Environmental Problem Shifting between International Environmental Treaty Regimes

–

Master's Thesis

Jonathan Hirschhäuser

j.j.hirschhauser@students.uu.nl

6507646

Utrecht University

M.Sc. Sustainable Development

Track: Earth System Governance

Supervisor: Dr. Rak Kim

Second Reader: Prof. Dr. F. Biermann

Utrecht, 14 July 2020

Abstract

Instead of solving a problem, decisions in international environmental governance sometimes shift problems from one issue to another. Environmental problem shifting at the global level needs to be avoided to cope with the pressing environmental challenges of today. This article presents a theory of problem shifting between environmental treaty regimes. A characteristic of interactions of treaty regimes is their degree of fragmentation. Building on the current literature on governance fragmentation and the analysis of the case of problem shifting between the ozone and the climate regime, this article argues that a high degree of fragmentation in the interaction of treaty regimes is one factor to explain the presence of problem shifting between those regimes. This theory enables the identification of relevant features of treaty regime governance structures that need to be adapted to reduce the risk of problem shifting. To test the theory, two pairs of treaty regimes are examined on their degree of fragmentation and the presence of problem shifting between those regimes.

Table of Contents

1. Introduction

Earth System governance is currently structured around problem-specific institutions that tackle one issue area of the Earth System. Because of the System's complexity, more than one thousand international environmental agreements are in place today resulting in a broadly fragmented governance architecture (Biermann et al., 2020). While the underlying assumption of this silo approach is to protect the whole system by protecting its parts individually, the risk of environmental problem shifting between these interlinked parts arises.

Kim and van Asselt (2016) define problem shifting to occur when "a solution for one problem backfires and generates one or more new problems at different times or locations" (p.473). In light of the urgent and threatening environmental challenges humanity faces today, environmental problem shifting should be of serious concern in international environmental governance to enable effective policy solutions (Sterner et al., 2019). Solely shifting a problem to a different location or time is not only unjust to the affected communities and future generations, potential unpredictable cascading effects may threaten all living beings.

Possibly the most prominent example of environmental problem shifting is the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) which promoted the substitution of ozone depleting substances with potent greenhouse gas emitting Hydrofluorocarbons (HFCs), solving the issue in its own domain by shifting it into that of the climate regime, later governed by the United Nations Framework Convention on Climate Change (UNFCCC) (Kim & van Asselt, 2016; UNEP, 2011). Another prominent example is the substitution of gasoline with biofuels, shifting the environmental impacts from greenhouse gas emissions towards *inter alia* increased eutrophication and water consumption (Yang et al., 2012).

While the term 'environmental problem shifting' has so far not attracted wide attention among the scientific community, the phenomenon itself can be found in many studies under different names. For instance, it is closely connected to the highly influential planetary boundary framework which conceptualises humanity's safe operating space within the individual but interlinked issue areas of the Earth System (Rockström et al., 2009a, 2009b; Steffen et al., 2015). This connection has been highlighted by van den Bergh et al. (2015) who call for policy making that controls and discourages problem shifting by including environmental impacts on all planetary boundaries into every strategy assessment. Kim and Bosselmann (2013) relate problem shifting and the interacting planetary boundaries to international environmental law, stressing the lacking consideration of problem shifting in multilateral environmental agreements.

This research seeks to provide useful knowledge on how the risk of problem shifting between international environmental treaty regimes can be minimised through effective international environmental governance. The article aims to answer the central research question *What characteristics in the architecture of international environmental treaty regimes increase the risk of environmental problem shifting between those regimes?* For this purpose, as a first step, a theory on governance

architecture characteristics and their effect on problem shifting between treaty regimes is developed based on an in-depth analysis of the ozone-climate case in light of the literature on governance fragmentation. Secondly, the theory is tested on the regime interaction between the UNFCCC regime and the Convention on Biological Diversity (CBD) as well as between the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE Water Convention).

The contributions of this article are threefold. First, it highlights the significance of problem shifting at the global level. Second, it contributes to the study of international environmental governance by offering a conceptual starting point for the research of problem shifting. Finally, it offers an analytical instrument to identify which features in the architecture of international environmental governance contribute to the risk of problem shifting addressing the central normative question in the study of governance architectures on how governance structures should be constructed or reshaped to improve their effectiveness in achieving their desired goals (Biermann & Kim, 2020).

The remainder of this article is structured as follows. The next section explores the literature on problem shifting and investigates the ozone-climate case in detail. Based on this, in the third section, a theory of problem shifting between environmental treaty regimes is developed. In the following methods section, variables are operationalised and choices in the case selection are laid out. Subsequently, the fifth section presents the results from testing the theory on the two selected treaty regime pairs. In the sixth section, potential implications of the findings are discussed and the theory of problem shifting is put into broader perspective. The article ends with some concluding remarks and recommendations for future research.

2. Environmental Problem Shifting

This article uses the definition of environmental problem shifting by Kim and van Asselt (2016) as a point of departure for the conceptualisation of problem shifting. There are various examples in the literature of environmental governance activities and practices that aim to solve a specific problem but, at the same time, create a different problem at a different context, location or time. However, the terms used to describe this phenomenon are diverse. For instance, Capaz et al. (2020) point at the 'environmental trade-offs' of promoting plant-based renewable jet fuels to decrease aviation emissions which may, however, cause higher terrestrial acidification or air pollution than kerosene. Another example are the 'environmental impacts' of ocean fertilisation which aims to enhance the oceans capacity as a carbon sink by stimulating the growth of plankton but causes ocean acidification and disruptions of the global carbon cycle (Williamson et al., 2012). Other terms found in the literature are 'unintended consequences' (Kiesecker et al., 2019) or 'unintended side-effects' (Grunwald, 2018).

Environmental problem shifting can be split into three parts represented by the three words of the term. The first word, 'environmental', defines the subject matter of the concept. Environmental problem shifting considers environmental factors only, which delineates the concept from considerations between environmental and economic or social factors (compare 'environmental trade-offs' in life cycle assessments, for example Modahl et al., 2012; Umer et al., 2017; Wu et al., 2019). However, in addition to their environmental consequences, some cases of problem shifting lead to negative socio-economic effects. For instance, the potential impacts of biofuel production on food prices has been discussed extensively (Ajanovic, 2011; Herrmann et al., 2018). In addition, as Jones (2018) points out, actions to mitigate environmental impacts often burden already marginalised communities disproportionately creating additional social problems out of environmental ones. To increase its feasibility, this article focuses solely on environmental problem shifting.

The term 'problem' seems intuitive but is hard to define and, therefore, challenging to conceptualise or to measure. To keep it simple, this article follows the definition in the Oxford Dictionary. A problem is a harmful situation that can be solved through action ("Problem," n.d.). Because of its subject matter, problem shifting only includes such conditions that are objectively considered (i.e. scientifically proven) to be harmful, explicitly excluding those that are subjectively perceived as harmful.

'Shifting' refers to a problem being intentionally or unintentionally transferred to a different location (spatial) or time (temporal) or the problem being transformed to a different type (Kim & van Asselt, 2016). This further indicates the broad scope of problem shifting as the shift can occur between different contexts, on all geographical levels and into the future.

Combined, the three parts result in the conceptualisation of problem shifting as the spatial or temporal transfer or transformation of an objectively harmful condition within the environmental domain. One reason why there are many different terms to describe the concept of problem shifting might lie in the difficulties the definition and connected measurability of the term 'problem' brings with it. To the best of the author's knowledge, there has been no comprehensive research carried out that aims to assess the significance of problem shifting in international environmental governance.

Nevertheless, problem shifting should be of concern in the study of environmental science and policy as its relevance, especially at the global level, cannot be underestimated. Problem shifting can be found between the Earth's interacting subsystems as conceptualised in the planetary boundary framework. While these interactions can be of synergistic nature, changes in one subsystem, for example through human interventions, can cause negative impacts in another subsystem (Steffen et al., 2015). In times of the Anthropocene, humanity has become a major geological force impacting the Earth System at the global level and with increasingly severe consequences (Crutzen, 2002; Rockström et al., 2009a, 2009b; Steffen et al., 2015). Human activities that aim to solve a problem at the global scale but instead shift it to another Earth subsystem might have unprecedented and unpredictable consequences for life on Earth. Because the initial problem and the newly created problem can exist in very different settings, a quantitative comparison between the significance of both, weighing up which problem has the lower overall impact, is often not feasible at a global scale.

Therefore, for effective international environmental governance, the focus must lie on implementing architectural characteristics of international environmental treaty regimes that avoid problem shifting in the first place.

To better understand the risks and consequences of problem shifting at the global level, it seems sensible to explore the most prominent case in international environmental governance in detail: the ozone-climate case in which the Montreal Protocol promoted the substitution of ozone depleting substances with potent greenhouse gas emitting HFCs, solving the issue in its own domain by shifting it into that of the climate regime. The Montreal Protocol from 1987, adopted under the Vienna Convention for the Protection of the Ozone Layer from 1985, regulates the global phase out of ozone depleting substances to reduce human impacts on the Earth's protective ozone layer. While these substances are also powerful greenhouse gases with a global warming potential four to five orders of magnitude higher than carbon dioxide, the ozone regime did "not contain an obligation to consider any global warming impact or other wider environmental impacts" when it was originally constructed (Oberthür, 2001, p. 368). Still, the physiochemical connection between stratospheric ozone depletion and the climate crisis is apparent.

The UNFCCC was established at the Earth Summit in Rio de Janeiro in 1992 as the first environmental agreement concerning anthropogenic interference with the climate system and causing global warming. As the name suggests, the convention was set up as a relatively broad starting point from which further agreements and protocols should follow to introduce specific actions towards the convention's objective. In 1997, the Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol) was adopted which set the first greenhouse gas emission limitations and reduction commitments for industrialised countries. It delineated itself from the ozone regime by covering all greenhouse gas emissions except those controlled by the Montreal Protocol (Kyoto Protocol, 1997). This convention plus protocol setup is clearly inspired by the ozone regime – a first structural link between the two treaty regimes (Oberthür, 2001). The Paris Agreement, signed in 2015, is often regarded as a major success in international environmental governance as it, for the first time, formulates a universal target, i.e. to limit global warming to 1.5 degrees Celsius compared to pre-industrial times. However, there is doubt if the introduced mechanisms to receive the necessary global greenhouse gas emission reduction, the 'Nationally Defined Contributions', are indeed effective (Lawrence & Wong, 2017; Pickering et al., 2019).

The physiochemical connection of the two issue areas through substances that harm both the stratospheric ozone layer as well as the climate system, is where problem shifting occurs. Amended five times, the objective of the ozone regime remains the same, i.e. to protect the ozone layer by phasing out ozone depleting substances, while the approach to reach that goal has been modified over time. First, the Montreal Protocol regulated the phase out of two groups of ozone depleting substances, Chlorofluorocarbons (CFCs) and halons while allowing the use of Hydrochlorofluorocarbons (HCFCs), a less potent ozone depleting substance, as a substitute. The agreement on suitable substituting substances was a crucial point during the negotiations of the Montreal Protocol without

which the approval of the ozone regime would not have been this high (Oberthür et al., 2011). With the production and use of CFCs decreasing quickly, attention shifted to the now increased production of HCFCs which were the next group of ozone depleting substances for which the Montreal Protocol regulated the phase out until 2030 in industrialised countries and until 2040 in developing countries (Oberthür et al., 2011). As a substitute for CFCs and HCFCs, HFCs became more and more popular. From the perspective of the ozone regime, HFCs appeared to be the ideal solution as they do not harm the ozone layer and the chemical producing industry could relatively adapt to producing HFCs (Reinstein, 2005). However, while HFCs are non-ozone depleting substances, they are still powerful greenhouse gases. With the global increase in HFC production, the problem has simply been shifted to the climate regime.

Already at the time, it was well known that HFCs are such powerful greenhouse gases. They are one of the six groups of greenhouse gases controlled under the Kyoto Protocol which requires the reduction of emissions of HFCs (Oberthür et al., 2011). Thus, the climate regime already dealt with HFCs in its own separate way. Here, the silo approach of international environmental governance lead to a situation where one issue is handled by two treaty regimes independent from another. While the Montreal Protocol promoted the use of HFCs, the Kyoto Protocol suggested to decrease it. This resulted in a shift of production of HFCs from industrialised countries to developing countries (Seidel et al., 2015). By the turn of the century, only a few countries were not parties to both treaty regimes. Eventually, almost all industrialised countries faced the problem that they somehow needed to substitute CFCs and HCFCs while at the same time reducing their greenhouse gas emissions. Using HFCs as substitute for the ozone depleting substances was only possible if the targets of the Kyoto Protocol were reached through the reduction of other greenhouse gases. In this regard, the problem shifting resulted in an inconvenient but manageable situation for industrialised countries. Developing countries, on the other hand, did not face such decisions since they were not bound to the emission reduction targets of the Kyoto Protocol. No wonder, China and India (grouped with 'developing countries' in the Kyoto Protocol) are the two largest producers of HFCs today (Stanley et al., 2020).

The issue of problem shifting was recognised within both treaty regimes but discussions around it were half-hearted (Oberthür, 2001). In 1999, a joint workshop was held but the "subsequent political debates remained largely inconclusive" (Oberthür et al., 2011, p. 122). Hence, there was no direct cooperation between the two treaty regimes and the climate regime remained unable to react because of the deadlock delineation in the Kyoto Protocol. Eventually, the case of problem shifting was addressed by the 2016 Kigali Amendment to the Montreal Protocol, regulating the phase out of the production and use of HFCs. By requiring the phase-out of non-ozone depleting substances, the Montreal Protocol diverges from its initial approach not to include any other environmental impacts than those on the ozone layer. And while the Kigali Amendment, in theory, puts an end to the problem shifting, it remains open when large HFC producers, such as China and India, will ratify and

successfully implement the amendment and how much unaccounted HFCs will be produced until then (Hoch et al., 2019; Simmonds et al., 2018; Stanley et al., 2020).

This example illustrates the significant consequences of problem shifting between treaty regimes. Only after considerable effort, the case could be solved through the breaking of the silo approach (of international environmental governance) by one treaty regime. The case further demonstrates the need for effective environmental governance that is not only able to solve cases of problem shifting but avoids them in the first place. Yet, the scientific community has not paid much attention to problem shifting falling short of providing much-needed knowledge enabling the creation of synergies between environmental regimes for effective environmental governance in the Anthropocene (Biermann et al., 2009; Johnson & Urpelainen, 2012; Jordan & Lenschow, 2010; Oberthür, 2009).

The few existing articles concentrate on the conceptualisation of problem shifting and its relevance in international environmental governance (Kim & Bosselmann, 2013; Kim & van Asselt, 2016). Potential cases of problem shifting have been explored qualitatively (van den Bergh et al., 2015) and quantitively (Yang et al., 2012). However, so far, cases of problem shifting have only been studied in case-specific research and do not provide any comparability between cases.

The interactions of international environmental treaty regimes has been studied with different focus points such as regime integration (Johnson & Urpelainen, 2012), the network of international environmental treaty regimes (Kim, 2019) or the increasing complexity of global environmental policy-making (Oberthür et al., 2011). In particular, the interactions of the climate regime and its role in international environmental governance have been in focus (see for example Hoch et al., 2019; Smith et al., 2019; van Asselt, 2014a). The possible synergies between international environmental regimes have received considerable attention (see for example Medvedieva et al., 2018; van Asselt, 2014b), but without consideration of problem shifting. While unintended consequences may be recognised by some, the shifting to another domain remains abstract (van den Bergh et al., 2015).

This article seeks to address these gaps by contributing a first theoretical approach to analyse what architectural characteristics of international environmental governance might underlie problem shifting between treaty regimes and to provide insights facilitating effective governance structures that are able to avoid problem shifting. Thus, this article also adds to the body of knowledge on structural fragmentation, an area that has, other than on functional fragmentation, not seen significant attention (Biermann et al., 2020).

3. Theory

International treaties, whether environmental or of any other field are part of a larger structure, the treaty regime or regime complex. Krasner (1983) defines international regimes as "sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of inter- national relations" (p.2). Following this definition, treaty regimes comprise the agreement itself as the central norm-setting and constituting document, its

amendments and protocols, the treaty secretariat as well as the meetings of the signatory states usually called conferences of the parties. States that are parties to the international agreement are not in themselves part of the regime but sovereign actors in international relations. This puts the concept of treaty regimes between the institutional and the overarching structural level of international governance allowing the analysis and comparison of issue-specific complexes (Gómez-Mera et al., 2020).

Environmental treaty regimes are constructed following a silo approach, i.e. there are various environmental regimes that tackle one specific environmental issue, some succeeding and some failing (Young & Stokke, 2020). However, multiple international treaty regimes might deal with the same environmental issue area. Within the Earth system, these issue areas are interconnected as conceptualised by the planetary boundary framework (Rockström et al., 2009a, 2009b; Steffen et al., 2015). The crucial point is that most treaty regimes create a hierarchy of issues in which their decisions primarily concern their core objective, but do not consider the interaction of the planetary boundaries and hence the regimes' impact on other issue areas (Ebbesson, 2014). Therefore, problem shifting can occur. The focus on one issue area introduces the risk of problem shifting from the core issue to another indirectly impacted area. It is assumed that, despite their concentration on one core issue area, avoiding negative effects on other issue areas lies within the interest of treaty regimes as cascading problems might eventually prevent them from reaching their core objective.

In the network of planetary boundary interactions, not all planetary boundaries are directly connected with each other and some have a stronger interactions (Lade et al., 2020). Hence, a necessary condition for problem shifting between treaty regimes is the biophysiochemical connection between the regimes' underlying issue areas. Changes in one planetary boundary, especially in the two core boundaries, climate change and biosphere integrity, still affect the whole system and therefore indirectly impact all other planetary boundaries. But system dynamics lie outside the scope of problem shifting as they are an inherent characteristic of complex systems. Furthermore, other kinds of problem shifting that include socio-economic factors can occur between all environmental treaty regimes, whether their issue areas are interconnected or not.

Despite the silo approach of environmental treaty regimes, they do not exist in isolation but are connected with each other in a complex network that has "coevolved with the increasing complexity and interconnectivity of global environmental challenges" (Kim, 2013, p. 980). The interacting treaty regimes are part of the larger Earth System governance architecture. While the term has been used in various ways, this article follows Biermann et al. (2009) defining governance architecture to be "the overarching system of public and private institutions that are valid or active in a given issue area of world politics" (p.15).

One structural quality of governance architectures is fragmentation. A common point of departure in the large body of literature on governance fragmentation is, again, the definition by Biermann et al. (2009) who identify fragmentated governance architecture as "a patchwork of international institutions that are different in their character (organizations, regimes, and implicit norms), their constituencies (public and private), their spatial scope (from bilateral to global), and their subject matter

(from specific policy fields to universal concerns)" (p.16). The concept itself is a value-free structural quality of governance architectures (Pattberg et al., 2014; Zelli & van Asselt, 2013). However, different degrees of fragmentation are likely to show differences in governance performance. Since governance fragmentation is a quality of an entity, it is a comparable variable that is inherent to today's international relations (Biermann et al., 2020; Zelli & van Asselt, 2013). In their analytical framework on governance fragmentation, Biermann et al. (2009) name three criteria for assessing the degree of governance fragmentation, i.e. actor constellation, institutional integration and norm conflicts. Although the concept of governance fragmentation is initially designed to characterise the overarching architecture of a governance system, it can also be applied to a part of a governance system. Regarding the complex network of environmental treaty regimes, the three criteria can also be applied to the interaction of pairs of treaty regimes.

Since the degree of fragmentation is likely to show differences in the effectiveness of treaty regimes, the fragmentation in the interaction of treaty regimes might indicate the risk of problem shifting. Highly fragmented treaty regimes might be less able to detect and solve problem shifting, whereas more integrated treaty regimes may have the capacity to avoid problem shifting in the first place or to settle problem shifting if it still occurs. The point that fragmented treaty regime interaction lead to an ineffective, non-optimal functioning of the treaty regimes has been highlighted before (Biermann et al., 2009; Kotzé, 2019; Pankakoski & Vihma, 2017; Zelli & van Asselt, 2013). These considerations lead to the main hypothesis of this article.

In highly fragmented interactions of two treaty regimes, problem shifting will occur.

Alternative Explanations

While this paper focuses on the fragmentation between two treaty regimes, it is important to consider alternative explanations of problem shifting between treaty regimes. These factors relate to the connection between two treaty regimes or to the characteristics of their issue areas.

It is a necessary condition of problem shifting between international environmental regimes that their respective issue areas interact. A first alternative explanation of the presence of problem shifting follows from this condition. The more one issue area overlaps with other issue areas, the more possible cases of problem shifting there are involving that treaty regime, hence, the more likely problem shifting is present regarding that regime. Furthermore, the interaction between some issue areas is stronger than between others (Lade et al., 2020). It appears that the stronger this connection, the higher the risk of problem shifting.

In the ozone-climate case, the complexity of the issue might have been a factor that led to problem shifting. A solution in the relatively simple issue area of ozone depletion caused a problem in the highly complex area of climate change. Complex problems are, by definition, more difficult to solve. They are also likely to be interconnected to a multitude of other problems, thereby further increasing the risk of problem shifting.

The risk of problem shifting might also be due to different degrees of politicisation of the issues. Decision-makers might address those environmental problems first that receive the highest public attention. Closely related to politicisation, another factor might be differences in the urgency of the issue areas. Decision-makers might intentionally accept shifting a problem to a less urgent area if it would provide a short-term success in a more urgent matter. Both, perceived and actual urgency could explain such decisions.

The high quantity of potential explanations of problem shifting between environmental treaty regimes make a holistic assessment of the phenomenon a thoroughly challenging if not impossible quest. For now, problem shifting remains a fuzzy concept. The analysis of possible explanations in the architectural characteristics of treaty regime interaction, however, potentially offers findings that can be used to improve the effectiveness of environmental governance that applies to all issue areas.

4. Methods

Variable Operationalisation

The dependent variable is the presence of problem shifting. In order to test the hypothesis, the dependent variable is operationalised as a binary variable. Problem shifting between two treaty regimes is either present or absent. A survey of the regime interaction literature provides evidence on cases of problem shifting. For each treaty regime pair, the literature is searched for 'problem shifting' and similar terms (negative side-effects, negative spill-overs, unintended consequences, unintended impacts, environmental trade-offs, rebound effects, negative cascading effects). The search results are then reviewed to identify those articles that address the presented concept of problem shifting. The absence of corresponding literature suggests the absence of problem shifting since it is assumed that cases of problem shifting at the global level have already been identified and addressed in the scientific literature.

The independent variable, the degree of fragmentation between two treaty regimes, is further split into explanatory factors based on the criteria of the analytical framework by Biermann et al. (2009), namely actor constellation, institutional integration and norm conflicts. In the analysis of treaty regime interaction, the three criteria translate into four explanatory factors: membership overlap, partnerships, eschewal of rigid delineation and flexibility of norms. Treaty regime pairs are examined on whether they show characteristics of synergistic, cooperative or conflictive degree of fragmentation regarding these four explanatory factors.

The first explanatory factor, 'membership', addresses the actor constellation of two treaty regimes. States, due to their role in the negotiations prior to the adoption of agreements, their signature and ratification of the treaty as well as due to their role during conferences of the parties are the core actors that define the subject and scope of the treaty regime. Similar to how Sommerer and Tallberg (2019) utilise membership to explain diffusion across international organisations, 'membership' can be a sign of conflictive fragmentation between two treaty regimes where major actors support only one

of the two treaty regimes and where the overall membership overlap is small. A high membership overlap and the support of most relevant countries for both treaty regimes indicate synergistic fragmentation that might ease information availability, decision making and organisational processes (Oberthür, 2002).

The second explanatory factor is 'partnerships' and addresses institutional integration between treaty regimes. While recent research focuses increasingly on the roles of treaty secretariats as actors with some political influence of their own (Hickmann et al., 2019; Jinnah, 2010), their primary duty remains servicing the member countries as a treaty's core institutional body. Synergistic fragmentation is present if the secretariats of two treaty regimes are closely connected through partnerships, memoranda of understanding or joint working groups. If those institutional links are absent and secretariats are largely unrelated, conflictive fragmentation might be present.

The third and fourth explanatory factors both address norm conflicts between treaty regimes. There is only a limited hierarchy of norms in public international law. Therefore, norm conflicts can occur when a party to two treaties "cannot simultaneously comply with its obligations under both treaties" (Jenks, 1953, p. 426). Following Biermann et al. (2009), conflicting core norms are a sign of conflictive fragmentation whereas integrated norms suggest synergistic fragmentation. One option to prevent or settle norm conflicts are conflict clauses that are included into the treaty text to clarify which norm is applicable in a certain conflict (Matz-Lück, 2010). In the ozone-climate case, the demarcation of the Kyoto Protocol through a conflict clause prevented the potential conflict between the two regimes on greenhouse gases relevant to both issue areas. However, the rigid delineation left no room for adjustments regarding the interaction of the two issue areas, leaving the climate regime in a deadlock, unable to react to the case of problem shifting. Therefore, the 'eschewal of rigid delineation' is the third explanatory factor. Conflict clauses that result in rigid delineation are a sign of conflictive fragmentation whereas conflict clauses that prevent or settle norm conflicts without limiting the treaties scope of action imply cooperative fragmentation.

Besides settling norm conflicts by formulating an additional norm (conflict clauses), norm conflicts can be also settled by adjusting the relevant norms. If treaty regimes are generally open to amendment, they can, in theory, react more flexibly to conflicts that arise with other regimes as well as to problem shifting. In the ozone-climate case, independent of whether the Kigali Amendment solved or only mitigated problem shifting, it was the Montreal Protocol's "solid but flexible" (Birmpili, 2018, p. 425) design that enabled this reaction. Revising and amending the treaties seems to be a reasonable first action to avoid and react to any negative unintended side-effects between treaty regimes. However, a general elasticity in the treaty's core norms, i.e. the scope of interpretation, as well as the willingness of the parties to revise their previous decisions are necessary to adapt a treaty regime in that way. Scholars have already argued that flexible decision-making improves treaty regimes' performance (Kim et al., 2017). In the case of the Montreal Protocol, some scholars argue that it was also the agreement's flexibility that led to its high adoption rates (Birmpili, 2018). This allowed the treaty regime to address the problem shifting with the Kigali Amendment. Hence, the fourth explanatory factor is the 'flexibility of norms' describing both, the elasticity of a norm and the effort necessary to adjust or amend the treaty. It asks how the treaty regime can adapt to emerging challenges

such as problem shifting through the flexibility given by its existing norms or through an adjustment of the treaty. Here, inflexible norms and hard to change treaty texts are not necessarily a sign of conflictive fragmentation and neither does the opposite directly imply synergistic fragmentation. Still, a high flexibility of norms eases the reaction to problem shifting while a low flexibility obscures solving the issue.

Case Selection

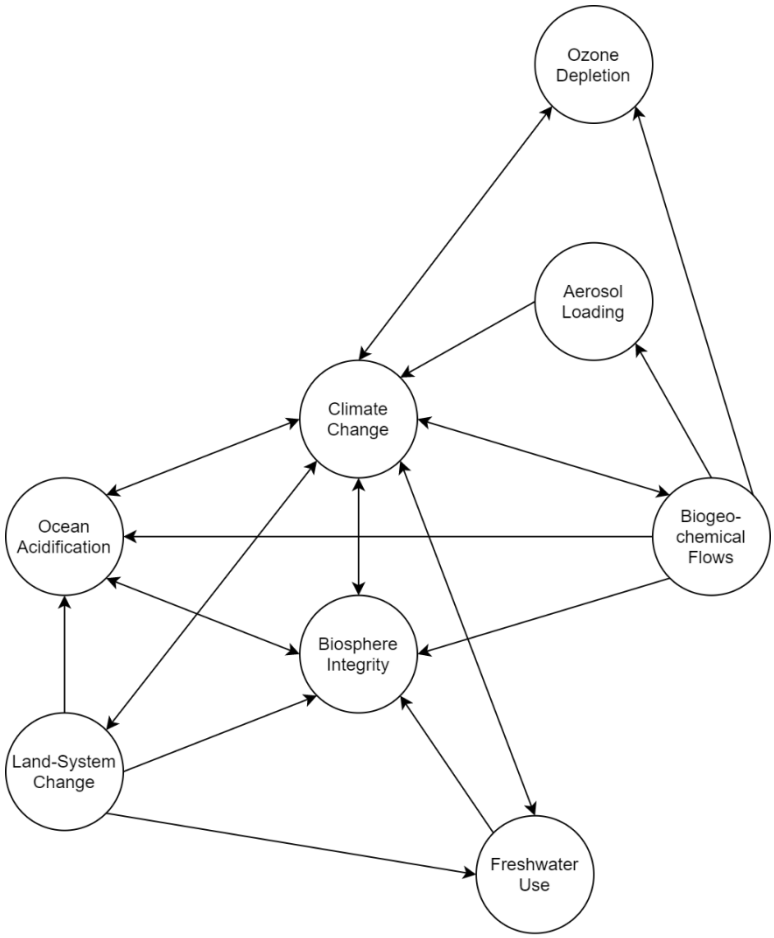

Figure 1: Biophysiochemical interaction of the planetary boundaries (adopted from Lade et al., 2020)

Problem shifting between international environmental treaty regimes does only occur where the underlying issue areas interact. Relevant global issue areas are conceptualised by the planetary boundary framework. Figure 1 shows the biophysiochemical interactions of the nine planetary boundaries adopted from Lade et al. (2020). Categorising treaty regimes according to the planetary boundaries they address has been done before (Ebbesson, 2014).

It is important to note that since the planetary boundaries and their biophysiochemical interactions are models that are only a representation of the real world, and since assigning treaty regimes to planetary boundaries requires some interpretation and is not in every case clear-cut, there can still be problem shifting between treaty regimes that seem not connected in this setting. The necessary

condition of interacting issue areas (that planetary boundaries or any other model might not perfectly represent) still applies.

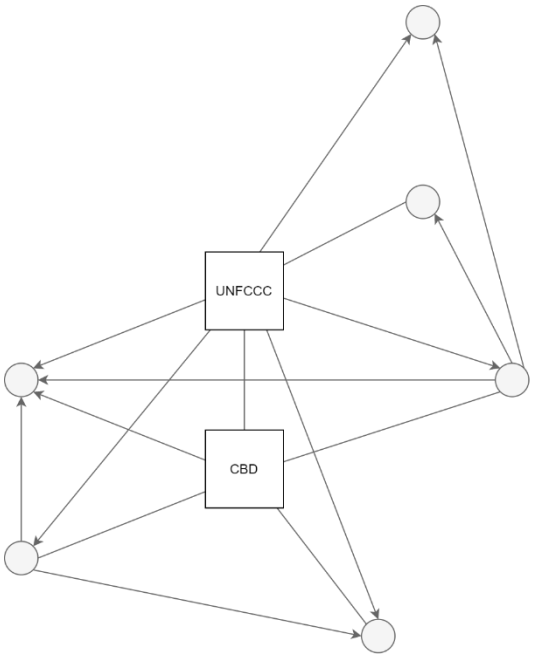

Figure 2: UNFCCC and CBD within the interacting planetary boundaries

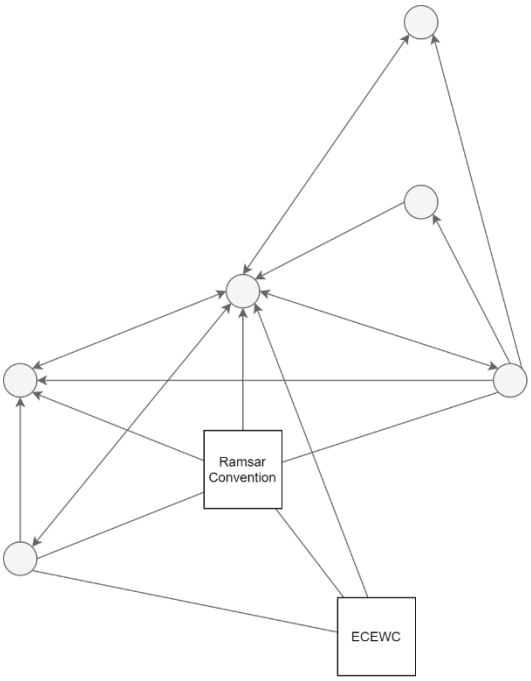

Figure 3: Ramsar Convention and UNECE Water Convention within the interacting planetary boundaries

The above theory will first be tested the interaction between the UNFCCC and the CBD. The two Rio Conventions seem to be natural candidates for the application of the theory since they are the core treaties on the two most pressing and interlinked environmental issues, the climate crisis and the biodiversity crisis as presented in Figure. In addition, they share a common history as they were both submitted for adoption to the Earth Summit in Rio de Janeiro in 1992. Similar to the aspirations of the UNFCCC to become the main treaty regime concerning the climate system, the CBD set out to become the central convention in addressing the conservation of biological diversity.

The underlying issue areas, the climate crisis and biodiversity loss, are not only the two most dangerous environmental threats for humanity, their interlinkages are also multifaceted and complex, so that solving one without addressing the other might be impossible. They are the core planetary boundaries that all other boundaries connect to and interact through (Lade et al., 2020; Steffen et al., 2015). The climate crisis poses major threats to the conservation of biodiversity and ecosystem stability. These negative impacts include shifts in species distribution, habitat loss and even regional extinction (IPBES, 2019). At the same time, stable and diverse ecosystems are more resilient to a changing climate, helping to secure the continued survival of plants and animals, including humans. Thus, actions to combat biodiversity loss can decrease the impacts of climate change and actions mitigating climate change can offer synergies for the conservation of biodiversity (IPCC, 2015; Secretariat of the Convention on Biological Diversity, 2016).

The second case considers the interaction between the Ramsar Convention and the UNECE Water Convention. The location of their underlying issue areas is presented in Figure. This connection has been highlighted before (De Charzournes et al., 2015; Lee, 2015; Verschuuren, 2008, 2010). As the official name suggests, the Ramsar Convention initially sought to protect the natural habitats of freshwater birds when it was adopted in 1971. Over the years, the objective of the treaty slowly expanded to the protection of the whole ecosystem of wetlands (Lee, 2015). While this objective is clearly to be categorised in the biosphere integrity planetary boundary, the protection of wetlands is closely connected to other issue areas, including climate change, land-use change, biochemical flows, and freshwater use.

The UNECE Water Convention, which was introduced in 1992, concerns the use of freshwater initially only open to states inside the United Nations Economic Commission for Europe (UNECE) region. In 2016, however, it followed its global aspirations by opening up to countries worldwide (Fitzmaurice & Merkouris, 2015). The treaty's objective is the prevention of transboundary environmental impacts related to transboundary water management. The UNECE Water Convention is not to be mistaken with yet another freshwater treaty, the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (UN Watercourse Convention).

Issue overlaps between the two treaties stem from the importance of freshwater resources for wetlands. One fourth of the under the Ramsar Convention protected wetlands are transboundary river basins (Ramsar Convention Secretariat, 2010). Scholars have already pointed at the potential synergies of transboundary wetland protection (Lee, 2015; Verschuuren, 2010).

This case selection is based on several considerations. First, the cases hold a substantive importance. The interaction between the climate and the biodiversity domains is an obvious candidate as the two issue areas are identified as the core planetary boundaries which originate and share the most interactions between the planetary boundaries (Lade et al., 2020; Steffen et al., 2015). This significance is also represented in the substantial literature on the interlinkages of the UNFCCC as the central climate treaty regime and the CBD as the most encompassing on biodiversity. Furthermore, the Ramsar Convention provides an interesting case being by far the oldest and most specific of the selected treaty regimes. The UNECE Water Convention is interesting because it is a regional treaty with global aspirations that is in a competing situation with the UN Watercourse Convention.

Secondly, the case selection illustrates the generalisability of the theory. The first case consists of two treaty regimes with the same age and global scope as well as a comprehensive approach within their issue area. In contrast, the second treaty regime pair differs in age and geographic scope. Overall, the selection thus provides a diverse mix, seeking to obtain transferable and generalisable results.

5. Results

This section presents the results from testing the theory on two pairs of treaty regimes summarised in Table 1.

Table 1: Summary of interactions between two treaty regimes pairs

Cases	**Degree of governance fragmentation**				**Problem shifting**	
	Membership	*Partnerships*	*Eschewal of rigid delineation*	*Flexibility of norms*	*Predicted outcome*	*Actual outcome*
UNFCCC – CBD	Cooperative	Conflictive	Synergistic	Cooperative	Present	Present
Ramsar Convention – UNECE Water Convention	Synergistic	Cooperative	Synergistic	Synergistic	Absent	Absent

UNFCCC – CBD

From the date of agreement in 1992, there has been a high membership overlap between the UNFCCC and the CBD. Today, both have reached near universal membership. Yet, as the United States is a notable exception to the membership of the Kyoto Protocol and the CBD but is a party to the UNFCCC, an important barrier to enhancing coordination between the two treaty regimes remains (van Asselt, 2014b). Overall, this suggests a cooperative degree of governance fragmentation.

Moving on the second explanatory factor, the UNFCCC and the CBD established various partnerships during their time of existence. Most importantly, the Joint Liaison Group, which also includes the United Nations Convention to Combat Desertification, was established to ease capacity building and technology transfer between member states. However, the potential of such a body in the promotion of synergistic actions and in reducing problem shifting remains unfulfilled (van Asselt, 2014b). Another direct link between the two treaty regimes, though not a formal partnership, is the Global Environment Facility that functions as the financial mechanism of both treaty regimes. However, since its task is not decision-making but the operationalisation thereof, it remains unclear if and what synergistic and conflict-avoiding potentials lie in a shared financial institution. Another indicator for the rather loose institutional connection between the two treaty regimes yields the observation of the CBD sharing many more partnerships with other treaty regimes within the biodiversity issue area, for example with the Convention on Migratory Species and the Convention on International Trade in Endangered Species of Wild Fauna and Flora. By and large, given the significant overlap of

their underlying issue areas, the lose partnership between the two treaty regimes implies conflictive fragmentation.

Regarding the treaty regimes' norms, there is no explicit delineation between the UNFCCC and the CBD. Both conventions recognise the significance of the other issue area for their own objective (van Asselt, 2014b). Both treaties contain conflict clauses that are implicitly (in the case of the Kyoto Protocol) and explicitly (in the case of the CBD) referring to the other regime but both fall short of addressing potential conflicts between the two regimes (van Asselt, 2014b). Still, other than in the ozone-climate case, the conflict clauses do also not prohibit the treaty regimes from reacting to potential conflicts, including problem shifting, because of the clauses' vague form. This thus suggests synergistic fragmentation.

On the fourth explaining factor, the climate regime has demonstrated a quite flexible approach with the adoption of the Paris Agreement. Hurdles from negotiations prior to Copenhagen have been overcome and the top-down emission limit approach set by the Kyoto Protocol was replaced by bottom-up nationally determined contributions. Moreover, in terms of norm elasticity, the approach of the Paris Agreement that combines ambitious procedural commitments with the soft-law mechanisms of the nationally determined contributions promises to address emission reduction in a flexible way that would also allow to factor in other environmental effects such as impacts on biodiversity (Pickering et al., 2019). Regarding the norms of the CBD, most of the treaty's provisions are phrased rather generally signifying a high norm elasticity (Chaytor et al., 2002). Yet, both treaty regimes are rather slow in adopting changes. The praise for the Paris Agreement may be partly based on the frustrations of earlier extensive but unsuccessful negotiations, in particular those around the Copenhagen conference. Overall, the factor 'flexibility of norms' indicates cooperative fragmentation between the two treaty regimes.

Following the hypothesis, the theory points to a likely presence of problem shifting between the two treaty regimes that is mostly based on the loose partnership and resulting seemingly half-hearted cooperation and less on normative conflicts. This is in line with the findings from the literature. One example for problem shifting in the implementation of the climate regime to the biodiversity regime are improperly located solar and wind energy parks that are used to reach the Paris Agreement emission reduction goals while they can impact thousands of already endangered species (Kiesecker et al., 2019). Smith et al. (2019) warn of the negative effects of an intensified bioenergy production on biodiversity. The most prominent example for problem shifting mentioned in the literature, however, is the utilisation of forests as carbon sinks. Reforesting drylands with highly fertilised monocultures offers effective carbon sequestration (Ferez et al., 2015). Yet, the disruptive mitigation measure has been criticised widely on its disruptive impacts on ecosystems and biodiversity (Sagemüller, 2006; Smith et al., 2019; van Asselt, 2014b; Van Asselt, 2011).

Ramsar Convention – UNECE Water Convention

All countries that are parties to the UNECE Water Convention are also parties to the Ramsar Convention. Following the theory, the high membership overlap suggests synergistic fragmentation.

Regarding the second explanatory factor, so far, partnerships between the two treaty regimes have been informal and are not manifested in formal agreements between the treaties' secretariats. However, both treaty regimes take part in UN-Water, the United Nations' forum on all freshwater issues (UN-Water, 2020). The informal partnerships point to cooperative fragmentation.

Moving on to the third factor, the two treaty regimes do not explicitly delineate themselves from each other. There are no conflict clauses that could apply in the event of problem shifting. The Ramsar Convention covers the overlap of the two treaties' objectives with a specific provision concerning transboundary wetlands (Verschuuren, 2010). Overall, this suggests a synergistic degree of governance fragmentation.

Both treaty regimes have demonstrated quite flexible norm developments. Over the years, the Ramsar Convention evolved from a species-focused to an ecosystem-focused convention, demonstrating its ability to adjust its objectives and norms where desirable. Furthermore, the definition in the Ramsar Convention of 'wise use of wetlands' has been revised several times to streamline the parties' actions for the conservation of wetlands (Verschuuren, 2010). The UNECE Water Convention has also proven its adaptive flexibility with the adoption of subsequent protocols and the further development of principles and guidelines "to actively face the challenges linked to the practical application of its provisions" (Bernardini, 2015, p. 33). Opening the treaty for adoption from outside the UNECE region is another indicator of flexibility in the treaty's principles. Overall, the high 'flexibility of norms' suggest synergistic fragmentation between the two treaty regimes.

With three out of the four factors indicating synergistic and one suggesting cooperative fragmentation, the theory implies the absence of problem shifting between the Ramsar Convention and the UNECE Water Convention. This is also reflected in the absence of literature pointing to problem shifting between the two treaty regimes. The articles, that were found, all highlight potential benefits of intensified cooperation and implementing conflict avoiding clauses regarding transboundary wetlands, but do not refer to possible conflicts (De Charzournes et al., 2015; Lee, 2015; Verschuuren, 2008, 2010).

6. Discussion

The hypothesis, that problem shifting will occur in highly fragmented interactions of two treaty regimes, is not falsified by the findings of the two case studies. In both cases, the predictions based on the hypothesis are reflected in the actual outcome. The degree of fragmentation in the treaty regime interaction seems to correlate with the presence and absence of problem shifting. This contributes to the general scientific consensus that a higher degree of fragmentation leads to ineffective

governance. Yet, alternative explanations of the presence of problem shifting are possible. Therefore, the risk of problem shifting can only be reduced but not necessarily eliminated by improvements to governance structures.

Hickmann et al. (2020) observe that the literature on treaty regime interaction focuses on conflicts between regimes. This article provides a first comprehensive conceptualisation of the negative effects that can arise from these regime conflicts, providing valuable insights into the effectiveness of international environmental governance. Still, the concept of problem shifting remains difficult if not unfeasible to quantify, at least at the global level. One option, as already suggested by van den Bergh et al. (2015), would be to use the planetary boundary framework to assess the impacts of decisions under one treaty regime to the associated planetary boundary of another regime. However, determining causality between the decisions and actions of a treaty regime and changes in the planetary boundaries' broad control variables seems rather challenging.

The contributions of this article to the growing body of literature on international environmental governance are at least threefold. First, it highlights the significance of problem shifting at the global level and the need for a better understanding thereof. While the phenomenon can be observed at all levels of environmental studies, cases of problem shifting on a global scale, as those considered during this research, can have severe impacts on the Earth System. Unaddressed problem shifting at the global level might lead to a spiral of negative cascading effects that lead to shrinking the System's capacity to support humanity.

Second, this research highlights the challenges of assessing and researching the fuzzy concept of problem shifting. In the still sparse literature on problem shifting, this theory provides a conceptual starting point, scholars can use to identify underlying conditions or to create instruments to prevent problem shifting.

Finally, the article offers an analytical instrument to identify which factors in the architecture of international environmental governance contribute to the risk of problem shifting. The central normative question of the study of governance architectures is how governance structures should be constructed or reshaped to improve their effectiveness in achieving their desired goals (Biermann & Kim, 2020). In light of the Anthropocene, scholars of international environmental governance have called for a rethinking of international institutions (Dryzek, 2016), for policies that address the underlying mechanisms of the Earth System (Sterner et al., 2019) and for constructive interactions between scholars and decision-makers involved in the study and negotiation of international environmental regimes (Young, 2018). As presented in the results section, the application of the theory to cases of interacting environmental treaty regimes provides valuable starting points for considerations on the architectural factors that should be addressed by decision-makers to minimise the risk of problem shifting and hence, to increase the effectiveness of international environmental governance. In this study, the theory is applied to regimes in different issue areas. However, the theory could equally be applied to cases of problem shifting between regimes within one issue area.

From the two case studies, some policy recommendation can be drawn. The interaction between the UNFCCC and the CBD contains a high risk of problem shifting due to the close interlinkages of the issue areas, but also through its high degree of fragmentation. The two treaty regimes should further deepen their partnership through a binding agreement that addresses problem shifting between the two domains and assures concrete mutual activities to decrease the effects of present problem shifting and to prevent future problem shifting. Another step could be the establishment of a joint institution solely commissioned to ensure the mitigation of problem shifting and the alleviation of synergistic and holistic policies. Structurally, the most effective way to mitigate problem shifting between the two treaties would be to merge the two treaty regimes into one, although this seems unlikely to be feasible in practice.

Intensifying partnerships is also the main recommendation for the second case regarding the Ramsar Convention and the UNECE Water Convention. In this instance, the advantages of a deeper cooperation between the two regimes lie not in the reduction of problem shifting but in the potential benefits regarding the complementing objectives of the two treaties and cooperation in the protection of transboundary wetlands. Furthermore, while no problems are currently shifted between the two treaty regimes, the risk of future problem shifting should not be neglected which the treaty regimes could better address with a strengthened partnership.

7. Conclusion

Environmental problem shifting is a sign of ineffective international environmental governance that concentrates on the Earth's sub-systems in a silo approach. One factor explaining the presence of problem shifting between environmental treaty regimes is the degree fragmentation the interaction of the treaty regimes. The theory presented in this article proposes the four relevant factors 'membership overlap', 'partnerships', 'eschewal of rigid delineation' and 'norm flexibility'. Applying the theory to cases of treaty regime interaction allows the identification of the relevant characteristics of the governance structures between those treaty regimes that need to be addressed to reduce the risk of problem shifting. The usefulness of the theory has been showcased in case studies of the interaction between the UNFCCC and the CBD as well as between the Ramsar Convention and the UNECE Water Convention.

Based on this research, four opportunities for further research can be highlighted. First, broader and more in-depth research that analyses a larger selection of treaties is needed to further explain the fuzzy concept of environmental problem shifting. For this article, inevitable choices had to be made to develop and apply a theory of problem shifting at the global level. A first step to confirm the validity of the presented approach would be to apply and test the theory to a more diverse selection of treaty regime pairs. This should also include treaty pairs from within one issue area.

Second, other possible explanations for problem shifting should be analysed to improve international environmental governance. Interactions between treaty regimes and their underlying issue areas are

complex. The fragmentation in treaty regime interaction can only explain a fraction of the risk of problem shifting. Therefore, further research on other factors that influence the risk of problem shifting needs to be carried out. The conceptualisation of environmental problem shifting in this article could serve as a good point of departure for future studies. Due to the potential detrimental consequences and the urgency of the problems, other explanations for problem shifting between the climate and biodiversity regimes are suggested as a priority case for future research.

Third, further analysis of problem-shifting at different levels of governance is needed. This research has focused on global environmental governance with treaty regimes as the unit of analysis. Yet, problem shifting is likely to also occur at regional, national or local level for instance between national or regional governments, local authorities or municipalities. This may be linked to governance structures global treaty regimes or to political and other priorities in the implementation of them. Elements of the theory developed in this article may nonetheless also be useful and transferable to other levels of environmental governance.

Lastly, non-environmental elements of problem shifting should also be researched in order to provide more holistic policy recommendations. As discussed at the outset of this article, problem shifting can also occur between environmental and socio-economic considerations and vice-versa. This article has focused solely on problem shifting within the environmental sphere. Yet, due to the broader social implications of our environmental challenges and to ensure that no one is left behind, more scholarly attention on socio-economic problem shifting and the avoidance of risk factors within governance structures is needed.

8. References

Ajanovic, A. (2011). Biofuels versus food production: Does biofuels production increase food prices? *Energy*, *36*(4), 2070–2076.

Bernardini, F. (2015). "The Normative and Institutional Evolution of the Convention". In *The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes* (pp. 32–43). Leiden: Brill | Nijhoff.

Biermann, F., & Kim, R. E. (2020). Architectures of Earth System Governance. In *Architectures of Earth System Governance* (pp. 1–34). Cambridge: Cambridge University Press.

Biermann, F., Pattberg, P., van Asselt, H., & Zelli, F. (2009). The Fragmentation of Global Governance Architectures: A Framework for Analysis. Global Environmental Politics, 9(4), 14–40.

Biermann, F., van Driel, M., Vijge, M. J., & Peek, T. (2020). Governance Fragmentation. In *Architectures of Earth System Governance* (pp. 158–180). Cambridge: Cambridge University Press.

Birmpili, T. (2018). Montreal Protocol at 30: The governance structure, the evolution, and the Kigali Amendment. *Comptes Rendus - Geoscience*, *350*(7), 425–431.

Chaytor, B., Gerster, R., & Herzog, T. (2002). The Convention on Biological Diversity: Exploring the Creation of a Mediation Mechanism. *The Journal of World Intellectual Property*, *5*(2), 157–180.

Crutzen, P. J. (2002). Geology of mankind. Nature, 415(6867), 23–23.

De Charzournes, L. B., Leb, C., & Tignino, M. (2015). The UNECE Water Convention and Multilateral Environmental Agreements. In *The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes* (pp. 60–72). Leiden: Brill | Nijhoff.

Dryzek, J. S. (2016). Institutions for the Anthropocene: Governance in a Changing Earth System. *British Journal of Political Science*, *46*(4), 937–956.

Ebbesson, J. (2014). Planetary boundaries and the matching of international treaty regimes. *Scandinavian Studies in Law*, *59*(59), 259–284.

Ferez, A. P. C., Campoe, O. C., Mendes, J. C. T., & Stape, J. L. (2015). Silvicultural opportunities for increasing carbon stock in restoration of Atlantic forests in Brazil. *Forest Ecology and Management*, *350*, 40–45.

Fitzmaurice, M., & Merkouris, P. (2015). Scope of the UNECE Water Convention. In *The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes* (pp. 101–115). Leiden: Brill | Nijhoff.

Gómez-Mera, L., Morin, J.-F., & Van de Graaf, T. (2020). Regime Complexes. In *Architectures of Earth System Governance* (pp. 137–157). Cambridge: Cambridge University Press.

Herrmann, R., Jumbe, C., Bruentrup, M., & Osabuohien, E. (2018). Competition between biofuel feedstock and food production: Empirical evidence from sugarcane outgrower settings in Malawi. *Biomass and Bioenergy*, *114*, 100–111.

Hickmann, T., van Asselt, H., Oberthür, S., Sanderink, L., Widerberg, O., & Zelli, F. (2020). Institutional Interlinkages. In *Architectures of Earth System Governance* (pp. 119–136). Cambridge: Cambridge University Press.

Hickmann, T., Widerberg, O., Lederer, M., & Pattberg, P. (2019). The United Nations Framework Convention on Climate Change Secretariat as an orchestrator in global climate policymaking. *International Review of Administrative Sciences*, 0(0), 1–18.

Hoch, S., Michaelowa, A., Espelage, A., & Weber, A. K. (2019). Governing complexity: How can the interplay of multilateral environmental agreements be harnessed for effective international market-based climate policy instruments? *International Environmental Agreements: Politics, Law and Economics*, *19*(6), 595–613.

IPBES. (2019). Summary for policymakers of the global asessment report on biodiversity and ecosystem services. Intergovernmental Platform on Biodiversity and Ecosystem Services Secretariat. Bonn. Retrieved July 14, 2020, from https://ipbes.net/system/tdf/ipbes_global_assessment_report_summary_for_policymakers.pdf?file=1&type=node&id=35329/

IPCC. (2015). Climate Change 2014: Synthesis Report. IPCC. Geneva. Retrieved July 14, 2020, from https://www.ipcc.ch/report/ar5/syr/

Jenks, C. W. (1953). The Conflict of Law-Making Treaties. *British Yearbook of International Law*, 30, 401.

Jinnah, S. (2010). Overlap management in the world trade organization: Secretariat influence on trade-environment politics. *Global Environmental Politics*, *10*(2), 54–79.

Johnson, T., & Urpelainen, J. (2012). A Strategic Theory of Regime Integration and Separation. *International Organization*, *66*(4), 645–677.

Jones, N. (2018). Safeguarding against Environmental Injustice: 1.5°C Scenarios, Negative Emissions, and Unintended Consequences. *Nature*, *631*, 635–636.

Jordan, A., & Lenschow, A. (2010). Environmental policy integration: a State of the Art Review. *Environmental Policy and Governance*, *20*(3), 147–158.

Kiesecker, J., Baruch-Mordo, S., Kennedy, C. M., Oakleaf, J. R., Baccini, A., & Griscom, B. W. (2019). Hitting the Target but Missing the Mark: Unintended Environmental Consequences of the Paris Climate Agreement. *Frontiers in Environmental Science*, 7, 1–12.

Kim, R. E. (2013). The emergent network structure of the multilateral environmental agreement system. *Global Environmental Change*, *23*(5), 980–991.

Kim, R. E. (2019). Is Global Governance Fragmented, Polycentric, or Complex? The State of the Art of the Network Approach. *International Studies Review*, 1–29.

Kim, R. E., & Bosselmann, K. (2013). International Environmental Law in the Anthropocene: Towards a Purposive System of Multilateral Environmental Agreements. *Transnational Environmental Law*, *2*(2), 285–309.

Kim, R. E., & van Asselt, H. (2016). Global governance: Problem shifting in the Anthropocene and the limits of international law. In *Research Handbook on International Law and Natural Resources* (pp. 473–495). Cheltenham: Edward Elgar Publishing.

Kim, Y., Tanaka, K., & Matsuoka, S. (2017). Institutional Mechanisms and the Consequences of International Environmental Agreements. *Global Environmental Politics*, *17*(1), 77–98.

Kotzé. (2019). Earth System Law for the Anthropocene. *Sustainability*, *11*(23), 1–13.

Krasner, S. D. (1983). *International regimes*. Cornell University Press.

Kyoto Protocol to the United Nations Framework Convention on Climate Change. (adopted 11 December 1997, entered into force 16 February 2005). 2303 UNTS 162

Lade, S. J., Steffen, W., de Vries, W., Carpenter, S. R., Donges, J. F., Gerten, D., Hoff, H., Newbold, T., Richardson, K., & Rockström, J. (2020). Human impacts on planetary boundaries amplified by Earth system interactions. *Nature Sustainability*, *3*(2), 119–128.

Lawrence, P., & Wong, D. (2017). Soft law in the paris climate agreement: Strength or weakness? *Review of European, Comparative and International Environmental Law*, *26*(3), 276–286.

Lee, J. (2015). The governance of wetland ecosystems and the promotion of transboundary water cooperation – opportunities presented by the Ramsar Convention. *Water International*, *40*(1), 33–47.

Matz-Lück, N. (2010). Treaties , Conflicts between. In *Max Planck Encyclopedias of International*

Law. Oxford University Press. Available July 14, 2020, from https://opil.ouplaw.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e1485/

Medvedieva, M., Sopilko, I., Guliiev, A., Bilotsky, S., Nevara, L., Lovin, A., & Sirokha, D. (2018). Fragmentation and Synergies in the International Climate-Change Regime. *Environmental Policy and Law, 48*(3/4), 160-168.

Modahl, I. S., Askham, C., Lyng, K. A., & Brekke, A. (2012). Weighting of environmental trade-offs in CCS-an LCA case study of electricity from a fossil gas power plant with post-combustion CO2 capture, transport and storage. In *International Journal of Life Cycle Assessment* (Vol. 17, Issue 7, pp. 932–943).

Oberthür, S. (2001). Linkages between the Montreal and Kyoto Protocols. *International Environmental Agreements: Politics, Law and Economics*, *1*(3), 357–377.

Oberthür, S. (2002). Clustering of Multilateral Environmental Agreements: Potentials and Limitations. *International Environmental Agreements*, *2*(4), 317–340.

Oberthür, S. (2009). Interplay management: Enhancing environmental policy integration among international institutions. *International Environmental Agreements: Politics, Law and Economics*, *9*(4), 371–391.

Oberthür, S., Dupont, C., & Matsumoto, Y. (2011). Managing Policy Contradictions between The Case of Fluorinated Greenhouse Gases. In *Managing Institutional Complexity: Regime Interplay and Global Environmental Change* (pp. 115–141). Cambridge, MS: MIT Press.

Pankakoski, T., & Vihma, A. (2017). Fragmentation in international law and global governance: A conceptual inquiry. *Contributions to the History of Concepts*, *12*(1), 22–48.

Pattberg, P., Widerberg, O., Isailovic, M., & Dias Guerra, F. (2014). Mapping and Measuring Fragmentation in Global Governance Architectures: A Framework for Analysis. *SSRN Electronic Journal*, 1–33.

Pickering, J., McGee, J. S., Karlsson-Vinkhuyzen, S. I., & Wenta, J. (2019). Global climate governance between hard and soft law: Can the Paris agreement's "Crème Brûleé" approach enhance ecological reflexivity? *Journal of Environmental Law*, *31*(1), 1–28.

Problem. (n.d.). In Lexico. Available July 14, 2020, from https://www.lexico.com/definition/problem/

Ramsar Convention Secretariat. (2010). *Handbook 20 International cooperation: Guidelines and other support for international cooperation under the Ramsar Convention on Wetlands*. Ramsar Convention Secretariat. Gland. Retrieved July 14, 2020, from https://www.ramsar.org/resources/ramsar-handbooks/

Reinstein, R. A. (2005). Ozone depletion and global climate change: Is the montreal protocol a good model for responding to climate change? In *Climate Change and Africa* (pp. 331-338). Cambridge: Cambridge University Press.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., ... Foley, J. A. (2009a).

A safe operating space for humanity. *Nature*, *461*(7263), 472–475.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S. I., Lambin, E., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., … Foley, J. (2009b). Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society*, *14*(2).

Sagemüller, I. (2006). Forest Sinks under the United Nations Framework Convention on Climate Change and the Kyoto Protocol : Opportunity or Risk for Biodiversity ? *Columbia Journal of Environmental Law*, *31*(2), 189–242.

Secretariat of the Convention on Biological Diversity. (2016). *Biodiversity and Climate Change: Making use of the findings of the IPCC's Fifth Assessment Report*. Secretariat of the Convention on Biological Diversity. Montreal, QC. Retrieved July 14, 2020, from https://www.cbd.int/climate/doc/biodiversity-ar5-brochure-en.pdf

Seidel, S., Ye, J., & Andersen, S. O. (2015). *Technological Change in the Production Sector under the Montreal Protocol*. Center for Climate and Energy Solutions. Arlington, VA. Retrieved July 14, 2020, from https://www.c2es.org/document/technological-change-in-the-production-sector-under-the-montreal-protocol/

Simmonds, P. G., Rigby, M., McCulloch, A., Vollmer, M. K., Henne, S., Mühle, J., O'Doherty, S., Manning, A. J., Krummel, P. B., Fraser, P. J., Young, D., Weiss, R. F., Salameh, P. K., Harth, C. M., Reimann, S., Trudinger, C. M., Paul Steele, L., Wang, R. H. J., Ivy, D. J., … Etheridge, D. M. (2018). Recent increases in the atmospheric growth rate and emissions of HFC-23 (CHF3) and the link to HCFC-22 (CHClF2) production. *Atmospheric Chemistry and Physics*, *18*(6), 4153–4169.

Smith, R., Guevara, O., Wenzel, L., Dudley, N., Petrone-Mendoza, V., Cadena, M., & Rhodes, A. (2019). Ensuring Co-benefits for Biodiversity, Climate Change and Sustainable Development. In *Climate Change Management* (pp. 151–166).

Sommerer, T., & Tallberg, J. (2019). Diffusion Across International Organizations: Connectivity and Convergence. *International Organization*, *73*(2), 399–433.

Stanley, K. M., Say, D., Mühle, J., Harth, C. M., Krummel, P. B., Young, D., O'Doherty, S. J., Salameh, P. K., Simmonds, P. G., Weiss, R. F., Prinn, R. G., Fraser, P. J., & Rigby, M. (2020). Increase in global emissions of HFC-23 despite near-total expected reductions. *Nature Communications*, *11*(1).

Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., & Ludwig, C. (2015). The trajectory of the anthropocene: The great acceleration. *Anthropocene Review*, *2*(1), 81–98.

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., De Vries, W., De Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B., & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, *347*(6223).

Sterner, T., Barbier, E. B., Bateman, I., van den Bijgaart, I., Crépin, A. S., Edenhofer, O., Fischer, C., Habla, W., Hassler, J., Johansson-Stenman, O., Lange, A., Polasky, S., Rockström, J., Smith, H.

G., Steffen, W., Wagner, G., Wilen, J. E., Alpízar, F., Azar, C., ... Robinson, A. (2019). Policy design for the Anthropocene. *Nature Sustainability*, *2*(1), 14–21.

Umer, A., Hewage, K., Haider, H., & Sadiq, R. (2017). Sustainability evaluation framework for pavement technologies: An integrated life cycle economic and environmental trade-off analysis. *Transportation Research Part D: Transport and Environment*, *53*, 88–101.

UN-Water. (2020). *Annual Report 2019*. UN-Water. Geneva. Retrieved July 14, 2020, from https://www.unwater.org/publications/un-water-annual-report-2019/

UNEP. (2011). *HFCs: A Critical Link in Protecting Climate and the Ozone Layer*. United Nations Environment Program. Nairobi. Retrieved February 22, 2020 from http://www.unep.org/dewa/Portals/67/pdf/HFC_report.pdf

van Asselt, H. (2014a). Regime interactions in global climate governance. In *The Fragmentation of Global Climate Governance* (pp. 207–243). Cheltenham: Edward Elgar Publishing.

van Asselt, H. (2014b). The UN climate regime and the Convention on Biological Diversity. In *The Fragmentation of Global Climate Governance* (pp. 119–157). Cheltenham: Edward Elgar Publishing.

Van Asselt, H. (2011). Integrating biodiversity in the climate regime's forest rules: Options and tradeoffs in greening REDD design. *Review of European Community and International Environmental Law*, *20*(2), 139–149.

van den Bergh, J., Folke, C., Polasky, S., Scheffer, M., & Steffen, W. (2015). What if solar energy becomes really cheap? A thought experiment on environmental problem shifting. *Current Opinion in Environmental Sustainability*, *14*, 170–179.

Verschuuren, J. (2008). The case of transboundary wetlands under the Ramsar Convention: Keep the lawyers out! *Colorado Journal of International Environmental Law and Policy*, *19*(1), 49–127.

Verschuuren, J. (2010). The right to water as a human right or a bird's right: Does cooperative governance offer a way out of a conflict of interests and legal complexity? *Water Governance in Motion: Towards Socially and Environmentally Sustainable Water Laws*, 359–387.

Wu, W., Beretta, C., Cronje, P., Hellweg, S., & Defraeye, T. (2019). Environmental trade-offs in fresh-fruit cold chains by combining virtual cold chains with life cycle assessment. *Applied Energy*, *254*, 359–387.

Yang, Y., Bae, J., Kim, J., & Suh, S. (2012). Replacing gasoline with corn ethanol results in significant environmental problem-shifting. *Environmental science & technology, 46*(7), 3671-3678.

Young, O. R. (2018). Research strategies to assess the effectiveness of international environmental regimes. *Nature Sustainability*, *1*(9), 461–465.

Young, O. R., & Stokke, O. S. (2020). Why is it hard to solve environmental problems? The perils of institutional reductionism and institutional overload. *International Environmental Agreements: Politics, Law and Economics, 20(*1), 5-19.

Zelli, F., & van Asselt, H. (2013). Introduction: The Institutional Fragmentation of Global Environmental Governance: Causes, Consequences, and Responses. *Global Environmental*

Politics, *13*(3), 1–13.