GLOBAL EXPERIMENTALIST GOVERNANCE, INTERNATIONAL LAW AND CLIMATE CHANGE TECHNOLOGIES

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Abstract:
Global experimentalist governance has emerged within and across a number of international regulatory regimes, but its potential contribution to the global governance of climate change remains largely unexplored. This article investigates the opportunities and barriers to developing global experimentalist governance approaches in the international regulation of climate change technologies, focusing on the recent framework for marine geoengineering under the London Dumping Protocol. It argues that, in the face of the limits of international law in dealing with uncertainty, multilevel distribution of power and regulatory disconnection, global experimentalist governance is attractive to catalyze adaptability, iterative learning, participation and cooperation. Such approach can help re-think the way international law deals with technological development, by emphasizing its problem-solving function.

Keywords: experimentalist governance, climate change, geoengineering, ocean iron fertilization, cooperation, participation.

I. INTRODUCTION

As 'one of the more profound and, to date, intractable sets of problems confronting humanity',[1] scholars have attempted to disentangle the global governance of climate change most prominently through the paradigms of regime complex, orchestration and transnational networks.[2] In this important academic debate, though, the potential contribution of global experimentalist governance has been left largely unexplored. This is surprising as experimentalist approaches have received considerable attention as a new mode of governance for emerging challenges. These governance practices rely on participatory and collaborative processes, where problems and solutions are widely debated, framed in an open-ended way, and subjected to periodical revision on the basis of local experience.[3]

Experimentalist practices have emerged at national and regional (especially EU) level, but they are by no means exclusive of regulatory settings within States, nor of the relatively unique transnational regulatory environment of the EU. At a supranational level, the recourse to global experimentalist governance practices sheds some light on the function, and limits, of international law in dealing with diversity, complexity, multiple legal orders and actors, the relative weakness of systems of coercion, knowledge deficit and

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[1] H Stevenson and JS Dryzek, 'The Discursive Democratisation of Global Climate Governance', (2012) 21 (2) *Environmental Politics* 189, 189.

[2] See eg RO Keohane and DG Victor, 'The Regime Complex for Climate Change' (January 2010) The Harvard Project on International Climate Agreements, Discussion Paper 10-33; KW Abbott, 'The Transnational Regime Complex for Climate Change' (2012) 30(4) Environment and Planning C: Government and Policy 571; T Hale and C Roges, 'Orchestration and Transnational Climate Governance', (2014) 9 (1) The Review of International Organizations 59.

[3] G de Búrca, RO Keohane and CF Sabel, 'Global Experimentalist Governance', (2014) 44 British Journal of Political Science 477.

uncertainty.[4] In an international order where international law fails to respond to strategic uncertainty and polyarchic distribution of power, experimentalist governance encourages recursive learning, cooperation between different levels of governance and deliberative participation of non-state actors and civil society (section II).

It is precisely by reflecting on the challenges of uncertainty and multilevel distribution of power in climate change governance that global experimentalist governance constitutes a potentially attractive model for rethinking the function of international law, by emphasizing its transformative nature and enhancing its problem-solving function (section III).[5] These issues become even more acute in the context of technological responses to climate change, ranging from the relatively mundane to the extremely challenging, from loft insulation through wind turbines on a variety of scales, carbon capture and storage, and, most recently, ambitious geoengineering. They are at different stages of development, with in some cases significant risks, uncertainties, and unknowns.[6] They have the potential to respond to climate change, but pose unprecedented governance challenges, as this is an area where socio-ethical concerns are pervasive, decision-making is multilevel, and the role of law sometimes becomes problematic.

Against this background, the article explores the opportunities and barriers to developing global experimentalist approaches in the international regulation of climate change technologies, focusing on the emerging regulation of marine geoengineering. The term 'geoengineering' refers to a variety of techniques aimed at the 'deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change'.[7] Owing to the lack of substantive progress in global emission reduction, these techniques are proposed by some as a means to go beyond mitigation by artificially modifying the climate system. Although their scientific and technical development is still in its infancy, they already present difficult social, legal and political hurdles.[8] Not only are there large differences amongst geoengineering technologies in terms of risks, uncertainties, feasibility and public acceptability; but the concept of manipulating the climate remains controversial in itself (section IV).

Considering their global scale and -intended and unintended- impact, it is not surprising that the debate on governance and regulation started at an international level.[9] Here, the dominant approach is to focus on evaluating the potential applicability of existing international treaties and customary international law norms and principles to geoengineering techniques.[10] Although this is a necessary starting point, existing international law instruments and institutions appear ill-equipped to effectively regulate all geoengineering methods, or all aspects of the most controversial methods, as they generally

[4] MP Cottrell and DM. Trubek, 'Law as Problem Solving: Standards, Networks, Experimentation, and Deliberation in Global Space' (2012) 21 Transnational Law and Contemporary Problems 359.

[5] Cottrell and Trubek (n 4) 363 (defining 'collective problem solving' as 'a dynamic process that involves the common identification of a problem, formation of a consensus that it ought to be solved, and the mobilization of appropriate expertise and resources to do so')

[6] B Wynne, 'Uncertainty and Environmental Learning: Reconceiving Science and Policy in the Preventive Paradigm' (1992) 2 Global Environmental Change 111.

[7] Royal Society, *Geoengineering the Climate – Science, Governance and Uncertainty* [2009], xi.

[8] ibid 57. See in general, WCG Burns and AL Strauss (eds), *Climate Change Geoengineering – Philosophical Perspectives, Legal Issues, and Governance Frameworks* (CUP 2013).

[9] The origins of the legal literature in this field can be traced back to the late 1990s. See D Bodansky, 'May We Engineer the Climate?' (1996) 33 Climatic Change 309.

[10] eg A Lin, 'Geoengineering Governance' (2009) 8 (3) Issues in Legal Scholarship (Supp. 'Balancing the Risks: Managing Technology and Dangerous Climate Change') 9; C Redgwell, 'Geoengineering the Climate: Technological Solutions to Mitigation – Failure or Continuing Carbon Addiction?' (2011) 2 Carbon and Climate Law Review 178; J Reynolds, 'Climate Engineering Field Research: The Favorable Setting of International Environmental Law' (2014) 5 Washington and Lee Journal of Energy, Climate, and the Environment 417.

lack the flexibility needed to cope with strategic uncertainty, multilevel distribution of power, and the pace of technological development. Addressing these limits, this article views experimentalist governance practices as a tool to help redirect international law towards effective and adaptive governance and, ultimately, strengthen its problem-solving function, should these technologies be implemented (section V).

Based on this argument, the article investigates the extent to which the recent marine geoengineering amendment to the Protocol to the London Convention on Dumping of Wastes and Other Matter at Sea could represent an example of experimentalist governance (section VI).[11] In common with experimentalist governance, this new regime is structured through provisional framework goals and metrics; decentralized implementation; regular reporting and peer-review obligations; and periodical re-evaluation and review of goals and decision-making practices. However, the limited scope (and mechanisms) for cooperation, aggravated by the absence of penalty defaults, and restricted opportunities for public participation constitute the main barriers to this regime's ability to encompass an ideal type of global experimentalist governance. Addressing the governance challenges of climate change technologies through an experimentalist model is nevertheless interesting, as it might provide an attractive normative approach to tackle uncertainty, reflect multipolar distribution of power between State and non-state actors, and re-conceptualize the way international law deals with technological development.

II. GLOBAL EXPERIMENTALIST GOVERNANCE: RATIONALE, ELEMENTS AND CONDITIONS

Since the 1990s, multiple approaches have shaped the language of 'global governance'.[12] The notion of govern*ance*, as opposed to the one of govern*ment*, prominently responds to the limits of States' individual action, and to the growing influence of a wider range of non-state actors in key areas of international relations and law.[13] From this perspective, the unitary idea of a sovereign, hierarchical, regulatory State needs rethinking, as States are now called to deal with issues that do not have obvious solutions and involve multilevel and transnational interactions and cooperation.[14] 'Global governance' then suggests a system of norms, processes and structures established, and implemented, by a constellation of State and non-state actors (e.g. private actors, business, NGOs, international organizations) formally and informally operating within the international order.[15] This notion points not only to the multilevel architecture of the system, but also to its pluralistic inspiration, calling for greater accountability, transparency and legitimacy. Inevitably, trends and modes of global governance have mutated over time to reflect increasing fragmentation, regime complexity, network orchestration and transnational dynamics.[16]

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[11] Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London), 11 ILM (1972) 1294 ('LC'); Protocol to the London Dumping Convention (London) 36 ILM (1996) ('LP').

[12] D Kennedy, 'The Mystery of Global Governance' (2008) 34 Ohio National University Law Review 827

[13] J Rosenau and EO Czempiel (eds), *Governance Without Government: Order and Change in World Politics*, (Cambridge Studies in International Relations 1992).

[14] K Jayasuriya, 'Globalization, Law and the Transformation of Sovereignty: The Emergency of Global Regulatory Governance' (1999) 6(2) Indiana Journal of Global Legal Studies 425; BC Karkkainen, 'Post-Sovereign Environmental Governance' (2004) 4(1) Global Environmental Politics 72. See also A Mc Grew and D Held (eds), *Governing Global Transformations: Power, Authority and Global Governance*, (Polity Press 2002).

[15] M Zurn, 'Global Governance as Multi-level Governance,' in D Levi-Faur (ed), *The Oxford Handbook of Governance* (OUP 2012) 730.

[16] eg ML Djelic and K Sahlin Andersson (eds.), *Transnational Governance: Institutional Dynamics of Regulation* (CUP 2008); F Biermann et al, 'The Fragmentation of Global Governance Architecture: A Framework for Analysis' (2009) 9(4) Global Environmental Politics 14; K Abbott et al, 'Orchestration: Global Governance through Intermediaries' (Conference on International Organizations as Orchestrators, Munich, September 2012)

Responding to these transformations, experimentalist governance has emerged as a 'template for governance reform in new areas'.[17] This entails 'an institutionalized process of participatory and multilevel collective problem-solving, in which the problems (and the means to address them) are framed in an open-ended way and subjected to periodic revision by various forms of peer review, in the light of locally generated knowledge'.[18] While this process retains a normative dimension, it does not operate within formal command-and-control mechanisms, as it favors 'regulatory approaches which are less rigid, less prescriptive, less committed to uniform outcomes, and less hierarchical in nature'.[19] In exploring its contours, de Búrca, Keohane and Sabel refer to 'a set of practices involving open participation by a variety of entities (public or private), lack of formal hierarchy within governance arrangements, and extensive deliberation throughout the process of decision making and implementation'.[20] Experimentalist governance practices can be recognized in various settings (e.g. private or public initiatives), operate at different levels of decision-making (e.g. local, national, regional or international) and emerge within and between regulatory regimes.

As a new mode of governance, experimentalist governance prominently responds to two specific challenges: 'strategic uncertainty' and 'polyarchic distribution of power'.[21] 'Strategic uncertainty' is said to arise where 'the parties face urgent problems, but know that their preferred problem-solving strategies fail and therefore are willing to engage in a joint, deliberative (potentially preference-changing) investigation of possible solutions'.[22] Strictly linked to this paradigm, 'polyarchic distribution of power' is the result of situations where horizontal, non-hierarchical, decision-making dynamics between State and non-state actors lead to a conundrum where no actor has the capacity to impose its own preferred solution, without taking into account other views.[23]

Of course, there is no single correct model of experimentalist governance, but rather an 'ideal type' against which evaluating governance practices as 'a basic default account of the world'.[24] This ideal type represents a multilevel architecture, based on four 'deliberation-fostering elements'.[25] First, the elaboration of framework goals and metrics for evaluating their achievement represents the foundation of the system. The open-ended nature of these goals means that they can have a provisional character, as they adjust to changing circumstances and are shaped by diverse experiences and local contexts, including new technological and scientific knowledge. Second, the implementation of these open-ended goals is left to 'lower-level' units– such as national authorities, local communities, or scientists - in coordination with the 'centre' and in consultation with civil society. This is where 'lower level' actors are recognized large discretion in adapting and experimenting

<http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2125452>; T Gehring and B Faude, 'The Dynamics of Regime Complexes: Microfoundations and Systemic Effects', (2013) 19 Global Governance 119.

[17] CF Sabel and J Zeitlin (eds), *Experimentalist Governance in the European Union: Towards a New Architecture* (OUP 2010) 9.

[18] de Búrca Keohane and Sabel (n 3) 477.

[19] G de Búrca and J Scott (eds), *Law and New Governance in the EU and the US* (OUP 2006) 2.

[20] G de Búrca, RO Keohane and CF Sabel, 'New Modes of Pluralist Global Governance' (2013) 45(3) New York University Journal of International Law and Politics 723, 738.

[21] Sabel and Zeitlin (n 17) 9. Experimentalism is a main characteristic of wider 'new governance' approaches, at times resulting in an overlap in terminology between 'new governance' and 'experimentalist governance'. See de Búrca and Scott (n 19); J Scott and DM Trubek, 'Mind the Gap: Law and New Governance Approaches' (2002) 8(1) European Law Journal 1.

[22] CF Sabel and J Zeitlin, 'Experimentalist Governance', in D. Levi-Faur (n 15) 179.

[23] CF Sabel and J Zeitlin, 'Learning from Difference: The New Architecture of Experimentalist Governance in the EU', (2008) 14 (3) European Law Journal 271.

[24] N Walker, 'EU Constitutionalism and New Governance' in de Búrca and Scott (n 19) 23.

[25] de Búrca, Keohane and Sabel (n 3) 478.

problem-solving practices, based on contingent knowledge and decentralized authority. Third, regular reporting obligations are imposed on local units to feedback on their performance, through monitoring, peer-review and benchmarking. As a result of peer-review of implementation experiences, the benchmarking of best practices is particularly important as it provides the basis for mutual learning and accountability.[26] Finally, as a result of this feedback loop, framework goals and decision-making practices are periodically re-evaluated, and, if necessary, revised.[27]

There is no universal model for experimentalist governance, but for a global experimentalist governance framework to be effective, it is generally thought that four preconditions must also be fulfilled. First, governments must be unable to agree on a comprehensive set of rules and efficiently monitor their compliance. This is a recurrent factor when central actors cannot easily foresee the local effects of rules, and when effective rules are subject to unforeseeable change. This condition is a challenge in climate change governance, where uncertainty and risks, including with respect to distributive impact, combines with a decentralized decision-making.[28] This is even more striking with respect to the governance of emerging technologies, where the predictability of regulation and its effects are frequently challenged by the need for constant update and revision, in the light of the fast pace of technological development.[29] This can lead to the problem of 'regulatory disconnection' between law and emerging technologies, which occurs where there is a 'mismatch between the regulation-in-the-books and the latest technology in action', as the technology emerges, circulates and evolves before regulators are able to reach an agreed position, finalize the terms of the regulation or adapt existing regulations.[30] Technology then repeatedly leaves the law behind, and often operates in contingent regulatory voids.

Second, although they are unable to agree on specific rules, governments must not disagree on basic principles, to allow discussion and deliberation on the goals and benchmarks.[31] Rather than a call for universal agreement, this condition requires a thin consensus. With respect to global climate governance, the fulfillment of this condition is less obvious. As polarized positions among actors persist, they are possibly combined with a thin, high level convergence towards the scale of the problem and the urgency of a new international climate agreement.[32] The Intergovernmental Panel on Climate Change (IPCC) has played a primary, and yet much criticized, function in thickening such consensus based on claims of objective, expert knowledge.[33]

Third, cooperation among decision-makers is pivotal, as experimentalist governance will not effectively thrive where (formal and informal) veto powers or obstructionism are exercised to block consensus and push forward hidden agendas and strategic interests. To

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[26] DM Trubek and LG Trubek, 'New Governance & Legal Regulation: Complementarity, Rivalry, and Transformation' (2007) 13(3) Columbia Journal of European Law 539, 551.

[27] de Búrca, Keohane and Sabel (n 20) argue that, when all these five elements operate together, they constitute 'a form of governance that fosters a normatively desirable form of deliberative and participatory problem-solving' ('ideal type')', but hybrid types also represent interesting governance practices.

[28] S Shackley and B Wynne, 'Representing Uncertainty in Global Climate Change Science and Policy: Boundary-Ordering Devices and Authority' (1996) 21(3) Science, Technology, & Human Values 275; V Heyvaert, 'Governing Climate Change - Towards a New Paradigm for Risk Regulation' (2011) 76(6) The Modern Law Review 817.

[29] GE Marchant, BR Allenby and JR Herkert (eds), *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight* (Springer 2011).

[30] R Brownsword, *Rights, Regulation and the Technological Revolution* (OUP 2008) 165.

[31] de Búrca, Keohane and Sabel (n 3) 484.

[32] see Stevenson and Dryzek (n 1) (analysing a constellation of discording climate discourses). On the possible convergence, L Rajamani, 'The Warsaw Climate Negotiations: Emerging Understandings and Battle Lines on the Road to the 2015 Climate Agreement' (2014) 63(3) International and Comparative Law Quarterly 721.

[33] For a review of the debate, M Hulme and M Mahoney, 'Climate Change: What Do We Know About the IPCC?' (2010) 34(5) Progress in Physical Geography 705. See also S Jasanoff, 'A New Climate for Society', Theory, Culture & Society (2010) 27(2–3) 233.

drive such cooperation, this model relies upon destabilization mechanisms, such as 'penalty defaults', established by the central authority as a disincentive for refusal to joining the proposed governance system. These are mechanisms for 'unblocking impasses in framework rules-making and revision by rendering the current situation untenable, while suggesting – or causing parties to suggest- plausible and superior alternatives'.[34] They are structured by imposing unfavorable default rules to push parties to cooperate by contributing to the information-sharing regime in order to avoid such rules.[35] At an international level, there are examples of these mechanisms being established, especially in international trade, to induce environmentally-oriented collaboration.[36] In global climate governance, where multi-actor cooperation is highly problematic, mostly due to political and economic interests, the threat of penalty defaults is potentially very powerful. The EU has, controversially, started to act in this direction by using (the threat of) unilateral action to catalyze adequate international or third countries climate regulation, through the contingent imposition of the rules governing the EU Emission Trading Scheme to emissions of greenhouse gases generated abroad.[37]

Finally, non-state actors (e.g. industry, the scientific community, consumers and NGOs) play an increasingly influential role in global governance.[38] As a result, to fill the information gaps in areas of uncertainty and provide a form of legitimacy through the involvement of different interests, a key role is attributed to participation of civil society. Compared to other global environmental issues, climate change has certainly engaged a wider range of actors, including NGOs and epistemic community.[39] But cooperation with, and participation of, civil society and NGOs at an international level is not straightforward, due to – inter alia- their legal status under international law, the debate on the democratic legitimacy of their participation, and the challenge of identifying the relevant public(s).[40]

Although experimentalist governance is far from a panacea, it has clear advantages. First, the focus on iterative processes based upon open-ended goals, benchmarking of best practices, reporting and periodical review allows decision-making to be based on much richer knowledge and information about alternatives than is traditionally available. This emphasizes cooperation between different actors and learning as a way to support accountability and transparency. As a result, some see experimentalist governance as a way to routinize dynamic accountability and transparency.[41]Second, experimentalist governance pursues deliberative participation in decision-making, where 'actors' initial preferences are

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[34] Sabel and Zeitlin (n 22) 176.

[35] The idea of 'penalty defaults' originates from contract law to mean penalties 'designed to give at least one party to the contract an incentive to contract around the default rule and therefore to choose affirmatively the contract provision they prefer. [They] are purposefully set at what the parties would not want in order to encourage the parties to reveal information to each other or to third parties (especially the courts)'. I Ayers and R Gertner, 'Filling Gaps in Incomplete Contracts: An Economic Theory of Default Rules' (1989) 99(1) The Yale Law Journal 86. For a discussion of penalty defaults in experimentalist governance, BC Karkkainen, 'Information-Forcing Regulation and Environmental Governance' in de Búrca and Scott (n 19) 293.

[36] RW Parker, 'The Use and Abuse of Trade Leverage to Protect the Global Commons: What We Can Learn from the Tuna-Dolphin Conflict' (1999) 12(1) Georgetown International Environmental Law Review 1.

[37] J Scott and L Rajamani, 'EU Climate Change Unilateralism' (2012) 23 (2) European Journal of International Law 469.

[38] S Charnovitz, 'Two Centuries of Participation: NGOs and International Governance' (1997) 18 Michigan Journal of International Law 183; A Boyle and C Chinkin, *The Making of International Law* (OUP 2007).

[39] D Tolbert, 'Global Climate Change and International Non-Governmental Organizations' in R Churchill and D Freestone (eds) *International Law and Global Climate Change: International Legal Issues and Implications*, (Graham & Trotman 1991) 95; C Gough and S Shackley, 'The Respectable Politics of Climate Change: The Epistemic Communities and NGOs' (2001) 77 (2) International Affairs 329.

[40] S Charnovitz, 'Nongovernamental Organizations and International Law' (2006) 100 American Journal of International Law 348.

[41] Sabel and Zeitlin (n 17) 12 define 'dynamic accountability' as the 'accountability that anticipates the transformation of rules in use'.

transformed through discussion by the force of the better argument'.[42] In this context, de Búrca, Keohane, Sabel argue that 'we should often establish processes that help us generate unimagined alternatives and improve our ability to choose among these alternatives by rigorously exposing each to criticism in light of the others'.[43] As explained later in the context of emerging climate change technologies, achieving deliberative participation is problematic as opportunities for upstream, substantive, participation are often limited, especially in international fora.[44] This also brings up the issue of deference toward scientific expertise at the expenses of non-scientific inputs from the lay public in the decision-making process, affecting the legitimacy of its outcome.[45] Finally, global experimentalist governance may have the merit of catalyzing innovation in international law practices and processes. Its constructive engagement with strategic uncertainty and polyarchic distribution of power allows the decision-making process to remain flexible and adaptable to changing circumstances and new practices towards effective and innovative regulation and institutions. As noted by Cottrell and Trubek, this approach suggests a transformative view of international law, which goes beyond a merely legalist vision of international law, as a rigid system of precise and enforceable rules, to unleash its expanded problem-solving potential.[46]

De Búrca, Keohane and Sabel note that '[t]he concept of experimentalist governance is more demanding than the broader category of pluralistic governance processes […]'.[47] The main difference lies in its ability to regularize pluralist practices that mostly emerge spontaneously and are undertaken on an ad hoc basis. While pluralist modes of governance run mostly in parallel with hierarchical international regimes, experimentalist governance constructively engages with them, using some of their features and procedures in a recursive and participatory fashion.[48] In so doing, experimentalist practices can get the best from both experiences: on the one hand, they do not reject legally binding norms, but use them as penalty defaults, which are characteristic of traditional modes of governance; on the other hand, they institutionalise ad hoc forms of decentralisation, consultation, discretion and cooperation, which are key features of transnational networks and regime complex.

III. AN EXPERIMENTALIST GOVERNANCE PERSPECTIVE OF CLIMATE CHANGE

The debate on experimentalist governance has flourished in the US and EU social science and legal doctrine since the 1990s.[49] Its resonance is now increasingly evident in international law and politics. In environmental policy, examples of global experimentalist governance have been identified most notably in forestry initiatives, the international agreement for the protection of dolphins against tuna fishing practices and the Montreal

[42] Sabel and Zeitlin (n 23).
[43] de Búrca, Keohane, Sabel (n 3) 484.
[44] M Lee et al, 'Public Participation and Climate Change Infrastructure' (2013) 25(1) Journal of Environmental Law 33 (analysing this issue with respect to the consenting process for a nationally significant wind energy or carbon capture and storage infrastructure project in England).
[45] On democratization of science in global risk decision-making and governance, J Peel, *Science and Risk Regulation in International Law* (CUP 2010).
[46] Cottrell and Trubek (n 4).
[47] de Búrca, Keohane and Sabel (n 20) 17.
[48] BC Karkkainen, '"New Governance" in Legal Thought and in the World: Some Splitting as Antidote to Overzealous Lumping- Reply' (2004) 89 Minnesota Law Review 471.
[49] eg MC Dorf and CF Sabel, 'A Constitution of Democratic Experimentalism' (1998) 98 (2) Columbia Law Review 267; de Búrca and Scott (n 19).

Protocol to the Vienna Convention on the Protection of the Ozone Layer.[50] But, in the context of climate change, experimentalist practices remain largely unexplored.[51] This is surprising as climate change has increasingly become a crucial global governance issue, which presents linkages with the paradigm of strategies uncertainty and polyarchic distribution of power, constituting the scope conditions for experimentalist governance.

On the one hand, climate change is seen as a wicked problem: that is a problem whose solutions cannot readily be found in existing mechanisms and which persists even after the application of the best-available practices.[52] Von Homeyer refers to climate change as a 'persistent environmental problem' that could drive the emergence of experimentalist governance, based on relatively close links between the problem and the operating logic of the economic sectors causing it; high complexity; low visibility and a global dimension.[53] These characteristics point towards the experimentalist idea of strategic uncertainty, where traditional problem-solving strategies fail.[54]

On the other hand, climate change certainly constitutes a collective action problem. In Cole's definition, this is 'one that cannot be solved by a single individual or member of a group, but requires the cooperation of others who often have disparate interests and incentives, raising the costs of transacting or negotiating a cooperative solution.'[55] In an experimentalist governance context, this could be framed as a question of 'polyarchic distribution of power', where no actor is able to operate in isolation, nor impose its preferred solution, without cooperating with others. Under this reading then, experimentalist experiences could make a valuable contribution to climate change governance, providing a new framework for dealing with the failure of traditional problem-solving strategies and multilevel cooperation in decision-making.

This paradigm of uncertainty and distribution of decision-making power is particularly relevant when it comes to the governance of climate change technologies. Over the last decade, these issues have increasingly been debated with respect to the potential governance of geoengineering research. While mechanisms are in place for dealing with some aspects of their potential control (e.g. environmental impact assessment), these techniques present huge challenges, raising the recurrent question of how to deal with uncertainties, risks and asymmetric distribution of impact across regions and communities, while ensuring effective participation, accountability, transparency and regulatory flexibility.

IV. GEOENGINEERING TECHNOLOGIES: RISKS AND UNCERTAINTIES

Geoengineering methods are generally divided into two categories: Carbon Dioxide Removal (CDR) and Solar Radiation Management (SRM) techniques.[56] CDR techniques 'address the

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[50] C Overdevest and J Zeitlin, 'Assembling an Experimentalist Regime: Transnational Governance Interactions in the Forest Sector' (2014) 8(1) Regulation & Governance 22; de Búrca, Keohane and Sabel (n 20).

[51] Among the few scholars developing this perspective, J Scott, 'The MuIti-Level Governance of Climate Change' in P Craig and G de Búrca (eds.), *The Evolution of EU Law* (OUP 2012); I von Homeyer, 'Emerging Experimentalism in EU Environmental Governance' in C Sabel and J Zeitlin (n 17).

[52] H Rittel and M Webber, 'Dilemmas in a General Theory of Planning', (1973) 4 Policy Sciences 155 (first introducing the concept of 'wicked', as opposed to 'tame', problems). On the link with climate change, RJ Lazarus, 'Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future', (2009) 94 Cornell Law Review 1153; K Levin et al, 'Overcoming the Tragedy of Super Wicked Problems: Constraining Our Future Selves to Ameliorate Global Climate Change' (2012) 45 Policy Sciences 123.

[53] I von Homeyer, 'Emerging Experimentalism in EU Environmental Governance' in Sabel and Zeitlin (n 17) 121,127.

[54] Sabel and Zeitlin (n 22) 179; De Búrca, Keohane, and Sabel (n 3) 477.

[55] DH Cole, 'Climate and Collective Action' (2008) 61 (1) Current Legal Problems 229, 232.

[56] B Lauden and JMT Thompson (eds), *Geoengineering Climate Change – Environmental Necessity or Pandora's Box?* (CUP 2010). See also N E Vaughan and TM Lenton, 'A Review of Climate Geoengineering Proposals' (2011) 109 Climatic Change 745.

root cause of climate change by removing greenhouse gases from the atmosphere'.[57] These include land-based methods, such as afforestation, reforestation, or direct air capture; as well as ocean-based methods, such as ocean iron fertilization. The latter aims at increasing the rate of CO_2 transfer into the deep sea by manipulating the ocean carbon cycle through addition of nutrients, such as iron.[58] SRM techniques, instead, 'attempt to offset the effects of increased greenhouse gas concentrations by causing the Earth to absorb less solar radiation'.[59] These refer to a series of untested methods that would increase the reflectivity of the Earth by making its surface brighter; cool the Earth through injection of cloud-condensing particles into the atmosphere; scatter sunlight back to space, through injection of sulphate aerosols into the stratosphere; or reflect solar radiation by positioning sun-shields into space. Most of these techniques are merely technological concepts and are not even at the stage of development, as 'much more research on the feasibility, effectiveness, cost, social and environmental impacts and possible unintended consequences is required to understand the potential benefits and drawbacks, before these methods can be properly evaluated'.[60]

However, all these methods assume that we can successfully manipulate the climate to counteract dangerous climate change, and present significant risks and uncertainties.[61] Ocean fertilization, for instance, is likely to increase ocean acidification and lead to ecosystem shifts and loss.[62] This would result in huge distributive impacts, especially upon those communities relying on traditional uses of marine resources for their livelihood.[63] SRM might adversely change and reduce the precipitation pathways, disrupting large scale food production,[64] causing droughts and water resources scarcity.[65] The ultimate effects of SRM and some CDR, such as ocean fertilization, remain largely unknown and unpredictable, as we remain ignorant of some of the potential impacts, including with respect to the scale and consequences of the 'rebound effect'. This refers to the circumstance by which, upon cessation of geoengineering, the climate would warm more rapidly than if no geoengineering had been conducted, making the impact of climate change much more disruptive than what we experience now.[66] These techniques are also characterized by uncertainties with respect to their potential effectiveness. According to the IPCC, the ability of CDR techniques to control the climate system is likely to be limited, as there is insufficient knowledge to calculate how much CO_2 could be offset by these techniques on a century timescale.[67] While SRM methods, if realizable, have the potential to substantially offset a global temperature rise, they would also modify the global water cycle, and would not reduce ocean acidification.[68] The insufficient knowledge about the

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[57] Royal Society (n 7).
[58] see IMO, Report of the First Meeting of the Intersessional Technical Working Group on Ocean Fertilization (LC/SG-CO2 3/5), 16 February 2009.
[59] Royal Society (n 7).
[60] ibid. xii.
[61] D Humphreys, 'Smoke and Mirrors: Some Reflections on the Science and Politics of Geoengineering' (2011) 20(2) The Journal of Environment and Development 99.
[62] Secretariat of the Convention on Biological Diversity, 'Scientific Synthesis of the Impacts of Ocean Fertilization on Marine Biodiversity', Montreal, Technical Series No 45 (2009); BD Russell and SD Connell, 'Honing the Geoengineering Strategy', *Science* (8 January 2010) 144.
[63] Secretariat of the Convention on Biological Diversity, '*Geoengineering in Relation to the Convention on Biological Diversity: Technical and Regulatory Matters*, Montreal, Technical Series No 66 (2012) 74.
[64] A Robock et al, 'A Test for Geoengineering?' *Science* (29 January 2010) 530; A Robock, '20 Reasons Why Geoengineering May Be a Bad Idea' (2008) 64(2) Bulletin of Atomic Scientists 14.
[65] GC Hegerl and S Solomon, 'Risks of Climate Engineering', *Science* (21 August 2009) 955.
[66] A Robock, et al (n 64).
[67] IPCC, *Climate Change 2013: The Physical Science Basis - Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change - Summary for Policymakers* (CUP 2013) 27.
[68] ibid.

potentially huge intended and unintended consequences of these techniques, and their probabilities, clearly constitutes a barrier to effective governance and regulation. [69]

These challenges are aggravated by social and ethical concerns, including issues of public engagement in, and consent to, a potential geoengineering scenario.[70] The side effects of these techniques are potentially going to be felt more by the poor, who are more vulnerable to climatic changes and less able to commit resources to adapt, raising substantive intra- and intergenerational equity dilemmas.[71] This makes the question of social consent and participation in the decision-making even more urgent, and yet problematic. Whose consent is necessary when it comes to manipulating the global climate? How can we control the eventuality of unilateral action by States, or individuals outside government oversight, on climate geoengineering, and reduce the risk of global conflicts and security threats? [72] These are all questions that should be addressed by allowing upstream public participation in the decision-making process.[73]

These risks and uncertainties expose the decision-making about these technologies to Collingridge's "control dilemma". This claims that until a technology is sufficiently developed, its impacts cannot be sufficiently understood in order to assess, regulate and control its deployment; but, at the same time, early regulation is necessary to control technological development and avoid negative impacts.[74] In a geoengineering context, this impasse is unavoidable. As most of these techniques are still in a conceptual stage, more research is needed to reduce risks and uncertainties, as a fundamental step to design effective governance and regulation. At the same time, 'global, transparent and effective control and regulatory mechanisms' are increasingly viewed as a pre-condition for any geoengineering research activity.[75]

While an unconditional prohibition is probably undesirable, international governance mechanisms are crucial to control and manage unintended, potentially dangerous, effects and the risk of unilateral action. [76] As existing international treaties and rules were not conceived with this technology in mind, they do not provide direct control of geoengineering techniques, nor bespoke mechanism to ensure participation, flexibility and transparency for the governance of these techniques. Although this is not to suggest that potential geoengineering activities would emerge in a legal vacuum, as customary international law principles would still apply, experimentalist governance theories could contribute to support and redirect international law towards effective governance of geoengineering research.

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[69] ibid. See also Royal Society (n 7) 38.

[70] N Pidgeon and A Corner, 'Geoengineering the Climate: the Social and Ethical Implications' (2010) 52(1) Environment: Science and Policy for Sustainable Development 24.

[71] SM Gardiner, 'Is "Arming the Future" with Geoengineering Really the Lesser Evil?: Some Doubts About the Ethics of Intentionally Manipulating the Climate System' in S Gardiner et al (eds), *Climate Ethics: Essential Readings* (OUP 2010) 284.

[72] DG Victor, 'On the regulation of geoengineering' (2008) 24 (2) Oxford Review of Economic Policy 322 (arguing that the threat of unilateral action makes existing international norms ineffective). Cf J Horton, 'Geoengineering and the Myth of Unilateralism: Pressures and Prospects for International Cooperation' (2011) 4 Stanford Journal of Law Science and Policy 56 (noting that the fear of unilateral action is misplaced).

[73] Pidgeon and Corner (n 70).

[74] D Collingridge, *The Social Control of Technology* (Bloomsbury Publishing PLC 1982).

[75] Convention on Biological Diversity (CBD) COP Decision IX/16 (2008) C para 4; CBD COP Decision X/33 (2010) para 8 (w). These decisions were endorsed in IMO Resolution LC/LP. 1 (2008) on the Regulation of Ocean Fertilization, 31 October 2008. See also EA Parson and D Keith, 'End the Deadlock on Governance of Geoengineering Research' *Science* (13 March 2013) 339; S Rayner et al, *Memorandum on draft principles for the conduct of geoengineering research. House of Commons Science and Technology Committee Enquiry into the Regulation of Geoengineering* (2009).

[76] D Victor, *Global Warming Gridlock – Creating More Effective Strategies for Protecting the Planet* (CUP 2011) 193.

V. THE LIMITS OF INTERNATIONAL LAW AND THE POTENTIAL FOR EXPERIMENTALIST GOVERNANCE IN GEOENGINEERING RESEARCH

The relationship between law and governance is unavoidably complex.[77] De Búrca and Scott have described such interaction based on three models.[78] In some instances law resists and inhibits governance, or is confronted with a general reduction of its capacity ('gap thesis'). In others, they are 'mutually interdependent and mutually sustaining', mainly through the interaction of soft and hard law ('hybridity thesis'). But there are also examples where both governance and law are reshaped and transformed, as a result of their reciprocal interaction ('transformation thesis'). Yet, governance practices appear to always question the role of law in its ability to reflectively adapt to uncertainty, changing circumstances and multipolar actor dynamics.[79] By conceiving a global experimentalist governance approach to the international regulation of geoengineering research, the relationship between governance and law might principally be viewed as transformative.

As most geoengineering techniques are largely untested and pervaded with unknowns, the debate on their governance and regulation remains mostly speculative. However, norms and institutions that can potentially control field-experiments and small-scale research are being analyzed. Domestic law and institutions would theoretically have the capacity to control encapsulated techniques through existing regulatory tools, such as existing environmental and planning law mechanisms within their jurisdiction.[80] However, they show a limited ability to address unencapsulated methods, entailing a higher probability of transboundary effects or impact upon areas beyond national jurisdiction, which require international control.

With respect to their international regulation, there is no international treaty specific enough, nor international institution with a sufficiently clear mandate, to provide a direct governance and regulatory framework for all geoengineering methods or all aspects of individual methods. As a result, there is virtually no dedicated transnational control on climate engineering research or, potentially, large-scale deployment. This means that, as a matter of international law, '[a]ny State may legally conduct [geoengineering], on or over its own territory, or that of other consenting states, or over the high seas'.[81]

However, this apparently permissive approach is limited by customary law principles of general application originated by State practice.[82] Here, the no harm principle, the duty to consult and notify of potential transboundary harm, and the obligation to conduct an environmental impact assessment are of specific interest.[83] First, the 'no harm' principle

[77] See the 'quarrel' between Lobel and Karkkainen on new governance and the role of law. O Lobel, 'The Renew Deal: The Fall of Regulation and the Rise of Governance in Contemporary Legal Thought' (2004) 89 Minnesota Law Review 324; BC Karkkainen (n 48); O Lobel, 'Setting the Agenda for New Governance Research- Surreply' (2004) 89 Minnesota Law Review 498.

[78] de Búrca and Scott (n 19) 4-10.

[79] de Búrca, Keohane and Sabel (n 20); J Cohen and C Sabel, 'Directly-Deliberative-Poliarchy' (1997) 3(4) European Law Journal 313.

[80] "Encapsulation" refers to whether the method is modular and contained, such as is the case with air capture and space reflectors, or whether it involves material released into the wider environment, as is the case with sulphate aerosols or ocean fertilisation (Royal Society (n 7) 38).

[81] EA Parson, 'Climate Engineering in Global Climate Governance: Implications for Participation and Linkages' (2014) 3(1)Transnational Environmental Law 89, 95.

[82] See, in general, N. De Sadeleer, *Environmental Principles: From Slogans to Legal Rules* (OUP 2002).

[83] For a comprehensive analysis of the customary international law principles applicable to geoengineering, KN Scott, 'International Law in the Anthropocene: Responding to the Geoengineering Challenge (2013) 34 Michigan Journal of International Law 309.

imposes an obligation on States to prevent, reduce and control pollution and significant transboundary environmental harm to the territory of other States or to areas beyond national jurisdiction arising from activities within their jurisdiction and control. This principle has been enunciated in soft law declarations,[84] endorsed by the UN General Assembly and the International Law Commission,[85] recognized in important judicial decisions,[86] and codified in most environmental law treaties through more specific treaty obligations, such as the obligation to protect and preserve the marine environment or to conserve biological diversity.[87] Fulfilling these obligations is likely to be problematic with respect to some geoengineering technologies. As this principle primarily operates in relation to shared natural resources and hazardous activities, the extent to which geoengineering techniques would affect shared natural resources and/or constitute hazardous activities will need to be clarified. Moreover the principle not only includes activities conducted within the territory of a State, but also under its jurisdiction and control, thus including State's flagged vessels and registered aircrafts wherever they may be. This clearly extends its applicability to most geoengineering-related activities, including unencapsulated methods.[88]

Second, the obligation to consult and notify of potential transboundary harm, as well as, to conduct an environmental impact assessment (EIA) will apply to geoengineering activities presenting a risk of 'significant adverse impact in a transboundary context, in particular, on a shared resource'.[89] Although the scope and content of the assessment is to be determined by national law through the establishment of a national procedure for the ex-ante and regular assessment of the impact, international law requires consideration of the 'nature and magnitude of the proposed development and its likely adverse impact on the environment',[90] as well as the inclusion of 'the effects of the activity not only on persons and property, but also on the environment of other States'.[91] The discretion left to national authorities in establishing the procedure is subject to the exercise of due diligence, in the absence of general international rules or specific treaty provisions.[92] In this context, treaty assessment frameworks, such as the one established for scientific research on ocean iron fertilization under the London Protocol - which I analyse below - can 'play an important role in ensuring both harmonization of national measures and the application of appropriate

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[84] 1972 Declaration of the UN Conference on the Human Environment (Stockholm) UN Doc A/CONF/48/14 REV.1, Principle 21; 1992 Declaration of the UN Conference on Environment and Development (Rio de Janeiro) UN Doc.A/CONF.151/26/Rev.1, *Report of the UNCED*,Vol.1 (New York), Principle 2.

[85] eg Charter of Economic Rights and Duties of States, UNGA Res 3281, UN GAOR, 29th Sess Supp No 31, UN Doc A/9631 (1974) 50, art 30; International Law Commission, 'International Liability for Injurious Consequences Arising out of Acts Not Prohibited by International Law (Prevention of Transboundary Harm from Hazardous Activities)' in ILC, 'Report of the International Law Commission to the General Assembly covering the work of its fifty-third session, with commentaries, 2001' (UN Doc A/56/10), Ch V, in *Yearbook of the International Law Commission 2001*, vol II, Part Two (UN, 2001) ('Draft Articles on Prevention').

[86] See *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, [1996] ICJ Rep 226 (*Legality of Nuclear Weapons*) para 29 (stating that this obligation is 'now part of the corpus of international law relating to the environment); *Case concerning Pulp Mills on the River Uruguay (Argentina v Uruguay)*, [2010] ICJ Rep 14 (*Pulp Mills*) para 101.

[87] UN Convention on the Law of the Sea (Montego Bay) 21 ILM (1982) 1261. In force 16 November 1994 ('LOSC') arts 192-5; Convention on Biological Diversity (Rio de Janeiro) 31 ILM (1992) ('CBD') art 3.

[88] See C Armeni and C Redgwell, 'International Legal and Regulatory Issues of Climate Geoengineering Governance: Rethinking the Approach' (2015) Climate Geoengineering Governance Working Paper no 21/2015 <http://geoengineering-governance-research.org/perch/resources/workingpaper21armeniredgwelltheinternationalcontext-2.pdf>.

[89] *Pulp Mills* (n 86), para 204. This obligation can also be also found in the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo) 30 ILM (1991) 801. In force 27 June 1997. Art 2(1).

[90] Ibid. para 205.

[91] Draft Articles on Prevention (n 85) Commentary to art 7.

[92] Pulp Mills, (n 86) para 197 (defining the obligation of due diligence as entailing 'the adoption of appropriate rules and measures, but also a certain level of vigilance in their enforcement and the exercise of administrative control applicable to public and private operators, such as the monitoring of activities undertaken by such operators, to safeguard the rights of the other party.')

standards and thresholds for assessment of geoengineering activities'.[93] These obligations however do not entail a duty to obtain the consent of neighboring States to the activity, as they do not provide them with a veto power over the conduct of the activity.

Against the backdrop of customary international law rules and soft-law principles (e.g. the precautionary principle), most of the international law literature has focused on how these techniques, particularly ocean fertilization and sulphate aerosol injection, could - directly and indirectly - be governed by existing international treaties and institutions.[94] This assessment has been based on their subject matter or mandate (e.g. climate change, protection of biological diversity, environmental modification techniques), geographic scope and impact (e.g. marine environment, atmosphere, outer space) and regulated substances (e.g. ozone depleting substances). It has then become clear that, in most cases, adjustments were needed to effectively regulate these techniques.[95]

Although existing international law is a necessary starting point, this approach risks underestimating the fundamental question of how decisions about these technologies should be made and who might legitimately make them.[96] In other words, the broader governance question about the legitimate forms and actors of the decision-making on these techniques becomes an afterthought. Using an experimentalist paradigm, these might be described as questions surrounding the ways to deal with strategic uncertainties related to successful problem-solving techniques, and polyarchic distribution of power across a multitude of States and non-state actors legitimately involved in the decision-making process.

Here, existing international law instruments appear ill-suited to answer these questions in isolation. This is because potentially applicable international treaties have not been conceived with geoengineering in mind, and could therefore merely perform a default, simply passive function with respect to the governance of these technologies, until and unless specific amendments are actively adopted. As it stands, potentially applicable international treaties are not flexible enough to take strategic uncertainties into account, nor reflect the multilevel distribution of power that we experience in this area. Moreover there is a concrete possibility of regulatory disconnection in geoengineering. Like with other technological developments (e.g. biotechnology, information technologies), the technology here might develop faster than its regulatory framework, reducing international law to a merely reactive function and requiring constant re-adjustment to new scientific and technological development.[97] These factors make most existing international treaties ill-equipped to constitute an effective governance framework for geoengineering, in the absence of specific mechanisms for building flexibility and adaptability.[98] More flexibility, collaborative participation and adaptability should be built into their framework to

[93] Armeni and Redgwell (n 88) 37.

[94] eg Redgwell (n 10); Scott (n 83); J Reynolds, 'The Regulation of Climate Engineering' (2011) 3 Law, Innovation and Technology 113; T Kuokkanen and Y Yamineva, ´Regulating Geoengineering in International Environmental Law' (2013) 3 Carbon and Climate Law Review 161. See also: J Reynolds and F Fleurke, 'Climate Engineering Research: A Precautionary Response to Climate Change?' (2013) 2 Carbon and Climate Law Review 108; E Tedsen and G Homann 'Implementing the Precautionary Principle for Climate Engineering' (2013) 2 Carbon and Climate Law Review 90.

[95] Armeni and Redgwell (n 88). Cf J Reynolds, **'**Climate Engineering Field Research: The Favorable Setting of International Environmental Law**'** (2014) 5 (2) Washington and Lee Journal of Energy, Climate, and the Environment 417(stating that existing international treaties would enable geoengineering research).

[96] PG Harris, 'Reconceptualising Global Governance' in JS Dryzek, RB Norgaard and D Schlosberg (eds.), *The Oxford Handbook of Climate Change and Society* (OUP 2012) 639 (making a similar point related to global climate governance).

[97] For a discussion of this issue in the regulation of other technologies, see eg F Francioni and T Scovazzi (eds), *Biotechnology and International Law* (Hart Publishing, 2006); GE Marchant, BR Allenby and R Herkert (eds), *The Growing Gap between Emerging Technologies and Legal-Ethical Oversight: The Pacing Problem* (Springer 2011);

[98] As examples of specific adjustment mechanisms, see: Cartagena Protocol on Biosafety (Cartagena) 39 ILM (2000). In force 11 September 2003; ECE, Meeting of the Parties to the Convention on Access to Information, Public Participation in the Decision-Making and Access to Justice in Environmental Matters ('Aarhus Convention'), Decision II/1 Genetically Modified Organisms (adopted at the second meeting of the Parties held in Almaty, Kazakhstan, on 25-27 May 2005).

adequately reflect uncertainties, involve actors at different levels of decision-making and ensure that regulation constantly connects with its regulatory target. Some have already started suggesting alternative paradigms to international treaties, focusing on the potential for regional collaborations, adaptive management and a stronger reliance on soft law mechanisms and bottom-up initiatives for governing geoengineering research.[99]

On this basis, I argue that lessons from experimentalist governance could help transform and redirect international law instruments towards a more adaptive and proactive approach to governing these technologies. An iterative reflection on the mechanisms for decision-making and participation, based on provisional goals, recursive learning and cooperation could enable a more effective governance framework. This might also allow the regulatory process to be more responsive to changes and therefore reduce the potential for regulatory disconnection between law and technology. Furthermore, as Cottrell and Trubek convincingly argue with respect to new governance-type mechanisms within transnational regulatory contexts (i.e. WTO and EU), the recourse to open-ended standards, benchmarking of best practices, deliberation and negotiation, networks for coordinating multiple levels of governance, and the use of soft and hard law suggests an 'expanded vision' of international law as a framework for problem-solving, to deal with strategic uncertainty and multilevel distribution of power.[100]

Certainly, this is not to suggest that the existing international law rules and institutions are irrelevant. On the contrary, international law provides indirect legal constraints on States' conduct associated with geoengineering through customary international law and any treaty provisions potentially applicable, or at least adaptable, to individual activities or their effects. It therefore serves an essential backstop function in constraining behavior and restraining unilateral action; helping structure international and national discussion; and directing geoengineering governance to specific international institutions.[101] As a result, international law provides the necessary context for global governance practices to emerge. Experimentalist governance structures cannot thrive in isolation, but will need to interact with, and rely upon, existing international law and institutions, with the result of eventually being influenced by these rules and processes. But using an experimentalist model for geoengineering governance would not be straightforward. As discussed later, its practical implementation within the new international marine geoengineering governance framework under the London Protocol remains difficult, due the barriers to cooperation and public participation.

VI. MARINE GEOENGINEERING UNDER THE LONDON PROTOCOL ON DUMPING OF WASTES AND OTHER MATTER AT SEA

Among the variety of geoengineering concepts, ocean fertilization has received greatest attention in the international legal literature.[102] This is due of its alleged technical viability

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[99] J Reynolds, 'The International Regulation of Climate Engineering: Lessons from Nuclear Power' (2014) 26 (2) Journal of Environmental Law 269. See also JSC Long, 'A Prognosis, and Perhaps a Plan, for Geoengineering Governance', (2013) 3 Carbon and Climate Law Review 177; T Hester, 'A Matter of Scale: Regional Climate Engineering and the Shortfalls of Multinational Governance' (2013) 3 Carbon and Climate Law Review 168.

[100] Cottrell and Trubek (n 4) 1.

[101] D Bodansky, 'Governing Climate Engineering: Scenarios for Analysis', (November 2011) The Harvard Project on International Climate Agreements, Discussion Paper 2011/47, 19-20 <http://belfercenter.ksg.harvard.edu/files/bodansky-dp-47-nov-final.pdf>.

[102] eg NR Rayfuse, M Lawrence and K Gjerde, 'Ocean Fertilization and Climate Change: The Need to Regulate Emerging High Seas Uses', (2008) 23 (2) The International Journal of Marine and Coastal Law 297; R Rayfuse and D Freestone, 'Ocean Iron Fertilization and International Law' (2008) 364 Marine Ecology Progress Series 277; T Markus and H Ginzky, 'Regulating Climate Engineering: Paradigmatic Aspects of the Regulation of Ocean Fertilization', (2011) 4 Carbon and

and the fact that some small-scale experiments concerning ocean fertilization have already taken place, steering the debate on their effective international regulation and control.[103]Here I analyse the 2013 marine geoengineering amendments to the Protocol to the London Convention on Dumping of Wastes and Other Matter at Sea. Subject to its entry into force, these would constitute the first internationally binding control mechanism for marine geoengineering activities.[104]

The London Convention regime's objective is to promote effective control of all sources of pollution of the marine environment, by preventing, reducing and, where practical, eliminating dumping of wastes and other matters at sea.[105] Dumping is defined as 'any deliberate disposal at sea of wastes or other matter from (and of) vessels, aircrafts, platforms or other man-made structures at sea' and is prohibited under this regime.[106] Placement of wastes for the purpose other than disposal is not considered dumping, and is permitted, insofar as this is not contrary to the aims of the Convention. The London Protocol (LP), which is intended to replace the Convention for Parties who have ratified it, applies a restrictive, 'prohibited unless permitted' approach to dumping, based on the precautionary principle.[107]

Parties started addressing marine geoengineering in 2007, issuing a Statement of Concern with respect to ocean fertilization experiments.[108] In line with a non-binding decision adopted by the Conference of the Parties to the Convention on Biological Diversity (CBD),[109] in 2008 they adopted a non-binding resolution, clarifying that ocean fertilization activities were not to be allowed as these would violate the aims of the Convention and Protocol, and qualify as dumping.[110] However, 'legitimate scientific research' on ocean fertilization was considered 'placement for a purpose other than disposal', and therefore permitted, subject to a national permit and provided that it is not contrary to the aims of the Convention and Protocol.[111] Legitimate scientific research was defined as 'those proposals that have been assessed and found acceptable under the assessment framework', on a case-by-case basis.[112] Ocean fertilization activities other than legitimate scientific research were not to be allowed.[113] In 2010, a Specific Assessment Framework for Scientific Research (AFSR) involving Ocean Fertilization was adopted to guide the evaluation of 'legitimate

Climate Law Review 477; R Rayfuse and R Warner, 'Climate Change Mitigation Activities in the Ocean: Turning Up the Regulatory Heat' in R Warner and C Schofield (eds), *Climate Change and The Oceans: Gauging the Legal and Policy Currents in the Asia Pacific and Beyond*, (Edward Elgar Publishing 2012), KN Scott, 'Regulating Ocean Fertilization under International Law: The Risk' (2013) 2 Carbon Climate Law Review 108.

[103] R Rayfuse, 'Drowning Our Sorrows to Create a Carbon Free Future? Some International Legal Considerations Relating to Sequestering Carbon by Fertilizing the Oceans' (2008) 14(2) University of New South Wales Law Journal Forum 54. N Craik, J Blackstock and AM Hubert, 'Regulating Geoengineering Research through Domestic Environmental Protection Frameworks: Reflections on the Recent Canadian Ocean Fertilization Case' (2013) 2 Carbon and Climate Law Review 117.

[104] The amendment will enter into force for those Parties which have accepted it on the 60th day after two-third of the Parties that have deposited their instrument of acceptance with the International Maritime Organization (art 21. (3) (The US is not a Party to the Protocol).

[105] LC, arts I and II and LP, art 2.

[106] LC, art III (1) (b) (ii) and LP, art 1.4.1.1. Under the LP, dumping also includes 'any storage of wastes or other matter in the seabed and the subsoil thereof from vessels, aircraft and platforms or other man-made statures at sea and any abandoned or toppling at side of platforms or other man-made structures at sea for the sole purpose of deliberate disposal. (LP, art 1 (4(3) and (4)).

[107] LP, art 3.

[108] IMO, Convention on the Prevention of Marine Pollution from Dumping of Wastes and Other Matter at Sea, 1972 and its 1996 Protocol, Statement of Concern Regarding Iron Fertilization of the Oceans to Sequester CO_2 (LC-LP.1/Circ.14, 13 July 2007).

[109] CBD COP Decision IX/16 (2008); CBD COP Decision X/33 (2010).

[110] IMO (n 75) para 8.

[111] ibid. para 3.

[112] ibid. para 4 and 7.

[113] ibid. para 8.

scientific research'.[114] This constitutes an iterative process to support national authorities in issuing the permit, intended to be reviewed at appropriate intervals, in light of new and relevant scientific knowledge and experience in applying the framework'.[115] Finally, in 2013 the Parties translated these non-binding resolutions into binding amendments to the Protocol to regulate marine geoengineering activities.[116] This has been presented as 'a mark of true leadership in global standard-setting'.[117]

'Marine geoengineering' is defined under the amendments as 'a deliberate intervention in the marine environment to manipulate natural processes, including to counteract anthropogenic climate change and/or its impacts, and that has the potential to result in deleterious effects, especially where those effects may be widespread, long-lasting or severe'.[118] Based on this definition, a new article 6bis states that 'Contracting Parties shall not allow the placement of matter into the sea from vessels, aircraft, platforms or other man-made structures at sea for marine geoengineering activities listed in Annex 4, unless the listing provides that the activity or the sub-category of an activity may be authorized under a permit'.[119] Ocean fertilization is the only type of marine geoengineering currently listed under a new Annex 4, which states that 'ocean iron fertilization may only be considered for a permit if it is assessed as constituting legitimate scientific research taking into account any specific placement assessment framework' (i.e. AFSR for ocean iron fertilization).[120] A binding Generic Assessment Framework established in a new Annex 5 is to guide the evaluation of 'matters that might be considered for placement under Annex 4'.[121] In the case of ocean iron fertilization, this Generic Framework is to be complemented with the Specific Assessment Framework for Scientific Research (AFSR) involving Ocean Iron Fertilization, which 'shall meet the requirements of [Annex 5] and may provide further guidance for assessing and issuing permits'.[122]

Other marine geoengineering activities could be included in Annex 4 in the future, based on a 'recommended non-binding procedure'.[123] This process enables the Protocol to remain flexible and adaptable to future developments in this field, while ensuring that the primary objective to protect the marine environment is pursued, in the light of the precautionary principle. Contextually, a procedure for the appointment of international

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[114] IMO, Resolution LC-LP. 2(2010) on the Assessment Framework for Scientific Research involving Ocean Fertilization, 14 October 2010.
[115] IMO (n 114) para 7.
[116] IMO, Resolution LP. 4(8) on the Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and Other Marine Geoengineering Activities, 18 October 2013.
[117] 36th Consultative Meeting of Contracting Parties (London Convention 1972) and 9th Meeting of Contracting Parties (London Protocol 1996), Opening address, 3 November 2014, delivered on behalf of the IMO Secretary-General by Mr. Andy Winbow, Assistant Secretary-General and Director, Maritime Safety Division).
[118] LP, new art 1.5bis. The language in relation to 'widespread, long-lasting and severe' effects is borrowed from the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD), New York 18 May 1977, in force 5 October 1978, 1108 UNTS 151. The Convention does not define these terms, but the Understandings attached to it provide the following interpretation: a. "widespread": encompassing an area on the scale of several hundred square kilometers; b. "long-lasting": lasting for a period of months, or approximately a season; c. "severe": involving serious or significant disruption or harm to human life, natural and economic resources or other assets'. See Understandings Relating to art I of ENMOD, 31 GAOR Supp. No. (A/31/27), Annex I para 5.
[119] IMO (n 116) new art 6bis 'Marine Geoengineering Activities'.
[120] ibid, new Annex 4 'Marine Geoengineering Activities' para 1 (3) Para. 1(1) defines ocean fertilization as 'any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans'. This definition expressly excludes other established legitimate uses of the sea, such as the direct harvesting of marine organisms; conventional aquaculture or mariculture; the creation of artificial reefs (para 1.2).
[121] ibid, new Annex 5 'Assessment Framework for Matters that Might be Considered for Placement Under Annex 4'.
[122] ibid, para 2.
[123] IMO, Convention on the Prevention of Marine Pollution from Dumping of Wastes and Other Matter at Sea, 1972 and its 1996 Protocol, Guidance for Consideration of Marine Geoengineering Activities (LC-LP.1/Circ.67, 6 January 2015) Annex, para 2.

independent experts was adopted. They should provide advice on listed activities or consideration for listing, under the oversight of the Secretariat, and can be nominated by both Parties and observers (e.g. NGOs). While the initial proposal envisaged a standing body, the final agreement was to appoint a roster of experts leaving discretion to the Parties as to when and how to seek their advice.[124]

Should these amendments enter into force, Parties would need to adapt their national permitting system to ocean fertilization research activities. For instance, an iron fertilization activity, when conducted in the UK marine areas (although unlikely), or anywhere in the sea from a British vessel or a vessel loaded in the UK, would constitute a licensable activity under the Marine and Coastal Access Act (2009) and the Marine (Scotland) Act (2010).[125] However, as of March 2015, no ratification has yet been notified to the IMO Secretariat. Some predict a period between five and ten years for it to come into force, during which the non-binding 2008 and 2010 resolutions will still apply, including the specific AFSR.[126] However, subject to its entry into force, this amendment could drive controlled marine geoengineering research and provide initial governance for these activities.

VII. A CASE FOR EXPERIMENTALIST GOVERNANCE IN CLIMATE CHANGE TECHNOLOGIES?

The new regime for marine geoengineering research under the LP represents a significant development in international environmental law. It combines a positive attitude towards scientific research and multilevel cooperation, with a desire to accommodate the regulatory disconnection between law and technology. These amendments reflect a number of features of experimentalist governance. This connection however remains loose as some fundamental barriers remain for them to embody an ideal type of this mode of governance. In section II, I outlined four deliberation-fostering elements. As set out above these elements are: provisional framework goals, and metrics for evaluation; implementation by 'lower level' units; regular reporting and peer-review obligations; and periodical re-evaluation and review of the goals and decision-making practices. These aspects of experimentalist governance are, at least loosely, reflected in the rationale of the amendments and the assessment framework(s), and operate within the normative backstop of the rules and institutions established under the Protocol.

First, the amendments' objective is to ensure that ocean fertilization activities are compatible with the protection and preservation of the marine environment. Based on a precautionary approach, this objective can be viewed as a provisional framework goal. Its scope is open-textured as it broadly relates to the protection of the marine environment, and the possible extension of the regulation to other marine geoengineering types suggests that its current regulatory target (i.e. ocean fertilization) might be merely provisional.[127] This approach then provides flexibility by 'future-proofing' the Protocol to allow for 'quick

[124] IMO, Convention on the Prevention of Marine Pollution from Dumping of Wastes and Other Matter at Sea, 1972 and its 1996 Protocol, Description of Arrangements for a Roster of Experts on Marine Geoengineering in the Consultation Process (with regard to para 12 of Annex 5 to the London Protocol) (LC-LP. 1/Circ. 66, 6 January 2015). (Parties can also consult experts outside the roster).

[125] UK Explanatory memorandum on the amendments to the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Protocol) to Regulate Marine Geoengineering (Command Paper 8965) (2014) <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/376395/EM_Misc_9.2014.pdf>.For a detailed analysis of the UK position on geoengineering, C Armeni and C Redgwell, 'Geoengineering Under National Law: A Case Study of the United Kingdom (2015) Climate Geoengineering Governance Working Paper no 23/2015 < http://www.geoengineering-governance-research.org/perch/resources/workingpaper23armeniredgwelltheukcombine.pdf>.

[126] See UK Explanatory Memorandum (n 125).

[127] IMO (n 116) new Annex 5.

regulatory responses to new techniques'.[128] This factor is significant as it directly responds to the issue of regulatory disconnection between law and technology. However, such flexibility seems pre-framed in favour of technological development, as there is no express indication that this objective can be provisional in the sense that a marine geoengineering type should be delisted from – rather than added to - the permitted activities, as a result of new knowledge. [129]

The Generic Assessment Framework, in combination with the AFSR involving ocean iron fertilization, represents the metric to evaluate the implementation of this framework goal. This is a central tool of the architecture established under the LP and is modelled on the London Protocol Annex II of Assessment of wastes or other matters that may be considered for dumping. This template is to be used by national authorities to judge whether the proposed activity amounts to legitimate scientific research, and can therefore be permitted, in compliance with the framework goal. The assessment is an iterative process of collection of information, peer review, and comparison of data, experiences and monitoring methodologies. The evaluation focuses in particular on the scientific questions at the basis of the field-experiment; research methodology; and potential conflict with economic interests. Project proponents must provide information for the assessment of the placement site, substances used, potential effects, risk management and monitoring. If the project is likely to have an impact on another area of the sea or in areas beyond national jurisdiction, consultation must be carried out with the State exercising jurisdiction or with any other potentially affected State. The consultation should engage with any other stakeholders and involve advice from independent international experts.[130]

Second, national authorities retain discretion in the implementation of the Protocol's obligations, including with respect to the application of the Generic and Specific Assessment Frameworks and other guidelines, and the selection of experts. This amounts to an opportunity to contribute to the identification and definition of the problems, through different solutions. National authorities are therefore the centre of gravity of the regime as they engage with both project proponents and the IMO Secretariat, while retaining clear autonomy in decision-making and implementation.

Third, and strictly linked to lower units' discretion, an institutionalised dialogue between key actors is established through regular reporting and peer-review. National decisions and experiences must feed back into the central international process as 'the outcome of any assessment and documentation of any permit issued shall be reported to the Secretariat and shall be made publicly available at or shortly after the time the decision is made'. [131] This reporting of information on the permitting supports the learning process and allows monitoring and peer-review to feed back to the Conference of the Parties, as the regime's ultimate decision-making body, and inform the benchmarking of best practices. In connection with this requirement, a web-based repository of references relating to the application of the AFSR is being developed, which would be accessible to all LC/LP Parties, in cooperation with the CBD, UNESCO-IOC and other forums.[132] Although the

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[128] H Ginzky and R Frost, 'Marine Geo-Engineering: Legally Binding Regulation under the London Protocol' (2014) 2 Carbon and Climate Law Review 82.

[129] Certainly Parties will always be able to prohibit previously permitted activities through an amending procedure, as it happened with other matters, most notably in 1993 with the adoption of a binding prohibition on dumping of low- and medium level radioactive wastes under the London Convention Annex. (IMO, Resolution LC. 51 (16) Amendments to the Annexes to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 concerning Disposal at Sea of Radioactive Wastes and Other Radioactive Matter, 15 December 1993.)

[130] IMO (n 116) new Annex 5, para 12.

[131] ibid para 30.

[132] IMO, Report of the Thirty-Third Consultative Meeting of Contracting Parties to the London Convention and the Sixth Meeting of Parties to the London Protocol (2011) para 4.25-4.28

terms of reference indicated that this will be open to all Parties, there is no indication that information will be confidential and that non-Parties or non-state actors, including NGOs, would be denied access.[133] Although this repository does not amount to an institutional clearing-house mechanism, such as the one under the Montreal Protocol's financial mechanism or the CBD, it is nevertheless important to centralise technical expertise and local decision-making practices, and enable exchange of experiences and best practices.[134] This iterative dialogue between project proponents, national authorities and international bodies reflects the attention to cooperation between local and central units, as we see in democratic experimentalism.[135] Following a recursive review of scientific information and permitting procedures, data from local units are regularly refined and shared with the Secretariat, as the global standard-setter.

This leads the reporting and peer-review process to finally trigger periodical revision and review as part of a reflexive exercise.[136] The learning process through the Assessment Frameworks and the central reporting could result in adjustments to be required to the research proposal, the national permit or the list of activities permitted under the rubric of marine geoengineering. This is to ensure that regulation and governance remain flexible and adaptable to evolving knowledge, while fulfilling the framework objective of protecting and preserving the marine environment. In particular, monitoring and peer-review of data under the Generic Framework 'will indicate whether field programmes need to be continued, revised or terminated and will inform decisions regarding the permits'.[137] K. Scott stresses how this '[…] risk assessment framework is a model for precautionary and adaptive management, and compares favorably with instruments providing for environmental impact assessment such as the 1991 Environmental Protocol to the 1959 Antarctic Treaty'. [138] The emphasis on the need to regularly review the decision-making regarding marine geoengineering has been central to the adoption of the 2014 guidance for revision of permitted marine geoengineering activities.[139]

At first glance, then, the presence of these elements suggests that we might fairly consider the governance regime for ocean iron fertilization as an example of experimentalist governance in the international regulation of climate change technologies. However, as also discussed in section II, four conditions are generally considered necessary for effective experimentalist governance. These are: the inability of governments to agree on a comprehensive set of rules and efficiently monitor their compliance; a general agreement on basic principles to allow discussion and deliberation on the goals and benchmarks; cooperation among decision-makers; and civil society participation.

The new amendments build on the first two conditions. On the one hand, they are limited to an ocean fertilization context as Parties were not able to agree on a 'one size fits all' governance mechanism for all marine geoengineering techniques. Such an approach would have fallen short of addressing the characteristics of each technique and prevented effective monitoring of compliance with the regulation. On the other hand, Parties were able to agree on a control mechanism for legitimate scientific research, establishing basic principles and procedures. The characterization of the main attributes of legitimate scientific

[133] At the time of writing, a prototype web-based repository including scientific, policy and legal literature and other documents was available for unrestricted access <https://sites.google.com/site/lclpofdocs/home>.
[134] Protocol on Substances that Deplete the Ozone Layer (Montreal) 26 ILM (1987). In force 1 January 1989, art 10; CBD, art 18.3.
[135] eg Dorf and Sabel (n 49).
[136] MC Dorf, 'The Domain of Reflexive Law: A Review Essay' (2003) 103 Columbia Law Review 384.
[137] IMO (n 116) new Annex 5, para 29.
[138] Scott (n 83) 351.
[139] IMO (n 123)

research is a central aspect of the framework, and rejoins with other international mechanisms for the control of marine scientific research (i.e. LOSC and the 1991 Environmental Protocol to the 1959 Antarctic Treaty).[140] But, despite these two factors, the overall architecture of the international regime for ocean iron fertilization demonstrates a limited scope for cooperation between decision-makers, aggravated by the absence of penalty defaults, and restricted opportunities for deliberative participation of civil society.

Cooperation between Parties is a necessary pre-condition for experimentalist governance to thrive.[141] But, the space for such cooperation under the LP amendments appears narrowly framed, effectively acting as a barrier to experimentalist governance. Here, cooperation has taken different routes. With respect to the negotiations of the amendments, cooperation among Parties (including non-state actors) has been high, and widely encouraged, both in plenaries and in working groups. This is important as, while the Protocol enjoys limited participation,[142] non-Parties, such as the US, have been active in the debate and suggestion of possible options for the amendments.[143]

But, with respect to the marine geoengineering framework as operated, cooperation in information-sharing essentially occurs between national authorities, project proponents and the Secretariat, with the potential support of nationally-designated experts. As discussed further below, there is limited space for external participation. Furthermore, even the scope for cooperation between 'insiders' appears restricted, as the exchange and learning process happens within the confined boundary of the specific proposal under discussion, taking a vertical approach to cooperation. Little is done to encourage horizontal cooperation among different national authorities and proponents to drive comparability and learning across experiences in implementation. Horizontal cooperation between national authorities is not uncommon within international environmental law treaties and institutions. Examples range from coordination between national Management Authorities under the Convention on International Trade of Endangered Species (CITES); through the IMO-supported Memoranda of Understanding for Port State Control (PSC) and cooperation under MARPOL, and multiple fora for cooperation between national nuclear energy regulators, including in the event of nuclear emergencies.[144] In this context, then, the lack of specific mechanism to encourage such horizontal cooperation under the new marine geoengineering regime appears short-sighted, given the potential transboundary, and even global, impact of these activities. Even the web-based repository of information under the Secretariat is a rather weak tool, as no formal obligation is imposed on Parties to take this information into account to drive recursive learning and inform revision of framework objectives and decision-making practices.

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[140] LOSC, art 87 (1)(f) and 239 (recognizing marine scientific research as a high seas freedom) and Protocol to the Antarctic Treaty on Environmental Protection, 30 ILM (1991) 1461, in force 14 January 1998, arts 3 and 8, Annex I.

[141] See other conditions in Section II above.

[142] The LP currently has 42 Contracting Parties (Status 28 May 2012).

[143] eg IMO, Thirty-Fourth Meeting of the contracting Parties to the London Protocol and Seventh Meeting of the Contracting to the London Protocol, Regulation of Ocean Fertilization and Other Activities – Information regarding the informal subgroup of experts examining questions under international law with regard to addressing ocean fertilization and other activities – Submitted by the United States (LC 34/4/5, 7 September 2012); IMO, Thirty-Fourth Meeting of the contracting Parties to the London Protocol and Seventh Meeting of the contracting to the London Protocol, Ocean Fertilization – Report of the Working Group on Ocean Iron Fertilization (LC 34/WP.4, 1 November 2012) (including a proposal by the United States).

[144] On these selected examples: Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington) 12 ILM (1973) 1085, art IX; International Convention on the Prevention of Pollution by Ships (MARPOL) (London) 12 ILM (1973) 1319, arts 6 and 17; Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, (Vienna) Misc. 3 25 ILM (1986) 1377, art 1. See P Birnie, A Boyle and C Redgwell, *International Law and the Environment* (3rd ed) (OUP 2009).

This approach potentially reduces the role of cooperation from a catalyst for learning, to a narrow procedural task within the permitting regime. To confirm this point, the new regime does not foresee a system of penalty defaults to induce cooperation. As illustrated above, experimentalist governance often works in the shadow of penalty defaults, as a threat of less favourable default rules to be applied in the event that Parties do not cooperate by signing up to a destabilisation regime. This is to encourage collaborative participation into the new system, by making alternative rules undesirable and inducing a re-evaluation of the benefit of collective action. In a global governance context, penalty defaults have effectively been designed as threats of trade sanctions, such as those established to penalise non-cooperation within the Inter-American Tropical Tuna Commission to minimise the death of dolphin by-catch, or of trade restrictions, such as those applicable to Ozone Depleting Substances under the Montreal Protocol regime, or those applied on an ad hoc basis by the COP under CITES. [145] But in the case of the LP amendments on marine geoengineering, penalty default rules are absent, or at least unclear. While it is true that penalty defaults do not constitute a foundational element of experimentalist governance, they represent a valuable deterrent to reduce the chances of parties 'to translate reluctance to participate in new arrangements into overt or covert obstructionism', and support cooperation. [146] As geoengineering remains deeply controversial, both nationally and internationally, the likelihood that veto powers and obstructionism inhibit collaboration in this new system is certainly high.

With respect to participation of civil society, some international NGOs and scientific groups have contributed, in the plenary and the working groups, to express concerns, share technical and scientific expertise, and submit draft texts.[147] The question however remains as to whether such participation opportunities will be retained as during the negotiation process, once (and if) the amendments come into force. Although lacking decision-making power, non-state actors' participation increasingly play an important role in global governance of technologies, from providing technical and scientific expertise to inform the learning exercise, to claiming more substantive participation in the decision-making process. [148] It is precisely with respect to the space for public participation in the deliberative process that the new LP mechanism appears limited, giving rise to the second barrier to experimentalist governance. Active participation by a broad range of stakeholders is a key feature of experimentalist governance, as a contribution to transparency and deliberative democracy.[149] But, the mechanisms of public participation in environmental decision-making are multifaceted, ranging from minimal consultation on technical matters to more deliberative approaches. [150]

Participation in the LP regime takes place mainly within the boundaries of the impact assessment under the Assessment Framework(s). In that context, the exchange of information to support decision-making occurs exclusively between project proponents, national authorities in charge of the permitting process, and possibly independent

[145] de Búrca, Keohane, Sabel (n 20). See also, R Reeve, 'Wildlife Trade, Sanctions and Compliance: Lessons from the CITES Regime' (2006) 82(5) International Affairs 881.
[146] de Búrca, Keohane and Sabel (n 20) 784.
[147] The Advisory Committee on Protection of the Sea (ACOPS), Greenpeace International and World Wide Fund for Nature (WWF) have been the most active observer organizations.
[148] C. Abbot, 'Bridging the Gap: Non-state Actors and the Challenges of New Technology', (2012) 39(3) Journal of Law and Society 329.
[149] de Búrca, Keohane, Sabel (n 20); de Búrca, Keohane and Sabel (n 3).
[150] eg J Holder, *Environmental Assessment: The Regulation of Decision-making* (OUP 2004); J Steele, Participation and Deliberation in Environmental Law: Exploring a Problem-solving Approach' (2001) 21 Oxford Journal of Legal Studies 415. For an international law perspective, J. Ebbesson, 'The Notion of Public Participation in International Law' (1997) 8 (1) Yearbook of International Environmental Law 51.

international experts. The specific AFSR include (minimal) avenues for consultation with stakeholders, mostly during the mandatory Environmental Impact Assessment for field experiments. Clearly, the choice of regulatory mechanisms for public participation in the permitting and implementation process for geoengineering research rests with the national authorities, leaving them considerable discretion. The AFSR procedure is highly technical and there are limited avenues for civil society to intercept it and engage. But, even when consulted, they have no official voice outside this precise realm, resulting in a limited ability to influence the international law decision-making process.

More importantly, the substantive grounds for participation are largely pre-framed within the limits of technical and scientific reasons under the Assessment Framework(s) umbrella. The evaluation of a project relies almost exclusively upon its risk assessment and management, while disregarding potential social, cultural and ethical concerns associated with it. For instance, while 'social and economic factors such as whether the activity, or regulation of the activity, could have important social and economic effects, including distributional effects, e.g. affecting certain countries or population groups' must be considered, they are likely to be interpreted as merely measurable impacts.[151]

In this context, cultural values, concerns beyond risk and alternative discourses about the technology may be equally important to reach 'good decisions' on the regulation and governance of technologies.[152] However, under these amendments, their legitimacy is overshadowed by a clear emphasis on merely technical, quantitative risk assessments, where other rationalities are not captured. This is unfortunate, but not overly surprising, given the enormous and perennial challenges of addressing socio-cultural values beyond risk in the governance of technological change, which are surely magnified at the international level.[153] This shows that public participation is conceived as an institutionalised process between pre-determined actors (i.e. national authorities, project developers and experts, affected local communities), insofar as it is to contribute to a defined and technical procedure to assess new proposals or new techniques. Although some of the LP Parties have obligations under the UNECE Aarhus Convention to provide effective mechanisms for public participation in the decision-making, access to information and access to justice on environmental matters, this instrument has a mainly regional scope and focuses on the national decision-making, rather than on opportunities for deliberative participation of civil society in international decisions-making and governance mechanisms.[154]

This analysis suggests that there is an unavoidable obstacle to qualify the new marine geoengineering regime as an example of global experimentalist governance, as this mode of governance is deeply focused on wide participation, especially from civil society groups, to increase dynamic accountability and transparency. Indeed, as Sabel et al note, experimentalist governance intends to reduce the gap between overall responsiveness of the governance system and democratic participation broadly conceived. Opening the decision-making to a variety of actors and a multiplicity of rationalities would then be a necessary condition to achieve deliberative outcomes under an experimentalist governance architecture. This would be of particular importance in the context of international

[151] IMO, (n 123).
[152] M Lee, 'Beyond Safety? The Broadening Scope of Risk Regulation' (2012) Current Legal Problems 242.
[153] See S Jasanoff, *Designs on Nature: Science and Democracy in Europe and the US* (Princeton University Press 2007); C Sustein, *Risk and Reasons: Safety, Law and the Environment* (CUP 2002). See also J Steele, *Risks and Legal Theory* (Legal Hart Publishing 2004).
[154] See UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters ('Aarhus Convention') 38 ILM (1999) 517. In force 24 February 2004. However, the Aarhus Convention is also open for accession to Member States of the United Nations outside the ECE region (see ECE/MP.PP/2/Add.1 (Lucca Declaration), paras. 32-33; ECE/MP.PP/2005/2/Add.13 (decision II/9); ECE/MP.PP/2008/2/Add.16 (decision III/8), objective II.4; ECE/MP.PP/2011/2/Add.1 (decision IV/5).

regulation of controversial technologies, such as geoengineering, if we are to seriously address social and ethical concerns beyond risk.

It now seems clear that, while some experimentalist elements are present, the new international regime for marine geoengineering falls short of embracing an experimentalist approach to problem-solving and multilevel distribution of power. Here, the two important features of cooperation between decision-makers and participation of civil society are confined, and there is no system of penalty default to provide an incentive towards their widening. This reduces the potential of the new LP amendment to represent an ideal type of experimentalist governance, to a much more modest example of loose experimentalist governance. Under these circumstances then, the advantages of flexibility and adaptability provided under this new global governance mechanism for climate change technologies are outweighed by a limited scope for effectively scrutinising the legitimacy of the decision-making process through cooperation and participation. From a global governance point of view, it seems that the key question about how decisions on controversial climate change technologies are made and who might legitimately make them is yet to be properly disentangled.

VIII. CONCLUSIONS

The idea of intentionally manipulating the climate through technology inevitably calls for a deeper reflection upon societal values and the human place in nature vis-à-vis climate change.[155] As a result, meaningful considerations about their potential global governance and regulation are not premature.

In the face of the limits of international law in addressing strategic uncertainty, multilevel distribution of power and regulatory disconnection, global experimentalist governance is normatively attractive. As a minimum, its implementation in a geoengineering research context would catalyze adaptability to changing scientific and technological knowledge, iterative learning from different experiences, deliberative participation of civil society and cooperation between decision-makers at different levels of governance. This could help redirect the role of traditional international law to better reflect the need for a flexible, adaptive and participatory control of these techniques. As such, lessons from experimentalist governance would then make a very valuable contribution to the governance of emerging climate change technologies, more broadly, in re-shaping the international decision-making process to effectively respond to strategic uncertainty, multilevel distribution of power and regulatory disconnection, and ultimately strengthen the problem-solving function of international law.

The analysis of the recent marine geoengineering amendments to the London Protocol has shown that there is a potential for experimentalist governance approaches to address these challenges in the global governance of climate change technologies. However, a limited scope for cooperation between decision-makers and participation of civil society prevents it to embody an ideal type of this new mode of governance. But although it falls short of constituting a pure model, the new regulatory framework for ocean fertilization under the London Protocol could be viewed as a case for a slow shift towards global experimentalist governance in the field of climate change technologies as it presents some of its foundational features. Such approach could help re-think global problem-solving and decision-making in the area of climate change technologies, against the backstop of international treaty rules and customary international law principles.

[155] Jasanoff (n 33).