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**Climate Change Scenarios and Future Legal Challenges: The Northern Seas Experiment**

Viljam Engström, Michel Rouleau-Dick

**Key words:** Climate change, territory, Baltic Sea, Arctic, law of the sea, governance, scenarios

**Abstract**

Legal frameworks are a core tool as societies address climate change. This is true also for international law which has a particularly important role, as climate change will require coordinated action on a global scale. Simultaneously, there is a comparative lack of knowledge on how climate change affects our current politico-legal system and what future regulatory needs may arise. The environmental impact of climate change is the subject of sustained research, and a discussion on its societal dimension is gaining pace. Yet, legal challenges posed by climate change seems so far vastly underexplored. This brings up the following question: how can we discuss and assess both the limits and possibilities of law in the context of a quickly evolving future? The use of scenarios has grown into a key tool through which to address not only environmental but also societal challenges in a climate changed future. The article asks whether legal research also could benefit from scenario analysis. The chapter discusses the use of scenarios in social science climate change research and tests the use of scenarios for assessing the severity of challenges to international law in the context of the northern seas of the Arctic and the Baltic regions.

**1. Introduction**

As the window of opportunity for effective action against climate change narrows, the focus of climate change discourse is progressively shifting from its existence to means of mitigating and adapting to its impacts. This brings more questions than answers, and tremendous obstacles stand in the way of a truly sustainable future. There is a notable discrepancy among scientific disciplines with respect to how they study the challenges posed by future change. Whereas environmental impacts are the subject of extensive research, the collective discussion on the societal impacts is still at a comparatively early stage, only being embedded by the Intergovernmental Panel on Climate Change [IPCC] recognising the value of social sciences to scenario building in the Sixth Assessment Report [AR6] in 2021.<sup>1</sup>

Law will be instrumental in climate change mitigation and adaptation, and international law in particular, as climate change requires action on a global level. While law can enable action, it is also notoriously slow to change. Because of this, law can even become an obstacle for mitigation and adaptation. A number of prospective concerns are being identified that challenge the capacity of international law to perform its function. By way of examples, the conventional idea of “statehood” is being questioned by the possible disappearance of several island-states (Challinor & Benton, 2021; Rouleau-Dick, 2021); the migration/refugee regime has so far failed to incorporate climate migration (Katsoni & Graf, 2021; Cullen, 2020); the idea of human rights is being threatened by “climate apartheid” (Alston, 2019); the public-private divide is perceived

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<sup>1</sup> The Sixth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC) is the sixth in a series of reports which assess scientific, technical, and socio-economic information concerning climate change (Arias et al., 2021).

as being in need of redefinition (De Vido, 2021); basic principles of the law of the sea regime are being questioned (International Law Commission, 2019), as is the international treaty regime at large (Baker, 2016; Kulaga, 2020). Even the global 'rule of law' is being called into question (Alston, 2019). Crucial mitigation and adaptation efforts could also present significant challenges to current regulatory frameworks (Brent, 2021; Reynolds, 2021; Arias et al., 2021).

Many of the identified legal concerns relate to territoriality, where climate change also potentially has its most dramatic physical impact. What makes this impact of particular relevance for the future of international law, is that territoriality is also the paramount building-block of the international politico-legal system. Geographical and spatial assumptions serve to divide the earth into state territories, and to distinguish territories that are beyond state jurisdiction (such as the high seas). Core concepts of the international order such as sovereignty and jurisdiction are informed by these spatial assumptions (Lythgoe 2021; International Law Commission, 2022). State physical space, meaning "a portion of the surface of the globe" (Permanent Court of Arbitration, 1928), is crucial in defining the dimensions of statehood. It hereby also constitutes rights and obligations towards other states, individuals, as well as the physical environment in which statehood exists (International Law Commission, 2022).

The impact of climate change on territoriality challenges fundamental features of the international legal system at the precise moment when its steering and stabilizing function is needed the most. International law is called upon to protect various aspects of nature and areas of the globe, to enhance litigation strategies, protect individuals and groups, to deal with particular sources and forms of pollution and environmental degradation, and in order to enhance compliance and enforcement. In this search, international law is often taken for granted. But what if current international law or parts of it become hopelessly outpaced by the current rate of change? Innovative analytical approaches to understanding international law's challenges have been called for (e.g. Craik et al., 2018; Ety et al., 2022; Fisher et al., 2017) but until now these calls have produced little in terms of response. More profoundly, there is a lack of methods, the article claims, to even enable a structured analytical discussion. Thus, an acute problem arises: how can we discuss and assess both the limits and possibilities of international law in an era of future fundamental change? What methods are available to identify and analyse key challenges but also the magnitude of those challenges? This lack of knowledge on the future relevance of international law seems paradoxical in light of increasing reliance on that law for demanding accountability and more ambitious action by states and other actors (e.g. on litigation, van Asselt et al., 2021; Nolan, 2021).

In natural and social sciences, scenarios have become a core methodological tool for structuring the inherent uncertainty of climate change impacts. Through scenarios, alternative plausible futures can be explored, tipping points identified, and responses evaluated. They help navigate uncertainty and assess choices made in the present. They also offer a baseline to develop a common understanding of future challenges across disciplines (Swart et al., 2004; van Vuuren et al., 2014; Auer et al., 2021). This article takes a tentative first step to bridge an existing methodological gap between international law and (other) social sciences in the application of scenarios in climate change research. It tests the use of scenarios in the context of the Arctic and the Baltic sea, in particular relating to the law of the sea, which defines and delimits state territories and maritime zones as well as rights and obligations within those.

Focusing this experiment on the context of the Arctic and the Baltic has particular value, as the specificities of these northern sea areas could hold valuable insights for global discussions. Both the Baltic and the Arctic are faced with rapid warming (World Meteorological Organization, 2021), and changes in the Arctic region are expected to not only be dramatic but also of particular significance to the rest of the globe (Oppenheimer et al., 2019). The environment of the Baltic sea region combined with the density of available scientific knowledge has been noted to make it a particularly relevant case study to help understand future challenges, and even a "time machine" for other areas of the globe (Reusch et al., 2018).

The article sets off by outlining territoriality concerns in global climate change debate, and current approaches to climate change challenges in governance instruments of core Arctic and Baltic international institutions. The article then moves on to explore scenario-building as a methodological tool. By applying two simplified scenarios in an exemplary manner to these northern seas, the article illustrates how scenarios can enhance our understanding of the plausibility and severity of legal challenges.

## 1. Climate Change and Territoriality

Climate change is modifying the face of our planet. Every year brings an increased number of extreme weather events and ever more alarming calls from climate scientists. In fact, the constant transformations introduced by climate change clash dramatically with the otherwise relatively static bases shared by our societies and the sciences that attempt to understand them. (International) Law is no exception. Perhaps the starkest example of the linkages between climate change and territoriality is the situation of a number of small island states (SISs), for whom sea level rise presents an existential threat. With a highest elevation point of barely five meters, it is easy to understand why vulnerable states such as Tuvalu, the Maldives or the Marshall Islands have been so active in advocating for urgent and effective action (Mead & Wewerinke-Singh, 2021; International Law Commission, 2022). SISs are a particularly clear and binary example of the implications of climate change for territoriality: according to international custom, statehood is premised upon the existence of a territory, among other constitutive elements (McAdam, 2012), and thus a complete loss of territory could potentially mean the end of statehood.

Even in less dramatic contexts, at least in comparison to the predicament faced by SISs, the effects of climate change are likely to challenge other dimensions of territoriality. One such example is the normative framework regulating the oceans of the globe: the law of the sea. While it may seem paradoxical, territory is foundational also to the law of the sea through delimitations, questions of jurisdiction, and by defining rights and obligations. Such reliance on physical features would have initially been a sensible, pragmatic choice due to the “immovable” nature of most of those features. However, with climate change that nature cannot be taken for granted anymore (Taroaniara, 2020). In addition to physical features of the earth being subject to change, also the “wicked problems” posed by climate change at large are characteristically in constant flux. Thus, core elements of the international legal framework are suddenly controversial precisely because of their reliance on territoriality in one form or another. The ambulatory nature of baselines is one of such topic of debate, and one that has implications for virtually any state with a coastline (Goyal & Gupta, 2020; Purcell, 2019). In fact, the relevance of even small distinctions for example between what constitutes a rock (as opposed to an island) have increased exponentially (UNCLOS, Art. 121(3); Guillaume, 2021).

In the framework of the broader question of the adverse impact of sea-level rise on low-lying coastal and archipelagic States, the specific question of the effects on baselines has been receiving increasing attention in the international debate (International Law Commission, 2022). The question is whether, once a State has determined its baselines by a legislative or administrative act, these lines are *fixed* and will not be altered by any subsequent physical change due to the sea level rise (Cogliati-Bantz, 2020). This question has been seen as central to recent works of codification and progressive development of international law in this field, both public and private. The topic was studied by the Baselines Committee of the International Law Association from 2008 to 2012 and by the Committee on “International law and sea-level rise” of the same Association from 2012 to 2018. Then, from 2019, the International Law Commission has been considering the issue under the topic “Sea-level rise in relation to international law” (for an overview, Starita, 2022).

The effects of climate change will also magnify some of the already existing inadequacies of the international legal system. The neat borders one can see on the world map are a lot more than abstract lines. As climate change and sea level rise start transforming the lives of many, territoriality is likely to present a major

obstacle to adaptation, especially in terms of migration as adaptation (Vinke et al., 2020). In this case, the primarily static nature of territoriality clashes with human movements, and it is easy to see why this is likely to be even more of an issue in the coming decades (Benveniste et al., 2020). Indeed, progress in opening borders such as the creation of the Schengen space can be contrasted with the increased securitization of borders to restrict international migration, and the ease with which governments reacted with border closures to the Covid-19 pandemic (Chetail, 2020).

Climate change adaptation efforts can also be a source of challenges to the existing international legal order, as the building of various defenses against the rise in sea levels or extreme weather events could affect the flow of sediments and create cross-border tensions. The building of defenses could also affect law of the sea foundational paradigms such as freedom of navigation. Such risks increase exponentially through more prospective geoengineering proposals such as refreezing of sea-ice (e.g. Smith et al., 2022). Consequently, not only will climate change challenge the role and function of territoriality for the international legal system, but it will also propel it to the forefront of discussions on the future of international law.

## **2. Climate Change Concerns in Northern Seas Governance**

Northern sea regions share a fragility of their respective ecosystems, heightened by long-term pollution in the Baltic (Zandersen et al., 2019) and high vulnerability to change in the Arctic (Oppenheimer et al., 2019, p. 205). Economic costs (but also possibilities), changes in land use, effects on agriculture and fisheries sectors, are well acknowledged future challenges in the Baltic Sea Area. As to the Arctic, while the most serious social impacts are noted to concern indigenous people, social concerns also arise through increased competition for access to resources, and challenges with reconciling different perspectives on how to make the most of new opportunities in the Arctic (Quillérou et al., 2019). Common to both areas, there is an acknowledgment that apart from impact on the marine environment and effectiveness and costs of measures, several crucial methodological and practical challenges remain, in addition to important knowledge gaps (HELCOM 2021a, p. 54; Oppenheimer et al., 2019, p. 329).

The Baltic Sea environment is governed on multiple levels (Engström, 2018; Van Well & Scherbenske, 2014). As to pan-Baltic institutions on the macro-regional level, the European Union (EU) stands out in particular in terms of regulatory and policy impact. The role of the EU is of heightened interest, since the Baltic Sea is almost EU-internal. As a consequence, the EU has also become the main actor for developing the Baltic Sea region regulatory framework. Even with regards to the Arctic the EU is profiling itself as a geopolitical actor. The European Commission adopted the new EU Strategy on Adaptation to Climate Change in February 2021. In it, territorial change is present, among other things, as a concern for sea level rise, territorial ecosystem change, and desertification. Although variation in regional adaptation needs is acknowledged, the northern regions of the EU are given fairly little attention in it. What it does underline, however, is the importance of pushing the frontiers of adaptation knowledge (European Commission, 2021a). Additionally, the EU Commission has launched the mission Adaptation to Climate Change, one of the main aims of which is to better understand climate change related risk and to foster technical, as well as social and policy innovations (European Commission, 2021b), including investigating regulatory barriers (European Commission, 2021c).

Another core actor in the Baltic Sea region, HELCOM, the monitoring body of the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention) has issued the Baltic Sea Climate Change Fact Sheet (HELCOM, 2021b). The Fact Sheet notes that while sea level rise in the area is uneven, a rise is predicted in most parts, with consequent cliff and beach erosion. While its main focus is on the environmental impact of climate change, the Fact Sheet also states that "land and marine spatial planning usually neglect natural coastal protection and other important ecosystem services, calling for a policy change". Interestingly the Fact Sheet uses a particular scenario (Representative Concentration Pathway 4.5)

to illustrate climate change impacts on the Baltic Sea environment. In so doing, it also identifies parameters with societal relevance, knowledge gaps and policy concerns for a number of societal areas and actions (HELCOM 2021b, p. 53). The 2021 update of the HELCOM Baltic Sea Action Plan also acknowledges, in addition to a range of practical challenges, as a major concern the multiple methodological and knowledge gaps that remain for better understanding the economic and social challenges facing the Baltic Sea area (HELCOM 2021a, p. 50).

Characteristically for these two regions, climate change is also seen as an economic opportunity (e.g. through oil and gas exploration and new shipping routes). For this reason, the EU has shown willingness to become a core actor in the Arctic region even if its direct geographical relevance is markedly in contrast from its position in the Baltic region. The EU Arctic Policy notes that ice cover level reduction as well as permafrost thawing will have profound impacts and contribute to sea level rise and coastal erosion. As to social impact, it underlines that indigenous populations will be hardest hit in this area. It further states that one of its main objectives is to address "the ecological, social, economic and political challenges arising as a consequence of climate change", and notes that "Intensified interest in Arctic resources and transport routes could transform the region into an arena of local and geopolitical competition and possible tensions, possibly threatening the EU's interests". Consequently "The EU's full engagement in Arctic matters is a geopolitical necessity" (European Commission, 2021d, p. 2).

From a pan-Arctic perspective, one of the core actors is the Arctic Council, which for example has facilitated the negotiation of agreements between Arctic countries.<sup>2</sup> Its Resilience Report (2016) explicitly emphasizes linkages between the ecological and social components of climate change, and highlights potential tipping points whereby the ability of social-ecological systems to withstand disruptive change would be seriously affected. It notes that global sea-level rise will transform coastal zones, and that sea-level rise varies widely on Arctic coasts. Melting sea-ice, coastal erosion, and thawing permafrost are also identified as imminent territorial changes. In addition, the Report emphasizes the need for enhancing societal learning to facilitate adaptation through knowledge co-production, engaging multi-disciplinary perspectives, and the use of scenarios and simulations (Arctic Council, 2016).

Territorial concerns, as noted in these instruments, mainly relate to the rising sea-level in the Baltic Sea, and in the Arctic to decline in ice coverage and melting permafrost. The social challenges connected to these, to the degree present, are strongly focused on the economic impact. Territorial change will affect some societal areas negatively (e.g. fisheries and tourism in the Baltic Sea) and be costly (e.g. building of dikes and dams, infrastructure), but is also seen as an opportunity especially in the Arctic, but also in the Baltic (see also e.g. Andersson, 2013, p. 16). At the same time there is a shared concern of knowledge gaps on policy needs, and an acknowledgement of the need for more integrated approaches to social change. To this effect, use of scenarios is seen as an important tool.

### **3. Scenarios as Methodology in Climate Change Research**

Scenarios are used to structure the discourse on future uncertainties. Scenarios can categorize alternative futures in terms of plausibility, and can reveal and help assess assumptions and choices made in the present (Earth System Governance, 2018). Scenarios are also used to unveil insights about both the Baltic and the Arctic regions (Haavisto et al., 2016; Middleton et al., 2021; Zandersen et al., 2019). There are two primary and mutually supportive scenario frameworks in current global climate change research: The Representative Concentration Pathways (RCPs) developed by the IPCC in its fifth Assessment Report (AR5, 2014) for mapping future severity of climate change, and the Shared Socioeconomic Pathways (SSPs), that address alternative

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<sup>2</sup> At the time of writing, due to the Russian invasion of Ukraine, the Arctic Council has however paused all official meetings until further notice.

futures from a societal angle and incorporate the challenges to both mitigation and adaptation in relation to the five proposed scenarios they include (incorporated by the IPCC in its sixth Assessment Report (AR6, 2021)). The RCPs project the effects of atmospheric concentrations of greenhouse gas on global warming as illustrated in image 1.

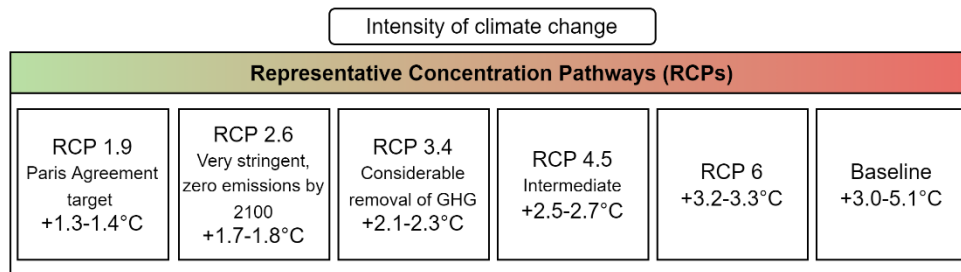


Image 1. Representative Concentration Pathways. Adapted from IPCC AR5, Summary for Policymakers.

As for the SSPs, they present a break from social sciences' long hesitancy to embrace scenario-based methods in climate change research (Chakraborty & Sherman, 2020). The SSPs are today increasingly used for discussing future societal concerns globally (O'Neill et al., 2020), regionally (Zandersen et al., 2019), and domestically (Lehtonen et al., 2021; Pedde et al., 2019). The five basic SSPs focus on: demographics, economic development, welfare, environmental and ecological factors, resources, institutions and governance, technological development, and societal factors such as lifestyle and attitudes, and policies, variations in which generate different societal futures as illustrated in image 2.

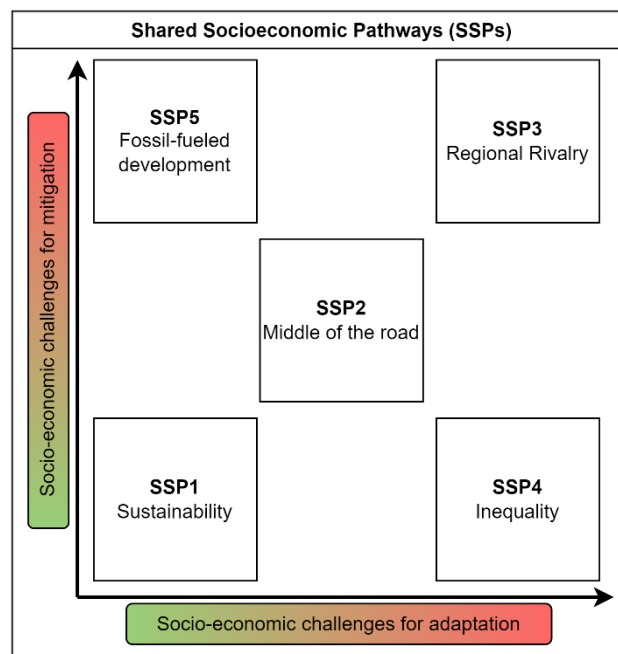


Image 2. Shared Socio-economic pathways (SSPs). Adapted from O'Neill et al. 2017.

SSPs are designed to be combined “orthogonally” with RCPs, and their purpose is explicitly to enable further research on socio-economic challenges (van Vuuren et al. 2011; O’Neill et al. 2017). Both sets of scenarios use mutually exclusive variables, although certain pairings are inevitably implausible (eg, RCP 8.5 & SSP1: O’Neill et al. 2020). Furthermore, scenario variables are extended in practical application in order to ensure the relevancy of outcomes (Lehtonen et al. 2021; O’Neill et al. 2020). Methodologically the application of RCPs and SSPs is still predominantly subject to quantitative analysis, although the introduction of Integrated Assessment Models (IAMs) and Shared Policy Assumptions (SPAs) aims to allow for more flexibility and a wider relevance (O’Neill et al. 2020). A quantitative approach is poorly suited for conceptualizing legal challenges. Applying scenarios in the context of law therefore taps into a growing strand of qualitative scenario research, as well as an emerging interest in the development of new methods to explore the societal implications of law-making (Benthal & Strandburg, 2021). Although scenarios are commonly applied to analyse the future of particular activities, there is a growing strand of reflexive and inclusive scenario practice, which underlines the reconciliation of different forms of knowledge, including conceptual analysis (e.g. Otero et al., 2020; Bodirsky et al., 2022; Soergel et al., 2021).

## **4. Scenarios for Northern Sea Areas**

### **4.1 Defining Scenarios**

In applying combinations of RCPs and SSPs for use for present purposes, some delimitations need to be made. The present chapter uses two pre-existing SSP-RCP combinations. The various elements of which the scenarios consist should, in a thorough scenario-building exercise need to be taken into account individually in respect of their impact and relevance for the region as well as for international law, and turned around, additional elements should be added in case important variables are missing in pre-existing scenarios. This is however not possible in the present context, and the application of scenarios should therefore only be seen as exemplary - a proof of concept.

The choice of scenarios / combinations of RCPs and SSPs rests upon the need to provide two contrasting options. The first SSP-RCP combination selected consists of "SSP 2 – Middle of the Road" and RCP 3.4 [here: Scenario 1]. This is intended to provide a slightly optimistic but plausible “default” option. SSP 2 (in contrast with the other SSPs) does not involve major alterations to current tendencies, no fundamental breakthroughs or major upheaval (O’Neill et al., 2017, p. 173). RCP 3.4 reflects a broadly similar outlook to that of SSP 2 in terms of the assumed severity of climate change, and is motivated by its relative plausibility in light of current projections (Pielke et al., 2021). Furthermore, this pairing is frequently used in scientific literature (e.g. O’Neill et al., 2020, p. 1077).

The second SSP-RCP pairing combines what essentially amounts to a worst-case scenario through "SSP 3 – Regional Rivalry" and RCP 6.0. SSP 3 is rooted in an assumed lack of cooperation and international fragmentation (O’Neill et al., 2017, p. 173) [here: Scenario 2]. The choice of RCP 6.0 aims to represent a relative lack of effectiveness in mitigation efforts, which is also implied in SSP 3, resulting in serious change in our climate and environment. Of particular relevance for international law, SSP 3 assumes a disruption of state cooperation, which is a core prerequisite for the current international legal order, as it fundamentally builds on state consent. In the regional context of the Arctic, this scenario loosely reflects what Haavisto et al. term a “conflict zone” (Haavisto et al., 2016, p. 50). On a global scale SSP 3 has been found to show end-of-century conflict rate being twice as high as today's (Hegre et al., 2016).



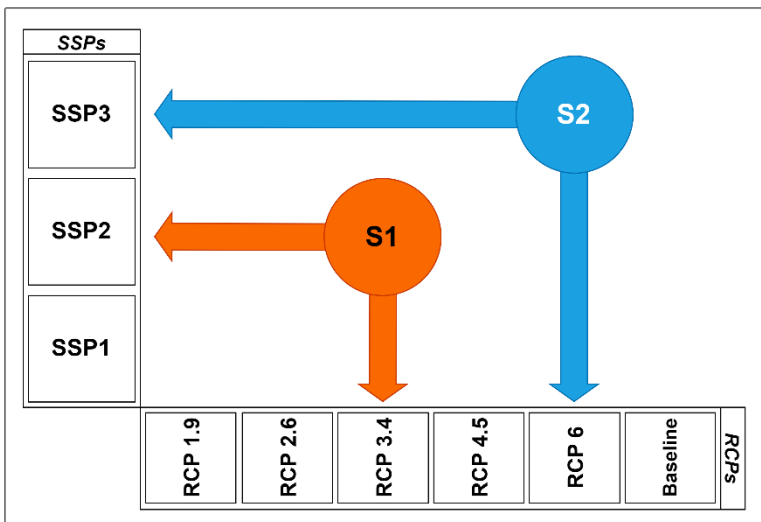


Image 3: Scenarios 1 and 2 illustrated through the combination of SSPs and RCPs. N.B., only three SSPs are included to simplify the visualization.

The choice of RCPs reflects the severity of the challenges implied by different SSPs. As mitigation presents comparatively lesser challenges in the context of SSP1 (“sustainability – taking the green road”), it would be unrealistic to expect a scenario set in SSP3 (“regional rivalry – a rocky road”) to have to deal with the same level of environmental change, since this would assume that both contexts display a similar capacity to enact effective mitigation. The choice of different RCPs thus reflects the dynamic relationship between SSPs and RCPs. The time frame of these scenarios is located within the 2040–2060 bracket, which still allows for a degree of predictability. This is also the common approximate frame of other projections on climate change impact on the Baltic and the Arctic. It should be noted that even if Scenario 1 is comparatively “milder” in relation to Scenario 2, it nevertheless implies substantial change and considerable disturbance to the current state of the environment. In terms of global mean temperatures, Scenario 1 (RCP 3.4) predicts mean global warming between 2.0–2.4 degrees, whereas in Scenario 2 (RCP 6.0) it reaches 2.8 degrees. Both scenarios, in other words, exceed the 1.5 degrees threshold set by the Paris Agreement. Moreover, current trends are expected to persist even if all greenhouse gas emissions came to a stop (AMAP, 2017, p. 5).

#### 4.2. Applying the Scenarios on the Arctic

According to the IPCC, “Under all climate and socio-economic scenarios, low-lying cities and settlements, small islands, Arctic communities, remote indigenous communities, and deltaic communities will face severe disruption by 2100 – and as early as 2050 in many cases (*very high confidence*)” (Arias et al., 2021, p. 32). In the Arctic, key climate impacts also concern rising sea levels, but in addition, melting ice and permafrost, infrastructure degradation, transformation of the natural environment, and physical accessibility of resources and routes. Warming is occurring three times faster than anywhere else in the world (AMAP, 2021), which adds a multiplier to existing scenarios in global comparison. Researchers previously predicted that the Arctic Ocean could be completely ice free by the year 2100, but more recent estimates suggest that might happen in 20 to 30 years’ time, or even sooner (Guarino et al., 2020; Middleton et al., 2021). The probability of an ice-free Arctic summer is ten times greater with a 2°C global warming (Scenario 1) compared with the 1.5°C Paris Agreement threshold (AMAP, 2021). Even if the Paris Agreement’s 1.5°C temperature goal would be reached, the Arctic could warm by as much as 5°C by 2100. The Arctic, in other words, will likely be summer-ice-free within the next decades irrespective of which scenario materializes (cf. Bodansky & Hunt, 2020).

From the perspective of the international legal system, changes in the Arctic can raise various challenges for the law of the sea. The first example concerns Article 234 of the United Nations Convention on the Law of the Sea (UNCLOS) which provides that coastal states have a right to adopt and enforce laws and regulations for the prevention, reduction, and control of marine pollution from vessels in ice-covered areas within the limits of their exclusive economic zone (EEZ). This article has not been utilized for making such claims but has served to uphold the prior status quo, in addition to providing a backdrop for additional negotiations and compromises (Solski, 2021). With the reducing ice-sheet, the sea area becomes more accessible and hereby more interesting for states. As a consequence, states can be expected to attempt to make use of the special regime that allows for additional control over their respective EEZs, for example through environmental regulation (Solski, 2021). Confronted with ever shrinking ice sheets, what had initially been a relatively adequate compromise in the eyes of the key actors involved, is likely to turn into a source of tension between coastal states, and/or coastal and shipping states.

This development highlights one of the problems with territoriality transitioning progressively from being implicitly static to a much more fluid concept. In Scenario 1, it is likely that satisfactory solutions could be found within the existing normative setting. Firstly, while an ice-free Arctic may still materialize within Scenario 1, this process would be less dramatic and would thus afford more time to reach an adequate solution. Secondly, as Scenario 1 assumes continued cooperation between states through current institutional structures, the likelihood increases (compared to Scenario 2) that a conflict on the interpretation of relevant provisions could be settled through negotiation, or through established institutional forums such as the International Tribunal on the Law of the Sea.

The more intense the melting, and the longer the annual period of an ice-free Arctic becomes, the greater the economic and geopolitical interest in the newly-freed area. This heightened interest relates to the availability of new shipping routes, but also to uncovered natural resources due to melting permafrost. Arctic areas have the potential to become zones of rapid economic growth and thereby will bear increased strategic importance (Middleton et al., 2021). This development is magnified in Scenario 2, due to tremendous environmental change (RCP6.0). At the same time, Scenario 2 as designed for present purposes, indicates a hostile geopolitical environment and a weak institutional setting, where territorial and jurisdictional claims not only deter interaction between Arctic states, but also challenge current governance structures that rely on tight collaboration. In the absence of such collaboration, the likelihood increases that the current normative framework would prove inadequate to regulate the Arctic, as the loosely worded provisions of the Law of the Sea might turn into a tool for expressing geopolitical claims. Maritime law already represents the bulk of international arbitration cases (Dispute Register, 2019) and it is easy to see how this might be further increased by the uncertainty created by climate change. The dysfunction of international law, as we know from the past, is magnified when states display nationalist tendencies and focus on domestic gains, which is what is predicted in SSP3 (O'Neill et al., 2017, p. 173).

Scenario 2 would also affect the functioning of the current Law of the Sea framework beyond the EEZ of Arctic states. As states make increasing claims concerning rights to exploit the continental shelf, the role of governing institutions such as the United Nations Commission on the Limits of the Continental Shelf that is tasked with settling such claims is elevated. Even today its decisions are considered recommendations rather than binding decisions, yet, as states do present claims to the Commission, this testifies to its governing function (see e.g. Mendez, 2010; Hossain, 2021). The presumed lack of a shared political commitment in Scenario 2 to a common procedure, would likely lead to a loss of that function.

The second example shows that even climate change mitigation efforts in the Arctic can raise territorial concerns. There is already an ongoing discussion on how to characterize the Northwest Passage, as for example Canada has claimed sovereignty over many of the islands in the Arctic sea, potentially enabling a claim that these islands create Canadian archipelagic waters under UNCLOS (instead of the Passage being

classified as an international strait with freedom of navigation) (Ebinger & Zambetakis, 2009). While this discussion in itself can be constructed differently, depending on the specific scenario used as a starting point, let's assume for a moment that refreezing of sea ice becomes a necessary (and possible) measure of mitigation. Such refreezing may trigger problems with the law of the sea if it, for example, prevents transit of ships, or freedom of navigation as guaranteed in UNCLOS. The law of the sea does not specifically deal with whether preventing the melting of sea ice or refreezing could constitute interference with freedom of navigation. By way of an analogy, the law of the sea gives coastal States the exclusive right to construct artificial islands within their EEZ and allows any State to construct artificial islands on the high seas. The freedom to construct artificial islands on the high seas must have 'due regard' to the freedom of navigation of other States, and the right of coastal States to construct artificial islands in their EEZ is limited by freedom of navigation when it would interfere with "the use of recognized sea lanes essential to international navigation" (UNCLOS, Article 147(b)). To the extent refreezing of sea ice is analogous to constructing an artificial island (in itself a question of the future applicability of the law of the sea), the law of the sea would limit a coastal State's right to refreeze its EEZ (Bodansky & Hunt, 2020). The further we move towards Scenario 2, the more "essential" as well as "recognized" the Northwest Passage would become. The current legal system, in other words, could be utilized by states in order not to engage in refreezing in order to promote other interests, with detrimental effects on climate change mitigation.

For states to start refreezing ice it seems likely that there would have to be a shared interest by Arctic states to jointly invest in and use such a technology (as such an act by an individual state would have only marginal impact). With this in mind, a more systemic challenge to the law of the sea is more likely to occur under Scenario 1, despite the substantive degree of maintained cooperation. As states agree to refreeze sea-ice, they jointly choose not to comply with the law of the sea, forcing the current international legal system to adjust. And to add yet another twist to the application of scenarios, was refreezing *not* analogous to the construction of artificial islands, *nor* regulated by other means, this would open up a Pandora's box for the use of geoengineering technologies for geopolitical purposes under the guise of climate change mitigation, with the potential consequence of rendering international law and the law of the sea to this effect obsolete.

### 4.3. Applying the Scenarios on the Baltic Sea Region

Sea level rise will occur also in the Baltic Sea. However, it is predicted not to be particularly dramatic (at least within the specified time frame), especially in the northern parts of the area as land-rise mitigates its effects. In the IPCC worst-case scenario (RCP 8.5) the projection is for example + 29 to + 162 cm in Copenhagen (median + 68 cm), whereas for coastal sites in the Bothnian Sea – 66 to + 65 cm (median – 5 cm) and for the Bothnian Bay – 72 to + 28 cm (median – 27 cm) (Meier et al., 2022). For this reason, the main environmental concerns are the deterioration of the state of the sea environment and its impact on tourism and fisheries, and in respect of territoriality, flooding and erosion with a corresponding need for dikes and dams (in the southern parts). To a large extent, the concerns arising relate to the economic costs of mitigation (see e.g. European Commission, 2019).

Territorial changes overall, including mean temperatures, variations in precipitation, and rising sea levels will be more limited in the Baltic than in the Arctic. Territorial challenges overall are foreseen to be more modest in the Baltic than in the Arctic, and adaptation possibilities far better. As in the Arctic, the changes facing the Baltic Sea area not only come with negative implications, as for example farming conditions are predicted to improve (von Storch et al., 2015). Territoriality-related concerns therefore relate more to socio-political expectations of what climate change means for the countries of the region (Haldén, 2018). In this respect it is important to note that the countries of the Baltic Sea region differ considerably with regard to their willingness to address climate change. While the EU, to which all littoral states belong with the exception of Russia, profiles itself as a leader on climate change action, Russia on its part is reluctant to act and displays a

marked lack of willingness to cooperate. By the time of writing, this is further compounded by Russia's invasion of Ukraine and the resulting heavy sanctions.

Against this background, the two Scenarios produce quite different pictures in respect of regulatory challenges concerning the Baltic sea area. If flooding and water management is considered as the most serious concern, Baltic Sea region states are likely to be equipped with means for mitigation and adaptation (Scenario 1). It is only when the capacity of the buffering systems is exceeded (Scenario 2) that the likelihood of more severe consequences grows. However, neither Scenario 1 nor Scenario 2 seem to raise comparable concerns about the applicability of the law of the sea to that of the Arctic, at least within the specified period. One difference to note between the two sea areas is, then, that while climate change in the Arctic climate has the potential to raise regulatory concerns in both scenarios, the situation in the Baltic Sea is the reverse. By extension, this could be thought to increase the likelihood of tailor-made solutions rather than paradigmatic change in the Baltic Sea area, in cases of dysfunction. The marked contrast between the Arctic and Baltic sea regions is interesting on its own terms, as it illustrates the highly contextual nature of climate change impact. Even the region of "northern seas", in other words, display great variation as to how the functionality of the current regulatory framework is affected.

With its multiple layers of governance and regulation, the functioning of these in the Baltic Sea region play a key role for orderly mitigation and adjustment. Looking beyond the functionality of the law of the sea, a more crucial regulatory challenge in the Baltic Sea relates to the political ability to uphold the regional EU regulatory framework. Assuming that Scenario 2 entails a potential breakdown of the EU, such a chain of events would radically change the regulatory landscape as new blocs and alliances of states would emerge, creating rivalry and conflict on the one hand, and isolationism on the other (Kok et al., 2019; Zandersen, 2019). With the loss of core policy and legislative instruments such as the EU Climate Change Strategy and the Maritime Strategy Framework Directive, the future of the Baltic Sea would be up for renegotiation in a radically deteriorated policy framework. In this respect a change in the regulatory landscape caused by Scenario 2 could be even greater than for the Arctic where no comparable framework exists. The multiple layers of regulation, combined with the prospective absence of paradigmatic challenges to the law of the sea in the Baltic sea region, could however instil hope that UNCLOS and other pan-Baltic frameworks such as the Helsinki Convention would retain their function even in Scenario 2.

## 5. Concluding Remarks

Societal transformation due to climate change is inevitable. This transformation encompasses social, cultural, technological, political, economic and *legal* change (Driessen et al., 2015). The present chapter claims that scenarios can help us discuss this legal change in a systematic manner. Scenarios can help assess both the plausibility and severity of the challenge to current international law, and in extension, reveal legislative needs. As a tentative implementation of scenario-based methodology to international law, this chapter combined two established sets of scenarios, SSPs and RCPs, and applied two scenarios for analyzing some of the international legal challenges ahead in the northern sea areas.

Both the Arctic and the Baltic Sea areas are subject to heightened speed of climate change. Yet, the environmental changes predicted are rather dissimilar. The experimental application of scenarios suggests that prospects of paradigmatic legal challenges to the law of the sea are far more likely to occur in the Arctic. This does not mean that systemic challenges to the current regulatory framework could not arise also in the Baltic, but rather that the application of scenarios to the Baltic would need to take a more detailed focus beyond the scope of this chapter. The scenarios, as applied in the current chapter, have been used rather bluntly, strongly emphasizing for example only one element of SSP3 in Scenario 2, reduced international cooperation, without detailing further what different expressions that might take. Yet, we believe that this

brief “proof of concept” experiment demonstrates that there are no inherent obstacles that would prevent analysing prospective legal challenges through a scenario methodology.

The inevitable transformation that we will face can be managed. Dealing with changes of this magnitude and complexity requires an integrative approach that encompasses a multiplicity of factors and dimensions across disciplines (Hernandez, 2021). This is particularly true in the context of the northern seas. The absence of a common frame of reference for analysing future transformation needs and obstacles radically limits the potential for conjoint efforts in both science and politics. As scenarios are becoming the main methodological approach by which natural and social sciences address the unknown, the introduction of scenarios methodologically also in international legal research is therefore necessary for building towards such a shared frame of reference. Not incorporating the function (or dysfunction) of law into this knowledge would overlook a core mechanism for societal stability, predictability and trust (Latour, 2010).

Applying scenarios in international legal research can provide guidance in the present for acting proactively. Even if we fail to slow down climate change, international law may be our last hope to deal in an orderly way with the devastating consequences of climate change (Voigt, 2020). The capacity of international law to cope with future challenges will, in other words, constitute the difference between irrelevance and a reinvigorated rules-based future. The aim of this chapter has not been to offer conclusions, and it lies beyond this exemplary application to make conclusive findings on the added value of scenarios for international legal research. The chapter does however suggest that it is possible to explore future legal challenges through scenarios. This suggests that scenarios could offer a plausible way of bridging the current disconnect between international law and climate change research in social sciences. It is time to set a research agenda.

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