



# Scientific Knowledge: Its Impacts on Judicial Decision-Making and International Law in the Era of Sustainability

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## Abstract

Science has become a tool for taking decisions in international (as well as domestic) disputes and acts to ensure the relevance of global ecological responsibility. This role of science has become particularly relevant as the sustainable development narrative has grown into a predominant form of global cooperation. The following contribution looks specifically at the role of decision-makers, including judges and arbitrators, and their interaction with scientific knowledge during the decision-making process in international (economic) disputes. Beginning with early cross-border environmental disputes and tracing the increasing inclusion of scientific inputs over the past decades, the contribution critically examines the role of judges in integrating expert inputs into legal decisions and its impact on achieving a more ecologically aware application of the law.

## Keywords

Scientific knowledge · Economic law · Systemic integration · Judicial reasoning · Sustainable development

## 1 Introduction

When the arbitrators in the *Trail Smelter* dispute assessed the parties' scientific submissions, the idea of sustainability, despite already existing in the context of forestry, amongst other uses (Von Carlowitz 1713; Du Pisani 2006), had not yet emerged as a guiding term for global cooperation (International Union for the Conservation of Nature's 1980; Brown 1981; Meyers 1984; Brundtland Commission and Brundtland 1987; French 2005; Ramlogan 2010, p. 201; Beyerlin 2013; Humphreys 2018).<sup>1</sup> The relevant issue in the dispute was pollution emitted from a refinery and the transboundary nature of that pollution. Agriculture on the US side of the border was impacted by industry on the Canadian side: the pollutants had caused harm and affected the profitability of businesses. Thus, while *Trail Smelter* is now characterised as a key environmental dispute, its origins lie in the economic harm connected to that environmental damage. Furthermore, it was the case's cross-border character that allowed the dispute, the inputs, and the arbitral decision to become the basis for later decisions in environmental law and, arguably, a guide in more recent decisions under the umbrella of sustainable

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<sup>1</sup> Arguably, based on more recent judicial decisions and case law, sustainable development has neared a greater designation in international law, possibly attaining some of the attributes of a principle. See its use by the ICJ in the *Gabčíkovo-Nagymaros* dispute, *infra* note 21.

development. Its positioning as a key case for transboundary pollution can be attributed in part to the methods of analysis used by the tribunal, since the judgment was guided by the use of scientific inputs.

This type of reliance on scientific inputs had already been integrated into aspects of decision-making prior to this decision,<sup>2</sup> and it has been extensively applied since (Riddell 2009).<sup>3</sup> The need for science in international litigation has generally become widely recognised (Rosenne 2007). It can be argued that the value and relevance of scientific expert inputs has substantially increased in the past decades, as the realities of climate change have moved beyond the academic literature and into the public consciousness, forcing the interpretation and application of law to interact in a more scientifically-aware space. Yet little consideration is given to the way in which those expert inputs are assessed, even when they are deemed to be relevant in a dispute.<sup>4</sup> This contribution looks at the use of scientific inputs in the process of assessing legal obligations, particularly in disputes that go beyond the classic definitions of environmental law—thus including the use of science in, for example, economic disputes when environmental issues are at stake

(Anderson 2007; Treves 2012; Liao 2017).<sup>5</sup> It is these periphery international disputes that ultimately demonstrate the successful integration of conceptualisations of scientific knowledge and its role in enabling the creation of law for a *blue planet* outside of the systemic boundaries of environmental disputes and regulations.

The following contribution looks carefully at the need for scientific knowledge in the current era of the Anthropocene and its key positioning in several exemplary international legal disputes. The role of scientific knowledge in domestic law is intentionally excluded from this contribution,<sup>6</sup> since the aim is to focus more specifically on the role of scientific knowledge in achieving the narrative of global cooperation through sustainable development. The analysis is framed around representative claims arising out of international disputes brought to the International Court of Justice, under the framework of the World Trade Organization, and in the context of international investment arbitration. This sampling of both development and economic disputes that lean towards environmental factors demonstrates the integration of ecologically-relevant narratives throughout the practice of international law and also reveals the role of scientific knowledge above and beyond more specifically-defined environmental disputes. The text first examines the use of science by judges, before turning to the role of science in the sustainable development

<sup>2</sup> Award of the Arbitral Tribunal Established Under the Treaty Signed in Washington, on the 29th of February 1892, Between United States and Her Majesty the Queen of United Kingdom of Great-Britain and Ireland (Relating to the Rights of Jurisdiction of United States in the Bering's Sea and the Preservation of Fur Seals), Decision of 15 August 1893, Reprinted from Moore (1898, p. 935).

<sup>3</sup> See *inter alia*, Lac Lanoux (France v. Spain), Award, [1957] 12 R.I.A.A. 281; Pulp Mills on the River Uruguay (Argentina v. Uruguay), Judgment, [2010] ICJ Reports 14, paras. 160–168; Whaling in the Antarctic (Australia v. Japan, New Zealand intervening), Judgment, [2014] ICJ Reports 226, paras. 74–246; United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WT/DS381/RW/USA, WT/DS381/AB/RW2, 14 December 2018, Report of the Appellate Body, para 6.84; Dispute Concerning the Delimitation of the Maritime Boundary between Bangladesh and Myanmar in the Gulf of Bengal (14 March 2012).

<sup>4</sup> See generally, de Chazournes (2012). Regarding international trade law, see Fukunaga (2012). The process of scientific-factfinding, as a preliminary discussion to the decision-making also warrants serious consideration. See Mbengue (2012, p. 511).

<sup>5</sup> Beyond environmental law, the issue of scientific evidence has been most prominently explored with respect to the law of the sea, namely due to express recognition of the role of scientific and technical matters in Article 289 of UNCLOS. See e.g., Rosenne (2007, p. 245) (highlighting the ability to use qualified scientific bodies in taking decisions as a departure from other international courts and tribunals).

<sup>6</sup> For substantial literature on the role of scientific inputs in domestic law, see *inter alia* Jasanoff (1997); regarding intellectual property law, see Pottage (2011, p. 621), Swanson (2007), Clifford and Peltz-Steele (2014, pp. 558–560); regarding environmental regulations, see for example, Murase (2017), Čavoški (2020, p. 285), Rimkutė and Haverland (2015); regarding discovery and evidence, see for example, Lynch and Jasanoff (1998), Cole (2001, p. 32), and regarding resource conservation, see for example, Carden (2006, p. 182), and United States, Environmental Species Acts, 16 U.S.C. §§ 1531–1544.

narrative and the accompanying “scientific turn”. The contribution attempts to identify the potential for a unified approach to these scientific inputs throughout the sphere of international law, pushing beyond fragmentary applications.

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## 2 The Role of Science, the Role of Judges

Scientific inputs are of no value if they are not afforded credibility by the judges taking the decisions, integrating those inputs as meaningful expressions of truth that can be used to find justice. More generally, courts and tribunals, as legal decision makers, play an essential role when taking decisions on the admissibility of evidence.<sup>7</sup> This power grants the tribunal a certain ability to mould and determine how evidence should be construed in the non-scientific context, beginning with the simple issue of whether such evidence is even relevant to the decision. Relevance of the evidence must first be established before admissibility can be allowed. Once the scientific evidence is admitted and the experts have submitted their reports, potentially being called to the hearing to provide further explanation, that science gains the power of persuasion. It attains a status within the dispute, and while the tribunal is not obliged to give it significant weight, its very existence may elevate the analysis of the dispute beyond the determined legal rationalities and into the field of scientific rationality. This first section looks at both the practice of submitting scientific expertise into opinions and the specific ways in which those inputs are dealt with by international tribunals.

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<sup>7</sup> In general, see Statute of the International Court of Justice, Article 52 (providing for the right of the Court to “refuse or accept any further oral or written evidence”); International Bar Association Rules on the Taking of Evidence in International Arbitration, 17 December 2020, Article 3(10) (allowing for the parties to submit evidence in addition to the power of the tribunal to independently request evidence on a particular point). For its relevance in the US context, see Brewer (1998, p. 1543) (noting the judge’s power to take “threshold decisions” about admissibility of evidence).

The role played by science, and specifically the role of scientific inputs in the decision-making process, is necessary for an understanding of the development of the law within the conceptualisation of the *blue planet*.<sup>8</sup> While legal theory has extensively explored the role of science in the rule-making stage of relevant domestic and international policy-making,<sup>9</sup> respecting its central position in policy-making in health and environmental coordination,<sup>10</sup> studies on the role of science at the decision-making stage have proven less systematic (Alemanno 2008).<sup>11</sup> There is still work to be done regarding whether such evidence can or should be admitted in legal proceedings. If it can assist in finding justice, the assumption is generally that such evidence ought to be admitted.<sup>12</sup> The gap arises when that evidence is added to the record. How should it be applied to the relevant legal rules? How should the judges and arbitrators judge the veracity of the evidence? Are those individuals equipped to take such decisions without *ex officio* interventions? There is a significant gap in coordinating the approach to these inputs in decisions that lie beyond the sphere of a clear environmental dispute.

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<sup>8</sup> While this contribution focuses on the role of science in the adjudicatory stage, not to be neglected in this larger discussion is the central role of science in the creation of certain law—especially environmental law, patent law, etc. In this respect, see for example, Lachs (1992).

<sup>9</sup> Klabbers (2014, pp. 84–85), (acknowledging the interplay between scientific expertise in creating regulatory frameworks and the politics necessary for ratification).

<sup>10</sup> See for example, Meyer (2013, p. 17), (Meyer considers that the work of relevant coordinating organisations, including *inter alia* the Codex Alimentarius Commission and the World Health Organization, “involve[s], in part, the compilation and dissemination of research about technological solutions to environmental problems, a task similar to the compilation and dissemination of other kinds of scientific research.”); Ayal et al. (2013) and Helfer (2004).

<sup>11</sup> Regarding the role of experts in the process, see generally, see Ambrus et al. (2014) and White (1965). From the perspective of international politics, see Werner (2014). In the context of European risk regulation, Majone (2017, pp. 8–10) (proposing a probability-based method to ensure consistency in decision-making regarding matters of scientific uncertainty).

<sup>12</sup> See note 7 above.

Timothy Meyer speaks of the value of epistemic cooperation for the purpose of distributing scientific knowledge, thus creating “optimal environmental policies” on a global scale (Meyer 2013, p. 20). The ideal of such coordination at the decision-making stage is complicated by the variety of tribunals involved in such decisions, the numerous applicable laws, and the autonomy of the judges and tribunals in their process of taking decisions.<sup>13</sup>

In the *Trail Smelter* dispute, mentioned above in the introduction of this contribution, scientific submissions were extensive, arguably complex, and key to the ultimate decision reached by the arbitrator. There is no indication that the arbitrators had special knowledge that would allow for a more in-depth understanding of the scientific submissions. The US-appointed arbitrator, Charles Warren, was a respected lawyer and legal scholar. He had won a Pulitzer Prize for a book on the US Supreme Court (The Pulitzer Prizes 2022). Nothing, however, indicates a strong background in science. The Canadian appointed arbitrator, Robert A. E. Greenshields, was a professor of law, dean of the law school at McGill University, and later Chief Justice of the Superior Court of Quebec (Court of Appeal of Quebec 2022; History of McGill’s Faculty of Law 2022). Similarly, nothing points to any expertise in science. Finally, the chairman, Jan Frans Hostie, was a barrister and legal advisor in Belgium (United Nations Archive 2022). He was frequently appointed to legal commissions regarding rivers—which points to expertise in cross-border issues, if not specific expertise in the scientific factors that enable the determination of sovereign boundaries.

This legal pedigree of the arbitrators is not meant as a criticism of the interaction with scientific inputs; rather, it remains typical of judges and arbitrators in more recent disputes, especially disputes that interact with environmental law but

arise in other contexts.<sup>14</sup> The *Trail Smelter* dispute points to an early integration of scientific knowledge as key to how the dispute would be decided. The conflicting submissions of the parties would need to be assessed. The specific relevance of scientific *facts* would need to be applied to the standing legal framework on cross-border pollution. Despite the legal backgrounds of the arbitrators, the scientific inputs were given a certain agency in the decision-making process. They were highly relevant. The materiality that they represented became essential in taking the decision. It remains unclear how much of the proceedings were focused on those submissions, how much the submissions of one expert or another were attacked and questioned, or how much the arbitrator engaged with the numbers. What is clear, however, is the focus in the decision on those figures and the inclusion of those aspects of the parties’ submissions in the final award. That relevance of scientific expertise can be further identified in more recent decisions, and the method in which the judges and arbitrators interact with those inputs in the decision-making space exposes a new dimension to the ability to integrate ecologically-relevant inputs.

D’Aspremont and Mbengue (2014) have already examined the role of fact-finding in international disputes that rest on scientific controversy. Their analysis divides the approaches by tribunals into nihilism, protectionism, and outsourcing, indicating a certain inability by judges to fully interact with the scientific expertise that is put before them. They reason “that when confronted with scientific fact-finding, international adjudicators are dealing with knowledge that is as unstable as the law and which brings them to make a choice between different types of reasoning or rationality. It ultimately makes the argument that the question of scientific

<sup>13</sup> Meyer (2013, pp. 23–24) (pointing to the disconnect between the rule makers and decision makers regarding sanctions as well as under international investment law).

<sup>14</sup> Meyer (2013, p. 31) (“The credibility of scientific information is often a key component of international environmental governance. Legal decision-makers are usually not scientific experts and thus have to have confidence that the scientific record upon which they are asked to decide legal and policy questions is reliable.”).

fact-finding inevitably confronts international judges and arbitrators with a choice of epistemic rationality (D’Aspremont and Mbengue 2014, p. 241).” The varying rationalities—the law on one hand, and science on the other—create a divide in the decision-making, revealing an instability when scientific knowledge necessarily intersects with the law, whether in treaties or other agreements. A translation of that scientific information is necessary before it enters the legal discourse.<sup>15</sup> Like any fact brought before a tribunal, that fact is then integrated into the decision-making. And like other facts that require a high level of expertise, the ability to apply legal reasoning with the application of those facts leads to just decisions. The court itself poses its own constraints in this respect, leaving the decision-makers with a choice of rationality.<sup>16</sup>

The various approaches taken by tribunals in relation to those facts expose fragmentary realities even in areas of law that require a cooperative approach. The ability to integrate these scientific sources is often derived from the openness (or vagueness) of the respective treaty provisions.<sup>17</sup> Case analysis reveals inconsistent approaches amongst international courts and tribunals: some appoint independent experts (Simma 2012, p. 230), many assess the data to the best of their abilities, some choose to

understand the inputs on a first-hand basis,<sup>18</sup> and others may use the inputs to encourage further negotiation between the parties (Tanaka 2017).<sup>19</sup> This variance also extends to standards of proof when scientific inputs are considered either necessary or essential.<sup>20</sup> Even where respect is given to spheres of law beyond the specific decision at hand, if judges and tribunals are applying different methodologies to assess the inputs, the very idea of sustainability as a matter of law will not be coordinated or effective.

While science has become an essential input in legal decisions within the “blue planet” framework, these various ways in which it engages with law reveal complexity. This results in the need for a certain degree of caution. This caution arises in many senses from the inherent degree of rationality that upholds scientific studies. Phoebe Ellsworth notes that “[b]oth law and science pride themselves on the rationality of their intellectual methods and believe that those methods are designed to analyse questions and reach the correct conclusions by means of reason, free from cognitive or emotional biases. Of course, both law and science often fall short of this ideal at all levels, from the decisions about individual legal cases or scientific studies to the acceptance of general theories. In many ways, the biases that mislead legal and scientific thinkers are similar (Ellsworth 2011, p. 895).” These limitations to the rationality of both law and science make a

<sup>15</sup> Meyer (2013, p. 20) (refers to the translation of “basic scientific research [...] before it can be used in law and policy-making.”).

<sup>16</sup> This relates to how and whether the forum can be used with respect to these additional scientific inputs. On this issue in the common law context, see Schiff (1963, p. 373) (“As the forum provided by the State to settle disputes, a court of law is not designed to be a scientific laboratory for the search of objective facts.”).

<sup>17</sup> In general, see ILC, Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law, UN Doc. A/CN.4/L.702, 18 July 2006 (Report of the Study Group) (ILC Report), 16 (“Rules of international law subsequent to the treaty to be interpreted may be taken into account especially where the concepts used in the treaty are open or evolving. This is the case, in particular, where: (a) the concept is one which implies taking into account subsequent technical, economic or legal developments[.]”).

<sup>18</sup> *Burlington Resources Inc v Republic of Ecuador*, ICSID Case No. ARB/08/5, Decision on Ecuador’s Counterclaims, 7 December 2017.

<sup>19</sup> See for example, *Southern Bluefin Tuna Case* (New Zealand v Japan; Australia v Japan), Provisional Measures, Case Nos. 3 and 4, Order of 27 August 1999, 38 ILM 1624, 1635–36; *MOX Plant Case* (Ireland v. United Kingdom), Provisional Measures, ITLOS Case No. 10, Order of 3 Dec.2001, 41 ILM 405, 416 (2002).

<sup>20</sup> Sulyok (2017, p. 527) (“Tort law, for instance, uses the preponderance of the evidence standard, i.e., the balance of probability. By contrast, there is no generally agreed standard for proof of causality in science. These different approaches toward proof of causation might be attributable to the fact that the basis of scientific inquiry is the rejection of the null hypothesis that posits that the factors examined are random variables.”).

reflection on judicial reasoning of scientific inputs complicated and dynamic, but necessary.

The very existence of uncertainty creates another tension. While there are well-developed areas of law that build on the existence of scientific uncertainty, namely the precautionary principle, when scientific knowledge enters a dispute, the extent of scientific certainty is rarely acknowledged: “It is common knowledge among scientists that scientific uncertainty is inherent to some degree in all scientific results and can never be fully eliminated. Lawyers, however, often do not have a proper understanding of the true nature of scientific uncertainty (Sulyok 2017, p. 529).”

These systems of knowledge are thus structured on different ways of knowing. The forced convergence of the two creates tensions, incongruence, and possibly inconsistent decisions.

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### 3 The Need for Scientific Knowledge in Legal Sustainable Development Narratives

Science and scientific knowledge infiltrate law in both expected and unexpected ways. Environmental law, derived from science, reliant on science, and transforming alongside science, is the most apparent example. However, the role of science has also grown in the context of other regulatory developments and within legal disputes at both the domestic and international level, as the sustainable development narrative has grown in importance. From this perspective, respecting the overlaps and intersections between economics and the environment within the realisation of sustainable development, there is an interrelationship between science and law within the sustainability narrative. This points to a larger change in the aspect of judicial reasoning. Not only are judges and arbitrators confronted with expert reports that rely heavily on scientific language and logic, but those decision makers must interact with those reports and apply them reasonably to the law.

The *Gabčíkovo-Nagymaros* dispute can be identified as the most prominent use of scientific fact-finding when deciding a dispute with sustainable development relevance.<sup>21</sup> Respecting their necessary inclusion, but also bowing to their complexity and vulnerability to external factors, the International Court of Justice (ICJ) in the *Gabčíkovo-Nagymaros* decision used the scientific inputs as a mechanism for encouraging further negotiations by the parties.<sup>22</sup> Those scientific submissions with respect to the larger structural goal of sustainable development impacted the very process of dispute resolution. The ICJ considered the ongoing environmental impact assessments as a sufficient mechanism for facilitating and encouraging a settlement to the dispute between the parties. Not only was scientific fact-finding relied upon, but it was reverted to as a mechanism by which the parties were to continue negotiation—ultimately with the intention that the dispute would be settled between them based on those scientific findings. Science, therefore, served an instrumental purpose in transforming the way the dispute was framed and how the resolution could be found. In a certain sense, the ICJ’s reliance on those findings was a subtle acknowledgement of the limitations of traditional legal decisions in disputes framed around the sustainable development narrative.

In the context of trade law, the disputes that arose in relation to bans on imports of tuna and shrimp caught using fishing techniques that were harmful to other sea life again exposed this reliance on scientific knowledge to come to the

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<sup>21</sup> *Gabčíkovo-Nagymaros Project (Hungary v Slovakia)*, Judgment, Merits, ICJ GL No 92, [1997] ICJ Rep 7, [1997] ICJ Rep 88, (1998) 37 ILM 162, ICGJ 66 (ICJ 1997), 25 September 1997.

<sup>22</sup> *Ibid.*, paras 140–141 (“The numerous scientific reports which have been presented to the Court by the Parties—even if their conclusions are often contradictory - provide abundant evidence that this impact and these implications are considerable. [. . .] For the purposes of the present case, this means that the Parties together should look afresh at the effects on the environment of the operation of the *Gabčíkovo* power plant. [. . .] It is not for the Court to determine what shall be the final result of these negotiations to be conducted by the Parties. It is for the Parties themselves to find an agreed solution [. . .]”).



legally relevant conclusion in the case.<sup>23</sup> In the Appellate Body Report from the *US-Tuna* dispute, it was made clear that the US contended that the Panel had not given sufficient attention to the scientific reports submitted during the dispute.<sup>24</sup> The ultimate conclusion of the dispute, with the implementation of administrative mechanisms to ensure dolphin-safe practices, embodied the scientific conclusions that the measure was unnecessarily targeting only the Eastern Tropical Pacific Ocean whereas there were also established risks to dolphins outside that zone.<sup>25</sup>

As a final example, the tribunals in the *Burlington v Ecuador* and *Perenco v Ecuador* disputes used scientific inputs to justify investor liability under a bilateral investment treaty—a stretch for a system that typically exists only for the purpose of protecting and maintaining a stable foreign investment environment. The use of scientific evidence was key to allowing the counterclaims in both *Burlington v Ecuador*<sup>26</sup>

and *Perenco v Ecuador*.<sup>27</sup> While the decisions represent a marked break in the approach to protections in investment law by opening up the possibility of these environmental counterclaims, these closely related claims took differing approaches to the scientific evidence submitted by the parties. The *Burlington* tribunal chose to “see for themselves” the conclusions of the reports and required the experts to translate their conclusions into terms understandable to them and appropriate for their decision-making. The expert scientific submissions on soil and water contamination were examined in a site visit of that contamination with the lawyers, parties, and experts. In *Perenco*, an independent expert was appointed. In this regard, there is a substantial lack of uniformity in managing these scientific inputs. There is limited legal theory on the consequences and implications of this varied interaction with scientific and expert reports.

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#### 4 Scientific Turn and Sustainable Development

The cases discussed above corroborate the scientific turn that has already been recognised. This more recent use of science, however, does not manifest significantly differently than it did in the *Trail Smelter* decision. The parties still submit their own expert reports. The conclusions and figures included in those reports often contradict one another. In this turn towards scientific knowledge as part of sustainable development,<sup>28</sup> the

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<sup>23</sup> See for example, Panel Report United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WT/DS381/R, 15 September 2011 (US-Tuna II); Arcuri (2017, p. 185) (reflecting on the way the building of scientific evidence of harm to dolphins could be used to assess the timeframe of the non-discrimination claim: “if with the passage of time, scientific evidence emerge and unequivocally point at the fact that other fishing techniques outside the ETP are equally harmful for dolphins, it seems ‘WTO-reasonable’ to consider the discriminatory character of the measures at the time of the establishment of the Panel.”).

<sup>24</sup> Appellate Body Report United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products, WT/DS381/AB/R, 16 May 2012 (US-Tuna II), paras 27–28, 68.

<sup>25</sup> Appellate Body Report, United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products – Recourse to Article 21.5 of the DSU by the United States, WT/DS381/RW/USA and Add.1 / United States – Measures Concerning the Importation, Marketing and Sale of Tuna and Tuna Products – Second Recourse to Article 21.5 of the DSU by Mexico (US–Tuna II (Mexico) (Article 21.5 –US) / US–Tuna II (Mexico) (Article 21.5 – Mexico II)), WT/DS381/AB/RW/USA, WT/DS381/AB/RW2, adopted 11 January 2019; see also Baroncini and Brunel (2020, p. 197).

<sup>26</sup> *Burlington Resources Inc v Republic of Ecuador*, ICSID Case No. ARB/08/5, Decision on Ecuador’s Counterclaims, 7 December 2017, para 77.

<sup>27</sup> *Perenco Ecuador Ltd v Republic of Ecuador*, ICSID Case No. ARB/08/6, Award, 27 September 2019, paras 423 et seq., 489.

<sup>28</sup> For the widespread recognition of the turn to science, see for example, D’Aspremont and Mbengue (2014, p. 240) (noting in particular that “scientific fact-finding is as much a struggle for argumentative persuasiveness as traditional fact-finding and law interpretation”); Gruszczynski (2014) (“Science is used in order to establish necessity, i.e. to show the existence of certain risks and to prove the required relation between a measure and an identified risk”); Ellsworth (2011, p. 895) (“Training to think like a lawyer is not quite like training to think like a scientist, and, more important, the circumstances and constraints faced by lawyers and scientists when they

centrality of that knowledge and its impact on the decision makers is often overlooked. The judges and arbitrators are (typically) not specialised in science, and therefore have limited perspectives on the highly technical, highly relevant scientific submissions. The use of the precautionary principle where the amount of scientific information is not yet fully formed demonstrates a more dynamic relationship with these additional inputs. Katalin Sulyok has already highlighted the limitations to the approach to scientific uncertainty within the European Court of Human Rights.<sup>29</sup> Foster has suggested that the application of facts to the law can be characterised as the rationalist approach (Foster 2011). D’Aspremont and Mbengue (2014, p. 247) ask whether “scientific fact-finding [should] be left exclusively to the judge, should it be made the responsibility of the parties, or should it be outsourced to external experts? Depending on which of these methods of cognition is applied, scientific fact-finding will either resemble traditional law-establishment, come close to traditional fact-finding or grow into a wholly distinct adjudicative operation.” Some decades ago, and viewing the issue more specifically through the lens of US law—where the integration of science into criminal law and tort decisions has been well-established—Brewer noted that the judgment of the veracity of a scientific submission is typically deferred to expert scientific witnesses (Brewer 1998, p. 1538). He described the tools applied to give credence to a particular position on a scientific point as being based on a reasoning process but surely not connected to the scientific process itself.<sup>30</sup>

undertake the task of solving a problem are quite different.”); Haack (2009, pp. 14–21).

<sup>29</sup> Sulyok (2017, p. 523) (“By avoiding complex causal inquiries [in toxic exposure case law] and evidentiary assessments, the Strasbourg Court sacrifices predictable and nuanced judicial decision-making and leaves future plaintiffs without guidance as to the court’s evidentiary requirements. These shortcomings, if left unaddressed, could undermine the Court’s reputation of being a leading advocate of environmental protection based on human rights.”); see further, Sulyok (2020).

<sup>30</sup> Brewer (1998, pp. 1538–1539) (“Lacking the information necessary to make cogent independent judgments about which of the competing scientific experts to believe,

Yet, sustainable development, when applied in a legal context, virtually requires these scientific submissions—these perspectives outside of the law—in order to achieve the objectives of the law or regulatory measure. Scientific knowledge in that context is the material connection between the intention of the law and its application. That materiality is condensed to numbers on a page, graphs, and conclusions. The very reasoning applied and the required outcomes are distinct,<sup>31</sup> creating a difficulty in applying both legal reasoning and scientific reasoning in the same breath of a decision.

With this deference to the expertise of scientists as well as the inherent role of science in creating law,<sup>32</sup> science and the scientists that create it are gaining a new form in the sphere of international law. Beyond judges, scientists are arguably now becoming part of the law-making sphere in international law in the era of sustainable development, and are among the non-state

nonexpert legal decisionmakers choose among the experts by relying on such indicia of expertise as credentials, reputation, and demeanor. Thus, even the act of soliciting and deferring to expert scientific judgment requires nonexperts to use a reasoning process—the process of selecting the experts, deciding which expert to believe when the experts compete, and, finally, deciding how to use the believed expert’s information in resolving the central dispute being litigated.”).

<sup>31</sup> Ellsworth (2011, p. 913) (“The need to reach final decisions in individual cases also encourages categorical thinking: a defendant is either liable or not liable, sane or insane, a danger to society or not. Scientists, especially social scientists, are more likely to think in terms of continuous variables; there is always a grey area between the sane and the insane, the dangerous and the safe, and the deliberate or unintentional behavior. In dealing with people in these grey areas, the task is to assess the individual and the circumstantial pressures and to come up with an individually nuanced explanation, and if one is a psychiatrist or a clinical psychologist or some other kind of counselor, an individualized plan of treatment. But a judge has to make a decision.”).

<sup>32</sup> Avgerinopoulou (2019, p. 345) (providing that “[i]n the [ ] wake of the twenty-first century, it has become clear that environmental issues require multilateral answers and that science and policy should play a more central role to the policy-making and lawmaking model. Many scholars have argued that science and policy need to be explicitly and effectively interrelated; such interaction is inevitable.”)



actors that now colour the system.<sup>33</sup> Chapter 31 of Agenda 21 directly addressed the role of “the scientific and technological community, [...] to make a more open and effective contribution to the decision-making processes concerning environment and development. It is important that the role of science and technology in human affairs be more widely known and better understood, both by decision makers who help determine public policy and by the general public.”<sup>34</sup> Their input not only in the creation but in the stage of decision-making through these expert inputs suggests a rich integration.

The interactions of judges with science leads to diverse conclusions regarding how science is either being shunned (Alvarez 2011), or more interestingly, impacting the process of judicial reasoning. This impact of science on judicial reasoning has larger implications within the broader framing of law for a blue planet, suggesting a need for growth and awareness of how that knowledge changes the law generally and the specific impacts of the awareness of the Anthropocene and sustainable development as a legal concept.

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## 5 Conclusion and the Future of Scientific Integration into Law

As science and the law converge, there remains an interaction in the space of legal epistemologies: what materially exists to allow the possibilities of law’s future (Brewer 1998,

p. 1541)?<sup>35</sup> This interaction is essential in the space and narrative of sustainable development. The question that arises is: How are scientific inputs being applied in the development narrative to achieve the possibilities that lie therein? Have those possibilities been limited by the lack of knowledge of the scientific method by those judges and arbitrators entrusted with applying them and using them for the given ends? Is there a danger of material misuse or misunderstanding resulting in a “just” outcome for the purposes of engaging in the production of a globally-applicable ecologically-sensitive law outside the boundaries of what is in fact provided in such a scientific expert report?

Science as a mechanism for applying sustainable development and respecting the delicate balance between the varying goals of the principle is a necessary addition to legal reasoning and the process of decision-making. The effectiveness of such inputs, however, in a future perspective, requires a different relationship with those inputs. It must be decided at a more systemic level whether and how those inputs should be modifying the process of legal reasoning itself. The outcome in the *Gabčíkovo-Nagyymaros* dispute of using the ongoing accumulation of scientific information to unburden a decision-making process could have dangerous consequences. The more recent interaction with scientific knowledge, as in the *Burlington* dispute, points to a refreshing re-imagination of how science and law can both be enhanced with the integration.

The inclusion of scientific expertise forces law to push beyond its traditional boundaries—in the way that the inclusion of any expertise pushes a court’s analysis beyond a purely legal consideration of facts. Taking science as simply another

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<sup>33</sup> Carosso et al. (2019) and Mbengue (2011) (building on the idea of environmental law as formed around an environmental compact that individuals respect and specifically noting that in Section III of Agenda 21, “[n]ot a single major non-state actor is omitted. From women to children, from NGOs to the business sector and from indigenous communities to scientific communities, each component of the ‘sustainable development community’ is recognized as a key actor.”).

<sup>34</sup> United Nations Conference on Environment & Development, Rio de Janeiro, Brazil, 3 to 14 June 1992, Agenda 21, Section III.

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<sup>35</sup> Brewer notably highlights the *Brown v Board of Education* decision to “illustrate the crucial importance of a court’s use of putatively scientific results in reaching and attempting to justify legal decisions.” (1542). Emphasising the role of science in decisions of high societal importance, his analysis sets the groundwork for considering how international tribunals similarly use such scientific results to take decisions that impact international development, understood in the holistic environmental, social, and economic contexts.

fact entered into the record is limiting and dishonest to the scientific disciplines as well as the scientific method. This integration calls for a bolder inter-disciplinary interaction that has the potential to improve the realisation of law within the sustainable development narrative. In this movement towards a global legal system respecting the ideal of a blue planet, this integration, understanding and respect is not only necessary but also brings us closer to a post-fragmentary realisation of law that encompasses the realities of the planet.

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