states is not required for, e.g. the emergence of a universal customary law rule, in turn binding on all states. Moreover, while international law as a ‘horizontal’ legal system rests upon the logic of reciprocity (Simma, 2008, p. 6), which is inherent in the law of treaties in general, some treaties, as in the sphere of human rights, may contain obligations that are not subject to reciprocity.⁷

Each state has its own *territory* over which it exercises sovereignty. Rules of international law about the acquisition of territory and its spatial extension (also maritime and aerial), as well as about the delimitation of boundaries between states, apply equally to all states. And yet, on the geopolitical map of the world, states are profoundly different. This is clearly seen already from the

⁴ Other subjects of international law, including international organizations and, sometimes, also individuals and their associations, are all indirectly or directly related to the state as the principal subject of international law. In general, subjects of international law may be defined as ‘entities which are capable of possessing international rights and duties’; see Brownlie’s *Principles of Public International Law* (Crawford, ed., 2012), 115–126 pp.; Oppenheim’s *International Law* (Jennings and Watts, eds, 1992), 119–120 pp.; and Walter, 2007.

⁵ An authoritative statement of the sources of international law is found in Article 38(1) of the Statute of the International Court of Justice. The Statute is an integral part of the UN Charter, and the Court is the principal judicial organ of the UN.

⁶ International treaties may bind two or more states, and can therefore be bilateral or multilateral. However, rules inscribed in the provisions of international treaties can reflect customary law. Customary international law and general principles of law – the other two main sources of international law stated in Article 38(1) of the ICJ Statute – can be binding on all states and thereby can have universal application (Charney, 1993).

⁷ On aspects of reciprocity in environmental treaties, see Section 4 below.

size of their territory – from the biggest (Russia, with over 17 million sq.km) to the smallest (Monaco, less than 2 sq km) – as well as population size, ranging from China and India (with 1.36 and 1.26 billion, respectively) all to Nauru and Tuvalu (with only 10 to 11 thousand inhabitants).⁸ Uneven in their political influence, economic and technological development, military power, strategic placement, scientific capabilities, and in many other factors, states constitute a highly heterogeneous group. While considered equal as subjects of international law, states span the broad scale from 'micro-states' (see Grant, 2013) to 'Great Powers', even 'Superpowers' (see Kammerhofer, 2009). Various periods in history have witnessed the hegemonic roles of some states in the international sphere (Thürer, 2011); most recently, the USA in the post-Cold War situation since the 1990s, and especially with the 'War on Terror' later on.

International law, however, operates with the idea of the *international community* as its declared objective⁹ – not an international arena or the 'clash of civilizations' (see Huntington, 1993). In international law, Russia and Monaco, China and Nauru, and the USA (compared with any other state) – each of them can be only one state party to an international treaty, or only one member of an international organization. While promoting fundamental principles upon which legal rules in relations between states are based, international law is, however, not an abstract system detached from political, economic or other relevant contexts. Probably the best-known example is provided by the UN Charter, which—while guaranteeing one seat as well as an equal vote to all its members in the General Assembly, grants the five powers – China, France, Russia, UK and the USA – permanent membership on the Security Council and the effective right of veto over Council's decisions on matters of substance.¹⁰ Another example is the 1997 Kyoto Protocol to the UN Framework Convention on Climate Change, the entry into force of which required not only a certain number of ratifications by states (55), but also the inclusion of a specified minimum percentage of CO₂ emissions (55%) to be represented by those states.

The underlying principle of international law remains that any state is bound by these and other provisions of international treaties, including those establishing an international organization, only after freely deciding to accede to them. However, the reach of state's consent in international law can neither be understood in abstract nor as absolute; and already the increasing multilateralization of international relations and the necessity of regulating emerging needs in international life make it difficult for states to remain unbound by various treaties. The reach of states' consent in international law has therefore been carefully explored and discussed in the more recent international law literature (see Charney, 1993; Tomuschat, 1993; Kirsch, 2014).

Modern international law, especially as it has developed since the mid-20th century, has been marked by two main spheres of constant tension. First, the tension between sovereign equality of states on the one hand, and their political, military, strategic, economic and other differences on the other. Second, the tension between the legal guarantee of territorial integrity of sovereign states on the one hand, and claims, nurtured by a myriad of factors from economic to ethnic, in the political division of the world, on the other. In both spheres of tension, the objective of international law has been to facilitate political stability in interstate relations

through international cooperation and to maintain international peace and security (UN Charter, Art. 1(1) and (3)). The onset of the Anthropocene introduces a third, fundamentally different and profoundly new type of tension.

The tension between the sovereign equality of states and their geopolitical differences has been often presented as caused by the 'horizontal' nature of international law on the one hand, and the 'vertical' reality due to the many differences between states on the other. As noted by Falk (2014, p. 87):

the problematic character of world order premised on the interplay of territorial sovereignty and hegemonic geopolitics (that is, its horizontal juridical aspect of the equality of states, and its vertical political aspect of control exerted by the leading state acts) is unable to address in a satisfactory fashion any of humanity's most urgent challenges: climate change, nuclear weaponry, global poverty, unregulated world economy, pandemics, genetic engineering, preserving biodiversity. Reduced to fundamentals, the deficiencies of world order can be summarized as the fragmenting of a unified approach to problem solving by allowing unevenly situated states to pursue their distinct national interests at the expense of the overall human interest.

The second, related sphere of tension stems from the fact that the world is territorially divided into many parts, each under sovereignty of a distinct state (currently some 200 of these), delimited by interstate boundaries (incomplete in some cases). The adjoining maritime areas of states with their own coasts are divided as well (see further in Section 3, below). What remains beyond is one part of a water column under the sovereignty or sovereign rights of no state (the high seas); and one part of the seabed lying beyond the limits of national jurisdiction (the international seabed area).¹¹ Competing claims to territories, land and maritime, have abounded through history, often leading to wars or to territorial changes based on political power. In the same geographical spaces, new states have emerged and others collapsed, frequently through violence and power politics. Therefore, facilitating the peaceful settlement of territorial disputes based on the rules of international law is among the highest achievements of human civilization thus far.

Yet, international law had previously shown another face as well. The emergence of classical international law has been largely intertwined with the 'discoveries' of overseas lands by European powers; and their expansion has often included territorial acquisition (see Mégret, 2009). International law doctrines, concepts and rules have been affecting the political shape of the globe for quite some time. The key international documents that followed Columbus' 1492 voyage introduced a demarcation line. In discovering the *Globe*, we have not seen the *Earth*—we have aimed at dividing the *World*. Under the Treaty of Tordesillas, agreed by Spain and Portugal in 1494, the 'New World', including any lands yet to be 'discovered', was to be divided between them by a 'boundary or straight line... drawn north and south, from pole to pole, on the said ocean sea, from the Arctic to the Antarctic pole'. When lands distant from Europe became better known and their riches revealed, others, including England under Queen Elizabeth I, demanded different 'lines': first of all, the lines of unimpeded maritime trade and participation in the accumulation of profit.

⁸ Due to their exceptional aspects, the Holy See and the Order of Malta have not been included in this illustration span.

⁹ There are also legal implications in relation to the 'international community', as in the 1969 Vienna Convention on the Law of Treaties (Article 53), or as elaborated in some decisions of the International Court of Justice.

¹⁰ Articles 23(1) and 27(3) of the UN Charter.

¹¹ The Antarctic, understood as the area south of 60°S latitude, has a unique status, governed under the 1959 Antarctic Treaty, which is the legal basis of the Antarctic Treaty System applying to this area (see Stokke and Vidas, 1996; and especially for the Antarctic maritime area, Vidas, 2000).

Since the early days of international law as a discipline, our keen interest in the Earth – though perhaps perceived as a globe on the face of which the political world is being shaped – cannot be denied. Geography has become firmly and deeply embedded in the fundamentals of international law (Bethlehem, 2014).

2.2. The Anthropocene: the tension of the Earth system under human-induced change

A new sphere of tension is emerging—and its primary dimension is not unrelated to the world divided into territories of states (with their adjoining exclusive economic zones and continental shelves), and a portion of common areas beyond these. This new tension, however, has to do with the Earth as a whole, seen as a unique, single natural system. Showing relative stability throughout recent human history, the underlying condition of the Earth system has been taken as a given—and upon that premise our political structures were created. The relationship of international law with the observed geographical features and indeed the overall geological dimension of the Earth system has generally been confined to an implicit assumption about the undetermined, long-term horizon of current conditions—as an objective circumstance surrounding us since time immemorial. We are accustomed to understanding changes in the Earth system within the context of geological time, events stretching back millennia, or millions and even billions of years—as opposed to politically relevant time and the related pace of change, whether embodied in national election horizons, pre- and post-war periods, newly emerging or dissolved world alliances, the adoption and entry into force of international treaties, creation of international organizations, or other milestones on that scale.

Stability is deeply embedded in the fundamentals of international law, where it operates at two levels. One is the conscious objective of working towards legally guaranteed stability in international relations, in turn prone to frequent political change. The other level of stability is implied: it is the assumption, based on our experience so far, of constantly stable circumstances of the late Holocene. Many aspects of international law are based on such understanding of the stability of the Earth conditions.¹² Indeed, the definition of current international law is, in many respects, that of a *system of rules resting on foundations that evolved under the circumstances of the late Holocene, assumed to be ever-lasting*. International law takes the conditions of the Holocene for granted—and on that premise, a huge edifice of international law has been constructed over the past several centuries. The change introduced in that underlying element of stability – and that is what the transition from the Holocene to the Anthropocene involves – contains the potential for an unprecedented type of tension in relations between states. This can spill over to and aggravate existing tensions between the territorial integrity of states and territorial claims—coupled with the fact of immense geopolitical differences, on the one hand, and sovereign equality of states as the founding postulate of international law, on the other.

2.3. International law beyond the stability of the late Holocene

Many aspects of international law rely on an implicit pre-text of the familiar conditions of stability. For instance, a defined territory – indeed, *having* a territory – is a basic criterion of statehood under

¹² Exceptions found in international law to the overall conditions of stability are also based on experience: the changing courses of rivers (and the related rules on interstate boundaries in such situations); or the changing coastal geography in some large river deltas (and the related rules in the law of the sea; see further Section 3).

international law (as codified in Article 1(a) of the 1933 Montevideo Convention on Rights and Duties of States). The perspective of sea-level rise is but one of many symptoms in the outlook of an Anthropocene world—and challenges to the continuity of statehood of some low-lying small island states are bound to emerge. In the not-too-distant future, important questions may arise, requiring re-examination of currently accepted paradigms of international law (see Vidas, 2014).

Some of the serious changes are conceivable in the course of the 21st century—within the perspective of a human lifetime (see, e.g. Intergovernmental Panel on Climate Change, IPCC, 2014; World Bank, 2014; but also Rye et al., 2014; Hay et al., 2015). This means that the rules we start to discuss at present will in future perspective of the late 21st century govern the living conditions of some who are already born today, instead of just relating in abstract, to some hypothetical ‘future generations’. Other potential human-induced changes are, however, conceivable as imminent: consider the consequences of the possible use of nuclear weapons available today. Indeed, the hypothesis on the onset of the Anthropocene, now supported by a large majority of the Anthropocene Working Group members (Zalasiewicz et al., 2015), relates it to the mid-20th century, in particular to the first nuclear bomb detonation (16 July 1945 at Alamogordo, New Mexico) followed by additional detonations at an average rate of one every 9.6 days until 1988.

The international legal order will always be in search of stability and, ultimately, solutions to facilitate peace and prevent conflict. However, with a fundamental change of the context in which international law operates – and with the challenges increasingly recognized as the consequences of natural, not only political, change – new legal axioms will have to evolve. That transformation will have to embrace the fundamental principles of the international law architecture—with geography firmly and deeply embedded in its core. If international law is to be able to meet the new challenges of changing circumstances and achieve its overarching objectives of facilitating international cooperation and maintaining international peace and stability, humankind may have to organize society in the Anthropocene epoch differently from what we have known so far. In that broad framework of *our* needs and purposes looming on an Anthropocene horizon, the primacy given in international law to the assertion of sovereign rights over territory may have to be reconsidered, while the emphasis on population and human rights may have to gain in prominence and find expression in new forms of international law subjectivity. As international law rests on thick sediments of political power and accumulated vested interests, the challenges in changing the current course are deep-reaching, and involve many difficult questions. Whether and when these will be raised in practice will depend on the changing gravity of challenges over time. The initial examination of those questions in the academic international law debate has only started—in the literature, in research projects,¹³ and in the activity of academic societies like the International Law Association.¹⁴

¹³ In spring 2011, the Fridtjof Nansen Institute launched a three-year research project on ‘International Law for an Anthropocene Epoch’; see www.fni.no/projects/anthropocene_law.html. Since then, other research projects on the Anthropocene and international law have been initiated, including by the University of Sydney Faculty of Law in autumn 2014; see <http://sydney.edu.au/environment-institute/blog/international-law-and-the-anthropocene/>. Moreover, in October 2014 the Fridtjof Nansen Institute followed with an international interdisciplinary research project on ‘Climate change and sea-level rise in the Anthropocene: challenges for international law in the 21st century’; see www.fni.no/projects/climate_change_and_sea_level_rise.html.

¹⁴ On the ILA Committee on International Law and Sea Level Rise, which addressed the Anthropocene context in the proposal for its establishment, see: www.ila-hq.org/en/committees/index.cfm/cid/1043.

Besides addressing the overall challenges of and perspectives introduced by the Anthropocene, which have so far only initially been taken up in the literature on general aspects of international law (see Nagan and Otvos, 2010; Falk, 2010, 2014), some fields or areas of international law regulations may face specific challenges. Studies relating the Anthropocene to such distinct fields of international law have been initiated only recently: this concerns the literature on the traditional international law field such as the law of the sea (see Vidas, 2010, 2011), followed by several studies in the more recent field of international environmental law (see Robinson, 2012, 2013, 2014; Ebbesson, 2014; Scott, 2013; Kim and Bosselmann, 2013; Kotzé, 2014). The next three sections illustrate issues – and differences – involved in the outlook for the above two fields of international law and one additional issue-area, i.e. the one related to the legal regulation of genetic resources.

3. The law of the sea and the Anthropocene

3.1. The law of the sea: basic characteristics and driving forces

The development of the law of the sea spans several centuries, since the European overseas discoveries by Spain and Portugal in the late 15th and early 16th centuries, and the emergence of the new maritime powers of England and the Netherlands in the second half of the 16th and early 17th centuries. After the Second World War, the USA grew into a political and economic force decisively impacting law-of-the-sea developments, prompted largely by technological advances. In the 1960s and 1970s, the demands of many developing states, including newly created ones, in turn led to the Third UN Conference on the Law of the Sea (1973–1982).

Much of this centuries-long development ultimately resulted in the single law-of-the-sea framework: the 1982 UN Convention on the Law of the Sea (UNCLOS). An international treaty in force since 1994, UNCLOS contains both codification of customary norms and progressive development of international law.¹⁵ The Convention regulates how seas and oceans are to be divided among coastal states (currently, some 150 states) in various maritime zones, including the territorial sea, the exclusive economic zone and the continental shelf. Coastal state sovereignty extends to the outer limit of the territorial sea; in EEZs and the continental shelf, certain sovereign rights and exclusive jurisdiction of the coastal state apply. Beyond those zones is the high seas, where all states (also land-locked ones) – and all ships flying their flags – enjoy freedom of the sea. Further, the seabed beyond the limits of coastal state jurisdiction is, along with its resources, an international area regulated as the common heritage of mankind.

UNCLOS is often referred to as the *Constitution* of the oceans: a legal framework that governs all major issues of the entire ocean space. Despite some initial difficulties in attracting broader support, as of 3 January 2015 UNCLOS is binding on 167 parties (166 States and the EU).¹⁶ On the one hand, there is a broad political consensus that UNCLOS contains the legal framework the integrity of which needs to be maintained. On the other hand, the pace of change is tremendous: population trends, advances in technology, scientific achievements – with resultant uses of, and impacts on, the seas. The law of the sea, centred on UNCLOS, is to some extent flexible and adjustable as a framework for future regulation, but is also deeply rooted in earlier developments.

The law of the sea has gradually developed as an exponent of two main driving forces, the consequences of both now captured in UNCLOS. One driving force has been that of territorial appropriation of the seas. In some periods, territorial claims were reduced to a relatively narrow belt of the sea near the coast. In the post-Second World War period, however, the territorial driving force returned in the form of claims for segments of sovereignty – sovereign rights and exclusive jurisdiction – to be extended beyond the outer limits of the territorial sea (see Oxman, 2006). These claims related to fisheries resources in vast areas of the water column, as well as to the mineral (primarily oil) resources of the continental shelf.¹⁷ In consequence, there are now maritime zones in which, although found beyond the coastal state's (land and maritime) territory,¹⁸ sovereign rights and exclusive jurisdiction of the coastal state apply: the EEZ and the continental shelf.

The other driving force in the development of the Law of the Sea was that of economic profit by functional as opposed to territorial access; and of securing strategic gains of naval powers in distant sea areas. Both were promoted by the concept of the 'freedom of the seas', as initially conceived in Hugo Grotius' *Mare Liberum* of 1609 (Grotius, 1609; Scott, 1916; Armitage, 2004; Fenstra, 2009). This concept came to offer an ideological platform for securing unimpeded international trade for emerging (and thereupon established) maritime powers, with the dual goals of maximizing profits for their economies and increasing their strategic dominance over new territories (see, e.g. van Ittersum, 2006).

The ideology launched in the early 17th century, expounded in *Mare Liberum* – arguing for the freedom of navigation in order to secure participation in international trade and, ultimately, accumulation of profit from overseas ventures – facilitated the development of the forces that were to lead to the Industrial Revolution and eventually, in the course of the 20th century, to the levels of development that have resulted in ever-greater human impacts on the Earth System. The end of the Second World War in 1945 was also the time when the last 'tectonic change' in the law of the sea began. Out of that war came various new technologies – many of which represented new applications for fossil fuels – and a commitment by governments in some industrially advanced countries to subsidise research and development. Only months after the war ended, the USA initiated articulation of the continental shelf as a concept of international law, in which geological information has played a crucial role. We still can observe the final outcomes: the current process of determination of the outer limits of the continental shelf beyond 200 nautical miles, facilitated by the work of the Commission on the Limits of the Continental Shelf (Jensen, 2014).

The linkages between the development of the Law of the Sea and the onset of the Anthropocene epoch may be seen as two-fold (Vidas, 2011). First, there is a linkage of origin. The ideological foundations of the Law of the Sea, especially as found in *Mare Liberum* of the early 17th century, involve 'deep-time' origins for the later processes which have ultimately brought about the Anthropocene. Second, there may be a renewed linkage in interaction. Geological information has prompted key developments since the introduction of the continental shelf as a political and then international law concept in the mid-20th century; in the early 21st century geology may again provide an impetus for new law-of-the-sea trends.

This is now directing our attention to the changing ocean component of the Earth System in the Anthropocene.

¹⁵ In the past three decades, many UNCLOS rules grew into customary law, too (see Treves, 2010).

¹⁶ Beyond the EU, several UNCLOS parties are non-members of the UN: Cook Islands, Holy See, Niue, and the State of Palestine.

¹⁷ The claims were contained in two unilateral acts issued by the USA in 1945: the US Presidential Proclamation Nos. 2667 and 2668.

¹⁸ In contrast to the EEZ and the continental shelf, the territorial sea is a part of state's territory.

Consequences for the Law of the Sea may be seen in two main directions. First, there already are serious consequences for the biological and chemical conditions of the oceans across different legal maritime zones. Second, there are consequences of physical nature on the horizon, impacting how the limits of various maritime zones will be determined in the foreseeable future.

3.2. The Anthropocene and impacts on the oceans

3.2.1. Regulating across the maritime zones: a new functional need

As a source of food, fishing is a vital human activity; however, overfishing has already led to serious depletion of many fish stocks and even the extinction of some species. Massive oceanic trade is central in enabling the industrial societies to function; around 90% of international trade goes by sea. With globalization and modern maritime technology, impacts from one place can rapidly become felt elsewhere. For instance, the growth of the shipping industry in the past century brought a dramatic increase in the transfer of non-indigenous, potentially harmful and invasive species and aquatic organisms by vectors like ballast water and hull fouling. At any given moment, thousands of different species are being transported between bio-geographic regions in ballast tanks. That development is unprecedented and outstrips various natural migrations in the history of the Earth (Zalasiewicz, 2008).

World oceans are exposed to human-induced changes that go well beyond overfishing, transport of invasive species, or oil pollution from ships—all of which are recognized as constituting increasingly serious human impacts on the ocean environment and resources. Many factors have negative impacts that interact synergistically.

Within any part of the sea – under territorial sovereignty and jurisdiction or not – we should be guided by some of the same, shared concerns. That is where we should first look for solutions. The overarching need is now not primarily *freedom of, but responsibility for the seas* (see Vidas, 2010). That is a responsibility embodied in concepts that question neither territorial states' extent of sovereignty and sovereign rights nor sustainable maritime trade and industry benefits—adding, however, elements gravely needed to enable us to deal with human impacts on the marine component of the Earth System. Those impacts do not depend primarily on the boundaries between states or the driving forces shaping them. With few exceptions, however, today's rules regulate human impacts on the oceans in terms of the political boundaries of sovereignty and jurisdiction, translated into law. This is what is expressed through the maritime zones and the basic division of jurisdictional competences among coastal and flag states. In fact, many real concerns are global or transboundary in character: they neither depend on nor can be limited by such divisions. Regulatory approaches like ecosystem-based management and integrated coastal and ocean management need to be applied in areas located both under national jurisdiction and beyond it (Golitsyn, 2010). New approaches must envisage marine areas within and outside national jurisdiction as a whole (Treves, 2010). And that will require newly devised coordinating mechanisms.

3.2.2. Limits of the maritime zones: sea-level rise perspective

The complex role of the oceans in the climate system is now well acknowledged: the seas are a crucial heat buffer and absorb a significant share of the CO₂ released into the atmosphere. The seemingly insignificant increase in sea temperature in the past century has already led to global warming of the upper ocean layer. Water expands as it heats, contributing to sea-level rise. The major impact, in the perspective of global warming, concerns the gradual melting of Greenland and West Antarctic ice sheets, with studies confirming early signs already (see reports: [Intergovernmental](#)

[Panel on Climate Change, IPCC, 2014](#); and [World Bank, 2014](#) as well as, in literature: [Nicholls et al., 2011](#); [Rye et al., 2014](#); [Hay et al., 2015](#)).

Negotiators of UNCLOS did not foresee substantial changes in coastal geography, and certainly not caused by a major natural phenomenon such as sea-level rise.¹⁹ However, available scientific studies contain projections of a significant increase in sea levels already in the present century. While the exact amount and pace of sea-level rise are uncertain, the projected range indicates that challenges for the current Law of the Sea are bound to emerge.

With rising sea levels, the baselines from which the breadth of the territorial sea is measured will move landward, affecting the outer limits of various maritime zones. Ultimately, sea-level rise may call into question the entire structure of the maritime zones under today's Law of the Sea: the basis for all maritime zones as codified in UNCLOS is just one line, determined by reliance on coastal geography—the *baseline*. It either directly follows the coast ('normal baseline'); or depends on the specific configuration of the coastline and other coastal features (a chain of islands, fjords, etc.), in which case it is called the 'straight' baseline, and everything landward of it is considered the internal waters of the coastal state.

From the baselines (whether normal or straight), different maritime zones of coastal states are measured and, in consequence, the high seas are determined. This objective criterion, which relies on a given coastal geography, serves not only as the basis for the various maritime zones of a coastal state; it is also central to the delimitation of maritime boundaries between states. The purpose of those rules of international law of the sea is to maintain certainty and predictability. Sea-level rise may bring increasing uncertainty.

Seeking to find a solution, most law-of-the-sea experts have so far proposed the development of a new rule of international law that would have the effect of freezing the baselines, or permanently fixing the boundaries of maritime zones at today's status—by fixing them on a chart, or such-like (Caron, 1990, 2009; Soons, 1990; Jesus, 2003; Hayashi, 2011). In other words, proposals for dealing with sea-level rise aim at preserving a static legal situation in the face of an increasingly dynamic process of natural change. This illustrates a core dilemma: On the one hand, the natural processes of convergence between the Holocene and Anthropocene conditions will require a response or transformation in accordance with the needs and purposes in the new situation, rather than the imposition, by analogy or precedent, of static forms that were built on the basis of an earlier, no longer valid, situation. On the other hand, the international legal order will always be in search of stability and, ultimately, solutions to facilitate peace and prevent conflict. In the case of the Law of the Sea and the methods for determining baselines and their domino effect on other maritime zones, a gradual solution between the 'freezing' of current legal status and permanent fluctuation of the limits may be found in a new coordinating mechanism devised specifically with the effects of sea-level rise on baselines and maritime zones in mind. While the process of establishing a coordinating mechanism of that sort, as well as its composition and competencies, remains to be clarified, the example of the Commission on the Limits of the Continental Shelf might offer useful experience.

¹⁹ The 'Bangladesh exception' – Article 7(2) of UNCLOS, applying primarily to highly unstable coastlines caused by river deltas and the related impact on straight baselines – is of limited reach and is targeted to specific situations. Argumentum a contrario, it confirms the main rule as further described below.

3.3. Resilience of the law of the sea system in the changing Anthropocene conditions

The foundations of today's law of the sea are basically the product of centuries of often-antagonistic struggles among and between dominant human forces. These forces have produced impressive technological capabilities and made possible the modern way of life in industrialized societies, but they also seem to have contributed substantially towards threatening the stable conditions of the Holocene—and bringing about our entry into the Anthropocene.

The law of the sea is today a well-developed legal system, addressing human uses of the seas and oceans, organized through various maritime zones where the rights and duties of states (and the many stakeholders involved) are carefully balanced. The law-of-the-sea system aims at facilitating stable international relations regarding the maritime spaces and their uses, as well as promoting the peaceful settlement of disputes that may arise.

Evolving over centuries and resulting in the current legal framework that emerged in the second half of the 20th century, the Law of the Sea is aimed primarily at addressing the changing political and economic circumstances—not changes in the overall natural conditions as well. This is a legal system tailored to the circumstances of the Holocene, implicitly held to be permanently valid.

With the profoundly different circumstances on the Anthropocene horizon, responding to the challenges for the Law of the Sea may increasingly involve more than merely amending or adjusting the rules of individual treaties, or adding new ones. The very foundations of this legal system and its current parameters may need re-evaluation. Certain cornerstone concepts of the law-of-the-sea architecture, like the rules pertaining to baselines and the consequent determination of the maritime zones, may have to undergo thorough scrutiny and be supplemented by new rules—with new coordinating mechanisms to enable their implementation.

4. International environmental law for the Anthropocene

4.1. Some basic characteristics of international environmental law

International environmental law (IEL) – a recent subject of public law at the national level (since the mid-20th century) and a relatively new discipline within public international law (since the 1970s) – is still in the formative stages. It has developed largely as a response to the developments that have triggered the Anthropocene, although the scale of changes at the Earth System level has been recognized only quite recently. Examples of particularly relevant elements of IEL include treaties dating back to the 1960s concerning nuclear activities as well as cases before the International Court of Justice regarding nuclear weapons.²⁰ Importantly, IEL is the field of international law that aims at addressing these challenges from an inter-generational perspective.

Many countries are still in the process of elaborating environmental legislation and designing related domestic

institutions. In addition come the tasks of ensuring that the environment is appropriately integrated in the decision-making processes of relevant public authorities, and establishing appropriate divisions of work between central and local authorities. All this means that countries have highly differing starting points when they participate in international-level negotiations.

Unlike the law of the sea, *environmental treaties* and their associated institutional structures are in general ad hoc and fragmented. Moreover, a relatively common approach in IEL is to adopt framework treaties as a first binding step on the road towards agreement on more specific commitments. Among the characteristics of environmental treaties is their lack of reciprocity, in the sense that suspension of obligations is generally not accepted as an appropriate response to the non-compliance of other countries. The logic, of course, is that destroying environmental goods is not an adequate response to other countries' violation of their obligations. Environmental treaties frequently lack compliance and enforcement measures, and are based on non-confrontation and facilitative approaches to assist countries in their efforts to comply.

Customary international law in the field of IEL is essentially based on principles of good neighbourliness and state sovereignty. Customary law has so far had limited importance in the field of IEL, in terms of leading to changes in the policies of countries. At present IEL cannot be said to constitute a sufficient basis for 'global environmental governance', when that is understood as 'normative institutional regulatory intervention and social construct that is predominantly based on law and that aims to influence how people interact with the global environment' (Kotzé, 2014, pp. 141 ff.).

A challenge for national and international law is to find the appropriate level of integration of environmental issues in other fields of law. One example is the relationship between IEL and international trade law, where there is significant overlap, largely because IEL frequently resorts to trade-related measures, while international trade law often takes up environmental issues in case law. A main vehicle for integration of environmental issues has been to include references to the objective of environmental protection and sustainable development in the preambles of treaties in other fields, as in the 1994 Agreement Establishing the World Trade Organization. However, such references have generally had little impact on the operative clauses or the implementation of such treaties.

4.2. Sovereignty, sovereign rights and jurisdiction

The emergence of the Anthropocene raises the question whether we should amend fundamentally or reject aspects of state sovereignty (see Ebbesson, 2014, p. 84). The lack of results in important fields of IEL, such as biodiversity and climate change, has led governments and IEL scholars to raise similar questions. Many environmental treaties have modified the general principle of 'sovereign equality' among countries, the main example being the principle of common but differentiated responsibilities, where some add the phrase 'and respective capabilities'. Given the controversies surrounding the classification of states into 'developed', 'emerging', 'developing' and 'least developed', the future of this principle is currently among the most contested issues in IEL.

Another aspect of sovereignty is territorial sovereignty; in particular the right of states to regulate activities within their territory and the duty of other states not to take or allow actions that violate the territorial integrity of other states. An essential element is a country's sovereign right to regulate its natural resources. This right is, however, challenged by rules of international economic law that safeguard the interests of other states

²⁰ Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and under Water (1963) and Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (1967), as well as the Nuclear Tests Cases initiated by New Zealand and Australia against France in 1973 before the International Court of Justice.

that are dependent on access to such resources.²¹ The struggle for access to natural resources and the right to restrict access to such resources will become increasingly important in the Anthropocene. Perhaps the regulatory freedom of countries will need to be restricted by introducing environmental rights at the international and/or the national constitutional level (see Robinson, 2014, 15–17 pp.).

The duty not to allow activities that violate the territorial integrity of other states has been viewed in the literature as a core element of customary international law. Although this rule, which extends to ‘areas beyond the limits of national jurisdiction’ (see Principle 2 of the 1992 Rio Declaration on Environment and Development), has been formulated in very strict terms and could have significant implications for countries’ duty to protect the environment, there have been few cases in which it has been invoked and applied by international courts and tribunals. One important implication of this aspect of territorial sovereignty is the duty of states to cooperate—for example, to consult with neighbouring states when planning activities that may have significant transborder effects. Elaborating and implementing the latter aspects of territorial sovereignty may prove essential to prevent deteriorating environmental conditions during the Anthropocene.

Sovereignty is also closely linked to the extent to which states can act unilaterally to protect the environment by ‘forcing’ other states to adopt similar policies. Examples of such unilateralism are the imposition of environmental product standards by key importing countries, and requirements that states join environmental treaties in order to enjoy preferential trade relations. A related issue is the extraterritorial application of national legislation, for example by prohibiting domestic companies from conducting environmentally harmful activities in their operations abroad. Unilateralism and extraterritoriality are important tools of powerful states. They have been controversial and their status remains contested under international law. Will the emergence of the Anthropocene necessitate increased use of such tools?

4.3. Changing the principles of international environmental law?

Discussion about the founding principles of IEL is high on the agenda of states, international institutions, stakeholders and scholars. While significant political consensus has emerged on some principles,²² such as sustainable development and prevention, other principles have been controversial, as exemplified by the precautionary principle. There have come numerous calls for reconsideration of principles, also regarding principles that have received broad political support. In particular, scholars and non-governmental organizations have argued that today’s approaches to the principle of ‘sustainable development’ are inadequate, and that, with the emergence of the Anthropocene, our current understanding of the principle should be replaced by a concept of ‘strong sustainability’ (Kotzé, 2014, 137 pp. and 152–154; Robinson, 2014, p. 15). Moreover, the principle of common but differentiated responsibilities can be questioned from the perspective of the effectiveness of IEL, as it is in the climate change negotiations. However, this principle can also be seen as an essential precondition for states to move forward in negotiations, given their varying resources and capabilities (Ebbesson, 2014, p. 90).

As observed by Kotzé (2014, p. 144):

The new globalised reality of the Anthropocene entails that environmental lawyers will have to revisit these orthodox, and often archaic, social constructs that have been designed as institutional responses to less complicated or complex regulatory issues that existed during the Holocene epoch, which in turn might require a wholesale review of current regulatory interventions leading to proposals to reconceptualise and redesign our law and governance constructs.

Some even call for an entirely new set of founding principles in IEL. Kim and Bosselmann (2013) advocate the development of a ‘Grundnorm’ that can give IEL (and other fields of international law) a shared purpose to which their specific objectives must contribute. Robinson (2014, 17–24 pp.) has argued for a new paradigm based on principles of cooperation, biophilia and nature stewardship, resilience, foresight, sharing and sufficiency, wellbeing, and justice for humans and nature. His main argument for rethinking the principles and for his selection of new principles is that, to become effective agents for change, the principles must be firmly based on existing norms, reflecting accepted parts of human nature.

Hence, while the current situation of IEL demonstrates an important willingness – among scholars and increasingly among states and other stakeholders – to reconsider basic principles, the emergence of the Anthropocene has led some authors to call for fundamental new approaches to the founding principles of IEL. However, the need for stability and predictability as well as the need to build legal structures step by step remain essential considerations.

4.4. Issues regarding resilience—responding to challenges

Normally, the discussion of resilience in the context of the Anthropocene focuses on law as a means to achieve ‘social-ecological resilience’ (Garmestani and Allen, 2014). The context for the discussion here is somewhat different. We focus on the resilience of IEL as such, in other words the ability of IEL as it is currently designed to respond to upcoming challenges (see also Scott, 2013, 356–357 pp.). There are two main challenges that we want to consider: (1) factors that build the ability of IEL to withstand pressure from interest groups seeking to realize short-term benefits at the expense of longer-term interests; and (2) factors that promote flexibility and ability to respond to emerging challenges.

As to the first: arguably the most serious concern regarding the prevailing paradigm of democracy in Western countries is its inability to safeguard the interests of future generations. IEL is a mechanism by which countries may achieve stability in environmental policies with priority to longer-term benefits. Against this background, there are strong arguments that IEL should seek a high degree of resilience in the sense of enhancing its ability to safeguard existing rules and institutions against initiatives that weaken their ability to mitigate long-term environmental problems. One example is the current discussion of how IEL should respond to geoengineering (Scott, 2013).

The relatively strong tradition of consensus when negotiating environmental treaties means that IEL is considerably resilient to subsequent changes. Such treaties are therefore rarely opened for renegotiation. However, if consensus is measured according to the extent to which countries finally join the treaties, the picture becomes more nuanced. While some treaties enjoy near-universal acceptance (like the Convention on Biological Diversity and the UN Framework Convention on Climate Change), others (e.g. treaties regarding liability for environmental damage) have failed to enter into force due to acceptance by too few countries. There are limited

²¹ For example, the cases brought by Japan, the EU and the USA against China in the WTO regarding export restrictions on certain minerals: see China—Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum, WTO cases nos. DS431–433.

²² The main starting point when considering the principles of IEL is the 1992 Rio Declaration.

means available for encouraging countries to join environmental treaties or to refrain from withdrawing. Environmental treaties frequently encourage participation by establishing funds and providing for sharing of knowledge and technologies among participating countries. However, these arrangements depend extensively on the willingness of some countries to contribute to funds and make technologies available, thereby incurring additional burdens from participating. Whether countries during the Anthropocene will be more willing to contribute to the implementation of environmental treaties according to their ability remains to be seen. Moreover, although it has not been common for countries to withdraw from environmental treaties, the fate of the Kyoto Protocol may indicate that this may become more frequent in the Anthropocene. Against this background, IEL cannot be said to be very resilient if countries seek to undermine its effectiveness due to short-term interests.

As to the second point, there are several factors that contribute to IEL's flexibility and ability to respond to emerging challenges of the Anthropocene. There is significant focus on establishing common knowledge bases regarding environmental threats, their development, and means to deal with them within IEL. Such initiatives range from the UN Intergovernmental Panel on Climate Change, to clearing houses for information-sharing under the Biosafety Protocol. These arrangements promote science-based approaches to the design of IEL and contribute to the ability of IEL to withstand criticism and changing political priorities. They also promote science-based reforms of IEL.

Further, the resort to 'framework' treaties and the role of 'soft law' in IEL are prime examples of factors contributing to flexibility. Framework treaties are part of the tradition of building consensus stepwise, and represent the first formalization of consensus. However, in order to make progress in achieving their objectives, such framework treaties must be followed by development of 'hard' and 'soft' law²³ that further regulate and guide the acts of countries. Soft law is much used in IEL to specify how states should act in order to fulfil their duties under treaties, for example through documents on best practices and guidelines. Such documents can readily be updated and may thus add flexibility to adjust the treaty regime to new knowledge. The success story of mitigating the depletion of the ozone layer through negotiation of a framework treaty and subsequent protocols alongside efforts to develop related knowledge of causes and effects has been a model for subsequent environmental treaties. There is thus significant room for 'reflexivity' and adaptability under IEL (Kotzé, 2014, 146–147; Ebbesson, 2014, p. 80).

The emergence of the Anthropocene and the problems associated with effective implementation of IEL have moved countries from focusing on mitigation of environmental degradation to focusing on adaptation. This has been most clearly seen in the field of climate change (Kotzé, 2014, 149–150). This often involves reforming existing treaties, but can also be a question of negotiating new treaties.

5. Genetic resources: between patent law and sovereign rights

5.1. Basics of law governing genetic resources

Humans have been utilizing genetic resources ever since they settled down and began growing their own food. With the rediscovery of the 'Mendelian laws' of inheritance and the development of bio- and gene technology in the life sciences,

the value of genetic resources has increased. In the Anthropocene, the value of genetic resources for developing new plant varieties and animal breeds for agriculture, new active compounds for medicines, and industrial production, is likely to increase significantly. Main reasons why we are likely to see such developments include the current loss of biodiversity, the need for ways of responding to new situations (for example, due to changing climatic conditions and ocean acidification), and the growing human population with the consequent demand for increased food production.

Three main tendencies in legal development since the 1950s can be identified. First, in plant breeding there is broad recognition of the need for access to genetic resources so that new plant varieties can be bred. This has led to the emergence of publicly held collections of plant germplasm, governed in international law by a multilateral system for their exchange, embedded in the 2001 International Treaty on Plant Genetic Resources for Food and Agriculture under the UN Food and Agriculture Organization (FAO). The collections of plant genetic resources in the members of the Consortium of International Agricultural Research Centers and the back-up Svalbard Global Seed Vault are also expressions of the recognition that varieties must be preserved and secured for the future (see Fowler, 2008). In addition to promoting plant propagation, such collections make plant genetic resources available for research.

Second, during the 1950s intellectual property protection of plant varieties (plant variety protection) was established in some industrialized countries. Such rules, including requirements that countries introduce exclusive rights to the commercial sales of plant varieties, emerged in treaty law during the 1960s, in particular with the adoption in 1961 of the International Convention for the Protection of New Varieties of Plants. Industrialized countries had patent systems for technological invention. Because of gene-technological developments, during the 1980s industrialized countries started to apply patent law and grant patents to bio-inventions. In order to oblige developing countries to introduce stricter protection of intellectual property rights, including to genetic resources, rules regarding patents were brought into the trade negotiations that led to the 1994 Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) under the World Trade Organization (WTO). The main rationale for strengthening intellectual property rights is to help to create private incentives for investing in innovation.

And third, in parallel and probably also in response to the strengthening of intellectual property rights, rules recognizing the sovereign rights of countries to their genetic resources were negotiated under the 1992 Convention on Biological Diversity (CBD). This treaty is based on the concept that countries can use their sovereign rights to obtain a fair and equitable share of the benefits derived from their genetic resources, and that the value thus assigned to genetic resources will provide incentives for conserving them. The CBD, an environmental law treaty, provides the framework for balancing rights to genetic resources with trade and commercial law.

As with international environmental law, in the field of genetic resources there is a tension between the commercial and the environmental aspects. The changing conditions of the Anthropocene, already in the course of the current century, are set to increase these tensions.

5.2. Sovereign rights, exclusive private rights, and jurisdiction

There remain significant concerns regarding the extent to which the objectives of maintaining access to genetic resources, promoting innovation based on such resources, and ensuring their conservation have been achieved. After all, these objectives are

²³ While 'hard' law is legally binding, 'soft' law is not. However, this distinction, essential from a legal perspective, may not be decisive for the impact of 'hard' and 'soft' law have on the conduct of countries.

hard to reconcile, and there are inequalities in the capacities of various stakeholders to promote their interests. The onset of the Anthropocene prompts the question whether sovereign rights and private rights can be maintained as two distinct core legal concepts, or whether a change in their interaction will be required. Although private actors have gained significant control over important genetic resources, states remain key actors due to their regulatory powers. However, international rules limit the possibilities of states to intervene in the rights of private parties. Such rules make it more difficult for states to ensure broad access to genetic resources.

Several countries have traded their management rights otherwise protected by sovereignty so as to create a 'global commons' for plant genetic resources. A 'global commons' for plant genetic resources refers to how some countries have agreed on the sharing of the raw material for plant breeding because no country is itself self-sustaining in plant genetic variation. Exchange and openness are here regarded as prerequisites. Increasing privatization of plant varieties and other bio-inventions present a threat to this common vision of not claiming stringent sovereign rights over plant genetic resources.

The industrialized countries have had well-functioning patent systems for decades. Applying these to innovations based on genetic resources requires relatively little alteration in the practice of their patent laws and often no amendments to current patent acts. As a starting point, patents are time-limited (generally to 20 years), and are valid only in the country where the patent is granted. In addition, countries in Africa, Asia and Europe are establishing regional patent offices vested with elements of supra-national authority.²⁴ This means that a new level of jurisdiction and public authority is being established above the nation-state in those instances. These regional supra-national systems could subsequently be merged into a Global Patent System with a centralized system for trans-national granting of patents with validity in all member countries (Barton, 2005; Tvedt, 2007, 2010). Such arrangements for taking administrative decisions have been considered among the major patent systems of the world and indirectly by the World Intellectual Property Organization for some years. The 'unity patent' in Europe represents one further step: the establishment of common European court system for patent infringement cases, under the Agreement on a Unified Patent Court, signed in 2013 by 25 EU member states.²⁵ That is a significant move towards transferring judiciary sovereignty to the supra-national level. The intention is for this court system at the European level to have competence to hear cases between legal persons and have direct legal validity under the jurisdiction of all countries.

The CBD reconfirms the competence of states to regulate the access to and use of the genetic resources found within their territories. Enforcement of sovereign rights is a complex issue since the benefits ensuing from the use of genetic resources are often created under the jurisdiction of another country. The recognition of the sovereign rights to genetic resources can be viewed as an attempt to channel back some of the benefits created by such use and as a reaction to the privatization of genetic material through intellectual property rights. The legally binding obligations as embedded in the CBD are further specified in the 2010 Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. The Nagoya Protocol specifies in further detail the rights and duties of

countries, aimed at the sharing of benefits and thus also ensuring the enforcement of the sovereign rights of other nations. The Protocol allows for the development of new legal tools that could improve the ability to adapt to the circumstances of the Anthropocene. One example of such competing access- and benefit-sharing systems is the one for sharing influenza viruses under the 2011 WHO Standard Material Transfer Agreement, where special concerns justify a standardized system that narrows the scope of application of a country's sovereign rights.

5.3. Issues regarding resilience

To what extent are these legal systems suited and ready for the major changes facing humanity under the Anthropocene conditions of a warmer climate, the need for increased food production on a smaller fertile area, water scarcity, and diseases emerging and spreading? Let us first look at the existing norms in the legal system in a search for flexibility, and then turn to the institutional capacity to adapt.

Public collections for plant genetic resources, such as the Global Seed Vault at Svalbard, are set up for conservation and to enable re-introduction of plant genetic resources that have been lost. The 2001 Multilateral System grants rapid access to some categories of plant genetic resources and is thus relevant in the context of climate adaptation. While commercial actors are likely to respond to issues of climate adaptation for commercial crops, crops that feature mainly in self-subsistence farming will probably be dependent on public funding in order to respond to climate change. The CBD (Article 15) itself does not set any special rules for access to any particular genetic resources. The Nagoya Protocol (Article 8) encourages countries to take into consideration the need for expeditious access to genetic resources in cases of emergencies that threaten or damage human, animal or plant health. Balance in the system is maintained as both access- and benefit-sharing are to be 'expeditious' in such cases.

The next question is to what extent patent law as a branch of law provides for flexibility to deal with the changing Earth System conditions of the Anthropocene. National legislation and the TRIPS Agreement include mechanisms for balancing the rights of the inventor against the interests of the public. Three mechanisms are particularly relevant for such purposes: exclusions from patentability; specific exemptions from existing patent rights; and compulsory licensing. If there is a need to use an existing patent and a license cannot be obtained from the patent holder, the main measure is to seek a compulsory license. However, this approach has often proven difficult. After the expiry of a patent, of course, the invention will be freely available.

A further overall issue regarding resilience concerns the possibilities of altering treaties and related practices so that they may better meet the needs in the Anthropocene. A basic rule of international treaty law, as also codified in the 1969 Vienna Convention on the Law of Treaties, is that states can agree to amend existing treaties, or abandon these and negotiate new ones, and thereby alter their rights and duties. However, in order to change multilateral treaties in this manner, a general rule is that all states parties must agree to do so. In practice, where states are bound by existing multilateral treaties – as is the case with regard to patent law treaties – they are often faced with the difficult choice between achieving consensus on amendment among the parties to the existing treaty or withdrawing from the treaty (in the case of the TRIPS Agreement, the state in question would have to withdraw from the WTO itself). In a situation where a country is seeking greater flexibility in relation to patents, key developed countries, like the USA, are unlikely to accept modifications in existing rules. Thus, it is difficult to foresee, at least in a short- to mid-term perspective, that internationally binding patent law could be

²⁴ 'Supra-national' here means the authority to issue patents that are directly valid in the member states and binding for legal persons under their jurisdiction.

²⁵ On the Unified Patent Court see at www.epo.org/law-practice/unitary/patent-court.html; and at <http://unified-patent-court.org>.

adapted to deal with the consequences from, say, climate change or other types of changes in the Earth System expected in the Anthropocene. What is more common is to integrate flexibilities into regional patent law. For example, the European Patent Organization has procedures for altering the Convention on the Grant of European Patents (1973) through majority decisions—including rules that exclude countries which do not subsequently accept the amendments.

The issue of flexibility differs significantly as regards the right of access to genetic resources and the duty to share the associated benefits. The CBD and the Nagoya Protocol set the framework for national rules, but they leave significant room for discretion so that countries can adapt national rules to their particular needs. In this field, existing international rules would generally not hinder adaptation to the changing circumstances of the Anthropocene.

Because of the difference in flexibility between the CBD and Nagoya Protocol, on the one hand, and patent-related treaties, on the other, where the regimes are subject to external pressure, the more flexible regime is likely to respond first. The initial result could be that the current balance between the two regimes would be altered in favour of the patent regime. And, as an immediate response, there might be a further shift in the direction of privatization of genetic resources and bio-innovation.

5.4. Responses to challenges

This prompts the question of whether, in the long term, the regime for access to plant genetic resources, the sovereign rights of states to genetic resources, and the protection of patent rights can be maintained as core regulatory tools for genetic resources. In the Anthropocene, there will probably be strong calls for conserving genetic resources *ex situ*, i.e. outside their natural living conditions. This might require greater cooperation and coordination between countries, as well as the establishment of strong international institutions. We may also assume that there will be increasing calls for access to existing genetic resources, in the search for solutions to new problems. Where innovation is largely undertaken by private enterprises, there will be clear expectations that exclusive rights should be granted to inventions. However, private enterprises are likely to focus on sectors where (significant) profits can be made in the short or medium term. If so, there will be a great need for public research and development, where the research results must be made freely available, the problems to be resolved are long term, or the solutions needed are unlikely to generate profit (for example, due to lack of ability to pay). This might open a debate on how we can build *one global regime* that will enable us to strike a balance between sovereign rights, private rights, access to genetic resources and associated benefit-sharing, and conservation of genetic resources. Indeed, perhaps we will see the emergence of a new field of international law—*international genetic resources law*.

6. Conclusions

This article has reviewed the current state of knowledge in international law, based on the available literature, regarding potential implications of the Anthropocene for the future development of international law in general, and for some of its distinct fields in particular. Stability is deeply embedded in the fundamentals of international law, where it operates on two levels. One is the conscious objective of working towards legally guaranteed stability in international relations, in turn prone to frequent political change. The other level of stability is implied, and is based on human experience of the relatively stable circumstances of the late Holocene.

The Anthropocene contains the potential of profound implications for international law in two main ways. The first is a shorter-

term perspective: the formalisation of the Anthropocene as a new geological time-unit in the history of the Earth, ratified through due scientific process in stratigraphy, may significantly contribute to awareness-raising, prompting an increased focus on the implications for international law. The second aspect of international law implications is directly related to the consequences of the changing conditions in the Anthropocene. Here the perspective is a longer-term one, even if some of the changing conditions, such as sea-level rise – although still uncertain as to the pace and magnitude – may become serious already in the course of the current century.

The onset of the Anthropocene and the changes introduced in the underlying elements of stability that have characterised the Holocene contain the potential for new tensions in inter-state relations. A fundamental change of the context in which international law operates – with the challenges increasingly recognized as the consequences of natural, not only political, change – may spill over to and aggravate existing tensions between the territorial integrity of states and territorial claims, coupled with the fact of immense geopolitical differences, on the one hand, and sovereign equality of states as the founding postulate of international law, on the other.

A core dilemma emerges: the processes of convergence between Holocene and Anthropocene conditions will require response or transformation, including the development of new legal axioms, in accordance with the needs of the new situation—rather than responding by analogy or precedent based on the earlier situation, no longer valid. However, the international legal order will always be in search of stability and, ultimately, solutions to facilitate peace and prevent conflict, therefore requiring gradual changes.

Some of those changes, related to core aspects of state sovereignty and sovereign rights, will impact international law at the systemic level (as discussed in Section 2); these will reflect on various individual parts of international law. In addition, distinct fields of international law will respond in profoundly different ways, as seen in the examples of the law of the sea (Section 3) and international environmental law (Section 4). Moreover, the emergence of new fields of international law may be expected, as in the case of international genetic resources law (Section 5).

Finally, the Anthropocene will enhance the importance, and provide new directions for future research, in several other fields of international law, so far rarely addressed from that perspective in the international law literature. In particular, this concerns international economic law, the field of disarmament and non-proliferation of especially nuclear weapons (Falk, 2014), and ultimately the broad fields of human rights and humanitarian law—all of which may be seen as increasingly exceeding the limits of individual state sovereignty and the related territorial boundaries, and requiring advances in keeping with the demands of a new, and profoundly different, epoch.

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