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International Law, Innovation, and Environmental Change in the Anthropocene

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This book deploys the concept of innovation to explore normative and institutional responses in international law to the challenges to global order posed by rapid environmental change. In this context the contributions to the book address two key innovation-related themes. The first is the theme of innovation in legal reactions to global environmental problems. How can law anticipate, prevent, and adapt to environmental transformations?[1] This is the notion of 'innovation originating in the legal and policy sphere' and is expressly directed to achieve desired policy outcomes.[2]

The second theme is legal responses to social, economic, and technological innovation. The book asks how international law can reflect, in an appropriate way, the changing needs of contemporary societies at national and international scales. In other words, how can or should innovation itself be the object of legal innovation? Examples of this challenge include law reform in response to, and in support of, technological change such as new media, new forms of commerce (such as the 'sharing economy'), new medical techniques (such as cloning), and new approaches and technologies devised to address global environmental threats ('geoengineering').[3]

In this opening chapter we seek to offer a systematic introduction to the concept of innovation and what a focus on innovation can bring to understanding processes of change in international law. We consider the accelerating and urgent nature of global environmental change and its paradoxical relationship with innovation, whereby forces of innovation (such as technological progress) have created

[1] Paula Castro, 'Legal Innovation for Social Change: Exploring Change and Resistance of Different Types of Sustainability Laws' (2012) 33 *Political Psychology* 105–21, 108.

[2] Ibid.

[3] See, e.g., Lyria Bennett Moses, 'Why Have a Theory of Law and Technological Change?' (2007) 8 *Minnesota Journal of Law, Science and Technology* 589–606.

increasing pressure on the Earth's environmental systems (primarily through increased consumption), but where innovation can also be seen as necessary to solve those same problems.

1.1. WHY WE NEED INNOVATION: GLOBAL ENVIRONMENTAL CHALLENGES

For the last 11,700 years, *Homo sapiens* has lived, and generally thrived, in the Holocene epoch. There were between one and ten million humans on Earth when this comparatively warm and climatically stable geological period began.[4] Now, with a population above 7.5 billion, it is evident that our historical and contemporary patterns of consumption, resource depletion, and pollution have had staggering consequences.

Humankind's ascent to the station of Earth's dominant species has had such pervasive and profound environmental effects that it has clearly erased the imagined divide between people and the natural world.[5] As Purdy observes, '[b]ecause we shape everything, from the upper atmosphere to the deep seas, there is no more nature that stands apart from human beings.'[6] Humans are now a 'telluric force' – a force of nature – capable of dominating natural processes and functions at a global scale and with a growing risk of future nonlinear shocks that may shift environmental systems into a new and entirely different state.[7] Thus, despite lacking formal recognition as a geological unit,[8] the current epoch is typically described as the

[4] Jedediah Purdy, *After Nature: A Politics for the Anthropocene* (Cambridge, MA: Harvard University Press, 2015), 1.

[5] See Tim Stephens, 'Reimagining International Environmental Law in the Anthropocene', in L. Kotzé, ed., *Environmental Law and Governance for the Anthropocene* (Oxford, UK: Hart Publishing, 2017), 31–54, 32.

[6] Purdy, *After Nature*, 2–3.

[7] Yves Cochet, 'Green Eschatology', in Clive Hamilton, Christophe Bonneuil, and François Gemenne, eds., *The Anthropocene and the Global Environmental Crisis* (New York: Routledge, 2015). This contention is not without controversy. While it is generally accepted that human activity can affect Earth's surface processes, there is ongoing debate regarding the extent to which it alters internal geomorphological processes, which are an important consideration in determining our overall influence on stratigraphical organization. See Antony G. Brown et al., 'The Geomorphology of the Anthropocene: Emergence, Status and Implications' (2017) 42:1 *Earth Surface Processes and Landforms* 71–90.

[8] The International Commission on Stratigraphy (ICS) has not adopted the Anthropocene as a formal designation. While the ICS has struck an Anthropocene Working Group, any proposal for official recognition would have to secure a number of approvals within the ICS and then ultimately be endorsed by the Executive Committee of the International Union of Geological Sciences. See Jan Zalasiewicz, Colin Waters, and Martin J. Head, 'Anthropocene: Its Stratigraphic Basis' 541 *Nature* 289.

Anthropocene ('the human era').[9] Our world is a 'New Earth';[10] one that is deeply impressed with a human fingerprint.

The Anthropocene and its rapid environmental change pose significant descriptive and normative challenges for international environmental governance. Before we can explore the meaning of innovation or formulate the correct questions with respect to how international law and policy can or should function in the Anthropocene, it is first necessary to conceptualize and describe the framework from which innovation can emerge. Humans have had to confront environmental challenges for as long as we have interacted with the natural world. For example, the agricultural and resource use activities of pre-industrial societies deforested landscapes, pushed species into extinction, and degraded environmental quality at a local and regional scale.[11] The processes of industrialization and the maintenance of industrial societies brought new environmental menaces: waterways, undeveloped land, and the atmosphere became convenient waste and effluent disposal sites, 'threatening to undermine the progress made through industrialization by damaging human health and degrading ecosystems'.[12] In the second half of the twentieth century, individual states and then the international community reacted through targeted regulatory schemes and discrete 'technocratic interventions', with varying degrees of success.[13] The appropriateness of continuing to pursue this approach to environmental governance is challenged by a fundamental feature of the Anthropocene: that the rate and extent of the changes wrought by human activity are so significant that they also shake the very foundations of Earth's ecological functionality at a global scale.[14]

Johan Rockström and colleagues have developed a 'planetary boundaries' (PBs) framework that transforms how we conceptualize the integration of continued human development and the maintenance of the self-regulating Earth system at a

[9] There are differing opinions as to when the Anthropocene began. Proposals include: (1) the start of agriculture, animal husbandry, deforestation, and gradual greenhouse gas accumulation many thousand years ago (see W. F. Ruddiman, 'The Anthropogenic Greenhouse Era Began Thousands of Years Ago' (2003) 61 *Climate Change* 261–93); (2) the species exchange that occurred with the European colonization of the Americas (see S. L. Lewis and M. A. Maslin, 'Defining the Anthropocene' (2015) 519 *Nature* 171–80); (3) the onset of the Industrial Revolution (see P. J. Crutzen, 'Geology of Mankind' (2002) 415 *Nature* 23); and (4) the mid-twentieth century 'Great Acceleration' of industrialization, energy production, mineral extraction, and population growth (see W. Steffen et al., 'The Trajectory of the Anthropocene: The Great Acceleration' (2015) 2:1 *Anthropocene Review* 81–98; J. Zalasiewicz et al., 'When Did the Anthropocene Begin? A Mid-twentieth Century Boundary Level is Stratigraphically Optimal' (2015) 383 *Quaternary International* 196–203).

[10] S. Nicholson and S. Jinnah, eds., *New Earth Politics: Essays from the Anthropocene* (Cambridge, MA: MIT Press, 2016).

[11] See, e.g., Christopher E. Doughty, 'Preindustrial Human Impacts on Global and Regional Environment' (2013) 38 *Annual Review of Environment and Resources* 503–27.

[12] Will Steffen et al., 'Planetary Boundaries: Guiding Human Development on a Changing Planet' (2015) 347:6223 *Science* 736–46.

[13] Stephens, 'Reimagining International Environmental Law', 32.

[14] Steffen et al., 'Planetary Boundaries', 737.

'resilient and accommodating state'.[15] The framework works to identify a series of PBs for various Earth-system environmental processes. There are nine main areas in which PBs have been identified: climate change, biosphere integrity, stratospheric ozone depletion, atmospheric aerosol loading, ocean acidification, biochemical flows, land-system change, freshwater use, and novel entities.

The PBs framework operates through the conceptualization of three zones: the safe operating space, the zone of uncertainty, and the high-risk zone. A PB is passed upon the transition from the safe operating space into the zone of uncertainty. Each PB is assessed, using control variables and the best available scientific knowledge and data, to identify the first zone – a 'safe operating space' – within which the Earth can continue in the Holocene-like state that is known to support human societies.[16] The safe operating space for each PB is set upstream from potential global thresholds or tipping points. For example, with respect to the climate-change PB, the measurable control variables are atmospheric CO_2 concentration and top-of-atmosphere energy imbalance; the safe operating space is set at CO_2 concentrations under 350 parts per million (ppm) and upper-atmosphere energy imbalance at less than +1 watt per square meter (W/m^2).[17] Adjacent to the safe operating space and past the PB is the 'zone of uncertainty' that exists to account for weaknesses and gaps in the scientific record and uncertainties inherent in Earth's systems. This zone begins where the control variable levels are relatively 'safe' and the probability of crossing a critical threshold is low and terminates where the risk becomes dangerously high. Continuing with the climate-change example, the zone of uncertainty is set at 350–450 ppm CO_2 and +1.0–1.5 W/m^2. Past the zone of uncertainty is the 'high-risk zone' where existing knowledge indicates a 'much higher probability of a change to the functioning of the Earth system that could potentially be devastating for human societies'.[18] To conclude our climate-change example, this zone begins at 450 ppm CO_2 and +1.5 W/m^2. With CO_2 concentrations currently increasing at a rate of three ppm per annum, the high-risk zone may be entered within a few decades.[19]

The framers of the PBs framework offer an assessment similar to the climate-change example described above for each remaining PB. Further, the PBs are organized into a two-tier hierarchical structure with climate change and biosphere integrity positioned as 'core' boundaries because they are connected to the other boundaries: they influence the other PBs by virtue of 'planetary-level overarching

[15] Ibid., 736. Rockström first offered the planetary boundaries theory in J. Rockström et al., 'Planetary Boundaries: Exploring the Safe Operating Space for Humanity' (2009) 14:2 *Ecology and Society* 32–63 and J. Rockström et al., 'A Safe Operating Space for Humanity' (2009) 461 *Nature* 472–5.
[16] Ibid.
[17] Ibid., 739.
[18] Ibid., 738.
[19] Brian Kahn, 'Carbon Dioxide Is Rising at Record Rates', *Climate Central*, 10 March 2017, available at: www.climatecentral.org/news/carbon-dioxide-record-rates-21242, Accessed 1 March 2018.

systems' but are also, in turn, partially regulated by the other boundaries.[20] Significant changes to either core boundary would probably be sufficient to disrupt the Earth's Holocene state.

The PBs framework is transformative for a number of reasons. For the purposes of establishing the context for this work, it identifies trends in global environmental degradation, illuminates the ways in which existing law and policy are (or are not) effectively confronting the problems associated with the Anthropocene, and demonstrates the pressing need for reimagining our collective responses. It is alarming that humanity has already passed four of the nine PBs, including the two 'core' boundaries. With respect to climate change, atmospheric CO_2 concentrations passed the symbolic 400 ppm levels in 2016 and a reading taken in April 2017 indicated that the atmospheric CO_2 level had, for the first time in recorded history, passed 410 ppm, which is well beyond the PB.[21] Turning to biosphere integrity, we are currently in the midst of the Earth's sixth mass extinction event and have exceeded the PB for rate of species extinction globally,[22] and the PB for functional diversity in southern Africa.[23] We have doubled the PBs for additive uses of phosphorus and nitrogen and have slipped well below the PB for the maintenance of forested areas[24] (Figure 1.1).

Future PBs work will further refine boundaries and limit uncertainties; however, Rockström and colleagues are explicit that their work will not 'dictate how societies should develop' nor will it offer normative solutions, since such decisions are political in nature and 'must include considerations of human dimensions, including equity, not incorporated in the PB framework'.[25] What it does clearly demonstrate to those interested in formulating the sort of prescriptive reforms needed to move society towards a more resilient state is the extent to which our existing collective response to many of these issues is failing to safeguard Earth's optimal conditions.

The PBs approach is one of many lenses through which the multiple crises of widespread environmental degradation and change can be considered. Others include, *inter alia*: the intersection of human rights and the environment;[26] the

[20] Steffen et al., 'Planetary Boundaries', 744.

[21] Brian Kahn, 'We Just Breached the 410 ppm Threshold for CO2', *Scientific American*, 21 April 2017, available at: www.scientificamerican.com/article/we-just-breached-the-410-ppm-threshold-for-co2, Accessed 1 March 2018.

[22] Anthony D. Barnosky et al., 'Has the Earth's Sixth Mass Extinction Already Arrived?' (2011) 471 *Nature* 51–7.

[23] Steffen et al., 'Planetary Boundaries', 9, 740–1. In addition to actual species extinctions, biosphere integrity is increasingly threatened by widespread reduction and extinction of flora and fauna at the population level; See Paul R. Ehrlich and Rodolfo Dirzo, 'Biological Annihilation via the Ongoing Sixth Mass Extinction Signalled by Vertebrate Population Losses and Declines' (2017) *Proceedings of the National Academy of Sciences* (early edition).

[24] Steffen et al., 'Planetary Boundaries', 740–1.

[25] Ibid., 736.

[26] Linda Hajjar Leib, *Human Rights and the Environment: Philosophical, Theoretical, and Legal Perspectives* (Leiden: Martinus Nijhoff Publishers, 2011).

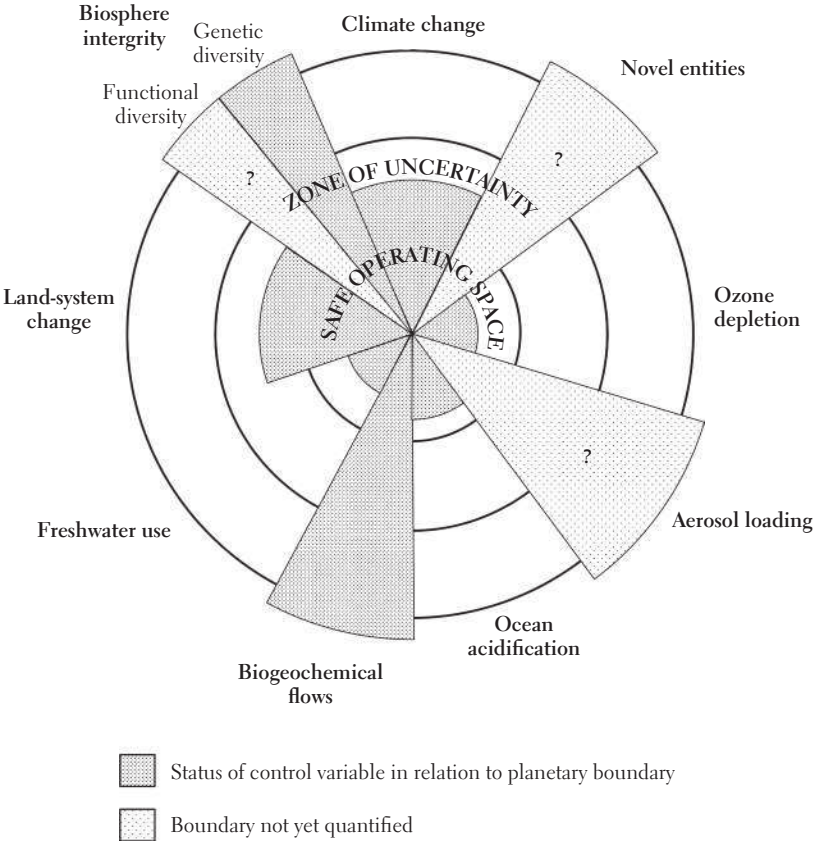

FIGURE 1.1. The planetary boundaries
Source: After Steffen et al., 'Planetary Boundaries', 736

nature and implication of linked socioecological systems;[27] the emergence of global administrative law (GAL);[28] and the role of resilience theory and principled adaptive management in the face of mounting uncertainty.[29] Regardless of the lens that is

[27] See Carl Folke and Fikret Berkes, eds., *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* (Cambridge: Cambridge University Press, 1998); Oran R. Young et al., 'The Globalization of Socio-Ecological Systems: An Agenda for Scientific Research' (2006) 16 *Global Environmental Change* 304–16; Frances R. Westley et al., 'A Theory of Transformative Agency in Linked Social-Ecological Systems' (2013) 18 *Ecology and Society Article* 27–42.

[28] Niko Krisch, 'The Pluralism of Global Administrative Law' (2006) 17 *European Journal of International Law* 247–78; Benedict Kingsbury, 'The Concept of 'Law' in Global Administrative Law' (2009) 20 *European Journal of International Law* 23–57.

[29] P. D. C. Milly et al., 'Stationarity is Dead: Whither Water Management?' (2008) 319 *Science* 573–4; J. B. Ruhl, 'Panarchy and the Law' (2012) 17 *Ecology and Society* 31–6; Melinda H. Benson and Robin K. Craig, 'The End of Sustainability' (2014) 27 *Society & Natural Resources* 777–82;

employed, it remains clear that international law, in all its forms, will need to play an important role in responding to our modern environmental crisis. And, as the contributors to this work demonstrate, there is considerable room for innovation. Law by itself, however, is not a panacea. Improving the socioecological interface requires a thorough investigation of how human societies are organized and operate politically, economically, and culturally.

1.2. HOW CAN INTERNATIONAL LAW RESPOND? PROSPECTS FOR NORMATIVE INNOVATION IN THE ANTHROPOCENE

1.2.1. *Defining Innovation*

The general meaning of 'innovation' is the introduction of something new, or change to something that is established through the addition of new elements. The term casts no judgment on the desirability or otherwise of the change, but in practice the idea of innovation is generally associated with positive change, that is to say, new ideas or inventions that carry beneficial societal or other outcomes.[30] In the legal context, innovation has clear connections with the task of planned law reform, which in a number of jurisdictions is advanced through the work of dedicated law-reform commissions. The mandates of these commissions typically invoke a catalogue of objectives to be achieved through law reform, such as making the law and legal systems modern, fair, just, efficient, accessible, simple, and cost-effective.[31]

International law has undergone profound change in the contemporary era, with the emergence of the international organization and the international legal subjectivity of individuals highlighted as among the most important 'innovations'.[32] Yet, despite a growing scholarly interest in innovation across multiple fields in the social and natural sciences, the relationship between innovation and international law has generally been under-studied and under-theorized. Mapping innovation, as a process of deliberate legal change and reform, on to the landscape of public international law is challenging because of the nature of the international lawmaking process. In contrast to national legal systems, the processes of international lawmaking are relatively slow, cumbersome, disaggregated, and disorderly. International law is generated through the expression of state consent via treaties and customary

J. B. Ruhl, 'Adaptive Management of Ecosystem Services Across Land Use Regimes' (2016) 183 *Journal of Environmental Management* 418–23.

[30] Anna Butenko and Pierre Larouche, 'Regulation for Innovativeness or Regulation of Innovation?' (2015) 7 *Law, Innovation and Technology* 52–82, 56.

[31] See, e.g., the mandates of the UK Law Commission (as set out in the Law Commissions Act 1965 [UK]) and the Australian Law Reform Commission (as set out in the Australian Law Reform Commission Act 1996 [Cth]). See also in the Canadian context the Law Commission of Canada Act 1996 (Can).

[32] Thomas M. Franck, 'Three Major Innovations of International Law in the Twentieth Century' (1997–8) 17 *Quinnipiac Law Review* 139–56.

practice, with courts and publicists also contributing to the ascertainment of international law rules.[33] It is the 'primitive' characteristic of international lawmaking whereby the authors and subjects of law are one and the same that led H.L.A. Hart to describe international law as being law properly so called, but not a true legal system.[34]

One response to the absence of intentional, deliberative, and organized mechanisms for international legal innovation was the establishment in 1947 of the International Law Commission (ILC) with the mandate to promote 'the progressive development of international law and its codification'.[35] The ILC's work has had a major influence on the reform of international law and its contributions have been a 'fluid' mixture of innovation (progressive development) and continuity (codification).[36] Some of the ILC's work has involved profound conceptual innovation, such as its contribution to clarifying the status of peremptory norms,[37] while in other respects the ILC has been relatively conservative and slow-moving. This includes the ILC's work on environmental matters, including international watercourses[38] and the atmosphere.

Since the late twentieth century there has been a radical departure in international legal scholarship from the formal strictures of rule determination characteristic of earlier work that focused, primarily or exclusively, on the attitudes and activities of governments.[39] Reflecting the complexity of the contemporary global order, and the need for more responsive lawmaking to address collective problems, there has been a much broader accommodation of nonstate actors and their activities as being relevant to the international lawmaking process.[40] The advent of 'soft'

[33] Statute of the International Court of Justice, 26 June 1945, in force 24 October 1945, 59 Stat. 1031, art. 38(1).

[34] H. L. A. Hart, *The Concept of Law* (Oxford: Oxford University Press, 3rd edn., 2012), 214.

[35] Statute of the International Law Commission, 21 November 2947, GA Resolution 174(II), art. 1(2).

[36] See, e.g., Francis G. Jacobs, 'Innovation and Continuity in the Law of Treaties' (1970) 33 *Modern Law Review* 508–17 (discussing the 1969 Vienna Convention on the Law of Treaties).

[37] Robledo described the ILC's characterization of *jus cogens* norms in its work on the law of treaties as 'une innovation profonde et un grand pas franchi': A. G. Robledo, 'Le Ius Cogens International: Sa Genese, Sa Nature, Ses Fonctions' (1982) 172 *Recueil des Cours* 17–36.

[38] Referring to the ILC's work on international rivers, Caron has questioned whether the ILC is the most appropriate forum for achieving legal change 'in areas of a fast-changing world requiring legal innovation': David D. Caron, 'The ILC Articles on State Responsibility: The Paradoxical Relationship Between Form and Authority' (2002) 96 *American Journal of International Law* 857–73, 857 (note 1) citing David D. Caron, 'The Frog That Wouldn't Leap: The International Law Commission and Its Work on International Watercourses' (1992) 3 *Colorado Journal of International Environmental Law and Policy* 269–79.

[39] Jean D' Aspremont, *Formalism and the Sources of International Law: A Theory of the Ascertainment of Legal Rules* (Oxford: Oxford University Press, 2011), 2–5.

[40] Nico Krisch, 'The Decay of Consent: International Law in an Age of Global Public Goods' (2014) 108 *American Journal of International Law* 1–40.

international law, which has been particularly important for the development of international environmental law (IEL),[41] is one manifestation of this.

Formalist accounts of international lawmaking typically describe the process as a purposive one, with states accepting obligations to be bound to norms via agreed treaty texts or, through their actions and statements, the emergence of customary norms. However, we know from international relations scholarship that the fashioning of international law is a far less programmatic endeavour, and is one that takes place in a dynamic international political environment in which states are constantly engaged in an interactive and iterative exchange of commitments.[42] Many areas of international law have taken on a life of their own and are shaped over time by a multitude of influences (e.g. economic change such as globalization) and influencers (e.g. international organizations and international courts). This also complicates a study of innovation in international law, as it means that innovation has to be examined both as a deliberate and extrinsic process, and also as an unplanned and intrinsic one.

1.2.2. *International Legal Innovation in the Anthropocene*

An increasingly important extrinsic influence on the making of international law, and the subject of this book, is rapid environmental change. Global governance scholars have been considering the implications of this change and have sought to devise innovative principles and institutions of 'earth systems governance' that can maintain 'the long-term stability of geobiophysical systems'.[43]

However, with few exceptions,[44] most accounts of international law have not clearly and directly addressed the implications of the Anthropocene for its norms and institutions. This is despite the obvious risk that environmental change poses to the international order. International law has undergone profound shocks and crises on multiple occasions, including the cataclysms of global war in the twentieth century that gave rise to the United Nations system and the contemporary international legal order. Will large-scale environmental change impel a similar process, including consolidation and collectivization of norms and institutions, or can we expect

[41] Pierre-Marie Dupuy, 'Soft Law and the International Law of the Environment' (1990) 12 *Michigan Journal of International Law* 420–35.

[42] Anne-Marie Slaughter, Andrew S. Tulumello, and Stepan Wood, 'International Law and International Relations Theory: A New Generation of Interdisciplinary Scholarship' (1998) 92 *American Journal of International Law* 367–97.

[43] Frank Biermann, *Earth System Governance: World Politics in the Anthropocene* (Cambridge, MA: MIT Press, 2014), 30. See also: www.earthsystemgovernance.org/about, Accessed 1 March 2018.

[44] See e.g., R .E. Kim and Klaus Bosselmann, 'International Environmental Law in the Anthropocene: Towards a Purposive System of Multilateral Environmental Agreements' (2013) 2 *Transnational Environmental Law* 285–309; and K. Bosselmann, *Earth Governance: Trusteeship of the Global Commons* (Cheltenham, UK: Edward Elgar, 2015).

(a) different response(s), including fragmentation, disorder, and even the dissolution of the global order?[45]

There is a strong sense that the existing catalogue of responses within international law will be ineffective at responding to the challenges of the Anthropocene. Oran Young cautions against the assumption that 'processes of self-organization' will avoid dramatic climate change and other major biophysical changes.[46] Young argues that 'solving the problems of the Anthropocene will require the creation and operation of innovative steering mechanisms that differ in important respects from those familiar to us from past experience'.[47] While 'the mainstream regulatory approach' of rules, regulations, and compliance remains useful, Young suggests that we need to explore new 'alternatives … or supplements' to the traditional approach.[48] Among those Young advocates are greater use of guiding principles (such as 'common but differentiated responsibility') and goal setting and benchmarking (e.g. the SDGs). Young's message is that what is needed is innovation that can produce transformative change, and not merely adjustments or tweaks to legal norms and institutions as they currently operate.

1.2.3. *The Science–Law Interface*

One of the largest challenges faced by international law in the Anthropocene is translating scientific guidance on socioecological risks into effective laws and policies in a time frame that matches the pace of change. One conduit for achieving this is through principles and goals directly informed by the science. Even if they have only 'soft law' status they can nonetheless significantly influence the development of environmental regimes. Prominent examples include the environmental objectives within the SDGs and the Aichi Biodiversity Targets adopted under the Convention on Biological Diversity.[49] One of the most important set of environmental goals is the temperature 'guardrails' embedded in the 2015 Paris Agreement on Climate Change. The Paris Agreement seeks to hold 'the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change'.[50]

[45] Frank Biermann et al., 'Navigating the Anthropocene: Improving Earth System Governance' (2012) 335 *Science* 1306–7.
[46] Oran R. Young, *Governing Complex Systems: Social Capital for the Anthropocene* (Cambridge, MA: MIT Press, 2017), 11.
[47] Ibid., 3.
[48] Ibid.
[49] See Convention on Biological Diversity, *Aichi Biodiversity Targets*, available at: www.cbd.int/sp/targets/, Accessed 1 March 2018.
[50] Paris Agreement on Climate Change, 12 December 2015, in force 4 November 2016, UN Doc FCCC/CP/2015/L.9/Rev.1, art. 2(1)(a).